



*Parameter Reference Guide*

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***Unidrive M702***

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*RFC-A Mode*

# About Parameter Reference Guide

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation or adjustment of the optional operating parameters of the equipment or from mismatching the variable speed drive with the motor.

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## Parameter mm.000

*Parameter mm.000* (mm.000) is one parameter that can be accessed from every drive menu so that the user can initiate various actions by setting a value in this parameter and then performing a drive reset. If the action is completed successfully parameter mm.000 is cleared when the action is complete. If the action is not started because the value does not correspond to an action, or because the action is not allowed (i.e. an attempt is made to load defaults and the drive is enabled), parameter mm.000 is not cleared. If the action is started and then fails a trip is produced and parameter mm.000 is not cleared.

There could be some conflict between the actions of *Parameter mm.000* (mm.000) and *Parameter Cloning* (11.042) when the drive is reset. If *Parameter Cloning* (11.042) has a value of 1 or 2 and a valid action is required from the value of parameter mm.000 then only the action required by parameter mm.000 is performed, but on successful completion of the action both parameters are cleared. If *Parameter Cloning* (11.042) has any other value it is not affected.

The table below shows the possible actions that can be initiated with *Parameter mm.000* (mm.000).

| Parameter<br>mm.000<br>(mm.000)<br>value | Action   | Possible failures   |
|--|--|---|
| 1000                                     | Save drive user save parameters to non-volatile memory. Power-down save parameters are saved when the drive enters the under voltage state.  | No action if the drive is in the under voltage state (i.e. <i>Under Voltage Active</i> (10.016)), or <i>Low Under Voltage Threshold Select</i> (06.067) =1 or <i>Backup Supply Mode Enable</i> (06.068) = 1 or <i>User Supply Select</i> (06.072).  |
| 1001                                     | Save drive parameters to non-volatile memory. It should be noted that power-down save parameters are also saved which will result in one background task scan being extended to 100ms.   |   |
| 1070                                     | Reset all option modules   |   |
| 1233                                     | Load 50Hz defaults   | No action if the drive is enabled   |
| 1234                                     | Load 50Hz defaults to all menus except option module menus (i.e 15 to 20 and 24 to 28)   | No action if the drive is enabled   |
| 1244                                     | Load 60Hz defaults   | No action if the drive is enabled   |
| 1245                                     | Load 60Hz defaults to all menus except option module menus (i.e 15 to 20 and 24 to 28)   | No action if the drive is enabled   |
| 1253                                     | Change drive mode and load 50Hz defaults   | No action if the drive is enabled   |
| 1254                                     | Change drive mode and load 60Hz defaults   | No action if the drive is enabled   |
| 1255                                     | Change drive mode and load 50Hz defaults except for menus 15 to 20 and 24 to 28  | No action if the drive is enabled   |
| 1256                                     | Change drive mode and load 60Hz defaults except for menus 15 to 20 and 24 to 28  | No action if the drive is enabled   |
| 1299                                     | Reset <i>Stored HF</i> trip.   |   |
| 2001                                     | Create a boot file on a non-volatile media card based on the present drive parameters including all Menu 20 parameters   | Non-volatile media card trips   |
| 4xxx                                     | NV media card: Transfer the drive parameters to parameter file xxx   | Non-volatile media card trips   |
| 5xxx                                     | NV media card: Transfer the onboard user program to onboard user program file xxx  | Non-volatile media card trips   |
| 6xxx                                     | NV media card: Load the drive parameters from parameter file xxx or the onboard user program from onboard user program file xxx  | No action if the drive is enabled<br>Non-volatile media card trips  |
| 7xxx                                     | NV media card: Erase file xxx  | Non-volatile media card trips   |
| 8xxx                                     | NV Media card: Compare the data in the drive with file xxx   | Non-volatile media card trips   |
| 9555                                     | NV media card: Clear the warning suppression flag  | Non-volatile media card trips   |
| 9666                                     | NV media card: Set the warning suppression flag  | Non-volatile media card trips   |
| 9777                                     | NV media card: Clear the read-only flag  | Non-volatile media card trips   |
| 9888                                     | NV media card: Set the read-only flag  | Non-volatile media card trips   |
| 9999                                     | NV media card: Erase and format the NV media card  | Non-volatile media card trips   |
| 110SI                                    | Transfer electronic nameplate data from an encoder into drive parameters.<br>I is the interface: 1=P1 position feedback interface, 2=P2 position feedback interface.<br>S is the source: 0=drive, 1=Option Slot 1, ... 4=Option Slot 4.  | If a drive interface is selected (i.e. S = 0): <ul style="list-style-type: none"> <li>If a suitable feedback device is not available then parameter zero will remain at the value set and no action will be taken.</li> <li>If the device does not respond, or there is a comms error or the CRC of the nameplate data is incorrect then a trip is initiated.</li> </ul> If an option module interface is selected (i.e. S = 1, 2, 3 or 4): <ul style="list-style-type: none"> <li>If the selected option module is not present or does not support the electronic nameplate function then the system will time out and initiate a trip.</li> <li>If the device does not respond, or there is a comms error or the CRC of the nameplate data is incorrect then a trip is initiated.</li> </ul> See <i>Name Plate</i> for more details on the trips. |
| 12000                                    | Only display parameters that are different from their default value. This action does not require a drive reset.   |   |
| 12001                                    | Only display parameters that are used to set-up destinations (i.e. DE format bit is 1). This action does not require a drive reset.  |   |
| 59999                                    | Deletes an onboard user program if a program is present.<br>Note: Any parameter changes that have not been saved will be lost during this action.  | No action if the drive is enabled.<br>No action if there is no program present.<br>No action if the user program is enabled (i.e. <i>Onboard User Program: Enable</i> (11.047) = 1)   |
| 40xxx                                    | If xxx is between 001 and 999 the system is cloned on to an SD card if fitted.<br>This system has been partially implemented, so initiating this process creates the back-up structure on the SD card but does not copy any drive or option module data. Future development is required to complete this function. | No action if the drive is enabled.<br>The drive will trip if the requested back-up data already exists or an option module does not respond correctly during the process.   |

|       |  |                                    |
|-------|--|------------------------------------|
| 60xxx | If xxx is between 001 and 999 the system is cloned from an SD card if fitted.<br>This system has not been implemented, but parameter mm.000 is reset if a value between 60001 and 60999 is entered and the drive is reset. Future development is required to complete this function. | No action if the drive is enabled. |
|-------|--|------------------------------------|

Parameter mm.000 (mm.000) values from 1 to 14 are equivalent to other values as shown in the table below to allow easy access to some commonly used functions. For 0 and each of these values the keypad provides a string as shown.

| Value | String             | Equivalent value | Action  |
|-------|--------------------|------------------|---|
| 0     | [No Action]        | 0                |   |
| 1     | [Save parameters]  | 1001             | Save drive parameters to non-volatile memory  |
| 2     | [Load file 1]      | 6001             | Load the data from file 1 on a non-volatile media card into the drive provided it is a parameter file |
| 3     | [Save to file 1]   | 4001             | Store the drive parameters in file 1 on a non-volatile media card                                     |
| 4     | [Load file 2]      | 6002             | Load the data from file 2 on a non-volatile media card into the drive provided it is a parameter file |
| 5     | [Save to file 2]   | 4002             | Store the drive parameters in file 2 on a non-volatile media card                                     |
| 6     | [Load file 3]      | 6003             | Load the data from file 3 on a non-volatile media card into the drive provided it is a parameter file |
| 7     | [Save to file 3]   | 4003             | Store the drive parameters in file 3 on a non-volatile media card                                     |
| 8     | [Show non-default] | 12000            | Only display parameters that are different from their default value                                   |
| 9     | [Destinations]     | 12001            | Only display parameters that are used to set-up destinations  |
| 10    | [Reset 50Hz defs]  | 1233             | Load 50Hz defaults  |
| 11    | [Reset 60Hz defs]  | 1244             | Load 60Hz defaults  |
| 12    | [Reset modules]    | 1070             | Reset all option modules  |
| 13    | [Read Enc. NP P1]  | 11001            | Encoder electronic nameplate transfer from the encoder connected to drive P1 interface to the drive.  |
| 14    | [Read Enc. NP P2]  | 11051            | Encoder electronic nameplate transfer from the encoder connected to drive P2 interface to the drive.  |

### Saving drive parameters

User-save and power-down save drive parameters are stored in non-volatile memory within the drive. Any values that have changed are copied to this memory under the following conditions.

| Parameter type                            | Conditions for copy to non-volatile memory   |
|---|--|
| User-save parameter not visible in menu 0 | Drive reset with 1000 in <i>Parameter mm.000</i> (mm.000) if the drive is not in the under voltage state and the standard under voltage threshold is being used (i.e. <i>Low Under Voltage Threshold Select</i> (06.067) = 0).<br>OR<br>A drive reset with 1001 in <i>Parameter mm.000</i> (mm.000).<br>OR<br>After parameters are transferred from a non-volatile media card.<br>OR<br>After the drive mode is changed.<br>OR<br>After default parameters are loaded.<br>OR<br>After parameters are transferred from an electronic nameplate.   |
| User save parameter visible in menu 0     | Under the conditions given above for user save parameters not visible in Menu 0.<br>OR<br>If the keypad is in edit mode for a user-save parameter in Menu 0, the parameter is saved when the keypad mode is changed from edit mode.  |
| Power-down save parameter                 | A drive reset with 1000 in <i>Parameter mm.000</i> (mm.000) if the drive is not in the under voltage state and the standard under voltage threshold is being used (i.e. <i>Low Under Voltage Threshold Select</i> (06.067) = 0).<br>OR<br>A drive reset with 1001 in <i>Parameter mm.000</i> (mm.000).<br>OR<br>On the transition into the under voltage state when the standard under voltage threshold is being used (i.e. <i>Low Under Voltage Threshold Select</i> (06.067) is zero).<br>OR<br>After the drive mode is changed.<br>OR<br>After parameters are transferred from a non-volatile media card which results in the drive mode changing. |

It can take some time for parameter data to be copied to non-volatile memory, especially if there are a large number of differences between the parameter values in the drive and the values stored in the memory. Saving Power-down save parameters takes a maximum of 300ms, but saving user-save parameters can take several seconds. If the drive is powered from a 24V control supply, or from a low voltage supply, the power down time of the control system can be very short and there is a risk that either the stored values of the power-down save or user-save parameters could be corrupted. This would result in an *EEPROM Fail* trip at the next power-up. To reduce this risk, the power-down save and user-save parameters are each stored in two banks. The banks are alternated each time a save is performed and the bank pointer is only updated once the save is complete. If the new bank is

corrupted a *User Save* or *Power Down Save* is initiated at the next power-up indicating an error in the user-save or power-down save data respectively, and the data from the old bank is used. The following points should be noted:

1. If a *User Save* or *Power Down Save* trip occur at power-up then parameter changes made before power down will be lost. To clear these trips a parameter save must be performed. If both the user-save and power-down save data is corrupted then a *Power Down Save* trip is produced.
2. When a Menu 0 parameter is changed its value is saved immediately to the active bank and the bank pointer is not changed. Therefore changes made via Menu 0 are not lost if a *User Save* trip occurs at power-up.
3. When the drive mode changes all the data in both banks in the non-volatile memory is cleared and the default parameters are saved in both banks. Therefore there is an extended parameter saving period immediately after a drive mode change.
4. Two banks are not provided in non-volatile media cards therefore the card could be corrupted if the power is removed when the drive is writing data to the card.

#### Loading defaults

A drive reset with 1233 in *Parameter mm.000* (mm.000) loads the defaults defined for each parameter. If defaults are loaded with 1244 in *Parameter mm.000* (mm.000) then the parameters in the table below have different defaults that are intended for the 60Hz regions.

| Parameter                           | Default | Drive modes             | Drive voltage rating |
|-------------------------------------|---------|-------------------------|----------------------|
| Maximum reference clamp (01.006)    | 60.0Hz  | Open-loop               | All                  |
| Maximum reference clamp (01.006)    | 1800rpm | RFC-A                   | All                  |
| Standard Ramp Voltage (02.008)      | 775V    | Open-loop, RFC-A, RFC-S | 400V                 |
| Rated Frequency (05.006)            | 60.0Hz  | Open-loop, RFC-A        | All                  |
| Rated Load rpm (05.008)             | 1800rpm | Open-loop               | All                  |
| Rated Load rpm (05.008)             | 1770rpm | RFC-A                   | All                  |
| Rated Voltage (05.009)              | 460V    | Open-loop, RFC-A, RFC-S | 400V                 |
| M2 Maximum Reference Clamp (21.001) | 60.0Hz  | Open-loop               | All                  |
| M2 Maximum Reference Clamp (21.001) | 1800rpm | RFC-A                   | All                  |
| M2 Rated Frequency (21.006)         | 60.0Hz  | Open-loop, RFC-A        | All                  |
| M2 Rated Load rpm (21.008)          | 1800rpm | Open-loop               | All                  |
| M2 Rated Load rpm (21.008)          | 1770rpm | RFC-A                   | All                  |
| M2 Rated Voltage (21.009)           | 460V    | Open-loop, RFC-A, RFC-S | All                  |

#### Non-volatile media card data transfer

Details of the data that can be stored on a non-volatile media card and the methods to transfer/access this data are given in Menu 11.

#### Stored HF trips

When the drive is subsequently powered up a *Stored HF* trip is initiated where the sub-trip number is the number of the HF trip that last occurred. This trip will occur at every power-up until it is reset. The trip can only be reset by first entering 1299 into *Parameter mm.000* (mm.000). If the drive is powered up and a *Stored HF* trip occurs, *Onboard User Program: Enable* (Pr 11.047) is reset to zero to prevent the on-board user program from running. This ensures that the user program can be changed or erased in case it causes an HF trip at every power-up. Once the *Stored HF* is cleared, it is necessary to power cycle the drive or to re-download the user program to allow the program to restart.

#### Electronic nameplate

The electronic nameplate is stored in an encoder as a table of bytes as shown in the example below which contains 7 parameter objects.

|    |    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|----|----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| N1 | N0 | CRC3 | CRC2 | CRC1 | CRC0 | FLG1 | FLG0 | 0xFF | 0xFF | 0xFF | 0xFF | 0xFF | 0xFF | 0xFF | 0xFF |
| M  | P  | V3   | V2   | V1   | V0   | M    | P    | V3   | V2   | V1   | V0   | M    | P    | V3   | V2   |
| V1 | V0 | M    | P    | V3   | V2   | V1   | V0   | M    | P    | V3   | V2   | V1   | V0   | M    | P    |
| V3 | V2 | V1   | V0   | M    | P    | V3   | V2   | V1   | V0   |      |      |      |      |      |      |

N1 (MS byte) and N0 (LS byte) gives the number of parameter objects stored in the nameplate. In this example N1=0x00 and N0=0x07.

CRC3 (MS byte) to CRC0 (LS byte) is a 32 bit CRC applied to all bytes in the nameplate except for the number of parameter objects and the CRC. The CRC is generated with a reverse polynomial 0xEDB88320.

FLG1 (MS byte) and FLG0 (LS byte) are assigned for bit flags. At present none of these flags are used, and so these bytes are always zero.

Each parameter object consists of 6 bytes:

M is the menu number between 1 and 41.

P is the parameter number between 0 and 255.

V3 (MS byte) to V0 (LS byte) give a signed 32 bit parameter value. This is equivalent to the largest parameter size used by the drive, and so it can be used to hold the maximum or minimum value of any parameter.

The total size of the nameplate in bytes is the 16 header bytes plus 6 x number of parameter objects.

In an EnDat encoder the nameplate begins at the start of MRS area 0xAB and finishes at the end of MRS area 0xAD. Although not guaranteed, these areas normally both consist of 256 words giving a total size of 1024 bytes. Therefore a nameplate can hold up to  $(1024 - 16 (\text{header})) / 6 = 168$  parameter objects. The time to read the nameplate is approximately 60ms per parameter object when *P1 Device Type* (03.038) is SC.EnDat, and 120ms per parameter when *P1 Device Type* (03.038) is EnDat.

In a Hiperface encoder the nameplate can be stored in up to 8 datafields starting at the beginning of datafield 0. The size of datafields can be between 16 and 128 bytes. It is recommended that 128 byte datafields are used, and so the maximum size of the nameplate is 1024 bytes. Therefore a nameplate can hold up to  $(1024 - 16 (\text{header})) / 6 = 168$  parameter objects. The time to read the nameplate is approximately 100ms per parameter object.

The nameplate can hold any parameters stored in drive menus (i.e. 1 to 41). If the menu and parameter number correspond to a parameter that does not exist or is read-only then the parameter is simply not written and no trip is initiated. If the value of the parameter is out of range for the parameter then the parameter is not written and a no trip is initiated.

# Current Ratings

The tables below give the maximum output current ratings, peak current ratings and power ratings for all drive sizes and voltage ratings.

## 200V Rated Drives

| Model    | Heavy Duty    |                   |     |                        |                  | Normal Duty   |                   |     |              | Kc      |
|----------|---------------|-------------------|-----|------------------------|------------------|---------------|-------------------|-----|--------------|---------|
|          | Rated Current | Motor Shaft Power |     | Peak Current Open Loop | Peak Current RFC | Rated Current | Motor Shaft Power |     | Peak Current |         |
|          | A             | kW                | hp  | A                      | A                | A             | kW                | hp  | A            |         |
| 03200050 | 5             | 0.75              | 1   | 7.5                    | 10               | 6.6           | 1.1               | 1.5 | 7.26         | 11.111  |
| 03200066 | 6.6           | 1.1               | 1.5 | 9.9                    | 13.2             | 8             | 1.5               | 2   | 8.8          | 14.667  |
| 03200080 | 8             | 1.5               | 2   | 12                     | 16               | 11            | 2.2               | 3   | 12.1         | 17.778  |
| 03200106 | 10.6          | 2.2               | 3   | 15.9                   | 21.2             | 12.7          | 3                 | 3   | 13.97        | 23.556  |
| 04200137 | 13.7          | 3                 | 3   | 20.55                  | 27.4             | 18            | 4                 | 5   | 19.8         | 30.444  |
| 04200185 | 18.5          | 4                 | 5   | 27.75                  | 37               | 25            | 5.5               | 7.5 | 27.5         | 41.111  |
| 05200250 | 25            | 5.5               | 7.5 | 37.5                   | 50               | 30            | 7.5               | 10  | 33           | 55.556  |
| 06200330 | 33            | 7.5               | 10  | 49.5                   | 66               | 50            | 11                | 15  | 55           | 73.333  |
| 06200440 | 44            | 11                | 15  | 66                     | 88               | 58            | 15                | 20  | 63.8         | 97.778  |
| 07200610 | 61            | 15                | 20  | 91.5                   | 122              | 75            | 18.5              | 25  | 82.5         | 135.556 |
| 07200750 | 75            | 18.5              | 25  | 112.5                  | 150              | 94            | 22                | 30  | 103.4        | 166.667 |
| 07200830 | 83            | 22                | 30  | 124.5                  | 166              | 117           | 30                | 40  | 128.7        | 184.444 |
| 08201160 | 116           | 30                | 40  | 174                    | 232              | 149           | 37                | 50  | 163.9        | 257.778 |
| 08201320 | 132           | 37                | 50  | 198                    | 264              | 180           | 45                | 60  | 198          | 293.333 |
| 09201760 | 176           | 45                | 60  | 264                    | 308              | 216           | 55                | 75  | 237.6        | 342.222 |
| 09202190 | 219           | 55                | 75  | 328.5                  | 383.25           | 266           | 75                | 100 | 292.6        | 425.833 |
| 10202830 | 283           | 75                | 100 | 424.5                  | 495.25           | 325           | 90                | 125 | 357.5        | 550.278 |
| 10203000 | 300           | 90                | 125 | 450                    | 525              | 360           | 110               | 150 | 396          | 583.333 |

## 400V Rated Drives

| Model    | Heavy Duty    |                   |     |                        |                  | Normal Duty   |                   |     |              | Kc      |
|----------|---------------|-------------------|-----|------------------------|------------------|---------------|-------------------|-----|--------------|---------|
|          | Rated Current | Motor Shaft Power |     | Peak Current Open Loop | Peak Current RFC | Rated Current | Motor Shaft Power |     | Peak Current |         |
|          | A             | kW                | hp  | A                      | A                | A             | kW                | hp  | A            |         |
| 03400025 | 2.5           | 0.75              | 1   | 3.75                   | 5                | 3.4           | 1.1               | 1.5 | 3.74         | 5.556   |
| 03400031 | 3.1           | 1.1               | 1.5 | 4.65                   | 6.2              | 4.5           | 1.5               | 2   | 4.95         | 6.889   |
| 03400045 | 4.5           | 1.5               | 2   | 6.75                   | 9                | 6.2           | 2.2               | 3   | 6.82         | 10      |
| 03400062 | 6.2           | 2.2               | 3   | 9.3                    | 12.4             | 7.7           | 3                 | 5   | 8.47         | 13.778  |
| 03400078 | 7.8           | 3                 | 5   | 11.7                   | 15.6             | 10.4          | 4                 | 5   | 11.44        | 17.333  |
| 03400100 | 10            | 4                 | 5   | 15                     | 20               | 12.3          | 5.5               | 7.5 | 13.53        | 22.222  |
| 04400150 | 15            | 5.5               | 10  | 22.5                   | 30               | 18.5          | 7.5               | 10  | 20.35        | 33.333  |
| 04400172 | 17.2          | 7.5               | 10  | 25.8                   | 34.4             | 24            | 11                | 15  | 26.4         | 38.222  |
| 05400270 | 27            | 11                | 20  | 40.5                   | 54               | 30            | 15                | 20  | 33           | 60      |
| 05400300 | 30            | 15                | 20  | 45                     | 60               | 31            | 15                | 20  | 34.1         | 66.667  |
| 06400350 | 35            | 15                | 25  | 52.5                   | 70               | 38            | 18.5              | 25  | 41.8         | 77.778  |
| 06400420 | 42            | 18.5              | 30  | 63                     | 84               | 48            | 22                | 30  | 52.8         | 93.333  |
| 06400470 | 47            | 22                | 30  | 70.5                   | 94               | 63            | 30                | 40  | 69.3         | 104.444 |
| 07400660 | 66            | 30                | 50  | 99                     | 132              | 79            | 37                | 50  | 86.9         | 146.667 |
| 07400770 | 77            | 37                | 60  | 115.5                  | 154              | 94            | 45                | 60  | 103.4        | 171.111 |
| 07401000 | 100           | 45                | 75  | 150                    | 200              | 112           | 55                | 75  | 123.2        | 222.222 |
| 08401340 | 134           | 55                | 100 | 201                    | 268              | 155           | 75                | 100 | 170.5        | 297.778 |
| 08401570 | 157           | 75                | 125 | 235.5                  | 314              | 184           | 90                | 125 | 202.4        | 348.889 |
| 09402000 | 200           | 90                | 150 | 300                    | 350              | 221           | 110               | 150 | 243.1        | 388.889 |
| 09402240 | 224           | 110               | 150 | 336                    | 392              | 266           | 132               | 200 | 292.6        | 435.556 |
| 10402700 | 270           | 132               | 200 | 405                    | 472.5            | 320           | 160               | 250 | 352          | 525     |
| 10403200 | 320           | 160               | 250 | 480                    | 560              | 361           | 200               | 300 | 397.1        | 622.222 |
| 11403770 | 377           | 185               | 300 | 565.5                  | 659.75           | 437           | 225               | 350 | 480.7        | 733.056 |
| 11404170 | 417           | 200               | 350 | 625.5                  | 729.75           | 487           | 250               | 400 | 535.7        | 810.833 |
| 11404640 | 464           | 250               | 400 | 696                    | 812              | 507           | 315               | 450 | 557.7        | 902.222 |

## 575V Rated Drives

| Model    | Heavy Duty    |                   |     |                        |                  | Normal Duty   |                   |     |              | Kc      |
|----------|---------------|-------------------|-----|------------------------|------------------|---------------|-------------------|-----|--------------|---------|
|          | Rated Current | Motor Shaft Power |     | Peak Current Open Loop | Peak Current RFC | Rated Current | Motor Shaft Power |     | Peak Current |         |
|          | A             | kW                | hp  | A                      | A                | A             | kW                | hp  | A            | A       |
| 05500030 | 3             | 1.5               | 2   | 4.5                    | 6                | 3.9           | 2.2               | 3   | 4.29         | 6.667   |
| 05500040 | 4             | 2.2               | 3   | 6                      | 8                | 6.1           | 4                 | 5   | 6.71         | 8.889   |
| 05500069 | 6.9           | 4                 | 5   | 10.35                  | 13.8             | 10            | 5.5               | 7.5 | 11           | 15.333  |
| 06500100 | 10            | 5.5               | 7.5 | 15                     | 20               | 12            | 7.5               | 10  | 13.2         | 22.222  |
| 06500150 | 15            | 7.5               | 10  | 22.5                   | 30               | 17            | 11                | 15  | 18.7         | 33.333  |
| 06500190 | 19            | 11                | 15  | 28.5                   | 38               | 22            | 15                | 20  | 24.2         | 42.222  |
| 06500230 | 23            | 15                | 20  | 34.5                   | 46               | 27            | 18.5              | 25  | 29.7         | 51.111  |
| 06500290 | 29            | 18.5              | 25  | 43.5                   | 58               | 34            | 22                | 30  | 37.4         | 64.444  |
| 06500350 | 35            | 22                | 30  | 52.5                   | 70               | 43            | 30                | 40  | 47.3         | 77.778  |
| 07500440 | 44            | 30                | 40  | 66                     | 88               | 53            | 45                | 50  | 58.3         | 97.778  |
| 07500550 | 55            | 37                | 50  | 82.5                   | 110              | 73            | 55                | 60  | 80.3         | 122.222 |
| 08500630 | 63            | 45                | 60  | 94.5                   | 126              | 86            | 75                | 75  | 94.6         | 140     |
| 08500860 | 86            | 55                | 75  | 129                    | 172              | 108           | 90                | 100 | 118.8        | 191.111 |
| 09501040 | 104           | 75                | 100 | 156                    | 182              | 125           | 110               | 125 | 137.5        | 202.222 |
| 09501310 | 131           | 90                | 125 | 196.5                  | 229.25           | 150           | 110               | 150 | 165          | 254.722 |
| 10501520 | 152           | 110               | 150 | 228                    | 266              | 200           | 130               | 200 | 220          | 295.556 |
| 10501900 | 190           | 132               | 200 | 285                    | 332.5            | 200           | 150               | 200 | 220          | 369.444 |
| 11502000 | 200           | 150               | 200 | 300                    | 350              | 248           | 175               | 250 | 272.8        | 388.889 |
| 11502540 | 254           | 185               | 250 | 381                    | 444.5            | 288           | 225               | 300 | 316.8        | 493.889 |
| 11502850 | 285           | 225               | 300 | 427.5                  | 498.75           | 315           | 250               | 350 | 346.5        | 554.167 |

### 690V Rated Drives

| Model    | Heavy Duty    |                   |     |                        |                  | Normal Duty   |                   |     |              | Kc      |
|----------|---------------|-------------------|-----|------------------------|------------------|---------------|-------------------|-----|--------------|---------|
|          | Rated Current | Motor Shaft Power |     | Peak Current Open Loop | Peak Current RFC | Rated Current | Motor Shaft Power |     | Peak Current |         |
|          | A             | kW                | hp  | A                      | A                | A             | kW                | hp  | A            | A       |
| 07600190 | 19            | 15                | 20  | 28.5                   | 38               | 23            | 18.5              | 25  | 25.3         | 42.222  |
| 07600240 | 24            | 18.5              | 25  | 36                     | 48               | 30            | 22                | 30  | 33           | 53.333  |
| 07600290 | 29            | 22                | 30  | 43.5                   | 58               | 36            | 30                | 40  | 39.6         | 64.444  |
| 07600380 | 38            | 30                | 40  | 57                     | 76               | 46            | 37                | 50  | 50.6         | 84.444  |
| 07600440 | 44            | 37                | 50  | 66                     | 88               | 52            | 45                | 60  | 57.2         | 97.778  |
| 07600540 | 54            | 45                | 60  | 81                     | 108              | 73            | 55                | 75  | 80.3         | 120     |
| 08600630 | 63            | 55                | 75  | 94.5                   | 126              | 86            | 75                | 100 | 94.6         | 140     |
| 08600860 | 86            | 75                | 100 | 129                    | 172              | 108           | 90                | 125 | 118.8        | 191.111 |
| 09601040 | 104           | 90                | 125 | 156                    | 182              | 125           | 110               | 150 | 137.5        | 202.222 |
| 09601310 | 131           | 110               | 150 | 196.5                  | 229.25           | 155           | 132               | 175 | 170.5        | 254.722 |
| 10601500 | 150           | 132               | 175 | 225                    | 262.5            | 172           | 160               | 200 | 189.2        | 291.667 |
| 10601780 | 178           | 160               | 200 | 267                    | 311.5            | 197           | 185               | 250 | 216.7        | 346.111 |
| 11602100 | 210           | 185               | 250 | 315                    | 367.5            | 225           | 200               | 250 | 247.5        | 408.333 |
| 11602380 | 238           | 200               | 250 | 357                    | 416.5            | 275           | 250               | 300 | 302.5        | 462.778 |
| 11602630 | 263           | 250               | 300 | 394.5                  | 460.25           | 305           | 315               | 400 | 335.5        | 511.389 |



## Variable Minimum / Maximum Pairs

The descriptions below define the variable minimum/maximum pairs that can be used with parameters when the VM format bit is set. The variable minimum and maximum themselves can be dependent on other parameters, or the drive rating or other conditions as defined. The variable minimum and the variable maximum have a limited range and this is defined for each minimum/maximum pair.

| Identifier     | VM_AC_VOLTAGE                                    |
|----------------|--|
| Description    | Range applied to parameters showing a.c. voltage |
| Units          | V  |
| Range of [MIN] | 0  |
| Range of [MAX] | 0 to 930   |

VM\_AC\_VOLTAGE[MAX] in drive voltage rating dependent. See the table below.

| Voltage level      | 200V | 400V | 575V | 690V |
|--------------------|------|------|------|------|
| VM_AC_VOLTAGE[MAX] | 325  | 650  | 780  | 930  |

VM\_AC\_VOLTAGE[MIN] = 0

| Identifier     | VM_AC_VOLTAGE_SET                               |
|----------------|---|
| Description    | Range applied to a.c. voltage set-up parameters |
| Units          | V   |
| Range of [MIN] | 0   |
| Range of [MAX] | 0 to 765  |

VM\_AC\_VOLTAGE\_SET[MAX] is drive voltage rating dependent. See the table below.

| Voltage level          | 200V | 400V | 575V | 690V |
|------------------------|------|------|------|------|
| VM_AC_VOLTAGE_SET[MAX] | 265  | 530  | 635  | 765  |

VM\_AC\_VOLTAGE\_SET[MIN] = 0

| Identifier     | VM_ACCEL_RATE   |
|----------------|---|
| Description    | Maximum applied to the ramp rate parameters                 |
| Units          | s/100Hz, s/1000rpm, s/1000mm/s                              |
| Range of [MIN] | Open-loop: 0.0<br>RFC-A, RFC-S: 0.000                       |
| Range of [MAX] | Open-loop: 0.0 to 3200.0<br>RFC-A, RFC-S: 0.000 to 3200.000 |

A maximum needs to be applied to the ramp rate parameters because the units are a time for a change of speed from zero to a defined level or to maximum speed. The defined level is 100Hz for Open-loop mode and 1000rpm or 1000mm/s for RFC-A and RFC-S modes. If the change of speed is to the maximum speed then changing the maximum speed changes the actual ramp rate for a given ramp rate parameter value. The variable maximum calculation ensures that longest ramp rate (parameter at its maximum value) is not slower than the rate with the defined level, i.e. 3200.00 s / Hz for Open-loop mode, and 3200.000 s / 1000rpm or 3200.000 s / 1000mm/s for RFC-A and RFC-S modes.

The maximum frequency/speed is taken from *Maximum Reference Clamp* (01.006) if *Select Motor 2 Parameters* (11.045) = 0, or *M2 Maximum Reference Clamp* (21.001) if *Select Motor 2 Parameters* (11.045) = 1.

### Open-loop mode

VM\_ACCEL\_RATE[MIN] = 0.0

If *Ramp Rate Units* (02.039) = 0:

VM\_ACCEL\_RATE[MAX] = 3200.0

Otherwise:

VM\_ACCEL\_RATE[MAX] = 3200.0 x Maximum frequency / 100.0

### RFC-A, RFC-S modes

VM\_ACCEL\_RATE[MIN] = 0.000

If *Ramp Rate Units* (02.039) = 0:

VM\_ACCEL\_RATE[MAX] = 3200.000

Otherwise:

VM\_ACCEL\_RATE[MAX] = 3200.000 x Maximum speed / 1000.0

| Identifier     | VM_AMC_JERK_UNIPOLAR                                 |
|----------------|--|
| Description    | Range applied to the parameters showing the AMC jerk |
| Units          | User units / ms / ms / ms                            |
| Range of [MIN] | 0  |
| Range of [MAX] | 107374.1823  |

VM\_AMC\_JERK\_UNIPOLAR[MAX] = 107374.1823 / *AMC Auto Resolution Scaling* (31.016)

VM\_AMC\_JERK\_UNIPOLAR[MIN] = 0

| Identifier     | VM_AMC_POSITION  |
|----------------|--|
| Description    | Range applied to the parameters showing the AMC position |
| Units          | User units   |
| Range of [MIN] | -2147483648  |
| Range of [MAX] | 2147483647   |

VM\_AMC\_POSITION is modified by *AMC Auto Resolution Scaling* (31.016) and *AMC Roll Over Limit* (31.010). See the table below.

| <i>AMC Roll Over Limit</i> (31.010) | = 0   | > 0                                     |
|-------------------------------------|---|---|
| VM_AMC_POSITION[MAX]                | 2147483647 / <i>AMC Auto Resolution Scaling</i> (31.016)  | <i>AMC Roll Over Limit</i> (31.010) - 1 |
| VM_AMC_POSITION[MIN]                | -2147483648 / <i>AMC Auto Resolution Scaling</i> (31.016) | 0                                       |

| Identifier     | VM_AMC_POSITION_CAM  |
|----------------|--|
| Description    | Range applied to the parameters showing the AMC cam position |
| Units          | User units   |
| Range of [MIN] | -1073741824  |
| Range of [MAX] | 1073741823   |

VM\_AMC\_POSITION\_CAM is modified by *AMC Auto Resolution Scaling* (31.016) and *AMC Roll Over Limit* (31.010). See the table below.

| <i>AMC Roll Over Limit</i> (31.010) | = 0   | > 0                                       |
|-------------------------------------|---|---|
| VM_AMC_POSITION_CAM[MAX]            | 1073741823 / <i>AMC Auto Resolution Scaling</i> (31.016)  | <i>AMC Roll Over Limit</i> (31.010) - 1   |
| VM_AMC_POSITION_CAM[MIN]            | -1073741824 / <i>AMC Auto Resolution Scaling</i> (31.016) | - <i>AMC Roll Over Limit</i> (31.010) + 1 |

| Identifier     | VM_AMC_POSITION_CAM_UNIPOLAR            |
|----------------|---|
| Description    | Unipolar version of VM_AMC_POSITION_CAM |
| Units          | User units                              |
| Range of [MIN] | 0                                       |
| Range of [MAX] | 1073741823                              |

VM\_AMC\_POSITION\_CAM\_UNIPOLAR is modified by *AMC Auto Resolution Scaling* (31.016) and *AMC Roll Over Limit* (31.010). See the table below.

| <i>AMC Roll Over Limit</i> (31.010) | = 0  | > 0                                     |
|-------------------------------------|--|---|
| VM_AMC_POSITION_CAM_UNIPOLAR[MAX]   | 1073741823 / <i>AMC Auto Resolution Scaling</i> (31.016) | <i>AMC Roll Over Limit</i> (31.010) - 1 |
| VM_AMC_POSITION_CAM_UNIPOLAR[MIN]   | 0  | 0                                       |

| Identifier     | VM_AMC_POSITION_REF                         |
|----------------|---|
| Description    | Range applied to the AMC position reference |
| Units          | User units                                  |
| Range of [MIN] | -2147483648                                 |
| Range of [MAX] | 2147483647                                  |

VM\_AMC\_POSITION\_REF is modified by *AMC Auto Resolution Scaling* (31.016), *AMC Roll Over Limit* (31.010) and *AMC Rotary Mode* (34.005). See the table below.

| <i>AMC Roll Over Limit</i> (31.010) | = 0   | > 0                                     | > 0   |
|-------------------------------------|---|---|---|
| <i>AMC Rotary Mode</i> (34.005)     | Not active  | < 4                                     | = 4   |
| VM_AMC_POSITION_REF[MAX]            | 2147483647 / <i>AMC Auto Resolution Scaling</i> (31.016)  | <i>AMC Roll Over Limit</i> (31.010) - 1 | 1073741823 / <i>AMC Auto Resolution Scaling</i> (31.016)  |
| VM_AMC_POSITION_REF[MIN]            | -2147483648 / <i>AMC Auto Resolution Scaling</i> (31.016) | 0                                       | -1073741824 / <i>AMC Auto Resolution Scaling</i> (31.016) |

| Identifier     | VM_AMC_POSITION_UNIPOLAR            |
|----------------|-------------------------------------|
| Description    | Unipolar version of VM_AMC_POSITION |
| Units          | User units                          |
| Range of [MIN] | 0                                   |
| Range of [MAX] | 2147483647                          |

VM\_AMC\_POSITION\_UNIPOLAR is modified by *AMC Auto Resolution Scaling* (31.016) and *AMC Roll Over Limit* (31.010). See the table below.

| <i>AMC Roll Over Limit</i> (31.010) | = 0  | > 0                                     |
|-------------------------------------|--|---|
| VM_AMC_POSITION_UNIPOLAR[MAX]       | 2147483647 / <i>AMC Auto Resolution Scaling</i> (31.016) | <i>AMC Roll Over Limit</i> (31.010) - 1 |
| VM_AMC_POSITION_UNIPOLAR[MIN]       | 0  | 0                                       |

| Identifier     | VM_AMC_RATE  |
|----------------|--|
| Description    | Range applied to the parameters showing the AMC acceleration |
| Units          | User units / ms / ms   |
| Range of [MIN] | 1073742.824  |
| Range of [MAX] | 1073741.823  |

VM\_AMC\_RATE\_UNIPOLAR[MAX] = 1073741.823 / AMC Auto Resolution Scaling (31.016)

VM\_AMC\_RATE\_UNIPOLAR[MIN] = -1073741.824 / AMC Auto Resolution Scaling (31.016)

| Identifier     | VM_AMC_RATE_UNIPOLAR            |
|----------------|---------------------------------|
| Description    | Unipolar version of VM_AMC_RATE |
| Units          | User units / ms / ms            |
| Range of [MIN] | 0                               |
| Range of [MAX] | 1073741.823                     |

VM\_AMC\_RATE\_UNIPOLAR[MAX] = 1073741.823 / AMC Auto Resolution Scaling (31.016)

VM\_AMC\_RATE\_UNIPOLAR[MIN] = 0

| Identifier     | VM_AMC_ROLLOVER                               |
|----------------|---|
| Description    | Maximum applied to the AMC Rollover parameter |
| Units          | User units                                    |
| Range of [MIN] | 0   |
| Range of [MAX] | 1073741823                                    |

VM\_AMC\_ROLLOVER[MAX] = 1073741823 / AMC Auto Resolution Scaling (31.016)

VM\_AMC\_ROLLOVER[MIN] = 0

| Identifier     | VM_AMC_SPEED  |
|----------------|---|
| Description    | Range applied to the parameters showing the AMC speed |
| Units          | User units / ms                                       |
| Range of [MIN] | -21474836.48  |
| Range of [MAX] | 21474836.47   |

VM\_AMC\_SPEED[MAX] = 21474836.47 / AMC Auto Resolution Scaling (31.016)

VM\_AMC\_SPEED[MIN] = -21474836.48 / AMC Auto Resolution Scaling (31.016)

| Identifier     | VM_AMC_SPEED_UNIPOLAR            |
|----------------|----------------------------------|
| Description    | Unipolar version of VM_AMC_SPEED |
| Units          | User units / ms                  |
| Range of [MIN] | 0                                |
| Range of [MAX] | 21474836.47                      |

VM\_SPEED\_UNIPOLAR[MAX] = 21474836.47 / AMC Auto Resolution Scaling (31.016)

VM\_SPEED\_UNIPOLAR[MIN] = 0

| Identifier     | VM_DC_VOLTAGE                                      |
|----------------|--|
| Description    | Range applied to d.c. voltage reference parameters |
| Units          | V  |
| Range of [MIN] | 0  |
| Range of [MAX] | 0 to 1190  |

VM\_DC\_VOLTAGE[MAX] is the full scale d.c. link voltage feedback (over voltage trip level) for the drive. This level is drive voltage rating dependent. See the table below.

| Voltage level      | 200V | 400V | 575V | 690V |
|--------------------|------|------|------|------|
| VM_DC_VOLTAGE[MAX] | 415  | 830  | 990  | 1190 |

VM\_DC\_VOLTAGE[MIN] = 0

| Identifier     | VM_DC_VOLTAGE_SET                                  |
|----------------|--|
| Description    | Range applied to d.c. voltage reference parameters |
| Units          | V  |
| Range of [MIN] | 0  |
| Range of [MAX] | 0.0 to 1150.0                                      |

VM\_DC\_VOLTAGE\_SET[MAX] is drive voltage rating dependent. All values are shown in the table below.

| Voltage level          | 200V | 400V | 575V | 690V |
|------------------------|------|------|------|------|
| VM_DC_VOLTAGE_SET[MAX] | 400  | 800  | 955  | 1150 |

VM\_DC\_VOLTAGE\_SET[MIN] = 0

| Identifier     | VM_DRIVE_CURRENT                                 |
|----------------|--|
| Description    | Range applied to parameters showing current in A |
| Units          | A  |
| Range of [MIN] | -99999.999 to 0.000                              |
| Range of [MAX] | 0.000 to 99999.999                               |

VM\_DRIVE\_CURRENT[MAX] is equivalent to the full scale (over current trip level) for the drive and is given by *Full Scale Current Kc* (11.061).

VM\_DRIVE\_CURRENT[MIN] = - VM\_DRIVE\_CURRENT[MAX]

| Identifier     | VM_DRIVE_CURRENT_UNIPOLAR            |
|----------------|--------------------------------------|
| Description    | Unipolar version of VM_DRIVE_CURRENT |
| Units          | A                                    |
| Range of [MIN] | 0.000                                |
| Range of [MAX] | 0.000 to 99999.999                   |

VM\_DRIVE\_CURRENT\_UNIPOLAR[MAX] = VM\_DRIVE\_CURRENT[MAX]

VM\_DRIVE\_CURRENT\_UNIPOLAR[MIN] = 0.000

| Identifier     | VM_HIGH_DC_VOLTAGE  |
|----------------|---|
| Description    | Range applied to the parameters showing high d.c. voltage |
| Units          | V   |
| Range of [MIN] | 0   |
| Range of [MAX] | 0 to 1500   |

VM\_HIGH\_DC\_VOLTAGE[MAX] = 1500. This is the full scale d.c. link voltage feedback for the high d.c. link voltage measurement which can measure the voltage if it goes above the normal full scale value.

VM\_HIGH\_DC\_VOLTAGE[MIN] = 0

| Identifier     | VM_LOW_UNDER_VOLTS                               |
|----------------|--|
| Description    | Range applied to the low under voltage threshold |
| Units          | V  |
| Range of [MIN] | 24   |
| Range of [MAX] | 24 to 1150                                       |

If *Back-up Mode Enable* (06.068) = 0

VM\_LOW\_UNDER\_VOLTS[MAX] = VM\_STD\_UNDER\_VOLTS[MIN]

Otherwise

VM\_LOW\_UNDER\_VOLTS[MAX] = VM\_STD\_UNDER\_VOLTS[MIN] / 1.1.

VM\_LOW\_UNDER\_VOLTS[MIN] = 0.

| Identifier     | VM_MIN_SWITCHING_FREQUENCY                                 |
|----------------|--|
| Description    | Range applied to the minimum switching frequency parameter |
| Units          | User units   |
| Range of [MIN] | 0  |
| Range of [MAX] | 0 to 6   |

VM\_MIN\_SWITCHING\_FREQUENCY[MAX] = *Maximum Switching Frequency* (05.018)

VM\_MIN\_SWITCHING\_FREQUENCY[MIN] = 0 for motor control modes, or 1 for Regen mode (subject to the maximum)

| Identifier     | VM_MOTOR1_CURRENT_LIMIT                             |
|----------------|---|
| Description    | Range applied to current limit parameters (motor 1) |
| Units          | %   |
| Range of [MIN] | 0.0   |
| Range of [MAX] | 0.0 to 1000.0                                       |

VM\_MOTOR1\_CURRENT\_LIMIT[MAX] is dependent on the drive rating and motor set-up parameters.

VM\_MOTOR1\_CURRENT\_LIMIT[MIN] = 0.00

| Identifier     | VM_MOTOR2_CURRENT_LIMIT                             |
|----------------|---|
| Description    | Range applied to current limit parameters (motor 2) |
| Units          | %   |
| Range of [MIN] | 0.0   |
| Range of [MAX] | 0.0 to 1000.0                                       |

VM\_MOTOR2\_CURRENT\_LIMIT[MAX] is dependent on the drive rating and motor set-up parameters.

VM\_MOTOR2\_CURRENT\_LIMIT[MIN] = 0.0

| Identifier     | VM_NEGATIVE_REF_CLAMP1  |
|----------------|---|
| Description    | Limits applied to the negative frequency or speed clamp (motor 1)             |
| Units          | Open-loop: Hz<br>RFC-A, RFC-S: rpm or mm/s                                    |
| Range of [MIN] | Open-loop: -599.0 to 0.0<br>RFC-A, RFC-S: -550 x 60 / Motor pole pairs to 0.0 |
| Range of [MAX] | Open-loop: 0.0 to 599.0<br>RFC-A, RFC-S: 0.0 to 550 x 60 / Motor pole pairs   |

This variable maximum/minimum defines the range of the negative frequency or speed clamp associated with motor map 1 (*Minimum Reference Clamp* (01.007)). The minimum and maximum are affected by the settings of the *Negative Reference Clamp Enable* (01.008), *Bipolar Reference Enable* (01.010) and *Maximum Reference Clamp* (01.006) as shown in the table below.

| <i>Negative Reference Clamp Enable</i> (01.008) | <i>Bipolar Reference Enable</i> (01.010) | VM_NEGATIVE_REF_CLAMP1[MIN] | VM_NEGATIVE_REF_CLAMP1[MAX] |
|---|--|-----------------------------|-----------------------------|
| 0   | 0  | 0.0                         | Pr 01.006                   |
| 0   | 1  | 0.0                         | 0.0                         |
| 1   | X  | -VM_POSITIVE_REF_CLAMP[MAX] | 0.0                         |

| Identifier     | VM_NEGATIVE_REF_CLAMP2  |
|----------------|---|
| Description    | Limits applied to the negative frequency or speed clamp (motor 2)             |
| Units          | Open-loop: Hz<br>RFC-A, RFC-S: rpm or mm/s                                    |
| Range of [MIN] | Open-loop: -599.0 to 0.0<br>RFC-A, RFC-S: -550 x 60 / Motor pole pairs to 0.0 |
| Range of [MAX] | Open-loop: 0.0 to 599.0<br>RFC-A, RFC-S: 0.0 to 550 x 60 / Motor pole pairs   |

This variable maximum/minimum defines the range of the negative frequency or speed clamp associated with motor map 2 (*M2 Minimum Reference Clamp* (21.002)). It is defined in the same way as VM\_NEGATIVE\_REF\_CLAMP1 except that the *M2 Maximum Reference Clamp* (21.001) is used instead of *Maximum Reference Clamp* (01.006).

| Identifier     | VM_POSITIVE_REF_CLAMP1  |
|----------------|---|
| Description    | Limits applied to the positive frequency or speed reference clamp           |
| Units          | Open-loop: Hz<br>RFC-A, RFC-S: rpm or mm/s                                  |
| Range of [MIN] | Open-loop: 0.0<br>RFC-A, RFC-S: 0.0   |
| Range of [MAX] | Open-loop: 0.0 to 599.0<br>RFC-A, RFC-S: 0.0 to 550 x 60 / Motor pole pairs |

VM\_POSITIVE\_REF\_CLAMP1[MAX] defines the range of the positive reference clamp, *Maximum Reference Clamp* (01.006), which in turn limit the references. In RFC-A and RFC-S modes an additional limit is applied so that the position feedback does not exceed the speed where the drive can no longer interpret the feedback signal correctly as given in the table below. The limit is based on the position feedback device selected with *Motor Control Feedback Select* (03.026). It is possible to disable this additional limit if the *RFC Feedback Mode* (03.024)  $\geq 1$ , so that the motor can be operated at a speed above the level where the drive can interpret the feedback in sensorless mode. It should be noted that the position feedback device itself may have a maximum speed limit that is lower than those given in the table. Care should be taken not to exceed a speed that would cause damage to the position feedback device.

| Feedback device                          | VM_POSITIVE_REF_CLAMP1[MAX]  |
|--|--|
| AB, AB Servo                             | (500kHz x 60 / rotary lines per revolution) rpm<br>(500kHz x linear line pitch in mm) mm/s     |
| FD, FR, FD Servo, FR Servo               | (500kHz x 60 / rotary lines per revolution)/2 rpm<br>(500kHz x linear line pitch in mm)/2 mm/s |
| SC, SC Hiper, SC EnDat, SC SSI, SC Servo | (500kHz x 60 / sine waves per revolution) rpm<br>(500kHz x linear line pitch in mm) mm/s       |
| Resolver                                 | 30000 rpm*<br>(250Hz x pole pitch in mm) mm/s  |
| Any other device                         | 50000.0 rpm or mm/s*   |

\*Note that even though these are shown as fixed values they are subject to the maximum of 550 x 60 / Motor Pole Pairs, as are all the other values in this table.

The limit ensures that the frequency of incremental digital or sine wave signals from the encoder do not exceed 500kHz and the modulation frequency for a resolver does not exceed 1kHz, neglecting any speed controller overshoot. The position feedback resolution remains fixed over the whole frequency for digital signals, but reduces with increased frequency or reduced voltage with sine wave signals. The position resolution with sine wave signals is given by the equations below.

Position resolution for a rotary device = K x sine waves per revolution

Position resolution for a linear device = K x sine waves per pole pitch

The value of K varies with the frequency and magnitude of the sine wave signals. The nominal value of K is 1024, and the drive interface provides at least this resolution with 1.0Vp-p sine waves up to a frequency of 50kHz. The table below shows the variation of K with sine wave peak to peak voltage and frequency.

|         | 1kHz | 5kHz | 50kHz | 100kHz | 200kHz | 500kHz |
|---------|------|------|-------|--------|--------|--------|
| 1.2Vp-p | 2048 | 2048 | 1024  | 1024   | 512    | 512    |
| 1.0Vp-p | 2048 | 2048 | 1024  | 512    | 512    | 128    |
| 0.8Vp-p | 1024 | 1024 | 1024  | 512    | 256    | 128    |
| 0.6Vp-p | 1024 | 1024 | 512   | 512    | 256    | 128    |
| 0.4Vp-p | 512  | 512  | 512   | 256    | 128    | 64     |

VM\_POSITIVE\_REF\_CLAMP1[MIN] = 0.0

VM\_POSITIVE\_REF\_CLAMP2[MAX] defines the range of the positive reference clamp, *M2 Maximum Reference Clamp* (21.001), which in turn limit the references. See VM\_POSITIVE\_REF\_CLAMP1 for more details.

| Identifier     | VM_POWER   |
|----------------|--|
| Description    | Range applied to parameters that either set or display power |
| Units          | kW   |
| Range of [MIN] | -99999.999 to 0.000  |
| Range of [MAX] | 0.000 to 99999.999   |

VM\_POWER[MAX] is rating dependent and is chosen to allow for the maximum power that can be output by the drive with maximum a.c. output voltage, at maximum controlled current and unity power factor.

$VM\_POWER[Max] = \sqrt{3} \times VM\_AC\_VOLTAGE[Max] \times VM\_DRIVE\_CURRENT[Max] / 1000$

VM\_POWER[MIN] = -VM\_POWER[MAX]

| Identifier     | VM_RATED_CURRENT                          |
|----------------|---|
| Description    | Range applied to rated current parameters |
| Units          | A   |
| Range of [MIN] | 0.000                                     |
| Range of [MAX] | 0.000 to 99999.999                        |

VM\_RATED\_CURRENT [MAX] = *Maximum Rated Current* (11.060) and is dependent on the drive rating.

VM\_RATED\_CURRENT [MIN] = 0.000

| Identifier     | VM_REGEN_REACTIVE   |
|----------------|---|
| Description    | Range applied to the reactive current reference in Regen mode |
| Units          | %   |
| Range of [MIN] | -1000.0 to 0.0  |
| Range of [MAX] | 0.0 to 1000.0   |

VM\_REGEN\_REACTIVE[MAX] applies a limit to the reactive current reference in Regen mode so that the total current reference does not exceed its maximum allowed level.

VM\_REGEN\_REACTIVE[MIN] = - VM\_REGEN\_REACTIVE[MAX]

| Identifier     | VM_SPEED                                  |
|----------------|---|
| Description    | Range applied to parameters showing speed |
| Units          | Open-loop, RFC-A, RFC-S: rpm or mm/s      |
| Range of [MIN] | Open-loop, RFC-A, RFC-S: -50000.0 to 0.0  |
| Range of [MAX] | Open-loop, RFC-A, RFC-S: 0.0 to 50000.0   |

This variable minimum/maximum defines the range of speed monitoring parameters. To allow headroom for overshoot the range is set to twice the range of the speed references.

$$VM\_SPEED[MIN] = 2 \times VM\_SPEED\_FREQ\_REF[MIN]$$

$$VM\_SPEED[MAX] = 2 \times VM\_SPEED\_FREQ\_REF[MAX]$$

| Identifier     | VM_SPEED_FREQ_KEYPAD_REF  |
|----------------|---|
| Description    | Range applied to the keypad reference   |
| Units          | Open-loop: Hz<br>RFC-A, RFC-S: rpm or mm/s  |
| Range of [MIN] | Open-loop: -599.0 to 599.0<br>RFC-A, RFC-S: -550 x 60 / Motor pole pairs to 550 x 60 / Motor pole pairs |
| Range of [MAX] | Open-loop: 0.0 to 5990.0<br>RFC-A, RFC-S: 0.0 to 550 x 60 / Motor pole pairs                            |

This variable maximum is applied to *Keypad Control Mode Reference* (01.017). The maximum applied to these parameters is the same as other frequency reference parameters.

$$VM\_SPEED\_FREQ\_USER\_REFS [MAX] = VM\_SPEED\_FREQ\_REF[MAX]$$

However the minimum is dependent on *Negative Reference Clamp Enable* (01.008) and *Bipolar Reference Enable* (01.010).

| <b>Negative Reference Clamp Enable (01.008)</b> | <b>Bipolar Reference Enable (01.010)</b> | <b>VM_SPEED_FREQ_USER_REFS[MIN]</b>  |
|---|--|--|
| 0   | 0  | If <i>Select Motor 2 Parameters</i> (11.045) = 0 <i>Minimum Reference Clamp</i> (01.007), otherwise <i>M2 Minimum Reference Clamp</i> (21.002) |
| 0   | 1  | -VM_SPEED_FREQ_REF[MAX]  |
| 1   | 0  | 0.0  |
| 1   | 1  | -VM_SPEED_FREQ_REF[MAX]  |

| Identifier     | VM_SPEED_FREQ_REF   |
|----------------|---|
| Description    | Range applied to the frequency or speed reference parameters                  |
| Units          | Open-loop: Hz<br>RFC-A, RFC-S: rpm or mm/s                                    |
| Range of [MIN] | Open-loop: -599.0 to 0.0<br>RFC-A, RFC-S: -550 x 60 / Motor pole pairs to 0.0 |
| Range of [MAX] | Open-loop: 0.0 to 599.0<br>RFC-A, RFC-S: 0.0 to 550 x 60 / Motor pole pairs   |

This variable minimum/maximum is applied throughout the frequency and speed reference system so that the references can vary in the range from the minimum to maximum clamps.

| <b>Negative Reference Clamp Enable (01.008)</b> | <b>VM_SPEED_FREQ_REF[MAX] if Select Motor 2 Parameters (11.045) = 0</b>                                 | <b>VM_SPEED_FREQ_REF[MAX] if Select Motor 2 Parameters (11.045) = 1</b>                                       |
|---|---|---|
| 0   | <i>Maximum Reference Clamp</i> (01.006)   | <i>M2 Maximum Reference Clamp</i> (21.001)  |
| 1   | <i>Maximum Reference Clamp</i> (01.006) or <i>Minimum Reference Clamp</i> (01.007) whichever the larger | <i>M2 Maximum Reference Clamp</i> (21.001) or <i>M2 Minimum Reference Clamp</i> (21.002) whichever the larger |

$$VM\_SPEED\_FREQ\_REF[MIN] = -VM\_SPEED\_FREQ\_REF[MAX].$$

| Identifier     | VM_SPEED_FREQ_REF_UNIPOLAR  |
|----------------|---|
| Description    | Unipolar version of VM_SPEED_FREQ_REF                                       |
| Units          | Open-loop: Hz<br>RFC-A, RFC-S: rpm or mm/s                                  |
| Range of [MIN] | Open-loop: 0.0<br>RFC-A, RFC-S: 0.0   |
| Range of [MAX] | Open-loop: 0.0 to 599.0<br>RFC-A, RFC-S: 0.0 to 550 x 60 / Motor pole pairs |

$$VM\_SPEED\_FREQ\_REF\_UNIPOLAR[MAX] = VM\_SPEED\_FREQ\_REF[MAX]$$

$$VM\_SPEED\_FREQ\_REF\_UNIPOLAR[MIN] = 0.0$$

| Identifier     | VM_SPEED_FREQ_USER_REFS   |
|----------------|---|
| Description    | Range applied to analogue reference parameters  |
| Units          | Open-loop: Hz<br>RFC-A, RFC-S: rpm or mm/s  |
| Range of [MIN] | Open-loop: -599.00 to 599.00<br>RFC-A, RFC-S: -550 x 60 / Motor pole pairs to 550 x 60 / Motor pole pairs |
| Range of [MAX] | Open-loop: 0.0 to 599.00<br>RFC-A, RFC-S: 0.0 to 550 x 60 / Motor pole pairs                              |

This variable maximum is applied to *Analogue Reference 1* (01.036) and *Analogue Reference 2* (01.037). It should be noted that in Open-loop mode the analogue reference parameters have two decimal places.

The maximum applied to these parameters is the same as other frequency reference parameters.

$$VM\_SPEED\_FREQ\_USER\_REFS [MAX] = VM\_SPEED\_FREQ\_REF[MAX]$$

However the minimum is dependent on *Negative Reference Clamp Enable* (01.008) and *Bipolar Reference Enable* (01.010).

| <i>Negative Reference Clamp Enable</i> (01.008) | <i>Bipolar Reference Enable</i> (01.010) | VM_SPEED_FREQ_USER_REFS[MIN]   |
|---|--|--|
| 0   | 0  | If <i>Select Motor 2 Parameters</i> (11.045) = 0 <i>Minimum Reference Clamp</i> (01.007), otherwise <i>M2 Minimum Reference Clamp</i> (21.002) |
| 0   | 1  | -VM_SPEED_FREQ_REF[MAX]  |
| 1   | 0  | 0.0  |
| 1   | 1  | -VM_SPEED_FREQ_REF[MAX]  |

| Identifier     | VM_STD_UNDER_VOLTS                                    |
|----------------|---|
| Description    | Range applied to the standard under voltage threshold |
| Units          | V   |
| Range of [MIN] | 0 to 1150   |
| Range of [MAX] | 0 to 1150   |

$$VM\_STD\_UNDER\_VOLTS[MAX] = VM\_DC\_VOLTAGE\_SET / 1.1$$

VM\_STD\_UNDER\_VOLTS[MIN] is voltage rating dependent. See the table below.

| Voltage level           | 200V | 400V | 575V | 690V |
|-------------------------|------|------|------|------|
| VM_STD_UNDER_VOLTS[MIN] | 175  | 330  | 435  | 435  |

| Identifier     | VM_SUPPLY_LOSS_LEVEL                       |
|----------------|--|
| Description    | Range applied to the supply loss threshold |
| Units          | V  |
| Range of [MIN] | 0 to 1150                                  |
| Range of [MAX] | 0 to 1150                                  |

$$VM\_SUPPLY\_LOSS\_LEVEL[MAX] = VM\_DC\_VOLTAGE\_SET[MAX]$$

VM\_SUPPLY\_LOSS\_LEVEL[MIN] is drive voltage rating dependent. See the table below.

| Voltage level             | 200V | 400V | 575V | 690V |
|---------------------------|------|------|------|------|
| VM_SUPPLY_LOSS_LEVEL[MIN] | 205  | 410  | 540  | 540  |

| Identifier     | VM_SWITCHING_FREQUENCY                                      |
|----------------|---|
| Description    | Range applied to the maximum switching frequency parameters |
| Units          | User units  |
| Range of [MIN] | 0   |
| Range of [MAX] | 0 to 6  |

$$VM\_SWITCHING\_FREQUENCY[MAX] = \text{Power stage dependent}$$

VM\_SWITCHING\_FREQUENCY[MIN] = 0 for motor control modes, or 1 for Regen mode (subject to the maximum)



| Identifier     | VM_TORQUE_CURRENT  |
|----------------|--|
| Description    | Range applied to torque and torque producing current parameters. (Where this is used in Regen mode it refers to the active current.) |
| Units          | %  |
| Range of [MIN] | -1000.0 to 0.0   |
| Range of [MAX] | 0.0 to 1000.0  |

| Select Motor 2 Parameters (11.045) | VM_TORQUE_CURRENT[MAX]       |
|------------------------------------|------------------------------|
| 0                                  | VM_MOTOR1_CURRENT_LIMIT[MAX] |
| 1                                  | VM_MOTOR2_CURRENT_LIMIT[MAX] |

VM\_TORQUE\_CURRENT[MIN] = -VM\_TORQUE\_CURRENT[MAX]

| Identifier     | VM_TORQUE_CURRENT_UNIPOLAR            |
|----------------|---------------------------------------|
| Description    | Unipolar version of VM_TORQUE_CURRENT |
| Units          | %                                     |
| Range of [MIN] | 0.0                                   |
| Range of [MAX] | 0.0 to 1000.0                         |

VM\_TORQUE\_CURRENT\_UNIPOLAR[MAX] = VM\_TORQUE\_CURRENT[MAX]

VM\_TORQUE\_CURRENT\_UNIPOLAR[MIN] = 0.0

| Identifier     | VM_USER_CURRENT   |
|----------------|---|
| Description    | Range applied to torque reference and percentage load parameters with one decimal place |
| Units          | %   |
| Range of [MIN] | -1000.0 to 0.0  |
| Range of [MAX] | 0.0 to 1000.0   |

VM\_USER\_CURRENT[MAX] = *User Current Maximum Scaling* (04.024)

VM\_USER\_CURRENT[MIN] = -VM\_USER\_CURRENT[MAX]

| Identifier     | VM_USER_CURRENT_HIGH_RES   |
|----------------|--|
| Description    | Range applied to torque reference and percentage load parameters with two decimal places |
| Units          | %  |
| Range of [MIN] | -1000.00 to 0.00   |
| Range of [MAX] | 0.00 to 1000.00  |

VM\_USER\_CURRENT\_HIGH\_RES[MAX] = *User Current Maximum Scaling* (04.024) with an additional decimal place

VM\_USER\_CURRENT\_HIGH\_RES[MIN] = -VM\_USER\_CURRENT\_HIGH\_RES[MAX]

# Menu 1 Single Line Descriptions – *Speed References*

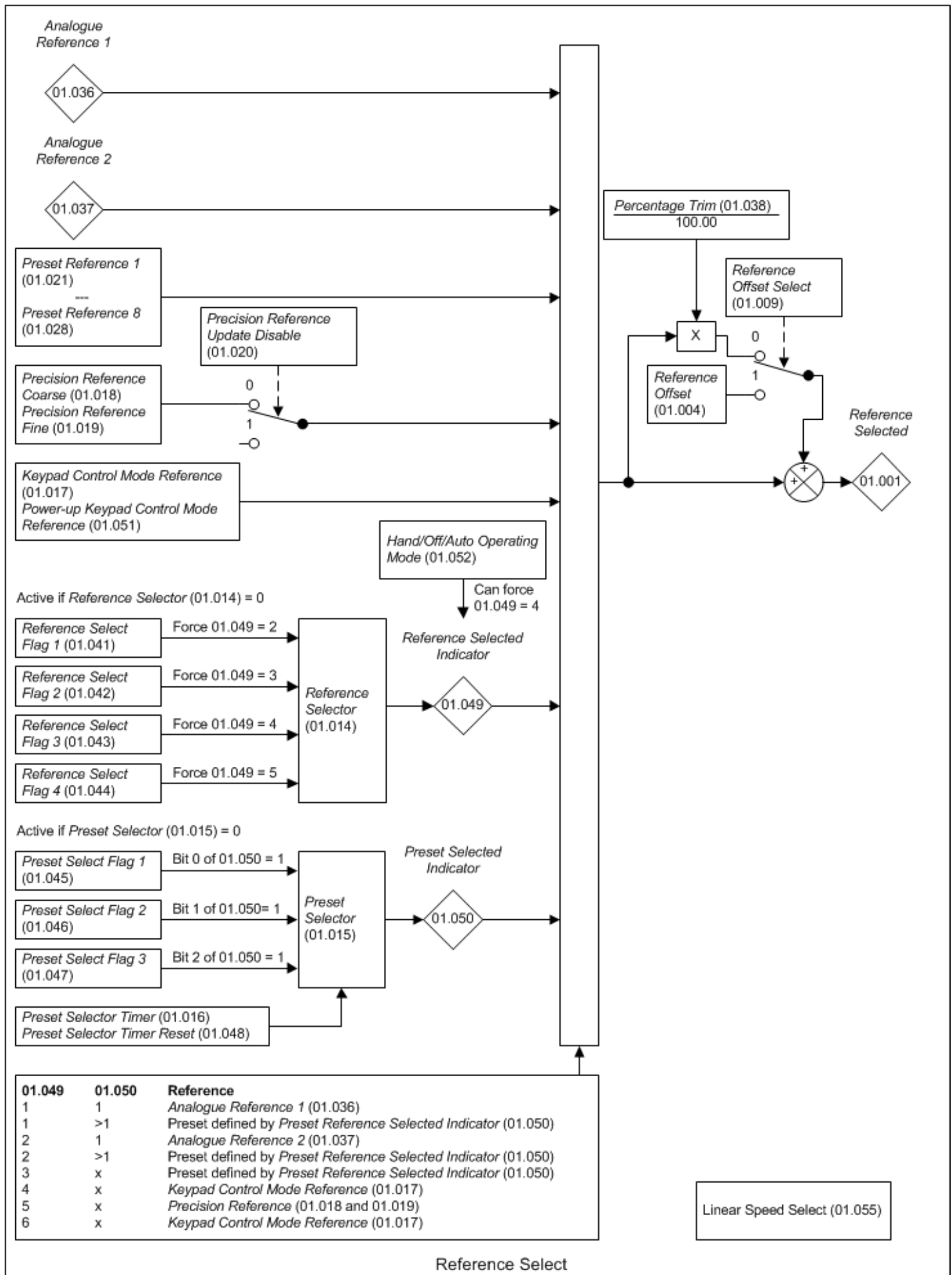
Mode: RFC-A

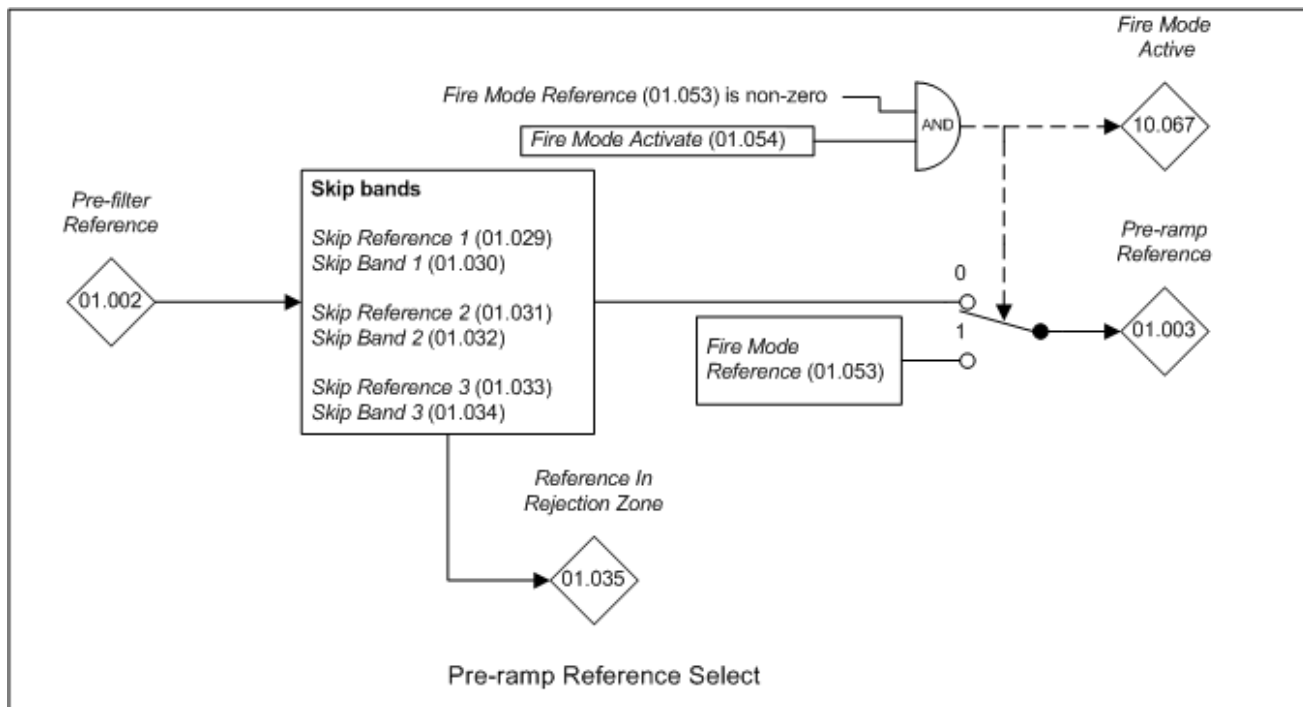
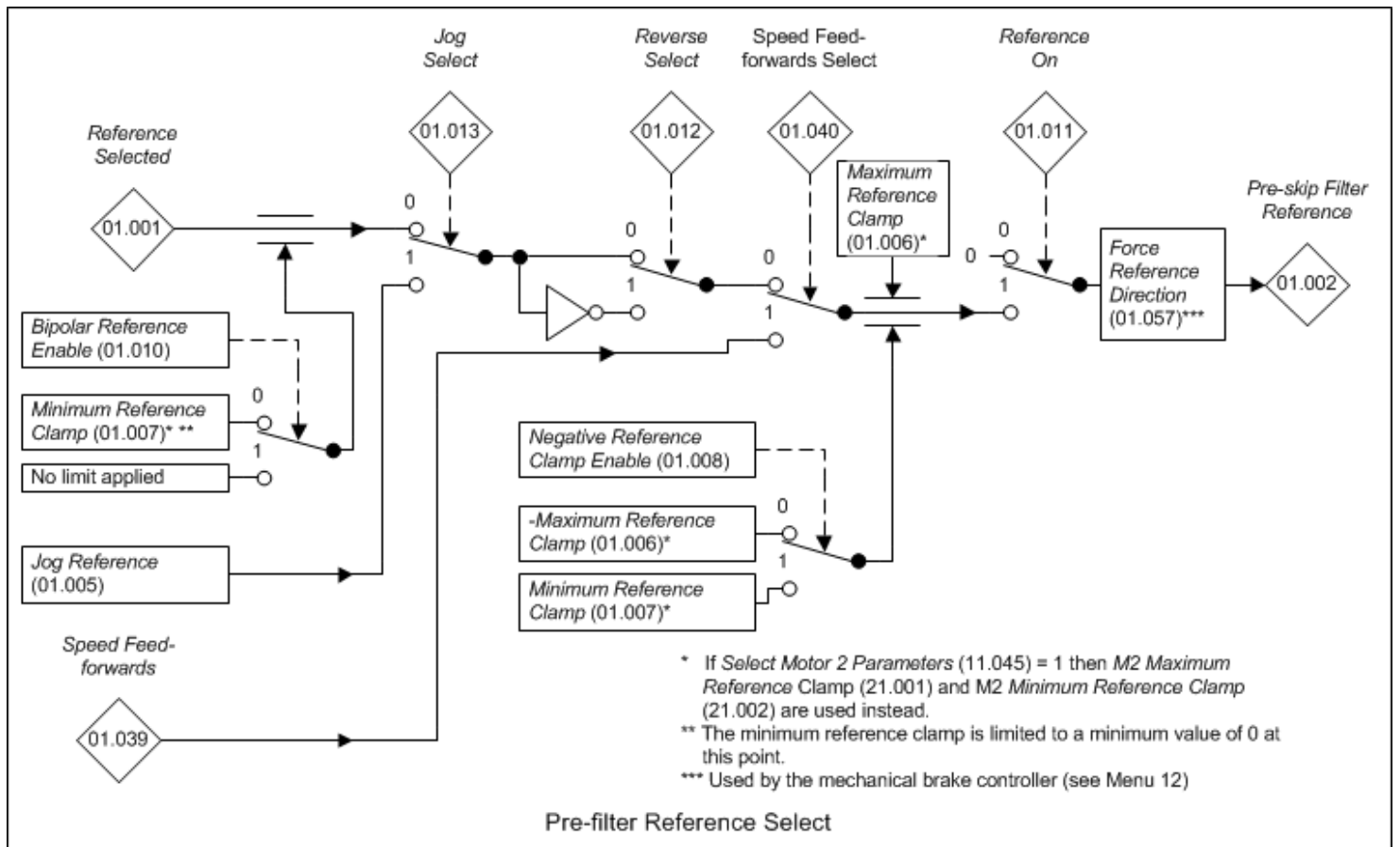
| Parameter |  | Range  | Default                      | Type |     |    |    |    |    |
|-----------|--|--|------------------------------|------|-----|----|----|----|----|
| 01.001    | Reference Selected                     | ±VM_SPEED_FREQ_REF   |                              | RO   | Num | ND | NC | PT |    |
| 01.002    | Pre-skip Filter Reference              | ±VM_SPEED_FREQ_REF   |                              | RO   | Num | ND | NC | PT |    |
| 01.003    | Pre-ramp Reference                     | ±VM_SPEED_FREQ_REF   |                              | RO   | Num | ND | NC | PT |    |
| 01.004    | Reference Offset                       | ±VM_SPEED_FREQ_REF   | 0.0                          | RW   | Num |    |    |    | US |
| 01.005    | Jog Reference                          | 0.0 to 4000.0  | 0.0                          | RW   | Num |    |    |    | US |
| 01.006    | Maximum Reference Clamp                | ±VM_POSITIVE_REF_CLAMP1  | 50Hz: 1500.0<br>60Hz: 1800.0 | RW   | Num |    |    |    | US |
| 01.007    | Minimum Reference Clamp                | ±VM_NEGATIVE_REF_CLAMP1  | 0.0                          | RW   | Num |    |    |    | US |
| 01.008    | Negative Reference Clamp Enable        | Off (0) or On (1)  | Off (0)                      | RW   | Bit |    |    |    | US |
| 01.009    | Reference Offset Select                | Off (0) or On (1)  | Off (0)                      | RW   | Bit |    |    |    | US |
| 01.010    | Bipolar Reference Enable               | Off (0) or On (1)  | Off (0)                      | RW   | Bit |    |    |    | US |
| 01.011    | Reference On                           | Off (0) or On (1)  |                              | RO   | Bit | ND | NC | PT |    |
| 01.012    | Reverse Select                         | Off (0) or On (1)  |                              | RO   | Bit | ND | NC | PT |    |
| 01.013    | Jog Select                             | Off (0) or On (1)  |                              | RO   | Bit | ND | NC | PT |    |
| 01.014    | Reference Selector                     | A1 A2 (0), A1 Preset (1), A2 Preset (2),<br>Preset (3), Keypad (4), Precision (5),<br>Keypad Ref (6) | Preset (3)                   | RW   | Txt |    |    |    | US |
| 01.015    | Preset Selector                        | 0 to 9   | 0                            | RW   | Num |    |    |    | US |
| 01.016    | Preset Selector Timer                  | 0.0 to 400.0 s   | 10.0 s                       | RW   | Num |    |    |    | US |
| 01.017    | Keypad Control Mode Reference          | ±VM_SPEED_FREQ_KEYPAD_REF  | 0.0                          | RO   | Num |    | NC | PT | PS |
| 01.018    | Precision Reference Coarse             | ±VM_SPEED_FREQ_REF   | 0.0                          | RW   | Num |    |    |    | US |
| 01.019    | Precision Reference Fine               | 0.000 to 0.099   | 0.000                        | RW   | Num |    |    |    | US |
| 01.020    | Precision Reference Update Disable     | Off (0) or On (1)  | Off (0)                      | RW   | Bit |    | NC |    |    |
| 01.021    | Preset Reference 1                     | ±VM_SPEED_FREQ_REF   | 0.0                          | RW   | Num |    |    |    | US |
| 01.022    | Preset Reference 2                     | ±VM_SPEED_FREQ_REF   | 0.0                          | RW   | Num |    |    |    | US |
| 01.023    | Preset Reference 3                     | ±VM_SPEED_FREQ_REF   | 0.0                          | RW   | Num |    |    |    | US |
| 01.024    | Preset Reference 4                     | ±VM_SPEED_FREQ_REF   | 0.0                          | RW   | Num |    |    |    | US |
| 01.025    | Preset Reference 5                     | ±VM_SPEED_FREQ_REF   | 0.0                          | RW   | Num |    |    |    | US |
| 01.026    | Preset Reference 6                     | ±VM_SPEED_FREQ_REF   | 0.0                          | RW   | Num |    |    |    | US |
| 01.027    | Preset Reference 7                     | ±VM_SPEED_FREQ_REF   | 0.0                          | RW   | Num |    |    |    | US |
| 01.028    | Preset Reference 8                     | ±VM_SPEED_FREQ_REF   | 0.0                          | RW   | Num |    |    |    | US |
| 01.029    | Skip Reference 1                       | 0 to 33000   | 0                            | RW   | Num |    |    |    | US |
| 01.030    | Skip Reference Band 1                  | 0 to 250   | 0                            | RW   | Num |    |    |    | US |
| 01.031    | Skip Reference 2                       | 0 to 33000   | 0                            | RW   | Num |    |    |    | US |
| 01.032    | Skip Reference Band 2                  | 0 to 250   | 0                            | RW   | Num |    |    |    | US |
| 01.033    | Skip Reference 3                       | 0 to 33000   | 0                            | RW   | Num |    |    |    | US |
| 01.034    | Skip Reference Band 3                  | 0 to 250   | 0                            | RW   | Num |    |    |    | US |
| 01.035    | Reference In Rejection Zone            | Off (0) or On (1)  |                              | RO   | Bit | ND | NC | PT |    |
| 01.036    | Analog Reference 1                     | ±VM_SPEED_FREQ_USER_REFS   | 0.0                          | RO   | Num |    | NC |    |    |
| 01.037    | Analog Reference 2                     | ±VM_SPEED_FREQ_USER_REFS   | 0.0                          | RO   | Num |    | NC |    |    |
| 01.038    | Percentage Trim                        | ±100.00 %  | 0.00 %                       | RW   | Num |    | NC |    |    |
| 01.039    | Speed Feed-forwards                    | ±VM_SPEED_FREQ_REF   |                              | RO   | Num | ND | NC | PT |    |
| 01.040    | Speed Feed-forwards Select             | Off (0) or On (1)  |                              | RO   | Bit | ND | NC | PT |    |
| 01.041    | Reference Select Flag 1                | Off (0) or On (1)  | Off (0)                      | RW   | Bit |    | NC |    |    |
| 01.042    | Reference Select Flag 2                | Off (0) or On (1)  | Off (0)                      | RW   | Bit |    | NC |    |    |
| 01.043    | Reference Select Flag 3                | Off (0) or On (1)  | Off (0)                      | RW   | Bit |    | NC |    |    |
| 01.044    | Reference Select Flag 4                | Off (0) or On (1)  | Off (0)                      | RW   | Bit |    | NC |    |    |
| 01.045    | Preset Select Flag 1                   | Off (0) or On (1)  | Off (0)                      | RW   | Bit |    | NC |    |    |
| 01.046    | Preset Select Flag 2                   | Off (0) or On (1)  | Off (0)                      | RW   | Bit |    | NC |    |    |
| 01.047    | Preset Select Flag 3                   | Off (0) or On (1)  | Off (0)                      | RW   | Bit |    | NC |    |    |
| 01.048    | Preset Selector Timer Reset            | Off (0) or On (1)  | Off (0)                      | RW   | Bit |    | NC |    |    |
| 01.049    | Reference Selected Indicator           | 1 to 6   |                              | RO   | Num | ND | NC | PT |    |
| 01.050    | Preset Selected Indicator              | 1 to 8   |                              | RO   | Num | ND | NC | PT |    |
| 01.051    | Power-up Keypad Control Mode Reference | Reset (0), Last (1), Preset (2)  | Reset (0)                    | RW   | Txt |    |    |    | US |
| 01.052    | Hand/Off/Auto Operating Mode           | 0 to 3   | 0                            | RW   | Num |    |    |    | US |
| 01.053    | Fire Mode Reference                    | ±VM_SPEED_FREQ_REF   | 0.0                          | RW   | Num |    |    |    | US |
| 01.054    | Fire Mode Activate                     | Off (0) or On (1)  | Off (0)                      | RO   | Bit |    | NC |    |    |
| 01.055    | Linear Speed Select                    | Off (0) or On (1)  | Off (0)                      | RW   | Bit |    |    |    | US |
| 01.056    | Linear Speed Selected                  | Off (0) or On (1)  |                              | RO   | Bit | ND | NC | PT |    |
| 01.057    | Force Reference Direction              | None (0), Forward (1), Reverse (2)   | None (0)                     | RW   | Txt |    |    |    |    |

|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| Fl  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 1 – *Speed References*

Mode: RFC-A





| Parameter         | 01.001 Reference Selected  |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Displays the basic reference selected from the available sources |                |                   |
| Mode              | RFC-A  |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF   | Maximum        | VM_SPEED_FREQ_REF |
| Default           | Units  |                |                   |
| Type              | 32 Bit Volatile  | Update Rate    | 4ms write         |
| Display Format    | Standard   | Decimal Places | 1                 |
| Coding            | RO, VM, ND, NC, PT   |                |                   |

Reference Selected (01.001) is the basic reference selected from the available sources including the effect of the reference offset.

| Parameter         | 01.002 Pre-skip Filter Reference                               |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Displays the level of the reference after the reference clamps |                |                   |
| Mode              | RFC-A  |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF   | Maximum        | VM_SPEED_FREQ_REF |
| Default           |  | Units          |                   |
| Type              | 32 Bit Volatile  | Update Rate    | 4ms write         |
| Display Format    | Standard   | Decimal Places | 1                 |
| Coding            | RO, VM, ND, NC, PT   |                |                   |

The *Pre-skip Filter Reference* (01.002) is the level of the reference after the reference clamps but before the skip filters.

| Parameter         | 01.003 Pre-ramp Reference                                  |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Displays the final output from the Menu 1 reference system |                |                   |
| Mode              | RFC-A  |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF   | Maximum        | VM_SPEED_FREQ_REF |
| Default           |  | Units          |                   |
| Type              | 32 Bit Volatile  | Update Rate    | 4ms write         |
| Display Format    | Standard   | Decimal Places | 1                 |
| Coding            | RO, VM, ND, NC, PT   |                |                   |

The *Pre-ramp Reference* (01.003) is the final output from the Menu 1 reference system that is fed into the Menu 2 ramp system.

| Parameter         | 01.004 Reference Offset                         |                |                   |
|-------------------|---|----------------|-------------------|
| Short description | Defines the the offset applied to the reference |                |                   |
| Mode              | RFC-A   |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                              | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.0   | Units          |                   |
| Type              | 32 Bit User Save                                | Update Rate    | 4ms read          |
| Display Format    | Standard  | Decimal Places | 1                 |
| Coding            | RW, VM  |                |                   |

If *Reference Offset Select* (01.009) = 0 then *Reference Selected* (01.001) is the selected reference multiplied by  $[1 + (\text{Percentage Trim (01.038)} / 100.00)]$ .  
If *Reference Offset Select* (01.009) = 1 then the *Reference Offset* (01.004) is added to the selected reference to give *Reference Selected* (01.001).

| Parameter         | 01.005 Jog Reference                      |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the reference when jog is enabled |                |          |
| Mode              | RFC-A                                     |                |          |
| Minimum           | 0.0                                       | Maximum        | 4000.0   |
| Default           | 0.0                                       | Units          |          |
| Type              | 16 Bit User Save                          | Update Rate    | 4ms read |
| Display Format    | Standard                                  | Decimal Places | 1        |
| Coding            | RW, BU                                    |                |          |

The *Jog Reference* (01.005) is selected when *Jog Select* (01.013) = 1. *Jog Select* (01.013) is controlled by the drive sequencer (see Menu 6).

| Parameter         | 01.006 Maximum Reference Clamp              |                |                        |
|-------------------|---|----------------|------------------------|
| Short description | Defines the maximum value for the reference |                |                        |
| Mode              | RFC-A                                       |                |                        |
| Minimum           | -VM_POSITIVE_REF_CLAMP1                     | Maximum        | VM_POSITIVE_REF_CLAMP1 |
| Default           | See exceptions below                        | Units          |                        |
| Type              | 32 Bit User Save                            | Update Rate    | Background read        |
| Display Format    | Standard                                    | Decimal Places | 1                      |
| Coding            | RW, VM                                      |                |                        |

| Region | Default Value |
|--------|---------------|
| 50Hz   | 1500.0        |
| 60Hz   | 1800.0        |

*Maximum Reference Clamp* (01.006) provides a limit on the maximum frequency or speed. (If *Select Motor 2 Parameters* (11.045) = 1 then *M2 Maximum Reference Clamp* (21.001) is used instead.)



| Parameter         | 01.007 <i>Minimum Reference Clamp</i>       |                |                        |
|-------------------|---|----------------|------------------------|
| Short description | Defines the minimum value for the reference |                |                        |
| Mode              | RFC-A                                       |                |                        |
| Minimum           | -VM_NEGATIVE_REF_CLAMP1                     | Maximum        | VM_NEGATIVE_REF_CLAMP1 |
| Default           | 0.0   | Units          |                        |
| Type              | 32 Bit User Save                            | Update Rate    | Background read        |
| Display Format    | Standard                                    | Decimal Places | 1                      |
| Coding            | RW, VM                                      |                |                        |

If *Negative Reference Clamp Enable* (01.008) = 1 then *Minimum Reference Clamp* (01.007) is forced to be a negative value and is applied to the final reference as the negative limit. If *Negative Reference Clamp Enable* (01.008) = 0 then *-Maximum Reference Clamp* (01.006) is applied to the final reference as the negative limit. (If *Select Motor 2 Parameters* (11.045) = 1 then *M2 Minimum Reference Clamp* (21.002) is used instead.)

The minimum reference clamp is also used to provide the minimum speed limit for uni-polar mode (i.e. *Bipolar Reference Enable* (01.010) = 0) after the *Reference Selected* (01.001).

| Parameter         | 01.008 <i>Negative Reference Clamp Enable</i>                      |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to allow the minimum reference clamp value to be negative |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *Minimum Reference Clamp* (01.007).

| Parameter         | 01.009 <i>Reference Offset Select</i>   |                |          |
|-------------------|---|----------------|----------|
| Short description | Enables the use of the reference offset |                |          |
| Mode              | RFC-A                                   |                |          |
| Minimum           | 0                                       | Maximum        | 1        |
| Default           | 0                                       | Units          |          |
| Type              | 1 Bit User Save                         | Update Rate    | 4ms read |
| Display Format    | Standard                                | Decimal Places | 0        |
| Coding            | RW                                      |                |          |

See *Reference Offset* (01.004).

| Parameter         | 01.010 <i>Bipolar Reference Enable</i>                    |                |          |
|-------------------|---|----------------|----------|
| Short description | Enables the minimum value of the reference to be negative |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW  |                |          |

See *Minimum Reference Clamp* (01.007).

| Parameter         | 01.011 <i>Reference On</i>                                       |                |           |
|-------------------|--|----------------|-----------|
| Short description | Indicates that the reference from the reference system is active |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile   | Update Rate    | 2ms write |
| Display Format    | Standard   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT   |                |           |

*Reference On* (01.011), which is controlled by the drive sequencer (see Menu 6) indicates that the reference from the reference system is active. Note that *Reference On* (01.011) is also used in RFC-A and RFC-S modes to enable and disable the *Hard Speed Reference* (03.022).

| Parameter         | 01.012 <i>Reverse Select</i>                  |                |           |
|-------------------|---|----------------|-----------|
| Short description | Indicates when the reverse function is active |                |           |
| Mode              | RFC-A   |                |           |
| Minimum           | 0   | Maximum        | 1         |
| Default           |   | Units          |           |
| Type              | 1 Bit Volatile                                | Update Rate    | 2ms write |
| Display Format    | Standard                                      | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                                |                |           |

*Reverse Select* (01.012), which is controlled by the drive sequencer (see Menu 6), is used to invert *Reference Selected* (01.001) or the *Jog Reference* (01.005).

| <b>Parameter</b>         |   |                |           |
|--------------------------|---|----------------|-----------|
| <b>01.013 Jog Select</b> |   |                |           |
| Short description        | Indicates when the jog function is active |                |           |
| Mode                     | RFC-A                                     |                |           |
| Minimum                  | 0   | Maximum        | 1         |
| Default                  |   | Units          |           |
| Type                     | 1 Bit Volatile                            | Update Rate    | 2ms write |
| Display Format           | Standard                                  | Decimal Places | 0         |
| Coding                   | RO, ND, NC, PT                            |                |           |

*Jog Select* (01.013), which is controlled by the drive sequencer (see Menu 6), is used to select the *Jog Reference* (01.005).

| <b>Parameter</b>                 |                                       |                |          |
|----------------------------------|---------------------------------------|----------------|----------|
| <b>01.014 Reference Selector</b> |                                       |                |          |
| Short description                | Defines the source for the references |                |          |
| Mode                             | RFC-A                                 |                |          |
| Minimum                          | 0                                     | Maximum        | 6        |
| Default                          | 3                                     | Units          |          |
| Type                             | 8 Bit User Save                       | Update Rate    | 4ms read |
| Display Format                   | Standard                              | Decimal Places | 0        |
| Coding                           | RW, TE                                |                |          |

| <b>Value</b> | <b>Text</b> |
|--------------|-------------|
| 0            | A1 A2       |
| 1            | A1 Preset   |
| 2            | A2 Preset   |
| 3            | Preset      |
| 4            | Keypad      |
| 5            | Precision   |
| 6            | Keypad Ref  |

*Reference Selector* (01.014) defines how *Reference Selected Indicator* (01.049) is derived. If *Reference Selector* (01.014) is not 0 then *Reference Selected Indicator* (01.049) is equal to *Reference Selector* (01.014). If *Reference Selector* (01.014) = 0 then *Reference Selected Indicator* (01.049) is controlled by the reference select flags as shown below. The higher numbered flags have priority over the lower numbered flags.

| <b>Reference select flag states</b>         | <b>Reference Selected Indicator (01.049)</b> |
|---|--|
| All reference select flags equal to 0       | 1  |
| <i>Reference Select Flag 1</i> (01.041) = 1 | 2  |
| <i>Reference Select Flag 2</i> (01.042) = 1 | 3  |
| <i>Reference Select Flag 3</i> (01.043) = 1 | 4  |
| <i>Reference Select Flag 4</i> (01.044) = 1 | 5  |

*Preset Selector* (01.015) defines how *Preset Selected Indicator* (01.050) is derived as shown below.

| <b>Preset Selector (01.015)</b> | <b>Preset Selected Indicator (01.050)</b>   |
|---------------------------------|---|
| 0                               | Controlled by the preset select flags ( 01.045 to 01.047)                                     |
| 1                               | 1   |
| 2                               | 2   |
| 3                               | 3   |
| 4                               | 4   |
| 5                               | 5   |
| 6                               | 6   |
| 7                               | 7   |
| 8                               | 8   |
| 9                               | Controlled by the preset reference selector timer (see <i>Preset Selector Timer</i> (01.016)) |

When *Preset Selector* (01.015) = 0 then *Preset Selected Indicator* (01.050) is defined by the preset select flags as shown below.

| Preset Select Flag 3<br>(01.047) | Preset Select Flag 2<br>(01.046) | Preset Select Flag 1<br>(01.045) | Preset Selected Indicator<br>(01.050) |
|----------------------------------|----------------------------------|----------------------------------|---------------------------------------|
| 0                                | 0                                | 0                                | 1                                     |
| 0                                | 0                                | 1                                | 2                                     |
| 0                                | 1                                | 0                                | 3                                     |
| 0                                | 1                                | 1                                | 4                                     |
| 1                                | 0                                | 0                                | 5                                     |
| 1                                | 0                                | 1                                | 6                                     |
| 1                                | 1                                | 0                                | 7                                     |
| 1                                | 1                                | 1                                | 8                                     |

Reference Selected Indicator (01.049) and Preset Selected Indicator (01.050) then define the reference to be used as shown below.

| Reference Selected Indicator<br>(01.049) | Preset Selected Indicator<br>(01.050) | Reference   |
|--|---------------------------------------|---|
| 1  | 1                                     | Analog Reference 1 (01.036)   |
| 1  | >1                                    | Preset reference defined by the value of Preset Selected Indicator (01.050) |
| 2  | 1                                     | Analog Reference 2 (01.037)   |
| 2  | >1                                    | Preset reference defined by the value of Preset Selected Indicator (01.050) |
| 3  | x                                     | Preset reference defined by the value of Preset Selected Indicator (01.050) |
| 4  | x                                     | Keypad Control Mode Reference (01.017)                                      |
| 5  | x                                     | Precision Reference Coarse (01.018) and Precision Reference Fine (01.019)   |
| 6  | x                                     | Keypad Control Mode Reference (01.017)                                      |

If Reference Selected Indicator (01.049) = 4 the Keypad Control Mode Reference (01.017) is used and the sequencer operates in keypad mode where the start, stop and optionally the reverse selection functions are provided from the drive keypad. Jog Select (01.013) and Speed Feed-forwards Select (01.040) are always 0 when keypad mode is active.

If Reference Selected Indicator (01.049) = 6 the Keypad Control Mode Reference (01.017) is used, but keypad control mode is not active.

| Parameter         | 01.015 Preset Selector                         |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines which preset is used for the reference |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 9        |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save                                | Update Rate    | 4ms read |
| Display Format    | Standard                                       | Decimal Places | 0        |
| Coding            | RW   |                |          |

See Reference Selector (01.014).

| Parameter         | 01.016 Preset Selector Timer                        |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the time between changes of preset selector |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.0   | Maximum        | 400.0           |
| Default           | 10.0  | Units          | s               |
| Type              | 16 Bit User Save                                    | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW  |                |                 |

If Preset Selector (01.015) = 9 then Preset Selected Indicator (01.050) is incremented by one at intervals defined by Preset Selector Timer (01.016). When Preset Selected Indicator (01.050) has a value of 8 and is incremented it rolls over to 1. If Preset Selector Timer Reset (01.048) = 1 and Preset Selector (01.015) = 9, then Preset Selected Indicator (01.050) is held at 1.

| Parameter         | 01.017 Keypad Control Mode Reference      |                |                          |
|-------------------|---|----------------|--------------------------|
| Short description | Defines the value of the keypad reference |                |                          |
| Mode              | RFC-A                                     |                |                          |
| Minimum           | -VM_SPEED_FREQ_KEYPAD_REF                 | Maximum        | VM_SPEED_FREQ_KEYPAD_REF |
| Default           | 0.0                                       | Units          |                          |
| Type              | 32 Bit Power Down Save                    | Update Rate    | 4ms read                 |
| Display Format    | Standard                                  | Decimal Places | 1                        |
| Coding            | RO, VM, NC, PT                            |                |                          |

Keypad control mode is active if the Reference Selected Indicator (01.049) is 4 or 6. The value of this parameter is controlled by the reference selector system and whether Hand/Off/Auto mode is selected (see Hand/Off/Auto Operating Mode (01.052)). If keypad control is selected the frequency/speed reference is defined by Keypad Control Mode Reference (01.017) which is a read-only parameter. The parameter can only be adjusted by pressing the Up or Down keys when the keypad is in Status Mode and only when keypad control mode is active. Holding the Up or down keys auto-increments or decrements Keypad Control Mode Reference (01.017), and the rate of adjustment increases the longer the key is held. Keypad Control Mode Reference (01.017) can be adjusted whether the drive is enabled or not, and can be retained at power-down if required (see Power-

up Keypad Control Mode Reference (01.051)).

If the *Reference Selected Indicator* (01.049) is 6 then the normal drive sequencer is used and the run commands are derived from the sequencer control bit parameters. If *Reference Selected Indicator* (01.049) is 4 then the keypad control sequencer is used and the drive run commands are derived using keys on the keypad. If the keypad control sequencer is active the Stop and Run keys automatically become active and the Auxilliary key may be optionally enabled as the reverse key with *Enable Auxiliary Key* (06.013).

| Parameter         | 01.018 Precision Reference Coarse                   |                |                   |
|-------------------|---|----------------|-------------------|
| Short description | Defines the value of the coarse precision reference |                |                   |
| Mode              | RFC-A   |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                                  | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.0   | Units          |                   |
| Type              | 32 Bit User Save                                    | Update Rate    | 4ms read          |
| Display Format    | Standard  | Decimal Places | 1                 |
| Coding            | RW, VM  |                |                   |

The *Precision Reference Coarse* (01.018) and *Precision Reference Fine* (01.019) can be combined to provide a reference with a precision of 3 decimal places. The precision reference value is given by *Precision Reference Coarse* (01.018) + *Precision Reference Fine* (01.019), therefore *Precision Reference Fine* (01.019) increases positive values of *Precision Reference Coarse* (01.018) away from zero, and negative values of *Precision Reference Coarse* (01.018) towards zero.

If *Precision Reference Update Disable* (01.020) = 0 then any changes to *Precision Reference Coarse* (01.018) or *Precision Reference Fine* (01.019) have an effect immediately. When *Precision Reference Update Disable* (01.020) is changed to 1 then *Precision Reference Coarse* (01.018) and *Precision Reference Fine* (01.019) are stored in memory and used to provide the precision reference until *Precision Reference Update Disable* (01.020) is changed back to 0. This allows the component values of the precision reference to be changed without giving an unwanted intermediate value due to data skew.

| Parameter         | 01.019 Precision Reference Fine                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the value of the fine precision reference |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0.000   | Maximum        | 0.099    |
| Default           | 0.000   | Units          |          |
| Type              | 8 Bit User Save                                   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *Precision Reference Coarse* (01.018).

| Parameter         | 01.020 Precision Reference Update Disable  |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to 1 to prevent immediate update to the reference from the precision reference |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit Volatile   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, NC   |                |          |

See *Precision Reference Coarse* (01.018).

| Parameter         | 01.021 Preset Reference 1                |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the value for preset reference 1 |                |                   |
| Mode              | RFC-A                                    |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                       | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.0                                      | Units          |                   |
| Type              | 32 Bit User Save                         | Update Rate    | 4ms read          |
| Display Format    | Standard                                 | Decimal Places | 1                 |
| Coding            | RW, VM                                   |                |                   |

See *Reference Selector* (01.014).

| Parameter         | 01.022 Preset Reference 2                |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the value for preset reference 2 |                |                   |
| Mode              | RFC-A                                    |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                       | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.0                                      | Units          |                   |
| Type              | 32 Bit User Save                         | Update Rate    | 4ms read          |
| Display Format    | Standard                                 | Decimal Places | 1                 |
| Coding            | RW, VM                                   |                |                   |

See *Reference Selector* (01.014).

| Parameter         | 01.023 Preset Reference 3                |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the value for preset reference 3 |                |                   |
| Mode              | RFC-A                                    |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                       | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.0                                      | Units          |                   |
| Type              | 32 Bit User Save                         | Update Rate    | 4ms read          |
| Display Format    | Standard                                 | Decimal Places | 1                 |
| Coding            | RW, VM                                   |                |                   |

See Reference Selector (01.014).

| Parameter         | 01.024 Preset Reference 4                |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the value for preset reference 4 |                |                   |
| Mode              | RFC-A                                    |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                       | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.0                                      | Units          |                   |
| Type              | 32 Bit User Save                         | Update Rate    | 4ms read          |
| Display Format    | Standard                                 | Decimal Places | 1                 |
| Coding            | RW, VM                                   |                |                   |

See Reference Selector (01.014).

| Parameter         | 01.025 Preset Reference 5                |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the value for preset reference 5 |                |                   |
| Mode              | RFC-A                                    |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                       | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.0                                      | Units          |                   |
| Type              | 32 Bit User Save                         | Update Rate    | 4ms read          |
| Display Format    | Standard                                 | Decimal Places | 1                 |
| Coding            | RW, VM                                   |                |                   |

See Reference Selector (01.014).

| Parameter         | 01.026 Preset Reference 6                |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the value for preset reference 6 |                |                   |
| Mode              | RFC-A                                    |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                       | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.0                                      | Units          |                   |
| Type              | 32 Bit User Save                         | Update Rate    | 4ms read          |
| Display Format    | Standard                                 | Decimal Places | 1                 |
| Coding            | RW, VM                                   |                |                   |

See Reference Selector (01.014).

| Parameter         | 01.027 Preset Reference 7                |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the value for preset reference 8 |                |                   |
| Mode              | RFC-A                                    |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                       | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.0                                      | Units          |                   |
| Type              | 32 Bit User Save                         | Update Rate    | 4ms read          |
| Display Format    | Standard                                 | Decimal Places | 1                 |
| Coding            | RW, VM                                   |                |                   |

See Reference Selector (01.014).

| Parameter         | 01.028 Preset Reference 8                |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the value for preset reference 8 |                |                   |
| Mode              | RFC-A                                    |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                       | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.0                                      | Units          |                   |
| Type              | 32 Bit User Save                         | Update Rate    | 4ms read          |
| Display Format    | Standard                                 | Decimal Places | 1                 |
| Coding            | RW, VM                                   |                |                   |

See Reference Selector (01.014).

| Parameter         | 01.029 Skip Reference 1                 |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the 1st reference point to skip |                |                 |
| Mode              | RFC-A                                   |                |                 |
| Minimum           | 0                                       | Maximum        | 33000           |
| Default           | 0                                       | Units          |                 |
| Type              | 16 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW, BU                                  |                |                 |

The skip references functions are available to prevent continuous operation within a specified speed range (i.e. where mechanical resonance may occur). When *Skip Reference 1* (01.029) = 0 Filter 1 is disabled. *Skip Reference Band 1* (01.030) defines the range either side of *Skip Reference 1* (01.029) over which references are rejected in either direction. The actual rejection band is therefore twice that defined by *Skip Reference Band 1* (01.030) with *Skip Reference 1* (01.029) as the centre of the band. When the selected reference is within the rejection band the lower limit of the band is passed through the filter so that reference is always less than demanded.

Filter 2 (*Skip Reference 2* (01.031), *Skip Reference Band 2* (01.032)) and Filter 3 (*Skip Reference 3* (01.033), *Skip Reference Band 3* (01.034)) operate in the same ways as Filter 1.

If any of the filters are active (i.e. the reference is within their rejection band) *Reference In Rejection Zone* (01.035) is set to 1, otherwise it is 0.

| Parameter         | 01.030 Skip Reference Band 1  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the range either side of skip reference 1 to be implemented |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 250             |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, BU  |                |                 |

See *Skip Reference 1* (01.029).

| Parameter         | 01.031 Skip Reference 2                 |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the 2nd reference point to skip |                |                 |
| Mode              | RFC-A                                   |                |                 |
| Minimum           | 0                                       | Maximum        | 33000           |
| Default           | 0                                       | Units          |                 |
| Type              | 16 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW, BU                                  |                |                 |

See *Skip Reference 1* (01.029).

| Parameter         | 01.032 Skip Reference Band 2  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the range either side of skip reference 2 to be implemented |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 250             |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, BU  |                |                 |

See *Skip Reference 1* (01.029).

| Parameter         | 01.033 Skip Reference 3                 |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the 3rd reference point to skip |                |                 |
| Mode              | RFC-A                                   |                |                 |
| Minimum           | 0                                       | Maximum        | 33000           |
| Default           | 0                                       | Units          |                 |
| Type              | 16 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW, BU                                  |                |                 |

See *Skip Reference 1* (01.029).

| Parameter         | 01.034 Skip Reference Band 3  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the range either side of skip reference 3 to be implemented |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 250             |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, BU  |                |                 |

See Skip Reference 1 (01.029).

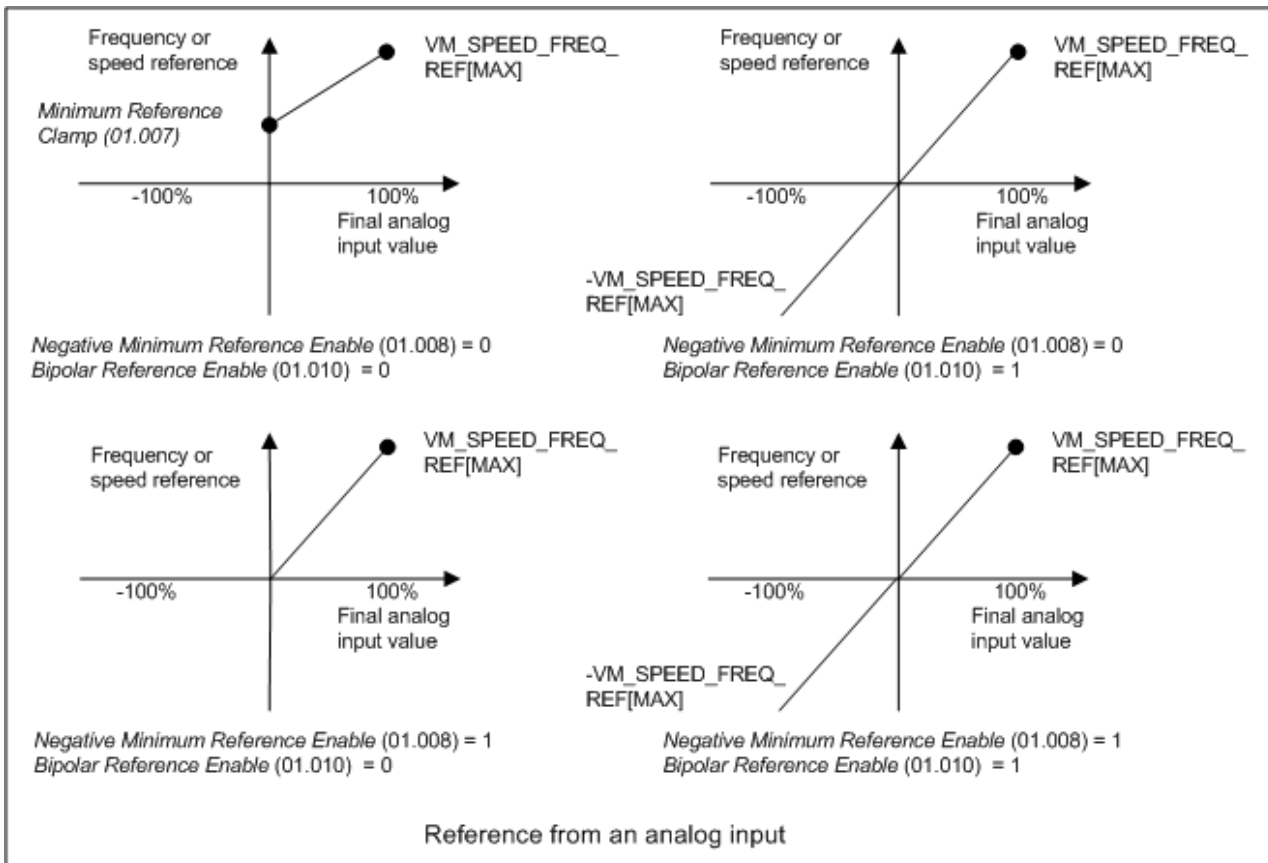
| Parameter         | 01.035 Reference In Rejection Zone                                     |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays when the reference is in 1 of the pre-defined rejection zones |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile   | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT   |                |           |

See Skip Reference 1 (01.029).

| Parameter         | 01.036 Analog Reference 1   |                |                         |
|-------------------|---|----------------|-------------------------|
| Short description | Defines the relationship between the final value from analog 1 input and the frequency or speed reference |                |                         |
| Mode              | RFC-A   |                |                         |
| Minimum           | -VM_SPEED_FREQ_USER_REFS  | Maximum        | VM_SPEED_FREQ_USER_REFS |
| Default           | 0.0   | Units          |                         |
| Type              | 32 Bit Volatile   | Update Rate    | 4ms read*               |
| Display Format    | Standard  | Decimal Places | 1                       |
| Coding            | RO, VM, NC  |                |                         |

\* A faster update rate of 250µs is possible for the speed reference from an analog input. See Menu 7 for details. Note that this parameter has higher resolution than other frequency parameters in Open-loop mode as this prevents loss of resolution when an analogue input is routed to this parameter with a typical drive output frequency range.

Analog Reference 1 (01.036) or Analog Reference 2 (01.037) should be used as the destinations for drive analog inputs when these provide the frequency or speed reference. The variable maximum/minimum applied to Analog Reference 1 (01.036) or Analog Reference 2 (01.037) gives the relationship shown below between the final value from the analog input and the frequency or speed reference.



| Parameter         | 01.037 Analog Reference 2   |                |                         |
|-------------------|---|----------------|-------------------------|
| Short description | Defines the relationship between the final value from analog input 2 and the frequency or speed reference |                |                         |
| Mode              | RFC-A   |                |                         |
| Minimum           | -VM_SPEED_FREQ_USER_REFS  | Maximum        | VM_SPEED_FREQ_USER_REFS |
| Default           | 0.0   | Units          |                         |
| Type              | 32 Bit Volatile   | Update Rate    | 4ms read*               |
| Display Format    | Standard  | Decimal Places | 1                       |
| Coding            | RO, VM, NC  |                |                         |

\* A faster update rate of 250µs is possible for the speed reference from an analog input. See Menu 7 for details. Note that this parameter has higher resolution than other frequency parameters in Open-loop mode as this prevents loss of resolution when an analogue input is routed to this parameter with a typical drive output frequency range.

See *Analog Reference 1* (01.036).

| Parameter         | 01.038 Percentage Trim                                  |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the value of the reference trim as a percentage |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | -100.00   | Maximum        | 100.00   |
| Default           | 0.00  | Units          | %        |
| Type              | 16 Bit Volatile   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 2        |
| Coding            | RW, NC  |                |          |

See *Reference Offset Select* (01.009).

| Parameter         | 01.039 Speed Feed-forwards   |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Displays the value of the speed feed-forwards used by the standard motion controller |                |                   |
| Mode              | RFC-A  |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF   | Maximum        | VM_SPEED_FREQ_REF |
| Default           |  | Units          |                   |
| Type              | 32 Bit Volatile  | Update Rate    | 4ms write         |
| Display Format    | Standard   | Decimal Places | 1                 |
| Coding            | RO, VM, ND, NC, PT   |                |                   |

*Speed Feed-forwards* (01.039) can be used by the Standard Motion Controller (Menu 13) to provide a speed feed-forwards term which uses the drive ramp system (Menu 2) to provide a speed profile. The speed feed-forwards is enabled with *Speed Feed-forwards Select* (01.040), which is controlled directly by the Standard Motion Controller.

| Parameter         | 01.040 Speed Feed-forwards Select  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates if the speed feed-forwards is being used by the standard motion controller |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

See *Speed Feed-forwards* (01.039).

| Parameter         | 01.041 Reference Select Flag 1                   |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines which reference is selected by the drive |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit Volatile                                   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, NC   |                |          |

See *Reference Selector* (01.014).

| Parameter         | 01.042 Reference Select Flag 2                   |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines which reference is selected by the drive |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit Volatile                                   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, NC   |                |          |



See *Reference Selector* (01.014).

| Parameter         | 01.043 Reference Select Flag 3                   |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines which reference is selected by the drive |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit Volatile                                   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, NC   |                |          |

See *Reference Selector* (01.014).

| Parameter         | 01.044 Reference Select Flag 4                   |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines which reference is selected by the drive |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit Volatile                                   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, NC   |                |          |

See *Reference Selector* (01.014).

| Parameter         | 01.045 Preset Select Flag 1                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines which preset is selected by the drive |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile                                | Update Rate    | 4ms read |
| Display Format    | Standard                                      | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

See *Reference Selector* (01.014).

| Parameter         | 01.046 Preset Select Flag 2                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines which preset is selected by the drive |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile                                | Update Rate    | 4ms read |
| Display Format    | Standard                                      | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

See *Reference Selector* (01.014).

| Parameter         | 01.047 Preset Select Flag 3                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines which preset is selected by the drive |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile                                | Update Rate    | 4ms read |
| Display Format    | Standard                                      | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

See *Reference Selector* (01.014).

| Parameter         | 01.048 Preset Selector Timer Reset                  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to hold the preset selected indicator at 1 |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit Volatile                                      | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, NC  |                |                 |

See *Preset Selector Timer* (01.016).

| Parameter         | 01.049 Reference Selected Indicator            |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays which reference is currently selected |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | 1  | Maximum        | 6         |
| Default           |  | Units          |           |
| Type              | 8 Bit Volatile                                 | Update Rate    | 4ms write |
| Display Format    | Standard                                       | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                                 |                |           |

See Reference Selector (01.014).

| Parameter         | 01.050 Preset Selected Indicator            |                |           |
|-------------------|---|----------------|-----------|
| Short description | Displays which preset is currently selected |                |           |
| Mode              | RFC-A                                       |                |           |
| Minimum           | 1   | Maximum        | 8         |
| Default           |   | Units          |           |
| Type              | 8 Bit Volatile                              | Update Rate    | 4ms write |
| Display Format    | Standard                                    | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                              |                |           |

See Reference Selector (01.014).

| Parameter         | 01.051 Power-up Keypad Control Mode Reference                                 |                |               |
|-------------------|---|----------------|---------------|
| Short description | Defines which value of keypad control mode reference is displayed at power-up |                |               |
| Mode              | RFC-A   |                |               |
| Minimum           | 0   | Maximum        | 2             |
| Default           | 0   | Units          |               |
| Type              | 8 Bit User Save   | Update Rate    | Power-up read |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, TE  |                |               |

| Value | Text   |
|-------|--------|
| 0     | Reset  |
| 1     | Last   |
| 2     | Preset |

Power-up Keypad Control Mode Reference (01.051) defines the value written to Keypad Control Mode Reference (01.017) at power-up as given below.

| Power-up Keypad Control Mode Reference (01.051) | Value written to Keypad Control Mode Reference (01.017) at power-up            |
|---|--|
| 0   | 0.0  |
| 1   | The value in Keypad Control Mode Reference (01.017) at the previous power-down |
| 2   | The value saved in Preset Reference 1 (01.021)                                 |

| Parameter         | 01.052 Hand/Off/Auto Operating Mode                   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the hand/off/auto operating mode of the drive |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 3               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                                       | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

Hand/Off/Auto Operating Mode (01.052) defines the operating mode for this system as given in below.

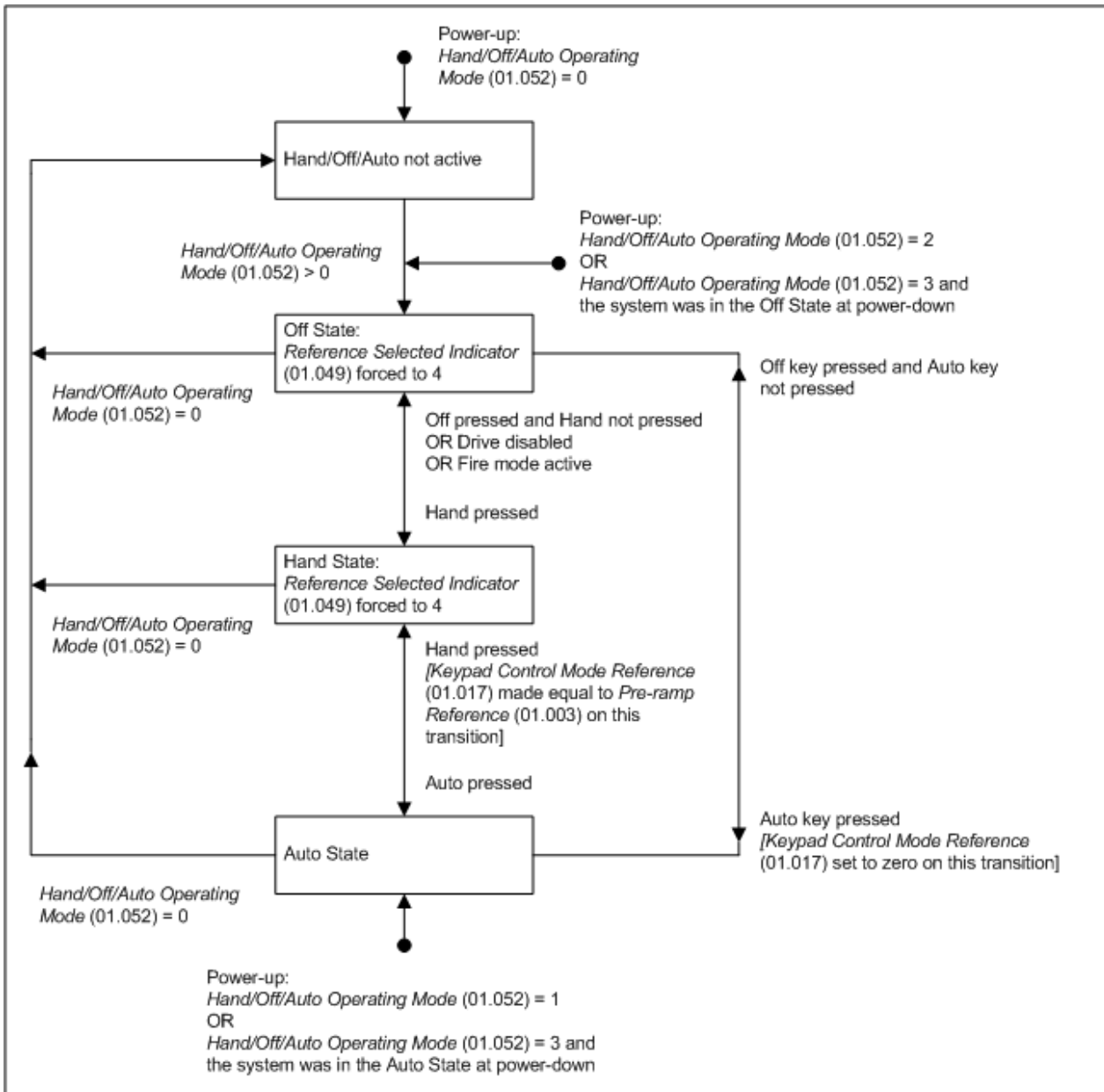
| Hand/Off/Auto Operating Mode (01.052) | Operating mode   |
|---------------------------------------|--|
| 0                                     | Hand/Off/Auto system disabled  |
| 1                                     | Hand/Off/Auto system enabled<br>Auto state at power-up   |
| 2                                     | Hand/Off/Auto system enabled<br>Off state at power-up  |
| 3                                     | Hand/Off/Auto system enabled<br>Off state at power-up if off or hand state at previous power-down<br>Auto state if auto state at previous power-down |

Hand/Off/Auto mode is an additional state machine that directly controls Reference Selected Indicator (01.049) and Keypad Control Mode Reference (01.017). When Hand/Off/Auto mode is active the drive state and keypad keys are defined as shown in the tables below.

| Hand/Off/Auto state | Equivalent normal state   |
|---------------------|---|
| Off                 | Ready with <i>Reference Selected Indicator</i> (01.049) = 4                           |
| Hand                | Run with <i>Reference Selected Indicator</i> (01.049) = 4                             |
| Auto                | <i>Reference Selected Indicator</i> (01.049) defined by the reference selector system |

| Hand/Off/Auto key | Equivalent normal key   |
|-------------------|---|
| Off               | Stop  |
| Hand              | Run   |
| Auto              | Auxilliary (the reverse key does not function normally, and so the system behaves as though <i>Enable Auxiliary Key</i> (06.013) = 0) |

The state diagram below shows how the system moves between states when the keypad keys are pressed and *Hand/Off/Auto Operating Mode* (01.052) is adjusted.



| Parameter         | 01.053 Fire Mode Reference                              |                |                   |
|-------------------|---|----------------|-------------------|
| Short description | Defines the reference value when fire mode is activated |                |                   |
| Mode              | RFC-A   |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                                      | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.0   | Units          |                   |
| Type              | 32 Bit User Save  | Update Rate    | Background read   |
| Display Format    | Standard  | Decimal Places | 1                 |
| Coding            | RW, VM  |                |                   |

See *Fire Mode Activate* (01.054).

| Parameter         | 01.054 Fire Mode Activate                                     |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Route a digital input to this parameter to activate fire mode |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit Volatile  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RO, NC  |                |                 |

*Fire Mode Activate* (01.054) cannot be written directly, but it can be controlled from a digital input. This prevents fire mode from being enabled from the keypad, comms or an option module.

Fire mode is intended for purging air from a ventilation system in the event of a fire. All trips are either disabled or are automatically reset after 1s. The use of fire mode can result in damage to the drive, and so if fire mode is enabled and any trip is initiated an indication that cannot be reset by the user is stored in *Potential Drive Damage Conditions* (10.106). For Open-loop, RFC-A or RFC-S modes fire mode is activated and if *Fire Mode Reference* (01.053) has a non-zero value and *Fire Mode Activate* (01.054) = 1. When fire mode is activated normal drive operation is overridden as follows.

1. *Pre-ramp Reference* (01.003) is forced to the value in *Fire Mode Reference* (01.053).
2. The Final drive enable is forced to be active provided the safe torque off hardware input will allow the drive to be enabled. The Final drive run is forced to be active.
3. *Forward Limit Switch* (06.035) and *Reverse Limit Switch* (06.036) are disabled.
4. *Hard Speed Reference* (03.022) is forced to 0 (RFC-A and RFC-S modes). The hard speed reference should not be used when fire mode can be activated as this could cause an abrupt change in speed.
5. The hand/off/auto system is disabled. If this system is in the hand state when fire mode is activated it will be forced to the off state, so that hand state is not active when fire mode is de-activated.
6. Keypad control mode is disabled.
7. All latched states in the sequencer (Menu 6) are reset.

For Regen mode fire mode is activated if *Fire Mode Activate* (01.054) = 1. When fire mode is activated the Final drive enable is forced to be active provided the safe torque off hardware input will allow the drive to be enabled.

If the drive is in the tripped state when fire mode is activated the trip is reset and then only the trips listed in the table below can be initiated whilst fire mode is active. If any of the trips shown as resettable occur, the drive will attempt to automatically reset the trip after 1s.

| Trip number | Trip            | Resettable |
|-------------|-----------------|------------|
| 2           | Over Volts      | Yes        |
| 3           | OI ac           | Yes        |
| 4           | OI Brake        | Yes        |
| 5           | PSU             | Yes        |
| 9           | PSU 24V         | Yes        |
| 21          | OHI Inverter    | Yes        |
| 31          | EEPROM Fail     | No         |
| 36          | User Save       | No         |
| 37          | Power Down Save | No         |
| 109         | OI dc           | Yes        |
| 200         | Slot1 HF        | No         |
| 205         | Slot2 HF        | No         |
| 210         | Slot3 HF        | No         |
| 217-249     |                 | No         |
| 250         | Slot4 HF        | No         |

| Parameter         | 01.055 Linear Speed Select            |                |                 |
|-------------------|---------------------------------------|----------------|-----------------|
| Short description | Set to 1 to enable linear speed units |                |                 |
| Mode              | RFC-A                                 |                |                 |
| Minimum           | 0                                     | Maximum        | 1               |
| Default           | 0                                     | Units          |                 |
| Type              | 1 Bit User Save                       | Update Rate    | Background read |
| Display Format    | Standard                              | Decimal Places | 0               |
| Coding            | RW                                    |                |                 |

Normally the units for speed parameters are rpm for both rotary and linear applications. For a linear application one revolution corresponds to one motor pole. If the position feedback device that is selected for motor control with *Motor Control Feedback Select* (03.026) is a linear device then

if *Linear Speed Select* (01.055) = 1 the units for speed parameters are mm/s with the following exceptions:

1. All speed parameters are displayed in rpm if sensorless mode is active, i.e. *Sensorless Mode Active* (03.078) = 1.
2. Speed feedback parameters associated with each feedback interface, i.e. *P1 Speed Feedback* (03.027) for position feedback interface P1, etc., are always displayed in rpm for a rotary device.

*Linear Speed Selected* (01.056) shows whether rotary or linear speed is being used. If *Linear Speed Selected* (01.056) = 0 then rotary speed is being used otherwise if it is 1 then linear speed is being used.

To enable the use of linear speed units, *P1 Linear Feedback Select* (03.051) must also be set to 1 to allow *Linear Speed Selected* (01.056) to be set to 1.

| Parameter         |  | 01.056 <i>Linear Speed Selected</i> |                  |
|-------------------|--|-------------------------------------|------------------|
| Short description | Indicates if linear speed units are being used |                                     |                  |
| Mode              | RFC-A  |                                     |                  |
| Minimum           | 0  | Maximum                             | 1                |
| Default           |  | Units                               |                  |
| Type              | 1 Bit Volatile                                 | Update Rate                         | Background write |
| Display Format    | Standard                                       | Decimal Places                      | 0                |
| Coding            | RO, ND, NC, PT                                 |                                     |                  |

See *Linear Speed Select* (01.055).

| Parameter         |  | 01.057 <i>Force Reference Direction</i> |          |
|-------------------|--|---|----------|
| Short description | Defines the direction of the reference |   |          |
| Mode              | RFC-A                                  |   |          |
| Minimum           | 0                                      | Maximum                                 | 2        |
| Default           | 0                                      | Units                                   |          |
| Type              | 8 Bit Volatile                         | Update Rate                             | 4ms read |
| Display Format    | Standard                               | Decimal Places                          | 0        |
| Coding            | RW, TE                                 |   |          |

| Value | Text    |
|-------|---------|
| 0     | None    |
| 1     | Forward |
| 2     | Reverse |

If *Force Reference Direction* (01.057) = 0 then it has no effect. If *Force Reference Direction* (01.057) is non-zero then the modulus of the reference is used and the sign is defined by the value of *Force Reference Direction* (01.057). If *Force Reference Direction* (01.057) = 1 then *Pre-skip Filter Reference* (01.002) is always positive, and if *Force Reference Direction* (01.057) = 2 then *Pre-skip Filter Reference* (01.002) is always zero or negative.

## Menu 2 Single Line Descriptions – Speed Ramps

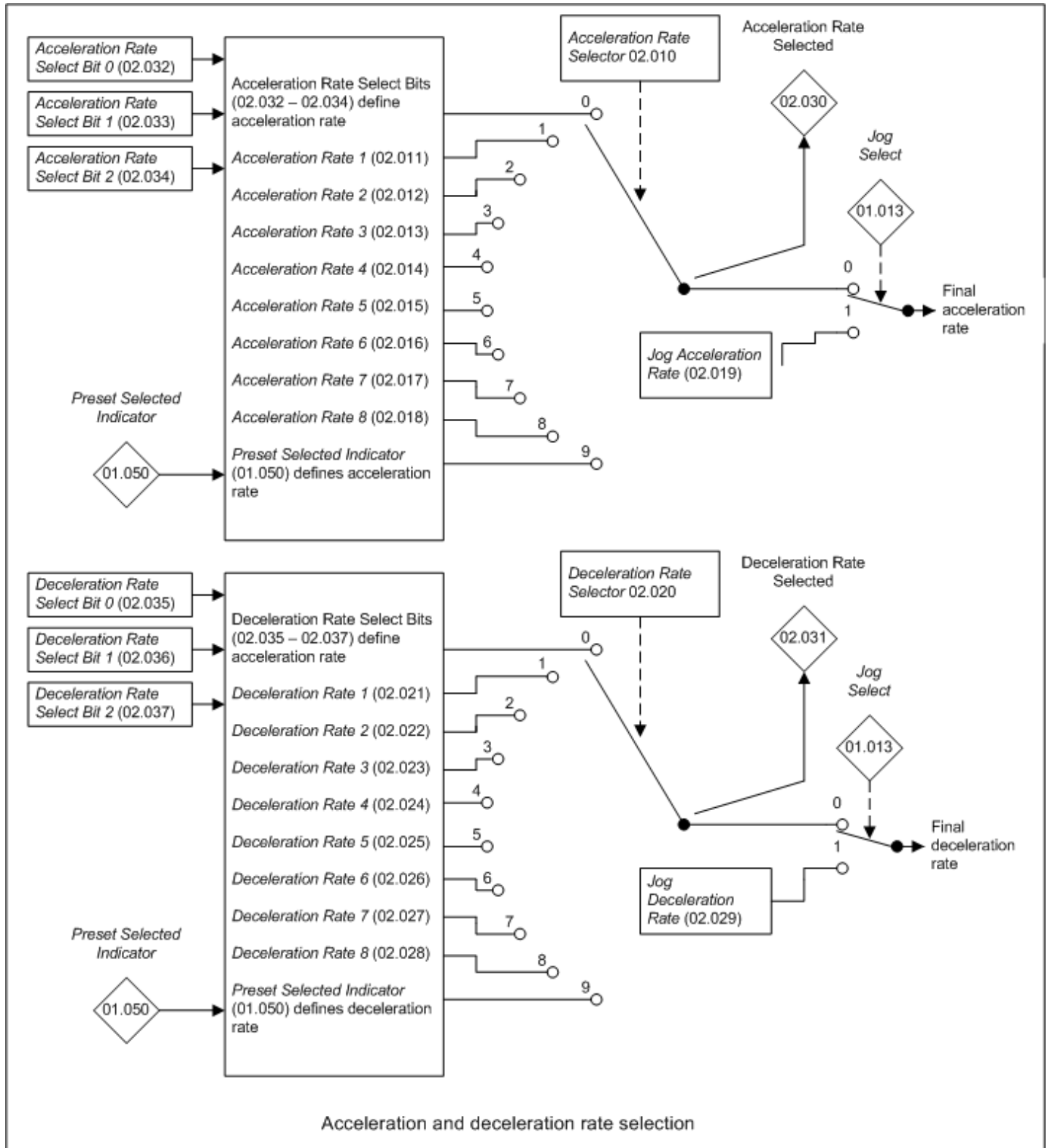
Mode: RFC-A

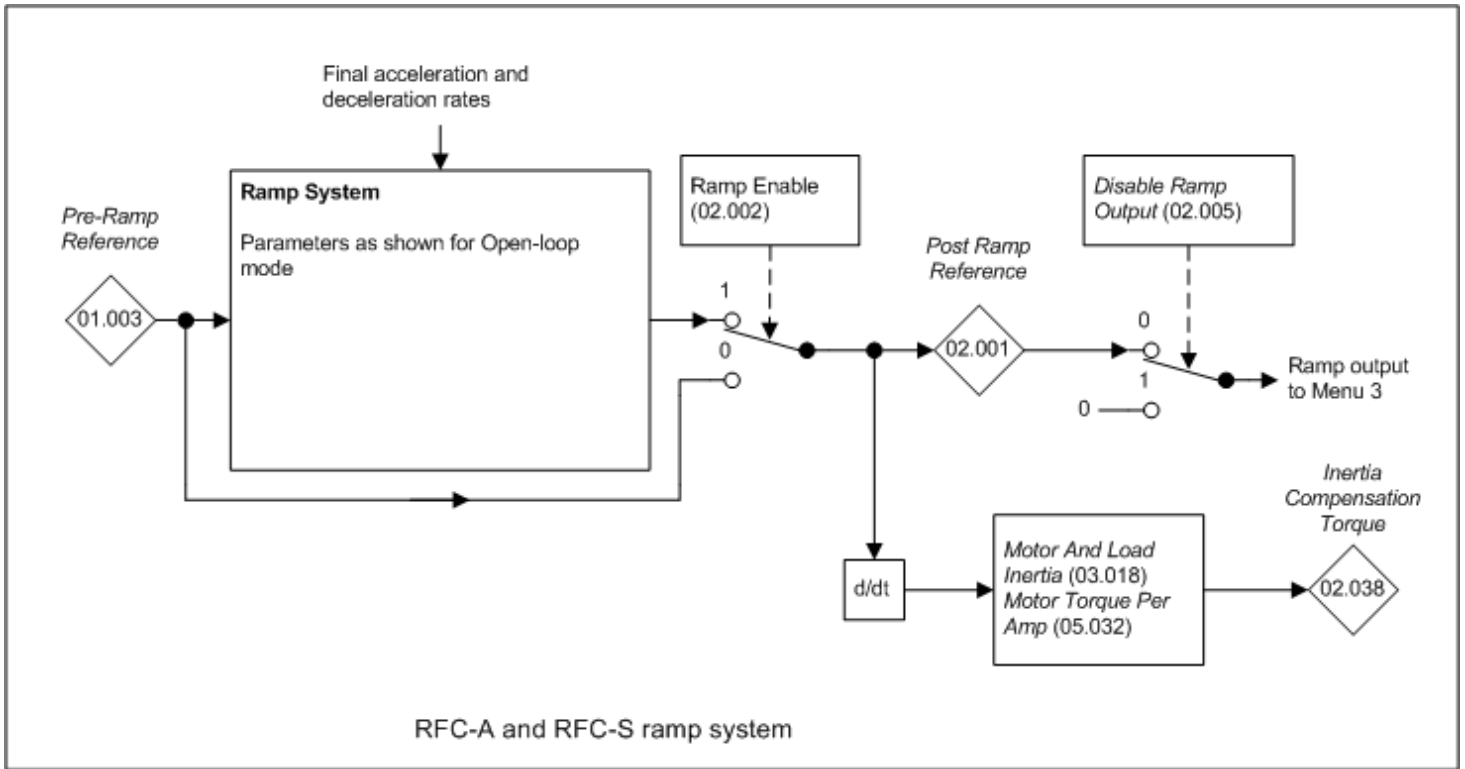
| Parameter |  | Range  | Default  | Type |     |    |    |    |    |
|-----------|--|--|--|------|-----|----|----|----|----|
| 02.001    | Post Ramp Reference                      | ±VM_SPEED_FREQ_REF                             |  | RO   | Num | ND | NC | PT |    |
| 02.002    | Ramp Enable                              | Off (0) or On (1)                              | On (1)   | RW   | Bit |    |    |    | US |
| 02.003    | Ramp Hold                                | Off (0) or On (1)                              | Off (0)  | RW   | Bit |    |    |    | US |
| 02.004    | Ramp Mode                                | Fast (0), Standard (1)                         | Standard (1)   | RW   | Txt |    |    |    | US |
| 02.005    | Disable Ramp Output                      | Off (0) or On (1)                              | Off (0)  | RW   | Bit |    |    |    | US |
| 02.006    | S Ramp Enable                            | Off (0) or On (1)                              | Off (0)  | RW   | Bit |    |    |    | US |
| 02.007    | Maximum Rate Of Change Of Acceleration   | 0.000 to 100.000                               | 1.500  | RW   | Num |    |    |    | US |
| 02.008    | Standard Ramp Voltage                    | ±VM_DC_VOLTAGE_SET V                           | 200V drive: 375 V<br>400V drive 50Hz: 750 V<br>400V drive 60Hz: 775 V<br>575V drive: 895 V<br>690V drive: 1075 V | RW   | Num |    | RA |    | US |
| 02.009    | Deceleration Fail Detection Disable      | Off (0) or On (1)                              | Off (0)  | RW   | Bit |    |    |    | US |
| 02.010    | Acceleration Rate Selector               | 0 to 9   | 0  | RW   | Num |    |    |    | US |
| 02.011    | Acceleration Rate 1                      | ±VM_ACCEL_RATE s                               | 2.000 s  | RW   | Num |    |    |    | US |
| 02.012    | Acceleration Rate 2                      | ±VM_ACCEL_RATE s                               | 2.000 s  | RW   | Num |    |    |    | US |
| 02.013    | Acceleration Rate 3                      | ±VM_ACCEL_RATE s                               | 2.000 s  | RW   | Num |    |    |    | US |
| 02.014    | Acceleration Rate 4                      | ±VM_ACCEL_RATE s                               | 2.000 s  | RW   | Num |    |    |    | US |
| 02.015    | Acceleration Rate 5                      | ±VM_ACCEL_RATE s                               | 2.000 s  | RW   | Num |    |    |    | US |
| 02.016    | Acceleration Rate 6                      | ±VM_ACCEL_RATE s                               | 2.000 s  | RW   | Num |    |    |    | US |
| 02.017    | Acceleration Rate 7                      | ±VM_ACCEL_RATE s                               | 2.000 s  | RW   | Num |    |    |    | US |
| 02.018    | Acceleration Rate 8                      | ±VM_ACCEL_RATE s                               | 2.000 s  | RW   | Num |    |    |    | US |
| 02.019    | Jog Acceleration Rate                    | ±VM_ACCEL_RATE s                               | 0.000 s  | RW   | Num |    |    |    | US |
| 02.020    | Deceleration Rate Selector               | 0 to 9   | 0  | RW   | Num |    |    |    | US |
| 02.021    | Deceleration Rate 1                      | ±VM_ACCEL_RATE s                               | 2.000 s  | RW   | Num |    |    |    | US |
| 02.022    | Deceleration Rate 2                      | ±VM_ACCEL_RATE s                               | 2.000 s  | RW   | Num |    |    |    | US |
| 02.023    | Deceleration Rate 3                      | ±VM_ACCEL_RATE s                               | 2.000 s  | RW   | Num |    |    |    | US |
| 02.024    | Deceleration Rate 4                      | ±VM_ACCEL_RATE s                               | 2.000 s  | RW   | Num |    |    |    | US |
| 02.025    | Deceleration Rate 5                      | ±VM_ACCEL_RATE s                               | 2.000 s  | RW   | Num |    |    |    | US |
| 02.026    | Deceleration Rate 6                      | ±VM_ACCEL_RATE s                               | 2.000 s  | RW   | Num |    |    |    | US |
| 02.027    | Deceleration Rate 7                      | ±VM_ACCEL_RATE s                               | 2.000 s  | RW   | Num |    |    |    | US |
| 02.028    | Deceleration Rate 8                      | ±VM_ACCEL_RATE s                               | 2.000 s  | RW   | Num |    |    |    | US |
| 02.029    | Jog Deceleration Rate                    | ±VM_ACCEL_RATE s                               | 0.000 s  | RW   | Num |    |    |    | US |
| 02.030    | Acceleration Rate Selected               | 0 to 8   |  | RO   | Num | ND | NC | PT |    |
| 02.031    | Deceleration Rate Selected               | 0 to 8   |  | RO   | Num | ND | NC | PT |    |
| 02.032    | Acceleration Rate Select Bit 0           | Off (0) or On (1)                              | Off (0)  | RW   | Bit |    | NC |    |    |
| 02.033    | Acceleration Rate Select Bit 1           | Off (0) or On (1)                              | Off (0)  | RW   | Bit |    | NC |    |    |
| 02.034    | Acceleration Rate Select Bit 2           | Off (0) or On (1)                              | Off (0)  | RW   | Bit |    | NC |    |    |
| 02.035    | Deceleration Rate Select Bit 0           | Off (0) or On (1)                              | Off (0)  | RW   | Bit |    | NC |    |    |
| 02.036    | Deceleration Rate Select Bit 1           | Off (0) or On (1)                              | Off (0)  | RW   | Bit |    | NC |    |    |
| 02.037    | Deceleration Rate Select Bit 2           | Off (0) or On (1)                              | Off (0)  | RW   | Bit |    | NC |    |    |
| 02.038    | Inertia Compensation Torque              | ±1000.0 %                                      |  | RO   | Num | ND | NC | PT |    |
| 02.039    | Ramp Rate Units                          | Off (0) or On (1)                              | Off (0)  | RW   | Bit |    |    |    | US |
| 02.040    | S Ramp Percentage                        | 0.0 to 50.0 %                                  | 0.0 %  | RW   | Num |    |    |    | US |
| 02.041    | S Ramp Set-up Mode                       | Single (0), Percentage (1),<br>Independent (2) | Single (0)   | RW   | Txt |    |    |    | US |
| 02.042    | Maximum Rate Of Change Of Acceleration 1 | 0.000 to 100.000                               | 0.000  | RW   | Num |    |    |    | US |
| 02.043    | Maximum Rate Of Change Of Acceleration 2 | 0.000 to 100.000                               | 0.000  | RW   | Num |    |    |    | US |
| 02.044    | Maximum Rate Of Change Of Acceleration 3 | 0.000 to 100.000                               | 0.000  | RW   | Num |    |    |    | US |
| 02.045    | Maximum Rate Of Change Of Acceleration 4 | 0.000 to 100.000                               | 0.000  | RW   | Num |    |    |    | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 2 – Speed Ramps

Mode: RFC-A





| Parameter         | 02.001 Post Ramp Reference             |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Displays the output of the ramp system |                |                   |
| Mode              | RFC-A                                  |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF                     | Maximum        | VM_SPEED_FREQ_REF |
| Default           |  | Units          |                   |
| Type              | 32 Bit Volatile                        | Update Rate    | 4ms write         |
| Display Format    | Standard                               | Decimal Places | 1                 |
| Coding            | RO, VM, ND, NC, PT                     |                |                   |

The *Post Ramp Reference* (02.001) can be combined with the *Hard Speed Reference* (03.022) to give the final speed reference at the input to the speed controller (see Menu 3). If the *Hard Speed Reference* (03.022) is used alone to give the final speed reference, and the ramp output is not required, then the ramp output can be disconnected by setting *Disable Ramp Output* (02.005) = 1. This ensures that the reference and ramp systems do not affect the final speed reference.

It should be noted that the ramps are applied during starting and stopping (i.e. when *Reference On* (01.011) changes from 0 to 1 and vice versa) even when the hard speed reference is being used. This is achieved on starting by making the ramp output equal to *Speed Feedback* (03.002) - *Hard Speed Reference* (03.022). (See *Catch A Spinning Motor* (06.009) for more details.) For example, if the motor is stationary then the initial value of the ramp output is equal to *-Hard Speed Reference* (03.022). On stopping the ramp output is made equal to *Final Speed Reference* (03.001) and the setting of *Disable Ramp Output* (02.005) is ignored and so the ramp is always used, but just while the drive is in the deceleration state. If the hard speed reference is being used alone and ramps are not required on starting the ramps should be disabled. If ramps are not required on stopping then stopping without ramps should be used (i.e. *Stop Mode* (06.001) should be set for no ramp stop). The same feature is applied when stopping when the supply is lost, so that if *Supply Loss Mode* (06.003) is set to select a ramped stop, the speed will be ramped to standstill even if the hard speed reference is being used.

If the Advanced Motion Controller is being used, ramped stopping is selected and the run is deactivated (i.e. *Reference On* (01.011) changes from 1 to 0), but the drive enable remains active, the AMC will be disabled and the speed will be ramped to zero using the ramp rate selected with Menu 2. If ramped stop on supply loss is selected then on supply loss the AMC is disabled and the ramp selected via Menu 2 will be used to stop the motor. It should be noted that orientation stop cannot be used when the run is deactivated if the AMC is selected (i.e. *AMC Select* (31.001) = 1).

| Parameter         | 02.002 Ramp Enable                 |                |          |
|-------------------|------------------------------------|----------------|----------|
| Short description | Set to 1 to enable the ramp system |                |          |
| Mode              | RFC-A                              |                |          |
| Minimum           | 0                                  | Maximum        | 1        |
| Default           | 1                                  | Units          |          |
| Type              | 1 Bit User Save                    | Update Rate    | 4ms read |
| Display Format    | Standard                           | Decimal Places | 0        |
| Coding            | RW, BU                             |                |          |

If *Ramp Enable* (02.002) = 1 then the ramp system is present between the *Pre-ramp Reference* (01.003) and the *Post Ramp Reference* (02.001). If *Ramp Enable* (02.002) = 0 then any changes in the *Pre-ramp Reference* (01.003) are reflected immediately in the *Post Ramp Reference* (02.001).



| Parameter         | 02.003 Ramp Hold                                      |                |            |
|-------------------|---|----------------|------------|
| Short description | Set to 1 to hold the ramp system at its present value |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | 0   | Maximum        | 1          |
| Default           | 0   | Units          |            |
| Type              | 1 Bit User Save                                       | Update Rate    | 250µs read |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

If *Ramp Hold* (02.003) = 0 the ramp system functions normally. If *Ramp Hold* (02.003) is set to 1 and *S Ramp Enable* (02.006) = 0 the ramp system output is held at its current level. If *Ramp Hold* (02.003) is subsequently set to 0 the ramp system output is released and continues to operate normally. If *S Ramp Enable* (02.006) = 1 when *Ramp Hold* (02.003) is set to 1 the acceleration will ramp towards zero and the frequency or speed will change in an S curve towards a constant speed. If a drive stop is requested (i.e. *Reference On* (01.011) = 0) the ramp hold function is disabled.

| Parameter         | 02.004 Ramp Mode                         |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the mode used by the ramp system |                |          |
| Mode              | RFC-A                                    |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 1  | Units          |          |
| Type              | 8 Bit User Save                          | Update Rate    | 4ms read |
| Display Format    | Standard                                 | Decimal Places | 0        |
| Coding            | RW, TE                                   |                |          |

| Value | Text     |
|-------|----------|
| 0     | Fast     |
| 1     | Standard |

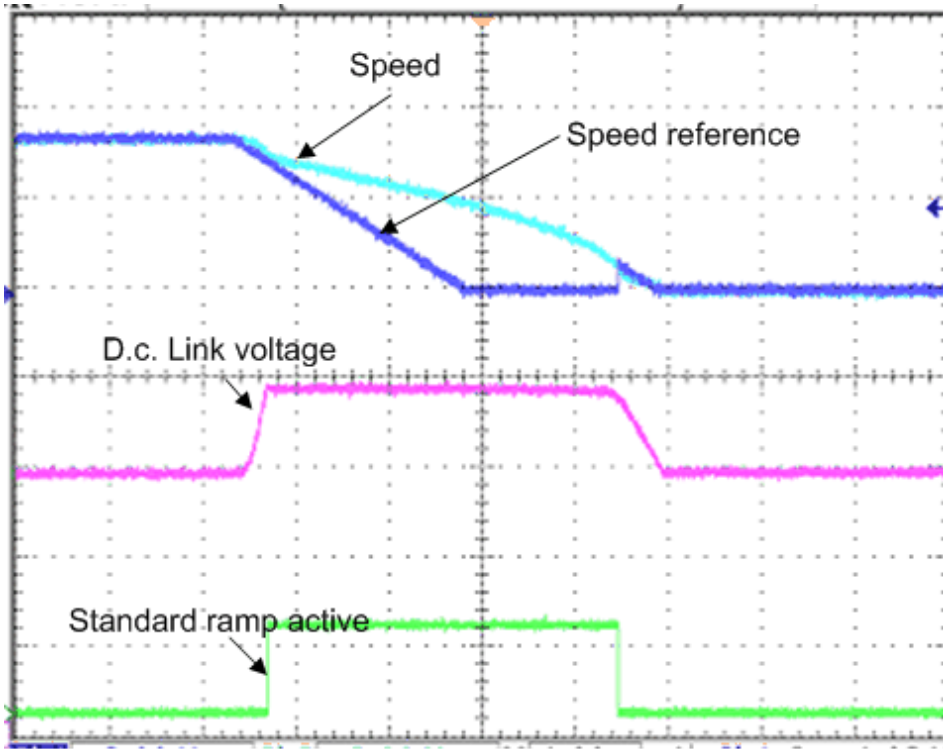
Acceleration is defined as a positive (forward) or negative (reverse) frequency or speed change away from zero, and deceleration is defined as a change towards zero. *Ramp Mode* (02.004) defines the ramp mode used for deceleration. During acceleration the frequency or speed changes are based on the final acceleration rate only.

#### 0: Fast ramp

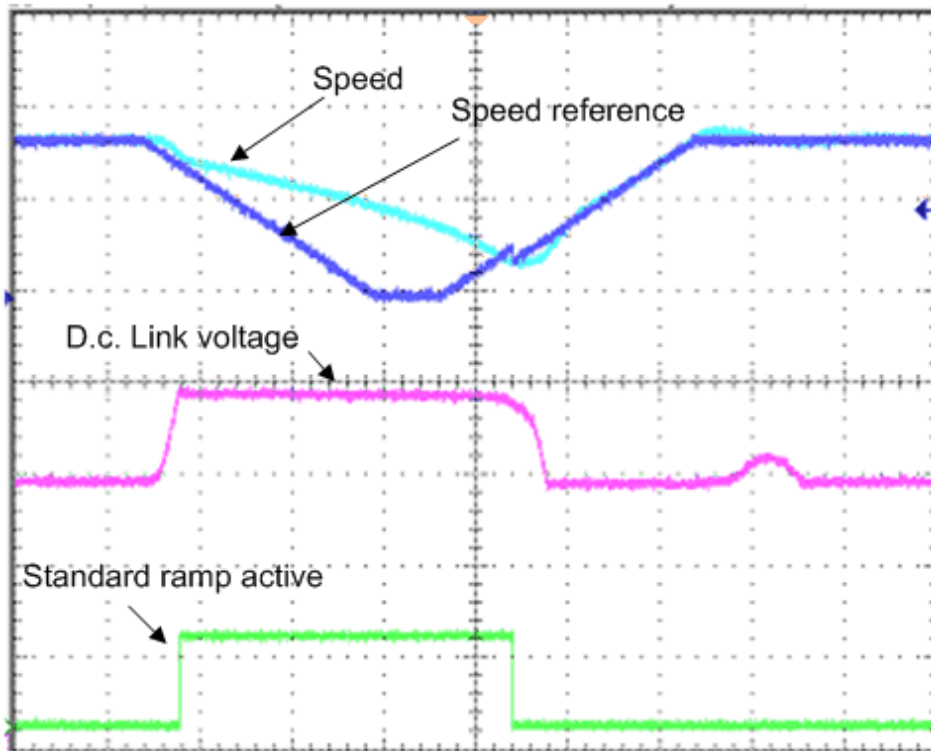
During deceleration the frequency or speed changes are based on the final deceleration rate.

#### 1: Standard ramp

If the d.c. bus voltage rises to the level defined by *Standard Ramp Voltage* (02.008) the regenerative current limit is modified to prevent the voltage from rising any higher. This form of control applies to speed or torque control and during supply loss. If the *Standard Ramp Voltage* (02.008) is set to a level that is below the nominal d.c. bus voltage level the motor is likely to accelerate with a low level of torque. The waveforms below show the behaviour of the system when the speed reference is set to zero and standard ramp control becomes active. In the first example the speed reference (ramp output) reaches zero before the actual speed reaches zero because the deceleration is being controlled to limit the d.c. link voltage. Then when standard ramp control becomes inactive the ramp output is set to the actual speed, so that the required ramp rate is used to decelerate to stop. In the second example the reference is reapplied before the speed reaches zero. Because the speed reference has fallen faster than the actual speed, there is a recovery time before the speed reference rises to meet the actual speed.



Deceleration to stop



Deceleration and then acceleration before stop

| Parameter         | 02.005 <i>Disable Ramp Output</i>   |                |          |
|-------------------|-------------------------------------|----------------|----------|
| Short description | Set to 1 to disable the ramp system |                |          |
| Mode              | RFC-A                               |                |          |
| Minimum           | 0                                   | Maximum        | 1        |
| Default           | 0                                   | Units          |          |
| Type              | 1 Bit User Save                     | Update Rate    | 4ms read |
| Display Format    | Standard                            | Decimal Places | 0        |
| Coding            | RW                                  |                |          |

See *Post Ramp Reference* (02.001).

| Parameter         | 02.006 <i>S Ramp Enable</i>           |                |          |
|-------------------|---------------------------------------|----------------|----------|
| Short description | Set to 1 to enable the use of S ramps |                |          |
| Mode              | RFC-A                                 |                |          |
| Minimum           | 0                                     | Maximum        | 1        |
| Default           | 0                                     | Units          |          |
| Type              | 1 Bit User Save                       | Update Rate    | 4ms read |
| Display Format    | Standard                              | Decimal Places | 0        |
| Coding            | RW                                    |                |          |

If *S Ramp Enable* (02.006) = 0 linear ramps are used, but if *S Ramp Enable* (02.006) = 1 an acceleration limit is applied to give S ramps. See *Maximum Rate Of Change Of Acceleration* (02.007) for more details of S ramps.

| Parameter         | 02.007 <i>Maximum Rate Of Change Of Acceleration</i>                       |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the maximum rate of change of acceleration used by the ramp system |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000  | Maximum        | 100.000         |
| Default           | 1.500  | Units          |                 |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW   |                |                 |

A rate of change of acceleration ramp (S ramp) can be applied by different methods depending on the value of *S Ramp Set-up Mode* (02.041). If *S Ramp Set-up Mode* (02.041) = 0 then the maximum rate of change of acceleration in both directions, accelerating away from or towards zero, is defined by *Maximum Rate Of Change Of Acceleration* (02.007).

The general equations are given below for a linear ramp and S ramp where  
 $\Delta w$  is the required change of frequency or speed  
 $a_{Max}$  is the maximum allowed acceleration in units of frequency/s or speed/s  
 $J_{Max}$  is the maximum rate of change of acceleration (i.e. jerk) in units of frequency/s<sup>2</sup> or speed/s<sup>2</sup>

The time for a linear ramp to give a change of frequency or speed  $\Delta w$  is

$$T_{Linear} = \Delta w / a_{Max}$$

If an S ramp is used  $w_B$  is the change of frequency or speed as the acceleration changes from zero to  $a_{Max}$ , i.e. the S shaped part of the frequency or speed change.

$$w_B = a_{Max}^2 / 2J_{Max}$$

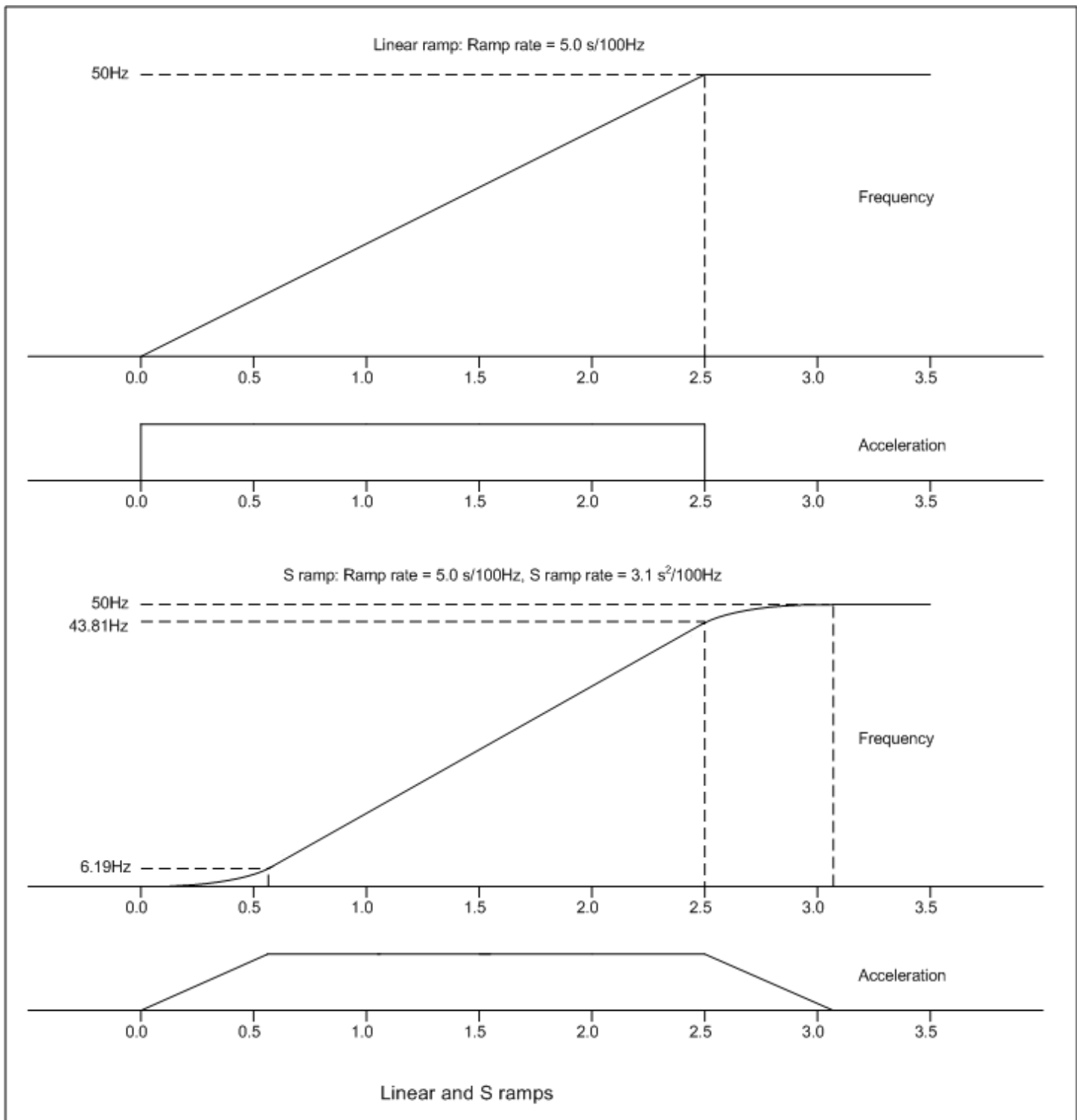
If the required frequency or speed change is less than  $2w_B$ , i.e.  $\Delta w < 2w_B$ , then the acceleration never reaches its limit and the ramp does not contain a linear ramp section and the time for the ramp is given by

$$T_{SRamp1} = 2 \sqrt{(\Delta w / J_{Max})}$$

Otherwise

$$T_{SRamp2} = (\Delta w / a_{Max}) + (a_{Max} / J_{Max})$$

The following is an example based on the default parameter values for Open-loop mode. The diagram below shows a change of frequency from 0Hz to 50Hz with the ramp rate set to 5.0s/100Hz and *Maximum Rate Of Change Of Acceleration* (02.007) set to its default value of 3.1s<sup>2</sup>/100Hz.



The required change of frequency  $\Delta w = 50\text{Hz}$ . The acceleration and jerk are converted from the parameter values as follows:

$$a_{\text{Max}} = 100 / \text{ramp rate} = 20.0\text{Hz/s}$$

$$J_{\text{Max}} = 100 / \text{Maximum Rate Of Change Of Acceleration (02.007)} = 32.3\text{Hz/s}^2$$

$$\text{The linear ramp time } T_{\text{Linear}} = \Delta w / a_{\text{Max}} = 50.0 / 20.0 = 2.5\text{s}$$

$$\text{The frequency change for the acceleration to reach its limit } w_B = a_{\text{Max}}^2 / 2J_{\text{Max}} = 20.0^2 / (2 \times 32.3) = 6.19\text{Hz}$$

The required frequency change for  $\Delta w = 50\text{Hz}$  and this is greater than  $2w_B$ , i.e.  $\Delta w > 2 \times 6.19\text{Hz}$ . Therefore the time for the ramp

$$T_{\text{SRamp2}} = (\Delta w / a_{\text{Max}}) + (a_{\text{Max}} / J_{\text{Max}}) = (50.0 / 20.0) + (20.0 / 32.3) = 2.5 + 0.62 = 3.12\text{s}$$

Note that the default value of *Maximum Rate Of Change Of Acceleration (02.007)* has been chosen so that when it is combined with the default acceleration rate, each of the S sections of the ramp is 20% of the overall time for the frequency change, i.e.  $0.62/3.12 \times 100\% = 20\%$ . This is the same as if *S Ramp Set-up Mode (02.041)* = 2 and *S Ramp Percentage (02.040)* = 20%.

If the required change of frequency had been 5.0Hz, i.e. less than  $2 \times w_B$ , then the alternative equation should be used:

$$T_{\text{SRamp1}} = 2 \sqrt{(\Delta w / J_{\text{Max}})} = 2 \sqrt{(5.0 / 32.3)} = 0.78\text{s}$$

For RFC-A and RFC-S modes the general equations are used in the same way as for Open-loop mode. The required values are calculated as follows:

$$\Delta w = 1000 / \text{ramp rate}$$

$$a_{\text{Max}} = 1000 / \text{ramp rate}$$

$$J_{\text{Max}} = 1000 / \text{Maximum Rate Of Change Of Acceleration (02.007)}$$

| Parameter         |  |                    |  | 02.008 Standard Ramp Voltage                              |  |                   |  |                 |  |
|-------------------|--|--------------------|--|---|--|-------------------|--|-----------------|--|
| Short description |  |                    |  | Defines the standard ramp voltage used by the ramp system |  |                   |  |                 |  |
| Mode              |  |                    |  | RFC-A   |  |                   |  |                 |  |
| Minimum           |  | -VM_DC_VOLTAGE_SET |  | Maximum   |  | VM_DC_VOLTAGE_SET |  |                 |  |
| Default           |  |                    |  | See exceptions below                                      |  | Units             |  | V               |  |
| Type              |  |                    |  | 16 Bit User Save  |  | Update Rate       |  | Background read |  |
| Display Format    |  |                    |  | Standard  |  | Decimal Places    |  | 0               |  |
| Coding            |  |                    |  | RW, VM, RA  |  |                   |  |                 |  |

| Voltage | Region | Default Value |
|---------|--------|---------------|
| 200V    | All    | 375           |
| 400V    | 50Hz   | 750           |
| 400V    | 60Hz   | 775           |
| 575V    | All    | 895           |
| 690V    | All    | 1075          |

See Ramp Mode (02.004).

| Parameter         |  |   |  | 02.009 Deceleration Fail Detection Disable                   |  |                |  |                 |  |
|-------------------|--|---|--|--|--|----------------|--|-----------------|--|
| Short description |  |   |  | Set to 1 to disable the deceleration fail detection function |  |                |  |                 |  |
| Mode              |  |   |  | RFC-A  |  |                |  |                 |  |
| Minimum           |  | 0 |  | Maximum  |  | 1              |  |                 |  |
| Default           |  |   |  | 0  |  | Units          |  |                 |  |
| Type              |  |   |  | 1 Bit User Save  |  | Update Rate    |  | Background read |  |
| Display Format    |  |   |  | Standard   |  | Decimal Places |  | 0               |  |
| Coding            |  |   |  | RW   |  |                |  |                 |  |

In the following circumstances it is possible that the motor may not decelerated or even accelerate.

1. When standard ramp is selected with a high inductance supply it is possible for the d.c. bus voltage to rise as the motor speed approaches zero, and so the motor will continue to rotate slowly and not stop.
2. An overhauling load can cause the motor to accelerate.

It can be a problem if the drive state is changed to the "Decelerating" state and the motor does not stop. If *Deceleration Fail Detection Disable* (02.009) is at its default value of 0, the motor frequency or speed is monitored in the "Decelerating" state, and if this does not fall over a period of 10s the ramp output is forced to zero and the drive state is changed to "Stop" or "Inhibit" as appropriate.

If *Deceleration Fail Detection Disable* (02.009) = 1 this feature is disabled. This can be used in the following circumstances to prevent the system state from changing from the "Decelerating" state before the motor has stopped:

1. If S ramps are being used with long ramp rates, and the motor is still accelerating when the drive is changed to the "Decelerating" state because the run command is removed, then the ramp output may increase further before falling again towards zero.
2. In RFC-A or RFC-S modes the speed may appear not to reduce when very long ramp rates are used.

| Parameter         |  |   |  | 02.010 Acceleration Rate Selector                          |  |                |  |          |  |
|-------------------|--|---|--|--|--|----------------|--|----------|--|
| Short description |  |   |  | Defines which acceleration rate is used by the ramp system |  |                |  |          |  |
| Mode              |  |   |  | RFC-A  |  |                |  |          |  |
| Minimum           |  | 0 |  | Maximum  |  | 9              |  |          |  |
| Default           |  |   |  | 0  |  | Units          |  |          |  |
| Type              |  |   |  | 8 Bit User Save  |  | Update Rate    |  | 4ms read |  |
| Display Format    |  |   |  | Standard   |  | Decimal Places |  | 0        |  |
| Coding            |  |   |  | RW   |  |                |  |          |  |

The *Acceleration Rate Selector* (02.010) is used to either select an acceleration rate directly or to define the method used to select an acceleration rate. If  $1 \leq \text{Acceleration Rate Selector (02.010)} \leq 8$  the acceleration rate is selected directly, i.e. 1 selects *Acceleration Rate 1* (02.011), 2 selects *Acceleration Rate 2* (02.012), etc. If *Acceleration Rate Selector* (02.010) = 0 the acceleration rate is selected with the acceleration rate select bits as shown in the table below.

| Acceleration Rate Select Bit 2 (02.034) | Acceleration Rate Select Bit 1 (02.033) | Acceleration Rate Select Bit 0 (02.032) | Acceleration rate selected   |
|---|---|---|------------------------------|
| 0                                       | 0                                       | 0                                       | Acceleration Rate 1 (02.011) |
| 0                                       | 0                                       | 1                                       | Acceleration Rate 2 (02.012) |
| 0                                       | 1                                       | 0                                       | Acceleration Rate 3 (02.013) |
| 0                                       | 1                                       | 1                                       | Acceleration Rate 4 (02.014) |
| 1                                       | 0                                       | 0                                       | Acceleration Rate 5 (02.015) |
| 1                                       | 0                                       | 1                                       | Acceleration Rate 6 (02.016) |
| 1                                       | 1                                       | 0                                       | Acceleration Rate 7 (02.017) |
| 1                                       | 1                                       | 1                                       | Acceleration Rate 8 (02.018) |

If *Acceleration Rate Selector* (02.010) = 9 the acceleration rate is selected based on the value of *Preset Selected Indicator* (01.050), i.e. 1 selects *Acceleration Rate 1* (02.011), 2 selects *Acceleration Rate 2* (02.012), etc.

| Parameter         | 02.011 Acceleration Rate 1                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate present in acceleration rate 1 |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 2.000  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read      |
| Display Format    | Standard   | Decimal Places | 3             |
| Coding            | RW, VM   |                |               |

*Acceleration Rate 1* (02.011) to *Acceleration Rate 8* (02.018) can be selected to define the linear ramp rate. The acceleration rate applies when the frequency/speed is changing away from zero.

Selecting a ramp rate that has been set to zero in Open-loop mode disables the ramp system so that the *Post Ramp Reference* (02.001) follows the *Pre-ramp Reference* (01.003) without any delay for acceleration or deceleration. It should be noted that this also disables the standard ramp d.c. link voltage controller and the frequency based current limits.

The units of *Acceleration Rate 1* (02.011) to *Acceleration Rate 8* (02.018) are s / Ramp rate frequency or s / Ramp rate speed. See *Ramp Rate Units* (02.039) for the definition of Ramp rate frequency and Ramp rate speed.

| Parameter         | 02.012 Acceleration Rate 2                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate present in acceleration rate 2 |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 2.000  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read      |
| Display Format    | Standard   | Decimal Places | 3             |
| Coding            | RW, VM   |                |               |

See *Acceleration Rate 1* (02.011).

| Parameter         | 02.013 Acceleration Rate 3                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate present in acceleration rate 3 |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 2.000  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read      |
| Display Format    | Standard   | Decimal Places | 3             |
| Coding            | RW, VM   |                |               |

See *Acceleration Rate 1* (02.011).

| Parameter         | 02.014 Acceleration Rate 4                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate present in acceleration rate 4 |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 2.000  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read      |
| Display Format    | Standard   | Decimal Places | 3             |
| Coding            | RW, VM   |                |               |

See *Acceleration Rate 1* (02.011).

| Parameter         | 02.015 Acceleration Rate 5                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate present in acceleration rate 5 |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 2.000  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read      |
| Display Format    | Standard   | Decimal Places | 3             |
| Coding            | RW, VM   |                |               |

See *Acceleration Rate 1* (02.011).

| Parameter         | 02.016 Acceleration Rate 6                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate present in acceleration rate 6 |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 2.000  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read      |
| Display Format    | Standard   | Decimal Places | 3             |
| Coding            | RW, VM   |                |               |

See *Acceleration Rate 1* (02.011).

| Parameter         | 02.017 Acceleration Rate 7                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate present in acceleration rate 7 |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 2.000  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read      |
| Display Format    | Standard   | Decimal Places | 3             |
| Coding            | RW, VM   |                |               |

See *Acceleration Rate 1* (02.011).

| Parameter         | 02.018 Acceleration Rate 8                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate present in acceleration rate 8 |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 2.000  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read      |
| Display Format    | Standard   | Decimal Places | 3             |
| Coding            | RW, VM   |                |               |

See *Acceleration Rate 1* (02.011).

| Parameter         | 02.019 Jog Acceleration Rate  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the acceleration rate present when the jog function is selected |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | -VM_ACCEL_RATE  | Maximum        | VM_ACCEL_RATE   |
| Default           | 0.000   | Units          | s               |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 3               |
| Coding            | RW, VM  |                |                 |

The *Jog Acceleration Rate* (02.019) is selected when *Jog Select* (01.013) is active and when the frequency/speed is changing away from zero in either direction. The units of *Jog Acceleration Rate* (02.019) are s / Ramp rate frequency or s / Ramp rate speed. See *Ramp Rate Units* (02.039) for the definition of Ramp rate frequency and Ramp rate speed.

| Parameter         | 02.020 Deceleration Rate Selector                          |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines which deceleration rate is used by the ramp system |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 9        |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW   |                |          |

The *Deceleration Rate Selector* (02.020) operates in the same way as the *Acceleration Rate Selector* (02.010). If *Deceleration Rate Selector* (02.020) = 0 the deceleration rate is selected with the deceleration rate select bits as shown in the table below.

| <b>Deceleration Rate Select Bit 2 (02.037)</b> | <b>Deceleration Rate Select Bit 1 (02.036)</b> | <b>Deceleration Rate Select Bit 0 (02.035)</b> | <b>Deceleration rate selected</b>   |
|--|--|--|-------------------------------------|
| 0  | 0  | 0  | <i>Deceleration Rate 1</i> (02.021) |
| 0  | 0  | 1  | <i>Deceleration Rate 2</i> (02.022) |
| 0  | 1  | 0  | <i>Deceleration Rate 3</i> (02.023) |
| 0  | 1  | 1  | <i>Deceleration Rate 4</i> (02.024) |
| 1  | 0  | 0  | <i>Deceleration Rate 5</i> (02.025) |
| 1  | 0  | 1  | <i>Deceleration Rate 6</i> (02.026) |
| 1  | 1  | 0  | <i>Deceleration Rate 7</i> (02.027) |
| 1  | 1  | 1  | <i>Deceleration Rate 8</i> (02.028) |

| <b>Parameter</b>  |  |  |  | <b>02.021 Deceleration Rate 1</b> |  |               |  |
|-------------------|--|--|--|-----------------------------------|--|---------------|--|
| Short description |  | Defines the deceleration rate present in deceleration rate 1 |  |                                   |  |               |  |
| Mode              |  | RFC-A  |  |                                   |  |               |  |
| Minimum           |  | -VM_ACCEL_RATE   |  | Maximum                           |  | VM_ACCEL_RATE |  |
| Default           |  | 2.000  |  | Units                             |  | s             |  |
| Type              |  | 32 Bit User Save   |  | Update Rate                       |  | 4ms read      |  |
| Display Format    |  | Standard   |  | Decimal Places                    |  | 3             |  |
| Coding            |  | RW, VM   |  |                                   |  |               |  |

*Deceleration Rate 1* (02.021) to *Deceleration Rate 8* (02.028) can be selected to define the linear ramp rate. The deceleration rate applies when the frequency/speed is changing towards zero.

Selecting a ramp rate that has been set to zero in Open-loop mode disables the ramp system so that the *Post Ramp Reference* (02.001) follows the *Pre-ramp Reference* (01.003) without any delay for acceleration or deceleration. It should be noted that this also disables the standard ramp d.c. link voltage controller and the frequency based current limits.

The units of *Deceleration Rate 1* (02.021) to *Deceleration Rate 8* (02.028) are s / Ramp rate frequency or s / Ramp rate speed. See *Ramp Rate Units* (02.039) for the definition of Ramp rate frequency and Ramp rate speed.

| <b>Parameter</b>  |  |  |  | <b>02.022 Deceleration Rate 2</b> |  |               |  |
|-------------------|--|--|--|-----------------------------------|--|---------------|--|
| Short description |  | Defines the deceleration rate present in deceleration rate 2 |  |                                   |  |               |  |
| Mode              |  | RFC-A  |  |                                   |  |               |  |
| Minimum           |  | -VM_ACCEL_RATE   |  | Maximum                           |  | VM_ACCEL_RATE |  |
| Default           |  | 2.000  |  | Units                             |  | s             |  |
| Type              |  | 32 Bit User Save   |  | Update Rate                       |  | 4ms read      |  |
| Display Format    |  | Standard   |  | Decimal Places                    |  | 3             |  |
| Coding            |  | RW, VM   |  |                                   |  |               |  |

See *Deceleration Rate 1* (02.021).

| <b>Parameter</b>  |  |  |  | <b>02.023 Deceleration Rate 3</b> |  |               |  |
|-------------------|--|--|--|-----------------------------------|--|---------------|--|
| Short description |  | Defines the deceleration rate present in deceleration rate 3 |  |                                   |  |               |  |
| Mode              |  | RFC-A  |  |                                   |  |               |  |
| Minimum           |  | -VM_ACCEL_RATE   |  | Maximum                           |  | VM_ACCEL_RATE |  |
| Default           |  | 2.000  |  | Units                             |  | s             |  |
| Type              |  | 32 Bit User Save   |  | Update Rate                       |  | 4ms read      |  |
| Display Format    |  | Standard   |  | Decimal Places                    |  | 3             |  |
| Coding            |  | RW, VM   |  |                                   |  |               |  |

See *Deceleration Rate 1* (02.021).



| Parameter         | 02.024 Deceleration Rate 4                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the deceleration rate present in deceleration rate 4 |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 2.000  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read      |
| Display Format    | Standard   | Decimal Places | 3             |
| Coding            | RW, VM   |                |               |

See *Deceleration Rate 1* (02.021).

| Parameter         | 02.025 Deceleration Rate 5                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the deceleration rate present in deceleration rate 5 |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 2.000  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read      |
| Display Format    | Standard   | Decimal Places | 3             |
| Coding            | RW, VM   |                |               |

See *Deceleration Rate 1* (02.021).

| Parameter         | 02.026 Deceleration Rate 6                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the deceleration rate present in deceleration rate 6 |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 2.000  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read      |
| Display Format    | Standard   | Decimal Places | 3             |
| Coding            | RW, VM   |                |               |

See *Deceleration Rate 1* (02.021).

| Parameter         | 02.027 Deceleration Rate 7                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the deceleration rate present in deceleration rate 7 |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 2.000  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read      |
| Display Format    | Standard   | Decimal Places | 3             |
| Coding            | RW, VM   |                |               |

See *Deceleration Rate 1* (02.021).

| Parameter         | 02.028 Deceleration Rate 8                                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the deceleration rate present in deceleration rate 8 |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | -VM_ACCEL_RATE   | Maximum        | VM_ACCEL_RATE |
| Default           | 2.000  | Units          | s             |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read      |
| Display Format    | Standard   | Decimal Places | 3             |
| Coding            | RW, VM   |                |               |

See *Deceleration Rate 1* (02.021).

| Parameter         | 02.029 Jog Deceleration Rate  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the deceleration rate present when the jog function is selected |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | -VM_ACCEL_RATE  | Maximum        | VM_ACCEL_RATE   |
| Default           | 0.000   | Units          | s               |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 3               |
| Coding            | RW, VM  |                |                 |

The *Jog Deceleration Rate* (02.029) is selected when *Jog Select* (01.013) is active and when the frequency/speed is changing towards zero in either direction. It should be noted that when jog is selected and the drive run is de-activated *Jog Deceleration Rate* (02.029) is used to decelerate the motor to stop. The units of *Jog Deceleration Rate* (02.029) are s / Ramp rate frequency or s / Ramp rate speed. See *Ramp Rate Units* (02.039) for the

definition of Ramp rate frequency and Ramp rate speed.

| Parameter         | 02.030 Acceleration Rate Selected             |                |           |
|-------------------|---|----------------|-----------|
| Short description | Indicates which acceleration rate is selected |                |           |
| Mode              | RFC-A   |                |           |
| Minimum           | 0   | Maximum        | 8         |
| Default           |   | Units          |           |
| Type              | 8 Bit Volatile                                | Update Rate    | 4ms write |
| Display Format    | Standard                                      | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                                |                |           |

*Acceleration Rate Selected* (02.030) shows a value between 1 and 8 that corresponds to parameters 02.011 to 02.018 indicating which of these acceleration rates is actually being used.

| Parameter         | 02.031 Deceleration Rate Selected             |                |           |
|-------------------|---|----------------|-----------|
| Short description | Indicates which deceleration rate is selected |                |           |
| Mode              | RFC-A   |                |           |
| Minimum           | 0   | Maximum        | 8         |
| Default           |   | Units          |           |
| Type              | 8 Bit Volatile                                | Update Rate    | 4ms write |
| Display Format    | Standard                                      | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                                |                |           |

*Deceleration Rate Selected* (02.031) shows a value between 1 and 8 that corresponds to parameters 02.021 to 02.028 indicating which of these deceleration rates is actually being used.

| Parameter         | 02.032 Acceleration Rate Select Bit 0                                     |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines which acceleration rate is used if acceleration rate selector = 0 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

See *Acceleration Rate Selector* (02.010).

| Parameter         | 02.033 Acceleration Rate Select Bit 1                                     |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines which acceleration rate is used if acceleration rate selector = 0 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

See *Acceleration Rate Selector* (02.010).

| Parameter         | 02.034 Acceleration Rate Select Bit 2                                     |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines which acceleration rate is used if acceleration rate selector = 0 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

See *Acceleration Rate Selector* (02.010).

| Parameter         | 02.035 Deceleration Rate Select Bit 0                                     |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines which deceleration rate is used if deceleration rate selector = 0 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

See *Deceleration Rate Selector* (02.020).

| Parameter         | <b>02.036 Deceleration Rate Select Bit 1</b>                              |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines which deceleration rate is used if deceleration rate selector = 0 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

See *Deceleration Rate Selector* (02.020).

| Parameter         | <b>02.037 Deceleration Rate Select Bit 2</b>                              |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines which deceleration rate is used if deceleration rate selector = 0 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

See *Deceleration Rate Selector* (02.020).

| Parameter         | <b>02.038 Inertia Compensation Torque</b>           |                |           |
|-------------------|---|----------------|-----------|
| Short description | Displays the torque as a percentage of rated torque |                |           |
| Mode              | RFC-A   |                |           |
| Minimum           | -1000.0   | Maximum        | 1000.0    |
| Default           |   | Units          | %         |
| Type              | 16 Bit Volatile                                     | Update Rate    | 4ms write |
| Display Format    | Standard  | Decimal Places | 1         |
| Coding            | RO, ND, NC, PT                                      |                |           |

The *Motor And Load Inertia* (03.018), *Torque Per Amp* (05.032) and the rate of change of the *Post Ramp Reference* (02.001) are used to produce a torque feed-forwards value that should accelerate and decelerate the load at the required rate. This value can be used as a feed-forwards term that is added to the speed controller output if *Inertia Compensation Enable* (04.022) = 1. *Inertia Compensation Torque* (02.038) gives the torque as a percentage of rated torque.

| Parameter         | <b>02.039 Ramp Rate Units</b>             |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the units used by the ramp system |                |                 |
| Mode              | RFC-A                                     |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save                           | Update Rate    | Background read |
| Display Format    | Standard                                  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

The ramp rate parameters (*Acceleration Rate 1* (02.011) to *Acceleration Rate 8* (02.018), *Jog Acceleration Rate* (02.019), *Deceleration Rate 1* (02.021) to *Deceleration Rate 8* (02.028) and *Jog Deceleration Rate* (02.029)) are specified in s / Ramp rate frequency for Open-loop mode and s / Ramp rate speed for RFC-A and RFC-S modes. Ramp rate frequency and Ramp rate speed are selected with *Ramp Rate Units* (02.039) as defined in the table below.

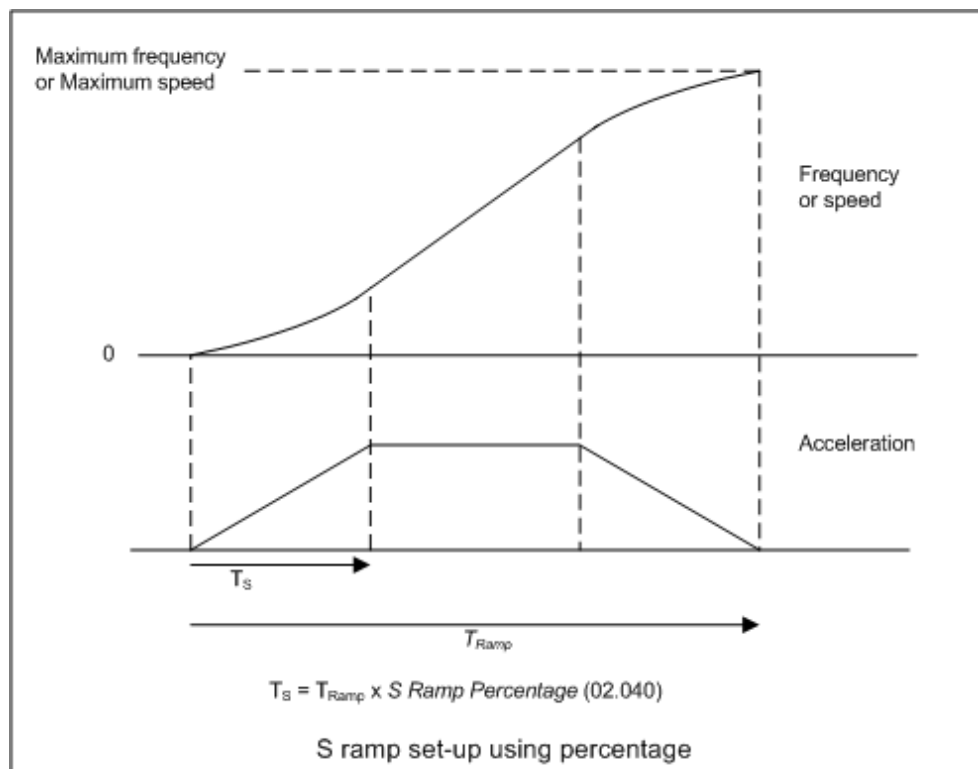
| <b>Ramp Rate Units (02.039)</b> | <b>Open-loop Ramp rate frequency</b> | <b>RFC-A and RFC-S mode Ramp rate speed</b> |
|---------------------------------|--------------------------------------|---|
| 0                               | 100Hz                                | 1000rpm or 1000mm/s                         |
| 1                               | Maximum frequency                    | Maximum speed                               |

Maximum frequency and Maximum speed are defined by *Maximum Reference Clamp* (01.006) if *Select Motor 2 Parameters* (11.045) = 0, or *M2 Maximum Reference Clamp* (21.001) if *Select Motor 2 Parameters* (11.045) = 1.

| Parameter         | <b>02.040 S Ramp Percentage</b>                          |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the profile of the S ramp system as a percentage |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.0  | Maximum        | 50.0            |
| Default           | 0.0  | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW   |                |                 |

If *S Ramp Set-up Mode* (02.041) = 1 the percentage of the ramp to Maximum frequency or Maximum speed that includes half the S ramp profile can be specified with *S Ramp Percentage* (02.040) as shown in the diagram below. If motor map one is active (i.e. *Select Motor 2 Parameters* (11.045) = 0),

the acceleration or deceleration times are defined by *Acceleration Rate 1* (02.011) and *Deceleration Rate 1* (02.021) respectively irrespective of which ramps rates are selected. The maximum frequency/speed is defined by *Maximum Reference Clamp* (01.006). The time for the frequency/speed change remains constant at the time defined by the acceleration or deceleration rate, and so as the percentage S ramp is changed the maximum acceleration is modified automatically. If motor map 2 is selected then *M2 Maximum Reference Clamp* (21.001), *M2 Acceleration Rate 1* (21.004) and *M2 Deceleration Rate 1* (21.005) are used to define the ramp profile. It should be noted that for ramp times to the maximum speed/frequency exceeding 30s this system becomes less accurate and the ramp time may become shorter than expected.



| Parameter         | 02.041 S Ramp Set-up Mode                  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the mode used by the S ramp system |                |                 |
| Mode              | RFC-A                                      |                |                 |
| Minimum           | 0  | Maximum        | 2               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                   | Decimal Places | 0               |
| Coding            | RW, TE                                     |                |                 |

| Value | Text        |
|-------|-------------|
| 0     | Single      |
| 1     | Percentage  |
| 2     | Independent |

*S Ramp Set-up Mode* (02.041) defines the method used to set up the S ramp function.

#### 0: Single maximum rate of change of acceleration

The maximum rate of change of acceleration in either direction, when the frequency/speed is changing away from or towards zero, is defined by *Maximum Rate Of Change Of Acceleration* (02.007).

#### 1: Percentage

A single maximum rate of change of acceleration is used in either direction, when the frequency/speed is changing away from or towards zero, but this is specified as the percentage of the ramp from zero to Maximum frequency or Maximum speed which is covered by the S shaped profile. See *S Ramp Percentage* (02.040).

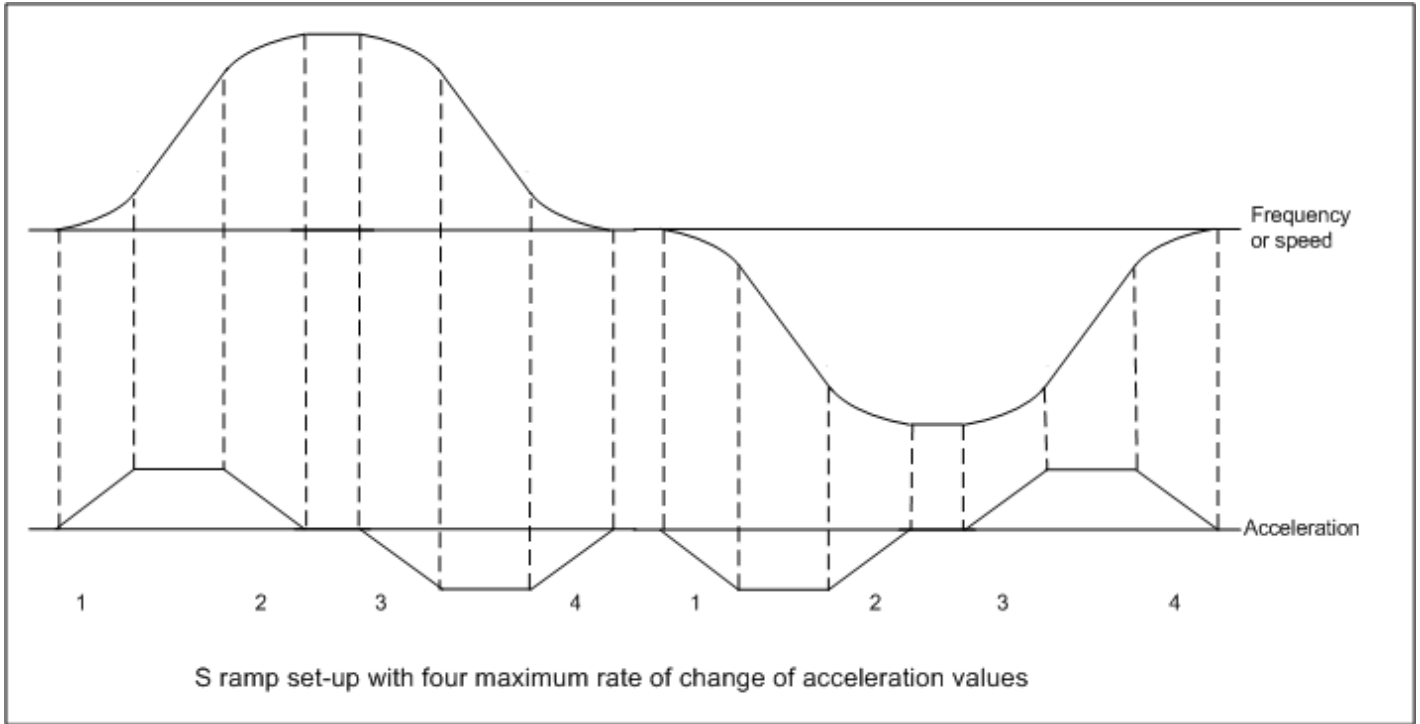
#### 2: Independent maximum rate of change of acceleration values

The maximum rate of change of acceleration can be specified as four independent values. See *Maximum Rate Of Change Of Acceleration 1* (02.042).

| Parameter         | 02.042 Maximum Rate Of Change Of Acceleration 1                                  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the 1st maximum rate of change of acceleration used by the S ramp system |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000  | Maximum        | 100.000         |
| Default           | 0.000  | Units          |                 |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW   |                |                 |

If *S Ramp Set-up Mode* (02.041) = 2 it is possible to set up four independent maximum rate of change of acceleration values as shown in the diagram below. The values from 1 to 4 correspond to *Maximum Rate Of Change Of Acceleration 1* (02.042) to *Maximum Rate Of Change Of Acceleration 4*

(02.045) respectively.



| Parameter         | <b>02.043 Maximum Rate Of Change Of Acceleration 2</b>                           |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the 2nd maximum rate of change of acceleration used by the S ramp system |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000  | Maximum        | 100.000         |
| Default           | 0.000  | Units          |                 |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW   |                |                 |

See *Maximum Rate Of Change Of Acceleration 1* (02.042).

| Parameter         | <b>02.044 Maximum Rate Of Change Of Acceleration 3</b>                           |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the 3rd maximum rate of change of acceleration used by the S ramp system |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000  | Maximum        | 100.000         |
| Default           | 0.000  | Units          |                 |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW   |                |                 |

See *Maximum Rate Of Change Of Acceleration 1* (02.042).

| Parameter         | <b>02.045 Maximum Rate Of Change Of Acceleration 4</b>                           |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the 4th maximum rate of change of acceleration used by the S ramp system |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000  | Maximum        | 100.000         |
| Default           | 0.000  | Units          |                 |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW   |                |                 |

See *Maximum Rate Of Change Of Acceleration 1* (02.042).

## Menu 3 Single Line Descriptions – *Speed Control and Position Feedback*

Mode: RFC-A

| Parameter |   | Range   | Default                  | Type |     |    |    |    |    |
|-----------|---|---|--------------------------|------|-----|----|----|----|----|
| 03.001    | Final Speed Reference                           | ±VM_SPEED   |                          | RO   | Num | ND | NC | PT | FI |
| 03.002    | Speed Feedback                                  | ±VM_SPEED   |                          | RO   | Num | ND | NC | PT | FI |
| 03.003    | Speed Error                                     | ±VM_SPEED   |                          | RO   | Num | ND | NC | PT | FI |
| 03.004    | Speed Controller Output                         | ±VM_TORQUE_CURRENT %  |                          | RO   | Num | ND | NC | PT | FI |
| 03.005    | Zero Speed Threshold                            | 0 to 200  | 5                        | RW   | Num |    |    |    | US |
| 03.006    | At Speed Lower Limit                            | 0 to 33000  | 5                        | RW   | Num |    |    |    | US |
| 03.007    | At Speed Upper Limit                            | 0 to 33000  | 5                        | RW   | Num |    |    |    | US |
| 03.008    | Over Speed Threshold                            | 0 to 33000  | 0                        | RW   | Num |    |    |    | US |
| 03.009    | Absolute At Speed Select                        | Off (0) or On (1)   | Off (0)                  | RW   | Bit |    |    |    | US |
| 03.010    | Speed Controller Proportional Gain Kp1          | 0.0000 to 200.0000 s/rad  | 0.0300 s/rad             | RW   | Num |    |    |    | US |
| 03.011    | Speed Controller Integral Gain Ki1              | 0.00 to 655.35 s <sup>2</sup> /rad  | 0.10 s <sup>2</sup> /rad | RW   | Num |    |    |    | US |
| 03.012    | Speed Controller Differential Feedback Gain Kd1 | 0.00000 to 0.65535 1/rad  | 0.00000 1/rad            | RW   | Num |    |    |    | US |
| 03.013    | Speed Controller Proportional Gain Kp2          | 0.0000 to 200.0000 s/rad  | 0.0300 s/rad             | RW   | Num |    |    |    | US |
| 03.014    | Speed Controller Integral Gain Ki2              | 0.00 to 655.35 s <sup>2</sup> /rad  | 0.10 s <sup>2</sup> /rad | RW   | Num |    |    |    | US |
| 03.015    | Speed Controller Differential Feedback Gain Kd2 | 0.00000 to 0.65535 1/rad  | 0.00000 1/rad            | RW   | Num |    |    |    | US |
| 03.016    | Speed Controller Gain Select                    | Off (0) or On (1)   | Off (0)                  | RW   | Bit |    |    |    | US |
| 03.017    | Speed Controller Set-up Method                  | Disabled (0), Bandwidth (1),<br>Comp Angle (2),<br>Kp Gain Times 16 (3),<br>Low Performance (4),<br>Std Performance (5),<br>High Performance (6),<br>First Order (7)  | Disabled (0)             | RW   | Txt |    |    |    | US |
| 03.018    | Motor And Load Inertia                          | 0.00000 to 1000.00000 kgm <sup>2</sup>  | 0.00000 kgm <sup>2</sup> | RW   | Num |    |    |    | US |
| 03.019    | Compliance Angle                                | 0.0 to 360.0 °  | 4.0 °                    | RW   | Num |    |    |    | US |
| 03.020    | Bandwidth                                       | 1 to 1000 Hz  | 10 Hz                    | RW   | Num |    |    |    | US |
| 03.021    | Damping Factor                                  | 0.0 to 10.0   | 1.0                      | RW   | Num |    |    |    | US |
| 03.022    | Hard Speed Reference                            | ±VM_SPEED_FREQ_REF  | 0.0                      | RW   | Num |    |    |    | US |
| 03.023    | Hard Speed Reference Select                     | Off (0) or On (1)   | Off (0)                  | RW   | Bit |    |    |    | US |
| 03.024    | RFC Feedback Mode                               | Feedback (0), Sensorless (1),<br>Feedback NoMax (2),<br>Sensorless NoMax (3)  | Feedback (0)             | RW   | Txt |    |    |    | US |
| 03.026    | Motor Control Feedback Select                   | P1 Drive (0), P2 Drive (1),<br>P1 Slot1 (2), P2 Slot1 (3),<br>P1 Slot2 (4), P2 Slot2 (5),<br>P1 Slot3 (6), P2 Slot3 (7)   | P1 Drive (0)             | RW   | Txt |    |    |    | US |
| 03.027    | P1 Speed Feedback                               | ±VM_SPEED   |                          | RO   | Num | ND | NC | PT | FI |
| 03.028    | P1 Revolution/Pole Pitch Counter                | 0 to 65535  |                          | RO   | Num | ND | NC | PT | PS |
| 03.029    | P1 Position                                     | 0 to 65535  |                          | RO   | Num | ND | NC | PT | PS |
| 03.030    | P1 Fine Position                                | 0 to 65535  |                          | RO   | Num | ND | NC | PT |    |
| 03.031    | P1 Marker Mode                                  | 0000 to 1111  | 0100                     | RW   | Bin |    |    |    | US |
| 03.032    | P1 Marker Flag                                  | Off (0) or On (1)   | Off (0)                  | RW   | Bit |    | NC |    |    |
| 03.033    | P1 Rotary Turns Bits                            | 0 to 16   | 16                       | RW   | Num |    |    |    | US |
| 03.034    | P1 Rotary Lines Per Revolution                  | 1 to 100000   | 1024                     | RW   | Num |    |    |    | US |
| 03.035    | P1 Comms Bits                                   | 0 to 48   | 0                        | RW   | Num |    |    |    | US |
| 03.036    | P1 Supply Voltage                               | 5V (0), 8V (1), 15V (2)   | 5V (0)                   | RW   | Txt |    |    |    | US |
| 03.037    | P1 Comms Baud Rate                              | 100k (0), 200k (1), 300k (2),<br>400k (3), 500k (4), 1M (5),<br>1.5M (6), 2M (7), 4M (8) Baud   | 300k (2) Baud            | RW   | Txt |    |    |    | US |
| 03.038    | P1 Device Type                                  | AB (0), FD (1), FR (2),<br>AB Servo (3), FD Servo (4),<br>FR Servo (5), SC (6),<br>SC Hiperface (7), EnDat (8),<br>SC EnDat (9), SSI (10),<br>SC SSI (11), SC Servo (12),<br>BiSS (13), Resolver (14),<br>SC SC (15),<br>Commutation Only (16),<br>SC BiSS (17) | AB (0)                   | RW   | Txt |    |    |    | US |
| 03.039    | P1 Termination Select                           | 0 to 2  | 1                        | RW   | Num |    |    |    | US |
| 03.040    | P1 Error Detection Level                        | 00000000 to 11111111  | 00000001                 | RW   | Bin |    |    |    | US |
| 03.041    | P1 Auto-configuration Select                    | Disabled (0), Enabled (1)   | Enabled (1)              | RW   | Txt |    |    |    | US |
| 03.042    | P1 Feedback Filter                              | Disabled (0), 1ms (1), 2ms (2),<br>4ms (3), 8ms (4), 16ms (5)   | Disabled (0)             | RW   | Txt |    |    |    | US |
| 03.043    | P1 Maximum Reference                            | 0 to 33000  | 1500                     | RW   | Num |    |    |    | US |
| 03.044    | P1 Reference Scaling                            | 0.000 to 4.000  | 1.000                    | RW   | Num |    |    |    | US |
| 03.045    | P1 Reference                                    | ±100.0 %  |                          | RO   | Num | ND | NC | PT | FI |
| 03.046    | P1 Reference destination                        | 0.000 to 59.999   | 0.000                    | RW   | Num | DE |    | PT | US |
| 03.047    | P1 SSI Incremental Mode                         | Off (0) or On (1)   | Off (0)                  | RW   | Bit |    |    |    | US |

|        |  |   |                     |    |     |    |    |    |    |
|--------|--|---|---------------------|----|-----|----|----|----|----|
| 03.048 | P1 SSI Binary Mode                             | Off (0) or On (1)   | Off (0)             | RW | Bit |    |    |    | US |
| 03.049 | P1 Additional Power-up Delay                   | 0.0 to 25.0 s   | 0.0 s               | RW | Num |    |    |    | US |
| 03.050 | P1 Feedback Lock                               | Off (0) or On (1)   | Off (0)             | RW | Bit |    |    |    | US |
| 03.051 | P1 Linear Feedback Select                      | Off (0) or On (1)   | Off (0)             | RW | Bit |    |    |    | US |
| 03.052 | P1 Linear Comms Pitch                          | 0.001 to 100.000  | 0.001               | RW | Num |    |    |    | US |
| 03.053 | P1 Linear Line Pitch                           | 0.001 to 100.000  | 0.001               | RW | Num |    |    |    | US |
| 03.054 | P1 Linear Comms And Line Pitch Units           | millimetres (0), micrometres (1)  | millimetres (0)     | RW | Txt |    |    |    | US |
| 03.055 | P1 Pole Pair Pitch                             | 0.01 to 1000.00 mm  | 10.00 mm            | RW | Num |    |    |    | US |
| 03.056 | P1 Feedback Reverse                            | Off (0) or On (1)   | Off (0)             | RW | Bit |    |    |    | US |
| 03.057 | P1 Normalisation Turns                         | 0 to 16   | 16                  | RW | Num |    |    |    | US |
| 03.058 | P1 Normalised Position                         | -2147483648 to 2147483647   |                     | RO | Num | ND | NC | PT |    |
| 03.059 | P1 Normalised Marker Position                  | -2147483648 to 2147483647   |                     | RO | Num | ND | NC | PT |    |
| 03.060 | P1 Calculation Time                            | 0 to 20 µs  | 5 µs                | RW | Num |    |    |    | US |
| 03.061 | P1 Recovery Time                               | 4 to 100 µs   | 30 µs               | RW | Num |    |    |    | US |
| 03.062 | P1 Line Delay Time                             | 0 to 5000 ns  |                     | RO | Num | ND | NC | PT | US |
| 03.063 | P1 Low Speed Update Rate Active                | Off (0) or On (1)   |                     | RO | Bit | ND | NC | PT |    |
| 03.064 | P1 Encoder Protocol Detected                   | None (0), Hiperface (1),<br>EnDat2.1 (2), EnDat2.2 (3),<br>BiSS (4)   |                     | RO | Txt | ND | NC | PT |    |
| 03.065 | P1 Resolver Poles                              | 2 (1) to 20 (10) Poles  | 2 (1) Poles         | RW | Txt |    |    |    | US |
| 03.066 | P1 Resolver Excitation                         | 6kHz 3V (0), 8kHz 3V (1),<br>6kHz 2V (2), 8kHz 2V (3),<br>6kHz 3V Fast (4),<br>8kHz 3V Fast (5),<br>6kHz 2V Fast (6),<br>8kHz 2V Fast (7) | 6kHz 3V (0)         | RW | Txt |    |    |    | US |
| 03.067 | P1 User Comms Enable                           | 0 to 1  | 0                   | RW | Num |    | NC | PT |    |
| 03.068 | P1 User Comms Transmit Register                | 0 to 65535  | 0                   | RW | Num |    | NC | PT |    |
| 03.069 | P1 User Comms Receive Register                 | 0 to 65535  | 0                   | RW | Num |    | NC | PT |    |
| 03.070 | P1 Position Feedback Signals                   | 000000 to 111111  |                     | RO | Bin | ND | NC | PT |    |
| 03.071 | P1 Error Detected                              | Off (0) or On (1)   |                     | RO | Bit | ND | NC | PT |    |
| 03.073 | P1 Absolute Turns Recovery Enable              | Off (0) or On (1)   | Off (0)             | RW | Bit |    |    |    | US |
| 03.074 | P1 Additional Configuration                    | 0 to 511116116  | 0                   | RW | Num |    |    |    | US |
| 03.075 | Initialise Position Feedback                   | Off (0) or On (1)   | Off (0)             | RW | Bit |    | NC |    |    |
| 03.076 | Position Feedback Initialized                  | 0000000000 to 1111111111  | 0000000000          | RO | Bin |    | NC | PT |    |
| 03.078 | Sensorless Mode Active                         | Off (0) or On (1)   |                     | RO | Bit | ND | NC | PT |    |
| 03.079 | Sensorless Mode Filter                         | 4 (0), 8 (1), 16 (2), 32 (3),<br>64 (4) ms  | 4 (0) ms            | RW | Txt |    |    |    | US |
| 03.080 | Sensorless Position                            | -2147483648 to 2147483647   |                     | RO | Num | ND | NC | PT |    |
| 03.085 | Encoder Simulation Source                      | 0.000 to 59.999   | 0.000               | RW | Num |    |    | PT | US |
| 03.086 | Encoder Simulation Status                      | None (0), Full (1),<br>No Marker Pulse (2)  |                     | RO | Txt | ND | NC | PT |    |
| 03.087 | Encoder Simulation Sample Period               | 0.25 (0), 1 (1), 4 (2), 16 (3) ms   | 0.25 (0) ms         | RW | Txt |    |    |    | US |
| 03.088 | Encoder Simulation Mode                        | Hardware (0), Lines Per Rev (1),<br>Ratio (2), SSI (3)  | Hardware (0)        | RW | Txt |    |    |    | US |
| 03.089 | Encoder Simulation Hardware Divider            | 0 to 7  | 0                   | RW | Num |    |    |    | US |
| 03.090 | Encoder Simulation Hardware Marker Lock        | Off (0) or On (1)   | Off (0)             | RW | Bit |    |    |    | US |
| 03.091 | Encoder Simulation Incremental Mode Select     | Off (0) or On (1)   | Off (0)             | RW | Bit |    |    |    | US |
| 03.092 | Encoder Simulation Output Lines Per Revolution | 1 to 16384  | 4096                | RW | Num |    |    |    | US |
| 03.093 | Encoder Simulation Numerator                   | 1 to 65536  | 65536               | RW | Num |    |    |    | US |
| 03.094 | Encoder Simulation Denominator                 | 1 to 65536  | 65536               | RW | Num |    |    |    | US |
| 03.095 | Encoder Simulation Output Roll-over Limit      | 1 to 65535  | 65535               | RW | Num |    |    |    | US |
| 03.096 | Encoder Simulation SSI Turns Bits              | 0 to 16   | 16                  | RW | Num |    |    |    | US |
| 03.097 | Encoder Simulation SSI Comms Bits              | 2 to 48   | 33                  | RW | Num |    |    |    | US |
| 03.098 | Encoder Simulation Output Mode                 | AB/Gray (0), FD/Binary (1),<br>FR/Binary (2)  | AB/Gray (0)         | RW | Txt |    |    |    | US |
| 03.100 | F1 Freeze Trigger Source                       | Digital Input 4 (0),<br>Digital Input 5 (1), P1 Marker (2),<br>P2 Marker (3), Common (4),<br>P1 Zero (5), P2 Zero (6)                     | Digital Input 4 (0) | RW | Txt |    |    |    | US |
| 03.101 | F1 Freeze Mode                                 | Rising 1st (0), Falling 1st (1),<br>Rising all (2), Falling all (3)   | Rising 1st (0)      | RW | Txt |    |    |    | US |
| 03.102 | F1 Freeze Position Source                      | P1 (0), P2 (1), Time (2)  | P1 (0)              | RW | Txt |    |    |    | US |
| 03.103 | F1 Normalised Freeze Position                  | -2147483648 to 2147483647   |                     | RO | Num | ND | NC | PT |    |
| 03.104 | F1 Freeze Flag                                 | Off (0) or On (1)   |                     | RW | Bit | ND | NC | PT |    |
| 03.105 | F2 Freeze Trigger Source                       | Digital Input 4 (0),<br>Digital Input 5 (1), P1 Marker (2),<br>P2 Marker (3), Common (4),<br>P1 Zero (5), P2 Zero (6)                     | Digital Input 4 (0) | RW | Txt |    |    |    | US |



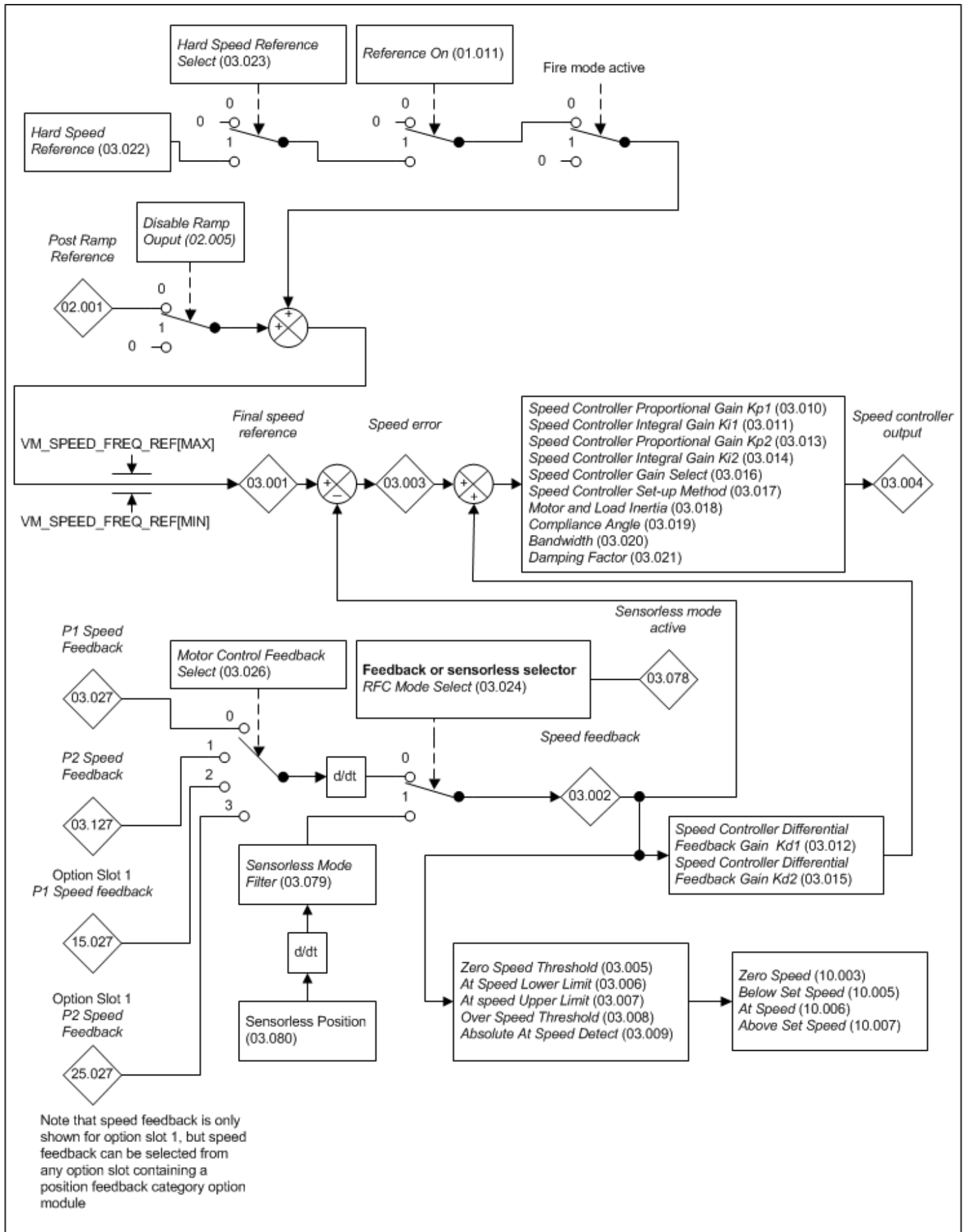
|        |                                      |   |                     |    |     |    |    |    |    |    |
|--------|--------------------------------------|---|---------------------|----|-----|----|----|----|----|----|
| 03.106 | F2 Freeze Mode                       | Rising 1st (0), Falling 1st (1),<br>Rising all (2), Falling all (3)                           | Rising 1st (0)      | RW | Txt |    |    |    |    | US |
| 03.107 | F2 Freeze Position Source            | P1 (0), P2 (1), Time (2)  | P1 (0)              | RW | Txt |    |    |    |    | US |
| 03.108 | F2 Normalised Freeze Position        | -2147483648 to 2147483647   |                     | RO | Num | ND | NC | PT |    |    |
| 03.109 | F2 Freeze Flag                       | Off (0) or On (1)   |                     | RW | Bit | ND | NC | PT |    |    |
| 03.110 | Common Freeze Source 1               | Digital Input 4 (0),<br>Digital Input 5 (1), P1 Marker (2),<br>P2 Marker (3), Disabled (4)    | Digital Input 4 (0) | RW | Txt |    |    |    |    | US |
| 03.111 | Common Freeze Source 2               | Digital Input 4 (0),<br>Digital Input 5 (1), P1 Marker (2),<br>P2 Marker (3), Disabled (4)    | Digital Input 4 (0) | RW | Txt |    |    |    |    | US |
| 03.112 | Common Freeze Mode                   | 0000 to 1111  | 0000                | RW | Bin |    |    |    |    | US |
| 03.113 | Freeze Input States                  | 00 to 11  |                     | RO | Bin | ND | NC | PT |    |    |
| 03.118 | P1 Thermistor Type                   | DIN44082 (0), KTY84 (1),<br>0.8mA (2), Encoder (3)  | DIN44082 (0)        | RW | Txt |    |    |    |    | US |
| 03.119 | P1 Thermistor Feedback               | 0 to 5000 Ω   |                     | RO | Num | ND | NC | PT |    |    |
| 03.120 | P1 Thermistor Trip Threshold         | 0 to 5000 Ω   | 3300 Ω              | RW | Num |    |    |    |    | US |
| 03.121 | P1 Thermistor Reset Threshold        | 0 to 5000 Ω   | 1800 Ω              | RW | Num |    |    |    |    | US |
| 03.122 | P1 Thermistor Temperature            | -50 to 300 °C   |                     | RO | Num | ND | NC | PT |    |    |
| 03.123 | P1 Thermistor Fault Detection        | None (0), Temperature (1),<br>Temp or Short (2)   | None (0)            | RW | Txt |    |    |    |    | US |
| 03.127 | P2 Speed Feedback                    | ±VM_SPEED   |                     | RO | Num | ND | NC | PT | FI |    |
| 03.128 | P2 Revolution/Pole Pitch Counter     | 0 to 65535  |                     | RO | Num | ND | NC | PT | PS |    |
| 03.129 | P2 Position                          | 0 to 65535  |                     | RO | Num | ND | NC | PT | PS |    |
| 03.130 | P2 Fine Position                     | 0 to 65535  |                     | RO | Num | ND | NC | PT |    |    |
| 03.131 | P2 Marker Mode                       | 0000 to 1111  | 0100                | RW | Bin |    |    |    |    | US |
| 03.132 | P2 Marker Flag                       | Off (0) or On (1)   | Off (0)             | RW | Bit |    | NC |    |    |    |
| 03.133 | P2 Rotary Turns Bits                 | 0 to 16   | 16                  | RW | Num |    |    |    |    | US |
| 03.134 | P2 Rotary Lines Per Revolution       | 0 to 100000   | 1024                | RW | Num |    |    |    |    | US |
| 03.135 | P2 Comms Bits                        | 0 to 48   | 0                   | RW | Num |    |    |    |    | US |
| 03.137 | P2 Comms Baud Rate                   | 100k (0), 200k (1), 300k (2),<br>400k (3), 500k (4), 1M (5),<br>1.5M (6), 2M (7), 4M (8) Baud | 300k (2) Baud       | RW | Txt |    |    |    |    | US |
| 03.138 | P2 Device type                       | None (0), AB (1), FD (2), FR (3),<br>EnDat (4), SSI (5), BiSS (6)                             | None (0)            | RW | Txt |    |    |    |    | US |
| 03.140 | P2 Error Detection Level             | 00000 to 11111  | 00001               | RW | Bin |    |    |    |    | US |
| 03.141 | P2 Auto-configuration Select         | Disabled (0), Enabled (1)   | Enabled (1)         | RW | Txt |    |    |    |    | US |
| 03.142 | P2 Feedback Filter                   | Disabled (0), 1ms (1), 2ms (2),<br>4ms (3), 8ms (4), 16ms (5)                                 | Disabled (0)        | RW | Txt |    |    |    |    | US |
| 03.143 | P2 Maximum Reference                 | 0 to 33000  | 1500                | RW | Num |    |    |    |    | US |
| 03.144 | P2 Reference Scaling                 | 0.000 to 4.000  | 1.000               | RW | Num |    |    |    |    | US |
| 03.145 | P2 Reference                         | ±100.0 %  |                     | RO | Num | ND | NC | PT | FI |    |
| 03.146 | P2 Reference Destination             | 0.000 to 59.999   | 0.000               | RW | Num | DE |    | PT |    | US |
| 03.147 | P2 SSI Incremental Mode              | Off (0) or On (1)   | Off (0)             | RW | Bit |    |    |    |    | US |
| 03.148 | P2 SSI Binary Mode                   | Off (0) or On (1)   | Off (0)             | RW | Bit |    |    |    |    | US |
| 03.149 | P2 Additional Power-up Delay         | 0.0 to 25.0 s   | 0.0 s               | RW | Num |    |    |    |    | US |
| 03.150 | P2 Feedback Lock                     | Off (0) or On (1)   | Off (0)             | RW | Bit |    |    |    |    | US |
| 03.151 | P2 Linear Feedback Select            | Off (0) or On (1)   | Off (0)             | RW | Bit |    |    |    |    | US |
| 03.152 | P2 Linear Comms Pitch                | 0.001 to 100.000  | 0.001               | RW | Num |    |    |    |    | US |
| 03.153 | P2 Linear Line Pitch                 | 0.001 to 100.000  | 0.001               | RW | Num |    |    |    |    | US |
| 03.154 | P2 Linear Comms And Line Pitch Units | millimetres (0), micrometres (1)  | millimetres (0)     | RW | Txt |    |    |    |    | US |
| 03.155 | P2 Pole Pair Pitch                   | 0.01 to 1000.00 mm  | 10.00 mm            | RW | Num |    |    |    |    | US |
| 03.156 | P2 Feedback Reverse                  | Off (0) or On (1)   | Off (0)             | RW | Bit |    |    |    |    | US |
| 03.157 | P2 Normalisation Turns               | 0 to 16   | 16                  | RW | Num |    |    |    |    | US |
| 03.158 | P2 Normalised Position               | -2147483648 to 2147483647   |                     | RO | Num | ND | NC | PT |    |    |
| 03.159 | P2 Normalised Marker Position        | -2147483648 to 2147483647   |                     | RO | Num | ND | NC | PT |    |    |
| 03.160 | P2 Calculation Time                  | 0 to 20 µs  | 5 µs                | RW | Num |    |    |    |    | US |
| 03.161 | P2 Recovery Time                     | 4 to 100 µs   | 30 µs               | RW | Num |    |    |    |    | US |
| 03.162 | P2 Line Delay Time                   | 0 to 5000 ns  |                     | RO | Num | ND | NC | PT |    | US |
| 03.163 | P2 Low Speed Update Rate Active      | Off (0) or On (1)   |                     | RO | Bit | ND | NC | PT |    |    |
| 03.164 | P2 Encoder Protocol Detected         | None (0), Hiperface (1),<br>EnDat2.1 (2), EnDat2.2 (3),<br>BiSS (4)                           |                     | RO | Txt | ND | NC | PT |    |    |
| 03.167 | P2 User Comms Enable                 | 0 to 1  | 0                   | RW | Num |    | NC | PT |    |    |
| 03.168 | P2 User Comms Transmit Register      | 0 to 65535  | 0                   | RW | Num |    | NC | PT |    |    |
| 03.169 | P2 User Comms Receive Register       | 0 to 65535  | 0                   | RW | Num |    | NC | PT |    |    |
| 03.171 | P2 Error Detected                    | Off (0) or On (1)   |                     | RO | Bit | ND | NC | PT |    |    |

|        |                                   |   |         |    |     |    |    |    |    |
|--------|-----------------------------------|---|---------|----|-----|----|----|----|----|
| 03.172 | P2 Status                         | None (0), AB (1), FD (2), FR (3),<br>EnDat (4), SSI (5), BiSS (6),<br>EnDat Alt (7), SSI Alt (8),<br>BiSS Alt (9) |         | RO | Txt | ND | NC | PT |    |
| 03.173 | P2 Absolute Turns Recovery Enable | Off (0) or On (1)   | Off (0) | RW | Bit |    |    |    | US |
| 03.174 | P2 Additional Configuration       | 0 to 511116116  | 0       | RW | Num |    |    |    | US |

|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 3 – Speed Control and Position Feedback

Mode: RFC-A



Normally the units for speed parameters are rpm for both rotary and linear applications. For a linear application one revolution corresponds to one motor pole. If the position feedback device that is selected for motor control with *Motor Control Feedback Select* (03.026) is a linear device then if *Linear Speed Select* (01.055) is set to 1 the units for speed parameters are mm/s with the following exceptions:

1. All speed parameters are displayed in rpm if sensorless mode is active, i.e. *Sensorless Mode Active* (03.078) = 1.
2. Speed feedback parameters associated with each feedback interface, i.e. *P1 Speed Feedback* (03.027) for position feedback interface P1, etc., are always displayed in rpm for a rotary device.

## Position feedback interfaces

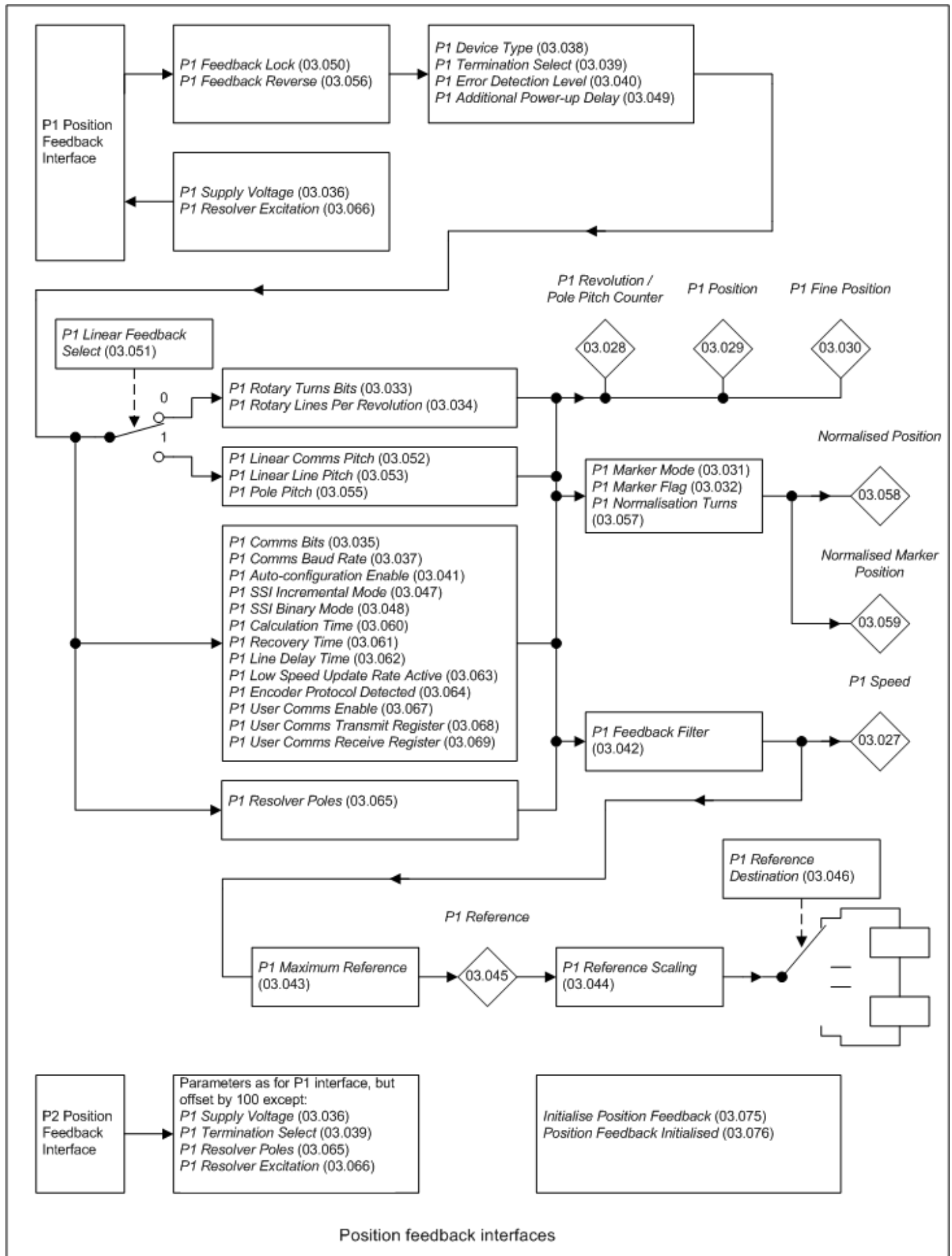
Two position feedback interfaces with associated freeze system are provided. Access to both these interfaces and the encoder simulation output are provided via one 15 way high density connector. There are limitations on the functions that can be provided simultaneously as shown in the table below along with the connections required for each combination of functions.

| Functions                        |                                 |                           | Connections |      |      |      |      |       |       |    |
|----------------------------------|---------------------------------|---------------------------|-------------|------|------|------|------|-------|-------|----|
| P1 Position feedback interface   | P2 Position feedback interface  | Encoder Simulation Output | 1/2         | 3/4  | 5/6  | 7/8  | 9/10 | 11/12 | 13/14 | 15 |
| AB Servo<br>FD Servo<br>FR Servo |                                 |                           | A1          | B1   | Z1   | U1   | V1   | W1    | PS1   | Th |
| SC Servo                         |                                 |                           | Cos1        | Sin1 | Z1   | U1   | V1   | W1    | PS1   | Th |
| AB, FD, FR                       | AB, FD, FR                      |                           | A1          | B1   | Z1   | A2   | B2   | Z2    | PS1   | Th |
| AB, FD, FR                       | EnDat, BiSS, SSI                |                           | A1          | B1   | Z1   | D2   | Clk2 | Z2    | PS1   | Th |
| AB, FD, FR                       |                                 | Full                      | A1          | B1   | Z1   | AOut | BOut | ZOut  | PS1   | Th |
| SC                               | AB, FD, FR                      |                           | Cos1        | Sin1 | Z1   | A2   | B2   | Z2    | PS1   | Th |
| SC                               | EnDat, BiSS, SSI                |                           | Cos1        | Sin1 | Z1   | D2   | Clk2 | Z2    | PS1   | Th |
| SC                               |                                 | Full                      | Cos1        | Sin1 | Z1   | AOut | BOut | ZOut  | PS1   | Th |
| Resolver                         | AB, FD, FR                      |                           | Cos1        | Sin1 | Ref1 | A2   | B2   | Z2    | PS1   | Th |
| Resolver                         | EnDat, BiSS, SSI                |                           | Cos1        | Sin1 | Ref1 | D2   | Clk2 | Z2    | PS1   | Th |
| Resolver                         |                                 | Full                      | Cos1        | Sin1 | Ref1 | AOut | BOut | ZOut  | PS1   | Th |
| SC Hiperface                     | AB, FD, FR                      |                           | Cos1        | Sin1 | D1   | A2   | B2   | Z2    | PS1   | Th |
| SC Hiperface                     | EnDat, BiSS, SSI                |                           | Cos1        | Sin1 | D1   | D2   | Clk2 | Z2    | PS1   | Th |
| SC Hiperface                     |                                 | Full                      | Cos1        | Sin1 | D1   | AOut | BOut | ZOut  | PS1   | Th |
| SC EnDat, SC SSI, SC BiSS        | AB, FD, FR<br>No Z marker pulse |                           | Cos1        | Sin1 | D1   | A2   | B2   | Clk1  | PS1   | Th |
| SC EnDat, SC SSI, SC BiSS        | EnDat, BiSS, SSI                |                           | Cos1        | Sin1 | D1   | D2   | Clk2 | Clk1  | PS1   | Th |
| SC EnDat, SC SSI, SC BiSS        |                                 | No Z marker pulse         | Cos1        | Sin1 | D1   | AOut | BOut | Clk1  | PS1   | Th |
| EnDat, BiSS, SSI                 | AB, FD, FR                      |                           | D1          | Clk1 | Z1   | A2   | B2   | Z2    | PS1   | Th |
| EnDat, BiSS, SSI                 | EnDat, BiSS, SSI                |                           | D1          | Clk1 | Z1   | D2   | Clk2 | Z2    | PS1   | Th |
| EnDat, BiSS, SSI                 |                                 | Full                      | D1          | Clk1 | Z1   | AOut | BOut | ZOut  | PS1   | Th |
| EnDat, BiSS, SSI                 | EnDat, BiSS, SSI                | No Z marker pulse         | D1          | Clk1 | D2   | AOut | BOut | Clk2  | PS1   | Th |
| SC SC                            |                                 |                           | Cos1        | Sin1 | Z1   | SCs1 | SSn1 | Z2    | PS1   | Th |
| Commutation Only                 |                                 |                           |             |      |      | U1   | V1   | W1    | PS1   | Th |
| Option Slot 1, 2, 3 or 4         | AB, FD, FR                      |                           |             |      | Z1   | A2   | B2   | Z2    | PS1   | Th |
| Option Slot 1, 2, 3 or 4         | EnDat, BiSS, SSI                |                           |             |      | Z1   | D2   | Clk2 | Z2    | PS1   | Th |
| Option Slot 1, 2, 3 or 4         |                                 | Full                      |             |      | Z1   | AOut | BOut | ZOut  | PS1   | Th |

The marker inputs can be used without their associated position feedback as freeze trigger inputs, therefore these are present where possible even if the associated incremental or SINCOS position feedback is not possible. The table below gives the connection functions associated with the codes used.

| Connection Function                             | Connection Definition   |
|---|---|
| <i>Position Interface inputs</i>                |   |
| A   | A input for AB, or AB Servo encoders<br>F input for FD, FD Servo, FR or FR Servo encoders   |
| B   | B input for AB, or AB Servo encoders<br>D input for FD or FD Servo encoders<br>R input for FR or FR Servo encoders                  |
| Z   | Z input for AB, AB Servo, FD, FD Servo, FR, FR Servo, SC encoders<br>Freeze input   |
| U, V, W   | Commutation signals for AB Servo, FD Servo, FR Servo, SC Servo or Commutation Only encoders   |
| Cos, Sin  | Cosine and Sine inputs for SC, SC EnDat, SC BiSS, SC Hiperface, SC SSI or SC Servo encoders<br>Cosine and Sine inputs for resolvers |
| Ref   | Reference output for resolvers  |
| D   | Data input/output for SC EnDat, SC BiSS, SC Hiperface, EnDat or BiSS encoders<br>Data input for SC SSI, SSI encoders                |
| Clk   | Clock output for SC EnDat, SC SSI, EnDat, BiSS or SSI encoders  |
| SCs, SSn  | Single turn Cosine and Sine signals used to determine the absolute position within one turn   |
| <i>Encoder Simulation Output</i>                |   |
| AOut  | A output for AB or AB Lock modes<br>F output for FD, FD Lock or FR modes<br>Data output for SSI Gray or SSI Binary modes            |
| BOut  | B output for AB or AB Lock modes<br>D output for FD, FD Lock or FR modes<br>Clock input for SSI Gray or SSI Binary modes            |
| Zout  | Z output for AB, AB Lock, FD, FD Lock or FR modes   |
| <i>Power Supply and Temperature Measurement</i> |   |
| PS1   | Power supply output (13 = Supply, 14 = 0V)  |
| Th  | Temperature measurement input   |

## P1 Position feedback interface



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## P2 Position feedback interface

The P2 position feedback interface duplicates most of the parameter structure and functions of the P1 feedback interface. The P2 interface parameters (03.127 to 03.169) have the same functions as the P1 interface parameters (03.027 to 03.069) except that parameters 03.136, 03.139, 03.162 and 03.163 are not included because the P2 interface does not have its own position feedback power supply, does not support resolvers, and the termination resistors are not selectable and are always enabled. Also *P2 Device type* (03.138) has less possible settings because the P2 interface does not support all the devices supported by the P1 interface.

Priority of the 15-way D-type is assigned in the following order from the highest priority to the lowest.

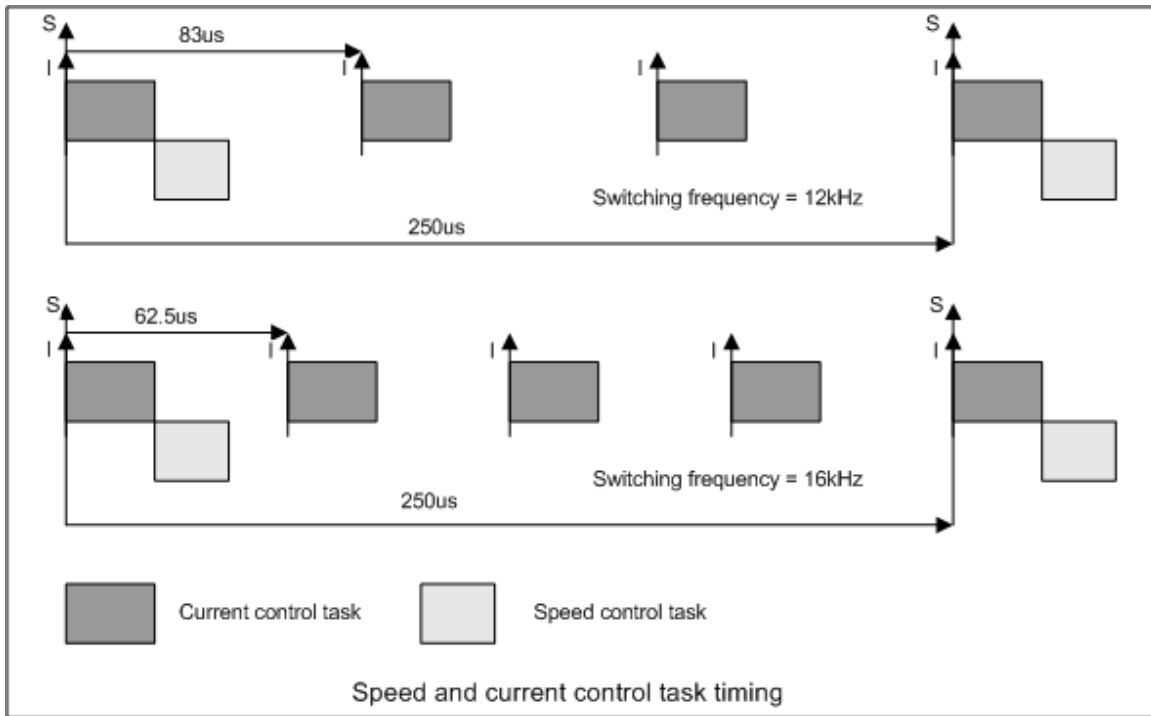
1. P1 position interface
2. Encoder simulation output
3. P2 position interface

The availability of the P2 position interface on the 15-way D-type on the drive is dependent on type of feedback device selected in *P1 Device Type* (03.038) and the encoder simulation mode selected in *Encoder Simulation Mode* (03.088). *P2 Status* (03.172) shows the status of the P2 position interface depending on the settings in *P2 Device type* (03.138), *P1 Device Type* (03.038), and *Encoder Simulation Mode* (03.088).



### Position and speed measurement timing

The position information is taken at each current control datum point which is at the start of each current controller task (shown as "I" in the diagram below). The current controller sample period varies with switching frequency. At each of these datum points the position of the motor within one revolution is required for basic motor control. The speed controller sample period is 250µs for all switching frequencies, and so the speed control datum points (shown as "S" in the diagram below) occur every 250µs. At each of these datum points the full encoder position is obtained and all calculations related to this are completed. The diagram below shows examples of the datum points for switching frequencies of 12kHz and 16kHz. The internal "I" datum points are not visible outside the drive control system. The "S" datum points are used to synchronise with option modules.



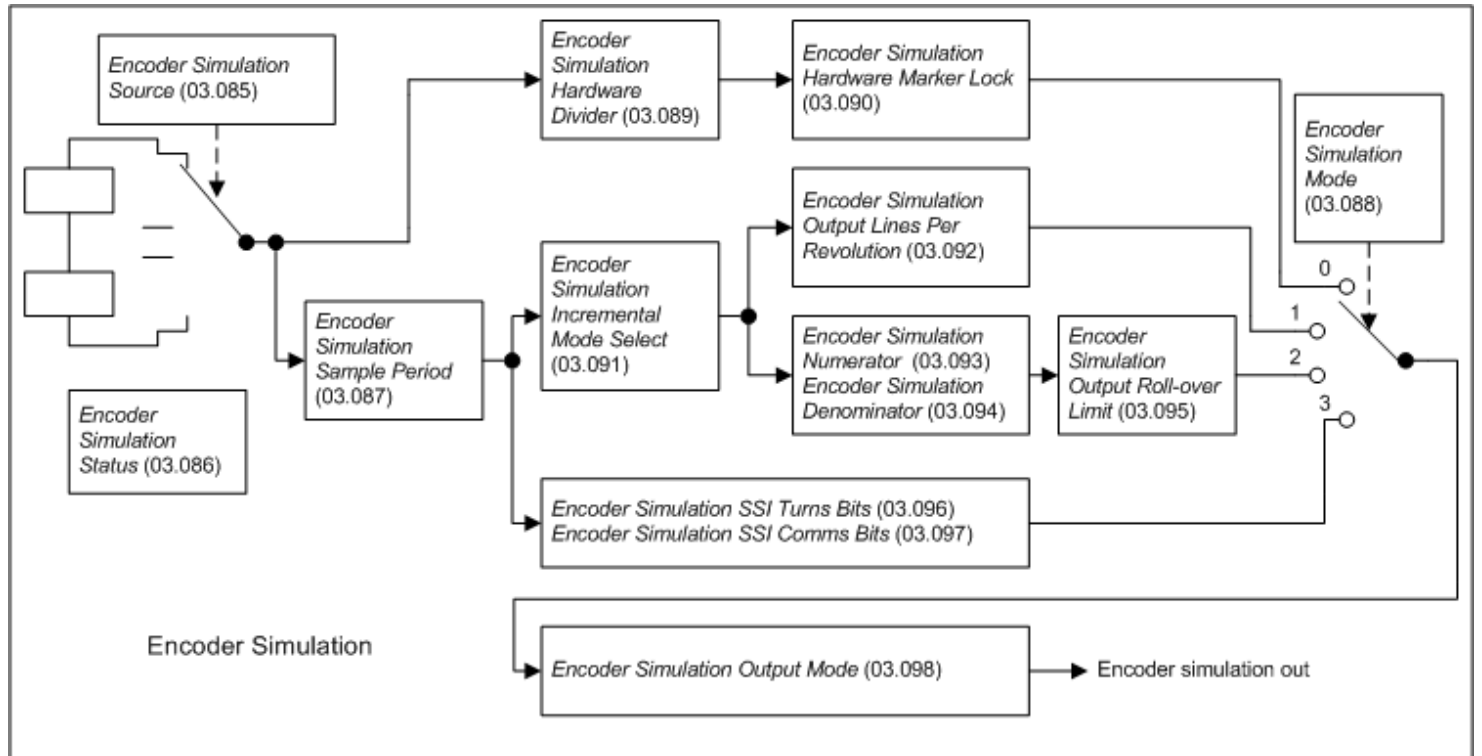
## Position feedback initialisation

Position feedback devices need to be initialised before they can provide position feedback information. For details of the initialisation required for each type of device see *Position Feedback Initialized* (03.076). The user can force all position feedback devices connected directly to the drive or to an option module to be initialised (see *Initialise Position Feedback* (03.075)). The drive also automatically initialises all position feedback devices connected to the drive position feedback interfaces immediately after power-up. An attempt is made to initialise any position feedback device that needs to be initialised when a drive reset occurs. This would happen inherently if the drive is tripped and the drive is reset to clear the trip.

It should be noted that the initialised bit for any position feedback interface in *Position Feedback Initialized* (03.076) is set to zero if any of the parameters given below are changed if they could be used by the position feedback device whether rotary or linear. If the parameter could not be used by the device then it remains initialised when the parameter is changed. The initialisation bit for a position feedback device is also set to zero if the number of motor poles parameter for the active motor is changed. If the device becomes uninitialised because of a parameter change then an *Encoder 7* trip will occur.

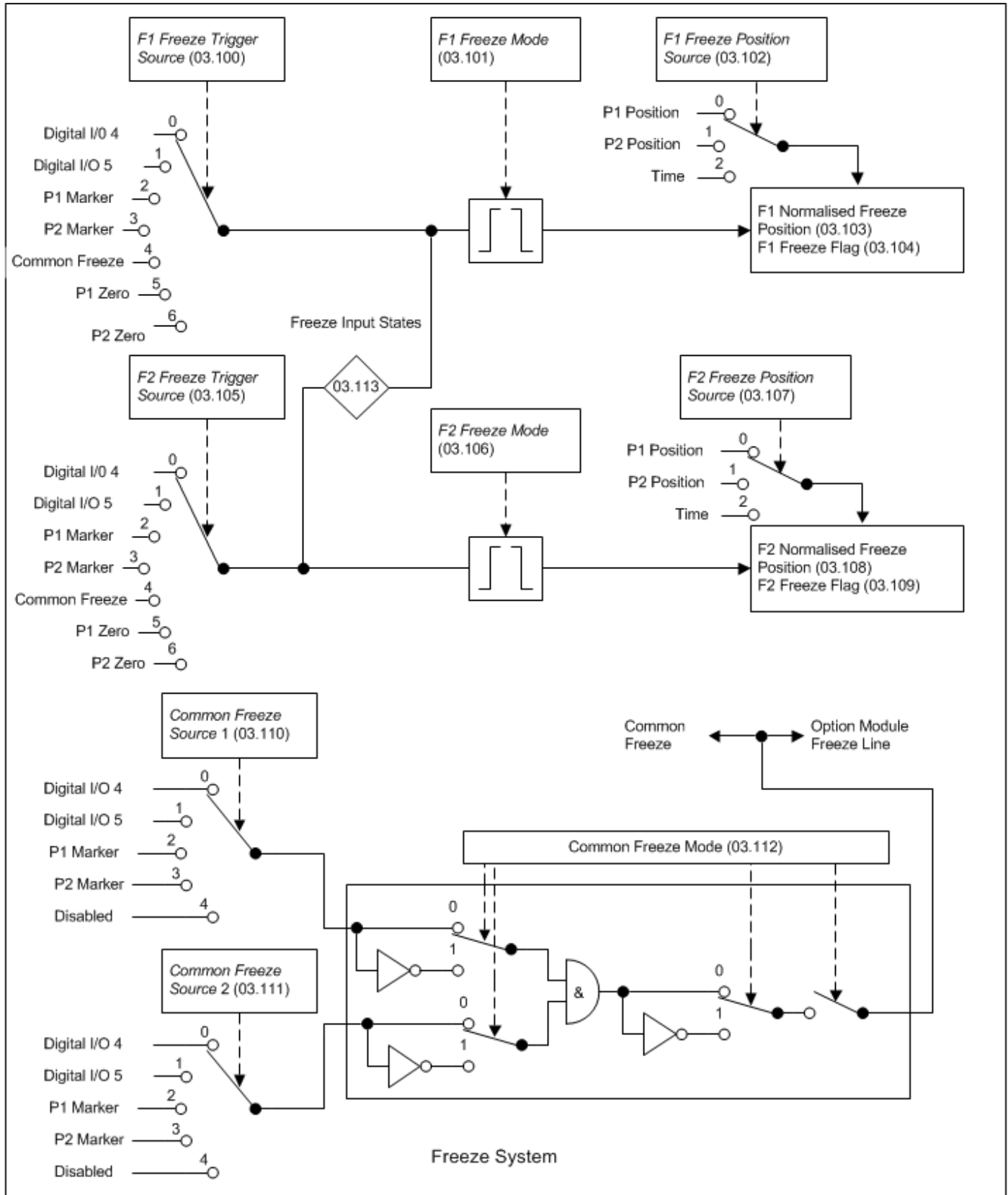
| <b>P1 Position feedback interface</b>                 | <b>P2 Position feedback interface</b>                 |
|---|---|
| <i>P1 Rotary Turns Bits</i> (03.033)                  | <i>P2 Rotary Turns Bits</i> (03.133)                  |
| <i>P1 Rotary Lines Per Revolution</i> (03.034)        | <i>P2 Rotary Lines Per Revolution</i> (03.134)        |
| <i>P1 Comms Bits</i> (03.035)                         | <i>P2 Comms Bits</i> (03.135)                         |
| <i>P1 Comms Baud Rate</i> (03.037)                    | <i>P2 Comms Baud Rate</i> (03.137)                    |
| <i>P1 Device Type</i> (03.038)                        |   |
| <i>P1 Auto-configuration Select</i> (03.041)          | <i>P2 Auto-configuration Select</i> (03.141)          |
| <i>P1 SSI Incremental Mode</i> (03.047)               | <i>P2 SSI Incremental Mode</i> (03.147)               |
| <i>P1 SSI Binary Mode</i> (03.048)                    | <i>P2 SSI Binary Mode</i> (03.148)                    |
| <i>P1 Linear Feedback Select</i> (03.051)             | <i>P2 Linear Feedback Select</i> (03.151)             |
| <i>P1 Linear Comms Pitch</i> (03.052)                 | <i>P2 Linear Comms Pitch</i> (03.152)                 |
| <i>P1 Linear Line Pitch</i> (03.053)                  | <i>P2 Linear Line Pitch</i> (03.153)                  |
| <i>P1 Pole Pair Pitch</i> (03.055)                    | <i>P2 Pole Pair Pitch</i> (03.155)                    |
| <i>P1 Feedback Reverse</i> (03.056)                   | <i>P2 Feedback Reverse</i> (03.156)                   |
| <i>P1 Calculation Time</i> (03.060)                   | <i>P2 Calculation Time</i> (03.160)                   |
| <i>P1 Recovery Time</i> (03.061)                      | <i>P2 Recovery Time</i> (03.161)                      |
| <i>P1 Resolver Poles</i> (03.065)                     |   |
| <i>P1 Resolver Excitation</i> (03.066)                |   |
| <i>P1 User Comms Enable</i> (03.067) (EnDat 2.2 only) | <i>P2 User Comms Enable</i> (03.167) (EnDat 2.2 only) |
|   | <i>P2 Status</i> (03.172)                             |
| Motor pole pairs for the currently active motor       | Motor pole pairs for the currently active motor       |

## Encoder Simulation Output

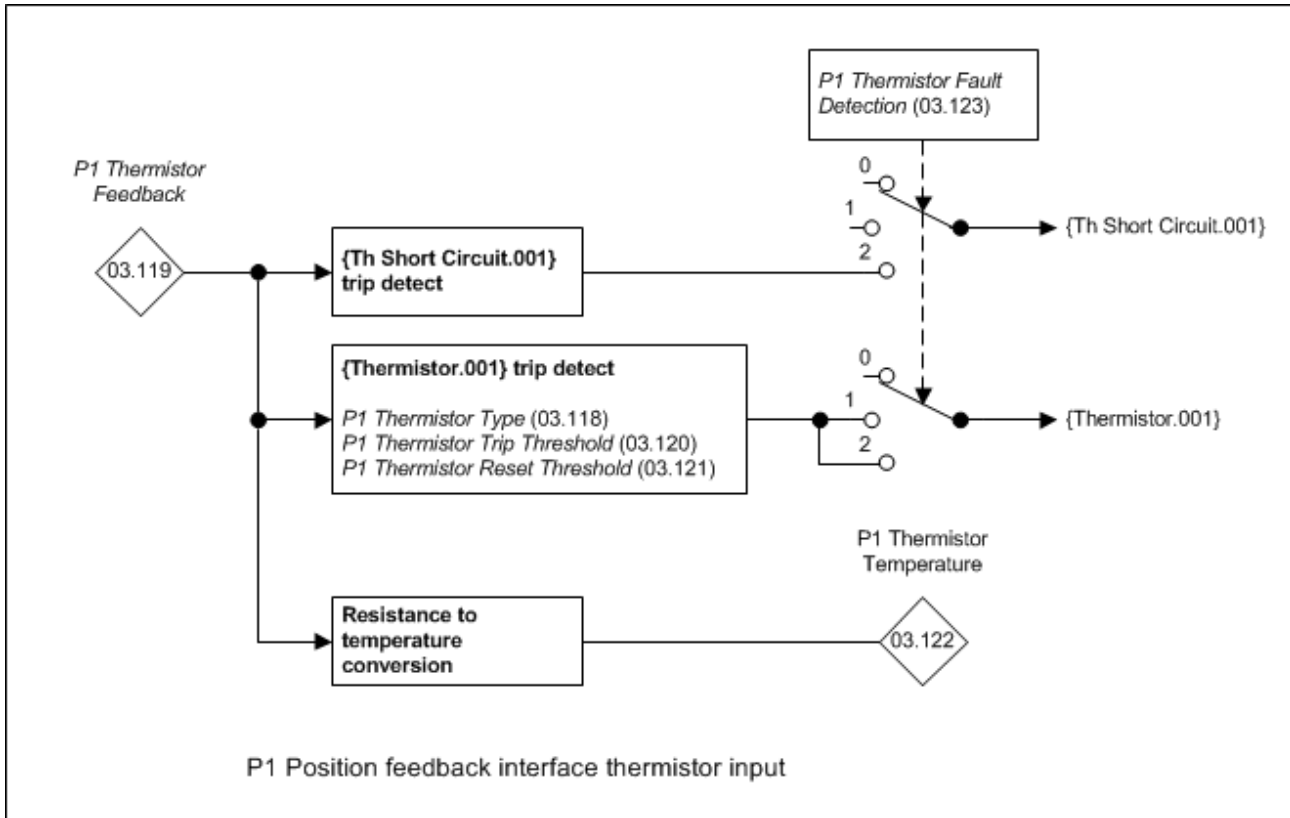


## Freeze System

The drive has two freeze functions that can capture the position from either the P1 or P2 position interface in the drive when a freeze trigger event occurs. A common freeze logic system is also provided, so that the freeze trigger events can be combined either to trigger the freeze system in the drive or to generate a freeze trigger for option modules. The freeze system is shown in the diagram below.



Position feedback interface thermistor input



| Parameter         | 03.001 Final Speed Reference                             |                |           |
|-------------------|--|----------------|-----------|
| Short description | Shows the reference at the input to the speed controller |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | -VM_SPEED  | Maximum        | VM_SPEED  |
| Default           |  | Units          |           |
| Type              | 32 Bit Volatile  | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 1         |
| Coding            | RO, FI, VM, ND, NC, PT                                   |                |           |

Final Speed Reference (03.001) shows the reference at the input to the speed controller, which is the sum of the Post Ramp Reference (02.001) if the ramp output is not disabled and the hard speed reference (if enabled).

| Parameter         | 03.002 Speed Feedback   |                |           |
|-------------------|---|----------------|-----------|
| Short description | Displays the speed feedback from the selected feedback source |                |           |
| Mode              | RFC-A   |                |           |
| Minimum           | -VM_SPEED   | Maximum        | VM_SPEED  |
| Default           |   | Units          |           |
| Type              | 32 Bit Volatile   | Update Rate    | 4ms write |
| Display Format    | Standard  | Decimal Places | 1         |
| Coding            | RO, FI, VM, ND, NC, PT  |                |           |

The speed feedback can be selected with Motor Control Feedback Select (03.026) to be taken from either of the drive position feedback interfaces or from a position feedback interface in a position feedback category option module. It is also possible to selected sensorless speed feedback with RFC Feedback Mode (03.024). Speed Feedback (03.002) shows the level of the speed feedback selected for the speed controller.

The FI attribute is set for this parameter, so display filtering is active when this parameter is viewed with one of the drive keypads. The value held in the drive parameter (accessible via comms or an option module) does not include this filter, but is a value that is obtained over a sliding 16ms period to limit the ripple. The speed feedback includes quantisation ripple given by the following equation in rpm:

$$\text{Ripple in Speed Feedback (03.002)} = 60 / 16\text{ms} / \text{Position resolution}$$

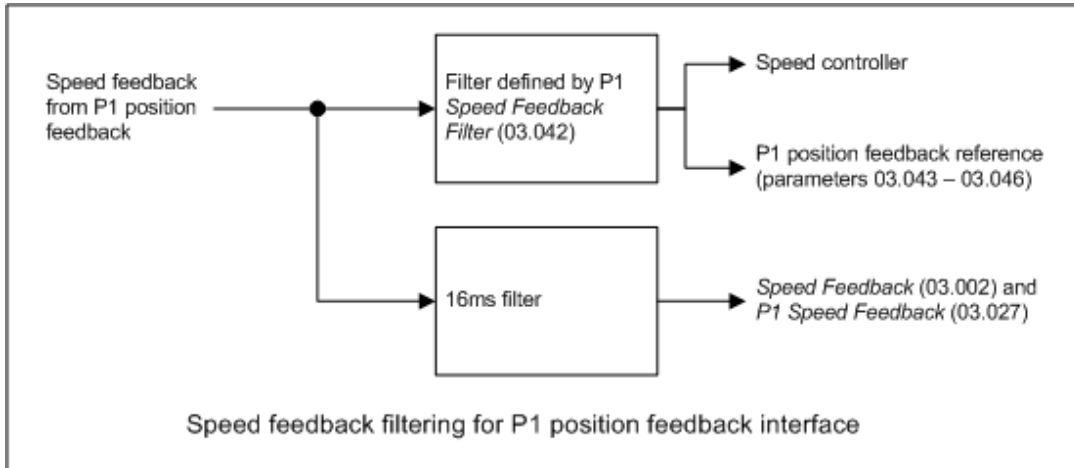
The ripple for a linear system is given by the following equation in mm/s:

$$\text{Ripple in Speed Feedback (03.002)} = \text{Pole pitch in mm} / 16\text{ms} / \text{Position resolution}$$

The position resolution for each type of feedback device is defined in the table below.

| Position feedback device                     | Position resolution                            |
|--|--|
| AB, AB Servo                                 | 4 x lines per revolution or pole pitch         |
| FD, FR, FD Servo, FR Servo                   | 2 x lines per revolution or pole pitch         |
| SC, SC Hiperface, SC EnDat, SC SSI, SC Servo | 1024 x sine waves per revolution or pole pitch |
| EnDat, SSI, BiSS                             | Comms bits per revolution or pole pitch        |
| Resolver                                     | See <i>P1 Resolver Excitation</i> (03.066)     |

For example the ripple in *Speed Feedback* (03.002) when a 4096 line AB type encoder is used is 0.23rpm. **It should be noted that no filtering is applied to the speed feedback used by the speed controller or for the position feedback reference system unless the feedback filter for that particular interface is activated by putting a non-zero value in the appropriate set up parameter (i.e. *P1 Feedback Filter* (03.042) for the P1 drive position feedback interface).** The diagram below shows the filtering applied to the speed feedback when this is taken from the P1 drive position feedback interface.



The speed feedback ripple seen by the speed controller and the position feedback reference is given by the following equations when the filter set up value *P1 Feedback Filter* (03.042) = 0.

Ripple for a rotary system in rpm =  $60 / \text{Speed controller sample time} / \text{Position resolution}$

Ripple for a linear system in mm/s =  $\text{Pole pitch in mm} / \text{Speed controller sample time} / \text{Position resolution}$

The speed controller sample time is 250µs. If the filter set up value is non-zero the ripple is given by:

Ripple for a rotary system in rpm =  $60 / \text{Filter time} / \text{Position resolution}$

Ripple for a linear system in mm/s =  $\text{Pole pitch in mm} / \text{Filter time} / \text{Position resolution}$

The description so far covers the P1 drive position feedback interface. Similar filtering is provided with the P2 drive position feedback interface and with position feedback interfaces in position feedback category option modules.

It is not advisable to use the speed feedback filter unless it is specifically required for high inertia applications with high controller gains, or if commutation signals alone are used for feedback, because the filter has a non-linear transfer function. It is preferable to use the current demand filters (*Current Reference Filter 1 Time Constant* (04.012) or *Current Reference Filter 2 Time Constant* (04.023)) as these are linear first order filters that provide filtering on noise generated from both the speed reference and the speed feedback. It should be noted that any filtering included within the speed controller feedback loop, either on the speed feedback or the current demand, introduces a delay and limits the maximum bandwidth of the controller for stable operation.

The speed ripple seen by the speed controller can be quite high in some cases, for example with a 4096 line encoder the speed ripple is 14.6rpm with a sample time of 250µs. This causes high frequency torque ripple and acoustic motor noise. These effects increase with the level of speed feedback ripple and with the gains used in the speed controller. Therefore high speed feedback ripple usually limits the maximum possible gain settings for the speed controller, and so a position feedback device with high position resolution is usually required for a system with high dynamic performance or stiffness. **It should be noted that the ripple caused by feedback quantisation and does not define speed feedback resolution. The speed controller accumulates all pulses from the position feedback, and so the speed controller resolution is not limited by the feedback, but by the resolution of the speed reference.**

| Parameter         | 03.003 Speed Error   |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the difference between the Final Speed Reference and the Speed Feedback |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | -VM_SPEED  | Maximum        | VM_SPEED  |
| Default           | Units  |                |           |
| Type              | 32 Bit Volatile  | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 1         |
| Coding            | RO, FI, VM, ND, NC, PT   |                |           |

The speed error is the difference between the final *Final Speed Reference* (03.001) and the *Speed Feedback* (03.002), and does not include the effect of the differential term in the speed controller feedback branch.

| Parameter         | 03.004 Speed Controller Output                |                |                   |
|-------------------|---|----------------|-------------------|
| Short description | Displays the output from the speed controller |                |                   |
| Mode              | RFC-A   |                |                   |
| Minimum           | -VM_TORQUE_CURRENT                            | Maximum        | VM_TORQUE_CURRENT |
| Default           |   | Units          | %                 |
| Type              | 16 Bit Volatile                               | Update Rate    | 4ms write         |
| Display Format    | Standard                                      | Decimal Places | 1                 |
| Coding            | RO, FI, VM, ND, NC, PT                        |                |                   |

The output of the speed regulator is a torque demand given as a percentage of rated motor torque. It should be noted that this will be modified to take into account in the level of motor flux if field weakening is active before it is converted into the *Final Current Reference* (04.004).

| Parameter         | 03.005 Zero Speed Threshold              |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to the required zero speed threshold |                |                 |
| Mode              | RFC-A                                    |                |                 |
| Minimum           | 0  | Maximum        | 200             |
| Default           | 5  | Units          |                 |
| Type              | 8 Bit User Save                          | Update Rate    | Background read |
| Display Format    | Standard                                 | Decimal Places | 0               |
| Coding            | RW, BU                                   |                |                 |

If the *Speed Feedback* (03.002) is at or below the level defined by this parameter in either direction *Zero Speed* (10.003) = 1, otherwise *Zero Speed* (10.003) = 0.

| Parameter         | 03.006 At Speed Lower Limit                    |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to the required minimum at speed threshold |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 33000           |
| Default           | 5  | Units          |                 |
| Type              | 16 Bit User Save                               | Update Rate    | Background read |
| Display Format    | Standard                                       | Decimal Places | 0               |
| Coding            | RW, BU   |                |                 |

*At Speed* (10.006) is set if the *Speed Feedback* (03.002) is on the boundaries or within the at speed window. *Above Set Speed* (10.007) and *Below Set Speed* (10.005) are set if the feedback is above or below the window respectively.

If *Absolute At Speed Select* (03.009) = 0 reference window mode is used.  
The "at speed" condition is true if,

$$(|\text{Pre-ramp Reference (01.003)}| - \text{At Speed Lower Limit (03.006)}) \leq |\text{Speed Feedback (03.002)}| \leq (|\text{Pre-ramp Reference (01.003)}| + \text{At Speed Upper Limit (03.007)})$$

(If the lower limit is less than zero then zero is used as the lower limit.)

If *Absolute At Speed Select* (03.009) = 1 absolute window mode is used.  
The "at speed" condition is true if,

$$\text{At Speed Lower Limit (03.006)} \leq |\text{Speed Feedback (03.002)}| \leq \text{At Speed Upper Limit (03.007)}$$

| Parameter         | 03.007 At Speed Upper Limit                    |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to the required maximum at speed threshold |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 33000           |
| Default           | 5  | Units          |                 |
| Type              | 16 Bit User Save                               | Update Rate    | Background read |
| Display Format    | Standard                                       | Decimal Places | 0               |
| Coding            | RW, BU   |                |                 |

See *At Speed Lower Limit* (03.006).

| Parameter         | 03.008 Over Speed Threshold              |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to the required over speed threshold |                |                 |
| Mode              | RFC-A                                    |                |                 |
| Minimum           | 0  | Maximum        | 33000           |
| Default           | 0  | Units          |                 |
| Type              | 16 Bit User Save                         | Update Rate    | Background read |
| Display Format    | Standard                                 | Decimal Places | 0               |
| Coding            | RW, BU                                   |                |                 |

If *Over Speed Threshold* (03.008) is set to a non-zero value it defines the over speed threshold. If the *Speed Feedback* (03.002) exceeds this threshold in

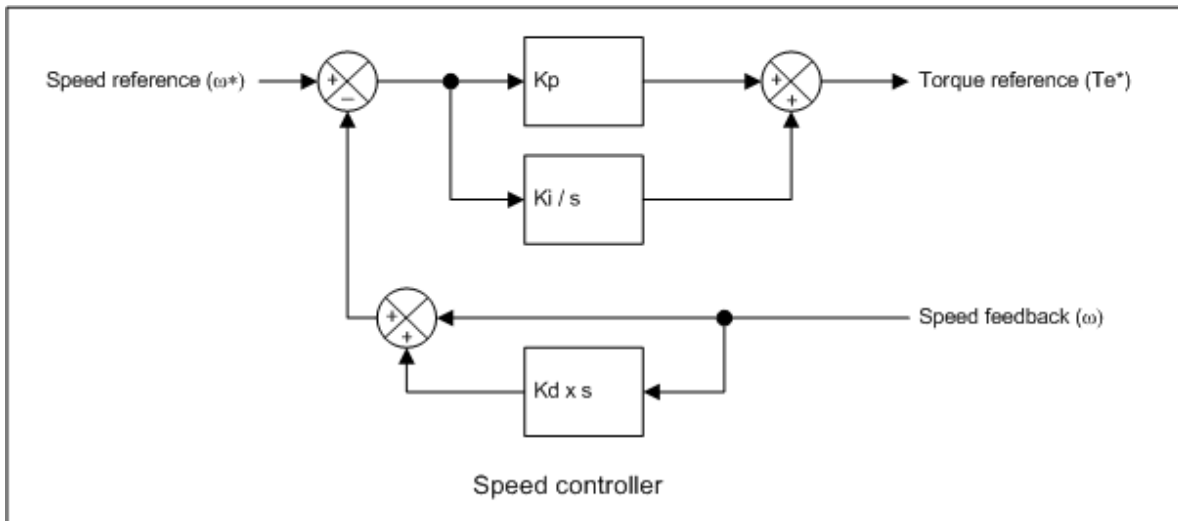
either direction an *Over Speed* trip is produced. If *Over Speed Threshold* (03.008) is set to 0.0 the threshold is based on the variable minimum/maximum for the references and is equal to  $1.2 \times VM\_SPEED\_FREQ\_REF[MAX]$ .

| Parameter         | 03.009 <i>Absolute At Speed Select</i>       |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Indicates when the motor is running at speed |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save                              | Update Rate    | Background read |
| Display Format    | Standard                                     | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *At Speed Lower Limit* (03.006).

| Parameter         | 03.010 <i>Speed Controller Proportional Gain Kp1</i>   |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the proportional gain for the speed controller |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0.0000   | Maximum        | 200.0000 |
| Default           | 0.0300   | Units          | s/rad    |
| Type              | 32 Bit User Save                                       | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 4        |
| Coding            | RW   |                |          |

The diagram below shows a generalised representation of the speed controller. The controller includes a feed forward proportional gain ( $K_p$ ), a feed forward integral gain ( $K_i$ ), and a differential feedback gain ( $K_d$ ). The description here refers to the first set of gains for motor map 1 (*Speed Controller Proportional Gain Kp1* (03.010), *Speed Controller Integral Gain Ki1* (03.011) and *Speed Controller Differential Feedback Gain Kd1* (03.012)). See *Speed Controller Gain Select* (03.016) on how to select a different set of gains.



**Proportional gain ( $K_p$ )** - *Speed Controller Proportional Gain Kp1* (03.010)

If  $K_p$  is non-zero and  $K_i$  is zero the controller will only have a proportional term, and there must be a speed error to produce a torque reference. Therefore, as the motor load increases there will be a difference between the reference and actual speeds. This effect, called regulation, depends on the level of the proportional gain, the higher the gain the smaller the speed error for a given load. If the proportional gain is too high either the acoustic noise produced due to speed feedback quantisation becomes unacceptable, or the closed-loop stability limit is reached.

**Integral gain ( $K_i$ )** - *Speed Controller Integral Gain Ki1* (03.011)

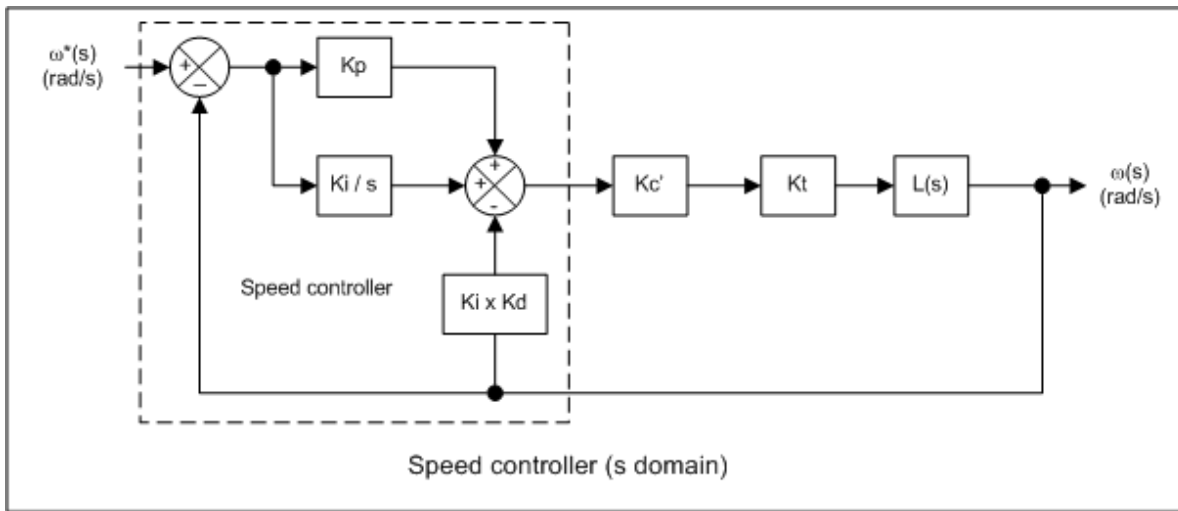
The integral gain is provided to prevent speed regulation. The error is accumulated over a period of time and used to produce the necessary torque reference without any speed error. Increasing the integral gain reduces the time taken for the speed to reach the correct level and increases the stiffness of the system, i.e. it reduces the positional displacement produced by applying a load torque to the motor. Unfortunately increasing the integral gain also reduces the system damping giving overshoot after a transient. For a given integral gain the damping can be improved by increasing the proportional gain. A compromise must be reached where the system response, stiffness and damping are all adequate for the application. The integral term is implemented in the form of  $\sum(K_i \times \text{error})$ , and so the integral gain can be changed when the controller is active without causing large transients on the torque reference.

**Differential gain ( $K_d$ )** - *Speed Controller Differential Feedback Gain Kd1* (03.012)

The differential gain is provided in the feedback of the speed controller to give additional damping. The differential term is implemented in a way that does not introduce excessive noise normally associated with this type of function. Increasing the differential term reduces the overshoot produced by under-damping, however for most applications the proportional and integral gains alone are sufficient. It should be noted that the differential term is limited internally so that it is ineffective if speed in rpm  $\times K_d \times K_i$  is greater than 170.

To analyse the performance of the speed controller it may be represented as an s-domain model as shown below.





$Kc'$  is the conversion between the speed controller output and the torque producing current reference. A value of unity at the output of the speed controller gives a torque producing current equal to  $Kc'$ . The drive automatically compensates the torque producing current reference for flux variations in field weakening, and so  $Kc'$  can be assumed to have a constant value even in field weakening.  $Kc' = Full\ Scale\ Current\ Kc\ (11.061) \times 0.45$ .

$Kt$  is the torque constant of the motor (i.e. torque in Nm per amp of torque producing current). This value is normally available from the manufacturer for a permanent magnet motor, however, for induction motors the value must be calculated from the motor parameters. In RFC-A mode this calculation is performed by the drive and the result is stored in *Torque Per Amp* (05.032)

$L(s)$  is the transfer function of the load.

The speed controller calculations are provided for a rotary application. However, for a linear application it is possible to set *Torque Per Amp* (05.032) to the force per amp and the *Motor And Load Inertia* (03.018) to the mass, and all the rotary system equations still apply.

It should be noted that the gain levels are compatible with those in Unidrive SP. The internal resolution of the integral gain parameter is twice that of Unidrive SP. In most applications this makes no difference to the performance, however, with Unidrive SP the internal value is zero (the integral term disabled) if the user parameter is less than 0.05. In Unidrive M the internal integral gain would be zero if *Speed Controller Integral Gain Ki1* (03.011) is less than 0.03. However, if *Speed Controller Integral Gain Ki1* (03.011) is non-zero and less than 0.03 (i.e. 0.01 or 0.02) the internal value is one, so that the integral term remains active, unless the user deliberately disables this term by setting *Speed Controller Integral Gain Ki1* (03.011) to zero.

| Parameter         | 03.011 Speed Controller Integral Gain Ki1          |                |                     |
|-------------------|--|----------------|---------------------|
| Short description | Defines the integral gain for the speed controller |                |                     |
| Mode              | RFC-A  |                |                     |
| Minimum           | 0.00   | Maximum        | 655.35              |
| Default           | 0.10   | Units          | s <sup>2</sup> /rad |
| Type              | 16 Bit User Save                                   | Update Rate    | 4ms read            |
| Display Format    | Standard   | Decimal Places | 2                   |
| Coding            | RW, BU   |                |                     |

See *Speed Controller Proportional Gain Kp1* (03.010).

| Parameter         | 03.012 Speed Controller Differential Feedback Gain Kd1 |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the differential gain for the speed controller |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0.00000  | Maximum        | 0.65535  |
| Default           | 0.00000  | Units          | 1/rad    |
| Type              | 16 Bit User Save                                       | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 5        |
| Coding            | RW, BU   |                |          |

See *Speed Controller Proportional Gain Kp1* (03.010).

| Parameter         | 03.013 Speed Controller Proportional Gain Kp2            |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines a 2nd proportional gain for the speed controller |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0.0000   | Maximum        | 200.0000 |
| Default           | 0.0300   | Units          | s/rad    |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 4        |
| Coding            | RW   |                |          |

See *Speed Controller Proportional Gain Kp1* (03.010).

| Parameter         | 03.014 Speed Controller Integral Gain Ki2            |                |                     |
|-------------------|--|----------------|---------------------|
| Short description | Defines a 2nd integral gain for the speed controller |                |                     |
| Mode              | RFC-A  |                |                     |
| Minimum           | 0.00   | Maximum        | 655.35              |
| Default           | 0.10   | Units          | s <sup>2</sup> /rad |
| Type              | 16 Bit User Save                                     | Update Rate    | 4ms read            |
| Display Format    | Standard   | Decimal Places | 2                   |
| Coding            | RW, BU   |                |                     |

See *Speed Controller Proportional Gain Kp1* (03.010).

| Parameter         | 03.015 Speed Controller Differential Feedback Gain Kd2   |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines a 2nd differential gain for the speed controller |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0.00000  | Maximum        | 0.65535  |
| Default           | 0.00000  | Units          | 1/rad    |
| Type              | 16 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 5        |
| Coding            | RW, BU   |                |          |

See *Speed Controller Proportional Gain Kp1* (03.010).

| Parameter         | 03.016 Speed Controller Gain Select  |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to 1 to enable the 2nd set of speed controller proportional, integral and differential gains |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW   |                |          |

If *Speed Controller Gain Select* (03.016) = 0 then Kp1, Ki1 and Kd1 are used as the speed controller gains. These gains are given by *Speed Controller Proportional Gain Kp1* (03.010), *Speed Controller Integral Gain Ki1* (03.011) and *Speed Controller Differential Feedback Gain Kd1* (03.012) if motor map 1 is selected (i.e. *Select Motor 2 Parameters* (11.045) = 0), or *M2 Speed Controller Proportional Gain Kp1* (21.017), *M2 Speed Controller Integral Gain Ki1* (21.018) and *M2 Speed Controller Differential Feedback Gain Kd1* (21.019) if motor map 2 is selected (i.e. *Select Motor 2 Parameters* (11.045) = 1). If *Speed Controller Gain Select* (03.016) = 1 then Kp2, Ki2 and Kd2 are used as the speed controller gains. These gains are given by *Speed Controller Proportional Gain Kp2* (03.013), *Speed Controller Integral Gain Ki2* (03.014) and *Speed Controller Differential Feedback Gain Kd2* (03.015). When *Speed Controller Gain Select* (03.016) is changed the gains are changed smoothly between the old and new values over a period of 250ms. This allows the system gains to be switched between two different sets of values without causing significant torque transients.

| Parameter         | 03.017 Speed Controller Set-up Method   |                |         |
|-------------------|---|----------------|---------|
| Short description | Defines how the speed controller gains are set up or are automatically calculated |                |         |
| Mode              | RFC-A   |                |         |
| Minimum           | 0   | Maximum        | 7       |
| Default           | 0   | Units          |         |
| Type              | 8 Bit User Save   | Update Rate    | 1s read |
| Display Format    | Standard  | Decimal Places | 0       |
| Coding            | RW, TE  |                |         |

| Value | Text             |
|-------|------------------|
| 0     | Disabled         |
| 1     | Bandwidth        |
| 2     | Comp Angle       |
| 3     | Kp Gain Times 16 |
| 4     | Low Performance  |
| 5     | Std Performance  |
| 6     | High Performance |
| 7     | First Order      |

#### 0: Disabled

When *Speed Controller Set-up Method* (03.017) is at its default value of 0, its functions are disabled and it has no effect.

#### 1: Bandwidth set-up

If the load is predominantly a constant inertia and constant torque, the drive can calculate the required speed loop gain values, provided the *Motor And Load Inertia* (03.018) and the *Torque Per Amp* (05.032) are set-up correctly. If *Speed Controller Set-up Method* (03.017) = 1 the gain values are calculated to give the required *Bandwidth* (03.020) and *Damping Factor* (03.021). The calculated values for Kp and Ki are written to *Speed Controller Proportional Gain Kp1* (03.010) and *Speed Controller Integral Gain Ki1* (03.011) once per second. The *Speed Controller Differential Feedback Gain Kd1* (03.012) is not affected. The gains are calculated from a linear model assuming a pure inertia load, not including unwanted delays in the speed and current controllers. The following equations are used by the drive to calculate the gains.

$$K_i = J / (K_c' \times K_t) \times (2\pi \times \omega_{bw} / K_{bw})^2$$

$$K_p = 2 \xi \sqrt{[(K_i \times J) / (K_c' \times K_t)]}$$

where:

$K_c'$  = Full Scale Current  $K_c$  (11.061) x 0.45

$J$  = Motor And Load Inertia (03.018)

$K_t$  = Torque Per Amp (05.032)

$\omega_{bw}$  = Bandwidth (03.020)

$\xi$  = Damping Factor (03.021)

$$K_{bw} = \sqrt{[(2\xi^2 + 1) + \sqrt{(2\xi^2 + 1)^2 + 1}]}$$

## 2: Compliance angle set-up

If *Speed Controller Set-up Method* (03.017) = 2 the speed controller gains are set up based on the required *Compliance Angle* (03.019) and *Damping Factor* (03.021) based on the following equations.

$$K_i = 1 / \alpha_{comp}(rs^{-1})$$

$$K_p = 2 \xi \sqrt{[(K_i \times J) / (K_c' \times K_t)]}$$

where:

$K_c'$  = Full Scale Current  $K_c$  (11.061) x 0.45

$J$  = Motor And Load Inertia (03.018)

$K_t$  = Torque Per Amp (05.032)

$\alpha_{comp}$  = Compliance Angle (03.019)

$\xi$  = Damping Factor (03.021)

## 3: Kp gain times 16

If *Speed Controller Set-up Method* (03.017) = 3 the selected proportional gain used by the drive is multiplied by 16. This feature was provided in Unidrive SP because the range of the proportional gain parameters was limited. The range has now been increased to allow higher gains to be selected, and so this feature is no longer necessary, but is provided for compatibility with Unidrive SP. It should be noted that if this feature is used the value of gain used by the speed controller (i.e. *Speed Controller Proportional Gain Kp1* (03.010) x 16) is limited internally to the maximum for *Speed Controller Proportional Gain Kp1* (03.010).

## 4-6: Low, Standard or High performance

If *Speed Controller Set-up Method* (03.017) is set to a value from 4 to 6 the *Speed Controller Proportional Gain Kp1* (03.010) and *Speed Controller Integral Gain Ki1* (03.011) are automatically set up to give the bandwidths given in the table below and a damping factor of unity. These settings give low, standard or high performance.

| Speed Controller Set-up Method (03.017) | Performance | Bandwidth |
|---|-------------|-----------|
| 4                                       | Low         | 5Hz       |
| 5                                       | Standard    | 25Hz      |
| 6                                       | High        | 100Hz     |

## 7: First order characteristic

If *Speed Controller Set-up Method* (03.017) = 7 then *Speed Controller Proportional Gain Kp1* (03.010), *Speed Controller Integral Gain Ki1* (03.011) and *Speed Controller Differential Feedback Gain Kd1* (03.012) are set up to give a closed-loop speed controller response that approximates to a first order system with a transfer function of  $1 / (s\tau + 1)$ , where  $\tau = 1/\omega_{bw}$  and  $\omega_{bw} = 2\pi \times \text{Bandwidth}$  (03.020). In this case the damping factor is meaningless, and *Damping Factor* (03.021) and *Compliance Angle* (03.019) have no effect. The following equations are used by the drive to calculate the gains.

$$K_i = J / (K_c' \times K_t) \times (2\pi \times \omega_{bw} / 2)^2$$

$$K_p = 2 \sqrt{[(K_i \times J) / (K_c' \times K_t)]}$$

$$K_d = K_p / 4K_i$$

where:

$K_c'$  = Full Scale Current  $K_c$  (11.061) x 0.45

$J$  = Motor And Load Inertia (03.018)

$K_t$  = Torque Per Amp (05.032)

$\omega_{bw}$  = Bandwidth (03.020)

| Parameter         | 03.018 Motor And Load Inertia   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the inertia of the motor and the load for use in calculating the speed controller gains |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.00000   | Maximum        | 1000.00000       |
| Default           | 0.00000   | Units          | kgm <sup>2</sup> |
| Type              | 32 Bit User Save  | Update Rate    | 1s read          |
| Display Format    | Standard  | Decimal Places | 5                |
| Coding            | RW  |                |                  |

The *Motor And Load Inertia* (03.018) represents the total inertia driven by the motor. This is used to set the speed controller

gains (see *Speed Controller Set-up Method* (03.017)) and to provide torque feed forwards during acceleration when required (see *Torque Mode Selector* (04.011)).

It is possible to measure the inertia as part of the auto-tune process (see *Auto-tune* (05.012)).

| Parameter         | 03.019 Compliance Angle  |                |         |
|-------------------|--|----------------|---------|
| Short description | Defines the required angular displacement when the drive delivers a torque producing current equivalent to drive rated current |                |         |
| Mode              | RFC-A  |                |         |
| Minimum           | 0.0  | Maximum        | 360.0   |
| Default           | 4.0  | Units          | °       |
| Type              | 16 Bit User Save   | Update Rate    | 1s read |
| Display Format    | Standard   | Decimal Places | 1       |
| Coding            | RW   |                |         |

The *Compliance Angle* (03.019) is the required angular displacement when the drive delivers a torque producing current equivalent to  $K_c'$ , i.e. *Full Scale Current*  $K_c$  (11.061) x 0.45, with no field weakening. The value of this parameter is used to automatically determine the speed controller gains if required. See *Speed Controller Set-up Method* (03.017).

| Parameter         | 03.020 Bandwidth  |                |         |
|-------------------|---|----------------|---------|
| Short description | Defines the theoretical 3dB point on the closed-loop gain characteristic of the speed controller as a second order system |                |         |
| Mode              | RFC-A   |                |         |
| Minimum           | 1   | Maximum        | 1000    |
| Default           | 10  | Units          | Hz      |
| Type              | 16 Bit User Save  | Update Rate    | 1s read |
| Display Format    | Standard  | Decimal Places | 0       |
| Coding            | RW  |                |         |

The *Bandwidth* (03.020) is defined as the theoretical 3dB point on the closed-loop gain characteristic of the speed controller as a second order system. At this point the phase shift is approximately 60°. The value of *Bandwidth* (03.020) is used to automatically determine the speed controller gains if required. See *Speed Controller Set-up Method* (03.017).

| Parameter         | 03.021 Damping Factor   |                |         |
|-------------------|---|----------------|---------|
| Short description | Defines the factor for the response of the system to a torque transient |                |         |
| Mode              | RFC-A   |                |         |
| Minimum           | 0.0   | Maximum        | 10.0    |
| Default           | 1.0   | Units          |         |
| Type              | 8 Bit User Save   | Update Rate    | 1s read |
| Display Format    | Standard  | Decimal Places | 1       |
| Coding            | RW  |                |         |

*Damping Factor* (03.021) defines this factor for the response of the system to a torque transient, and so if the *Damping Factor* (03.021) is unity, the response to a load torque transient is critically damped. The closed-loop step response of the speed controller gives approximately 10% overshoot with unity damping factor. *Damping Factor* (03.021) is used to automatically determine the speed controller gains if required. See *Speed Controller Set-up Method* (03.017).

| Parameter         | 03.022 Hard Speed Reference   |                |                   |
|-------------------|---|----------------|-------------------|
| Short description | Defines a speed reference value which does not pass through the ramp system |                |                   |
| Mode              | RFC-A   |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF  | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 0.0   | Units          |                   |
| Type              | 32 Bit User Save  | Update Rate    | 250µs read        |
| Display Format    | Standard  | Decimal Places | 1                 |
| Coding            | RW, VM  |                |                   |

The *Hard Speed Reference* (03.022) is a reference value which does not pass through the ramp system, but is added directly to the *Post Ramp Reference* (02.001). The *Hard Speed Reference* (03.022) is only added when selected by the *Hard Speed Reference Select* (03.023) and the *Reference On* (01.011) is active.

| Parameter         | 03.023 Hard Speed Reference Select                     |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to 1 to enable the use of the hard speed reference |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW   |                |          |

See *Hard Speed Reference* (03.022).

| Parameter         | 03.024 RFC Feedback Mode                                     |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the method of feedback used for the speed controller |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 3        |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, TE   |                |          |

| Value | Text             |
|-------|------------------|
| 0     | Feedback         |
| 1     | Sensorless       |
| 2     | Feedback NoMax   |
| 3     | Sensorless NoMax |

*RFC Feedback Mode* (03.024), which can be changed even when the motor is running, selects the feedback method used to provide position feedback to control the motor. The actual feedback method being used at any time is given by *Sensorless Mode Active* (03.078). When sensorless mode is used, a filter with a 4ms time constant is automatically included in the speed feedback as this is required for this system to operate correctly. The possible speed controller bandwidth will be reduced by a factor of approximately 10 compared with the bandwidth possible with a position feedback device. The maximum and minimum for the speed references are limited by the VM\_POSITIVE\_REF\_CLAMP variable minimum/maximum which prevents the speed from exceeding the level where the position feedback cannot be interpreted correctly. This limit is disabled if *RFC Feedback Mode* (03.024) is 2 or 3, so that it is possible to change between operation with or without position feedback if the speed range needs to be extended beyond the limit of the position feedback device. Care should be taken not to exceed a speed that would damage the position feedback device.

#### 0: Position feedback

RFC mode is active using the position feedback selected *Motor Control Feedback Select* (03.026) to control the motor.

#### 1: Sensorless

RFC mode using a sensorless algorithm to provide position feedback, is used to control the motor.

#### 2: Position feedback with no maximum speed limit

RFC mode with position feedback selected with *Motor Control Feedback Select* (03.026) is used to control the motor. The maximum reference limit is disabled.

#### 3: Sensorless with no maximum speed limit

RFC mode using a sensorless algorithm to provide position feedback, is used to control the motor. The maximum reference limit is disabled.

It should be noted that when sensorless mode is active the maximum torque that can be produced at low speeds (i.e. < 2% or rated speed) is reduced.

| Parameter         | 03.026 Motor Control Feedback Select    |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the source of position feedback |                |                 |
| Mode              | RFC-A                                   |                |                 |
| Minimum           | 0                                       | Maximum        | 7               |
| Default           | 0                                       | Units          |                 |
| Type              | 8 Bit User Save                         | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW, TE                                  |                |                 |

| Value | Text     |
|-------|----------|
| 0     | P1 Drive |
| 1     | P2 Drive |
| 2     | P1 Slot1 |
| 3     | P2 Slot1 |
| 4     | P1 Slot2 |
| 5     | P2 Slot2 |
| 6     | P1 Slot3 |
| 7     | P2 Slot3 |

*Motor Control Feedback Select* (03.026) should be used to select the position feedback interface for motor control. If the feedback interface does not exist then the drive will produce an *Encoder 9* trip if it is enabled. Note that if *RFC Feedback Mode* (03.024) is set to 1 or 3 to select sensorless control then this trip is suppressed.

| Parameter         | 03.027 P1 Speed Feedback                   |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the speed feedback from device P1 |                |           |
| Mode              | RFC-A                                      |                |           |
| Minimum           | -VM_SPEED                                  | Maximum        | VM_SPEED  |
| Default           |  | Units          |           |
| Type              | 32 Bit Volatile                            | Update Rate    | 4ms write |
| Display Format    | Standard                                   | Decimal Places | 1         |
| Coding            | RO, FI, VM, ND, NC, PT                     |                |           |

Provided the set-up parameters for the position feedback device connected to the drive P1 position interface are correct *P1 Speed Feedback* (03.027) shows the speed derived from the feedback. The speed is given in mm/s if *P1 Linear Feedback Select* (03.051) = 1 and *Linear Speed Select* (01.055) = 1,

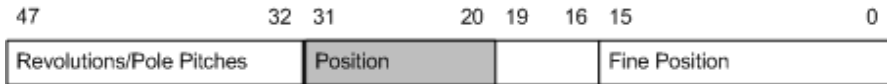
otherwise it is given in rpm. The value shown is measured over a 16ms sliding window period, and so the ripple in this value is as defined for *Speed Feedback* (03.002).

| Parameter         | 03.028 P1 Revolution/Pole Pitch Counter                   |                |           |
|-------------------|---|----------------|-----------|
| Short description | Displays the revolution/pole pitch counter from device P1 |                |           |
| Mode              | RFC-A   |                |           |
| Minimum           | 0   | Maximum        | 65535     |
| Default           |   | Units          |           |
| Type              | 16 Bit Power Down Save                                    | Update Rate    | 4ms write |
| Display Format    | Standard  | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT, BU  |                |           |

*P1 Revolution/Pole Pitch Counter* (03.028), *P1 Position* (03.029) and *P1 Fine Position* (03.030) combined give the encoder position with a resolution of  $1/2^{32}$  of a revolution/pole pitch as a 48 bit number. If a rotary position feedback device is being used (*P1 Linear Feedback Select* (03.051) = 0) then these quantities relate directly to the rotary position of the feedback device. If a linear feedback device is used then one revolution or pole pitch relates to the distance given by *P1 Pole Pair Pitch* (03.055).



Provided the position feedback interface set-up parameters are correct, the position is always converted to units of  $1/2^{32}$  of a revolution/pole pitch, but some parts of the value may not be relevant depending on the resolution of the feedback device. For example a 1024 line digital encoder produces 4096 counts per revolution, and so the position is represented by the bits in the shaded area only.



When the position feedback moves by more than one revolution or pole pitch the *P1 Revolution/Pole Pitch Counter* (03.028) increments or decrements in the form of a sixteen bit roll-over counter. If an absolute position feedback device (except AB Servo, FD Servo, FR Servo, SC Servo) is used the position is initialised at power-up and each time the encoder is subsequently initialised with the absolute position including the revolution count if a multi-turn absolute rotary encoder is used, or the pole pitch count if an absolute linear encoder is used. To avoid showing turns values that are outside the range of the encoder any bits beyond the turns information are normally masked. For example, if the encoder provides 12 bits of turns information, then the most significant 4 bits of the revolutions are always zero. If a single turn encoder is used all the bits of the revolutions are zero. To remove this masking *P1 Absolute Turns Recovery Enable* (03.073) should be set to one. In addition to removing the mask, the extended turns value is retained on power-down and will be recovered on power-up. See *P1 Absolute Turns Recovery Enable* (03.073) for more details.

The position interface parameter descriptions cover rotary and linear applications, but the revolutions or pole pitches are always referred to as turns.

| Parameter         | 03.029 P1 Position                            |                |           |
|-------------------|---|----------------|-----------|
| Short description | Displays the position feedback from device P1 |                |           |
| Mode              | RFC-A   |                |           |
| Minimum           | 0   | Maximum        | 65535     |
| Default           |   | Units          |           |
| Type              | 16 Bit Power Down Save                        | Update Rate    | 4ms write |
| Display Format    | Standard                                      | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT, BU                            |                |           |

See *P1 Revolution/Pole Pitch Counter* (03.028).

| Parameter         | 03.030 P1 Fine Position                            |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the fine position feedback from device P1 |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | 0  | Maximum        | 65535     |
| Default           |  | Units          |           |
| Type              | 16 Bit Volatile                                    | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT, BU                                 |                |           |

See *P1 Revolution/Pole Pitch Counter* (03.028).

| Parameter         | 03.031 P1 Marker Mode                 |                |                       |
|-------------------|---------------------------------------|----------------|-----------------------|
| Short description | Defines the marker mode for device P1 |                |                       |
| Mode              | RFC-A                                 |                |                       |
| Minimum           | 0<br>(Display: 0000)                  | Maximum        | 15<br>(Display: 1111) |
| Default           | 4<br>(Display: 0100)                  | Units          |                       |
| Type              | 8 Bit User Save                       | Update Rate    | Background read       |
| Display Format    | Binary                                | Decimal Places | 0                     |
| Coding            | RW                                    |                |                       |

**P1 Device Type** (03.038): AB, FD, FR, AB Servo, FD Servo, FR Servo

Each position feedback device produces incremental signals which are counted in hardware. If *P1 Marker Mode* (03.031) = 0 the following occurs when a marker event is produced by the Z1 input:

1. *P1 Position* (03.029) and *P1 Fine Position* (03.030) are reset to zero.
2. The bits in *P1 Normalised Position* (03.058) related to *P1 Position* (03.029) and *P1 Fine Position* (03.030) are reset to zero
3. *P1 Marker Flag* (03.032) is set to one.

The marker is a hardware function, and so the position appears as though it is reset at the marker event time even if this is between control system sample points. It should be noted that the marker event occurs on the rising edge of the marker pulse if the position change over the last sample was positive or on the falling edge if the position change over the last sample was negative. This ensures that the marker event occurs at the same physical location for either direction of rotation.

The action taken when a marker event occurs can be modified by setting the bits of *P1 Marker Mode* (03.031) as described in the table below.

| Bit | Effect of setting bit to one  |
|-----|---|
| 0   | No action is taken unless the marker flag is zero before the marker event occurs  |
| 1   | <i>P1 Revolution/Pole Pitch Counter</i> (03.028) and the whole of <i>P1 Normalised Position</i> (03.058) are also set to zero on a marker event   |
| 2   | <i>P1 Revolution/Pole Pitch Counter</i> (03.028), <i>P1 Position</i> (03.029), <i>P1 Fine Position</i> (03.030) and the related part of <i>P1 Normalised Position</i> (03.058) are not reset. (This overrides bit 1.) <i>P1 Normalised Position</i> (03.058) is transferred to <i>P1 Normalised Marker Position</i> (03.059) and <i>P1 Marker Flag</i> (03.032) is set to one.  |
| 3   | If this bit is 0 the state of the marker is only undefined when the differential input is in the range from -200mV to 200mV. The marker pulse is only guaranteed to be recognised if it is at least 500ns wide. This setting is used for most encoders with standard level marker pulses.<br>If this bit is set to 1 the undefined state region is reduced to the range from -30mV to 30mV. The marker pulse is only guaranteed to be recognised if it is at least 10us wide. The smaller undefined region is required for position feedback devices that produce a small marker pulse, such as the Heidenhain ERN1387 encoder. Note that the reduced undefined region is only provided for position feedback interface P1 and that this bit in <i>P2 Marker Mode</i> (03.131) has no effect. |

The marker input can be used for a standard type marker function or alternatively it can be used as an additional freeze input for the P1 position feedback interface.

**P1 Device Type (03.038): SC, SC Servo, SC SC**

The marker function operates in the same way as for the digital incremental encoders. The resolution of the marker actions is only as accurate as the zero crossings of the sine waves. The marker is used with an SC SC type device to trim the absolute position derived from the single sine wave per turn channels once after initialisation. Until this is done (i.e. the marker has been active once after initialisation) marker events will not be registered.

**P1 Device Type (03.038): Any other device type**

The marker function cannot be used and *P1 Marker Mode* (03.031) has no effect.

| Parameter         | 03.032 P1 Marker Flag                |                |             |
|-------------------|--------------------------------------|----------------|-------------|
| Short description | Indicates when a marker event occurs |                |             |
| Mode              | RFC-A                                |                |             |
| Minimum           | 0                                    | Maximum        | 1           |
| Default           | 0                                    | Units          |             |
| Type              | 1 Bit Volatile                       | Update Rate    | 250µs write |
| Display Format    | Standard                             | Decimal Places | 0           |
| Coding            | RW, NC                               |                |             |

*P1 Marker Flag* (03.032) is set to one when a marker event occurs. The flag must be cleared by the user.

| Parameter         | 03.033 P1 Rotary Turns Bits                           |                |   |
|-------------------|---|----------------|---|
| Short description | Defines the number of rotary turns bits for device P1 |                |   |
| Mode              | RFC-A   |                |   |
| Minimum           | 0   | Maximum        | 16  |
| Default           | 16  | Units          |   |
| Type              | 8 Bit User Save                                       | Update Rate    | Background read, auto-configuration write |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW  |                |   |

*P1 Rotary Turns Bits* (03.033) normally only has any effect if the position feedback interface is being used with a rotary device (i.e. *P1 Linear Feedback Select* (03.051) = 0).

**P1 Device Type (03.038): SC Hiperface, SC EnDat, SC SSI, EnDat, BiSS, SSI, SC BiSS**

*P1 Rotary Turns Bits* (03.033) is used to determine the number of bits within the comms messages from the position feedback device that represent turns. For a single turn encoder *P1 Rotary Turns Bits* (03.033) must be set to zero. The most significant bits in *P1 Revolution/Pole Pitch Counter* (03.028) that are not included in the turns information provided by the encoder comms are held at zero. If *P1 Rotary Turns Bits* (03.033) = 0 (single turn encoder) the whole of *P1 Revolution/Pole Pitch Counter* (03.028) is held at zero. The number of bits of position information within one revolution for a rotary device are

calculated from *P1 Rotary Turns Bits* (03.033) and *P1 Comms Bits* (03.035). If the resulting value is greater than 32 it is limited to 32.

Some SSI encoders include leading zeros before the turns information and in this case the number of turns bits should include the leading zeros. Some BiSS encoders include zero padding either before or after the turns information (see *P1 Additional Configuration* (03.074)). *P1 Rotary Turns Bits* (03.033) should include the actual turns bits and the additional padding.

**P1 Device Type (03.038): Option Slot 1, Option Slot 2, Option Slot 3, Option Slot 4**

Whatever the setting for *P1 Linear Feedback Select* (03.051) the number of rotary turns bits should be set up to indicate how many turns bits there are in the position provided by an option module. See *P1 Device Type* (03.038) for more details.

**P1 Device Type (03.038): Any other device type**

It is sometimes desirable to mask off the most significant bits of *P1 Revolution/Pole Pitch Counter* (03.028), but this does not have to be done for the drive to function correctly. If *P1 Rotary Turns Bits* (03.033) = 0 the whole of *P1 Revolution/Pole Pitch Counter* (03.028) is held at zero. If *P1 Rotary Turns Bits* (03.033) has any other value it indicates the number of bits in *P1 Revolution/Pole Pitch Counter* (03.028) that are not held at zero. For example, if *P1 Rotary Turns Bits* (03.033) = 5, then *P1 Revolution/Pole Pitch Counter* (03.028) counts up to 31 before being reset.

The description above is for normal operation when *P1 Absolute Turns Recovery Enable* (03.073) = 0. If *P1 Absolute Turns Recovery Enable* (03.073) = 1 no masking is applied to *P1 Rotary Turns Bits* (03.033), and so a 16 bit value is always shown.

| Parameter         | 03.034 P1 Rotary Lines Per Revolution                           |                |   |
|-------------------|---|----------------|---|
| Short description | Defines the number of rotary lines per revolution for device P1 |                |   |
| Mode              | RFC-A   |                |   |
| Minimum           | 1   | Maximum        | 100000                                    |
| Default           | 1024  | Units          |   |
| Type              | 32 Bit User Save  | Update Rate    | Background read, auto-configuration write |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW  |                |   |

*P1 Rotary Lines Per Revolution* (03.034) only has any effect if the position feedback interface is being used with a rotary device (i.e. *P1 Linear Feedback Select* (03.051) = 0).

**P1 Device Type (03.038): AB, AB Servo**

*P1 Rotary Lines Per Revolution* (03.034) should be set to the number of lines per revolution for the encoder connected to the P1 position feedback interface.

**P1 Device Type (03.038): FD, FR, FD Servo, FR Servo**

*P1 Rotary Lines Per Revolution* (03.034) should be set to the number of lines per revolution for the encoder connected to the P1 position feedback interface divided by 2.

**P1 Device Type (03.038): SC, SC Servo, SC Hiperface, SC EnDat, SC SSI, SC SC, SC BiSS**

*P1 Rotary Lines Per Revolution* (03.034) should be set to the number of sine waves per revolution for the encoder connected to the P1 position feedback interface.

**P1 Device Type (03.038): Any other device type**

*P1 Rotary Lines Per Revolution* (03.034) has no effect.

| Parameter         | 03.035 P1 Comms Bits   |                |   |
|-------------------|--|----------------|---|
| Short description | Defines the total number of bits of position information in the comms message from the encoder for device P1 |                |   |
| Mode              | RFC-A  |                |   |
| Minimum           | 0  | Maximum        | 48  |
| Default           | 0  | Units          |   |
| Type              | 8 Bit User Save  | Update Rate    | Background read, auto-configuration write |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RW   |                |   |

**P1 Device Type (03.038): SC Hiperface, EnDat, SC EnDat**

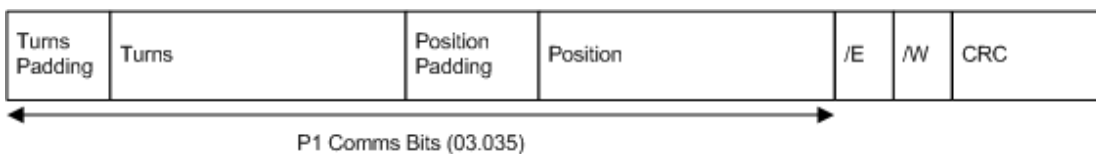
Total number of bits of position information in the comms message from the encoder.

**P1 Device Type (03.038): SSI, SC SSI**

Total number of bits of position information in the comms message from the encoder including any leading or trailing zeros and the power supply alarm bit if present.

**P1 Device Type (03.038): BiSS, SC BiSS**

Total number of bits of position information in the comms message from the encoder excluding the warning and error bits. It is always assumed there is one warning bit and one error bit. The length of the position information includes any zero padding that is included by the encoder. The CRC is applied to the whole message including the error (/E) and warning (/W) bits. The warning bit is ignored, but if the error bit is low then an *Encoder 6* trip is initiated.



**P1 Device Type (03.038): Any other device type**

*P1 Comms Bits* (03.035) has no effect.



| Parameter         | 03.036 P1 Supply Voltage                        |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the supply voltage output for device P1 |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 2               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                                 | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text |
|-------|------|
| 0     | 5V   |
| 1     | 8V   |
| 2     | 15V  |

*P1 Supply Voltage* (03.036) sets the level for the supply voltage output. To ensure that the maximum voltage for the position feedback device is not accidentally exceeded, the device should be disconnected from the drive when the level is being adjusted.

| Parameter         | 03.037 P1 Comms Baud Rate                             |                |   |
|-------------------|---|----------------|---|
| Short description | Defines the baud rate used for encoder communications |                |   |
| Mode              | RFC-A   |                |   |
| Minimum           | 0   | Maximum        | 8   |
| Default           | 2   | Units          | Baud                                      |
| Type              | 8 Bit User Save                                       | Update Rate    | Background read, Auto-configuration write |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW, TE  |                |   |

| Value | Text |
|-------|------|
| 0     | 100k |
| 1     | 200k |
| 2     | 300k |
| 3     | 400k |
| 4     | 500k |
| 5     | 1M   |
| 6     | 1.5M |
| 7     | 2M   |
| 8     | 4M   |

*P1 Comms Baud Rate* (03.037) defines the baud rate used for encoder communications. Restrictions are applied to the baud rate for different feedback devices, and so the baud rate may be different to the parameter value.

**P1 Device Type (03.038): SC.Hiperface**

A fixed baud rate of 9600 baud is always used with this type of encoder so *P1 Comms Baud Rate* (03.037) has no effect.

**P1 Device Type (03.038): SC.SSI, SC EnDat, SC BiSS**

Any baud rate that is within the range specified for the encoder may be used. The data from the encoder is not used for time critical functions, and so it is recommended that the default value of 300K baud is used unless this needs to be reduced because of a limitation imposed by the encoder.

**P1 Device Type (03.038): EnDat, BiSS, SSI**

Any baud rate that is within the range specified for the encoder may be used. The line delay is measured during initialisation, and used to compensate this delay during communications with the encoder. Therefore there is no timing based restriction on the length of the cable between the position feedback interface and the encoder. However, care should be taken to ensure that the wiring arrangement and the type of cable used are suitable for the selected baud rate and the distance between the position interface and the encoder. See *P1 Low Speed Update Rate Active* (03.063) for more details on timing restrictions related to the drive sample times.

**P1 Device Type (03.038): Any other device**

*P1 Comms Baud Rate* (03.037) has no effect.

| Parameter         | 03.038 P1 Device Type   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the device type connected to the drive P1 position feedback interface |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 17              |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text             |
|-------|------------------|
| 0     | AB               |
| 1     | FD               |
| 2     | FR               |
| 3     | AB Servo         |
| 4     | FD Servo         |
| 5     | FR Servo         |
| 6     | SC               |
| 7     | SC Hiperface     |
| 8     | EnDat            |
| 9     | SC EnDat         |
| 10    | SSI              |
| 11    | SC SSI           |
| 12    | SC Servo         |
| 13    | BiSS             |
| 14    | Resolver         |
| 15    | SC SC            |
| 16    | Commutation Only |
| 17    | SC BiSS          |

*P1 Device Type* (03.038) should be set up to match the device connected to the drive P1 position feedback interface. The table below gives the position feedback types supported by the P1 position feedback interface.

| <i>P1 Device Type</i> (03.038) | Signals  | Position feedback type  | Communications         |
|--------------------------------|--|---|------------------------|
| 0: AB                          | Quadrature   | Incremental   | None                   |
| 1: FD                          | Frequency and direction                                  | Incremental   | None                   |
| 2: FR                          | Forward and reverse                                      | Incremental   | None                   |
| 3: AB Servo                    | Quadrature and commutation                               | Absolute commutation signals with incremental                     | None                   |
| 4: FD Servo                    | Frequency and direction, and commutation                 | Absolute commutation signals with incremental                     | None                   |
| 5: FR Servo                    | Forward and reverse, and commutation                     | Absolute commutation signals with incremental                     | None                   |
| 6: SC                          | SINCOS   | Incremental SINCOS  | None                   |
| 7: SC Hiperface                | SINCOS and Hiperface comms                               | Absolute comms with incremental SINCOS                            | Hiperface              |
| 8: EnDat                       | EnDat comms  | Absolute comms  | EnDat 2.1<br>EnDat 2.2 |
| 9: SC EnDat                    | SINCOS and EnDat comms                                   | Absolute comms with incremental SINCOS                            | EnDat 2.1              |
| 10: SSI                        | SSI comms  | Absolute comms  | SSI                    |
| 11: SC SSI                     | SINCOS and SSI comms                                     | Absolute comms with incremental SINCOS                            | SSI                    |
| 12: SC Servo                   | SINCOS and commutation                                   | Absolute commutation signals with incremental                     | None                   |
| 13: BiSS                       | BiSS comms   | Absolute comms  | BiSS                   |
| 14: Resolver                   | Resolver   | Resolver  | None                   |
| 15: SC SC                      | SINCOS and single sine and cosine signals per revolution | SINCOS with absolute position from single sine and cosine signals | None                   |
| 16: Commutation Only           | Commutation only   | Absolute commutation signals only                                 | None                   |
| 17: SC BiSS                    | BiSS comms   | Absolute comms with incremental SINCOS                            | BiSS                   |
| 18: Option Slot 1              | None   | Provided by option module   | None                   |
| 19: Option Slot 2              | None   | Provided by option module   | None                   |
| 20: Option Slot 3              | None   | Provided by option module   | None                   |
| 21 Option Slot 4               | None   | Provided by option module   | None                   |

#### Position feedback type:

##### Incremental

Position devices that provide incremental feedback do not give absolute position feedback. The position is zero at power-up and accumulates the change of position from that point on. These devices are suitable for motor control in RFC-A mode. They can also be used for RFC-S mode, but some form of phasing auto-tune is required each time the position feedback is initialised.

##### Absolute commutation signals with incremental

Position devices with commutations signals are intended to provide absolute position feedback for motor control in RFC-S mode. If one of these devices is used for RFC-A mode the commutation signals are ignored. The position information given in *P1 Revolution/Pole Pitch Counter* (03.028), *P1 Position* (03.029) and *P1 Fine Position* (03.030) appears as though the position feedback device is an incremental type in that it is initialised to zero at power-up and then accumulates the change of position from that point on. The commutation signals are used directly by the motor control algorithms in RFC-S mode to determine the motor position after position feedback initialisation. There must be one period of the commutation signals for each pole pair for a rotary motor (i.e. 3 commutation signal periods per revolution for a 6 pole motor), or one period of the commutation signals must be equal to the motor pole pitch for a linear motor. It should be noted that for a movement of up to 1/3 of the commutation signal period after position feedback initialisation the

maximum motor torque is limited to 0.866 of the maximum possible torque.

**Absolute commutation signals only**

Position devices with commutations signals are intended to provide absolute position feedback for motor control in RFC-S mode but can also be used to provide position feedback for motor control in RFC-A mode. The position is derived from the commutation signals alone. A phase locked loop is used to smooth the feedback, but this introduces a delay and there is significant ripple in the position and speed feedback at low speeds. If this method is used for motor control then low speed loop gains should be used and *P1 Feedback Filter* (03.042) should be used to filter the feedback.

**Incremental SINCOS**

An incremental SINCOS encoder can be used in the same way as an AB incremental encoder, except that the position resolution is increased with interpolation. These devices are suitable for motor control in RFC-A mode. They can also be used for RFC-S mode, but some form of phasing auto-tune is required each time the position feedback is initialised. The increase in resolution due to interpolation depends on the magnitude and frequency of the sine wave signals at the position feedback interface inputs on the drive. The sine wave inputs take balanced signals each with a nominal 1V peak to peak level. (This means that the difference measured between the two signals for one sine wave input would be 2V peak to peak or 1V peak.) If interpolation is not used the position feedback would have a resolution related to the number of sine waves per revolution (i.e. 512 sine waves per revolution would give position feedback resolution equivalent to a 512 line incremental encoder, which gives 2048 discernible positions per revolution). With the nominal signal level and an input frequency below 5kHz the interpolation using sine waves instead of digital incremental signals increases the resolution by a factor of 900. For a 512 sine wave encoder this would give a resolution of  $512 \times 4 \times 900 = 1843200$  discernible positions per revolution. This is equivalent to a digital incremental encoder with 460800 lines per revolution. The increased resolution due to interpolation is directly proportional to the sine wave signal voltage levels, and also reduces with sine wave signal frequency. The resolution is given by

$$\text{Resolution} = P1 \text{ Rotary Lines Per Revolution (03.034)} \times 4 \times 900 \times V_{\text{peak to peak of the sine wave signals}} \times \text{Frequency Factor}$$

where the frequency factor is given below.

|      |      |       |        |        |        |
|------|------|-------|--------|--------|--------|
| 1kHz | 5kHz | 50kHz | 100kHz | 200kHz | 500kHz |
| 1.00 | 1.00 | 0.86  | 0.66   | 0.39   | 0.14   |

Increasing the sine wave signal level above 1V peak to peak will increase the resolution, but the level should not be increased above 1.5V or else the input will saturate and the sine waves will be distorted.

**Absolute comms with incremental SINCOS**

The absolute position is obtained after position feedback initialisation via the comms interface and then after that point by tracking the incremental change from the sine wave signals. Interpolation is used to increase the position resolution. The comms interface can be used to check the position derived from the sine waves. It can also be used for bi-direction transfer of data between the drive and encoder (except SSI comms). These devices can be used for motor control in RFC-A or RFC-S modes.

**Absolute comms**

The absolute position is obtained at all times via the encoder comms. The comms interface can also be used for bi-directional transfer of data between the drive and the encoder (except SSI mode). These devices can be used for motor control in RFC-A or RFC-S modes.

**Resolver**

A resolver can be used to provide absolute position feedback within the range covered by one electrical revolution of the resolver (i.e. 360° mechanical for a 2 pole device, 180° mechanical for a 4 pole device, etc.). An angle of 0 degrees corresponds to the position where the cosine input is at its maximum and in phase with the excitation and the sine input zero. A resolver can be used for motor control in RFC-A mode or RFC-S mode. In RFC-S mode a 2 pole resolver can be used with a motor with any number of motor poles, but with any other number of poles there must be an integer number of motor poles for each resolver pole. In RFC-A mode this restriction does not apply. Standard or high speed sampling can be selected with *P1 Resolver Excitation* (03.066). If standard sampling is selected and the position feedback used for motor control the maximum operating speed is limited before the control performance starts to deteriorate. See *P1 Resolver Excitation* (03.066) for more details.

**SINCOS with absolute position from sine and cosine signals**

This type of device, which is not recommended for new applications, is intended to provide absolute position feedback for motor control in RFC-S mode. If one of these devices is used for RFC-A mode the additional sine wave signals and the Z1 marker signal do not affect the motor control position feedback. The position information given in *P1 Position* (03.029) and *P1 Fine Position* (03.030) is initialised to the position within one turn and *P1 Revolution/Pole Pitch Counter* (03.028) is set to zero when the device is initialised based on the once per turn sine and cosine signals. This gives a moderately accurate absolute position. When a marker event occurs it is used to give a more accurate absolute position. Care should be taken to ensure that the position feedback device is connected correctly. For example a Heidenhain ERN1387 device should be connected as follows: 1/2=A+/A- (Cosine), 3/4=B+/B- (Sine), 5/6=R+/R- (Marker), 7/8=C+/C- (Single turn cosine), 9/10=D+/D- (Single turn sine). It is assumed that the marker occurs at the positive zero crossing of the single turn cosine signal when operating in the forwards direction (i.e. compatible with the ERN1387). To ensure the drive can correctly detect the reference marker pulse with a Heidenhain ERN1387 encoder it is recommended that bit 3 of *P1 Marker Mode* (03.031) is set to 1.

**Provided by Option Module**

Position feedback information can be provided via the P1 interface from an option module. This is intended to be used by option modules that are not position feedback category modules. If this type of device is selected, and the module in the selected slot supports this feature, the position provided by the P1 interface will be written by the module and the interface will become initialised. If the option does not support this feature then the position will remain at zero and the interface will not become initialised. It should be noted that the system allows 1.3s after power-up, or feedback interface re-initialisation, for the option module to indicate that it is providing feedback before a *Encoder 4* trip will be initiated. If the option module takes longer than this to indicate that position feedback is available the power up delay should be extended with *P1 Additional Power-up Delay* (03.049).

The option module will provide the position as a 32 bit value separated into turns and position within a turn as shown below.

|       |          |
|-------|----------|
| Turns | Position |
|-------|----------|

The number of turns bits should be set up in *P1 Rotary Turns Bits* (03.033) and the position value should be left justified. For example, if the information being provided contains 8 turns bits and 16 position bits then *P1 Rotary Turns Bits* (03.033) should be set to 8 and the information should be written as shown below.

|              |                  |         |
|--------------|------------------|---------|
| 8 turns bits | 16 position bits | 8 zeros |
|--------------|------------------|---------|

For a linear device *P1 Rotary Turns Bits* (03.033) should be used in the same way to partition the data from the module where one turn corresponds to one pole of the motor.

To avoid discontinuities when the whole position rolls over the maximum number of turns boundary, the drive calculates the change of position between the values provided by the option module at each sample and then accumulates the result. It is important that the change of position provided by the option module between samples is less than half the range of the position value. For example, if 16 position bits are being used the change must be less than 32767. This only applies when the position feedback interface is in the initialised state. If it is not initialised then larger changes can be applied.

**Communications:**

**Hiperface**

Hiperface is an asynchronous bi-direction communications protocol that is only used with incremental sine waves. Therefore it can be used to check the position derived from the sine waves or for bi-direction transfer of data between the drive and encoder. A checksum is provided for error checking.

**EnDat 2.1**

EnDat 2.1 is a synchronous bi-direction communications protocol that is intended to be used with incremental sine waves. Therefore it can be used to check the position derived from the sine waves or for bi-direction transfer of data between the drive and encoder. It can be used as an absolute comms only type position feedback interface, but the resolution of the position feedback using this method may be limited. If it is used in this way it is not possible to use the position feedback via comms at the same time as communicating with the encoder for data transfer. A CRC is provided for error checking.

**EnDat 2.2 and BiSS C Mode**

EnDat 2.2 and BiSS are synchronous bi-direction communications protocols that are intended to be used alone. It is possible to obtain position feedback at the same time as communicating with the encoder for data transfer. A CRC is provided for error checking.

**SSI**

SSI is a uni-directional communications protocol that is intended to be used alone. It is only possible to obtain the position information from the encoder and it is not possible to transfer data between the drive and the encoder. No error checking is provided by the SSI protocol, and so encoders based on this interface are not recommended for new applications.

| Parameter         | 03.039 P1 Termination Select   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Used to enable or disable the terminations on the position feedback interface inputs |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 2               |
| Default           | 1  | Units          |                 |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

*P1 Termination Select* (03.039) is used to enable or disable the terminations on the position feedback interface inputs. The function of *P1 Termination Select* (03.039) depends on the position feedback device type selected in *P1 Device Type* (03.038) as shown below.

Terminals 5/6 have selectable pull-apart resistors which follow the same state as the termination resistors for terminals 5/6, unless described differently below.

**P1 Device Type (03.038): AB, FD, FR, AB Servo, FD Servo, FR Servo**

| Terminal  | Input   | 03.039 = 0 | 03.039 = 1 | 03.039 = 2 |
|-----------|---------|------------|------------|------------|
| 1/2 & 3/4 | A1 & B1 | Disabled   | Enabled    | Enabled    |
| 5/6       | Z1      | Disabled   | Disabled   | Enabled    |

U1, V1 & W1 terminations (terminals 7/8, 9/10 & 11/12) are always enabled for AB Servo, FD Servo and FR Servo encoders.

**P1 Device Type (03.038): SC, SC Servo, SC SC**

| Terminal  | Input       | 03.039 = 0 | 03.039 = 1 | 03.039 = 2 |
|-----------|-------------|------------|------------|------------|
| 1/2 & 3/4 | Cos1 & Sin1 | Disabled   | Enabled    | Enabled    |
| 5/6       | Z1          | Disabled   | Disabled   | Enabled    |

U1, V1 & W1 (terminals 7/8, 9/10 & 11/12) terminations are always enabled for SC Servo encoders. SCs1 and SSn1 (terminals 7/8 & 9/10) terminations are always enabled for SC SC encoders.

**P1 Device Type (03.038): SC Hiperface, SC EnDat, SC SSI, SC BiSS**

| Terminal  | Input       | 03.039 = 0 | 03.039 = 1 | 03.039 = 2 |
|-----------|-------------|------------|------------|------------|
| 1/2 & 3/4 | Cos1 & Sin1 | Disabled   | Enabled    | Enabled    |
| 5/6       | D1          | Enabled    | Enabled    | Enabled    |

For SC EnDat and SC SSI encoder the pull-apart resistors on the D1 input/output (terminals 5/6) are always disabled, and for SC Hiperface encoders the pull-apart resistors on the D1 input/output (terminals 5/6) are always enabled.

**P1 Device Type (03.038): EnDat, BiSS, SSI**

| Terminal  | Input   | 03.039 = 0 | 03.039 = 1 | 03.039 = 2 |
|-----------|---------|------------|------------|------------|
| 1/2 & 3/4 | D1/CLK1 | Enabled    | Enabled    | Enabled    |
| 5/6       | Z1      | Disabled   | Disabled   | Enabled    |

If the *P2 Device type* (03.138) is set to EnDat, BiSS or SSI and the encoder simulation output is enabled, then the Z1 input becomes the data (D2) input for the P2 position interface and termination resistors are always enabled and pull-apart resistors are always disabled.

**P1 Device Type (03.038): Resolver**

*P1 Termination Select* (03.039) has no effect as terminations are always disabled.

**P1 Device Type (03.038): Commutation Only**

*P1 Termination Select* (03.039) has no effect as terminations are always enabled.

| Parameter         | 03.040 P1 Error Detection Level                            |                |                            |
|-------------------|--|----------------|----------------------------|
| Short description | Used to enable or disable position feedback trip functions |                |                            |
| Mode              | RFC-A  |                |                            |
| Minimum           | 0<br>(Display: 00000000)                                   | Maximum        | 255<br>(Display: 11111111) |
| Default           | 1<br>(Display: 00000001)                                   | Units          |                            |
| Type              | 8 Bit User Save  | Update Rate    | Background read            |
| Display Format    | Binary   | Decimal Places | 0                          |
| Coding            | RW, BU   |                |                            |

This parameter can be used to enable or disable position feedback trip functions as follows:

| Bit | Function   | Trip(s)                | Comments   |
|-----|--|------------------------|--|
| 0   | Enable wire break detection.   | Encoder 2              | Bits 5 and 6 have no effect if this bit is set to zero.  |
| 1   | Enable phase error detection.  | Encoder 3              |  |
| 2   | Enable SSI power supply alarm bit monitor.   | Encoder 6              |  |
| 3   | Disable indicated trips.   | Encoder 1 to Encoder 6 | Trips related to bits 0, 1, 2, 5 and 6 do not occur if this bit is set to one. See note below about the position feedback device becoming uninitialised.   |
| 4   | Disable indicated trip.  | Encoder 7.             |  |
| 5   | Enable wire break detection for sine wave commutation signals for SC SC type encoders.                           | Encoder 2              |  |
| 6   | Enable wire break detection for the marker with SC SC type encoders with Heidenhain ERN1387 type marker signals. | Encoder 2              |  |
| 7   | Enable more sensitive resolver wire break detection.   | Encoder 2              | The standard wire break detection is only likely to detect a break in the excitation signal, or both the sine and cosine signals together. The more sensitive system will detect a break in any signal provided the motor is rotating. If the motor is stationary, there are positions where wire break will not be detected. The standard system uses 10% of the expected 1Vrms feedback signals as the detection threshold, but the more sensitive system uses 80%. If the resolver ratio is significantly less than 3:1 with 3V excitation, or 2:1 with 2V excitation, then the more sensitive detection system should not be used. |

Bits 3 and 4 do not prevent the device from becoming un-initialised. The trip is suppressed, but the device is still un-initialised and this is indicated by the appropriate bit for the position feedback interface in *Position Feedback Initialized* (03.076).

#### Encoder trips

The following table shows trips that can be initiated that are related to the position feedback interface P1. The sub-trip number is 1 for the drive P1 position feedback interface.

| Drive trip    | Encoders   | Reason for error   |
|---------------|--|--|
| Encoder 1     | All  | Power supply short circuit   |
| Encoder 2     | AB, FD, FR, AB Servo, FD Servo, FR Servo                               | Hardware wire-break detect on A1, B1 and Z1 inputs <sup>1</sup> . (Note that there is no wire break detection on the U1, V1 and W1 commutation inputs.)  |
|               | SC, SC Servo, SC Hiperface, SC EnDat, SC SSI, Resolver, SC SC, SC BiSS | Software wire break detection on sine wave signals. Marker and single turn sine wave commutation signals for SC SC device <sup>5</sup> . (Note that there is no wire break detection on the U1, V1 and W1 commutation inputs.)   |
| Encoder 3     | AB Servo, FD Servo, FR Servo, SC Servo                                 | Phase error <sup>2</sup>   |
|               | SC Hiperface, SC EnDat, SC SSI, SC BiSS                                | Sine/cosine phase error <sup>3</sup>   |
| Encoder 4     | SC Hiperface, SC EnDat, EnDat, BiSS, SC BiSS                           | Comms timeout  |
|               | Option Slot 1, Option Slot 2, Option Slot 3, Option Slot 4             | The option module in the selected option slot has not indicated that it is providing position feedback.  |
| Encoder 5     | SC Hiperface, SC EnDat, EnDat, BiSS, SC BiSS                           | Checksum/CRC error   |
|               | SC SSI, SSI  | Not ready at start of position transfer (i.e. data input not one)  |
| Encoder 6     | SC Hiperface, SC EnDat, EnDat, BiSS, SC BiSS                           | The encoder has indicated an error   |
|               | SSI, SC SSI  | Power supply alarm bit active  |
| Encoder 7     | All  | A set-up parameter for the device or the number of pole pairs for the currently selected motor have been changed.  |
| Encoder 8     | EnDat, SSI, BiSS   | <i>P1 Device Type</i> (03.038), <i>P1 Comms Bits</i> (03.035), <i>P1 Comms Baud Rate</i> (03.037), <i>P1 Calculation Time</i> (03.060), <i>P1 Recovery Time</i> (03.061), <i>P1 Line Delay Time</i> (03.062) and <i>P1 User Comms Enable</i> (03.067) are used to determine the time taken for the communications exchange with the encoder. If this time exceeds 250µs an <i>Encoder 8</i> trip is initiated. |
| Encoder 9     | All  | Speed feedback selected from an option slot that does not have a position feedback category option module fitted   |
| Phasing Error | All  | Incorrect encoder phasing <sup>4</sup>   |
| Encoder 12    | SC Hiperface, BiSS   | The encoder could not be identified during auto-configuration  |
| Encoder 13    | SC Hiperface, SC EnDat, EnDat, BiSS, SC BiSS                           | Data read from the position feedback device during auto-configuration is out of range  |
| Encoder 14    | BiSS, SC BiSS  | The turns or position padding values in parameter <i>P1 Additional Configuration</i> (03.074) are out of range.  |

1. If the terminations are not enabled on the A1, B1 or Z1 inputs the wire break system will not operate. (Note that as default the Z1 input terminations are disabled to disable wire break detection on this input.)
2. Phase error detection for AB Servo, FD Servo, FR Servo or SC Servo encoders monitors the relationship between the position from the incremental signals and the commutation signals to ensure that the incremental pulses have been counted correctly. The error is detected if the incremental position moves outside the position range defined by the UVW commutation signals by 10°. The trip is initiated if the error is detected for 10 consecutive samples. This system should not be used unless one encoder line (AB Servo), or two lines (FD Servo, FR Servo), are less than 10° electrical or else spurious *Encoder 3* trips will occur.
3. Phase error detection for SINCOS encoders with comms monitors the relationship between the position derived from the sine waves with the position derived via comms. The encoder is interrogated via comms and the comparison is made once per second. If the error is greater than 10° electrical for 10 consecutive samples the trip is initiated. This system should not be used unless one sine wave is less than 10° electrical or else spurious *Encoder 3* trips will occur.
4. Incorrect encoder phasing is detected if the motor reaches half of the speed defined by VM\_SPEED\_FREQ\_REF[MAX] and the phasing error is large enough for the motor to accelerate uncontrollably.
5. Detection of wire break on the sine wave commutation signals or marker of an SC SC device may require the encoder to rotate by several mechanical turns before the fault is detected, i.e. up to 2 turns for the sine wave commutation signals and up to 3 turns for the marker).

#### Wire-break detection

It may be important to detect a break in the connections between the drive and the position feedback device. This feature is provided for most position feedback devices either directly or indirectly as listed below.

| Device  | Detection method  | Trip produced           |
|---|---|-------------------------|
| AB, FD, FR, AB Servo,<br>FD Servo, FR Servo                               | Hardware detectors on the A1, B1 and Z1 signal detect a wire break.   | Encoder 2               |
| SC, SC Servo,<br>SC Hiperface,<br>SC EnData,<br>SC SSI, SC SC, SC<br>BiSS | The magnitudes of the sine wave signals are monitored as the magnitude of a vector which is calculated as $\sqrt{(\text{Sine}^2 + \text{Cosine}^2)}$ . If this is less than the value produced by two valid waveforms with a peak to peak magnitude of 0.25V (i.e. 0.25 of the nominal level of 1V peak to peak) then a trip is initiated. This always detects wire break in the sine and cosine connections if the position feedback is changing. If the position feedback is stationary this may not detect wire break until the position feedback moves, e.g. if the sine connection is broken, but the cosine is at it's maximum then wirebreak will not be detected.<br><br>Additional monitoring is provided for SC SC encoders to give software wire break detection for the single turn sine wave commutation signals and the marker. If the device is a Heidenhain ERN1387 the marker is too small for hardware wire break detection, and so the additional software detection is required to detect wire break on the marker. | Encoder 2               |
| Resolver  | The magnitudes of the sine and cosine input signals are monitored in a similar way to SINCOS signals where the peak of the sine and cosine waveforms are used to calculate the vector magnitude. If the calculated value is less than the value produced by two valid waveforms with a differential peak to peak magnitude of 0.4V then a trip is initiated. This detects wire break in the sine and cosine connections. If the position feedback is stationary this may not detect wire break until the position feedback moves, e.g. if the sine connection is broken, but the cosine is at it's maximum then wirebreak will not be detected.   | Encoder 2               |
| SC Hiperface,<br>SC EnDat, EnDat,<br>BiSS, SC BiSS                        | Wire break in the comms link is detected by a CRC or timeout error.   | Encoder 4,<br>Encoder 5 |
| SSI, SC SSI   | Wire break detection in the comms is difficult with these devices. However, if power supply alarm bit monitoring is enabled the drive will be looking for a one at the start of the message and a zero to indicate that the power supply is okay. If the clock stops or the data line is disconnected the data input to the drive may stay in one state or the other and cause a trip.  | Encoder 5,<br>Encoder 6 |

#### Position feedback power supply trips

The position feedback power supply from the drive can be switched off by the drive either because the power supply is overloaded (*Encoder 1* trip) or because the internal 24V supply within the drive is overloaded (*PSU 24V* trip). The internal 24V supply provides power for the position feedback power supply, user 24V output, digital I/O, option modules etc. To ensure that an *Encoder 1* trip is not initiated when the internal 24V is overloaded, and subsequently switched off by the drive, there is a delay of 40ms in the detection of *Encoder 1* trip. It is possible for other position feedback trips, such as wire break detection (i.e. *Encoder 2*), to occur when the power supply is removed from the position feedback device. Therefore overloading the internal 24V supply or the position feedback supply could result in an immediate *Encoder 2* trip. To ensure that the correct reason for the trip is given *PSU 24V* and *Encoder 1* trips override an existing *Encoder 2* to *Encoder 6* trip. This means that both the original trip (*Encoder 2* to *Encoder 6*) and then the new trip (*PSU 24V* or *Encoder 1*) are stored in the trip log.

| Parameter         | 03.041 P1 Auto-configuration Select  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to enable interrogation of the encoder to determine the set up required |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 1  | Units          |                 |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text     |
|-------|----------|
| 0     | Disabled |
| 1     | Enabled  |

#### P1 Device Type (03.038): SC Hiperface, SC EnDat, EnDat

If auto-configuration has not been disabled (i.e. *P1 Auto-configuration Select* (03.041) is not 0) then during position feedback initialisation the encoder is interrogated to determine whether the encoder is a rotary or linear encoder and *P1 Linear Feedback Select* (03.051) is set up appropriately. Then the following parameters are set up based on information from the encoder:

| Rotary   | Linear   |
|--|--|
| <i>P1 Rotary Turns Bits</i> (03.033)           | <i>P1 Linear Comms Pitch</i> (03.052)                |
| <i>P1 Rotary Lines Per Revolution</i> (03.034) | <i>P1 Linear Line Pitch</i> (03.053)                 |
| <i>P1 Comms Bits</i> (03.035)                  | <i>P1 Comms Bits</i> (03.035)                        |
| <i>P1 Additional Configuration</i> (03.074)    | <i>P1 Linear Comms And Line Pitch Units</i> (03.054) |

The following actions are also taken to set up the timing for the encoder.

| Comms Protocol | Actions taken   |
|----------------|---|
| EnDat 2.1      | <i>P1 Calculation Time</i> (03.060) = From the encoder<br><i>P1 Recovery Time</i> (03.061) = 30µs<br>Line delay measured and result written to <i>P1 Line Delay Time</i> (03.062)   |
| EnDat 2.2      | <i>P1 Calculation Time</i> (03.060) = From the encoder<br><i>P1 Recovery Time</i> (03.061) is set to 4µs (and the encoder itself is set up to use its short recovery time of 3.75µs) if the <i>P1 Comms Baud Rate</i> (03.037) is 1M or more.<br>Line delay measured and result written to <i>P1 Line Delay Time</i> (03.062) |

Once these parameters have been set up it should be possible for the drive to operate correctly with the encoder. Auto-configuration occurs as part of the position interface initialisation if selected, and so if the auto-configuration fails (i.e. communications cannot be established) then initialisation will not be completed. If initialisation has not been completed successfully the drive cannot be enabled (see *Enable Conditions* (06.010)). For SC Hiperface encoders the drive must identify the encoder model number to perform auto-configuration. If communications is established, but the drive cannot recognise the encoder model, an *Encoder 12* trip is produced immediately.

If auto-configuration is disabled ((i.e. *P1 Auto-configuration Select* (03.041) = 0) then none of the above actions are carried out except for the line delay measurement.

**P1 Device Type (03.038): BiSS, SC BiSS**

With *P1 Auto-configuration Select* (03.041) set to either 0 or 1 the only action taken during initialisation is to measure the line delay and write the result to *P1 Line Delay Time* (03.062).

**P1 Device Type (03.038): All other device types**

*P1 Auto-configuration Select* (03.041) has no effect.

| Parameter         | 03.042 P1 Feedback Filter   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the time period for a sliding window filter that may be applied to the feedback taken from the drive P1 position feedback interface |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 5               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text     |
|-------|----------|
| 0     | Disabled |
| 1     | 1ms      |
| 2     | 2ms      |
| 3     | 4ms      |
| 4     | 8ms      |
| 5     | 16ms     |

*P1 Feedback Filter* (03.042) defines the time period for a sliding window filter that may be applied to the feedback taken from the drive P1 position feedback interface. This is particularly useful in applications where the drive encoder is used to give speed feedback for the speed controller and where the load includes a high inertia, and so the speed controller gains are very high. Under these conditions, without a filter on the feedback, it is possible for the speed loop output to change constantly from one current limit to the other and lock the integral term of the speed controller. In Unidrive SP this filter was applied to the output of the sensorless speed feedback, however, a separate filter is now provided (see *Sensorless Mode Filter* (03.079)).

| Parameter         | 03.043 P1 Maximum Reference                        |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the maximum speed reference from device P1 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 33000           |
| Default           | 1500   | Units          |                 |
| Type              | 16 Bit User Save                                   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, BU   |                |                 |

The speed feedback from the drive P1 position feedback interface can be used as a source to control a parameter. The speed feedback is scaled to give a value as a percentage of *P1 Maximum Reference* (03.043) in 0.1% units which is displayed in *P1 Reference* (03.045). The value is then scaled by the *P1 Reference Scaling* (03.044) and then routed to the destination defined by *P1 Reference destination* (03.046).

Normally the destination is updated every 4ms, but if the destination is the *Hard Speed Reference* (03.022), *P1 Maximum Reference* (03.043) = VM\_SPEED\_FREQ\_REF[MAX] and *P1 Reference Scaling* (03.044) = 1.000 it is updated every 250µs. Although the hard speed reference is updated every 250µs internally a value in rpm or mm/s is written to *Hard Speed Reference* (03.022) every 4ms for indication only. It should be noted that if the fast update method is used the resolution of the speed feedback derived from the position feedback device defines the resolution of the hard speed reference and that any ripple on the feedback will be present on the hard speed reference (see *Speed Feedback* (03.002)).



| Parameter         | 03.044 P1 Reference Scaling                 |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the scaling applied to P1 reference |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 4.000           |
| Default           | 1.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW  |                |                 |

See *P1 Maximum Reference* (03.043).

| Parameter         | 03.045 P1 Reference                |                |           |
|-------------------|------------------------------------|----------------|-----------|
| Short description | Displays the value in P1 reference |                |           |
| Mode              | RFC-A                              |                |           |
| Minimum           | -100.0                             | Maximum        | 100.0     |
| Default           |                                    | Units          | %         |
| Type              | 16 Bit Volatile                    | Update Rate    | 4ms write |
| Display Format    | Standard                           | Decimal Places | 1         |
| Coding            | RO, FI, ND, NC, PT                 |                |           |

See *P1 Maximum Reference* (03.043).

| Parameter         | 03.046 P1 Reference destination                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the destination parameter for P1 reference |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                     |                |                  |

See *P1 Maximum Reference* (03.043).

| Parameter         | 03.047 P1 SSI Incremental Mode          |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to enable SSI incremental mode |                |                 |
| Mode              | RFC-A                                   |                |                 |
| Minimum           | 0                                       | Maximum        | 1               |
| Default           | 0                                       | Units          |                 |
| Type              | 1 Bit User Save                         | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW                                      |                |                 |

#### **P1 Device Type (03.038): EnDat, BISS**

*P1 SSI Incremental Mode* (03.047) has no effect and these comms modes can only operate in incremental mode, i.e. the absolute position is taken during encoder initialisation and then incremental positions are accumulated from that point on, to determine the position. If there is an error in the position read from the encoder this will be detected from the CRC check, and the position data will be ignored until correct data is available or the drive trips after a number of consecutive errors. This prevents large spurious changes in position due to data errors, and so absolute mode is not required.

#### **P1 Device Type (03.038): SSI**

If *P1 SSI Incremental Mode* (03.047) = 0 the complete absolute position is read at each sample. Care should be taken when using this mode as some unwanted effects can occur when the encoder passes through the boundary between its maximum position and zero. In this mode the encoder can be used for motor control provided at least 6 bits of turns information are provided by the encoder otherwise an over speed trip will be produced as the position passes over the maximum position to zero boundary. *P1 Normalised Position* (03.058) can be used for position control over this boundary provided the normalised turns bits are set up so that the normalised positions do not contain turns information that is not available from the encoder. As the SSI format does not include any error checking it is not possible to detect if the position data has been corrupted by noise. The benefit of using the absolute position directly from an SSI encoder is that even if the encoder communications are disturbed by noise and position errors occur, the position will always recover the correct position after the disturbance has ended.

If *P1 SSI Incremental Mode* (03.047) = 1 the absolute position is only taken from the encoder during initialisation. The change of position over each sample is then accumulated to determine the position. This method always gives 16 bits of turns information that can always be used without jumps in position whatever value is used as the turns bits for normalisation. If noise corrupts the data from an SSI encoder it is possible to have apparent large change of position, and this can result in the turns information becoming and remaining corrupted until the encoder is re-initialised.

If an SSI encoder is used, but is not powered from the drive, and the encoder is powered up after the drive, it is possible that the first change of position detected could be large enough to cause the problems described above. This can be avoided if the encoder interface is initialised with *Initialise Position Feedback* (03.075) after the encoder has powered up. If the encoder includes a power supply alarm bit, the power supply monitor should be enabled. This will ensure that the drive remains tripped until the encoder is powered up and the action of resetting the trip will reinitialise the encoder interface.

#### **P1 Device Type (03.038): All other device types**

*P1 SSI Incremental Mode* (03.047) has no effect.

| Parameter         | 03.048 P1 SSI Binary Mode          |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Set to 1 to enable SSI binary mode |                |                 |
| Mode              | RFC-A                              |                |                 |
| Minimum           | 0                                  | Maximum        | 1               |
| Default           | 0                                  | Units          |                 |
| Type              | 1 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW                                 |                |                 |

**P1 Device Type (03.038): SC SSI, SSI**

SSI encoders normally use Gray code data format. However, some encoders use binary format which may be selected by setting *P1 SSI Binary Mode* (03.048) to one.

**P1 Device Type (03.038): All other device types**

*P1 SSI Binary Mode* (03.048) has no effect.

| Parameter         | 03.049 P1 Additional Power-up Delay  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines an additional delay for when any attempt is made to communicate to the device P1 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.0  | Maximum        | 25.0            |
| Default           | 0.0  | Units          | s               |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW, BU   |                |                 |

When the position feedback is initialised, at power-up or at any other time, a delay is included before the information from the feedback device is used or any attempt is made to communicate with the device. The minimum delays are shown in the table below. *P1 Additional Power-up Delay* (03.049) defines an additional delay that is added to the minimum delay.

| P1 Device Type (03.038)  | Minimum delay |
|--|---------------|
| AB, FD, FR<br>AB Servo, FD Servo, FR Servo<br>SC, SC Servo<br>Resolver, SC SC                                    | 100ms         |
| SC Hiperface   | 150ms         |
| EnDat, SC EnDat<br>SSI, SC SSI<br>BISS, SC BiSS<br>Option Slot 1, Option Slot 2,<br>Option Slot 3, Option Slot 4 | 1.3s          |

| Parameter         | 03.050 P1 Feedback Lock   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to prevent the position feedback parameters for P1 being updated |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

If *P1 Feedback Lock* (03.050) = 1 then *P1 Revolution/Pole Pitch Counter* (03.028), *P1 Position* (03.029) and *P1 Fine Position* (03.030) are not updated. If *P1 Feedback Lock* (03.050) = 0 then these parameters are updated normally.

| Parameter         | 03.051 P1 Linear Feedback Select   |                |   |
|-------------------|--|----------------|---|
| Short description | Set to 1 to configure the P1 interface to operate with a linear position feedback device |                |   |
| Mode              | RFC-A  |                |   |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |   |
| Type              | 1 Bit User Save  | Update Rate    | Background read, Auto-configuration write |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RW   |                |   |

If *P1 Linear Feedback Select* (03.051) = 0 then the drive P1 position feedback interface is configured to operate with a rotary position feedback device. *P1 Rotary Turns Bits* (03.033) and *P1 Rotary Lines Per Revolution* (03.034) should be used to set up the position feedback interface.

If *P1 Linear Feedback Select* (03.051) = 1 then the position feedback interface is configured to operate with a linear position feedback device. *P1 Linear Comms Pitch* (03.052) and *P1 Linear Line Pitch* (03.053) should be used to set up the position feedback interface.

| Parameter         | 03.052 P1 Linear Comms Pitch   |                |   |
|-------------------|--|----------------|---|
| Short description | Defines the distance covered by the least significant bit of the position information in a comms message from a linear encoder |                |   |
| Mode              | RFC-A  |                |   |
| Minimum           | 0.001  | Maximum        | 100.000                                   |
| Default           | 0.001  | Units          |   |
| Type              | 32 Bit User Save   | Update Rate    | Background read, auto-configuration write |
| Display Format    | Standard   | Decimal Places | 3   |
| Coding            | RW   |                |   |

**P1 Device Type (03.038): SC Hiperface, EnDat, SC EnDat, SSI, SC SSI, BiSS, SC BiSS**

*P1 Linear Comms Pitch* (03.052) is used to define the distance covered by the least significant bit of the position information in a comms message from a linear encoder. The units used by this parameter are defined by *P1 Linear Comms And Line Pitch Units* (03.054).

**P1 Device Type (03.038): Any other device**

*P1 Linear Comms Pitch* (03.052) has no effect.

| Parameter         | 03.053 P1 Linear Line Pitch                 |                |   |
|-------------------|---|----------------|---|
| Short description | Defines the linear line pitch for device P1 |                |   |
| Mode              | RFC-A                                       |                |   |
| Minimum           | 0.001                                       | Maximum        | 100.000                                   |
| Default           | 0.001                                       | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Background read, auto-configuration write |
| Display Format    | Standard                                    | Decimal Places | 3   |
| Coding            | RW  |                |   |

*P1 Linear Line Pitch* (03.053) only has any effect if the position feedback interface is being used with a linear device (i.e. *P1 Linear Feedback Select* (03.051) = 1) and should be used to define the distances listed below for each type of device. The units used by this parameter are defined by *P1 Linear Comms And Line Pitch Units* (03.054).

**P1 Device Type (03.038): AB, AB Servo**

*P1 Linear Line Pitch* (03.053) should be set to the distance covered by one line period on the encoder.

**P1 Device Type (03.038): FD, FR, FD Servo, FR Servo**

*P1 Linear Line Pitch* (03.053) should be set to the distance covered by two line periods on the encoder.

**P1 Device Type (03.038): SC, SC Hiperface, SC EnDat, SC SSI, SC Servo, SC SC, SC BiSS**

*P1 Linear Line Pitch* (03.053) should be set to the distance covered by one sine wave period on the encoder.

**P1 Device Type (03.038): Resolver**

*P1 Linear Line Pitch* (03.053) should be set to the distance covered by one pole of the resolver divided by 2<sup>14</sup>.

**P1 Device Type (03.038): Any other device**

*P1 Linear Line Pitch* (03.053) has no effect.

| Parameter         | 03.054 P1 Linear Comms And Line Pitch Units                   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the linear units in either millimetres or micrometres |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

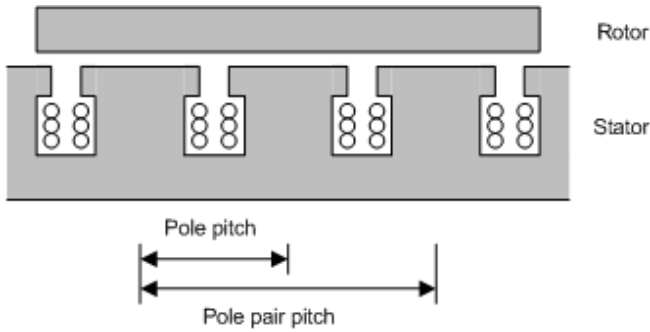
| Value | Text        |
|-------|-------------|
| 0     | millimetres |
| 1     | micrometres |

*P1 Linear Comms And Line Pitch Units* (03.054) defines the units used by *P1 Linear Comms Pitch* (03.052) and *P1 Linear Line Pitch* (03.053) in either millimetres or micrometres.

| Parameter         | 03.055 P1 Pole Pair Pitch   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the change of position for one electrical revolution of the drive output with a linear position device. |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.01  | Maximum        | 1000.00         |
| Default           | 10.00   | Units          | mm              |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 2               |
| Coding            | RW  |                |                 |

*P1 Pole Pair Pitch* (03.055) gives the distance equivalent to one electrical revolution when linear position feedback is used with a motor. One electrical

revolution is one cycle of the a.c. output current from the drive. If the linear position feedback device is being used with a linear motor, then *P1 Pole Pair Pitch* (03.055) should be set to the pole pair pitch of the motor. The pole pitch for linear motors can be the distance between the pole pieces on the stator as shown below. If this is the case the pole pair pitch is twice the length of the motor pole pitch. If *Number Of Motor Poles* (05.011) is set up correctly for a linear motor as 2, then the position feedback as shown in *P1 Position* (03.029) should change by one revolution (65536) over the distance defined by *P1 Pole Pair Pitch* (03.055).



If the linear position feedback is not being used with a motor then the pole pair pitch is the distance over which the position feedback as shown in *P1 Position* (03.029) should change by one revolution, i.e. 65536.

| Parameter         | 03.056 <i>P1 Feedback Reverse</i>                          |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to reverse the direction of the position feedback |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

If *P1 Feedback Reverse* (03.056) = 1 the position feedback is negated. This can be used to reverse the direction of the position feedback. It should be noted that the position and the turns are negated, so for example if *P1 Revolution/Pole Pitch Counter* (03.028) = 0 and *P1 Position* (03.029) = 1000 with *P1 Feedback Reverse* (03.056) = 0, then if *P1 Feedback Reverse* (03.056) is set to one then *P1 Revolution/Pole Pitch Counter* (03.028) = 65535 (-1) and *P1 Position* (03.029) = 64536 (65536 - 1000). This will have an effect on the initial position for example, for a resolver which is a single turn absolute device, where the initial *P1 Revolution/Pole Pitch Counter* (03.028) = 0 with *P1 Feedback Reverse* (03.056) = 0 or 65535 (-1) with *P1 Feedback Reverse* (03.056) = 1.

Reversing the position feedback will not compensate for the following situations:

1. The direction of the incremental signals and the direction of the digital commutation signals are different for encoders which have digital commutation signals (i.e. AB Servo)
2. The direction of the SINCOS signals are incorrect for a SINCOS encoder with comms.

| Parameter         | 03.057 <i>P1 Normalisation Turns</i>                                      |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the number of turns bits included in the normalisation parameters |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 16              |
| Default           | 16  | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

The combination of *P1 Revolution/Pole Pitch Counter* (03.028), *P1 Position* (03.029) and *P1 Fine Position* (03.030) give the position feedback as a 48 bit value. This position cannot be read atomically without locking the position feedback (*P1 Feedback Lock* (03.050) = 1) and it cannot be used directly by the Advanced Motion Controller (see Menu 31). It is useful to be able to create 32 bit position values that can be held by a single parameter as this value can be accessed atomically and can be used directly by the Advanced Motion Controller. *P1 Normalisation Turns* (03.057) defines the number of turns bits included in the following parameters.

*P1 Normalised Position* (03.058)

*P1 Normalised Marker Position* (03.059)

*F1 Normalised Freeze Position* (03.103) if P1 is the source position for freeze function F1

*F2 Normalised Freeze Position* (03.108) if P1 is the source position for freeze function F2

| Parameter         | 03.058 <i>P1 Normalised Position</i>  |                |             |
|-------------------|---|----------------|-------------|
| Short description | Displays the position taken from the position feedback device including the effect of the marker function |                |             |
| Mode              | RFC-A   |                |             |
| Minimum           | -2147483648   | Maximum        | 2147483647  |
| Default           |   | Units          |             |
| Type              | 32 Bit Volatile   | Update Rate    | 250µs write |
| Display Format    | Standard  | Decimal Places | 0           |
| Coding            | RO, ND, NC, PT  |                |             |

*P1 Normalised Position* (03.058) is the position taken from the position feedback device including the effect of the marker function.

See *P1 Normalisation Turns* (03.057) for details of the format.

| Parameter         | 03.059 <i>P1 Normalised Marker Position</i>               |                |             |
|-------------------|---|----------------|-------------|
| Short description | Displays the normalised position at the last marker event |                |             |
| Mode              | RFC-A   |                |             |
| Minimum           | -2147483648   | Maximum        | 2147483647  |
| Default           |   | Units          |             |
| Type              | 32 Bit Volatile   | Update Rate    | 250µs write |
| Display Format    | Standard  | Decimal Places | 0           |
| Coding            | RO, ND, NC, PT  |                |             |

*P1 Normalised Marker Position* (03.059) is the value *P1 Normalised Position* (03.058) at the last marker event provided bit 2 of *P1 Marker Mode* (03.031) is set to 1. See *P1 Marker Mode* (03.031) for more details.

| Parameter         | 03.060 <i>P1 Calculation Time</i>   |                |   |
|-------------------|---|----------------|---|
| Short description | Defines the time from the first edge of the clock signal from the position feedback interface until the encoder has calculated the position and is ready to return this information |                |   |
| Mode              | RFC-A   |                |   |
| Minimum           | 0   | Maximum        | 20  |
| Default           | 5   | Units          | µs  |
| Type              | 8 Bit User Save   | Update Rate    | Background read, auto-configuration write |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW  |                |   |

***P1 Device Type* (03.038): EnDat, BiSS**

*P1 Calculation Time* (03.060) is the time from the first edge of the clock signal from the position feedback interface until the encoder has calculated the position and is ready to return this information. This is used to calculate the overall time for a message interchange with the encoder. See *P1 Low Speed Update Rate Active* (03.063) for more details.

***P1 Device Type* (03.038): Any other type of device**

*P1 Calculation Time* (03.060) has no effect.

| Parameter         | 03.061 <i>P1 Recovery Time</i>   |                |   |
|-------------------|--|----------------|---|
| Short description | Defines the time that must be allowed after each message interchange before a new message begins |                |   |
| Mode              | RFC-A  |                |   |
| Minimum           | 4  | Maximum        | 100                                       |
| Default           | 30   | Units          | µs  |
| Type              | 8 Bit User Save  | Update Rate    | Background read, auto-configuration write |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RW   |                |   |

***P1 Device Type* (03.038): EnDat, SSI, BiSS**

*P1 Recovery Time* (03.061) is the time that must be allowed after each message interchange before a new message begins.

***P1 Device Type* (03.038): Any other type of device**

*P1 Recovery Time* (03.061) has no effect.

| Parameter         | 03.062 <i>P1 Line Delay Time</i>   |                |   |
|-------------------|--|----------------|---|
| Short description | Displays the transmission delay between the position feedback interface and the encoder and back again |                |   |
| Mode              | RFC-A  |                |   |
| Minimum           | 0  | Maximum        | 5000  |
| Default           |  | Units          | ns  |
| Type              | 16 Bit User Save   | Update Rate    | Background read, position feedback initialisation write |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RO, ND, NC, PT   |                |   |

***P1 Device Type* (03.038): EnDat, SC EnDat, BiSS, SC BiSS**

During position feedback initialisation the transmission delay between the position feedback interface and the encoder and back again is measured and stored in *P1 Line Delay Time* (03.062). This value is then used to compensate for this delay so that the clock/data skew does not prevent the data from the encoder from being read. This means that longer line lengths can be used with these feedback devices provided the correct cable and connection arrangements are used.

***P1 Device Type* (03.038): Any other type of device**

*P1 Line Delay Time* (03.062) is always zero.

|                   |  |                |                  |
|-------------------|--|----------------|------------------|
| <b>Parameter</b>  | <b>03.063 P1 Low Speed Update Rate Active</b>      |                |                  |
| Short description | Indicates when the low speed update rate is active |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                                     | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                     |                |                  |

**P1 Device Type (03.038): EnDat, SSI, BiSS**

There is a delay when the position information is obtained via a communications interface from an encoder. It is assumed that the position information is taken from all types of encoder at a fixed datum point during each sample period. The drive initiates the comms transfer at a suitable point in advance of the datum to ensure that the position information is available when required. A correction is then applied to the position information based on the change of position over the previous sample and the advance time so that the position appears to have been sampled at the datum. If the communications exchange, including allowing the encoder a recovery time (*P1 Recovery Time* (03.061)), is completed in 60µs and the time required to obtain the full position is completed in 40µs then the position is sampled at each current controller task and *P1 Low Speed Update Rate Active* (03.063) = 0. Otherwise if the communication exchange is completed in 230µs the position is sampled every 250µs and *P1 Low Speed Update Rate Active* (03.063) = 1. If the complete exchange takes any longer an *Encoder 8* trip is initiated. The following table shows the calculations used by the drive to determine the necessary time to obtain the required data.

| Protocol          | Time for full position  | Time for complete data exchange |
|-------------------|---|---------------------------------|
| EnDat 2.1 encoder | $t_{ST} + t_D + 10T + 2T + NtT + 5T$<br>where $t_{cal} \leq t_{ST} + t_D/2 + 10T$<br>$t_{ST} + t_D + t_{cal} + 2T + NtT + 5T$<br>where $t_{cal} > t_{ST} + t_D/2 + 10T$                     | Time for full position + $t_m$  |
| EnDat 2.2 encoder | $t_{ST} + t_D + 10T + 3T + NtT + 5T + t_{Add}$<br>where $t_{cal} \leq t_{ST} + t_D/2 + 10T$<br>$t_{ST} + t_D + t_{cal} + 3T + NtT + 5T + t_{Add}$<br>where $t_{cal} > t_{ST} + t_D/2 + 10T$ | Time for full position + $t_m$  |
| BiSS              | $t_D + t_{cal} + 2T + NtT + 2T + (CRCBits \times T)$  | Time for full position + $t_m$  |
| SSI               | $t_D + T + NtT$<br>( $t_D$ cannot be measured, and so a value of 1.25µs is used)  | Time for full position + $t_m$  |

where

| Value     | Description   | Source   |
|-----------|---|--|
| $t_{ST}$  | EnDat start time  | For 100K baud = 5µs, 200K baud = 2.5µs, for all other baud rates = 2µs |
| $t_D$     | Transmission delay from the drive to the encoder and back | <i>P1 Line Delay Time</i> (03.062)                                     |
| T         | 1 / baud rate   | <i>P1 Comms Baud Rate</i> (03.037)                                     |
| $t_{cal}$ | Position calculation time                                 | <i>P1 Calculation Time</i> (03.060)                                    |
| Nt        | Total number of position information bits                 | <i>P1 Comms Bits</i> (03.035)  |
| $t_m$     | Encoder recovery time                                     | <i>P1 Recovery Time</i> (03.061)                                       |
| $t_{Add}$ | Time for additional information                           | $t_{Add1} = 31T + t_{ST} + 30T$  |
| CRCBits   | The number of bits in the CRC applied to the position     | <i>P1 Additional Configuration</i> (03.074)                            |

**P1 Device Type (03.038): Option Slot 1, Option Slot 2, Option Slot 3, Option Slot 4**

It is intended that position information is provided by an option module with an update rate of 250µs. It is assumed that the position that is provided is sampled 230µs before the position datum point. *P1 Low Speed Update Rate Active* (03.063) is always one to indicate that a sample rate of 250µs is being used.

**P1 Device Type (03.038): Any other type of device**

*P1 Low Speed Update Rate Active* (03.063) is always zero.

| Parameter         | 03.064 P1 Encoder Protocol Detected               |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines which protocol is used with the device P1 |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 4                |
| Default           |   | Units          |                  |
| Type              | 8 Bit Volatile                                    | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT                                |                |                  |

| Value | Text      |
|-------|-----------|
| 0     | None      |
| 1     | Hiperface |
| 2     | EnDat2.1  |
| 3     | EnDat2.2  |
| 4     | BiSS      |

*P1 Encoder Protocol Detected* (03.064) shows the encoder comms protocol detected during position feedback initialisation. If *P1 Device Type* (03.038) is set to SC Hiperface or BiSS then *P1 Encoder Protocol Detected* (03.064) is set to the appropriate value after successful communication with the encoder during initialisation. If *P1 Device Type* (03.038) is set to EnDat or SC EnDat then *P1 Encoder Protocol Detected* (03.064) is set to the appropriate EnDat protocol after successful communication with the encoder during initialisation. If communications is not successful during initialisation then *P1 Encoder Protocol Detected* (03.064) is set to 0.

| Parameter         | 03.065 P1 Resolver Poles                                     |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the number of poles for the resolver connected to P1 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 1  | Maximum        | 10              |
| Default           | 1  | Units          | PolePairs       |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

#### **P1 Device Type (03.038): Resolver**

*P1 Resolver Poles* (03.065) should be set to the number pole pairs for the resolver connected to the P1 position feedback interface. If the resolver is being used for motor control then a 2 pole resolver can be used with any motor, but if the number of resolver poles is greater than 2, it can only be used when motor poles / resolver poles is an integer (i.e. a 4 pole resolver can be used with an 8 pole motor). Note that this value is only used if *P1 Linear Feedback Select* (03.051) = 0. If not then the position feedback must be set up using *P1 Linear Line Pitch* (03.053) and *P1 Pole Pair Pitch* (03.055).

#### **P1 Device Type (03.038): Any other type of device**

*P1 Resolver Poles* (03.065) has no effect.

| Parameter         | 03.066 P1 Resolver Excitation                               |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the excitation of the resolver when connected to P1 |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 7               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text         |
|-------|--------------|
| 0     | 6kHz 3V      |
| 1     | 8kHz 3V      |
| 2     | 6kHz 2V      |
| 3     | 8kHz 2V      |
| 4     | 6kHz 3V Fast |
| 5     | 8kHz 3V Fast |
| 6     | 6kHz 2V Fast |
| 7     | 8kHz 2V Fast |

#### **P1 Device Type (03.038): Resolver**

*P1 Resolver Excitation* (03.066) defines the excitation voltage and frequency. A level of 3V r.m.s. should be used with 3:1 resolvers and 2V r.m.s. with 2:1 resolvers. These give a nominal level of 1V r.m.s. feedback into the position feedback interface. Other ratios can be used, but if the feedback is increased above the expected levels the feedback seen by the drive will be distorted. The resolution of the position feedback will be reduced proportionally if the feedback is less than 1V r.m.s. With a 2 pole resolver the nominal resolution is equivalent to 1600 line encoder. If the number of resolver poles are increased then the resolution increases, for example a 4 pole resolver gives a resolution equivalent to a 3200 line encoder, etc. The position feedback system allows for a delay from the excitation to the feedback from the resolver of up to 45° and will compensate for this lag during the position feedback initialisation process. (It should be noted that the excitation voltage given is the nominal level, but this can be slightly higher than the nominal level.)

The resolver interface offers two sampling rates: standard and fast. With standard sampling (*P1 Resolver Excitation* (03.066) < 4) any switching frequency can be used with any resolver excitation frequency and the switching frequency can be changed when the position feedback is being used without any transient effects. There is a 250us sampling delay with this system and if the resolver feedback is used for motor control the system can become unstable at high speeds. It is recommended that the motor speed is limited to 9000rpm / Motor Pole Pairs. With fast sampling (*P1 Resolver Excitation* (03.066) ≥ 4)

the sample delay is significantly reduced and resolver feedback can be used up to the maximum limit of 30000rpm, but the feedback is much noisier and the acoustic noise produced by the motor is increased. It is possible to switch between standard and fast sampling while the drive is enabled and controlling a motor, so for example standard sampling can be used at low speeds, and then fast sampling can be used at higher speeds. Normally when *P1 Resolver Excitation* (03.066) is changed an *Encoder 7* is initiated because the position feedback set-up has been changed and the position feedback interface needs to be re-initialised. However, if the new value of *P1 Resolver Excitation* (03.066) is the old value plus or minus 4 (i.e. 0 to 4, or 5 to 1, etc.) then a trip is not initiated and the interface does not need to be initialised.

The following restrictions apply if fast sampling is selected:

1. 2, 4, 8 or 16kHz switching frequencies should be used with 8kHz excitation. 3, 6 or 12kHz switching frequencies should be used with 6kHz excitation. If these conditions are not met the system will automatically operate with standard sampling.
2. If the switching frequency is changed by one step, i.e. from 2 to 3kHz, there will be a transient in the position feedback. To ensure that this does not happen as the drive alters the switching frequency because it has become too hot *Auto-switching Frequency Step Size* (05.036) should be left at its default value, so that all changes are made in steps of 2.
3. If the resolver feedback is not being used as the feedback for motor control then its sample rate is automatically reduced and the position feedback will automatically operate with standard sampling.
4. If a linear mode is selected (i.e. *P1 Linear Feedback Select* (03.051) = 1) then the system will operate with standard sampling.

**P1 Device Type (03.038): Any other type of device**

*P1 Resolver Excitation* (03.066) has no effect

| Parameter         | 03.067 P1 User Comms Enable  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Enables the use of the user comms parameters to communicate to the encoder connected to P1 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit Volatile   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, NC, PT   |                |                 |

If *P1 User Comms Enable* (03.067) set to one it is possible to use *P1 User Comms Transmit Register* (03.068) and *P1 User Comms Receive Register* (03.069) to communicate with an encoder that has a Hiperface, EnDat 2.1, EnDat2.2 or BiSS interface. A description of how to use these registers is given below.

**P1 Device Type (03.038): SC Hiperface, SC EnDat**

Hiperface or EnDat 2.1 communications are used as appropriate if *P1 User Comms Enable* (03.067) is set to one.

**P1 Device Type (03.038): EnDat**

Communication is enabled when *P1 User Comms Enable* (03.067) is set to one. If the encoder supports EnDat 2.2 it is possible to enable user communications at any time even if the drive is enabled. Otherwise if the encoder only supports EnDat 2.1 communication with the encoder is not possible.

**P1 Device Type (03.038): BISS, SC BiSS**

If *P1 User Comms Enable* (03.067) is set to one it is possible to enable user communications at any time even if the drive is enabled.

**Encoder communications**

A communication channel is provided to allow the user to communicate with an encoder connected to one of the communications interfaces. It should be noted that the communications channel is disabled under the following conditions:

1. If auto-configuration is active.
2. During the transfer of electronic nameplate data.
3. If the position feedback device is not initialised.
4. The channel is being used by an option module with safety functions.

To send a message to the encoder the required message must be written to the transmit register. To read the response from the encoder the data is read from the receive register. The data is written one byte at a time and is stored in a 16 byte buffer before being sent to the encoder. The data should only be written to the transmit register when it has been cleared to zero by the drive. Bits 13 to 15 are used to control the interface.

| Bit | Function   |
|-----|--|
| 15  | This bit should be set to one each time data is written to the transmit register. This indicates that data has been written. This bit will be cleared when the LS byte of the data has been transferred into the comms buffer. |
| 14  | This bit should be set when the last byte of the message is written to the transmit register. The data will be read and transferred to the comms buffer and then the message will be sent to the encoder.                      |
| 13  | This bit should be set when the first byte of the message is written to the transmit register. Setting this bit will reset the pointer to the start of the comms buffer.   |

Data can be read from the receive register at any time. If there is data in the buffer bit 15 will be set. Once the data has been read the register should be cleared and the drive will transfer the next byte of data to the register.



| Bit | Function   |
|-----|--|
| 15  | Indicates that data from the last transfer can be read from the receive register.  |
| 14  | Indicates that the last byte from the receive message is in the register.  |
| 13  | There is no data in the receive buffer and the LS byte of the receive register is the comms system status. If there was an error in the received message one of the status error bits will also be set until the comms is used again by this system or by the drive. |

The status flags are defined as follows:

| Bit | Meaning   |
|-----|---|
| 0   | The number of bytes put into the transmit buffer is not consistent with the expected message length. (Hiperface only)   |
| 1   | The number of bytes written to the transmit buffer, or the expected length of the store data transmit message, or the expected length of a read data message have exceed the length of the buffer. (Hiperface only) |
| 2   | The command code is not supported.  |
| 3   | A valid response was not received from the encoder.   |

The following sequence should be followed when transmitting and receiving data to ensure that the received data is always read correctly.

1. Check that *P1 User Comms Receive Register* (03.069) is not zero.
2. Check that *P1 User Comms Transmit Register* (03.068) is zero.
3. Write each word of the transmit message to *P1 User Comms Transmit Register* (03.068) in turn, waiting each time for the drive to return *P1 User Comms Transmit Register* (03.068) back to zero before writing the next word.
4. Write zero to *P1 User Comms Receive Register* (03.069).
5. Read *P1 User Comms Receive Register* (03.069) and when it is not zero the drive has updated it with a receive word.
6. Read each receive word in turn writing zero to *P1 User Comms Receive Register* (03.069) after reading the word.

If the above sequence is not followed correctly, it is possible that data from the transmit message will be seen in the first read of the receive message. It is not essential that any or all of the receive message is read before sending a new transmit message, and so steps 4 to 6 can be omitted if required provided step 1 is not ignored.

#### Hiperface

Up to 15 bytes of data can be written to the buffer. The first byte should be the encoder address. The checksum will be calculated by the drive and added to the end of the message before the message is transmitted to the encoder. The drive checks the checksum of the received message. If successfully received, the receive message can be read via the receive register including the address and the checksum received from the encoder. It should be noted that the encoder must be set up for 9600 baud, 1 start bit, 1 stop bit and even parity (default set-up) for the encoder comms to operate with the drive. Also the data block security should not be enabled in the encoder if the drive encoder nameplate system is to operate correctly. See Hiperface specification for more details of the comms message format.

The following commands are supported:

| Code | Command                         |
|------|---------------------------------|
| 0x42 | Read position                   |
| 0x43 | Set position                    |
| 0x44 | Read analog value               |
| 0x46 | Read counter                    |
| 0x47 | Increment counter               |
| 0x49 | Clear counter                   |
| 0x4a | Read data (maximum of 10 bytes) |
| 0x4b | Store data (maximum of 9 bytes) |
| 0x4c | Data field status               |
| 0x4d | Create a data field             |
| 0x4e | Available memory                |
| 0x50 | Read encoder status             |
| 0x52 | Read type                       |
| 0x53 | Reset encoder                   |

#### SC EnDat

Up to 4 bytes can be written to the buffer in the following format.

|         |         |            |            |
|---------|---------|------------|------------|
| Byte 0  |         |            |            |
| Command | Address | Data (MSB) | Data (LSB) |

The following commands are supported.

| Code | Command                        | Address  | Data (MSB) | Data (LSB) |
|------|--------------------------------|----------|------------|------------|
| 0x07 | Encoder to send position value | Any      | Any        | Any        |
| 0x0E | Selection of memory area       | MRS code | Any        | Any        |
| 0x1C | Encoder to receive parameter   | Address  | Data (MSB) | Data (LSB) |
| 0x23 | Encoder to send parameter      | Address  | Any        | Any        |
| 0x2A | Encoder to receive reset       | Any      | Any        | Any        |

The message from the encoder contains a CRC which is checked. If there are no errors in the message, then the message is put into the comms buffer. The position is retrieved from the drive buffer most significant byte first (Byte 0) and least significant byte last (Byte 7). An example is shown below where a 48 bit value has been read from the encoder which contains an error bit (Bit 0) and 47 bits of position data (Bits 1 to 47) where Bit 1 is the least significant bit of the position. If there are less position bits the position is right justified with leading zeros.

| Byte 0 |   |           |            |            |            |           | Byte 7   |
|--------|---|-----------|------------|------------|------------|-----------|----------|
| 0      | 0 | Bits47-40 | Bits 39-32 | Bits 31-24 | Bits 23-16 | Bits 15-8 | Bits 7-0 |

If any other command is sent the response is shown below. The response is available when the encoder has responded, but for "Encoder to receive parameter" and "Encoder to receive reset" commands there is an additional delay of 12ms and 20ms respectively to allow the encoder to be ready again.

| Byte 0  |            | Byte 2     |
|---------|------------|------------|
| Address | Data (MSB) | Data (LSB) |

### EnDat

Up to 4 bytes can be written to the buffer in the same format as for EnDat 2.1. The following commands are supported.

| Code | Command  | Address  | Data (MSB) | Data (LSB)    |
|------|--|----------|------------|---------------|
| 0x09 | Encoder to send position value with additional information and select memory area  | MRS code | 0x00       | Block address |
| 0x1B | Encoder to send position value with additional information and receive parameters  | Address  | Data (MSB) | Data (LSB)    |
| 0x24 | Encoder to send position value with additional information and send parameters     | Address  | Any        | Any           |
| 0x2D | Encoder to send position value with additional information and receive error reset | Any      | Any        | Any           |
| 0x36 | Encoder to send position values and receive test command                           | Any      | Any        | Any           |

The message from the encoder contains a CRC which is checked. If there are no errors in the message the message is put into the comms buffer.

| Byte 0   |                                 | Byte 2                          |
|--|---------------------------------|---------------------------------|
| Additional information 1 Byte 0<br>(B7) WRN<br>(B6) RM<br>(B5) Busy<br>(B4) I4<br>(B3) I3<br>(B2) I2<br>(B1) I1<br>(B0) I0 | Additional Information 1 Byte 1 | Additional Information 1 Byte 2 |

It should be noted that the encoder is set up automatically so that it always returns Additional Information 1 with no data contents. An MRS is sent to the encoder to select which data contents should be included in Additional Information 1. An MRS code can also be used to select Additional Information 1, Additional Information 2 or no Additional Information to be sent from the encoder, but these commands must not be used. Although the contents of Additional Information 1 can be changed the encoder should always be in the state where it transmits only Additional Information 1.

### BiSS, SC BiSS

It is possible to read or write to 8 bit registers in a BiSS device. The addressing range is 0 to 127 giving access to 128 registers. Two bytes should be written to the buffer for both read or write operations. Byte 0 contains the command in bit 7 (0 = read, 1= write) and the register address in bit 6 to bit 0. For reading Byte 1 can contain any value, for writing it should contain the data to be written.

| Byte 0            | Byte 1 |
|-------------------|--------|
| Command + Address | Data   |

The response is always two bytes as shown below. Byte 0 is the same as Byte 0 in the request sent to the drive. For reading Byte 1 is the value read from the register and for writing it is always zero.

| Byte 0            | Byte 1 |
|-------------------|--------|
| Command + Address | Data   |

| Parameter         | 03.068 P1 User Comms Transmit Register                        |                |                       |
|-------------------|---|----------------|-----------------------|
| Short description | Defines the value present in the user comms transmit register |                |                       |
| Mode              | RFC-A   |                |                       |
| Minimum           | 0   | Maximum        | 65535                 |
| Default           | 0   | Units          |                       |
| Type              | 16 Bit Volatile   | Update Rate    | Background read/write |
| Display Format    | Standard  | Decimal Places | 0                     |
| Coding            | RW, NC, PT, BU  |                |                       |

See *P1 User Comms Enable* (03.067).

| Parameter         | 03.069 <i>P1 User Comms Receive Register</i>                 |                |                       |
|-------------------|--|----------------|-----------------------|
| Short description | Defines the value present in the user comms receive register |                |                       |
| Mode              | RFC-A  |                |                       |
| Minimum           | 0  | Maximum        | 65535                 |
| Default           | 0  | Units          |                       |
| Type              | 16 Bit Volatile  | Update Rate    | Background read/write |
| Display Format    | Standard   | Decimal Places | 0                     |
| Coding            | RW, NC, PT, BU   |                |                       |

See *P1 User Comms Enable* (03.067).

| Parameter         | 03.070 <i>P1 Position Feedback Signals</i>                       |                |                         |
|-------------------|--|----------------|-------------------------|
| Short description | Shows the state of the signals from the position feedback device |                |                         |
| Mode              | RFC-A  |                |                         |
| Minimum           | 0<br>(Display: 000000)   | Maximum        | 63<br>(Display: 111111) |
| Default           |  | Units          |                         |
| Type              | 16 Bit Volatile  | Update Rate    | Background write        |
| Display Format    | Binary   | Decimal Places | 0                       |
| Coding            | RO, ND, NC, PT   |                |                         |

*P1 Position Feedback Signals* (03.070) shows the state of the signals from the position feedback device as given in the table below where the signals are relevant for the type of device. *P1 Position Feedback Signals* (03.070) is only intended as a debugging aid.

| <i>P1 Position Feedback Signals</i> (03.070) bits | Signals            |
|---|--------------------|
| 0   | A or F or Cos      |
| 1   | B or D or R or Sin |
| 2   | Z                  |
| 3   | U                  |
| 4   | V                  |
| 5   | W                  |

For Cos and Sin signals the relevant bits of *P1 Position Feedback Signals* (03.070) will be set when the signals are positive and cleared when the signals are negative.

| Parameter         | 03.071 <i>P1 Error Detected</i>  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates if an error has been detected with the position feedback device connected to the P1 position interface |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*P1 Error Detected* (03.071) is set if an error has been detected with the position feedback device connected to the P1 position interface. This parameter is useful if encoder trips have been disabled by setting bit 3 of *P1 Error Detection Level* (03.040). It should be noted that this bit is not set if specific trips are disabled with bits 0 to 2 of *P1 Error Detection Level* (03.040).

| Parameter         | 03.073 <i>P1 Absolute Turns Recovery Enable</i>  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to allow turns information beyond the number of turns bits provided by the position feedback device connected to P1 to be stored on power-down and recovered at next power-up |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background Read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

*P1 Absolute Turns Recovery Enable* (03.073) can be used to remove the masking applied to *P1 Revolution/Pole Pitch Counter* (03.028) for any type of position feedback device. If *P1 Device Type* (03.038) is set to EnDat, SC.EnDat, SC.Hiperface, SSI, SC.SSI, BiSS, Option Slot 1, Option Slot 2, Option Slot 3 or Option Slot 4 then this parameter has an additional feature which allows turns bits beyond the number of turns bits provided by the position feedback device to be stored on power-down and then recovered on the next power-up. *P1 Revolution/Pole Pitch Counter* (03.028) is saved as a power-down save parameter. If *P1 Absolute Turns Recovery Enable* (03.073) = 0 the value saved at power-down is ignored on the next power-up and *P1 Revolution/Pole Pitch Counter* (03.028) is set up based on the information provided by the position feedback device. For example a device with 12 turns bits can define the position with up to 4096 turns. If *P1 Absolute Turns Recovery Enable* (03.073) = 1 the turns beyond those provide by the position feedback device are simulated from the saved value. This means that 65536 turns can be generated from a position feedback device with any number of turns bits. The following should be noted:

1. If the position feedback device moves by more than +/-1/4 of the range of the most significant turns bit while powered down the turns at power-up

will not be correct. For example a device with 12 turns bits must not move by more than the range defined by 10 turns bits, or a device with no turns bits must not move by more than 1/4 of a turn.

2. This feature is not applicable to linear position feedback devices.
3. If an SSI based device is being used then *P1 SSI Incremental Mode* (03.047) must be set to one.
4. The recovered turns bits are stored in *P1 Revolution/Pole Pitch Counter* (03.028). To reset the additional bits *P1 Absolute Turns Recovery Enable* (03.073) should be set to zero to remove the recovered turns bits. A parameter save should then be initiated using a value of 1 or 1001 in parameter mm.000 to save the contents of *P1 Revolution/Pole Pitch Counter* (03.028). Absolute turns recovery can then be selected again by setting *P1 Absolute Turns Recovery Enable* (03.073) to one.
5. Absolute turns recovery is not possible when *Low Under Voltage Threshold Select* (06.067) = 1 or *Backup Supply Mode Enable* (06.068) = 1 or *User Supply Select* (06.072) = 1. If absolute turns recovery is required when one of these modes is enabled then a user save (*Parameter mm.000* (mm.000) = 1 or 1001) should be performed before the drive is powered down.

| Parameter         | 03.074 P1 Additional Configuration  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Provides additional configuration information for the position feedback device not included in the other set-up parameters. |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 511116116       |
| Default           | 0   | Units          |                 |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

*P1 Additional Configuration* (03.074) provides configuration information, not covered by the other set-up parameters, for the position feedback device connected to the P1 position feedback interface and is specific to the type of device being used.

#### **P1 Device Type (03.038): BiSS, SC BiSS**

This parameter is split into 3 fields as shown below.

| Decimal Digits | 9-6            | 5-3                  | 2-0                     |
|----------------|----------------|----------------------|-------------------------|
|                | CRC polynomial | Rotary Turns Padding | Rotary Position Padding |
| Default        | 0067           | 000                  | 000                     |

#### **CRC polynomial**

The CRC polynomial is a bit representation of the terms of a polynomial used to generate the CRC applied to the position and the additional data transferred to/from the encoder via the BiSS communications channel. The standard value is 0067 which in hexadecimal is 0x0043, or in binary form is 0000 0000 0100 0011. The bits that are set to one show which terms exist in the polynomial. The standard value has bits 6, 1 and 0 set to one and gives the polynomial normally used with BiSS encoders which is  $X^6+X^1+1$ . If the encoder uses a different polynomial then this can be selected with the four digits (9-6). The maximum value is 511 (0x01FF), and so a polynomial up to degree 10 can be set up.

#### **Rotary Turns Padding**

The turns, and position within a turn, provided by a rotary encoder may not completely fill the number of bits provided. The unfilled bits will normally be padded with zeros. The total number of bits provided for the turns including zero padding is given by *P1 Rotary Turns Bits* (03.033). The zero padding is given by decimal digits 5 to 3 of *P1 Additional Configuration* (03.074). Digits 4 and 3 give the number of bits and digit 5 specifies whether the padding is on the left (0) or on the right (1). For example a value of 104 would specify 4 padding bits on the right of the turns data. The default value of 000 specifies no padding. If the padding value is outside the range +/-16 then an *Encoder 14* is initiated. If right padding is specified the turns data will be shifted right by the number of padding bits as shown below. If left padding is specified it simply means that there are zeros to the left of the turns information, and so no adjustment is required. Therefore specifying left padding is optional. It is not possible to specify padding for linear encoders.

Data from encoder with 4 right padding bits

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|

Data after adjustment for padding bits

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
|---|---|---|---|---|---|---|---|

#### **Rotary Position Padding**

The total number of bits provided for position within a turn is given by *P1 Comms Bits* (03.035) - *P1 Rotary Turns Bits* (03.033). The zero padding is given by decimal digits 2 to 0 of *P1 Additional Configuration* (03.074) in the same manner as is used for the turns padding. If left padding is specified the turns data will be shifted left by the number of padding bits as shown below. If right padding is specified it simply means that there are zeros to the right of the position information, and so no adjustment is required. Therefore specifying right padding is optional.

Data from encoder with 4 left padding bits

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
|---|---|---|---|---|---|---|---|

Data after adjustment for padding bits

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|

#### **P1 Device Type (03.038): Any other device type**

This parameter has no effect.

| Parameter         | 03.075 <i>Initialise Position Feedback</i>                       |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to re-initialise any position feedback device connected |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit Volatile   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, NC   |                |                 |

If *Initialise Position Feedback* (03.075) is set to one any position feedback devices connected to the drive position feedback interfaces or any position feedback category option modules will be re-initialised.

| Parameter         | 03.076 <i>Position Feedback Initialized</i>                               |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Indicates the initialisation state of position feedback devices connected |                |                               |
| Mode              | RFC-A   |                |                               |
| Minimum           | 0<br>(Display: 0000000000)  | Maximum        | 1023<br>(Display: 1111111111) |
| Default           | 0<br>(Display: 0000000000)  | Units          |                               |
| Type              | 16 Bit Volatile   | Update Rate    | Background write              |
| Display Format    | Binary  | Decimal Places | 0                             |
| Coding            | RO, NC, PT  |                |                               |

*Position Feedback Initialized* (03.076) contains flags that represent the initialisation state of position feedback devices connected to the drive position feedback interfaces or position feedback interfaces on position feedback category option modules. One indicates that the interface is initialised and zero indicates that the interface is not initialised. The flags are assigned as shown below.

| Bit | Position feedback interface |
|-----|-----------------------------|
| 0   | P1 Drive                    |
| 1   | P2 Drive                    |
| 2   | P1 Option slot 1            |
| 3   | P2 Option slot 1            |
| 4   | P1 Option slot 2            |
| 5   | P2 Option slot 2            |
| 6   | P1 Option slot 3            |
| 7   | P2 Option slot 3            |
| 8   | P1 Option slot 4            |
| 9   | P2 Option slot 4            |

If no option module, or an option module other than a position feedback category module, is fitted in an option slot then the relevant flag is always set to one. If an attempt is made to enable the drive when any of the flags are zero the drive initiates an *Encoder 7* trip. If a drive reset is initiated, the bits in *Position Feedback Initialized* (03.076) are checked, and if any position feedback devices are not initialised an attempt is made to initialise them.

The table below shows the initialisation process for different position feedback devices that can be connected to the drive.

| Encoder types                                | Initialisation process   |
|--|--|
| AB, FD, FR<br>Resolver                       | None. Initialisation is immediate and is always successful. The position feedback is set to zero on initialisation.  |
| AB Servo<br>FD Servo<br>FR Servo<br>SC Servo | The absolute position used to control a motor can only be defined accurately after two different changes of state of the UVW commutation signals. Initialisation resets the system that ensures that the UVW signals alone will be used to define the motor position until the encoder has moved through two valid commutation signal state changes. Initialisation is immediate and is always successful. The position feedback is set to zero on initialisation.   |
| SC   | The SINCOS interpolation system must be initialised. Initialisation is immediate and is always successful. The position feedback is set to zero on initialisation.   |
| SC Hiperface<br>SC EnDat<br>SC SSI           | Auto-configuration if required except SC SSI.<br>The absolute position must be obtained via comms. This may cause a large change in position feedback.<br>The SINCOS interpolation system must be initialised. This may have a small effect on the position feedback.  |
| EnDat<br>BiSS<br>SSI                         | Auto-configuration if required except SSI.<br>The absolute position must be obtained via comms. This may cause a large change in position feedback.  |
| SC SC  | The absolute position used to control a motor is obtained from the sine and cosine signals provided for one revolution until the marker pulse occurs. The position obtained from the marker pulse is assumed to be a position of zero. Once a marker has occurred the incremental position is used and the single turn sine wave signals are ignored. When the position feedback device is initialised the single turn sine wave signals are used again until another marker event occurs. No part of the initialisation process affects the position feedback seen in parameters, except that the SINCOS interpolation system must be initialised which may have a small effect on the position feedback. Initialisation is immediate and is always successful. |

| Parameter         | 03.078 <i>Sensorless Mode Active</i>     |                |           |
|-------------------|--|----------------|-----------|
| Short description | Indicates that sensorless mode is active |                |           |
| Mode              | RFC-A                                    |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile                           | Update Rate    | 4ms write |
| Display Format    | Standard                                 | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                           |                |           |

If *Sensorless Mode Active* (03.078) = 0 it indicates that the position feedback selected with *Motor Control Feedback Select* (03.026) is being used for motor control. If *Sensorless Mode Active* (03.078) = 1 it indicates that the sensorless algorithm is being used instead. See *RFC Feedback Mode* (03.024) for more information.

| Parameter         | 03.079 <i>Sensorless Mode Filter</i> |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description | Sensorless Mode Filter               |                |                 |
| Mode              | RFC-A                                |                |                 |
| Minimum           | 0                                    | Maximum        | 4               |
| Default           | 0                                    | Units          | ms              |
| Type              | 8 Bit User Save                      | Update Rate    | Background read |
| Display Format    | Standard                             | Decimal Places | 0               |
| Coding            | RW, TE                               |                |                 |

| Value | Text |
|-------|------|
| 0     | 4    |
| 1     | 8    |
| 2     | 16   |
| 3     | 32   |
| 4     | 64   |

When sensorless mode is active the measured speed can include some ripple, which increases as the drive passes into field weakening. A filter is applied to the estimated speed and *Sensorless Mode Filter* (03.079) defines the time constant. The default time constant is 4ms, but this can be extended to improve the filtering. This is particularly useful when using standard ramp or spinning start with a low friction high inertia load, and can prevent over voltage trips when the drive has no braking resistor.

| Parameter         | 03.080 <i>Sensorless Position</i>                          |                |            |
|-------------------|--|----------------|------------|
| Short description | Displays the motor position when sensorless mode is active |                |            |
| Mode              | RFC-A  |                |            |
| Minimum           | -2147483648  | Maximum        | 2147483647 |
| Default           |  | Units          |            |
| Type              | 32 Bit Volatile  | Update Rate    | 4ms write  |
| Display Format    | Standard   | Decimal Places | 0          |
| Coding            | RO, ND, NC, PT   |                |            |

When the drive is operating without position feedback *Sensorless Position* (03.080) gives the motor position where the least significant 16 bits represent a movement equivalent to one pole of the motor. The most significant 16 bits represent turns where one turn is the movement associate with one pole. For example in a rotary application with a 4 pole motor, the movement associated with one pole is a mechanical movement of 180°. In RFC-A mode *Sensorless Position* (03.080) is aligned with the motor flux and voltages, but this has no fixed relationship to the mechanical position of the rotor.

| Parameter         | 03.085 <i>Encoder Simulation Source</i>                      |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines the source parameter used for the encoder simulation |                |            |
| Mode              | RFC-A  |                |            |
| Minimum           | 0.000  | Maximum        | 59.999     |
| Default           | 0.000  | Units          |            |
| Type              | 16 Bit User Save   | Update Rate    | Reset read |
| Display Format    | Standard   | Decimal Places | 3          |
| Coding            | RW, PT, BU   |                |            |

*Encoder Simulation Source* (03.085) is used to select a parameter as the input to the encoder simulation system. If *Encoder Simulation Source* (03.085) is zero then no source is selected and the encoder simulation system is disabled. The encoder simulation output connections are shared with the P1 and P2 position feedback interfaces, and so encoder simulation may be disabled because the connections are not available. See *Encoder Simulation Status* (03.086) for details.

Any parameter can be selected as the source, but it is assumed that the input is a 16 bit value with a range from 0 to 65535 or from -32768 to 32767. The source parameter is treated differently depending on the value of *Encoder Simulation Mode* (03.088) as given in the table below.

|   |  |
|---|--|
| <b>Encoder Simulation Mode (03.088)</b> |  |
| <b>Hardware (0)</b>                     | <i>Encoder Simulation Source</i> (03.085) must be set to 3.029 for the output to be enabled and the position from the P1 position feedback interface is used and <i>P1 Position</i> (03.029) is the source.  |
| <b>Lines Per Rev (1) or Ratio (2)</b>   | <p>If <i>Encoder Simulation Source</i> (03.085) = 3.029 (i.e. <i>P1 Position</i> (03.029) is the source) then <i>P1 Position</i> (03.029) and <i>P1 Fine Position</i> (03.030) are combined as a 16 bit value with 16 bit fractional part as the input to the encoder simulation system, which gives additional output resolution if encoder simulation ratio is greater than unity.</p> <p>The encoder simulation system is intended to be used with a 16 bit source parameter. If the source of the encoder simulation system is not a 16 bit parameter then the drive uses the source parameter as follows.</p> <ul style="list-style-type: none"> <li>• 1 bit parameter: Zero extended</li> <li>• 8 bit parameter: Sign extended if BU attribute is zero (signed), otherwise zero extended (unsigned)</li> <li>• 32 bit parameter: Only the least significant word is used.</li> </ul> |
| <b>SSI (3)</b>                          | For SSI output mode the number of bits included in the output can be selected (see <i>Encoder Simulation Mode</i> (03.088) for details).   |

Although *Encoder Simulation Source* (03.085) is not a standard source parameter in common with other sources the actual source is only changed on drive reset.

| Parameter         | 03.086 Encoder Simulation Status              |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the status of the encoder simulation |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 2                |
| Default           |   | Units          |                  |
| Type              | 8 Bit Volatile                                | Update Rate    | Background write |
| Display Format    | Standard                                      | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT                            |                |                  |

| Value | Text            |
|-------|-----------------|
| 0     | None            |
| 1     | Full            |
| 2     | No Marker Pulse |

The availability of the encoder simulation output on the 15 way connector on the drive is dependent on the type of feedback device selected with *P1 Device Type* (03.038). Priority is as follows from highest to lowest priority:

1. P1 position feedback interface
2. Encoder simulation output
3. P2 position feedback interface

*Encoder Simulation Status* (03.086) shows the status of the encoder simulation output.

**0: None**

The encoder simulation output is not enabled or is not available.

**1: Full**

Full encoder simulation with marker output is available.

**2: No Marker**

Encoder simulation without marker output is available.

| Parameter         | 03.087 Encoder Simulation Sample Period             |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the sample period of the encoder simulation |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 3               |
| Default           | 0   | Units          | ms              |
| Type              | 8 Bit User Save                                     | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text |
|-------|------|
| 0     | 0.25 |
| 1     | 1    |
| 2     | 4    |
| 3     | 16   |

The update rate of the encoder simulation system is nominally 250µs, i.e. default value of *Encoder Simulation Sample Period* (03.087), but if the update rate of the source parameter is different, the encoder simulation output will consist of bursts of pulses at the update rate of the parameter. To prevent this

and to give a smooth output, the update rate can be adjusted with *Encoder Simulation Sample Period* (03.087). *Encoder Simulation Sample Period* (03.087) has no effect if hardware mode is selected, i.e. *Encoder Simulation Mode* (03.088) = 0.

| Parameter         | 03.088 Encoder Simulation Mode             |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the mode of the encoder simulation |                |                 |
| Mode              | RFC-A                                      |                |                 |
| Minimum           | 0  | Maximum        | 3               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                   | Decimal Places | 0               |
| Coding            | RW, TE                                     |                |                 |

| Value | Text          |
|-------|---------------|
| 0     | Hardware      |
| 1     | Lines Per Rev |
| 2     | Ratio         |
| 3     | SSI           |

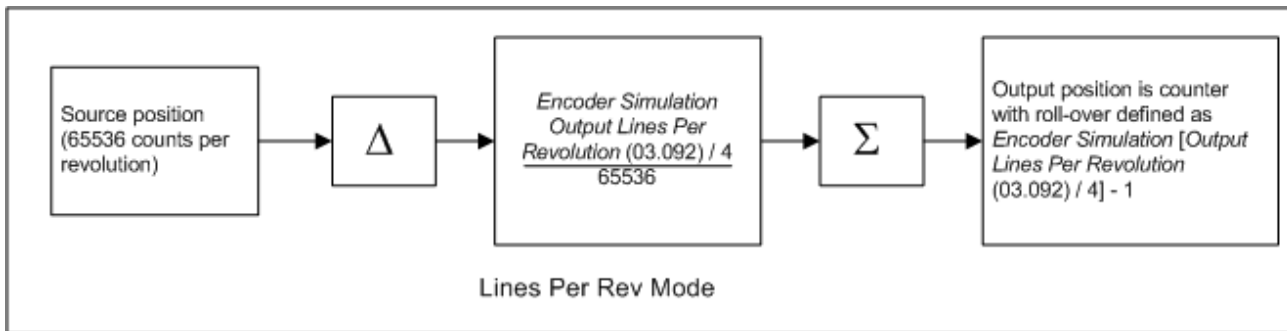
*Encoder Simulation Mode* (03.088) defines the encoder simulation output as incremental signals (AB, FD or FR) derived directly via hardware, incremental signals generated via software or SSI data generated via software.

### 0: Hardware

The encoder simulation output is derived directly in hardware from the P1 position feedback interface in the drive and the output is derived from the input with negligible delay. The ratio between the input at the P1 interface and the output is either unity or a limited number of binary divider ratios (see *Encoder Simulation Hardware Divider* (03.089)). Hardware mode only produces an output with AB, FD, FR, SC, SC Hiperface, SC EnDat or SC SSI type devices. It should be noted that with a SINCOS source device the output is based on the zero crossings of the sine wave inputs and does not include interpolation. If *Encoder Simulation Hardware Marker Lock* (03.090) = 0 the marker output is derived directly from the marker input. If *Encoder Simulation Hardware Marker Lock* (03.090) = 1 the incremental output signals are adjusted on each marker event so that the A and B are high with an AB type output, or F is high with an FD or FR type output. Marker locking is not recommended if the number of lines per revolution of the encoder simulation source combined with the ratio does not give an encoder simulation output with a multiple of 4 counts per revolution (i.e. between each output marker event) for AB signals, or a multiple of 2 counts for FD or FR signals, because this causes a count error in the system receiving these signals. The input marker pulse width is not adjusted to take account of the divider ratio, but is simply routed from the input to the output. Therefore the output marker pulse becomes shorter with respect to the output incremental signals as the divider ratio is increased.

### 1: Lines Per Rev

The encoder simulation output is derived via software from the selected source with a resolution defined by *Encoder Simulation Output Lines Per Revolution* (03.092) with a minimum delay of 250µs which may be extended by *Encoder Simulation Sample Period* (03.087) is set up for a longer sample period. Note that the number of output lines per revolution apply to a quadrature (AB) type device, and that if FD or FR mode are selected the number of lines per revolution are 2 x *Encoder Simulation Output Lines Per Revolution* (03.092). The output is derived by applying a ratio and output counter roll-over limit defined by *Encoder Simulation Output Lines Per Revolution* (03.092) as shown below. The output marker is produced when the output counter is zero.



If *P1 Position* (03.029) is selected as the source and *Encoder Simulation Incremental Mode Select* (03.091) = 0 then the input and output counters are synchronised at power-up and when the P1 position feedback interface becomes initialised, so that the output marker is synchronised with zero position for the P1 position feedback interface. For devices that support a marker, the effect of the marker on the position can be selected using *P1 Marker Mode* (03.031). At power-up and on device initialisation there will be a step change in position from zero to the actual position from the device and the pulses necessary to make this change are produced at the encoder simulation output. If a marker event occurs that causes a step change in position, again the necessary pulses will be produced for this change of position. Where large sudden changes occur the maximum output frequency is limited to 500kHz, and so it may take some time for the output position to reach the input position. This mode of operation gives an initial position change from zero position and then follows all changes of position from that point onwards, and may be used to follow the absolute position of the device connected to the P1 position feedback interface.

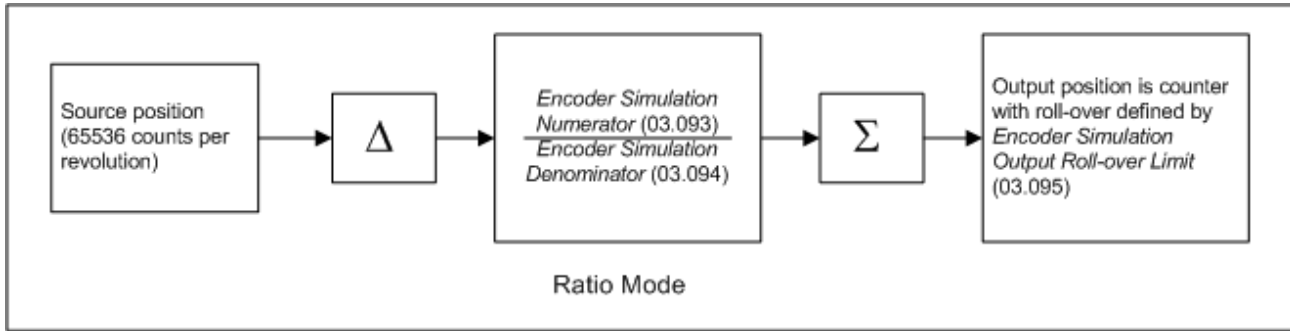
If *P1 Position* (03.029) is selected as the source and *Encoder Simulation Incremental Mode Select* (03.091) = 1 then the encoder simulation output only follows the changes of source position. At power-up, on device initialisation and a marker event no additional pulses are produced to give the absolute position of the device related to zero position. The encoder simulation output markers is not synchronised to the source marker.

If a source other than *P1 Position* (03.029) is selected *Encoder Simulation Incremental Mode Select* (03.091) has no effect and the encoder simulation system always operates in absolute mode.

### 2: Ratio

The encoder simulation is derived in the same way as described previously for *Encoder Simulation Mode* (03.088) = 1 (i.e. lines per rev mode), except that different parameters are used to set up the system giving more flexibility as shown below.

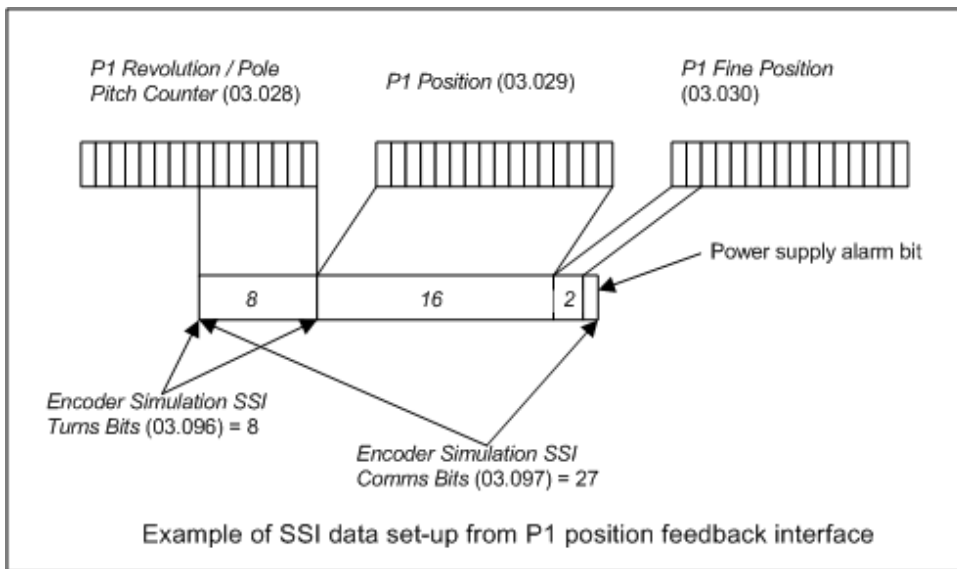




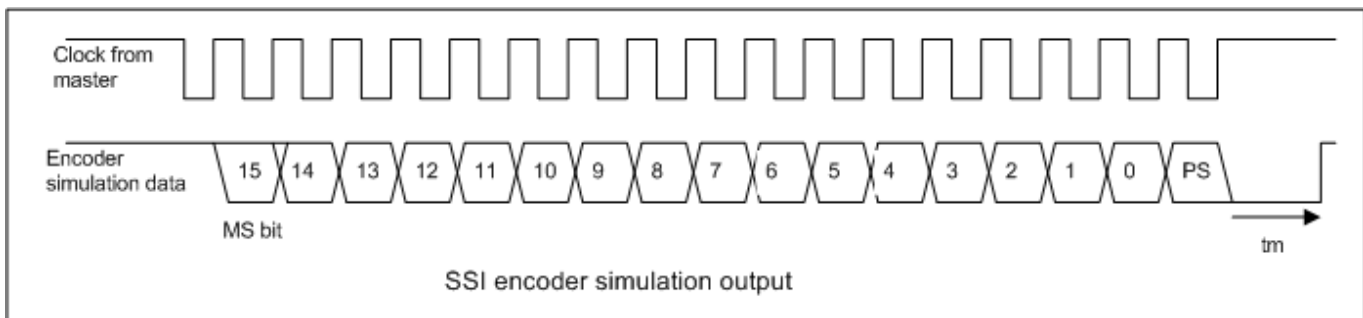
With the default settings (*Encoder Simulation Numerator* (03.093) = 65536, *Encoder Simulation Denominator* (03.094) = 65535 and *Encoder Simulation Output Roll-over Limit* (03.095) = 65535) the output produces a state change each time the source parameter changes by one. The numerator and denominator can be changed to provide a different ratio between the source and the output. Output markers are produced each time the output counter is zero and the counters are synchronised in the same way as for lines per rev mode. It is possible to control the roll-over limit of the output counter and hence the rate at which output markers are produced using *Encoder Simulation Output Roll-over Limit* (03.095). For example if the ratio is set to 1024/ 65536 and the roll-over limit is 1023 then one output marker is produced for every 1024 lines of output incremental signals. If the roll-over limit is changed to 512, then two output markers are produced for every 1024 lines of output incremental signals.

### 3: SSI

In this mode the B output becomes the clock input and the A output is the data output. If the source position is the P1 position feedback interface the data from the position feedback interface is transferred to the SSI output register once per sample period defined by *Encoder Simulation Sample Period* (03.087). An example is given below which shows how the data is aligned.



The SSI output is then clocked out from the register as shown in another example below which includes 15 bits of data.



It should be noted that the data is shifted out by a clock that is produced by the SSI master connected to the encoder simulation interface as the interface is emulating an SSI encoder. However, unlike an SSI encoder the position data is not sampled on the first edge of the clock, but is updated by the drive at the rate defined by *Encoder Simulation Sample Period* (03.087). If the P1 position interface is being used as the source the power supply alarm bit (PS) is the inverse of the initialised flag in *Position Feedback Initialized* (03.076) related to this interface. The master can clock out as many bits of data as required, but once the power supply alarm bit has been produced the output will remain low. The SSI interface reset time ( $t_m$ ) of 20 $\mu$ s is required so that the interface can detect the end of the transmission and reset itself so that the output data begins again at the most significant bit. During this period the master should hold the clock line high. The master should not use a clock frequency of less than 50kHz or else spurious reset periods may be detected.

If any other parameter is used as the source the most significant M bits of the source parameter are used, where  $M = \text{Encoder Simulation SSI Comms Bits (03.097)} - 1$ . If the source parameter has less than M bits then trailing zeros are added. The power supply alarm bit is always zero in this mode.

| Parameter         | 03.089 Encoder Simulation Hardware Divider   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the divider ratio between the device connected to the P1 interface and the encoder simulation output when hardware simulation mode is used |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 7               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

If hardware mode is selected (i.e. *Encoder Simulation Mode* (03.088) = 0) then *Encoder Simulation Hardware Divider* (03.089) defines the divider ratio between the device connected to the P1 position feedback interface and the output as  $1/2^{\text{Encoder Simulation Hardware Divider (03.089)}}$ . The maximum allowed input frequency is 500kHz, and so the maximum output frequency with the highest ratio of unity is 500kHz.

| Parameter         | 03.090 Encoder Simulation Hardware Marker Lock                         |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines if the marker output is derived directly from the marker input |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *Encoder Simulation Mode* (03.088).

| Parameter         | 03.091 Encoder Simulation Incremental Mode Select              |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to select incremental mode for the encoder simulation |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *Encoder Simulation Mode* (03.088).

| Parameter         | 03.092 Encoder Simulation Output Lines Per Revolution   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the required lines per revolution when using the encoder simulation mode of Lines Per Rev |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 1   | Maximum        | 16384           |
| Default           | 4096  | Units          |                 |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Encoder Simulation Mode* (03.088).

| Parameter         | 03.093 Encoder Simulation Numerator                                   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the numerator when using the encoder simulation mode of Ratio |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 1   | Maximum        | 65536           |
| Default           | 65536   | Units          |                 |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Encoder Simulation Mode* (03.088).

| Parameter         | 03.094 Encoder Simulation Denominator                                   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the denominator when using the encoder simulation mode of Ratio |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 1   | Maximum        | 65536           |
| Default           | 65536   | Units          |                 |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Encoder Simulation Mode* (03.088).

| Parameter         | 03.095 Encoder Simulation Output Roll-over Limit  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the roll-over limit of the output counter and hence the rate at which output markers are produced when using the encoder simulation mode of Ratio |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 1   | Maximum        | 65535           |
| Default           | 65535   | Units          |                 |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, BU  |                |                 |

See *Encoder Simulation Mode* (03.088).

| Parameter         | 03.096 Encoder Simulation SSI Turns Bits  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the number of bits of the outputted SSI data that are used to represent turns information |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 16              |
| Default           | 16  | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Encoder Simulation Mode* (03.088).

| Parameter         | 03.097 Encoder Simulation SSI Comms Bits                     |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the total number of bits of SSI data to be outputted |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 2  | Maximum        | 48              |
| Default           | 33   | Units          |                 |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *Encoder Simulation Mode* (03.088).

| Parameter         | 03.098 Encoder Simulation Output Mode               |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the format of the encoder simulation output |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 2               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                                     | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text      |
|-------|-----------|
| 0     | AB/Gray   |
| 1     | FD/Binary |
| 2     | FR/Binary |

*Encoder Simulation Output Mode* (03.098) is used to select the format of the encoder simulation output as given in the table below.

| Encoder Simulation Mode (03.088)           | Encoder Simulation Output Mode (03.098) | Format   |
|--|---|--|
| Hardware (0), Lines Per Rev (1), Ratio (2) | AB/Gray                                 | AB quadrature signals  |
| Hardware (0), Lines Per Rev (1), Ratio (2) | FD/Binary                               | Frequency and direction signals  |
| Hardware (0), Lines Per Rev (1), Ratio (2) | FR/Binary                               | Forward and reverse signals  |
| SSI (3)                                    | AB/Gray                                 | The position data is in Gray code format. This does not include the "power supply" bit if present. |
| SSI (3)                                    | FD/Binary, FR/Binary                    | The position data is in binary format  |

| Parameter         | 03.100 F1 Freeze Trigger Source   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Used to select the source that generates trigger events for the F1 system |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 6               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text            |
|-------|-----------------|
| 0     | Digital Input 4 |
| 1     | Digital Input 5 |
| 2     | P1 Marker       |
| 3     | P2 Marker       |
| 4     | Common          |
| 5     | P1 Zero         |
| 6     | P2 Zero         |

F1 Freeze Trigger Source (03.100) is used to select the source that generates trigger events for the F1 system.

#### 0, 1: Dig I/O 4, Dig I/O 5

Digital I/O 4 or Digital I/O 5 on the drive can be used as trigger sources. If the digital I/O is set up as an input, then trigger events will be produced on the relevant edge of the input signal. If the digital I/O is set up as an output, then trigger events will be produced on the relevant edge of the output signal.

#### 2, 3: Z1, Z2

Z1 selects the P1 position feedback interface marker input as the trigger source and Z2 selects the P2 position feedback interface marker input as the trigger source. No trigger events will be produced unless the selected maker input is available.

#### 4: Common

The output of the common freeze line is selected. If the output of the drive common freeze system is enabled (Bit 3 of *Common Freeze Mode* (03.112) = 1) then the drive common freeze system provides the freeze event triggers. If the output of the drive common freeze system is disabled the option module freeze line provides the freeze event triggers.

#### 5, 6: P1 Zero, P2 Zero

A freeze event is triggered when the turns for the respective position feedback interface change (i.e. the feedback position passes through zero in either direction). The freeze position stored in *F1 Normalised Freeze Position* (03.103) or *F2 Normalised Freeze Position* (03.108) will include the turns associated with the zero position whichever direction the position changes. For example if the turns change from 4 to 5 or 5 to 4 the turns value stored is 5. This mode can be used as a substitute for a physical marker, with a position device that does not have one, to trigger an event to occur at the zero position of the feedback device. For example, it can be used with the AMC to start a CAM at the zero position of the feedback device. It should be noted that if P1 Zero is selected as the trigger source then *F1 Freeze Position Source* (03.102) has no effect and P1 is always used as the freeze position source. If P2 Zero is selected as the trigger source then *F1 Freeze Position Source* (03.102) has no effect and P2 is always used as the freeze position source. This is because these freeze trigger sources are only intended to capture the zero position of the device being used to give the zero position trigger event.

| Parameter         | 03.101 F1 Freeze Mode                       |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Sets the mode used for the F1 freeze system |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0   | Maximum        | 3               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                             | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 0               |
| Coding            | RW, TE                                      |                |                 |

| Value | Text        |
|-------|-------------|
| 0     | Rising 1st  |
| 1     | Falling 1st |
| 2     | Rising all  |
| 3     | Falling all |

#### 0: Rising 1st

Freeze events are produced on the rising edge of the freeze trigger source. If the *F1 Freeze Flag* (03.104) is 0 then the first suitable edge produced by the trigger source causes the freeze position to be stored and the *F1 Freeze Flag* (03.104) to be set to 1. No further freeze events are possible until the *F1 Freeze Flag* (03.104) has been cleared by the user.

#### 1: Falling 1st

As for Rising 1st, but the falling edge is used to trigger freeze events.

#### 2: Rising All

Freeze events are produced on the rising edge of the freeze trigger source. If the *F1 Freeze Flag* (03.104) is 0 then the first suitable edge produced by the trigger source causes the freeze position to be stored and the *F1 Freeze Flag* (03.104) to be set to 1. If further suitable edges are produced by the trigger source the freeze position is updated with the current position.

#### 3: Falling All

As for Rising All, but the falling edge is used to trigger freeze events.

| Parameter         | 03.102 F1 Freeze Position Source                     |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the source position for the F1 freeze system |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 2               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                                      | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text |
|-------|------|
| 0     | P1   |
| 1     | P2   |
| 2     | Time |

*F1 Freeze Position Source* (03.102) defines the source for the F1 freeze system as follows:

#### P1 or P2

When a freeze event occurs, the position from the relevant position feedback interface within the drive (i.e. P1 or P2), including the effect of the marker (see *P1 Marker Mode* (03.031)), is stored and can be accessed as a 32 bit normalised value in *F1 Normalised Freeze Position* (03.103). For a digital incremental source (AB, FD, FR, AB Servo, FD Servo or FR Servo) the position is captured at the freeze event using a hardware system. For a resolver the freeze position is the position at the last 250us sample point. For all other position feedback devices the time of the freeze event is captured with hardware and then interpolation, based on the change of position during the previous nominal 250us period, is used to estimate the position at the freeze event.

#### Time

The time of the freeze event is stored with respect to the last datum used by the position feedback system and option modules fitted to the drive. These datum events occur at a nominal rate of 250us, but if the drive timing is being synchronised by the comms system in an option module then the actual timing may vary slightly depending on the accuracy of the clock providing the synchronisation. The time stored in *F1 Normalised Freeze Position* (03.103) is given as a proportion of the nominal 250us time period where 65536 corresponds to one nominal 250us time period. Note that the value may be positive or negative. Positive values give the time of an event that occurred after the last datum, but before the freeze information is processed. Negative values give the time of an event that occurred before the datum, but after the previous time when the freeze information was processed. The time of the freeze event could be used, for example, to determine the value of a virtual position being generated within an option module at the freeze event. The calculated value would only be meaningful if the freeze information is used during the period between the position datum before and after the freeze event, because the time is related to the datum before the freeze information is made available.

| Parameter         | 03.103 F1 Normalised Freeze Position                       |                |             |
|-------------------|--|----------------|-------------|
| Short description | Displays the normalised position from the F1 freeze system |                |             |
| Mode              | RFC-A  |                |             |
| Minimum           | -2147483648  | Maximum        | 2147483647  |
| Default           |  | Units          |             |
| Type              | 32 Bit Volatile  | Update Rate    | 250µs write |
| Display Format    | Standard   | Decimal Places | 0           |
| Coding            | RO, ND, NC, PT   |                |             |

See *F1 Freeze Position Source* (03.102).

| Parameter         | 03.104 F1 Freeze Flag   |                |             |
|-------------------|---|----------------|-------------|
| Short description | Displays when a freeze event occurs from the F1 freeze system |                |             |
| Mode              | RFC-A   |                |             |
| Minimum           | 0   | Maximum        | 1           |
| Default           |   | Units          |             |
| Type              | 1 Bit Volatile  | Update Rate    | 250µs write |
| Display Format    | Standard  | Decimal Places | 0           |
| Coding            | RW, ND, NC, PT  |                |             |

The freeze flag is set when a freeze event occurs. If 0 is written to *F1 Freeze Flag* (03.104) the freeze flag is cleared.

| Parameter         | 03.105 F2 Freeze Trigger Source  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | User to select the source that generates trigger events for the F2 freeze system |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 6               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text            |
|-------|-----------------|
| 0     | Digital Input 4 |
| 1     | Digital Input 5 |
| 2     | P1 Marker       |
| 3     | P2 Marker       |
| 4     | Common          |
| 5     | P1 Zero         |
| 6     | P2 Zero         |

*F2 Freeze Trigger Source* (03.105) is used to select the source that generates trigger events for the F2 freeze system.

#### 0, 1: Dig I/O 4, Dig I/O 5

Digital I/O 4 or Digital I/O 5 on the drive can be used as trigger sources. If the digital I/O is set up as an input, then trigger events will be produced on the relevant edge of the input signal. If the digital I/O is set up as an output, then trigger events will be produced on the relevant edge of the output signal.

#### 2, 3: Z1, Z2

Z1 selects the P1 position feedback interface marker input as the trigger source and Z2 selects the P2 position feedback interface marker input as the trigger source. No trigger events will be produced unless the selected maker input is available.

#### 4: Common

The output of the common freeze line is selected. If the output of the drive common freeze system is enabled (Bit 3 of *Common Freeze Mode* (03.112) = 1) then the drive common freeze system provides the freeze event triggers. If the output of the drive common freeze system is disabled the option module freeze line provides the freeze event triggers.

#### 5, 6: P1 Zero, P2 Zero

A freeze event is triggered when the turns for the respective position feedback interface change (i.e. the feedback position passes through zero in either direction). The freeze position stored in *F1 Normalised Freeze Position* (03.103) or *F2 Normalised Freeze Position* (03.108) will include the turns associated with the zero position whichever direction the position changes. For example if the turns change from 4 to 5 or 5 to 4 the turns value stored is 5. This mode can be used as a substitute for a physical marker with a position device that does not have one to trigger an event to occur at the zero position of the feedback device. For example, it can be used with the AMC to start a CAM at the zero position of the feedback device. It should be noted that if P1 Zero is selected as the trigger source then *F1 Freeze Position Source* (03.102) has no effect and P1 is always used as the freeze position source. If P2 Zero is selected as the trigger source then *F1 Freeze Position Source* (03.102) has no effect and P2 is always used as the freeze position source. This is because these freeze trigger sources are only intended to capture the zero position of the device being used to give the zero position trigger event.

| Parameter         | 03.106 F2 Freeze Mode                     |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the mode for the F2 freeze system |                |                 |
| Mode              | RFC-A                                     |                |                 |
| Minimum           | 0   | Maximum        | 3               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                           | Update Rate    | Background read |
| Display Format    | Standard                                  | Decimal Places | 0               |
| Coding            | RW, TE                                    |                |                 |

| Value | Text        |
|-------|-------------|
| 0     | Rising 1st  |
| 1     | Falling 1st |
| 2     | Rising all  |
| 3     | Falling all |

#### 0: Rising 1st

Freeze events are produced on the rising edge of the freeze trigger source. If the *F2 Freeze Flag* (03.109) is 0 then the first suitable edge produced by the trigger source causes the freeze position to be stored and the *F2 Freeze Flag* (03.109) to be set to 1. No further freeze events are possible until the *F2 Freeze Flag* (03.109) has been cleared by the user.

#### 1: Falling 1st

As for Rising 1st, but the falling edge is used to trigger freeze events.

#### 2: Rising All

Freeze events are produced on the rising edge of the freeze trigger source. If the *F2 Freeze Flag* (03.109) is 0 then the first suitable edge produced by the trigger source causes the freeze position to be stored and the *F2 Freeze Flag* (03.109) to be set to 1. If further suitable edges are produced by the trigger source the freeze position is updated with the current position.

#### 3: Falling All

As for Rising All, but the falling edge is used to trigger freeze events.

| Parameter         | 03.107 F2 Freeze Position Source                     |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the source position for the F2 freeze system |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 2               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                                      | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text |
|-------|------|
| 0     | P1   |
| 1     | P2   |
| 2     | Time |

*F2 Freeze Position Source* (03.107) defines the source for the F1 freeze system as follows:

#### P1 or P2

When a freeze event occurs, the position from the relevant position feedback interface within the drive (i.e. P1 or P2), including the effect of the marker (see *P1 Marker Mode* (03.031)), is stored and can be accessed as a 32 bit normalised value in *F2 Normalised Freeze Position* (03.108). For a digital incremental source (AB, FD, FR, AB Servo, FD Servo or FR Servo) the position is captured at the freeze event using a hardware system. For a resolver the freeze position is the position at the last 250us sample point. For all other position feedback devices the time of the freeze event is captured with hardware and then interpolation, based on the change of position during the previous nominal 250us period, is used to estimate the position at the freeze event.

#### Time

The time of the freeze event is stored with respect to the last datum used by the position feedback system and option modules fitted to the drive. These datum events occur at a nominal rate of 250us, but if the drive timing is being synchronised by the comms system in an option module then the actual timing may vary slightly depending on the accuracy of the clock providing the synchronisation. The time stored in *F2 Normalised Freeze Position* (03.108) is given as a proportion of the nominal 250us time period where 65536 corresponds to one nominal 250us time period. Note that the value may be positive or negative. Positive values give the time of an event that occurred after the last datum, but before the freeze information is processed. Negative values give the time of an event that occurred before the datum, but after the previous time when the freeze information was processed. The time of the freeze event could be used, for example, to determine the value of a virtual position being generated within an option module at the freeze event. The calculated value would only be meaningful if the freeze information is used during the period between the position datum before and after the freeze event, because the time is related to the datum before the freeze information is made available.

| Parameter         | 03.108 <i>F2 Normalised Freeze Position</i>                |                |             |
|-------------------|--|----------------|-------------|
| Short description | Displays the normalised position from the F2 freeze system |                |             |
| Mode              | RFC-A  |                |             |
| Minimum           | -2147483648  | Maximum        | 2147483647  |
| Default           |  | Units          |             |
| Type              | 32 Bit Volatile  | Update Rate    | 250µs write |
| Display Format    | Standard   | Decimal Places | 0           |
| Coding            | RO, ND, NC, PT   |                |             |

See *F2 Freeze Position Source* (03.107).

| Parameter         | 03.109 <i>F2 Freeze Flag</i>                                  |                |             |
|-------------------|---|----------------|-------------|
| Short description | Displays when a freeze event occurs from the F2 freeze system |                |             |
| Mode              | RFC-A   |                |             |
| Minimum           | 0   | Maximum        | 1           |
| Default           |   | Units          |             |
| Type              | 1 Bit Volatile  | Update Rate    | 250µs write |
| Display Format    | Standard  | Decimal Places | 0           |
| Coding            | RW, ND, NC, PT  |                |             |

The freeze flag is set when a freeze event occurs. If 0 is written to *F2 Freeze Flag* (03.109) the freeze flag is cleared.

| Parameter         | 03.110 <i>Common Freeze Source 1</i>          |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines source 1 for the common freeze system |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 4               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                               | Update Rate    | Background read |
| Display Format    | Standard                                      | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text            |
|-------|-----------------|
| 0     | Digital Input 4 |
| 1     | Digital Input 5 |
| 2     | P1 Marker       |
| 3     | P2 Marker       |
| 4     | Disabled        |

See *F1 Freeze Trigger Source* (03.100) or *F2 Freeze Trigger Source* (03.105). It should be noted that if the Disabled option is selected then the input is set to a one.

| Parameter         | 03.111 Common Freeze Source 2                 |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines source 2 for the common freeze system |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 4               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                               | Update Rate    | Background read |
| Display Format    | Standard                                      | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text            |
|-------|-----------------|
| 0     | Digital Input 4 |
| 1     | Digital Input 5 |
| 2     | P1 Marker       |
| 3     | P2 Marker       |
| 4     | Disabled        |

See *F1 Freeze Trigger Source* (03.100) or *F2 Freeze Trigger Source* (03.105). It should be noted that if the Disabled option is selected then the input is set to a one.

| Parameter         | 03.112 Common Freeze Mode                          |                |                       |
|-------------------|--|----------------|-----------------------|
| Short description | Defines the mode used for the common freeze system |                |                       |
| Mode              | RFC-A  |                |                       |
| Minimum           | 0<br>(Display: 0000)                               | Maximum        | 15<br>(Display: 1111) |
| Default           | 0<br>(Display: 0000)                               | Units          |                       |
| Type              | 8 Bit User Save                                    | Update Rate    | Background read       |
| Display Format    | Binary   | Decimal Places | 0                     |
| Coding            | RW   |                |                       |

The common freeze system can be used to logically combine two freeze trigger sources. The switches in the common freeze system are controlled by the bits in *Common Freeze Mode* (03.112) as defined in the table below.

| Bit | Function                |
|-----|-------------------------|
| 0   | Source 1 input invert 1 |
| 1   | Source 2 input invert   |
| 2   | Output invert           |
| 3   | Output enable           |

Therefore the value defined bits 2 to 0 can be used to generate various logic functions as given in the table below.

| Bits 2 to 0 | Function                  |
|-------------|---------------------------|
| 0           | Source1 AND Source2       |
| 1           | NOT(Source1) AND Source2  |
| 2           | Source1 AND NOT(Source2)  |
| 3           | Source1 NOR Source2       |
| 4           | Source1 NAND Source2      |
| 5           | NOT(Source1) NAND Source2 |
| 6           | Source1 NAND NOT(Source2) |
| 7           | Source1 OR Source2        |

| Parameter         | 03.113 Freeze Input States                       |                |                    |
|-------------------|--|----------------|--------------------|
| Short description | Displays the level of the selected freeze inputs |                |                    |
| Mode              | RFC-A  |                |                    |
| Minimum           | 0<br>(Display: 00)                               | Maximum        | 3<br>(Display: 11) |
| Default           |  | Units          |                    |
| Type              | 8 Bit Volatile                                   | Update Rate    | 4ms write          |
| Display Format    | Binary   | Decimal Places | 0                  |
| Coding            | RO, ND, NC, PT                                   |                |                    |

The bits in *Freeze Input States* (03.113) show the level of the selected freeze trigger inputs. Bit 0 corresponds to F1 freeze input and bit 1 corresponds to F2 freeze input. It should be noted that if the trigger option is P1Zero or P2Zero there is no hardware trigger input, and so the relevant bit is always zero.



| Parameter         | 03.118 P1 Thermistor Type                        |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the thermistor type for the P1 interface |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 3               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                                  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text     |
|-------|----------|
| 0     | DIN44082 |
| 1     | KTY84    |
| 2     | 0.8mA    |
| 3     | Encoder  |

P1 Thermistor Type (03.118) defines the operating mode of the P1 thermistor input.

| P1 Thermistor Type (03.118) | Compatible devices  |
|-----------------------------|---|
| 0: DIN44082                 | Three thermistors in series as specified in DIN44082 standard |
| 1: KTY84                    | KTY84 PTC thermistor  |
| 2: 0.8mA                    | Any device  |
| 3: Encoder                  | EnDat 2.2 encoder   |

#### All except 3(Encoder)

If a device is connected between the pin 15 of the encoder interface and 0V a current source will pass 0.8mA through the device with a maximum voltage of approximately 3.8V (i.e. maximum resistance of approximately 4750 Ohms). The resistance of the device is calculated and displayed in P1 Thermistor Feedback (03.119). If P1 Thermistor Type (03.118) is set to select KTY84 the temperature is also calculated and written to P1 Thermistor Temperature (03.122). Note that DIN44082 mode and 0.8mA mode operate in exactly the same way.

#### 3 (Encoder)

If an EnDat 2.2 encoder which supports external temperature feedback is connected to the P1 position feedback interface then it is possible to obtain the measured temperature from the encoder if P1 Thermistor Type (03.118) is set to 3. The temperature is displayed in P1 Thermistor Temperature (03.122) and a resistance equivalent to that for a KTY84 device is displayed in P1 Thermistor Feedback (03.119). The drive does not check if an external device is connected, but short circuit protection can be selected to detect if the device is not connected because the resistance will appear as zero.

| Parameter         | 03.119 P1 Thermistor Feedback                                 |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the resistance of the thermistor on the P1 interface |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 5000             |
| Default           |   | Units          | Ω                |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

See P1 Thermistor Type (03.118).

| Parameter         | 03.120 P1 Thermistor Trip Threshold                        |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the thermistor trip threshold for the P1 interface |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 5000            |
| Default           | 3300   | Units          | Ω               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See P1 Thermistor Fault Detection (03.123).

| Parameter         | 03.121 P1 Thermistor Reset Threshold                        |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the thermistor reset threshold for the P1 interface |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 5000            |
| Default           | 1800  | Units          | Ω               |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See P1 Thermistor Fault Detection (03.123).

| Parameter         | 03.122 P1 Thermistor Temperature  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the temperature of the device based on the resistance to temperature characteristic for the specified device |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | -50   | Maximum        | 300              |
| Default           |   | Units          | °C               |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

See *P1 Thermistor Type* (03.118).

| Parameter         | 03.123 P1 Thermistor Fault Detection                    |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the fault detection for the P1 thermistor input |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 2               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text          |
|-------|---------------|
| 0     | None          |
| 1     | Temperature   |
| 2     | Temp or Short |

Defines the fault detection for the P1 thermistor input:

| P1 Thermistor Fault Detection (03.123) | Fault detection                              |
|--|--|
| 0: None                                | No detection active                          |
| 1: Temperature                         | Over temperature detection                   |
| 2: Temp and short                      | Over temperature and short circuit detection |

If over temperature detection is enabled a *Thermistor.001* trip is initiated if *P1 Thermistor Feedback* (03.119) is above the level defined by *P1 Thermistor Trip Threshold* (03.120). The trip cannot be reset until *P1 Thermistor Feedback* (03.119) is below *P1 Thermistor Reset Threshold* (03.121).

If short circuit detection is enabled then a *Th Short Circuit.001* is initiated if *P1 Thermistor Feedback* (03.119) is below 50 Ohms.

| Parameter         | 03.127 P2 Speed Feedback                          |                |           |
|-------------------|---|----------------|-----------|
| Short description | Displays the speed feedback from the P2 interface |                |           |
| Mode              | RFC-A   |                |           |
| Minimum           | -VM_SPEED   | Maximum        | VM_SPEED  |
| Default           |   | Units          |           |
| Type              | 32 Bit Volatile                                   | Update Rate    | 4ms write |
| Display Format    | Standard  | Decimal Places | 1         |
| Coding            | RO, FI, VM, ND, NC, PT                            |                |           |

Provided the set-up parameters for the position feedback device connected to the drive P2 position interface are correct *P2 Speed Feedback* (03.127) shows the speed derived from the feedback. The speed is given in mm/s if *P2 Linear Feedback Select* (03.151) = 1 and *Linear Speed Select* (01.055) = 1, otherwise it is given in rpm. The value shown is measured over a 16ms sliding window period, and so the ripple in this value is as defined for *Speed Feedback* (03.002).

| Parameter         | 03.128 P2 Revolution/Pole Pitch Counter                          |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the revolution/pole pitch counter from the P2 interface |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | 0  | Maximum        | 65535     |
| Default           |  | Units          |           |
| Type              | 16 Bit Power Down Save   | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT, BU   |                |           |

*P2 Revolution/Pole Pitch Counter* (03.128), *P2 Position* (03.129) and *P2 Fine Position* (03.130) combined give the encoder position with a resolution of  $1/2^{32}$  of a revolution/pole pitch as a 48 bit number. If a rotary position feedback device is being used (*P2 Linear Feedback Select* (03.151) = 0) then these quantities relate directly to the rotary position of the feedback device. If a linear feedback device is used then one revolution or pole pitch relates to the distance given by *P2 Pole Pair Pitch* (03.155).

See *P1 Revolution/Pole Pitch Counter* (03.028) for more information.

| Parameter         | 03.129 P2 Position                                   |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the position feedback from the P2 interface |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | 0  | Maximum        | 65535     |
| Default           |  | Units          |           |
| Type              | 16 Bit Power Down Save                               | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT, BU                                   |                |           |

See *P2 Revolution/Pole Pitch Counter* (03.128).

| Parameter         | 03.130 P2 Fine Position                          |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the fine position from the P2 interface |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | 0  | Maximum        | 65535     |
| Default           |  | Units          |           |
| Type              | 16 Bit Volatile                                  | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT, BU                               |                |           |

See *P2 Revolution/Pole Pitch Counter* (03.128).

| Parameter         | 03.131 P2 Marker Mode                        |                |                       |
|-------------------|--|----------------|-----------------------|
| Short description | Defines the marker mode for the P2 interface |                |                       |
| Mode              | RFC-A  |                |                       |
| Minimum           | 0<br>(Display: 0000)                         | Maximum        | 15<br>(Display: 1111) |
| Default           | 4<br>(Display: 0100)                         | Units          |                       |
| Type              | 8 Bit User Save                              | Update Rate    | Background read       |
| Display Format    | Binary                                       | Decimal Places | 0                     |
| Coding            | RW   |                |                       |

#### **P2 Device type (03.138): AB, FD, FR**

Each position feedback device produces incremental signals which are counted in hardware. If *P2 Marker Mode* (03.131) = 0 the following occurs when a marker event is produced by the Z1 input:

1. *P2 Position* (03.129) and *P2 Fine Position* (03.130) are reset to zero.
2. The bits in *P2 Normalised Position* (03.158) related to *P2 Position* (03.129) and *P2 Fine Position* (03.130) are reset to zero
3. *P2 Marker Flag* (03.132) is set to one.

The marker is a hardware function, and so the position appears as though it is reset at the marker event time even if this is between control system sample points. It should be noted that the marker event occurs on the rising edge of the marker pulse if the position change over the last sample was positive or on the falling edge if the position change over the last sample was negative. This ensures that the marker event occurs at the same physical location for either direction of rotation.

The action taken when a marker event occurs can be modified by setting the bits of *P2 Marker Mode* (03.131) as described in the table below.

| Bit | Effect of setting bit to one   |
|-----|--|
| 0   | No action is taken unless the marker flag is zero before the marker event occurs   |
| 1   | <i>P2 Revolution/Pole Pitch Counter</i> (03.128) and the whole of <i>P2 Normalised Position</i> (03.158) are also set to zero on a marker event  |
| 2   | <i>P2 Revolution/Pole Pitch Counter</i> (03.128), <i>P2 Position</i> (03.129), <i>P2 Fine Position</i> (03.130) and the related part of <i>P2 Normalised Position</i> (03.158) are not reset. (This overrides bit 1.) <i>P2 Normalised Position</i> (03.158) is transferred to <i>P2 Normalised Marker Position</i> (03.159) and <i>P2 Marker Flag</i> (03.132) is set to one. |
| 3   | This bit in has not effect.  |

The marker input can be used for a standard type marker function or alternatively it can be used as an additional freeze input for the P1 position feedback interface.

#### **P2 Device type (03.138): Any other device type**

The marker function cannot be used and *P2 Marker Mode* (03.131) has no effect.

| Parameter         | 03.132 P2 Marker Flag                |                |             |
|-------------------|--------------------------------------|----------------|-------------|
| Short description | Indicates when a marker event occurs |                |             |
| Mode              | RFC-A                                |                |             |
| Minimum           | 0                                    | Maximum        | 1           |
| Default           | 0                                    | Units          |             |
| Type              | 1 Bit Volatile                       | Update Rate    | 250µs write |
| Display Format    | Standard                             | Decimal Places | 0           |
| Coding            | RW, NC                               |                |             |

*P2 Marker Flag* (03.132) is set to one when a marker event occurs. The flag must be cleared by the user.

| Parameter         | 03.133 P2 Rotary Turns Bits                                 |                |   |
|-------------------|---|----------------|---|
| Short description | Defines the number of rotary turns bit for the P2 interface |                |   |
| Mode              | RFC-A   |                |   |
| Minimum           | 0   | Maximum        | 16  |
| Default           | 16  | Units          |   |
| Type              | 8 Bit User Save   | Update Rate    | Background read, auto-configuration write |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW  |                |   |

*P2 Rotary Turns Bits* (03.133) only has any effect if the position feedback interface is being used with a rotary device (i.e. *P2 Linear Feedback Select* (03.151) = 0).

**P2 Device type (03.138): EnDat, BiSS, SSI**

*P2 Rotary Turns Bits* (03.133) is used to determine the number of bits within the comms messages from the position feedback device that represent turns. For a single turn encoder *P2 Rotary Turns Bits* (03.133) must be set to zero. It should be noted that some SSI encoders include leading zeros before the turns information and in this case the number of turns bits should include the leading zeros. The most significant bits in *P1 Revolution/Pole Pitch Counter* (03.028) that are not included in the turns information provided by the encoder comms are held at zero. If *P2 Rotary Turns Bits* (03.133) = 0 (single turn encoder) the whole of *P2 Revolution/Pole Pitch Counter* (03.128) is held at zero.

**P2 Device type (03.138): Any other device type**

It is sometimes desirable to mask off the most significant bits of *P2 Revolution/Pole Pitch Counter* (03.128), but this does not have to be done for the drive to function correctly. If *P2 Rotary Turns Bits* (03.133) = 0 the whole of *P2 Revolution/Pole Pitch Counter* (03.128) is held at zero. If *P2 Rotary Turns Bits* (03.133) has any other value it indicates the number of bits in *P2 Revolution/Pole Pitch Counter* (03.128) that are not held at zero. For example, if *P2 Rotary Turns Bits* (03.133) = 5, then *P2 Revolution/Pole Pitch Counter* (03.128) counts up to 31 before being reset.

| Parameter         | 03.134 P2 Rotary Lines Per Revolution                                  |                |   |
|-------------------|--|----------------|---|
| Short description | Defines the number of rotary lines per revolution for the P2 interface |                |   |
| Mode              | RFC-A  |                |   |
| Minimum           | 0  | Maximum        | 100000                                    |
| Default           | 1024   | Units          |   |
| Type              | 32 Bit User Save   | Update Rate    | Background read, auto-configuration write |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RW   |                |   |

*P2 Rotary Lines Per Revolution* (03.134) only has any effect if the position feedback interface is being used with a rotary device (i.e. *P2 Linear Feedback Select* (03.151) = 0).

**P2 Device type (03.138): AB**

*P2 Rotary Lines Per Revolution* (03.134) should be set to the number of lines per revolution for the encoder connected to the P1 position feedback interface.

**P2 Device type (03.138): FD, FR**

*P2 Rotary Lines Per Revolution* (03.134) should be set to the number of lines per revolution for the encoder connected to the P1 position feedback interface multiplied by 2.

**P2 Device type (03.138): Any other device type**

*P2 Rotary Lines Per Revolution* (03.134) has no effect.

| Parameter         | 03.135 P2 Comms Bits   |                |   |
|-------------------|--|----------------|---|
| Short description | Defines the total number of bits of position information in the comms message from the encoder on the P2 interface |                |   |
| Mode              | RFC-A  |                |   |
| Minimum           | 0  | Maximum        | 48  |
| Default           | 0  | Units          |   |
| Type              | 8 Bit User Save  | Update Rate    | Background read, auto-configuration write |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RW   |                |   |

**P2 Device type (03.138): EnDat, SSI, BiSS**

*P2 Comms Bits* (03.135) should be set to the total number of bits of position information in the comms message from the encoder. If SSI communications is being used this should include any leading or trailing zeros and the power supply alarm bit if present.

**P2 Device type (03.138): Any other device type**

P2 Comms Bits (03.135) has no effect.

| Parameter         | 03.137 P2 Comms Baud Rate                             |                |   |
|-------------------|---|----------------|---|
| Short description | Defines the baud rate used for encoder communications |                |   |
| Mode              | RFC-A   |                |   |
| Minimum           | 0   | Maximum        | 8   |
| Default           | 2   | Units          | Baud                                      |
| Type              | 8 Bit User Save                                       | Update Rate    | Background read, auto-configuration write |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW, TE  |                |   |

| Value | Text |
|-------|------|
| 0     | 100k |
| 1     | 200k |
| 2     | 300k |
| 3     | 400k |
| 4     | 500k |
| 5     | 1M   |
| 6     | 1.5M |
| 7     | 2M   |
| 8     | 4M   |

P2 Comms Baud Rate (03.137) defines the baud rate used for encoder communications. Restrictions are applied to the baud rate for different feedback devices, and so the baud rate may be different to the parameter value.

**P2 Device type (03.138): EnDat, BiSS, SSI**

Any baud rate that is within the range specified for the encoder may be used. The line delay is measured during initialisation, and used to compensate this delay during communications with the encoder. Therefore there is no timing based restriction on the length of the cable between the position feedback interface and the encoder. However, care should be taken to ensure that the wiring arrangement and the type of cable used are suitable for the selected baud rate and the distance between the position interface and the encoder. See P2 Low Speed Update Rate Active (03.163) for more details on timing restrictions related to the drive sample times.

**P2 Device type (03.138): Any other device**

P2 Comms Baud Rate (03.137) has no effect.

| Parameter         | 03.138 P2 Device type   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set this to the feedback device type connected to the P2 position interface |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 6               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text  |
|-------|-------|
| 0     | None  |
| 1     | AB    |
| 2     | FD    |
| 3     | FR    |
| 4     | EnDat |
| 5     | SSI   |
| 6     | BiSS  |

If P2 Device type (03.138) = Disabled, the P2 position feedback interface is disabled and does not provide any position feedback.

See P1 Device Type (03.038) for more information on the different position feedback device types.

| Parameter         | 03.140 P2 Error Detection Level                            |                |                        |
|-------------------|--|----------------|------------------------|
| Short description | Used to enable or disable position feedback trip functions |                |                        |
| Mode              | RFC-A  |                |                        |
| Minimum           | 0<br>(Display: 00000)                                      | Maximum        | 31<br>(Display: 11111) |
| Default           | 1<br>(Display: 00001)                                      | Units          |                        |
| Type              | 8 Bit User Save  | Update Rate    | Background read        |
| Display Format    | Binary   | Decimal Places | 0                      |
| Coding            | RW   |                |                        |

This parameter can be used to enable or disable position feedback trip functions as follows:

| Bit | Function   |
|-----|--|
| 0   | Not used with the P2 position interface.   |
| 1   | Not used with the P2 position interface.   |
| 2   | Enable SSI power supply alarm bit monitor (indicated by trip <i>Encoder 6</i> ). |
| 3   | Disable trips <i>Encoder 1</i> to <i>Encoder 6</i> .                             |
| 4   | Disable trip <i>Encoder 7</i> .  |

Bits 3 and 4 do not prevent the device from becoming un-initialised. The trip is suppressed, but the device is still un-initialised and this is indicated by the appropriate bit for the position feedback interface in *Position Feedback Initialized* (03.076).

### Encoder trips

The following table shows trips that can be initiated that are related to the position feedback interface P2. The sub-trip number is 2 for the drive P2 position feedback interface.

| Drive trip           | Encoders         | Reason for error  |
|----------------------|------------------|---|
| <i>Encoder 4</i>     | EnDat, BiSS      | Comms timeout   |
| <i>Encoder 5</i>     | EnDat, BiSS      | Checksum/CRC error  |
|                      | SSI              | Not ready at start of position transfer (i.e. data input not one)   |
| <i>Encoder 6</i>     | EnDat, BiSS      | The encoder has indicated an error  |
|                      | SSI              | Power supply alarm bit active   |
| <i>Encoder 7</i>     | EnDat, BiSS, SSI | An attempt has been made to enable the drive, but a position feedback device is not initialised   |
| <i>Encoder 8</i>     | EnDat, SSI, BiSS | <i>Maximum Switching Frequency</i> (05.018), <i>P2 Device type</i> (03.138), <i>P2 Comms Bits</i> (03.135), <i>P2 Comms Baud Rate</i> (03.137), <i>P2 Calculation Time</i> (03.160), <i>P2 Recovery Time</i> (03.161), <i>P2 Line Delay Time</i> (03.162) and <i>P2 User Comms Enable</i> (03.167) are used to determine the time taken for the communications exchange with the encoder. If this time exceeds 250µs an <i>Encoder 8</i> trip is initiated. |
| <i>Encoder 9</i>     | All              | Speed feedback selected from an option slot that does not have a position feedback category option module fitted  |
| <i>Phasing Error</i> | All              | Incorrect encoder phasing <sup>1</sup>  |
| <i>Encoder 12</i>    | BiSS             | The encoder could not be identified during auto-configuration   |

1. Incorrect encoder phasing is detected if the motor reaches half of the speed defined by VM\_SPEED\_FREQ\_REF[MAX] and the phasing error is large enough for the motor to accelerate uncontrollably.

### Wire-break detection

It may be important to detect a break in the connections between the drive and the position feedback device. This feature is provided for most position feedback devices either directly or indirectly as listed below.

| Device      | Detection method   | Trip produced                          |
|-------------|--|--|
| AB, FD, FR  | There is no wire break detection of the A2, B2, and Z2 signals on the P2 position interface.   | None                                   |
| EnDat, BiSS | Wire break in the comms link is detected by a CRC or timeout error.  | <i>Encoder 4</i> ,<br><i>Encoder 5</i> |
| SSI         | Wire break detection in the comms is difficult with these devices. However, if power supply alarm bit monitoring is enabled the drive will be looking for a one at the start of the message and a zero to indicate that the power supply is okay. If the clock stops or the data line is disconnected the data input to the drive may stay in one state or the other and cause a trip. | <i>Encoder 5</i> ,<br><i>Encoder 6</i> |

| Parameter         | 03.141 <i>P2 Auto-configuration Select</i>   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set this parameter to enable auto-configuration of EnDat and BiSS feedback devices |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 1  | Units          |                 |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text     |
|-------|----------|
| 0     | Disabled |
| 1     | Enabled  |

### *P2 Device type* (03.138): EnDat, BiSS

If auto-configuration has not been disabled (i.e. *P2 Auto-configuration Select* (03.141) = 0) then during position feedback initialisation the encoder is interrogated to determine whether the encoder is a rotary or linear encoder and *P2 Linear Feedback Select* (03.151) is set up appropriately. Then the following parameters are set up based on information from the encoder:

| Rotary                                  | Linear  |
|---|---|
| P2 Rotary Turns Bits (03.133)           | P2 Linear Comms Pitch (03.152)                |
| P2 Rotary Lines Per Revolution (03.134) | P2 Linear Line Pitch (03.153)                 |
| P2 Comms Bits (03.135)                  | P2 Comms Bits (03.135)                        |
|   | P2 Linear Comms And Line Pitch Units (03.154) |

The following actions are also taken to set up the timing for the encoder.

| Comms Protocol | Actions taken   |
|----------------|---|
| EnDat 2.1      | P2 Calculation Time (03.160) = From the encoder<br>P2 Recovery Time (03.161) = 30µs<br>Line delay measured and result written to P2 Line Delay Time (03.162)  |
| EnDat 2.2      | P2 Calculation Time (03.160) = From the encoder<br>P2 Recovery Time (03.161) = 4µs and the recovery time within the encoder is set up to the shortest value of 3.75µs if the P2 Comms Baud Rate (03.137) is 1M or more. Line delay measured and result written to P2 Line Delay Time (03.162) |
| BiSS           | P2 Recovery Time (03.161) = 12µs<br>Line delay measured and result written to P2 Line Delay Time (03.162)   |
| SSI            | Line delay measured and result written to P2 Line Delay Time (03.162)   |

If P2 Auto-configuration Select (03.141) = 1 then P2 Comms Baud Rate (03.137) is set to the minimum value that will give a total message transfer time of less than 62µs, so that the transfer will occur at the fast update rate with the minimum baud rate. It should be noted that the value of P2 User Comms Enable (03.167) is taken into account as this may affect the message time.

Once these parameters have been set up it should be possible for the drive to operate correctly with the encoder. The drive repeatedly attempts to initialise the encoder, including auto-configuration which is part of this process, until it is successful. Therefore if auto-configuration has not been successful by the time the drive is enabled because the drive cannot establish communications an *Encoder 7* trip occurs. For BiSS encoders the drive must identify the encoder model number to perform auto-configuration. If communications is established, but the drive cannot recognise the encoder model an *Encoder 12* trip is produced immediately.

If auto-configuration is disabled (i.e. P2 Auto-configuration Select (03.141) = 1) then none of the above actions are carried out except for the line delay measurement.

**P2 Device type (03.138): All other device types**  
P2 Auto-configuration Select (03.141) has no effect.

| Parameter         | 03.142 P2 Feedback Filter   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the time period for a sliding window filter that may be applied to the feedback taken from the P2 interface |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 5               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text     |
|-------|----------|
| 0     | Disabled |
| 1     | 1ms      |
| 2     | 2ms      |
| 3     | 4ms      |
| 4     | 8ms      |
| 5     | 16ms     |

P2 Feedback Filter (03.142) defines the time period for a sliding window filter that may be applied to the feedback taken from the drive P2 position feedback interface. This is particularly useful in applications where the drive encoder is used to give speed feedback for the speed controller and where the load includes a high inertia, and so the speed controller gains are very high. Under these conditions, without a filter on the feedback, it is possible for the speed loop output to change constantly from one current limit to the other and lock the integral term of the speed controller.

| Parameter         | 03.143 P2 Maximum Reference                               |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the maximum speed reference from the P2 interface |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 33000           |
| Default           | 1500  | Units          |                 |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, BU  |                |                 |

The speed feedback from the drive P1 position feedback interface can be used as a source to control a parameter. The speed feedback is scaled to give a value as a percentage of *P2 Maximum Reference* (03.143) in 0.1% units which is displayed in *P2 Reference* (03.145). The value is then scaled by the *P2 Reference Scaling* (03.144) and then routed to the destination defined by *P2 Reference Destination* (03.146).

Normally the destination is updated every 4ms, but if the destination is the *Hard Speed Reference* (03.022), *P2 Maximum Reference* (03.143) = VM\_SPEED\_FREQ\_REF[MAX] and *P2 Reference Scaling* (03.144) = 1.000 it is updated every 250µs. Although the hard speed reference is updated every 250µs internally a value in rpm or mm/s is written to *Hard Speed Reference* (03.022) every 4ms for indication only. It should be noted that if the fast update method is used the resolution of the speed feedback derived from the position feedback device defines the resolution of the hard speed reference and that any ripple on the feedback will be present on the hard speed reference (see *Speed Feedback* (03.002)).

| Parameter         | 03.144 P2 Reference Scaling                     |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the scaling applied to the P2 reference |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.000   | Maximum        | 4.000           |
| Default           | 1.000   | Units          |                 |
| Type              | 16 Bit User Save                                | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 3               |
| Coding            | RW  |                |                 |

See *P2 Maximum Reference* (03.143).

| Parameter         | 03.145 P2 Reference                |                |           |
|-------------------|------------------------------------|----------------|-----------|
| Short description | Displays the value in P2 reference |                |           |
| Mode              | RFC-A                              |                |           |
| Minimum           | -100.0                             | Maximum        | 100.0     |
| Default           |                                    | Units          | %         |
| Type              | 16 Bit Volatile                    | Update Rate    | 4ms write |
| Display Format    | Standard                           | Decimal Places | 1         |
| Coding            | RO, FI, ND, NC, PT                 |                |           |

See *P2 Maximum Reference* (03.143).

| Parameter         | 03.146 P2 Reference Destination                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the destination parameter for P2 reference |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                     |                |                  |

See *P2 Maximum Reference* (03.143).

| Parameter         | 03.147 P2 SSI Incremental Mode          |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to enable SSI incremental mode |                |                 |
| Mode              | RFC-A                                   |                |                 |
| Minimum           | 0                                       | Maximum        | 1               |
| Default           | 0                                       | Units          |                 |
| Type              | 1 Bit User Save                         | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW                                      |                |                 |

#### **P2 Device type (03.138): SSI**

If *P2 SSI Incremental Mode* (03.147) = 0 the complete absolute position is read at each sample. Care should be taken when using this mode as some unwanted effects can occur when the encoder passes through the boundary between its maximum position and zero. In this mode the encoder can be used for motor control provided at least 6 bits of turns information are provided by the encoder otherwise an over speed trip will be produced as the position passes over the maximum position to zero boundary. *P2 Normalised Position* (03.158) can be used for position control over this boundary provided the normalised turns bits are set up so that the normalised positions do not contain turns information that is not available from the encoder. As the SSI format does not include any error checking it is not possible to detect if the position data has been corrupted by noise. The benefit of using the absolute position directly from an SSI encoder is that even if the encoder communications are disturbed by noise and position errors occur, the position will always recover the correct position after the disturbance has ended.

If *P2 SSI Incremental Mode* (03.147) = 1 the absolute position is only taken from the encoder during initialisation. The change of position over each



sample is then accumulated to determine the position. This method always gives 16 bits of turns information that can always be used without jumps in position whatever value is used as the turns bits for normalisation. If noise corrupts the data from an SSI encoder it is possible to have apparent large change of position, and this can result in the turns information becoming and remaining corrupted until the encoder is re-initialised.

If an SSI encoder is used, but is not powered from the drive, and the encoder is powered up after the drive, it is possible that the first change of position detected could be large enough to cause the problems described above. This can be avoided if the encoder interface is initialised with *Initialise Position Feedback* (03.075) after the encoder has powered up. If the encoder includes a power supply alarm bit, the power supply monitor should be enabled. This will ensure that the drive remains tripped until the encoder is powered up and the action of resetting the trip will reinitialise the encoder interface.

**P2 Device type (03.138): All other device types**  
*P2 SSI Incremental Mode* (03.147) has no effect.

| Parameter         |  |                 |  | 03.148 P2 SSI Binary Mode          |  |                 |  |
|-------------------|--|-----------------|--|------------------------------------|--|-----------------|--|
| Short description |  |                 |  | Set to 1 to enable SSI binary mode |  |                 |  |
| Mode              |  |                 |  | RFC-A                              |  |                 |  |
| Minimum           |  | 0               |  | Maximum                            |  | 1               |  |
| Default           |  | 0               |  | Units                              |  |                 |  |
| Type              |  | 1 Bit User Save |  | Update Rate                        |  | Background read |  |
| Display Format    |  | Standard        |  | Decimal Places                     |  | 0               |  |
| Coding            |  |                 |  | RW                                 |  |                 |  |

**P2 Device type (03.138): SSI**

SSI encoders normally use Gray code data format. However, some encoders use binary format which may be selected by setting *P2 SSI Binary Mode* (03.148) to one.

**P2 Device type (03.138): All other device types**  
*P2 SSI Binary Mode* (03.148) has no effect.

| Parameter         |  |                 |  | 03.149 P2 Additional Power-up Delay  |  |                 |  |
|-------------------|--|-----------------|--|--|--|-----------------|--|
| Short description |  |                 |  | Defines an additional delay for when any attempt is made to communicate to the device P2 |  |                 |  |
| Mode              |  |                 |  | RFC-A  |  |                 |  |
| Minimum           |  | 0.0             |  | Maximum  |  | 25.0            |  |
| Default           |  | 0.0             |  | Units  |  | s               |  |
| Type              |  | 8 Bit User Save |  | Update Rate  |  | Background read |  |
| Display Format    |  | Standard        |  | Decimal Places   |  | 1               |  |
| Coding            |  |                 |  | RW, BU   |  |                 |  |

When the position feedback is initialised, at power-up or at any other time, a delay is included before the information from the feedback device is used or any attempt is made to communicate with the device. *P2 Additional Power-up Delay* (03.149) defines an additional delay that is added to the minimum delay. See *P1 Additional Power-up Delay* (03.049) for the minimum delays for the different position feedback device types.

| Parameter         |  |                 |  | 03.150 P2 Feedback Lock   |  |                 |  |
|-------------------|--|-----------------|--|---|--|-----------------|--|
| Short description |  |                 |  | Set to 1 to prevent the position feedback parameters for P2 being updated |  |                 |  |
| Mode              |  |                 |  | RFC-A   |  |                 |  |
| Minimum           |  | 0               |  | Maximum   |  | 1               |  |
| Default           |  | 0               |  | Units   |  |                 |  |
| Type              |  | 1 Bit User Save |  | Update Rate   |  | Background read |  |
| Display Format    |  | Standard        |  | Decimal Places  |  | 0               |  |
| Coding            |  |                 |  | RW  |  |                 |  |

If *P2 Feedback Lock* (03.150) = 1 then *P2 Revolution/Pole Pitch Counter* (03.128), *P2 Position* (03.129) and *P2 Fine Position* (03.130) are not updated. If *P2 Feedback Lock* (03.150) = 0 then these parameters are updated normally.

| Parameter         |  |                 |  | 03.151 P2 Linear Feedback Select   |  |   |  |
|-------------------|--|-----------------|--|--|--|---|--|
| Short description |  |                 |  | Set to 1 to configure the P2 interface to operate with a linear position feedback device |  |   |  |
| Mode              |  |                 |  | RFC-A  |  |   |  |
| Minimum           |  | 0               |  | Maximum  |  | 1   |  |
| Default           |  | 0               |  | Units  |  |   |  |
| Type              |  | 1 Bit User Save |  | Update Rate  |  | Background read, auto-configuration write |  |
| Display Format    |  | Standard        |  | Decimal Places   |  | 0   |  |
| Coding            |  |                 |  | RW   |  |   |  |

If *P2 Linear Feedback Select* (03.151) = 0 then the drive P1 position feedback interface is configured to operate with a rotary position feedback device. *P2 Rotary Turns Bits* (03.133) and *P2 Rotary Lines Per Revolution* (03.134) should be used to set up the position feedback interface.

If *P2 Linear Feedback Select* (03.151) = 1 then the position feedback interface is configured to operate with a linear position feedback device. *P2 Linear Comms Pitch* (03.152) and *P2 Linear Line Pitch* (03.153) should be used to set up the position feedback interface.

| Parameter         | 03.152 P2 Linear Comms Pitch   |                |   |
|-------------------|--|----------------|---|
| Short description | Defines the distance covered by the least significant bit of the position information in a comms message from a linear encoder |                |   |
| Mode              | RFC-A  |                |   |
| Minimum           | 0.001  | Maximum        | 100.000                                   |
| Default           | 0.001  | Units          |   |
| Type              | 32 Bit User Save   | Update Rate    | Background read, auto-configuration write |
| Display Format    | Standard   | Decimal Places | 3   |
| Coding            | RW   |                |   |

**P2 Device type (03.138): EnDat, SSI, BiSS**

*P2 Linear Comms Pitch* (03.152) is used to define the distance covered by the least significant bit of the position information in a comms message from a linear encoder. The units used by this parameter are defined by *P2 Linear Comms And Line Pitch Units* (03.154).

**P2 Device type (03.138): Any other device**

*P2 Linear Comms Pitch* (03.152) has no effect.

| Parameter         | 03.153 P2 Linear Line Pitch                 |                |   |
|-------------------|---|----------------|---|
| Short description | Defines the linear line pitch for device P2 |                |   |
| Mode              | RFC-A                                       |                |   |
| Minimum           | 0.001                                       | Maximum        | 100.000                                   |
| Default           | 0.001                                       | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Background read, auto-configuration write |
| Display Format    | Standard                                    | Decimal Places | 3   |
| Coding            | RW  |                |   |

*P2 Linear Line Pitch* (03.153) only has any effect if the position feedback interface is being used with a linear device (i.e. *P2 Linear Feedback Select* (03.151) = 1) and should be used to define the distances listed below for each type of device. The units used by this parameter are defined by *P2 Linear Comms And Line Pitch Units* (03.154).

**P2 Device type (03.138): AB**

*P2 Linear Line Pitch* (03.153) should be set to the distance covered by one line period on the encoder.

**P2 Device type (03.138): FD, FR**

*P2 Linear Line Pitch* (03.153) should be set to the distance covered by two line periods on the encoder.

**P2 Device type (03.138): Any other device**

*P2 Linear Line Pitch* (03.153) has no effect.

| Parameter         | 03.154 P2 Linear Comms And Line Pitch Units                   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the linear units in either millimetres or micrometres |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text        |
|-------|-------------|
| 0     | millimetres |
| 1     | micrometres |

*P2 Linear Comms And Line Pitch Units* (03.154) defines the units used by *P2 Linear Comms Pitch* (03.152) and *P2 Linear Line Pitch* (03.153) in millimetres or micrometres.

| Parameter         | 03.155 P2 Pole Pair Pitch   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the change of position for one electrical revolution of the drive output with a linear position device. |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.01  | Maximum        | 1000.00         |
| Default           | 10.00   | Units          | mm              |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 2               |
| Coding            | RW  |                |                 |

*P2 Pole Pair Pitch* (03.155) gives the distance equivalent to one electrical revolution when linear position feedback is used. See *P1 Pole Pair Pitch* (03.055) for more detail.

| Parameter         | 03.156 P2 Feedback Reverse                                 |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to reverse the direction of the position feedback |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

If *P2 Feedback Reverse* (03.156) = 1 the position feedback is negated. This can be used to reverse the direction of the position feedback.

| Parameter         | 03.157 P2 Normalisation Turns   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the number of turns bits included in the normalisation parameters |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 16              |
| Default           | 16  | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

*P2 Normalisation Turns* (03.157) defines the number of turns bits included in the following parameters. See *P1 Normalisation Turns* (03.057) for more information.

*P2 Normalised Position* (03.158)

*P2 Normalised Marker Position* (03.159)

*F1 Normalised Freeze Position* (03.103) if P2 is the source position for freeze function F1

*F2 Normalised Freeze Position* (03.108) if P2 is the source position for freeze function F2

| Parameter         | 03.158 P2 Normalised Position   |                |             |
|-------------------|---|----------------|-------------|
| Short description | Displays the position taken from the position feedback device including the effect of the marker function |                |             |
| Mode              | RFC-A   |                |             |
| Minimum           | -2147483648   | Maximum        | 2147483647  |
| Default           |   | Units          |             |
| Type              | 32 Bit Volatile   | Update Rate    | 250µs write |
| Display Format    | Standard  | Decimal Places | 0           |
| Coding            | RO, ND, NC, PT  |                |             |

*P2 Normalised Position* (03.158) is the position taken from the position feedback device including the effect of the marker function. See *P2 Normalisation Turns* (03.157) for details of the format.

| Parameter         | 03.159 P2 Normalised Marker Position                      |                |             |
|-------------------|---|----------------|-------------|
| Short description | Displays the normalised position at the last marker event |                |             |
| Mode              | RFC-A   |                |             |
| Minimum           | -2147483648   | Maximum        | 2147483647  |
| Default           |   | Units          |             |
| Type              | 32 Bit Volatile   | Update Rate    | 250µs write |
| Display Format    | Standard  | Decimal Places | 0           |
| Coding            | RO, ND, NC, PT  |                |             |

*P2 Normalised Marker Position* (03.159) is the value *P2 Normalised Position* (03.158) at the last marker event provided bit 2 of *P2 Marker Mode* (03.131) is set to 1. See *P2 Marker Mode* (03.131) for more details.

| Parameter         | 03.160 P2 Calculation Time  |                |   |
|-------------------|---|----------------|---|
| Short description | Defines the time from the first edge of the clock signal from the position feedback interface until the encoder has calculated the position and is ready to return this information |                |   |
| Mode              | RFC-A   |                |   |
| Minimum           | 0   | Maximum        | 20  |
| Default           | 5   | Units          | µs  |
| Type              | 8 Bit User Save   | Update Rate    | Background read, auto-configuration write |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW  |                |   |

**P2 Device type (03.138): EnDat**

*P2 Calculation Time* (03.160) is the time from the first edge of the clock signal from the position feedback interface until the encoder has calculated the position and is ready to return this information. This is used to calculate the overall time for a message interchange with the encoder. See *P2 Low Speed Update Rate Active* (03.163) for more details.

**P2 Device type (03.138): Any other type of device**

*P2 Calculation Time* (03.160) has no effect.

| Parameter         | 03.161 P2 Recovery Time  |                |   |
|-------------------|--|----------------|---|
| Short description | Defines the time that must be allowed after each message interchange before a new message begins |                |   |
| Mode              | RFC-A  |                |   |
| Minimum           | 4  | Maximum        | 100                                       |
| Default           | 30   | Units          | µs  |
| Type              | 8 Bit User Save  | Update Rate    | Background read, auto-configuration write |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RW   |                |   |

**P2 Device type (03.138): EnDat, SSI, BiSS**

*P2 Recovery Time* (03.161) is the time that must be allowed after each message interchange before a new message begins.

**P2 Device type (03.138): Any other type of device**

*P2 Recovery Time* (03.161) has no effect.

| Parameter         | 03.162 P2 Line Delay Time  |                |   |
|-------------------|--|----------------|---|
| Short description | Displays the transmission delay between the position feedback interface and the encoder and back again |                |   |
| Mode              | RFC-A  |                |   |
| Minimum           | 0  | Maximum        | 5000  |
| Default           |  | Units          | ns  |
| Type              | 16 Bit User Save   | Update Rate    | Background read, position feedback initialisation write |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RO, ND, NC, PT, BU   |                |   |

**P2 Device type (03.138): EnDat, SSI, BiSS**

During position feedback initialisation the transmission delay between the position feedback interface and the encoder and back again is measured and stored in *P2 Line Delay Time* (03.162). This value is then used to compensate for this delay so that the clock/data skew does not prevent the data from the encoder from being read. This means that longer line lengths can be used with these feedback devices provided the correct cable and connection arrangements are used.

**P2 Device type (03.138): Any other type of device**

*P2 Line Delay Time* (03.162) is always zero.

| Parameter         | 03.163 P2 Low Speed Update Rate Active             |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates when the low speed update rate is active |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                                     | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                     |                |                  |

**P2 Device type (03.138): EnDat, SSI, BiSS**

If the position can be sampled in 60µs *P2 Low Speed Update Rate Active* (03.163) = 0, otherwise *P2 Low Speed Update Rate Active* (03.163) = 1.

The following parameters are used by the drive to determine the necessary time to obtain the required data from the position feedback device.

- P2 Rotary Turns Bits* (03.133)
- P2 Comms Bits* (03.135)
- P2 Comms Baud Rate* (03.137)
- P2 Calculation Time* (03.160)
- P2 Recovery Time* (03.161)
- P2 Line Delay Time* (03.162)
- P2 User Comms Enable* (03.167)

See *P1 Low Speed Update Rate Active* (03.063) for more information on how this time is calculated.

**P2 Device type (03.138): Any other type of device**

*P2 Low Speed Update Rate Active* (03.163) is always zero.

| Parameter         | 03.164 P2 Encoder Protocol Detected               |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines which protocol is used with the device P2 |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 4                |
| Default           |   | Units          |                  |
| Type              | 8 Bit Volatile                                    | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT                                |                |                  |

| Value | Text      |
|-------|-----------|
| 0     | None      |
| 1     | Hiperface |
| 2     | EnDat2.1  |
| 3     | EnDat2.2  |
| 4     | BiSS      |

*P2 Encoder Protocol Detected* (03.164) shows the encoder comms protocol detected during position feedback initialisation. If *P2 Device type* (03.138) is set to BiSS then *P2 Encoder Protocol Detected* (03.164) is set to the appropriate value after successful communication with the encoder during initialisation. If *P2 Device type* (03.138) is set to EnDat then *P2 Encoder Protocol Detected* (03.164) is set to the appropriate EnDat protocol after successful communication with the encoder during initialisation. If communications is not successful during initialisation then *P2 Encoder Protocol Detected* (03.164) is set to 0 (*None*).

| Parameter         | 03.167 P2 User Comms Enable  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Enables the use of the user comms parameters to communicate to the encoder connected to P2 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit Volatile   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, NC, PT   |                |                 |

If *P2 User Comms Enable* (03.167) set to a non-zero value it is possible to use *P2 User Comms Transmit Register* (03.168) and *P2 User Comms Receive Register* (03.169) to communicate with an encoder that has a Hiperface, EnDat 2.1, EnDat2.2 or BiSS interface. See *P1 User Comms Enable* (03.067) for a description of how to use these registers.

| Parameter         | 03.168 P2 User Comms Transmit Register                        |                |                       |
|-------------------|---|----------------|-----------------------|
| Short description | Defines the value present in the user comms transmit register |                |                       |
| Mode              | RFC-A   |                |                       |
| Minimum           | 0   | Maximum        | 65535                 |
| Default           | 0   | Units          |                       |
| Type              | 16 Bit Volatile   | Update Rate    | Background read/write |
| Display Format    | Standard  | Decimal Places | 0                     |
| Coding            | RW, NC, PT, BU  |                |                       |

See *P2 User Comms Enable* (03.167).

| Parameter         | 03.169 P2 User Comms Receive Register                        |                |                       |
|-------------------|--|----------------|-----------------------|
| Short description | Defines the value present in the user comms receive register |                |                       |
| Mode              | RFC-A  |                |                       |
| Minimum           | 0  | Maximum        | 65535                 |
| Default           | 0  | Units          |                       |
| Type              | 16 Bit Volatile  | Update Rate    | Background read/write |
| Display Format    | Standard   | Decimal Places | 0                     |
| Coding            | RW, NC, PT, BU   |                |                       |

See *P2 User Comms Enable* (03.167).

| Parameter         | 03.171 P2 Error Detected   |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates if an error has been detected with the position feedback device connected to the P1 position interface |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*P2 Error Detected* (03.171) is set if an error has been detected with the position feedback device connected to the P2 position interface. This parameter is useful if encoder trips have been disabled with *P2 Error Detection Level* (03.140).

| Parameter         | 03.172 P2 Status                                 |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the status of the P2 position interface |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 9                |
| Default           |  | Units          |                  |
| Type              | 8 Bit Volatile                                   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT                               |                |                  |

| Value | Text      |
|-------|-----------|
| 0     | None      |
| 1     | AB        |
| 2     | FD        |
| 3     | FR        |
| 4     | EnDat     |
| 5     | SSI       |
| 6     | BiSS      |
| 7     | EnDat Alt |
| 8     | SSI Alt   |
| 9     | BiSS Alt  |

Priority of the 15-way D-type is assigned in the following order from the highest priority to the lowest.

1. P1 position interface
2. Encoder simulation output
3. P2 position interface

The availability of the P2 position interface on the 15-way D-type on the drive is dependent on type of feedback device selected in *P1 Device Type* (03.038) and the encoder simulation mode selected in *Encoder Simulation Mode* (03.088). *P2 Status* (03.172) shows the status of the P2 position interface depending on the settings in *P2 Device type* (03.138), *P1 Device Type* (03.038), and *Encoder Simulation Mode* (03.088).

**0: None**

The P2 position interface is not available.

**1: AB**

**2: FD**

**3: FR**

**4: EnDat**

**5: SSI**

**6: BiSS**

The P2 position interface is available. The connections for the P2 position interface are shown below.

| P2 Status (03.172) | 15-way D-type connections |     |     |     |      |       |
|--------------------|---------------------------|-----|-----|-----|------|-------|
|                    | 1/2                       | 3/4 | 5/6 | 7/8 | 9/10 | 11/12 |
| AB                 |                           |     |     | A2  | B2   | Z2    |
| FD                 |                           |     |     | F2  | D2   | Z2    |
| FR                 |                           |     |     | F2  | R2   | Z2    |
| EnDat              |                           |     |     | D2  | Clk2 | Z2    |
| SSI                |                           |     |     | D2  | Clk2 | Z2    |
| BiSS               |                           |     |     | D2  | Clk2 | Z2    |

**7: EnDat Alt**

**8: SSI Alt**

**9: BiSS Alt**

The P2 position interface is available but uses alternative connections as shown below as connection 7/8 and 9/10 are used by the encoder simulation output.

| P2 Status (03.172) | 15-way D-type connections |     |     |      |      |       |
|--------------------|---------------------------|-----|-----|------|------|-------|
|                    | 1/2                       | 3/4 | 5/6 | 7/8  | 9/10 | 11/12 |
| EnDat Alt          |                           |     | D2  | AOut | BOut | Clk2  |
| SSI Alt            |                           |     | D2  | AOut | BOut | Clk2  |
| BiSS Alt           |                           |     | D2  | AOut | BOut | Clk2  |

See the introduction to this menu for more information on the position feedback interfaces.

| Parameter         | 03.173 P2 Absolute Turns Recovery Enable   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to allow turns information beyond the number of turns bits provided by the position feedback device connected to P2 to be stored on power-down and recovered at next power-up |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background Read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *P1 Absolute Turns Recovery Enable* (03.073).

| Parameter         | 03.174 P2 Additional Configuration  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Provides additional configuration information for the position feedback device not included in the other set-up parameters. |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 511116116       |
| Default           | 0   | Units          |                 |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See P1 Additional Configuration (03.074).

# Menu 4 Single Line Descriptions – Torque and current control

Mode: RFC-A

| Parameter |  | Range  | Default        | Type |     |    |    |    |    |
|-----------|--|--|----------------|------|-----|----|----|----|----|
| 04.001    | Current Magnitude                            | ±VM_DRIVE_CURRENT_UNIPOLAR A   |                | RO   | Num | ND | NC | PT | FI |
| 04.002    | Torque Producing Current                     | ±VM_DRIVE_CURRENT A  |                | RO   | Num | ND | NC | PT | FI |
| 04.003    | Final Torque Reference                       | ±VM_TORQUE_CURRENT %   |                | RO   | Num | ND | NC | PT | FI |
| 04.004    | Final Current Reference                      | ±VM_TORQUE_CURRENT %   |                | RO   | Num | ND | NC | PT | FI |
| 04.005    | Motoring Current Limit                       | ±VM_MOTOR1_CURRENT_LIMIT %   | 0.0 %          | RW   | Num |    | RA |    | US |
| 04.006    | Regenerating Current Limit                   | ±VM_MOTOR1_CURRENT_LIMIT %   | 0.0 %          | RW   | Num |    | RA |    | US |
| 04.007    | Symmetrical Current Limit                    | ±VM_MOTOR1_CURRENT_LIMIT %   | 0.0 %          | RW   | Num |    | RA |    | US |
| 04.008    | Torque Reference                             | ±VM_USER_CURRENT_HIGH_RES %  | 0.00 %         | RW   | Num |    |    |    | US |
| 04.009    | Torque Offset                                | ±VM_USER_CURRENT %   | 0.0 %          | RW   | Num |    |    |    | US |
| 04.010    | Torque Offset Select                         | Off (0) or On (1)  | Off (0)        | RW   | Bit |    |    |    | US |
| 04.011    | Torque Mode Selector                         | 0 to 5   | 0              | RW   | Num |    |    |    | US |
| 04.012    | Current Reference Filter 1 Time Constant     | 0.0 to 25.0 ms   | 0.0 ms         | RW   | Num |    |    |    | US |
| 04.013    | Current Controller Kp Gain                   | 0 to 30000   | 150            | RW   | Num |    |    |    | US |
| 04.014    | Current Controller Ki Gain                   | 0 to 30000   | 2000           | RW   | Num |    |    |    | US |
| 04.015    | Motor Thermal Time Constant 1                | 1.0 to 3000.0 s  | 89.0 s         | RW   | Num |    |    |    | US |
| 04.016    | Thermal Protection Mode                      | Motor Trip (0), Motor Limit (1), Drive Limit (2), Both Limit (3), Disabled (4) | Motor Trip (0) | RW   | Txt |    |    |    | US |
| 04.017    | Magnetising Current                          | ±VM_DRIVE_CURRENT A  |                | RO   | Num | ND | NC | PT | FI |
| 04.018    | Final Current Limit                          | ±VM_TORQUE_CURRENT %   |                | RO   | Num | ND | NC | PT |    |
| 04.019    | Motor Protection Accumulator                 | 0.0 to 200.0 %   |                | RO   | Num | ND | NC | PT | PS |
| 04.020    | Percentage Load                              | ±VM_USER_CURRENT %   |                | RO   | Num | ND | NC | PT | FI |
| 04.021    | Current Feedback Filter Disable              | Off (0) or On (1)  | Off (0)        | RW   | Bit |    |    |    | US |
| 04.022    | Inertia Compensation Enable                  | Off (0) or On (1)  | Off (0)        | RW   | Bit |    |    |    | US |
| 04.023    | Current Reference Filter 2 Time Constant     | 0.0 to 25.0 ms   | 0.0 ms         | RW   | Num |    |    |    | US |
| 04.024    | User Current Maximum Scaling                 | ±VM_TORQUE_CURRENT_UNIPOLAR %  | 175.0 %        | RW   | Num |    | RA |    | US |
| 04.025    | Low Speed Thermal Protection Mode            | 0 to 1   | 0              | RW   | Num |    |    |    | US |
| 04.026    | Percentage Torque                            | ±VM_USER_CURRENT %   |                | RO   | Num | ND | NC | PT | FI |
| 04.027    | Low Load Detection Level                     | 0.0 to 100.0 %   | 0.0 %          | RW   | Num |    |    |    | US |
| 04.028    | Low Load Detection Speed/Frequency Threshold | ±VM_SPEED_FREQ_REF_UNIPOLAR  | 0.0            | RW   | Num |    |    |    | US |
| 04.029    | Enable Trip On Low Load                      | Off (0) or On (1)  | Off (0)        | RW   | Bit |    |    |    | US |
| 04.030    | Current Controller Mode                      | Off (0) or On (1)  | Off (0)        | RW   | Bit |    |    |    | US |
| 04.031    | Notch Filter Centre Frequency                | 50 to 1200 Hz  | 100 Hz         | RW   | Num |    |    |    | US |
| 04.032    | Notch Filter Bandwidth                       | 0 to 500 Hz  | 0 Hz           | RW   | Num |    |    |    | US |
| 04.033    | Inertia Times 1000                           | Off (0) or On (1)  | Off (0)        | RW   | Bit |    |    |    | US |
| 04.036    | Motor Protection Accumulator Power-up Value  | Power down (0), Zero (1), Real time (2)  | Power down (0) | RW   | Txt |    |    |    | US |
| 04.037    | Motor Thermal Time Constant 2                | 1.0 to 3000.0 s  | 89.0 s         | RW   | Num |    |    |    | US |
| 04.038    | Motor Thermal Time Constant 2 Scaling        | 0 to 100 %   | 0 %            | RW   | Num |    |    |    | US |
| 04.039    | Rated Iron Losses As Percentage Of Losses    | 0 to 100 %   | 0 %            | RW   | Num |    |    |    | US |
| 04.041    | Rated Torque                                 | 0.00 to 50000.00 Nm  | 0.00 Nm        | RW   | Num |    |    |    | US |
| 04.042    | Torque Estimation Minimum Frequency          | 0 to 100 %   | 5 %            | RW   | Num |    |    |    | US |
| 04.043    | Torque Correction Time Constant              | 0.00 to 10.00 s  | 0.00 s         | RW   | Num |    |    |    | US |
| 04.044    | Torque Correction Maximum                    | 0 to 100 %   | 20 %           | RW   | Num |    |    |    | US |
| 04.045    | No-load Core Loss                            | 0.000 to 99999.999 kW  | 0.000 kW       | RW   | Num |    |    |    | US |
| 04.046    | Rated Core Loss                              | 0.000 to 99999.999 kW  | 0.000 kW       | RW   | Num |    |    |    | US |
| 04.049    | Magnetising Current Limit                    | 0.0 to 100.0 %   | 100.0 %        | RW   | Num |    |    |    | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

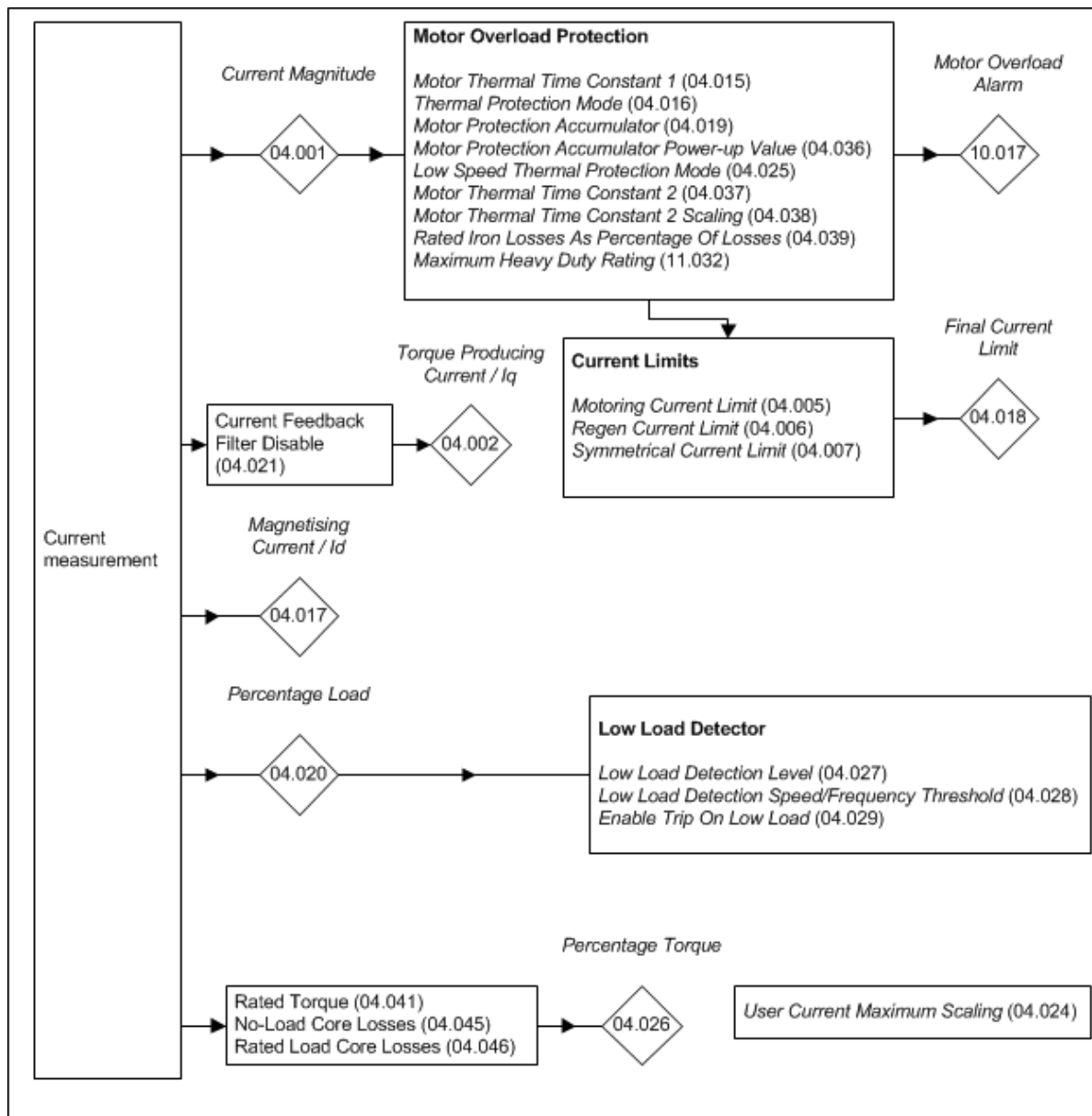


## Menu 4 – Torque and current control

Mode: RFC-A

RFC-A and RFC-S modes

The diagram below is common between RFC-A and RFC-S modes.



Throughout this section *Rated Current* (05.007) and other parameters related to motor 1 are used. It should be noted that this applies if *Select Motor 2 Parameters* (11.045) = 0. If *Select Motor 2 Parameters* (11.045) = 1 then *M2 Rated Current* (21.007) and other parameter associated with motor 2 should be used instead.

The full scale current is the maximum current that the drive can measure and if the current exceeds this level the drive may produce an over current trip.  $K_c$  is the current scaling for the drive and is used in determining the control performance of the drive. This is given in *Full Scale Current  $K_c$*  (11.061) and  $K_c$  is equal the full scale current in r.m.s. Amps. (Note that this is a change from Unidrive SP which used the full scale current multiplied by 0.45 for  $K_c$ .)

The maximum current reference is the highest magnitude of the current reference vector in the drive under any circumstances. The area between the maximum current reference and the full scale current provides headroom to allow for overshoot in the current controllers without tripping the drive. The current limits can be adjusted so that the maximum current reference vector ( $I_{MaxRef}$ ) is equal to  $0.9 \times K_c$  provided *Rated Current* (05.007) is set to the *Maximum Heavy Duty Rating* (11.032) or less. If *Rated Current* (05.007) is set to a higher level then the current limits can be adjusted so that the maximum current reference vector ( $I_{MaxRef}$ ) is equal to  $1.1 \times \text{Maximum Rated Current}$  (11.060) or  $0.9 \times K_c$  whichever is lower.

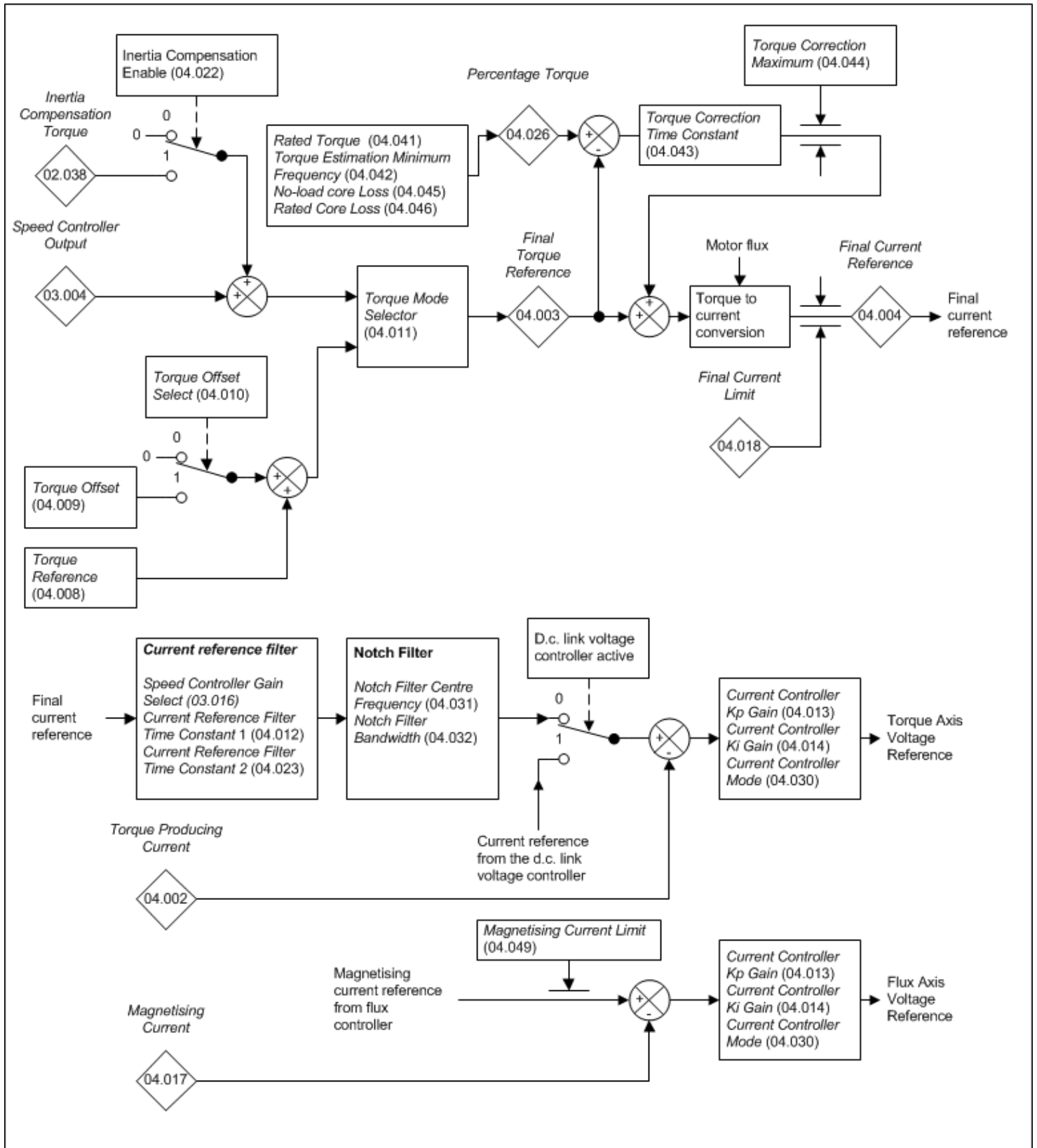
The drive can have a heavy duty rating intended for applications where high overload current may be required under transient conditions, or it can have a normal duty rating where a lower level of overload current is required. The duty rating is selected automatically by the drive based on the setting of *Rated Current* (05.007). The *Maximum Heavy Duty Rating* (11.032) and *Maximum Rated Current* (11.060) are fixed for each drive size and the table below shows the possible duty ratings that can be selected depending on the levels of these parameters.

| Conditions   | Possible duty ratings  |
|--|--|
| <i>Maximum Heavy Duty Rating</i> (11.032) = 0.00                                     | Normal duty operation only   |
| <i>Maximum Heavy Duty Rating</i> (11.032) <<br><i>Maximum Rated Current</i> (11.060) | Heavy duty operation if rated current > MAX, otherwise normal duty operation |
| <i>Maximum Heavy Duty Rating</i> (11.032) =<br><i>Maximum Rated Current</i> (11.060) | Heavy duty operation only  |

The different duty ratings modify the motor protection characteristic (see *Motor Thermal Time Constant 1* (04.015)). The different duty ratings can also change the level of  $I_{MaxRef}$  as described previously.

In a drive that contains multiple power modules *Full Scale Current Kc* (11.061) is the full scale current of an individual module multiplied by the number of modules. *Maximum Heavy Duty Rating* (11.032) and *Maximum Rated Current* (11.060) are the value for an individual module multiplied by the number of modules.

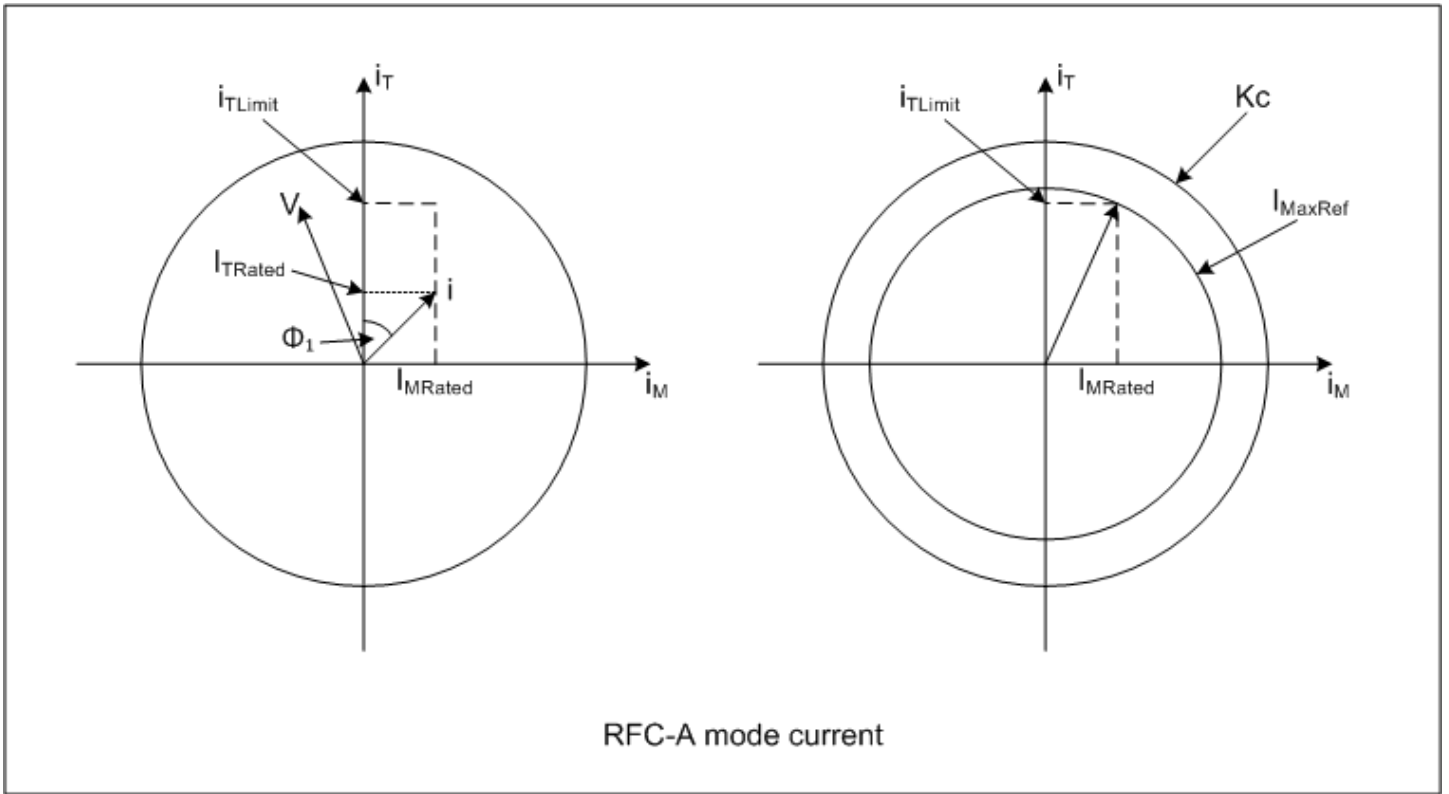
RFC-A mode



The torque reference is normally provided by the speed controller, or from the torque reference, or as a combination of both depending on the value of the *Torque Mode Selector* (04.011). During supply loss or when standard ramp mode is selected and the motor is regenerating it is possible that the torque producing current reference may be provided by the d.c. bus voltage controller as shown above. The torque reference becomes the torque producing current reference.

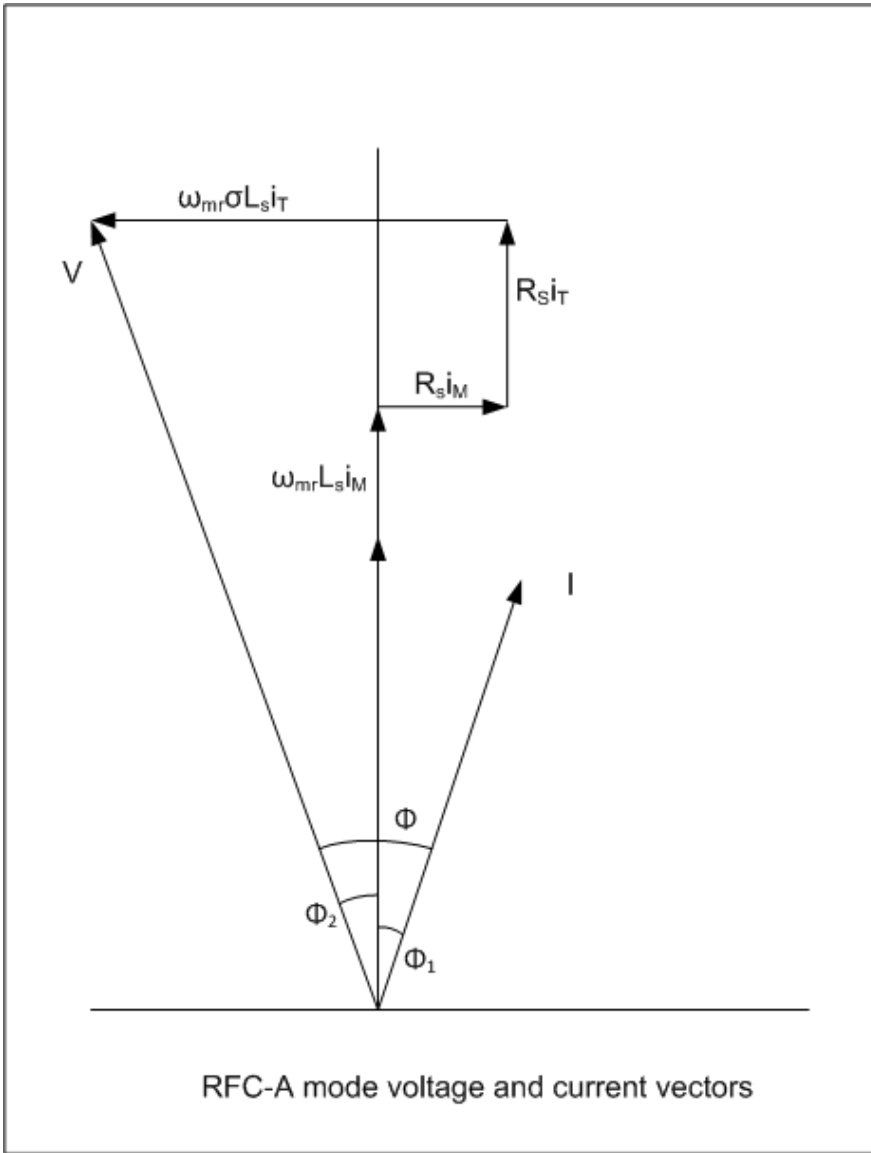
#### Variable Maximums applied to the current limits

The variable maximums applied to the current limit parameters are VM\_MOTOR1\_CURRENT\_LIMIT for motor map 1 and VM\_MOTOR2\_CURRENT\_LIMIT for motor map 2. The calculations given below are used in each drive mode to define VM\_MOTOR1\_CURRENT\_LIMIT. Similar calculations based on the equivalent motor map 2 parameters are used to define VM\_MOTOR2\_CURRENT\_LIMIT.



The diagram shows a motor operating with *Rated Current* (05.007) and at  $I_{MaxRef}$ . RFC-A mode uses rotor oriented flux control, and so the magnetising current does not vary with load. The magnetising and torque producing motor currents are defined for rated conditions as follows.

With rotor flux oriented control there is a significant difference between the angle from the total current vector to the torque producing current ( $\cos \phi_1$ ) and the power factor. The diagram below shows the voltages and currents in the motor represented as vectors.



$I_{\text{Rated}}$  = Rated Current (05.007)

$I_{\text{Trated}}$  and  $I_{\text{Mrated}}$  are the torque producing current and magnetising current under rated conditions. An initial approximation to these can be used in order to calculate  $\cos \phi_1$  which in turn will be used to provide a more accurate estimate of  $I_{\text{Trated}}$  and  $I_{\text{Mrated}}$ .

$\cos \phi$  = Rated Power Factor (05.010)

Initial estimates for the rated magnetising and torque producing currents are:

$$I_{\text{Mrated}}' = I_{\text{Rated}} \times \sin \phi$$

$$I_{\text{Trated}}' = I_{\text{Rated}} \times \cos \phi$$

$\cos \phi_1$  can then be calculated from the power factor ( $\cos \phi$ ) and  $\phi_2$  as shown in the diagram above. It can be seen that under rated conditions:

$$\phi_2 = \sin^{-1}((R_s I_{\text{Mrated}}' - 2\pi F_{\text{Rated}} \sigma L_s I_{\text{Trated}}') / V_{\text{Rated}})$$

where

$R_s$  is the Stator Resistance (05.017)

$F_{\text{Rated}}$  is the Rated Frequency (05.006)

$\sigma L_s$  is the Transient Inductance (05.024)

$V_{\text{Rated}}$  is the Rated Voltage (05.009)

And

$$\phi_1 = \phi + \phi_2$$

Note that in most cases  $\phi_2$  is negative, and so  $\phi_1$  is smaller than  $\phi$ .  $\phi_1$  can then be used to give more accurate values of the current components in the rotor flux reference frame.

$$I_{\text{Mrated}} = I_{\text{Rated}} \sin \phi_1$$

$$I_{T\text{Rated}} = I_{\text{Rated}} \cos \phi_1$$

At the maximum current limit the torque producing current is given by:

$$I_{T\text{limit}} = I_{\text{MaxRef}} \times \cos(\sin^{-1}(I_{M\text{Rated}} / I_{\text{MaxRef}}))$$

The maximum required current limit setting is given by:

$$\text{VM\_MOTOR1\_CURRENT\_LIMIT} = (I_{T\text{limit}} / I_{T\text{Rated}}) \times 100\%$$

The above assumes that the user provides the *Rated Power Factor* (05.010). However, the user may provide the *Stator Inductance* (05.025) or this may be obtained by auto-tuning. In this case a more accurate value for  $\phi_1$  is calculated using *Stator Inductance* (05.025) as follows:

$$I_{M\text{Rated}}' = V_{\text{Rated}} / 2\pi f_{\text{Rated}} L_s$$

The magnetising current would give  $V_{\text{Rated}}$  as the terminal voltage under no load conditions, however this should be  $V_{\text{Rated}}$  under rated conditions. Therefore the rated magnetising current is adjusted assuming that the difference in terminal voltage between no load and rated load is dominated by the stator resistance drop. An estimate of  $\phi_1$  is produced as  $\phi_1'$ .

$$\phi_1' = \sin^{-1}(I_{M\text{Rated}}' / I_{\text{Rated}})$$

The magnetising current is then rescaled by a factor K so that  $I_{M\text{Rated}} = K I_{M\text{Rated}}'$ .

$$K = (V_{\text{Rated}} - R_s I_{T\text{Rated}}) / V_{\text{Rated}}$$

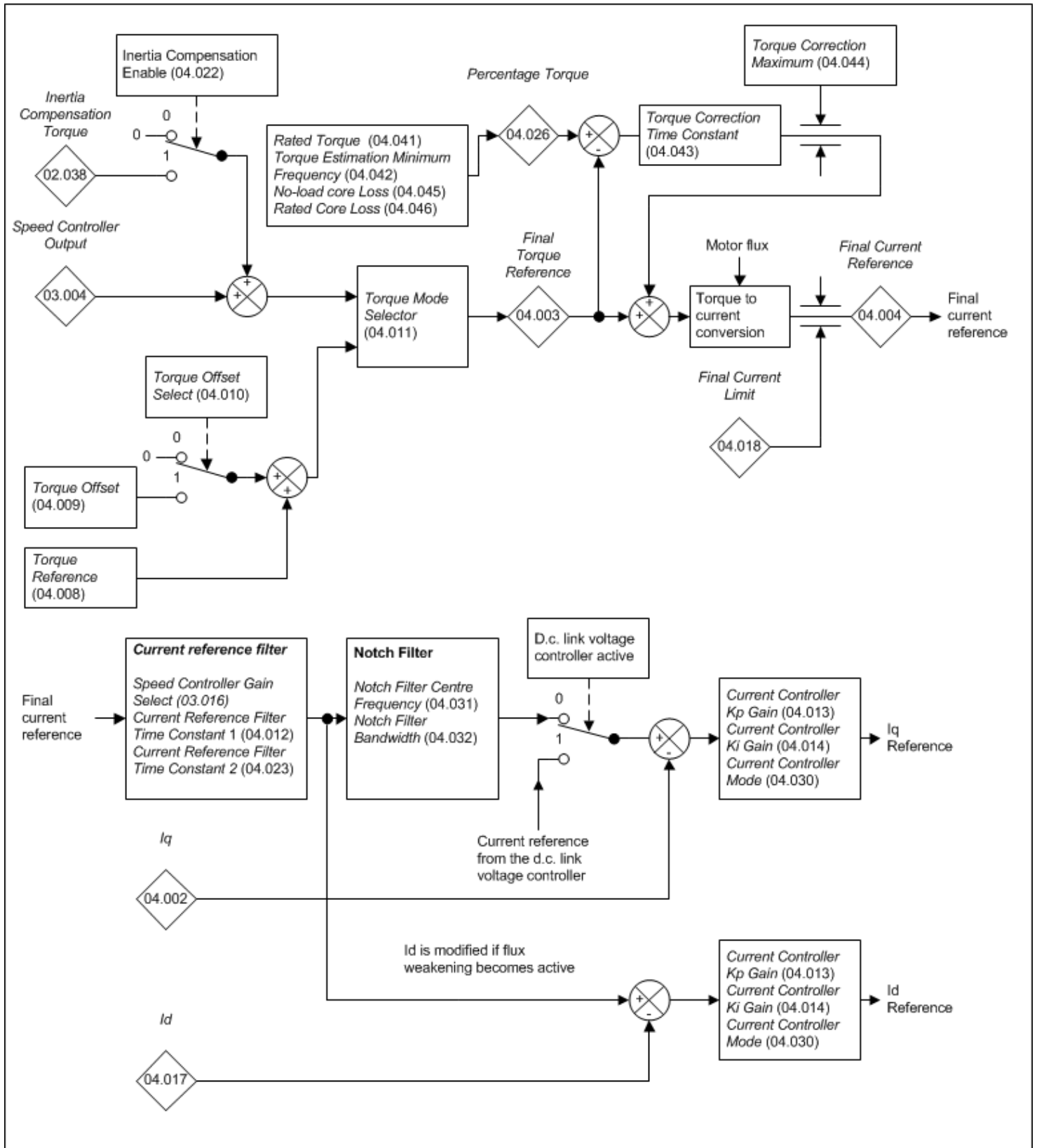
$$\text{where } I_{T\text{Rated}}' = I_{\text{Rated}} \cos \phi_1'$$

An accurate value for  $\phi_1$  can now be obtained from

$$\phi_1 = \cos^{-1}(I_{M\text{Rated}} / I_{\text{Rated}})$$

$\phi_2$  can then be calculated in the same way as before and the result used with the calculated value of  $\phi_1$  to give the power factor which is written to the *Rated Power Factor* (05.010) as an indication of the motor power factor.

#### RFC-S mode



The torque reference is normally provided by the speed controller, or from the torque reference, or as a combination of both depending on the value of the *Torque Mode Selector* (04.011). During supply loss or when standard ramp mode is selected and the motor is regenerating it is possible that the torque producing current reference may be provided by the d.c. bus voltage controller as shown above. The torque reference becomes the final current reference after the current limits. Whether saliency torque is exploited or not (i.e. whatever the value of *Saliency Torque Control Select* (05.065)) a combination of d and q axis current is applied to the motor where the magnitude of the resulting current vector is approximately proportional to the *Final Current Reference* (04.004) when flux weakening is not active.

#### Variable Maximums applied to the current limits

The variable maximums applied to the current limit parameters are VM\_MOTOR1\_CURRENT\_LIMIT for motor map 1 and VM\_MOTOR2\_CURRENT\_LIMIT for motor map 2. The calculations given below are used in each drive mode to define VM\_MOTOR1\_CURRENT\_LIMIT. Similar calculations based on the equivalent motor map 2 parameters are used to define VM\_MOTOR2\_CURRENT\_LIMIT.

$$VM\_MOTOR1\_CURRENT\_LIMIT = (I_{MaxRef} / Rated\ Current\ (05.007)) \times 100\%$$

| Parameter         | 04.001 Current Magnitude                     |                |                           |
|-------------------|--|----------------|---------------------------|
| Short description | Shows the instantaneous drive output current |                |                           |
| Mode              | RFC-A  |                |                           |
| Minimum           | -VM_DRIVE_CURRENT_UNIPOLAR                   | Maximum        | VM_DRIVE_CURRENT_UNIPOLAR |
| Default           |  | Units          | A                         |
| Type              | 32 Bit Volatile                              | Update Rate    | 4ms write                 |
| Display Format    | Standard                                     | Decimal Places | 3                         |
| Coding            | RO, FI, VM, ND, NC, PT                       |                |                           |

*Current Magnitude* (04.001) is the instantaneous drive output current scaled so that it represents the r.m.s. phase current in Amps under steady state conditions.

| Parameter         | 04.002 Torque Producing Current                           |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Shows the instantaneous level of torque producing current |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | -VM_DRIVE_CURRENT   | Maximum        | VM_DRIVE_CURRENT |
| Default           |   | Units          | A                |
| Type              | 32 Bit Volatile   | Update Rate    | 250µs write      |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RO, FI, VM, ND, NC, PT                                    |                |                  |

*I<sub>q</sub>, Torque Producing Current* (04.002) is the instantaneous level of torque producing current scaled so that it represents the r.m.s. level of current under steady state conditions. *I<sub>q</sub>, Torque Producing Current* (04.002) is proportional to the torque produced by the motor provided field weakening is not active. For field weakening operation the *I<sub>q</sub>, Torque Producing Current* (04.002) is boosted for a given level of torque to compensate for the reduction in the motor flux.

| Sign of <i>I<sub>q</sub>, Torque Producing Current</i> (04.002) | Sign of frequency or speed | Direction of motor torque |
|---|----------------------------|---------------------------|
| +   | +                          | Accelerating              |
| -   | +                          | Decelerating              |
| +   | -                          | Decelerating              |
| -   | -                          | Accelerating              |

| Parameter         | 04.003 Final Torque Reference    |                |                   |
|-------------------|----------------------------------|----------------|-------------------|
| Short description | Shows the final torque reference |                |                   |
| Mode              | RFC-A                            |                |                   |
| Minimum           | -VM_TORQUE_CURRENT               | Maximum        | VM_TORQUE_CURRENT |
| Default           |                                  | Units          | %                 |
| Type              | 16 Bit Volatile                  | Update Rate    | 250µs write       |
| Display Format    | Standard                         | Decimal Places | 1                 |
| Coding            | RO, FI, VM, ND, NC, PT           |                |                   |

The *Speed Controller Output* (03.004) can include a feed forward torque that will provide the torque necessary to accelerate the load inertia. This can be combined with the *Torque Reference* (04.008) and the *Torque Offset* (04.009) as defined by the *Torque Mode Selector* (04.011) to give the *Final Torque Reference* (04.003) as a percentage of rated motor torque.

| Parameter         | 04.004 Final Current Reference                             |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Shows the final current reference after the current limits |                |                   |
| Mode              | RFC-A  |                |                   |
| Minimum           | -VM_TORQUE_CURRENT   | Maximum        | VM_TORQUE_CURRENT |
| Default           |  | Units          | %                 |
| Type              | 16 Bit Volatile  | Update Rate    | 4ms write         |
| Display Format    | Standard   | Decimal Places | 1                 |
| Coding            | RO, FI, VM, ND, NC, PT                                     |                |                   |

The *Final Torque Reference* (04.003) is converted into the *Final Current Reference* (04.004) by applying a torque to current conversion and by applying the *Final Current Limit* (04.018). The torque to current conversion is applied as follows:

$$\text{Current reference} = \text{Final Torque Reference (04.003)} \times \text{Motor Rated Flux} / \text{Motor Flux}$$

It is possible to disable, or change the method for the flux compensation using *Flux Compensation* (05.028). This may be required, for example to prevent motor instability when an inaccurate value for *Rated Speed* (05.008) is being used.

| Parameter         | 04.005 Motoring Current Limit   |                |                         |
|-------------------|---|----------------|-------------------------|
| Short description | Defines the current limit used when the motor is being accelerated away from standstill |                |                         |
| Mode              | RFC-A   |                |                         |
| Minimum           | -VM_MOTOR1_CURRENT_LIMIT  | Maximum        | VM_MOTOR1_CURRENT_LIMIT |
| Default           | 0.0   | Units          | %                       |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read                |
| Display Format    | Standard  | Decimal Places | 1                       |
| Coding            | RW, VM, RA  |                |                         |



The *Motoring Current Limit* (04.005) limits the current when the motor is being accelerated away from standstill. The *Regenerating Current Limit* (04.006) limits the current when the motor is being decelerated towards standstill. If the *Symmetrical Current Limit* (04.007) is below the *Motoring Current Limit* (04.005) then it is used instead of the *Motoring Current Limit* (04.005). If the *Symmetrical Current Limit* (04.007) is below the *Regenerating Current Limit* (04.006) then it is used instead of the *Regenerating Current Limit* (04.006).

The maximum possible current limit (VM\_MOTOR1\_CURRENT\_LIMIT [MAX]) varies between drive sizes with default parameters loaded. For some drive sizes the default value may be reduced below the value given by the parameter range limiting.

| Parameter         | 04.006 Regenerating Current Limit   |                |                         |
|-------------------|---|----------------|-------------------------|
| Short description | Defines the current limit used when the motor is being decelerated towards standstill |                |                         |
| Mode              | RFC-A   |                |                         |
| Minimum           | -VM_MOTOR1_CURRENT_LIMIT  | Maximum        | VM_MOTOR1_CURRENT_LIMIT |
| Default           | 0.0   | Units          | %                       |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read                |
| Display Format    | Standard  | Decimal Places | 1                       |
| Coding            | RW, VM, RA  |                |                         |

See *Motoring Current Limit* (04.005).

| Parameter         | 04.007 Symmetrical Current Limit      |                |                         |
|-------------------|---------------------------------------|----------------|-------------------------|
| Short description | Defines the symmetrical current limit |                |                         |
| Mode              | RFC-A                                 |                |                         |
| Minimum           | -VM_MOTOR1_CURRENT_LIMIT              | Maximum        | VM_MOTOR1_CURRENT_LIMIT |
| Default           | 0.0                                   | Units          | %                       |
| Type              | 16 Bit User Save                      | Update Rate    | 4ms read                |
| Display Format    | Standard                              | Decimal Places | 1                       |
| Coding            | RW, VM, RA                            |                |                         |

See *Motoring Current Limit* (04.005).

| Parameter         | 04.008 Torque Reference      |                |                          |
|-------------------|------------------------------|----------------|--------------------------|
| Short description | Defines the torque reference |                |                          |
| Mode              | RFC-A                        |                |                          |
| Minimum           | -VM_USER_CURRENT_HIGH_RES    | Maximum        | VM_USER_CURRENT_HIGH_RES |
| Default           | 0.00                         | Units          | %                        |
| Type              | 32 Bit User Save             | Update Rate    | 250µs read               |
| Display Format    | Standard                     | Decimal Places | 2                        |
| Coding            | RW, VM                       |                |                          |

Gives the required torque reference as a percentage of rated motor torque.

| Parameter         | 04.009 Torque Offset  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the torque offset to be added to the torque reference |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | -VM_USER_CURRENT  | Maximum        | VM_USER_CURRENT |
| Default           | 0.0   | Units          | %               |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read        |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW, VM  |                |                 |

The torque offset added to *Torque Reference* (04.008) if *Torque Offset Select* (04.010) = 1.

| Parameter         | 04.010 Torque Offset Select                          |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to add the torque offset to the torque reference |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save                                      | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW   |                |          |

See *Torque Reference* (04.008).

| Parameter         | 04.011 Torque Mode Selector               |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the torque mode used by the drive |                |          |
| Mode              | RFC-A                                     |                |          |
| Minimum           | 0   | Maximum        | 5        |
| Default           | 0   | Units          |          |
| Type              | 8 Bit User Save                           | Update Rate    | 4ms read |
| Display Format    | Standard                                  | Decimal Places | 0        |
| Coding            | RW  |                |          |

The value of the *Torque Mode Selector* (04.011) defines how the *Final Torque Reference* (04.003) is produced. The inputs to the torque mode selector system are referred to below as the Speed control torque reference and the User torque reference. The Speed control torque reference is the *Speed Controller Output* (03.004), combined with the *Inertia Compensation Torque* (02.038) if this is enabled. The User torque reference is the *Torque Reference* (04.008), combined with the *Torque Offset* (04.009) if this is enabled. Each of the modes is described below.

Mode 0 and Mode 4 use speed control with the combined output of the ramp system and the hard speed reference as the reference. The other modes are torque control modes (although the speed controller may be active). In these modes the ramp system output is not used, but the output of the ramp system (*Post Ramp Reference* (02.001)) is constantly preset with *Speed Feedback* (03.002) – *Hard Speed Reference* (03.022). This prevents a transient if the mode is changed to 0 or 4 while the drive is active, or the drive run is removed and the motor is stopped under ramp control, i.e. *Stop Mode* (06.001) is 1 or 2.

**0: Speed control mode**

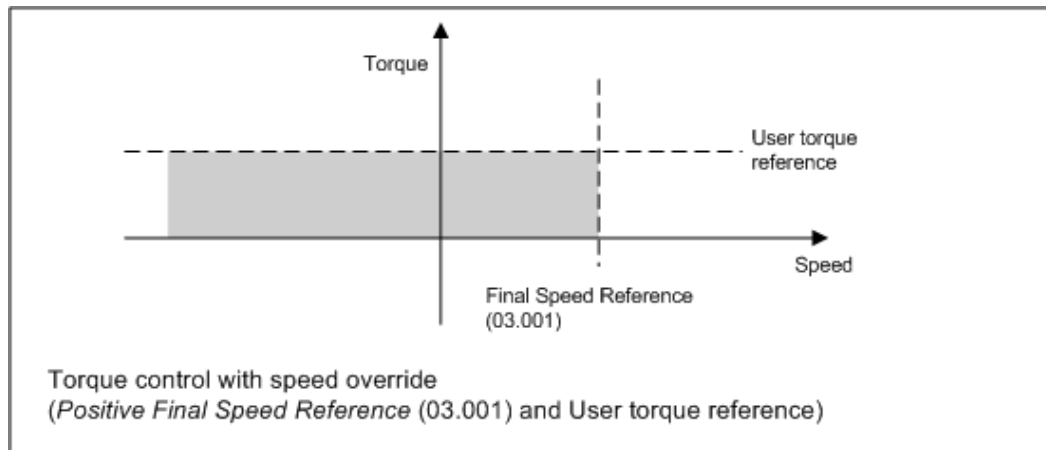
The *Final Torque Reference* (04.003) is the Speed controller torque reference.

**1: Torque control**

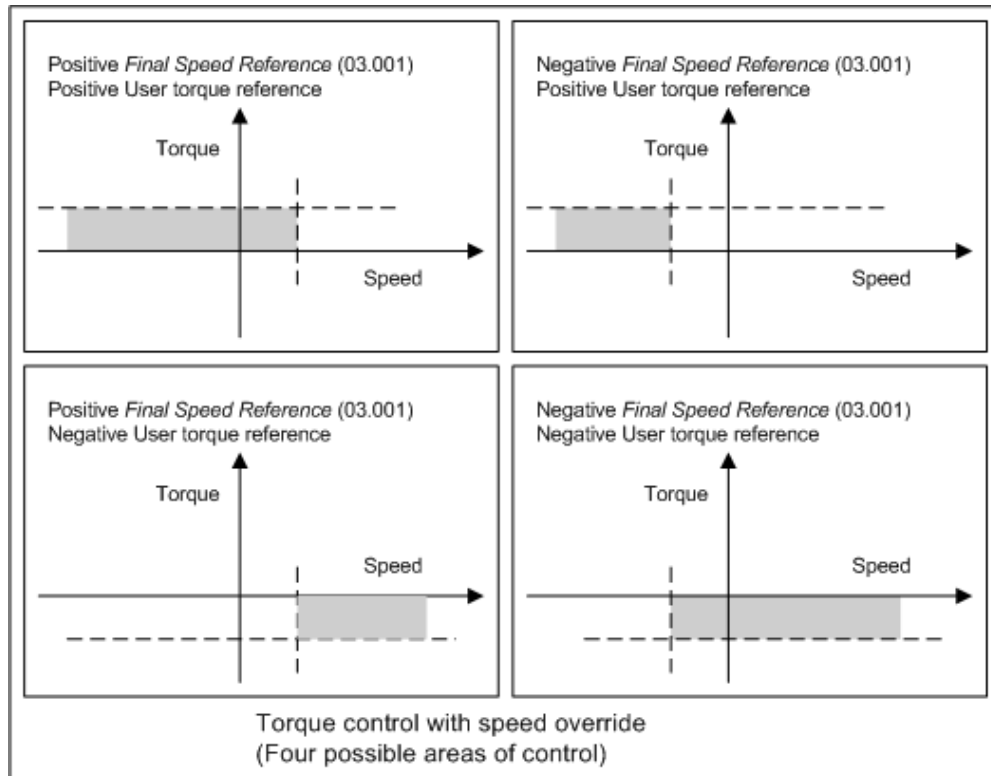
The *Final Torque Reference* (04.003) is the User torque reference. The speed is not limited by the drive but, the drive will trip at the over-speed threshold if runaway occurs.

**2: Torque control with speed override**

The drive effectively operates in speed control and *Final Torque Reference* (04.003) is controlled by the Speed controller torque reference, however this is limited between 0 and the User torque reference. The effect is to produce an operating area as shown below if the Speed controller torque reference and the User torque reference are both positive. The speed controller will attempt to accelerate the motor to the *Final Speed Reference* (03.001) with a torque equivalent to the User torque reference. However, the speed cannot be forced above the *Final Speed Reference* (03.001) by the drive because the required torque would be negative, and so it would be clamped to zero.



Depending on the sign of the *Final Speed Reference* (03.001) and the User torque reference there are four possible areas of operation as shown below.



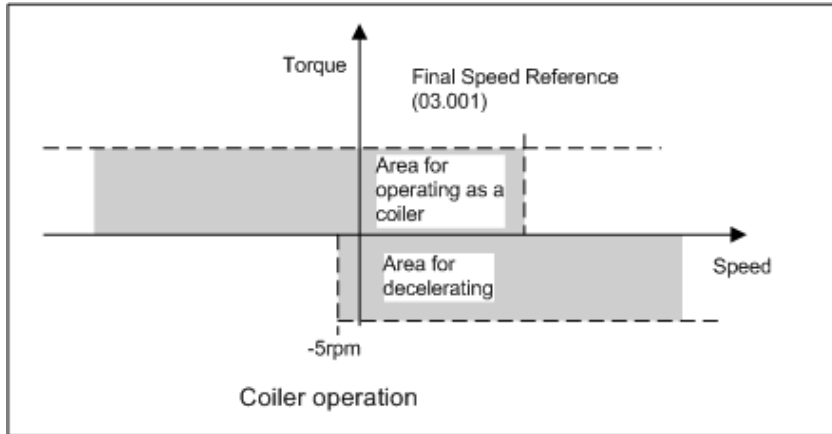
**3: Coiler/uncoiler mode**

Positive *Final Speed Reference* (03.001): Positive User torque reference gives torque control with a positive speed limit defined by the *Final Speed Reference* (03.001). A negative User torque reference gives torque control with a negative speed limit of -5rpm.

Negative *Final Speed Reference* (03.001): Negative User torque reference gives torque control with a negative speed limit defined by the *Final Speed Reference* (03.001). A positive User torque reference gives torque control with a positive speed limit of +5rpm.

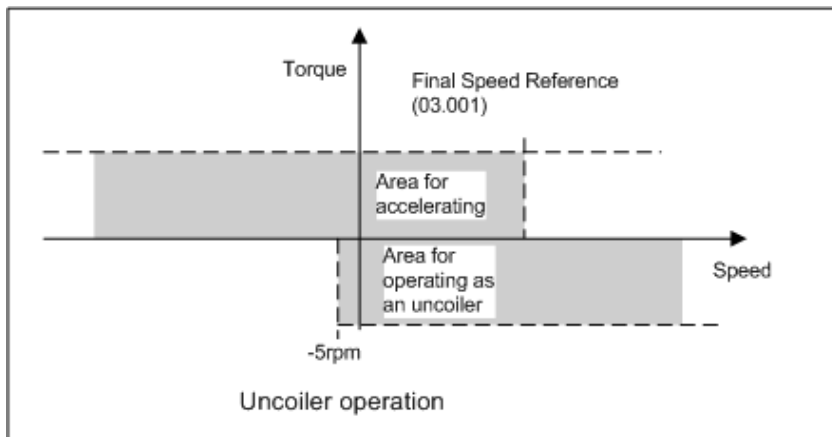
Example of coiler operation:

This is an example of a coiler operating in the positive direction. The *Final Speed Reference* (03.001) is set to a positive value just above the coiler reference speed. If the User torque reference is positive the coiler operates with a limited speed, so that if the material breaks the speed does not exceed a level just above the reference. It is also possible to decelerate the coiler with a negative User torque reference. The coiler will decelerate down to -5rpm until a stop is applied. The operating area is shown below:



**Example of uncoiler operation:**

This is an example for an uncoiler operating in the positive direction. The *Final Speed Reference* (03.001) should be set to a level just above the maximum normal speed. When the User torque reference is negative the uncoiler will apply tension and try and rotate at 5rpm in reverse, and so take up any slack. The uncoiler can operate at any positive speed applying tension. If it is necessary to accelerate the uncoiler a positive User torque reference is used. The speed will be limited to the *Final Speed Reference* (03.001). The operating area is the same as that for the coiler and is shown below:

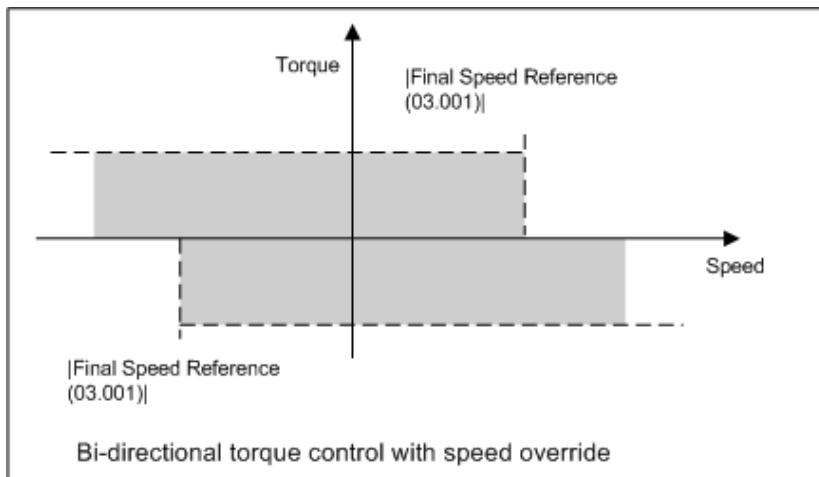


**4: Speed control with torque feed-forward**

The Speed control torque reference and User torque reference are summed so that the drive operates under speed control, but a torque value may be added to the output of the speed controller. This can be used to improve the regulation of systems where the speed controller gains need to be low for stability.

**5: Bi-directional torque control with speed override**

The drive effectively operates in speed control and *Final Torque Reference* (04.003) is controlled by the Speed controller torque reference. If the User torque reference is positive then the speed reference is *Final Speed Reference* (03.001) and the torque is limited to the User torque reference. Therefore for any negative speed and any positive speed up to *Final Speed Reference* (03.001) the motor will produce the required positive torque. If the speed exceeds *Final Speed Reference* (03.001) no torque will be produced. The system works in the same way for a negative User torque reference, but with a speed limit of *-Final Speed Reference* (03.001). This system can be used for torque control in either direction if the load torque is less than the applied torque (i.e. the load is removed). The diagram below shows the possible regions of operation.



| Parameter         | 04.012 Current Reference Filter 1 Time Constant  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the time constant of a first order filter that can be applied to the final current reference |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.0  | Maximum        | 25.0            |
| Default           | 0.0  | Units          | ms              |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW, BU   |                |                 |

*Current Reference Filter 1 Time Constant* (04.012) defines the time constant of a first order filter that can be applied to the *Final Current Reference* (04.004). The filter is provided to reduce acoustic noise and vibration produced as a result of position feedback quantisation. The filter introduces a lag in the speed controller loop, and so the speed controller gains may need to be reduced to maintain stability as the filter time constant is increased. The time constant used is dependent on *Speed Controller Gain Select* (03.016) so that different time constants can be used with different gains.

*Current Reference Filter 1 Time Constant* (04.012) is used if *Speed Controller Gain Select* (03.016) = 0, and *Current Reference Filter 2 Time Constant* (04.023) is used if *Speed Controller Gain Select* (03.016) = 1.

| Parameter         | 04.013 Current Controller Kp Gain                     |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the current loop controller proportional gain |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 30000           |
| Default           | 150   | Units          |                 |
| Type              | 16 Bit User Save                                      | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

*Current Controller Kp Gain* (04.013) and *Current Controller Ki Gain* (04.014) are the proportional and integral gains of the current controllers. It is possible to use the current controller in standard mode (*Current Controller Mode* (04.030) = 0) or high performance mode (*Current Controller Mode* (04.030) = 1). The set up method for the current controller gains is described separately for each of these modes below. It should be noted that when an auto-tune is performed that measures the *Transient Inductance* (05.024) and *Stator Resistance* (05.017) the *Current Controller Kp Gain* (04.013) and *Current Controller Ki Gain* (04.014) are automatically set to the levels defined in the description for standard mode even if high performance mode is selected. These gains will give good performance in standard mode and produce moderate acoustic noise due to position feedback quantisation with a standard incremental encoder. These represent the maximum levels that are likely to be used with this mode in most applications. For high performance mode it is recommended that a high resolution position feedback device is used or else the acoustic noise due to position feedback quantisation is likely to be excessive. In high performance mode the proportional gain can be increased to a higher level as given in the description of this mode.

#### Standard mode

Standard mode can be used to give good current control dynamic performance and is compatible with the performance of Unidrive SP. The current controller gains can either be set using auto-tuning (see *Auto-tune* (05.012)) or the values can be set up manually by the user. The calculations given below are those used by the auto-tuning system and should give good performance without excessive overshoot.

The proportional gain, *Current Controller Kp Gain* (04.013), is the most critical value in controlling the performance of the current controllers. The required value can be calculated as

$$\text{Current Controller Kp Gain (04.013)} = (L / T) \times (I_{fs} / V_{fs}) \times (256 / 5)$$

where:

T is the sample time of the current controllers. The drive compensates for any change of sample time, and so it should be assumed that the sample time is equivalent to the base value of 167µs.

L is the motor inductance. For a servo motor this is half the phase to phase inductance that is normally specified by the manufacturer. For an induction motor this is the per phase transient inductance ( $\sigma$ Ls). The inductance for either of these motors can be taken from the manufacturers data or it can be obtained from the value stored in the *Transient Inductance* (05.024) after auto-tuning.

$I_{fs}$  is the peak full scale current feedback, i.e. full scale current  $\times \sqrt{2}$ . The r.m.s. full scale current is given by *Full Scale Current Kc* (11.061), and so  $I_{fs} = \text{Full Scale Current Kc (11.061)} \times \sqrt{2}$ .

$V_{fs}$  is the maximum d.c. bus voltage.

Therefore:

$$\text{Current Controller Kp Gain (04.013)} = (L / 167\mu\text{s}) \times (Kc \times \sqrt{2} / V_{fs}) \times (256 / 5) = K \times L \times Kc$$

$$\text{Where } K = [\sqrt{2} / (V_{fs} \times 167\mu\text{s})] \times (256 / 5)$$

There is one value of the scaling factor K for each drive voltage rating as shown in the table below.

| Drive Rated Voltage (11.033) | Vfs   | K    |
|------------------------------|-------|------|
| 200V                         | 415V  | 1045 |
| 400V                         | 830V  | 522  |
| 575V                         | 990V  | 438  |
| 690V                         | 1190V | 364  |

The integral gain, *Current Controller Ki Gain* (04.014), is less critical. A suggested value which matches the zero with the pole caused by the electrical time constant of the motor and ensures that the integral term does not contribute to current overshoot is given by

$$\text{Current Controller Ki Gain (04.014)} = \text{Current Controller Kp Gain (04.013)} \times 256 \times T / \tau_m$$

Where  $\tau_m$  is the motor time constant (L / R). R is the per phase stator resistance of the motor (i.e. half the resistance measured between two phases).

Therefore:

$$\text{Current Controller Ki Gain (04.014)} = (K \times L \times Kc) \times 256 \times 167\mu\text{s} \times R / L = 0.0427 \times K \times R \times Kc$$

The above equations give the gain values that should give a good response with minimal overshoot. If required the gains can be adjusted to modify the performance as follows:

1. *Current Controller Ki Gain (04.014)* can be increased to improve the performance of the current controllers by reducing the effects of inverter non-linearity. These effects become more significant with higher switching frequency. These effects will be more significant for drives with higher current ratings and higher voltage ratings. If *Current Controller Ki Gain (04.014)* is increased by a factor of 4 it is possible to get up to 10% overshoot in response to a step change of current reference. For high performance applications, it is recommended that *Current Controller Ki Gain (04.014)* is increased by a factor of 4 from the auto-tuned values. As the inverter non-linearity is worse with higher switching frequencies it is may be necessary to increase *Current Controller Ki Gain (04.014)* by a factor of 8 for operation with 16kHz switching frequency.
2. It is possible to increase *Current Controller Kp Gain (04.013)* to reduce the response time of the current controllers. If *Current Controller Kp Gain (04.013)* is increased by a factor of 1.5 then the response to a step change of reference will give 12.5% overshoot. It is recommended that *Current Controller Ki Gain (04.014)* is increased in preference to *Current Controller Kp Gain (04.013)*.

As already stated, the drive compensates for changes of switching frequency and the sampling method used by the controller. The table below shows the adjustment applied to the proportional and integral gains.

| Switching Frequency (05.037) | Current controller sample time Current | Current Controller Kp Gain (04.013) adjustment | Current Controller Ki Gain (04.014) adjustment |
|------------------------------|--|--|--|
| 2kHz                         | 250µs                                  | x 167 / 250 = 0.7                              | x 1.0  |
| 3kHz                         | 167µs                                  | x 167 / 167 = 1.0                              | x 1.0  |
| 4kHz                         | 125µs                                  | x 167 / 125 = 1.3                              | x 1.0  |
| 6kHz                         | 83µs                                   | x 167 / 83 = 2.0                               | x 1.0  |
| 8kHz                         | 62.5µs                                 | x 167 / 62.5 = 2.7                             | x 1.0  |
| 12kHz                        | 83µs                                   | x (167 / 83) x (4 / 3) = 2.7                   | x 4 / 3 = 1.3                                  |
| 16kHz                        | 62.5µs                                 | x (167 / 62.5) x (4 / 3) = 3.6                 | x 4 / 3 = 1.3                                  |

The amount of acoustic noise produced in the motor from position feedback quantisation is related to the resolution of the position feedback and the product of the speed controller and current controller proportional gains. The values in this table can be used in conjunction with the speed controller loop proportional gain to assess the amount of acoustic noise that is likely to be produced.

#### High performance mode

High performance mode gives fast closed-loop dynamic performance as though the proportional gain has been set to the maximum value defined below. This is the maximum value that should be used to prevent excessive over-shoot or instability. It should be noted that this is 5 times the maximum value used for standard mode.

$$\text{Current Controller Kp Gain (04.013)} = (L / T) \times (I_{fs} / V_{fs}) \times 256 = K \times L \times Kc \times 5$$

The closed-loop dynamic performance defines the response of the current controllers to a change of current reference. This response cannot be changed by modifying *Current Controller Kp Gain (04.013)*, however the ability of the current controllers to reject voltage disturbances is affected by *Current Controller Kp Gain (04.013)*. Normally the auto-tuned value (which is one fifth of the maximum recommended value) will give good rejection of voltage disturbances, but the proportional gain can be increased up to the maximum value to improve this. It should be noted that the higher closed-loop response of the controllers means that encoder position quantisation will cause significant acoustic noise in the motor unless a high resolution encoder is used. Increasing *Current Controller Kp Gain (04.013)* also increases acoustic noise due to noise on the current feedback. High performance mode uses the measured motor resistance and inductance, and so it is recommended that these are obtained with auto-tuning using test 1 or 2.

The integral gain provides a trim on the currents, and generally the auto-tuned value should be sufficient, however, this may be increased if required.

The drive compensates for changes of switching frequency used by the controller. The table below shows the adjustment applied to the proportional and integral gains.

| Switching Frequency (05.037) | Current controller sample time Current | Current Controller Kp Gain (04.013) adjustment | Current Controller Ki Gain (04.014) adjustment |
|------------------------------|--|--|--|
| 2kHz                         | 500us                                  | x 167 / 500 = 0.3                              | x 1.0  |
| 3kHz                         | 333us                                  | x 167 / 333 = 0.5                              | x 1.0  |
| 4kHz                         | 250us                                  | x 167 / 250 = 0.7                              | x 1.0  |
| 6kHz                         | 167µs                                  | x 167 / 167 = 1.0                              | x 1.0  |
| 8kHz                         | 125µs                                  | x 167 / 125 = 1.3                              | x 1.0  |
| 12kHz                        | 83µs                                   | x 167 / 83 = 2.0                               | x 1.0  |
| 16kHz                        | 62.5µs                                 | x 167 / 62.5 = 2.7                             | x 1.0  |

| Parameter         | 04.014 Current Controller Ki Gain                 |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the current loop controller integral gain |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 30000           |
| Default           | 2000  | Units          |                 |
| Type              | 16 Bit User Save                                  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Current Controller Kp Gain (04.013)*.

| Parameter         | 04.015 Motor Thermal Time Constant 1           |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to the thermal time constant for the motor |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 1.0  | Maximum        | 3000.0          |
| Default           | 89.0   | Units          | s               |
| Type              | 16 Bit User Save                               | Update Rate    | Background read |
| Display Format    | Standard                                       | Decimal Places | 1               |
| Coding            | RW   |                |                 |

A dual time constant thermal model is provided that can be used to estimate the motor temperature as a percentage of its maximum allowed temperature. The input to the model is the *Current Magnitude* (04.001). Throughout the following discussion *Rated Current* (05.007) is used in the model assuming *Select Motor 2 Parameters* (11.045) = 0. If *Select Motor 2 Parameters* (11.045) = 1 then *M2 Rated Current* (21.007) is used instead. It should be noted that if the parameters that have been added in addition to those in Unidrive SP are left at their default values the model is a simple single time constant model as provided in Unidrive SP.

#### Percentage Losses

The losses in the motor are calculated as a percentage value.

$$\text{Percentage Losses} = 100\% \times [\text{Load Related Losses} + \text{Iron Losses}]$$

where:

$$\text{Load Related Losses} = (1 - K_{fe}) \times (I / (K_1 \times I_{\text{Rated}}))^2$$

$$\text{Iron Losses} = K_{fe} \times (w / w_{\text{Rated}})^{1.6}$$

where:

$$I = \text{Current Magnitude (04.001)}$$

$$I_{\text{Rated}} = \text{Rated Current (05.007)}$$

$$K_{fe} = \text{Rated Iron Losses As Percentage Of Losses (04.039)} / 100\%$$

The iron losses are relatively low in motors that have a rated frequency of 60Hz or less, and so the motor could be modelled based on load related losses alone. This can be done by setting  $K_{fe}$  to zero. In motors where iron losses are significant,  $K_{fe}$  defines the proportion of losses that are iron losses under rated conditions (i.e. rated current and rated frequency). For example if the iron losses are 30% of losses and other losses are 70% of losses under rated conditions *Rated Iron Losses As Percentage Of Losses* (04.039) should be set to 30%.

The value of  $K_1$  defines the continuous allowable motor overload as a proportion of the *Rated Current* (05.007) before the *Motor Protection Accumulator* (04.019) reaches 100%. The value of  $K_1$  can be used to model reduced cooling at low speeds and to allow the motor to operate under rated conditions with a small margin to prevent spurious trips.  $K_1$  is defined in more detail later.

#### Motor Protection Accumulator

So far the steady state motor losses have been defined, but the motor model must estimate the temperature within the motor under dynamically changing conditions, and so the *Motor Protection Accumulator* (04.019) is given by the following equation.

$$T = \text{Percentage Losses} \times [(1 - K_2)(1 - e^{-t/\tau_1}) + K_2(1 - e^{-t/\tau_2})]$$

where

$$T = \text{Motor Protection Accumulator (04.019)}$$

$$K_2 = \text{Motor Thermal Time Constant 2 Scaling (04.038)} / 100\%$$

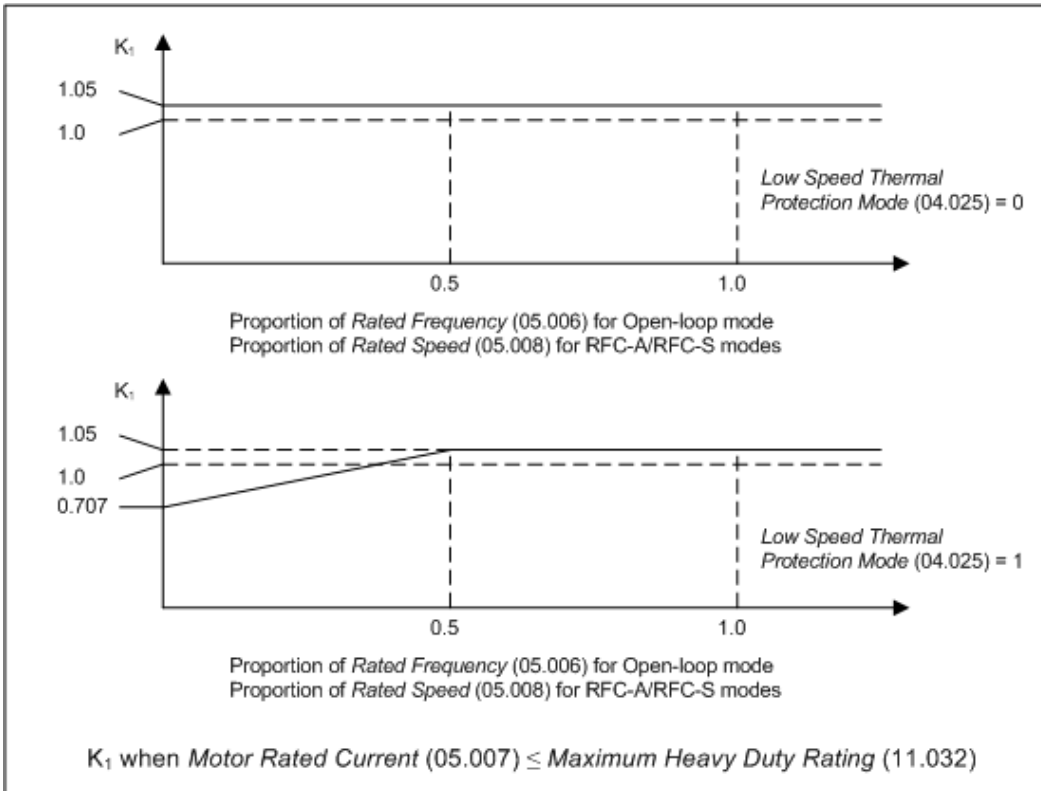
$$\tau_1 = \text{Motor Thermal Time Constant 1 (04.015)}$$

$$\tau_2 = \text{Motor Thermal Time Constant 2 (04.037)}$$

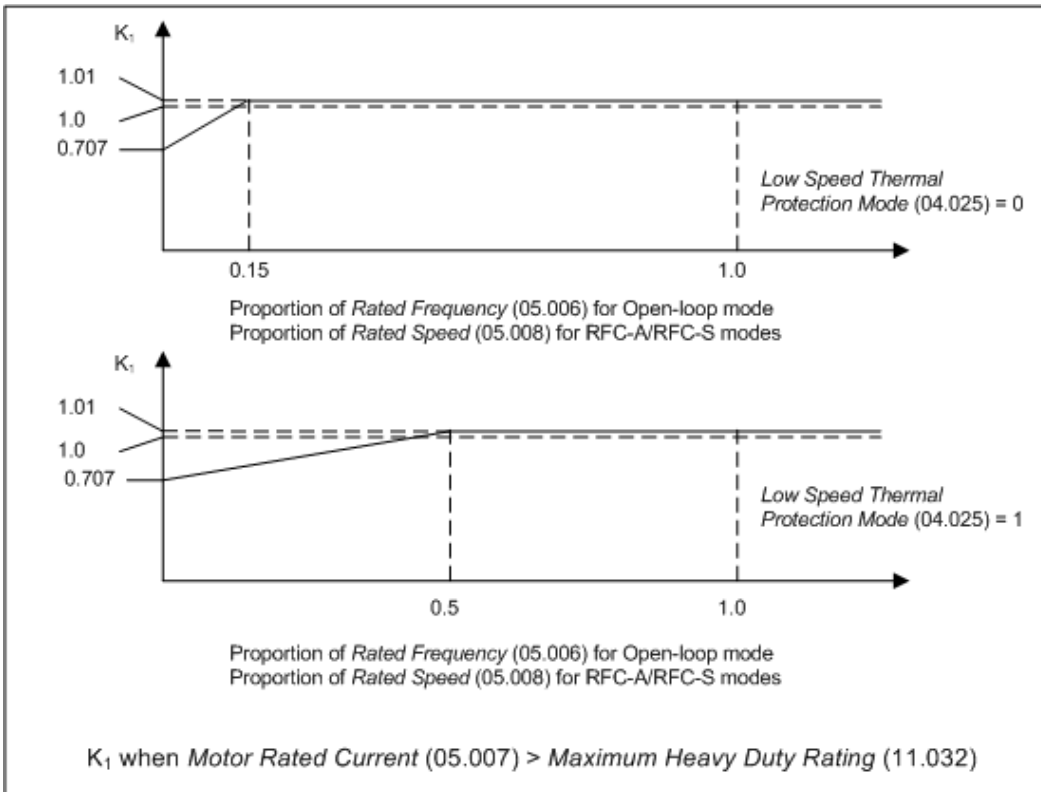
$[(1 - K_2)(1 - e^{-t/\tau_1}) + K_2(1 - e^{-t/\tau_2})]$  gives the effects of the thermal time constants in the motor.  $K_2$  defines the ratio of the contribution to the *Motor Protection Accumulator* (04.019) value from each of the time constants. If  $K_2$  is set to its default value of 0 then only *Motor Thermal Time Constant 1* (04.015) is included and the model will give the temperature of the main mass of the motor body. To give better protection to the motor, the model can be used to model a particular point in the motor, for example the stator windings. This can be done by including an additional shorter time constant representing the thermal impedance between the windings and the main mass of the motor body which can be modelled with *Motor Thermal Time Constant 2* (04.037).

#### Reduced cooling with lower speed

If *Rated Current* (05.007)  $\leq$  *Maximum Heavy Duty Rating* (11.032) then  $K_1$  is defined as shown below. If *Low Speed Thermal Protection Mode* (04.025) = 0 the characteristic is intended for a motor which can operate at rated current over the whole speed range. Induction motors with this type of characteristic normally have forced cooling. If *Low Speed Thermal Protection Mode* (04.025) = 1 the characteristic is intended for motors where the cooling effect of motor fan reduces with reduced motor speed below half of rated speed. The maximum value for  $K_1$  is 1.05, so that above the knee of the characteristics the motor can operate continuously up to 105% of rated current.



If *Rated Current* (05.007) > *Maximum Heavy Duty Rating* (11.032) then  $K_1$  is defined as shown below. Two different characteristics are provided, but in both cases the motor performance is limited at lower speeds and the permissible overload is reduced from 105% to 101%.



#### Time for Motor Protection Accumulator to reach 100%

Assuming a single time constant model is being used (i.e. *Motor Thermal Time Constant 2 Scaling* (04.038)), the time for the *Motor Protection Accumulator* (04.019) to change from its initial value to 100% is given by the following equation:

$$\text{Time to reach 100.0\%} = -\tau_1 \times \ln\left[\frac{1 - C_1}{C_0 - C_1}\right]$$

$C_0$  represents the conditions that have persisted for long enough for the *Motor Protection Accumulator* (04.019) to reach a steady state value. If the motor current and speed are  $I_0$  and  $w_0$  then,

$$C_0 = [(1 - K_{fe}) \times (I_0 / (K_1 \times I_{Rated}))^2] + [K_{fe} \times (w_0 / w_{Rated})^{1.6}]$$

$C_1$  represents the conditions that begin at the start of the time being calculated. If the motor current and speed are by  $I_1$  and  $w_1$  then,

$$C_1 = [(1 - K_{fe}) \times (I_1 / (K_1 \times I_{Rated}))^2] + [K_{fe} \times (w_1 / w_{Rated})^{1.6}]$$

**Example 1:** The effect of iron losses are not modelled ( $K_{fe} = 0$ ), *Motor Thermal Time Constant 1* (04.015) = 89s, the initial current is zero, *Rated Current* (05.007)  $\leq$  *Maximum Heavy Duty Rating* (11.032) and the new level of current is  $1.5 \times$  *Rated Current* (05.007).

$$C_0 = 0$$

$$C_1 = [1.5 / (1.05 \times 1.0)]^2 = 2.041$$

$$\text{Time to reach 100.0\%} = -89 \times \ln(1 - 1/C_1) = -89 \times \ln(1 - 1/2.041) = 60\text{s}$$

This is the default setting for Open-loop and RFC-A modes allowing an induction motor to run at 150% rated current for 60s from cold.

**Example 2:** The effect of iron losses are not modelled ( $K_{fe} = 0$ ), *Motor Thermal Time Constant 1* (04.015) = 89s, the initial current is *Rated Current* (05.007), *Rated Current* (05.007)  $\leq$  *Maximum Heavy Duty Rating* (11.032) and the new level of current is  $1.5 \times$  *Rated Current* (05.007).

$$C_0 = [1.0 / (1.05 \times 1.0)]^2 = 0.907$$

$$C_1 = [1.5 / (1.05 \times 1.0)]^2 = 2.041$$

$$\text{Time to reach 100.0\%} = -89 \times \ln((1 - C_1) / (C_0 - C_1)) = -89 \times \ln[(1 - 2.041) / (0.907 - 2.041)] = 7.6\text{s}$$

This is the default setting for Open-loop and RFC-A modes allowing an induction motor to run at 150% rated current for 7.6s after running under rated conditions for a significant period of time.

#### Motor Protection Accumulator Reset

The initial value in the *Motor Protection Accumulator* (04.019) at power-up is defined by *Motor Protection Accumulator Power-up Value* (04.036) as given in the table below.

| <i>Motor Protection Accumulator Power-up Value</i> (04.036) | <i>Motor Protection Accumulator</i> (04.019) at power-up  |
|---|---|
| Power Down  | The value is saved at power-down and is used as the initial value at power-up.  |
| Zero  | The value is set to zero  |
| Real Time   | If a real-time clock is present and if <i>Date/Time Selector</i> (06.019) is set up to select the real-time clock then the value saved at power-down is modified to include the effect of the motor thermal protection time constants over the time between power-down and power-up. This modified value is then used as the initial value at power-up.<br><br>If no real time clock is present then and this option is selected then the value saved at power-down is used as the initial value. |

The *Motor Protection Accumulator* (04.019) is reset under the following conditions:

- Motor Thermal Time Constant 1* (04.015) is set to 0.0. Note that this is not possible in the standard product as the minimum parameter value is 1.0.
- Select Motor 2 Parameters* (11.045) is modified.
- Rated Current* (05.007) is modified when *Select Motor 2 Parameters* (11.045) = 0, or *M2 Rated Current* (21.007) is modified when *Select Motor 2 Parameters* (11.045) = 1.
- Thermal Protection Mode* (04.016) is modified.

#### Motor Protection Accumulator Warning

If Percentage Losses > 100% then eventually the *Motor Protection Accumulator* (04.019) will reach 100% causing the drive to trip or the current limits to be reduced. If this is the case and *Motor Protection Accumulator* (04.019) > 75.0% then [Motor Overload] alarm indication is given and *Motor Overload Alarm* (10.017) is set to one.

| Parameter         | 04.016 <i>Thermal Protection Mode</i>      |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to the require thermal protection mode |                |                 |
| Mode              | RFC-A                                      |                |                 |
| Minimum           | 0  | Maximum        | 4               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                   | Decimal Places | 0               |
| Coding            | RW, TE                                     |                |                 |

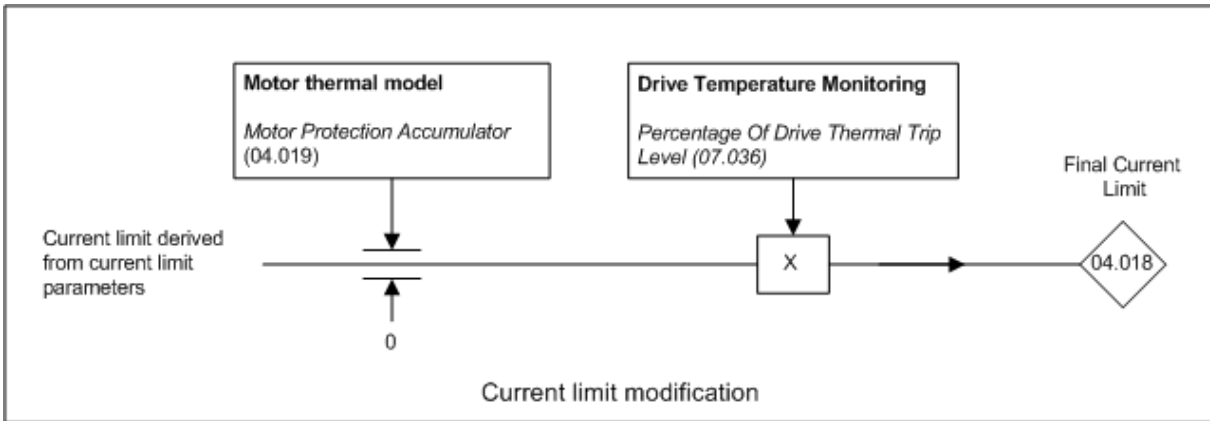
| Value | Text        |
|-------|-------------|
| 0     | Motor Trip  |
| 1     | Motor Limit |
| 2     | Drive Limit |
| 3     | Both Limit  |
| 4     | Disabled    |

*Thermal Protection Mode* (04.016) defines the action taken by the drive when *Motor Protection Accumulator* (04.019) reaches 100% and/or *Percentage Of Drive Thermal Trip Level* (07.036) exceeds 90%. The actions for each mode are given in the table below.



| Thermal Protection Mode (04.016)  | Actions  |
|-----------------------------------|--|
| Motor Trip (0)                    | <i>Motor Too Hot</i> trip is initiated when <i>Motor Protection Accumulator</i> (04.019) reaches 100%.<br>No current limiting.<br><i>Motor Protection Accumulator</i> (04.019) is limited to 100.0%.   |
| Motor Current Limit (1)           | <i>Motor Too Hot</i> trip is disabled.<br>Current limiting on motor overload as described below.<br><i>Motor Protection Accumulator</i> (04.019) is limited to 100.0%.   |
| Drive Current Limit (2)           | <i>Motor Too Hot</i> trip is initiated when <i>Motor Protection Accumulator</i> (04.019) reaches 100%.<br>Current limiting on drive thermal monitoring as described below.<br><i>Motor Protection Accumulator</i> (04.019) is limited to 100.0%. |
| Motor and Drive Current Limit (3) | <i>Motor Too Hot</i> trip is disabled.<br>Current limiting on motor overload and drive thermal monitoring as described below.<br><i>Motor Protection Accumulator</i> (04.019) is limited to 100.0%.  |
| Disabled (4)                      | <i>Motor Too Hot</i> trip is disabled and <i>Motor Overload</i> alarm is disabled.<br>No current limiting.<br><i>Motor Protection Accumulator</i> (04.019) is limited to 200.0%.   |

The current limit is derived from the current limit parameters (i.e. *Motoring Current Limit* (04.005), etc.) depending on the set-up and conditions. The current limit can be further limited by current limit on motor overload and/or drive temperature monitoring as shown below to give the *Final Current Limit* (04.018).



#### Current limiting on motor overload

When the *Motor Protection Accumulator* (04.019) reaches 100.0% the current limit is limited to  $(K_1 - 0.05) \times 100.0\%$ . This limitation is removed when the *Motor Protection Accumulator* (04.019) falls below 95.0%. ( $K_1$  is defined in the description of *Motor Thermal Time Constant 1* (04.015).)

#### Drive thermal monitoring current limiting

If *Percentage Of Drive Thermal Trip Level* (07.036) exceeds 90% the current limit is modified as follows:

$$\text{Final Current Limit (04.018)} = \text{Current limit} \times (100\% - \text{Percentage Of Drive Thermal Trip Level (07.036)}) / 10\%$$

If both of the above attempt to reduce the final current limit the lowest calculated value of current limit is used.

This system has the effect of reducing the current limit to zero at the point where the drive should be tripped because its thermal monitoring has reached a trip threshold. This is intended to limit the load on the drive to prevent it from tripping when supplying a load that increases with speed and does not include rapid transients.

| Parameter         | 04.017 Magnetising Current                           |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Shows the instantaneous level of magnetising current |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | -VM_DRIVE_CURRENT                                    | Maximum        | VM_DRIVE_CURRENT |
| Default           |  | Units          | A                |
| Type              | 32 Bit Volatile                                      | Update Rate    | 250µs write      |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RO, FI, VM, ND, NC, PT                               |                |                  |

*Id*, *Magnetising Current* (04.017) is the instantaneous level of magnetising current scaled so that it represents the r.m.s. level of magnetising current under steady state conditions.

| Parameter         | 04.018 Final Current Limit  |                |                   |
|-------------------|---|----------------|-------------------|
| Short description | Shows the final current limit that is applied to the torque producing current |                |                   |
| Mode              | RFC-A   |                |                   |
| Minimum           | -VM_TORQUE_CURRENT  | Maximum        | VM_TORQUE_CURRENT |
| Default           |   | Units          | %                 |
| Type              | 16 Bit Volatile   | Update Rate    | 4ms write         |
| Display Format    | Standard  | Decimal Places | 1                 |
| Coding            | RO, VM, ND, NC, PT  |                |                   |

*Final Current Limit* (04.018) is the current limit level that is applied to give the *Final Current Reference* (04.004).

| Parameter         | 04.019 Motor Protection Accumulator                 |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Shows the level of the motor protection accumulator |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.0   | Maximum        | 200.0            |
| Default           |   | Units          | %                |
| Type              | 16 Bit Power Down Save                              | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 1                |
| Coding            | RO, ND, NC, PT                                      |                |                  |

See *Motor Thermal Time Constant 1* (04.015).

| Parameter         | 04.020 Percentage Load  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Shows the level of torque producing current as a percentage of rated torque producing current for the motor |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | -VM_USER_CURRENT  | Maximum        | VM_USER_CURRENT  |
| Default           |   | Units          | %                |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 1                |
| Coding            | RO, FI, VM, ND, NC, PT  |                |                  |

*Percentage Load* (04.020) gives the *I<sub>q</sub>, Torque Producing Current* (04.002) as a percentage of the rated torque producing current for the motor. Positive values indicate motoring and negative values represent regenerating.

| Parameter         | 04.021 Current Feedback Filter Disable                         |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Disables the 4ms filter applied to current feedback parameters |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

If *Current Feedback Filter Disable* (04.021) = 0 a 4ms filter is applied to the current feedback components measured by the drive to be used in *I<sub>q</sub>, Torque Producing Current* (04.002) and *I<sub>d</sub>, Magnetising Current* (04.017). This filter removes ripple components associated with the PWM switching. If *Current Feedback Filter Disable* (04.021) = 1, the filter is disabled and the user parameters are based on the current components sampled every 250µs.

| Parameter         | 04.022 Inertia Compensation Enable |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Set to enable inertia compensation |                |                 |
| Mode              | RFC-A                              |                |                 |
| Minimum           | 0                                  | Maximum        | 1               |
| Default           | 0                                  | Units          |                 |
| Type              | 1 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW                                 |                |                 |

If *Inertia Compensation Enable* (04.022) is set to one the *Inertia Compensation Torque* (02.038) is added to the output of the speed controller. The *Inertia Compensation Torque* (02.038) is calculated based on a value of load inertia supplied by the user (*Motor And Load Inertia* (03.018)) and the rate of change of the speed reference. This can be used in speed or torque controller applications to provide the torque necessary to accelerate or decelerate the load.

| Parameter         | 04.023 Current Reference Filter 2 Time Constant   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the time constant of an alternative first order filter that can be applied to the final current reference |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.0   | Maximum        | 25.0            |
| Default           | 0.0   | Units          | ms              |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW, BU  |                |                 |

See *Current Reference Filter 1 Time Constant* (04.012).

| Parameter         | 04.024 User Current Maximum Scaling   |                |                            |
|-------------------|---|----------------|----------------------------|
| Short description | Defines the maximum for the torque reference and percentage load parameters |                |                            |
| Mode              | RFC-A   |                |                            |
| Minimum           | -VM_TORQUE_CURRENT_UNIPOLAR   | Maximum        | VM_TORQUE_CURRENT_UNIPOLAR |
| Default           | 175.0   | Units          | %                          |
| Type              | 16 Bit User Save  | Update Rate    | Background read            |
| Display Format    | Standard  | Decimal Places | 1                          |
| Coding            | RW, VM, RA  |                |                            |

*User Current Maximum Scaling* (04.024) defines the variable maximum/minimums VM\_USER\_CURRENT and VM\_USER\_CURRENT\_HIGH\_RES which are applied to *Percentage Load* (04.020), *Torque Reference* (04.008) and *Torque Offset* (04.009). This is useful when routing these parameters to an analog output as it allows the full scale output value to be defined by the user.

The maximum value (VM\_TORQUE\_CURRENT\_UNIPOLAR [MAX]) varies between drive sizes with default parameters loaded. For some drive sizes the default value may be reduced below the value given by the parameter range limiting.

| Parameter         | 04.025 Low Speed Thermal Protection Mode        |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to enable low speed thermal protection mode |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                                 | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Motor Thermal Time Constant 1* (04.015).

| Parameter         | 04.026 Percentage Torque                                    |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Shows the calculated torque as a percentage of rated torque |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | -VM_USER_CURRENT  | Maximum        | VM_USER_CURRENT |
| Default           |   | Units          | %               |
| Type              | 16 Bit Volatile   | Update Rate    | 4ms write       |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RO, FI, VM, ND, NC, PT                                      |                |                 |

The shaft torque of the motor is estimated by the drive and *Percentage Torque* (04.026) gives this torque as a percentage of the expected torque defined by *Rated Torque* (04.041). The default value for *Rated Torque* (04.041) is zero which disables this feature so that *Percentage Torque* (04.026) is always zero. To enable the torque estimation system *Rated Torque* (04.041) should be set to the expected torque from the motor under rated conditions. For accurate torque estimation, and consistent results for both motoring and regenerating conditions, it is necessary to provide the drive with the core losses under no-load and rated load conditions at rated speed (i.e. *No-load Core Loss* (04.045) and *Rated Core Loss* (04.046) respectively). The drive will then include the core power loss in the torque calculation as

$PCoreLoss = No\text{-}load\ Core\ Loss\ (04.045) + (Rated\ Core\ Loss\ (04.046) - No\text{-}load\ Core\ Loss\ (04.045)) \times (Torque\ Producing\ Current / Rated\ Torque\ Producing\ Current)$

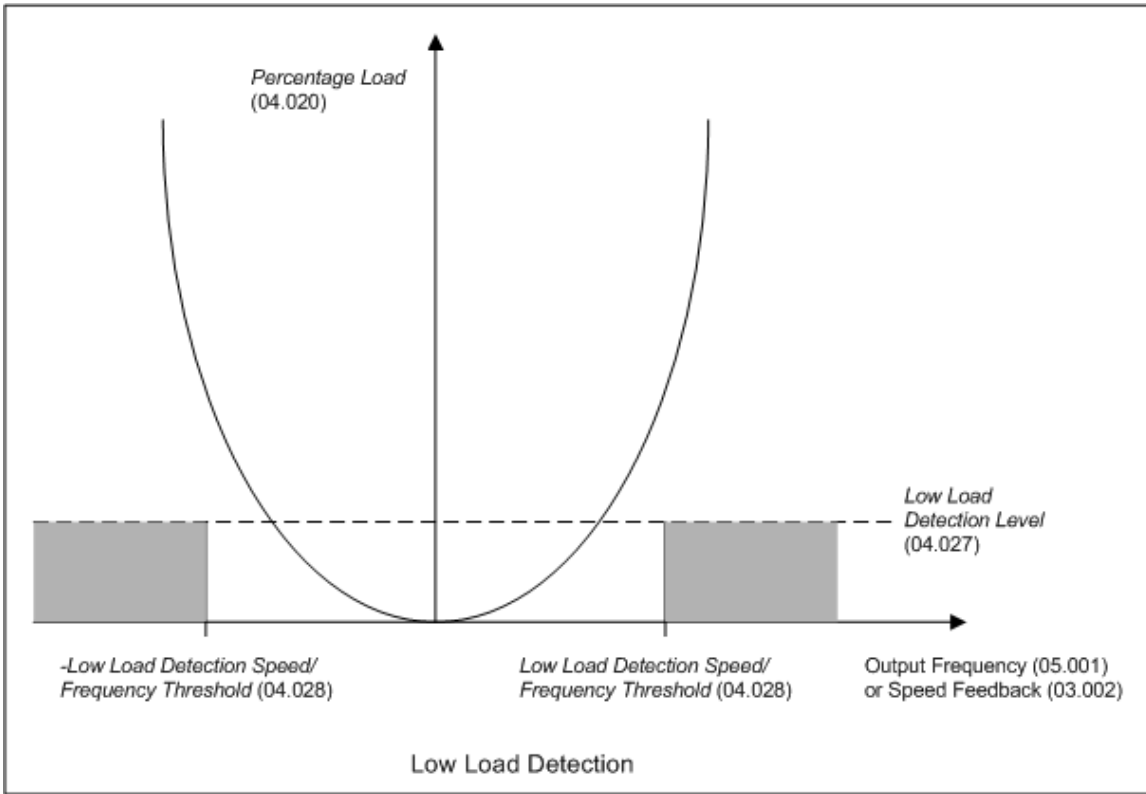
If *Rated Core Loss* (04.046)  $\leq$  *No-load Core Loss* (04.045) then only the no load value is used and  $PCoreLoss = No\text{-}load\ Core\ Loss\ (04.045)$ . This provides some compensation for core losses, but not the load dependent component. The core loss power values can be difficult to obtain except by experimental measurement because the loss mechanisms within the motor are complex and are affected by the PWM frequencies applied to the motor by the drive. It is possible to obtain an estimate for *No-load Core Loss* (04.045) during auto-tuning for RFC-A mode, but not RFC-S mode. As the auto-tuning algorithm cannot measure *Rated Core Loss* (04.046) this is set to zero, so that it is not used. If power dependent core losses are to be included *Rated Core Loss* (04.046) must be set by the user.

| Parameter         | 04.027 Low Load Detection Level      |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description | Defines the low load detection level |                |                 |
| Mode              | RFC-A                                |                |                 |
| Minimum           | 0.0                                  | Maximum        | 100.0           |
| Default           | 0.0                                  | Units          | %               |
| Type              | 16 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                             | Decimal Places | 1               |
| Coding            | RW                                   |                |                 |

If *Low Load Detection Level* (04.027) is set to 0.0 the low load detection system is disabled, otherwise the low load detection system is enabled. The low load detection system is provided so that loss of load can be detected and action taken. So that the detector can be used with fan and pump type loads, where the load is relatively light at low motor speed, the detector is only active when the output frequency or speed is above the level defined by *Low Load Detection Speed/Frequency Threshold* (04.028). The detector is also only enabled when the motor is at the required speed (i.e. not accelerating or decelerating), and so it is only active when *At Speed* (10.006) = 1. Once the detector is active, the low load condition is detected when the *Percentage Load* (04.020) falls below the threshold defined by *Low Load Detection Level* (04.027). Therefore the condition for detecting low load is given by,

$At\ Speed\ (10.006) = 1\ AND\ |Speed\ Feedback\ (03.002)| > Low\ Load\ Detection\ Speed/Frequency\ Threshold\ (04.028)\ AND\ Percentage\ Load\ (04.020) < Low\ Load\ Detection\ Level\ (04.027)$

The diagram below shows a typical fan type load and the shaded areas define where low load is detected.



*Enable Trip On Low Load* (04.029) defines the action taken when low load is detected. If *Enable Trip On Low Load* (04.029) = 0 a Low Load warning is displayed and *Low Load Detected Alarm* (10.062) is set to one. If *Enable Trip On Low Load* (04.029) = 1 no warning is given, but a *Low Load* trip is initiated.

| Parameter         | 04.028 Low Load Detection Speed/Frequency Threshold      |                |                            |
|-------------------|--|----------------|----------------------------|
| Short description | Defines the low load detection speed/frequency threshold |                |                            |
| Mode              | RFC-A  |                |                            |
| Minimum           | -VM_SPEED_FREQ_REF_UNIPOLAR                              | Maximum        | VM_SPEED_FREQ_REF_UNIPOLAR |
| Default           | 0.0  | Units          |                            |
| Type              | 32 Bit User Save   | Update Rate    | Background read            |
| Display Format    | Standard   | Decimal Places | 1                          |
| Coding            | RW, VM   |                |                            |

See *Low Load Detection Level* (04.027).

| Parameter         | 04.029 Enable Trip On Low Load                     |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the action taken when low load is detected |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save                                    | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *Low Load Detection Level* (04.027).

| Parameter         | 04.030 Current Controller Mode                         |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to enable high performance current controller mode |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *Current Controller Kp Gain* (04.013).

| Parameter         | 04.031 Notch Filter Centre Frequency   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the centre frequency for a notch filter to cancel a mechanical resonance |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 50   | Maximum        | 1200            |
| Default           | 100  | Units          | Hz              |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

A notch filter can be inserted be applied to the *Final Current Reference* (04.004) to remove the effect of a mechanical resonance in the system. *Notch Filter Centre Frequency* (04.031) defines the centre frequency ( $f_0$ ) in Hertz and *Notch Filter Bandwidth* (04.032) defines the bandwidth ( $f_{BW}$ ) which is the frequency difference between the 3dB points of the notch filter in Hertz. The Q of the filter is given by  $Q = f_0 / f_{BW}$ . If *Notch Filter Bandwidth* (04.032) is at its default value of zero then the notch filter is disabled. It should be noted that although it is possible to set a bandwidth that is higher than half the centre frequency, the bandwidth of the filter is limited to half the centre frequency.

| Parameter         | 04.032 Notch Filter Bandwidth   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the bandwidth for a notch filter to cancel mechanical resonance |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 500             |
| Default           | 0   | Units          | Hz              |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Notch Filter Centre Frequency* (04.031).

| Parameter         | 04.033 Inertia Times 1000                |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Inertia is in 1000kgm <sup>2</sup> units |                |                 |
| Mode              | RFC-A                                    |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save                          | Update Rate    | Background Read |
| Display Format    | Standard                                 | Decimal Places | 0               |
| Coding            | RW                                       |                |                 |

The inertia in *Motor And Load Inertia* (03.018) is in kgm<sup>2</sup> if this parameter is zero, otherwise if it is one the inertia is in 1000kgm<sup>2</sup> units.

| Parameter         | 04.036 Motor Protection Accumulator Power-up Value                     |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the initial power-up value of the motor protection accumulator |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 2                |
| Default           | 0  | Units          |                  |
| Type              | 8 Bit User Save  | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RW, TE   |                |                  |

| Value | Text       |
|-------|------------|
| 0     | Power down |
| 1     | Zero       |
| 2     | Real time  |

See *Motor Thermal Time Constant 1* (04.015).

| Parameter         | 04.037 Motor Thermal Time Constant 2                            |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Can be used to define an additional motor thermal time constant |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 1.0   | Maximum        | 3000.0          |
| Default           | 89.0  | Units          | s               |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW  |                |                 |

See *Motor Thermal Time Constant 1* (04.015).

| Parameter         | 04.038 Motor Thermal Time Constant 2 Scaling  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the ratio of the contribution to the motor protection accumulator value from each of the time constants |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 100             |
| Default           | 0   | Units          | %               |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See Motor Thermal Time Constant 1 (04.015).

| Parameter         | 04.039 Rated Iron Losses As Percentage Of Losses  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to the rated iron losses of the motor as a percentage of the total losses for the motor |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 100             |
| Default           | 0   | Units          | %               |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See Motor Thermal Time Constant 1 (04.015).

| Parameter         | 04.041 Rated Torque                               |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Rated torque used by the torque correction system |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.00  | Maximum        | 50000.00        |
| Default           | 0.00  | Units          | Nm              |
| Type              | 32 Bit User Save                                  | Update Rate    | Background Read |
| Display Format    | Standard  | Decimal Places | 2               |
| Coding            | RW  |                |                 |

The estimated torque (*Percentage Torque* (04.026)) is given as a percentage of *Rated Torque* (04.041). If *Rated Torque* (04.041) is left at the default value of zero then *Percentage Torque* (04.026) will remain at zero under all conditions.

| Parameter         | 04.042 Torque Estimation Minimum Frequency             |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Minimum frequency used by the torque correction system |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 100             |
| Default           | 5  | Units          | %               |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

The drive estimates the motor shaft torque (*Percentage Torque* (04.026)), but at low output frequencies this estimate is very inaccurate. *Torque Estimation Minimum Frequency* (04.042) defines the point where the estimate of torque is too inaccurate to use as a percentage of *Rated Frequency* (05.006), i.e.  $F_{\text{Threshold}} = \text{Rated Frequency (05.006)} \times \text{Torque Estimation Minimum Frequency (04.042)} / 100$ .

| Condition   | Percentage Torque (04.026)  |
|---|---|
| $ \text{Output Frequency (05.001)}  < F_{\text{Threshold}}$                         | Torque reference with no core losses  |
| $F_{\text{Threshold}} <  \text{Output Frequency (05.001)}  < 2F_{\text{Threshold}}$ | Changes linearly between torque reference with no core losses and calculated torque including core losses |
| $ \text{Output Frequency (05.001)}  > 2F_{\text{Threshold}}$                        | Calculated torque including core losses   |

| Parameter         | 04.043 Torque Correction Time Constant             |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Time constant used by the torque correction system |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.00   | Maximum        | 10.00           |
| Default           | 0.00   | Units          | s               |
| Type              | 16 Bit User Save                                   | Update Rate    | Background Read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

The torque correction system uses the *Final Torque Reference* (04.003) and the *Percentage Torque* (04.026) to calculate the error between the required and actual torque. This error is used by the torque correction system to apply a trim to the torque reference being used by the drive. If *Torque Correction Time Constant* (04.043) is set to a non-zero value this system is enabled and *Torque Correction Time Constant* (04.043) defines the time constant of the correction system. The maximum positive or negative trim that can be applied is defined by *Torque Correction Maximum* (04.044).

| Parameter         | 04.044 Torque Correction Maximum  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Maximum trim that can be applied to the torque reference to correct the torque. |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 100             |
| Default           | 20  | Units          | %               |
| Type              | 8 Bit User Save   | Update Rate    | Background Read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Torque Correction Time Constant* (04.043).

| Parameter         | 04.045 No-load Core Loss   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the no-load core loss for the motor used by the torque correction system |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000  | Maximum        | 99999.999       |
| Default           | 0.000  | Units          | kW              |
| Type              | 32 Bit User Save   | Update Rate    | Background Read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW   |                |                 |

See *Percentage Torque* (04.026).

| Parameter         | 04.046 Rated Core Loss   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the rated core loss for the motor used by the torque correction system |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000  | Maximum        | 99999.999       |
| Default           | 0.000  | Units          | kW              |
| Type              | 32 Bit User Save   | Update Rate    | Background Read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW   |                |                 |

See *Percentage Torque* (04.026).

| Parameter         | 04.049 Magnetising Current Limit |                |            |
|-------------------|----------------------------------|----------------|------------|
| Short description | Magnetising Current Limit        |                |            |
| Mode              | RFC-A                            |                |            |
| Minimum           | 0.0                              | Maximum        | 100.0      |
| Default           | 100.0                            | Units          | %          |
| Type              | 16 Bit User Save                 | Update Rate    | Background |
| Display Format    | Standard                         | Decimal Places | 1          |
| Coding            | RW                               |                |            |

*Magnetising Current Limit* (04.049) defines the maximum level of magnetising current used as a percentage of *Rated Current* (05.007). The magnetising current is normally at the rated level for the motor, but may increase up to this limit when the drive is enabled to raise the flux in the motor as fast as possible. The magnetising current can also be increased above the rated level when the motor is decelerated rapidly from the flux weakening range. The default value for *Magnetising Current Limit* (04.049) is normally suitable, but may be decreased if required. The maximum level of magnetising current will not be decreased below the rated level for the motor how ever low the value in *Magnetising Current Limit* (04.049). This parameter is not used in RFC-S mode.

## Menu 5 Single Line Descriptions – *Motor Control*

Mode: RFC-A



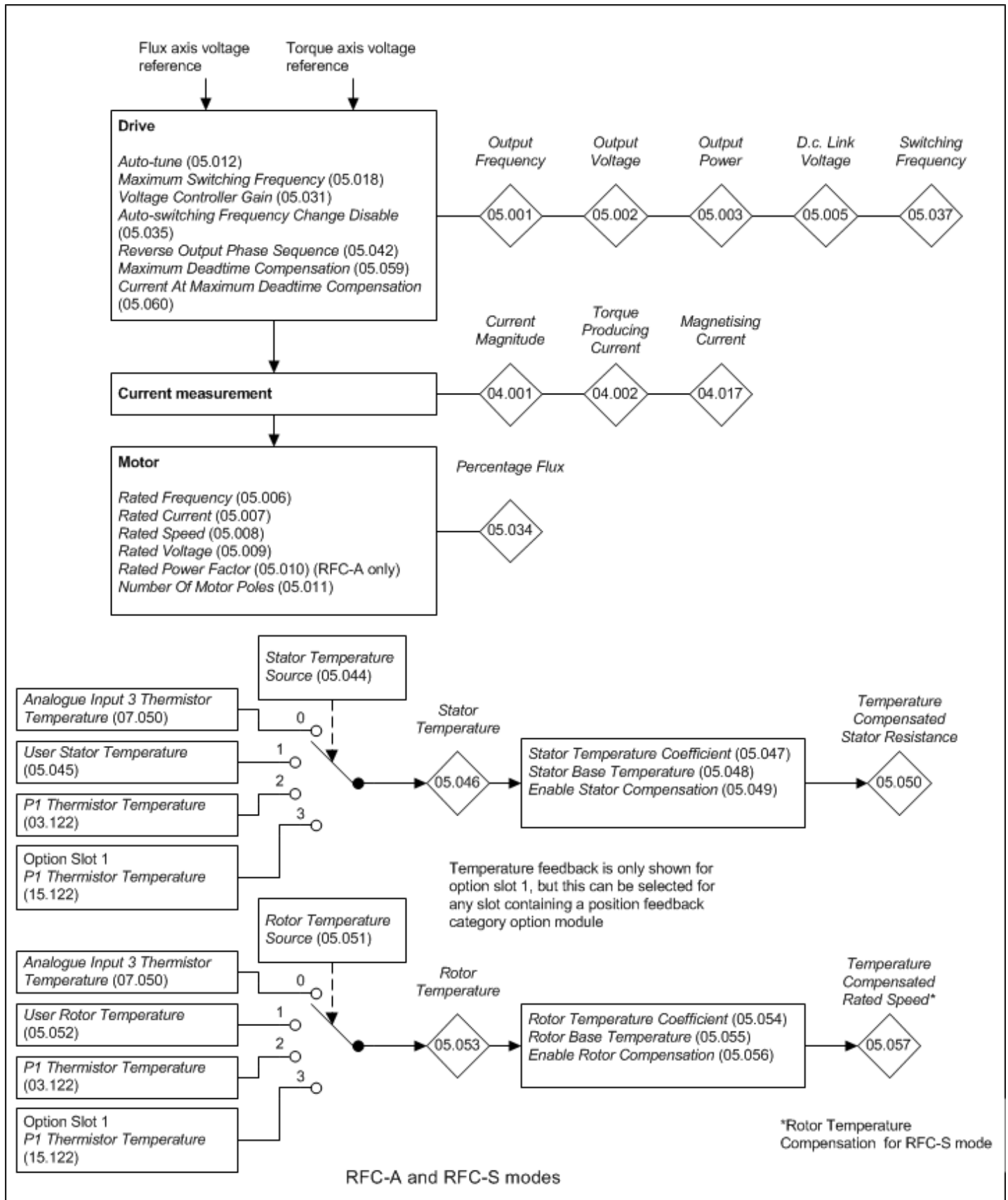
| Parameter |  | Range   | Default   | Type |     |    |    |    |    |
|-----------|--|---|---|------|-----|----|----|----|----|
| 05.001    | Output Frequency                           | ±2000.0 Hz  |   | RO   | Num | ND | NC | PT | FI |
| 05.002    | Output Voltage                             | ±VM_AC_VOLTAGE V  |   | RO   | Num | ND | NC | PT | FI |
| 05.003    | Output Power                               | ±VM_POWER kW  |   | RO   | Num | ND | NC | PT | FI |
| 05.005    | D.c. Bus Voltage                           | ±VM_DC_VOLTAGE V  |   | RO   | Num | ND | NC | PT | FI |
| 05.006    | Rated Frequency                            | 0.0 to 550.0 Hz   | 50Hz: 50.0 Hz<br>60Hz: 60.0 Hz  | RW   | Num |    |    |    | US |
| 05.007    | Rated Current                              | ±VM_RATED_CURRENT A   | 0.000 A   | RW   | Num |    | RA |    | US |
| 05.008    | Rated Speed                                | 0.00 to 33000.00 rpm  | 50Hz: 1500.00 rpm<br>60Hz: 1800.00 rpm  | RW   | Num |    |    |    | US |
| 05.009    | Rated Voltage                              | ±VM_AC_VOLTAGE_SET V  | 200V drive: 230 V<br>400V drive 50Hz: 400 V<br>400V drive 60Hz: 460 V<br>575V drive: 575 V<br>690V drive: 690 V | RW   | Num |    | RA |    | US |
| 05.010    | Rated Power Factor                         | 0.000 to 1.000  | 0.850   | RW   | Num |    | RA |    | US |
| 05.011    | Number Of Motor Poles                      | Automatic (0) to 480 (240) Poles  | Automatic (0) Poles   | RW   | Txt |    |    |    | US |
| 05.012    | Auto-tune                                  | None (0), Basic (1), Improved (2), Inertia 1 (3), Inertia 2 (4)                                 | None (0)  | RW   | Txt |    | NC |    |    |
| 05.013    | Flux Optimisation Select                   | Off (0) or On (1)   | Off (0)   | RW   | Bit |    |    |    | US |
| 05.015    | Low Frequency Voltage Boost                | 0.0 to 25.0 %   | 3.0 %   | RW   | Num |    |    |    | US |
| 05.016    | Rated Speed Optimisation Select            | Disabled (0), Classic Slow (1), Classic Fast (2), Combined (3), VARs Only (4), Voltage Only (5) | Disabled (0)  | RW   | Txt |    |    |    | US |
| 05.017    | Stator Resistance                          | 0.000000 to 1000.000000 Ω   | 0.000000 Ω  | RW   | Num |    | RA |    | US |
| 05.018    | Maximum Switching Frequency                | 0 to VM_SWITCHING_FREQUENCY kHz   | 3 (1) kHz   | RW   | Txt |    | RA |    | US |
| 05.019    | Rated Speed Optimisation Minimum Frequency | 0 to 100 %  | 10 %  | RW   | Num |    |    |    | US |
| 05.020    | Rated Speed Optimisation Minimum Load      | 0 to 100 %  | 50 %  | RW   | Num |    |    |    | US |
| 05.021    | Mechanical Load Test Level                 | 0 to 100 %  | 0 %   | RW   | Num |    |    |    | US |
| 05.023    | D.c. Bus Voltage High Range                | ±VM_HIGH_DC_VOLTAGE V   |   | RO   | Num | ND | NC | PT | FI |
| 05.024    | Transient Inductance                       | 0.000 to 500.000 mH   | 0.000 mH  | RW   | Num |    | RA |    | US |
| 05.025    | Stator Inductance                          | 0.00 to 5000.00 mH  | 0.00 mH   | RW   | Num |    | RA |    | US |
| 05.026    | High Dynamic Performance Enable            | Off (0) or On (1)   | Off (0)   | RW   | Bit |    |    |    | US |
| 05.027    | Flux Control Gain                          | ±10.0   | 1.0   | RW   | Num |    |    |    | US |
| 05.028    | Flux Compensation                          | 0 to 2  | 0   | RW   | Num |    |    |    | US |
| 05.029    | Saturation Breakpoint 1                    | 0.0 to 100.0 %  | 50.0 %  | RW   | Num |    |    |    | US |
| 05.030    | Saturation Breakpoint 3                    | 0.0 to 100.0 %  | 75.0 %  | RW   | Num |    |    |    | US |
| 05.031    | Voltage Controller Gain                    | 1 to 30   | 1   | RW   | Num |    |    |    | US |
| 05.032    | Torque Per Amp                             | 0.00 to 500.00 Nm/A   |   | RO   | Num | ND | NC | PT |    |
| 05.034    | Percentage Flux                            | 0.0 to 150.0 %  |   | RO   | Num | ND | NC | PT | FI |
| 05.035    | Auto-switching Frequency Change            | Enabled (0), Disabled (1), No Ripple Detect (2)   | Enabled (0)   | RW   | Txt |    |    |    | US |
| 05.036    | Auto-switching Frequency Step Size         | 1 to 2  | 2   | RW   | Num |    |    |    | US |
| 05.037    | Switching Frequency                        | 2 (0), 3 (1), 4 (2), 6 (3), 8 (4), 12 (5), 16 (6) kHz   |   | RO   | Txt | ND | NC | PT |    |
| 05.038    | Minimum Switching Frequency                | 0 to VM_MIN_SWITCHING_FREQUENCY kHz   | 2 (0) kHz   | RW   | Txt |    |    |    | US |
| 05.039    | Maximum Inverter Temperature Ripple        | 20 to 60 °C   | 60 °C   | RW   | Num |    |    |    | US |
| 05.040    | Spin Start Boost                           | 0.0 to 10.0   | 1.0   | RW   | Num |    |    |    | US |
| 05.041    | Voltage Headroom                           | 0 to 20 %   | 0 %   | RW   | Num |    |    |    | US |
| 05.042    | Reverse Output Phase Sequence              | Off (0) or On (1)   | Off (0)   | RW   | Bit |    |    |    | US |
| 05.044    | Stator Temperature Source                  | An In 3 (0), User (1), P1 Drive (2), P1 Slot1 (3), P1 Slot2 (4), P1 Slot3 (5), P1 Slot4 (6)     | User (1)  | RW   | Txt |    |    |    | US |
| 05.045    | User Stator Temperature                    | -50 to 300 °C   | 0 °C  | RW   | Num |    |    |    |    |
| 05.046    | Stator Temperature                         | -50 to 300 °C   |   | RO   | Num | ND | NC | PT |    |
| 05.047    | Stator Temperature Coefficient             | 0.00000 to 0.10000 1/°C   | 0.00390 1/°C  | RW   | Num |    |    |    | US |
| 05.048    | Stator Base Temperature                    | -50 to 300 °C   | 0 °C  | RW   | Num |    |    |    | US |
| 05.049    | Enable Stator Compensation                 | Off (0) or On (1)   | Off (0)   | RW   | Bit |    |    |    | US |
| 05.050    | Temperature Compensated Stator Resistance  | 0.000000 to 1000.000000   |   | RO   | Num | ND | NC | PT |    |
| 05.051    | Rotor Temperature Source                   | An In 3 (0), User (1), P1 Drive (2), P1 Slot1 (3), P1 Slot2 (4), P1 Slot3 (5), P1 Slot4 (6)     | User (1)  | RW   | Txt |    |    |    | US |
| 05.052    | User Rotor Temperature                     | -50 to 300 °C   | 0 °C  | RW   | Num |    |    |    |    |
| 05.053    | Rotor Temperature                          | -50 to 300 °C   |   | RO   | Num | ND | NC | PT |    |
| 05.054    | Rotor Temperature Coefficient              | 0.00000 to 0.10000 1/°C   | 0.00390 1/°C  | RW   | Num |    |    |    | US |
| 05.055    | Rotor Base Temperature                     | -50 to 300 °C   | 0 °C  | RW   | Num |    |    |    | US |
| 05.056    | Enable Rotor Compensation                  | Off (0) or On (1)   | Off (0)   | RW   | Bit |    |    |    | US |
| 05.057    | Temperature compensated rated speed        | 0.00 to 33000.00 rpm  |   | RO   | Num | ND | NC | PT |    |
| 05.059    | Maximum Deadtime Compensation              | 0.000 to 10.000 µs  | 0.000 µs  | RO   | Num |    | NC | PT | US |
| 05.060    | Current At Maximum Deadtime Compensation   | 0.00 to 100.00 %  | 0.00 %  | RO   | Num |    | NC | PT | US |
| 05.061    | Disable Deadtime Compensation              | Off (0) or On (1)   | Off (0)   | RW   | Bit |    |    |    | US |
| 05.062    | Saturation Breakpoint 2                    | 0.0 to 100.0 %  | 0.0 %   | RW   | Num |    |    |    | US |

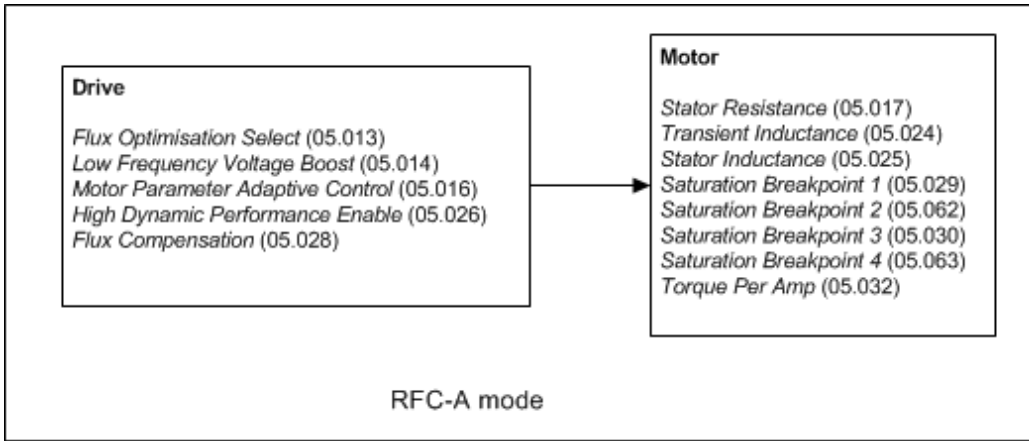
|        |                         |  |                |  |       |    |     |  |  |  |    |
|--------|-------------------------|--|----------------|--|-------|----|-----|--|--|--|----|
| 05.063 | Saturation Breakpoint 4 |  | 0.0 to 100.0 % |  | 0.0 % | RW | Num |  |  |  | US |
|--------|-------------------------|--|----------------|--|-------|----|-----|--|--|--|----|

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 5 – Motor Control

Mode: RFC-A





| Parameter         | 05.001 Output Frequency                     |                |           |
|-------------------|---|----------------|-----------|
| Short description | Displays the frequency applied to the motor |                |           |
| Mode              | RFC-A                                       |                |           |
| Minimum           | -2000.0                                     | Maximum        | 2000.0    |
| Default           |   | Units          | Hz        |
| Type              | 32 Bit Volatile                             | Update Rate    | 4ms write |
| Display Format    | Standard                                    | Decimal Places | 1         |
| Coding            | RO, FI, ND, NC, PT                          |                |           |

The output frequency is not controlled directly, but the *Output Frequency* (05.001) is a measurement of the frequency applied to the motor.

| Parameter         | 05.002 Output Voltage   |                |               |
|-------------------|---|----------------|---------------|
| Short description | Displays the r.m.s. line to line voltage at the a.c. terminals of the drive |                |               |
| Mode              | RFC-A   |                |               |
| Minimum           | -VM_AC_VOLTAGE  | Maximum        | VM_AC_VOLTAGE |
| Default           |   | Units          | V             |
| Type              | 16 Bit Volatile   | Update Rate    | 4ms write     |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RO, FI, VM, ND, NC, PT  |                |               |

The *Output Voltage* (05.002) is the r.m.s. line to line voltage at the a.c. terminals of the drive.

| Parameter         | 05.003 Output Power  |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the power flowing via the a.c. terminals of the drive |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | -VM_POWER  | Maximum        | VM_POWER  |
| Default           |  | Units          | kW        |
| Type              | 32 Bit Volatile  | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 3         |
| Coding            | RO, FI, VM, ND, NC, PT   |                |           |

The *Output Power* (05.003) is the power flowing via the a.c. terminals of the drive. The power is derived as the dot product of the output voltage and current vectors, and so this is correct even if the motor parameters are incorrect and the motor model does not align the reference frame with the flux axis of a motor in RFC-A mode. For Open-loop, RFC-A and RFC-S modes a positive value of power indicates power flowing from the drive to motor. For Regen mode a positive value of power indicates power flowing from the supply to the regen drive.

| Parameter         | 05.005 D.c. Bus Voltage                                |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Displays the voltage across the d.c. link of the drive |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | -VM_DC_VOLTAGE   | Maximum        | VM_DC_VOLTAGE   |
| Default           |  | Units          | V               |
| Type              | 16 Bit Volatile  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RO, FI, VM, ND, NC, PT                                 |                |                 |

*D.c. Bus Voltage* (05.005) gives the voltage across the d.c. link of the drive.

| Parameter         | 05.006 Rated Frequency                  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to the rated frequency of the motor |                |                 |
| Mode              | RFC-A                                   |                |                 |
| Minimum           | 0.0                                     | Maximum        | 550.0           |
| Default           | See exceptions below                    | Units          | Hz              |
| Type              | 16 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 1               |
| Coding            | RW                                      |                |                 |

| Region | Default Value |
|--------|---------------|
| 50Hz   | 50.0          |
| 60Hz   | 60.0          |

*Rated Frequency* (05.006), *Rated Speed* (05.008) and *Number Of Motor Poles* (05.011) are used to calculate the rated slip of the motor which is used by the motor control algorithm. An incorrect estimate of rated slip has the following effects:

1. Reduced efficiency
2. Reduction of maximum torque available from the motor
3. Reduced transient performance
4. Inaccurate control of absolute torque in torque control modes
5. The drive will produce rated flux in the motor in the shortest possible time when it is enabled. Incorrect parameter values will affect the flux build-up time.

The rated speed on the motor nameplate is normally the value for a hot motor, however, some adjustment may be required when the drive is commissioned if this is inaccurate. Either a fixed value can be entered for *Rated Speed* (05.008) or the optimisation system within the drive may be used to automatically adjust the *Rated Speed* (05.008). See *Rated Speed Optimisation Select* (05.016). It should be noted that the optimisation system does not operate when sensorless RFC-A mode is used (i.e. *Sensorless Mode Active* (03.078) = 1).

| Parameter         | 05.007 Rated Current                        |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Set to the rated current rated of the motor |                |                  |
| Mode              | RFC-A                                       |                |                  |
| Minimum           | -VM_RATED_CURRENT                           | Maximum        | VM_RATED_CURRENT |
| Default           | 0.000                                       | Units          | A                |
| Type              | 32 Bit User Save                            | Update Rate    | Background read  |
| Display Format    | Standard                                    | Decimal Places | 3                |
| Coding            | RW, VM, RA                                  |                |                  |

*Rated Current* (05.007) is used as follows:

| Function                 | Details  |
|--------------------------|--|
| Motor thermal protection | Defines the motor rated current.   |
| Motor pre-heat           | Motor pre-heat is set up as a percentage of rated current.                   |
| Motor control            | Used in the motor control algorithm.   |
| Current limits           | Current limits are set up as a percentage of rated torque producing current. |

| Parameter         | 05.008 Rated Speed                  |                |                 |
|-------------------|-------------------------------------|----------------|-----------------|
| Short description | Set to the rated speed of the motor |                |                 |
| Mode              | RFC-A                               |                |                 |
| Minimum           | 0.00                                | Maximum        | 33000.00        |
| Default           | See exceptions below                | Units          | rpm             |
| Type              | 32 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                            | Decimal Places | 2               |
| Coding            | RW                                  |                |                 |

| Region | Default Value |
|--------|---------------|
| 50Hz   | 1500.00       |
| 60Hz   | 1800.00       |

See *Rated Frequency* (05.006).

| Parameter         | 05.009 Rated Voltage                  |                |                   |
|-------------------|---------------------------------------|----------------|-------------------|
| Short description | Set to the rated voltage of the motor |                |                   |
| Mode              | RFC-A                                 |                |                   |
| Minimum           | -VM_AC_VOLTAGE_SET                    | Maximum        | VM_AC_VOLTAGE_SET |
| Default           | See exceptions below                  | Units          | V                 |
| Type              | 16 Bit User Save                      | Update Rate    | 4ms read          |
| Display Format    | Standard                              | Decimal Places | 0                 |
| Coding            | RW, VM, RA                            |                |                   |

| <b>Voltage</b> | <b>Region</b> | <b>Default Value</b> |
|----------------|---------------|----------------------|
| 200V           | All           | 230                  |
| 400V           | 50Hz          | 400                  |
| 400V           | 60Hz          | 460                  |
| 575V           | All           | 575                  |
| 690V           | All           | 690                  |

The *Rated Voltage* (05.009) is the maximum continuous voltage that is applied to the motor. Normally this should be set to the motor nameplate value. If the drive is supplied through its own diode rectifier the maximum possible output voltage is just below the supply voltage level, and so the output voltage will not reach *Rated Voltage* (05.009) if this is equal to or above the supply voltage. If high transient performance is required at higher speeds then *Rated Voltage* (05.009) should be set to 95% of the minimum d.c. link voltage divided by  $\sqrt{2}$  to allow some headroom for the drive to control the motor current. If the drive is fed through its own diode rectifier the minimum d.c. link voltage is approximately supply voltage  $\times \sqrt{2}$ .

In some cases it may be necessary to set the *Rated Voltage* (05.009) to a value other than the motor nameplate value. If this is the case the *Rated Frequency* (05.006) and *Rated Speed* (05.008) should be set up as follows:

$K = \text{Rated Voltage (05.009)} / \text{motor rated voltage}$

$\text{Rated Frequency (05.006)} = \text{motor rated frequency} \times K$

$\text{Rated Speed (05.008)} = \text{motor rated speed} + [(K - 1) \times \text{motor rated frequency} \times 60 / (\text{number of motor poles} / 2)]$

The *Rated Voltage* (05.009), *Rated Frequency* (05.006) and *Number Of Motor Poles* (05.011) are used during the auto-tuning process to determine the flux level required in the motor for normal operation. Therefore if the *Rated Voltage* (05.009) is set to a value other than the nameplate value and the above adjustment is not applied the motor may be under or over-fluxed

| <b>Parameter</b>  | <b>05.010 Rated Power Factor</b>  |                |                       |
|-------------------|---|----------------|-----------------------|
| Short description | Set to the rated power factor of the motor. This value can be measured by the drive during a rotating autotune. |                |                       |
| Mode              | RFC-A   |                |                       |
| Minimum           | 0.000   | Maximum        | 1.000                 |
| Default           | 0.850   | Units          |                       |
| Type              | 16 Bit User Save  | Update Rate    | Background read/write |
| Display Format    | Standard  | Decimal Places | 3                     |
| Coding            | RW, RA  |                |                       |

*Rated Power Factor* (05.010) is the true power factor of the motor under rated conditions, i.e. the cosine of the angle between the motor voltage and current. If *Stator Inductance* (05.025) is set to a non-zero value then the stator inductance is used to calculate the rated magnetising current for the motor and the rated power factor can be calculated by the drive. Therefore if *Stator Inductance* (05.025) is non-zero *Rated Power Factor* (05.010) is continuously set to the calculated value of rated power factor by the drive. If *Stator Inductance* (05.025) is set to zero then *Rated Power Factor* (05.010) is used to estimate the rated magnetising current which is an approximation and not as accurate. *Stator Inductance* (05.025) can be measured by the drive during auto-tuning and this is the preferred option, however, if it is not possible to obtain the value for *Stator Inductance* (05.025) then *Rated Power Factor* (05.010) should be set to the motor nameplate value.

| <b>Parameter</b>  | <b>05.011 Number Of Motor Poles</b>     |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to the number of poles of the motor |                |                 |
| Mode              | RFC-A                                   |                |                 |
| Minimum           | 0                                       | Maximum        | 240             |
| Default           | 0                                       | Units          | PolePairs       |
| Type              | 8 Bit User Save                         | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW, BU                                  |                |                 |

\* The units relate to the numeric value of the parameter and not the text string.

The numeric value in *Number Of Motor Poles* (05.011) should be set to the number of motor pole pairs (i.e. number of motor poles / 2). The text strings associated with *Number Of Motor Poles* (05.011) show the number of motor poles (i.e. the parameter value  $\times 2$ ). If a linear position feedback device is used *Number Of Motor Poles* (05.011) should be set to 1 (2 Poles).

If *Number Of Motor Poles* (05.011) = 0 the number of motor poles are calculated automatically as given below.

$\text{Pole pairs} = 60 \times \text{Rated Frequency (05.006)} / \text{Rated Speed (05.008)}$  rounded down to the nearest integer.

| <b>Parameter</b>  | <b>05.012 Auto-tune</b>                    |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the auto-tune test to be performed |                |                 |
| Mode              | RFC-A                                      |                |                 |
| Minimum           | 0  | Maximum        | 4               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit Volatile                             | Update Rate    | Background read |
| Display Format    | Standard                                   | Decimal Places | 0               |
| Coding            | RW, TE, NC                                 |                |                 |

| Value | Text      |
|-------|-----------|
| 0     | None      |
| 1     | Basic     |
| 2     | Improved  |
| 3     | Inertia 1 |
| 4     | Inertia 2 |

The following describes how an auto-tune test can be initiated and normal operation can be resumed after the test for RFC-A mode:

1. An auto-tune test cannot be initiated if the drive is tripped or the drive inverter is active, i.e. *Drive Healthy* (10.001) = 0 or *Drive Active* (10.002) = 1. The inverter can be made inactive by ensuring that the Final drive enable is inactive, or the Final drive run is inactive and *Hold Zero Speed* (06.008) = 0.
2. An auto-tune test is initiated by setting *Auto-tune* (05.012) to a non-zero value and making the Final drive enable and the Final drive run active.
3. All tests that move the motor will move the motor in the forward direction if *Reverse Select* (01.012) = 0 or the reverse direction if *Reverse Select* (01.012) = 1.
4. If the auto-tune sequence is completed successfully the Final drive enable is set to the inactive state and *Auto-tune* (05.012) is set to zero. The Final drive enable can only be set to the active state again by removing the enable and reapplying it. The enable can be removed by setting *Drive Enable* (06.015) = 0, or by setting bit 0 of the *Control Word* (06.042) to 0 provided *Control Word Enable* (06.043) = 1, or by making *Hardware Enable* (06.029) = 0.
5. If a trip occurs during the auto-tune sequence the drive will go into the trip state and *Auto-tune* (05.012) is set to zero. As in 4. above the enable must be removed and re-applied before the drive can be restarted after the trip has been reset. However, care should be taken because if the auto-tune was not completed the drive parameters that should have been measured and set up will still have their original values.
6. If the Final drive enable is made active, the Final drive run is inactive and *Hold Zero Speed* (06.008) = 1 the drive would normally be in the Stop state (i.e. the inverter is active, but the frequency or speed reference is 0).

The following describes the effects of the auto-tune test on the drive parameters for RFC-A mode:

1. All auto-tune tests rely on the motor being stationary when the test is initiated to give accurate results.
2. If *Select Motor 2 Parameters* (11.045) = 0 then the parameters associated with motor map 1 are updated as a result of the test, and if *Select Motor 2 Parameters* (11.045) = 1 the parameters associated with motor map 2 are updated.
3. When each stage of the test is completed the results written to the appropriate parameters and these parameters saved in the drive non-volatile memory. If *Parameter Cloning* (11.042) is set to 3 or 4 the parameters are also written to a non-volatile media card fitted in the drive.

The table below shows the parameters required for motor control indicating which should be set by the user and which can be measured with an auto-tune test.

| Parameter  | Required for                                     | Measured in test |
|--|--|------------------|
| <i>Rated Frequency</i> (05.006)                          | Basic control                                    | User set-up      |
| <i>Rated Current</i> (05.007)                            | Basic control                                    | User set-up      |
| <i>Rated Speed</i> (05.008)                              | Basic control                                    | User set-up      |
| <i>Rated Voltage</i> (05.009)                            | Basic control                                    | User set-up      |
| <i>Rated Power Factor</i> (05.010)                       | Basic control                                    | 2                |
| <i>Number Of Motor Poles</i> (05.011)                    | Basic control                                    | User set-up      |
| <i>Stator Resistance</i> (05.017)                        | Basic control                                    | 1, 2             |
| <i>Transient Inductance</i> (05.024)                     | Basic control                                    | 1, 2             |
| <i>Stator Inductance</i> (05.025)                        | Improved performance                             | 2                |
| <i>Saturation Breakpoint 1</i> (05.029)                  | Improved performance with flux weakening         | 2                |
| <i>Saturation Breakpoint 3</i> (05.030)                  | Improved performance with flux weakening         | 2                |
| <i>Maximum Deadtime Compensation</i> (05.059)            | Basic control                                    | 1, 2             |
| <i>Current At Maximum Deadtime Compensation</i> (05.060) | Basic control                                    | 1, 2             |
| <i>Saturation Breakpoint 2</i> (05.062)                  | Improved performance with flux weakening         | 2                |
| <i>Saturation Breakpoint 4</i> (05.063)                  | Improved performance with flux weakening         | 2                |
| <i>Motor And Load Inertia</i> (03.018)                   | Speed controller set-up and torque feed-forwards | 3, 4             |
| <i>Inertia Times 1000</i> (04.033)                       | Speed controller set-up and torque feed-forwards | 3, 4             |
| <i>Current Controller Kp Gain</i> (04.013)               | Basic control                                    | 1, 2             |
| <i>Current Controller Ki Gain</i> (04.014)               | Basic control                                    | 1, 2             |
| <i>No-load Core Loss</i> (04.045)                        | *Torque feedback                                 | 2                |
| <i>Rated Core Loss</i> (04.046)                          | *Torque feedback                                 | User set-up      |

\*Torque feedback is provided in *Percentage Torque* (04.026). The estimated value can be improved by setting up the *No-load Core Loss* (04.045) and *Rated Core Loss* (04.046) for the motor. It should be noted that the core loss characteristic for a motor is complex and depends to some extent on the switching frequency, but the drive can include an approximation to the core losses based on these two parameters. The value for the no-load core losses measured by the auto-tuning is likely to be higher than the actual value, but can be used to significantly reduce the difference that will be seen in the estimate torque between motoring and regenerating operation. If more accurate core loss compensation is required *No-load Core Loss* (04.045) and *Rated Core Loss* (04.046) must be set up based on testing the motor using a torque transducer.

#### 1: Basic

This test measures the basic control parameters without moving the motor.

1. A stationary test is performed to measure *Stator Resistance* (05.017), *Transient Inductance* (05.024), *Maximum Deadtime Compensation* (05.059) and *Current At Maximum Deadtime Compensation* (05.060). If *Enable Stator Compensation* (05.049) = 1 then *Stator Base Temperature* (05.048) is made equal to *Stator Temperature* (05.046).

2. *Stator Resistance* (05.017) and *Transient Inductance* (05.024) are used to set up *Current Controller Kp Gain* (04.013) and *Current Controller Ki Gain* (04.014). This is only performed once during the test, and so the user can make further adjustments to the current controller gains if required.

## 2: Improved

This test measures the parameters for improved performance by rotating the motor.

1. Auto-tune 1 test is performed.
2. A rotating test is performed in which the motor is accelerated with the currently selected ramps up to a frequency of *Rated Frequency* (05.006) x 2/3, and the frequency is maintained at that level for up to 40 seconds. *Stator Inductance* (05.025) is measured and this value is used in conjunction with other motor parameters to calculate *Rated Power Factor* (05.010). *Saturation Breakpoint 1* (05.029), *Saturation Breakpoint 3* (05.030), *Saturation Breakpoint 2* (05.062) and *Saturation Breakpoint 4* (05.063) are measured. The no-load motor core losses are measured and written to *No-load Core Loss* (04.045). It is not possible to measure the rated load motor core losses, and so *Rated Core Loss* (04.046) is set to zero. The motor should be unloaded for this test.

## 3: Inertia 1

This test measures the mechanical characteristic of the motor and load by rotating the motor at the speed defined by the present speed reference and injecting a series of speed test signals. This test should only be used provided all the basic control parameters have been set-up correctly and the speed controller parameters should be set to conservative levels, such as the default values, so that the motor is stable when it runs. The test may give inaccurate results if standard ramp is active, particularly with high inertia low loss loads. The test measures the motor and load inertia, which can be used in automatic set-up of the speed controller gains and in producing a torque feed-forward term. If *Mechanical Load Test Level* (05.021) is left at its default value of zero then the peak level of the injection signal will be 1% of the maximum speed reference subject to a maximum of 500rpm. If a different test level is required then *Mechanical Load Test Level* (05.021) should be set to a non-zero value to define the level as a percentage of the maximum speed reference, again subject to a maximum of 500rpm. The user defined speed reference which defines the speed of the motor should be set to a level higher than the test level, but not high enough for flux weakening to become active. In some cases however, it is possible to perform the test at zero speed provided the motor is free to move, but it may be necessary to increase the test signal from the default value. The test will give the correct results when there is a static load applied to the motor and in the presence of mechanical damping. This test should be used if possible, however for sensorless mode, or if the speed controller cannot be set up for stable operation an alternative test is provided (*Auto-tune* (05.012) = 4) where a series of torque levels are applied to accelerate and decelerate the motor to measure the inertia.

1. A rotating test is performed in which the motor is accelerated with the currently selected ramps up to the currently selected speed reference, and this speed is maintained for the duration of the test. The *Motor And Load Inertia* (03.018) is set up.

## 4: Inertia 2

Auto-tune test 3 should normally be used for mechanical load measurement, but under some circumstances this test may be used as an alternative. This test will not give such accurate results as test 3 if the motor rated speed is not set to the correct value for the motor. Also this test is likely to give incorrect results if standard ramp mode is active. A series of progressively larger torque levels are applied to the motor (20%, 40% ... 100% of rated torque) to accelerate the motor up to 3/4 x *Rated Speed* (05.008) to determine the inertia from the acceleration/deceleration time. The test attempts to reach the required speed within 5s, but if this fails the next torque level is used. When 100% torque is used the test allows 60s for the required speed to be reached, but if this is unsuccessful a trip is initiated. To reduce the time taken for the test it is possible to define the level of torque to be used for the test by setting *Mechanical Load Test Level* (05.021) to a non-zero value. When the test level is defined the test is only carried out at the defined test level and 60s is allowed for the motor to reach the required speed. It should be noted that if the maximum speed allows for flux weakening then it may not be possible to achieve the required torque level to accelerate the motor fast enough. If this is the case, the maximum speed reference should be reduced.

1. The motor is accelerated in the required direction up to 3/4 of the maximum speed reference and then decelerated to zero speed.
2. The test is repeated with progressively higher torques until the required speed is reached.
3. *Motor And Load Inertia* (03.018) and *Inertia Times 1000* (04.033) are set up.

The table below shows the trips that can occur during an auto-tune test:

| Trip                    | Reason   |
|-------------------------|--|
| <i>Autotune Stopped</i> | The final drive enable or the final drive run were removed before the test was completed.  |
| <i>Resistance.001</i>   | The measured value of <i>Stator Resistance</i> (05.017) exceeded a value of $(V_{FS} / \sqrt{2}) / \text{Full Scale Current Kc}$ (11.061), where $V_{FS}$ is the full scale d.c. link voltage.                     |
| <i>Resistance.002</i>   | It has not been possible to measure the drive inverter characteristic to define <i>Maximum Deadtime Compensation</i> (05.059) and <i>Current At Maximum Deadtime Compensation</i> (05.060).                        |
| <i>Autotune 1.001</i>   | The position feedback did not change when position feedback is being used.   |
| <i>Autotune 1.002</i>   | The motor did not reach the required speed.  |
| <i>Autotune 2.001</i>   | Position feedback direction is incorrect when position feedback is being used.   |
| <i>Autotune 2.002</i>   | A SINCOS encoder with comms is being used for position feedback and the comms position is rotating in the opposite direction to the sine wave based position.  |
| <i>Autotune 3.001</i>   | The measured inertia exceeds the parameter range.  |
| <i>Autotune 3.003</i>   | The mechanical load test has failed to identify the inertia.   |
| <i>Autotune 7</i>       | The motor poles or the position feedback resolution have been set up incorrectly where position feedback is being used. The trip will not occur if <i>Number Of Motor Poles</i> (05.011) $\geq 6$ (i.e. 12 poles). |

If *Sensorless Mode Active* (03.078) = 1 then trips *Autotune 1* (except *Autotune 1.008*), *Autotune 2* and *Autotune 7* are disabled.



| Parameter         | 05.013 Flux Optimisation Select      |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description | Set to 1 to enable Flux Optimisation |                |                 |
| Mode              | RFC-A                                |                |                 |
| Minimum           | 0                                    | Maximum        | 1               |
| Default           | 0                                    | Units          |                 |
| Type              | 1 Bit User Save                      | Update Rate    | Background read |
| Display Format    | Standard                             | Decimal Places | 0               |
| Coding            | RW                                   |                |                 |

If *Flux Optimisation Select* (05.013) = 0 the rated level of flux is used in the motor when flux weakening is not active. If *Flux Optimisation Select* (05.013) = 1 the flux is reduced so that the *Id, Magnetising Current* (04.017) is approximately equal to the *Iq, Torque Producing Current* (04.002) to optimise copper losses and reduce iron losses in the motor under low load conditions. The flux can be reduced from the rated level down to half the rated level. This feature is not available with sensorless mode (i.e. when *Sensorless Mode Active* (03.078) = 1).

| Parameter         | 05.015 Low Frequency Voltage Boost                                      |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the level of low voltage boost when performing auto-tune test 2 |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.0   | Maximum        | 25.0            |
| Default           | 3.0   | Units          | %               |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW, BU  |                |                 |

The default value for this parameter depends on the frame size of the drive as follows:

- 3.0% up to frame size 06 drives,
- 2.0% for frame size 07 and frame size 08 drives
- 1.0% for larger sizes

During auto-tune test 2 the drive uses the Open-loop mode control strategy with fixed voltage boost. *Low Frequency Voltage Boost* (05.015) is used to define the level of low voltage boost used during the test. See *Open-loop Control Mode* (05.014) in Open-loop mode for more details.

| Parameter         | 05.016 Rated Speed Optimisation Select |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Rated Speed Optimisation Select        |                |                 |
| Mode              | RFC-A                                  |                |                 |
| Minimum           | 0                                      | Maximum        | 5               |
| Default           | 0                                      | Units          |                 |
| Type              | 8 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                               | Decimal Places | 0               |
| Coding            | RW, TE                                 |                |                 |

| Value | Text         |
|-------|--------------|
| 0     | Disabled     |
| 1     | Classic Slow |
| 2     | Classic Fast |
| 3     | Combined     |
| 4     | VARs Only    |
| 5     | Voltage Only |

The *Rated Frequency* (05.006) and *Rated Speed* (05.008) are used to define the rated slip of the motor. The rated slip is used in sensorless mode (*Sensorless Mode Active* (03.078) = 1) to correct the motor speed with load. When this mode is active *Rated Speed Optimisation Select* (05.016) has no effect.

If sensorless mode is not active (*Sensorless Mode Active* (03.078) = 0) the rated slip is used in the motor control algorithm and an incorrect value of slip can have a significant effect on the motor performance. If *Rated Speed Optimisation Select* (05.016) = 0 then the adaptive control system is disabled. However, if *Rated Speed Optimisation Select* (05.016) is set to a non-zero value the drive can automatically adjust the *Rated Speed* (05.008) to give the correct value of rated slip. *Rated Speed* (05.008) is not saved at power-down, and so when the drive is powered-down and up again it will return to the last value saved by the user. The rate of convergence and the accuracy of the adaptive controller reduces at low output frequency and low load. The minimum frequency is defined as a percentage of *Rated Frequency* (05.006) by *Rated Speed Optimisation Minimum Frequency* (05.019). The minimum load is defined as a percentage of rated load by *Rated Speed Optimisation Minimum Load* (05.020). The adaptive controller is enabled when a motoring or regenerative load rises above *Rated Speed Optimisation Minimum Load* (05.020) + 5%, and is disabled again when it falls below *Rated Speed Optimisation Minimum Load* (05.020). For best optimisation results the correct values of *Stator Resistance* (05.017), *Transient Inductance* (05.024), *Stator Inductance* (05.025), *Saturation Breakpoint 1* (05.029), *Saturation Breakpoint 2* (05.062), *Saturation Breakpoint 3* (05.030) and *Saturation Breakpoint 4* (05.063) should be used.

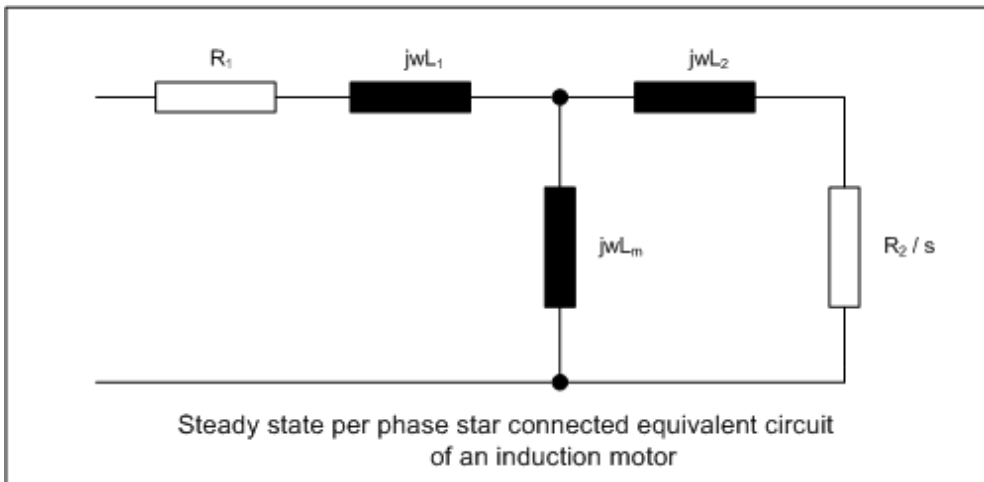
A number of different adaptive control methods can be selected as follows:

| Rated Speed Optimisation Select (05.016) | Adaptive Method   |
|--|---|
| 0 - Disabled                             | None  |
| 1 - Classic Slow                         | VARs at low speed and vsy at higher speeds with low adaptive gain                                   |
| 2 - Classic Fast                         | VARs at low speed and vsy at higher speeds with high adaptive gain                                  |
| 3 - Combined                             | VARs when flux weakening is not active, vsy when flux weakening is active with medium adaptive gain |
| 4 - VARs                                 | VARs with medium adaptive gain  |
| 5 - Vsy                                  | vsy with medium adaptive gain   |

The classic methods normally operate correctly, but can diverge from the corrected rated speed especially with regenerative operation. These are provided for legacy applications. The "Combined" method is the preferred method as this is more robust against divergence. However the VARs method can be affected if the value of *Transient Inductance* (05.024) used by the drive is incorrect for the motor. It is possible to select the VARs or vsy methods alone if required. All except the "Classic Slow" adaptive method use high adaptive gain which gives faster convergence.

| Parameter         | 05.017 Stator Resistance                   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the resistance of the motor stator |                |                 |
| Mode              | RFC-A                                      |                |                 |
| Minimum           | 0.000000                                   | Maximum        | 1000.000000     |
| Default           | 0.000000                                   | Units          | $\Omega$        |
| Type              | 32 Bit User Save                           | Update Rate    | Background read |
| Display Format    | Standard                                   | Decimal Places | 6               |
| Coding            | RW, RA                                     |                |                 |

The *Stator Resistance* (05.017), *Transient Inductance* (05.024) and *Stator Inductance* (05.025) are derived from the star connected per phase equivalent circuit of an induction motor shown below.



The steady state parameters are converted to equivalent transient model parameters:

$$R_s = R_1$$

$$L_m = L_m$$

$$L_s = L_1 + L_m$$

$$L_r = L_2 + L_m$$

$$\sigma L_s = L_s - (L_m^2 / L_r)$$

The equivalent drive parameters are:

$$\text{Stator Resistance (05.017)} = R_s$$

$$\text{Transient Inductance (05.024)} = \sigma L_s$$

$$\text{Stator Inductance (05.025)} = L_s$$

*Stator Resistance* (05.017) is used as described in the table below.

| Function   | Details   |
|--|---|
| Control above low speeds with sensorless control | The stator resistance is used by the algorithm that determines the rotor position.  |
| Current controller integral gain set-up          | During auto-tuning the stator resistance is used in the calculation of the current controller integral gain.                |
| High performance current control                 | If high performance current control is selected the stator resistance is used in the control for both d and q axis current. |

| Parameter         | 05.018 <i>Maximum Switching Frequency</i>                             |                |                        |
|-------------------|---|----------------|------------------------|
| Short description | Defines the maximum switching frequency that can be used by the drive |                |                        |
| Mode              | RFC-A   |                |                        |
| Minimum           | 0   | Maximum        | VM_SWITCHING_FREQUENCY |
| Default           | 1   | Units          | kHz                    |
| Type              | 8 Bit User Save   | Update Rate    | Background read        |
| Display Format    | Standard  | Decimal Places | 0                      |
| Coding            | RW, TE, VM, RA  |                |                        |

| Value | Text |
|-------|------|
| 0     | 2    |
| 1     | 3    |
| 2     | 4    |
| 3     | 6    |
| 4     | 8    |
| 5     | 12   |
| 6     | 16   |

*Maximum Switching Frequency* (05.018) should be set to the required PWM switching frequency. The drive inverter will operate at this frequency unless the inverter temperature becomes too hot. Under these conditions the drive will reduce the switching frequency in an attempt to avoid tripping (see *Auto-switching Frequency Change* (05.035) ). The actual switching frequency is shown in *Switching Frequency* (05.037). The switching frequency has a direct effect on the sample rate for the current controllers (see *Current Controller Kp Gain* (04.013)). All other control tasks are at a fixed rate.

| Task                            |       |
|---------------------------------|-------|
| Speed controller (RFC-A, RFC-S) | 250µs |
| D.c. link voltage controller    | 1ms   |
| Flux controller (RFC-A, RFC-S)  | 1ms   |

| Parameter         | 05.019 <i>Rated Speed Optimisation Minimum Frequency</i> |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Rated Speed Optimisation Minimum Frequency               |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 100             |
| Default           | 10   | Units          | %               |
| Type              | 8 Bit User Save  | Update Rate    | Background Read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *Rated Speed Optimisation Select* (05.016).

| Parameter         | 05.020 <i>Rated Speed Optimisation Minimum Load</i> |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Rated Speed Optimisation Minimum Load               |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 100             |
| Default           | 50  | Units          | %               |
| Type              | 8 Bit User Save                                     | Update Rate    | Background Read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Rated Speed Optimisation Select* (05.016).

| Parameter         | 05.021 <i>Mechanical Load Test Level</i> |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Mechanical Load Test Level               |                |                 |
| Mode              | RFC-A                                    |                |                 |
| Minimum           | 0  | Maximum        | 100             |
| Default           | 0  | Units          | %               |
| Type              | 8 Bit User Save                          | Update Rate    | Background Read |
| Display Format    | Standard                                 | Decimal Places | 0               |
| Coding            | RW                                       |                |                 |

See *Auto-tune* (05.012).

| Parameter         | 05.023 <i>D.c. Bus Voltage High Range</i>           |                |                    |
|-------------------|---|----------------|--------------------|
| Short description | Displays the d.c. bus level but with a higher range |                |                    |
| Mode              | RFC-A   |                |                    |
| Minimum           | -VM_HIGH_DC_VOLTAGE                                 | Maximum        | VM_HIGH_DC_VOLTAGE |
| Default           |   | Units          | V                  |
| Type              | 16 Bit Volatile                                     | Update Rate    | Background read    |
| Display Format    | Standard  | Decimal Places | 0                  |
| Coding            | RO, FI, VM, ND, NC, PT                              |                |                    |

*D.c. Bus Voltage High Range* (05.023) provides voltage feedback that has lower resolution and a higher range than *D.c. Bus Voltage* (05.005), and so it is possible to determine the d.c. link voltage even if this exceeds the level of the over-voltage trip. It should be noted that due to tolerances, *D.c. Bus Voltage High Range* (05.023) may not correspond exactly with the level given by *D.c. Bus Voltage* (05.005). In a system with parallel power modules where the control pod is remote from any of the power modules, this parameter always shows zero.

| Parameter         | 05.024 <i>Transient Inductance</i>                                     |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the inductance of the transient components in the motor stator |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000  | Maximum        | 500.000         |
| Default           | 0.000  | Units          | mH              |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW, RA   |                |                 |

See *Stator Resistance* (05.017).

*Transient Inductance* (05.024) is used as described in the table below.

| Function                                    | Details  |
|---|--|
| Current controller proportional gain set-up | During auto-tuning the stator resistance is used in the calculation of the current controller proportional gain. |

| Parameter         | 05.025 <i>Stator Inductance</i>            |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the inductance of the motor stator |                |                 |
| Mode              | RFC-A                                      |                |                 |
| Minimum           | 0.00                                       | Maximum        | 5000.00         |
| Default           | 0.00                                       | Units          | mH              |
| Type              | 32 Bit User Save                           | Update Rate    | Background read |
| Display Format    | Standard                                   | Decimal Places | 2               |
| Coding            | RW, RA                                     |                |                 |

See *Stator Resistance* (05.017).

*Stator Inductance* (05.025) is used as described in the table below.

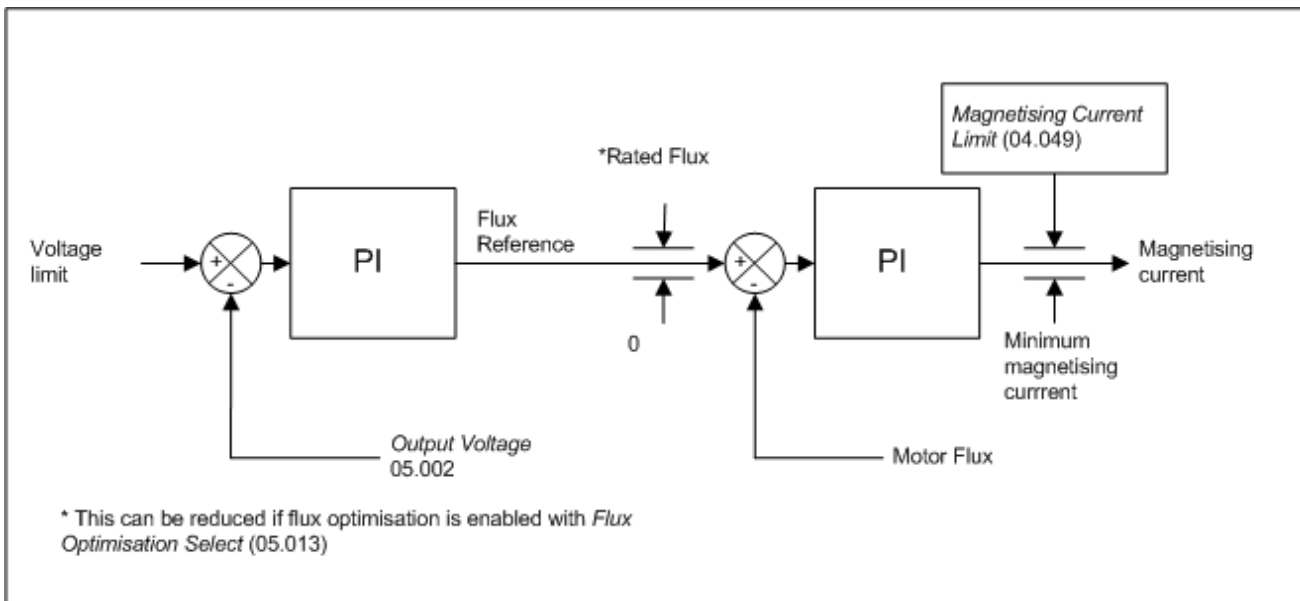
| Function                 | Details   |
|--------------------------|---|
| Rated current components | Along with the stator resistance and transient inductance, the stator inductance is used to calculate the flux producing and torque producing current components, and the power factor. |

| Parameter         | 05.026 High Dynamic Performance Enable      |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to enable High Dynamic Performance |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save                             | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 0               |
| Coding            | RW  |                |                 |

Whatever the value of *High Dynamic Performance Enable* (05.026) a feed-forward term based on the estimated level of flux in the motor and the motor speed is used to improve the performance of the current controllers and to avoid transients during spinning start. However, if *High Dynamic Performance Enable* (05.026) = 1 additional feed-forward terms are provided to remove the effects of cross-coupling between the flux and torque axes. This improves the performance of the current controllers under dynamic conditions at high speeds. It should be noted that *High Dynamic Performance Enable* (05.026) has no effect if sensorless control is active (i.e. *Sensorless Mode Active* (03.078) = 1).

| Parameter         | 05.027 Flux Control Gain |                |                 |
|-------------------|--------------------------|----------------|-----------------|
| Short description | Flux Control Gain        |                |                 |
| Mode              | RFC-A                    |                |                 |
| Minimum           | -10.0                    | Maximum        | 10.0            |
| Default           | 1.0                      | Units          |                 |
| Type              | 8 Bit User Save          | Update Rate    | Background read |
| Display Format    | Standard                 | Decimal Places | 1               |
| Coding            | RW                       |                |                 |

The output voltage is limited to the voltage limit defined either by the maximum possible drive output voltage or *Rated Voltage* (05.009) whichever is lowest by the outer voltage controller shown below. If the voltage limit is not active then the output of the voltage controller is clamped to give rated flux in the motor. An inner flux controller is provided to control the magnetising current which is limited by *Magnetising Current Limit* (04.049). Using an inner flux controller gives faster rate of rise of flux on enable because a magnetising current higher than rated magnetising current can be used to force the flux to increase. It also gives faster reduction of flux as the motor accelerates into flux weakening because negative flux producing current can be used to reduce the flux.



#### Default set-up

If *Flux Control Gain* (05.027) is set to the default value of 1.0 the system that controls the flux and motor voltage is automatically set up based on the motor parameters to give stable operation. The closed-loop transfer function of the flux controller approximates to a first order time constant of 25ms, and the closed-loop transfer function of the voltage controller approximates to a first order time constant of 50ms. The automatic set-up of the flux controller can result in very high gains if the motor has a very long rotor time constant (i.e. greater than 0.5s), and this can result in noise on the magnetising current. To avoid this the gain is limited, and so the response time of the flux and voltage controllers will reduce proportionally when the rotor time constant exceeds 0.5s. For example if the rotor time constant is 1s then the response time of the controllers will be doubled (i.e. flux control 50ms and voltage control 100ms).

#### Improved voltage control

The integral gain of the voltage controller is set to a conservative value to ensure the system is always stable. If *Flux Control Gain* (05.027) is changed from the default value of 1.0 in the range from 0.1 to 10.0 the integral gain of the voltage controller is multiplied by *Flux Control Gain* (05.027). This is most useful to increase the integral gain of the voltage controller, so that the motor voltage is more tightly controlled during fast acceleration into the flux weakening region. The only gain that is affected is the integral gain of the voltage controller and the maximum limit on the flux controller gains described in the default set-up still applies.

#### Reduced noise on the magnetising current

The maximum limit on the flux controller gains should prevent excessive noise on the magnetising current when the motor has a long rotor time constant. However, if *Flux Control Gain* (05.027) is reduced below -1.0 the time constants of the flux controller and voltage closed-loop transfer function are extended. For example a value of -2.0 will extend these to 50ms and 100ms respectively. It should be noted that if the motor has a long rotor time constant, smaller negative values may not have an effect because the maximum limits on the flux controller gain may already be extending the time constants.

The settings for *Flux Control Gain* (05.027) are summarised below.

| Range         | Effect  |
|---------------|---|
| -10.0 to -1.0 | Equivalent time constants of the controllers are Default Time Constant x <i>-Flux Control Gain</i> (05.027).                                  |
| -1.0 to 0.0   | Default set-up is used.   |
| 0.1 to 10.0   | Default set-up is used, except that the integral gain of the voltage controller is Default Integral Gain x <i>Flux Control Gain</i> (05.027). |

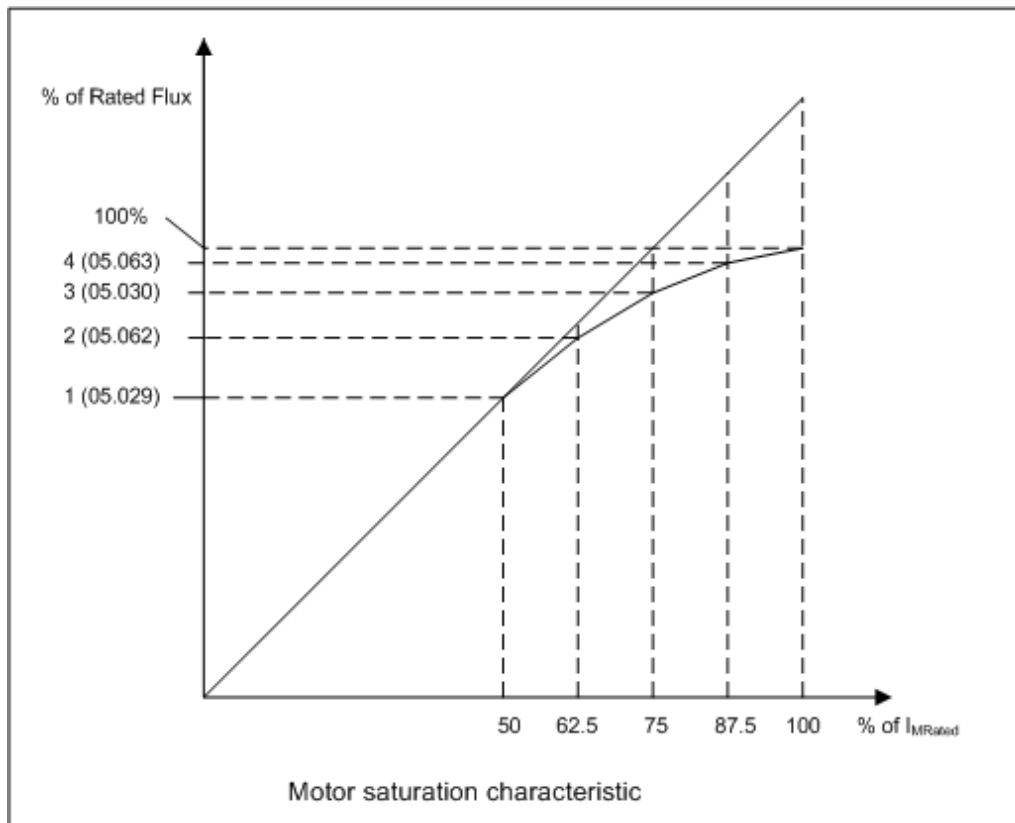
In all cases the controller gains are limited with a rotor time constant that is longer than 0.5s.

| Parameter         | 05.028 Flux Compensation                         |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Determines the method used for flux compensation |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 2               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                                  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

To maintain the system gain if speed control is being used, or to maintain the correct relationship between the torque reference and the actual torque, the conversion from *Final Torque Reference* (04.003) to *Final Current Reference* (04.004) normally includes the level of flux in the motor. If *Flux Compensation* (05.028) is left at its default value of 0, the drive uses an estimate of motor flux to perform the conversion. This is the preferred method of operation. There can be stability problems especially at very high speeds under some circumstances and *Flux Compensation* (05.028) can be used to change the method of compensation to overcome the issues. If *Flux Compensation* (05.028) = 1, then torque to torque producing current compensation is disabled altogether. This can be used for example, if *Rated Speed* (05.008) is set up incorrectly. If *Flux Compensation* (05.028) = 2,  $Final\ Current\ Reference\ (04.004) = Final\ Torque\ Reference\ (04.003) \times Rated\ Frequency\ (05.006) / |Output\ Frequency\ (05.001)|$ . This is not as accurate as using the calculated flux, and does not boost the torque on starting as the flux is increased in the motor, but it reduces the likelihood of instability at high speeds and high levels of flux weakening.

| Parameter         | 05.029 Saturation Breakpoint 1                                       |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines Saturation Breakpoint 1 within the saturation characteristic |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.0  | Maximum        | 100.0           |
| Default           | 50.0   | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW   |                |                 |

The relationship between the *Id*, *Magnetising Current* (04.017) and the motor flux is non-linear because of saturation. For accurate control of torque and good dynamic performance when flux weakening is active it is important that the control system can estimate the flux level from the *Id*, *Magnetising Current* (04.017). The saturation characteristic is provided with a set of breakpoints as shown below.



The default values for the breakpoints are *Saturation Breakpoint 1* (05.029) = 50.0%, *Saturation Breakpoint 2* (05.062) = 0.0%, *Saturation Breakpoint 3* (05.030) = 75.0% and *Saturation Breakpoint 4* (05.063) = 0.0%. For compatibility with Unidrive SP, *Saturation Breakpoint 2* (05.062) and

*Saturation Breakpoint 4* (05.063) are ignored if they are left at their default values of 0.0%. Therefore the default values give a linear relationship between the *Id*, *Magnetising Current* (04.017) and the flux. The required values are not normally available from the motor manufacturer and should be obtained by auto-tuning.

| Parameter         | 05.030 Saturation Breakpoint 3                                       |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines Saturation Breakpoint 3 within the saturation characteristic |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.0  | Maximum        | 100.0           |
| Default           | 75.0   | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW   |                |                 |

See *Saturation Breakpoint 1* (05.029).

| Parameter         | 05.031 Voltage Controller Gain                                    |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the proportional gain of the d.c. link voltage controller |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 1   | Maximum        | 30              |
| Default           | 1   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

*Voltage Controller Gain* (05.031) can be used to modify the proportional gain of the d.c. link voltage controller used for standard ramp and supply loss control.

| Parameter         | 05.032 Torque Per Amp   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the calculated value of $k_t$ for the attached motor |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.00  | Maximum        | 500.00           |
| Default           |   | Units          | Nm/A             |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 2                |
| Coding            | RO, ND, NC, PT, BU  |                |                  |

*Torque Per Amp* (05.032) is automatically calculated from the motor parameters assuming a motor efficiency of 90%.

$$\text{Torque Per Amp (05.032)} = \text{Estimated rated shaft power} / [\text{Rated Speed (05.008)} \times I_{T\text{Rated}}]$$

where

$I_{T\text{Rated}}$  is the rated torque producing current

and

$$\text{Estimated rated shaft power} = \sqrt{3} \times \text{Rated Voltage (05.009)} \times \text{Rated Current (05.007)} \times \text{Rated Power Factor (05.010)} \times 0.9$$

*Torque Per Amp* (05.032) is used in the automatic calculation of the speed controller gains. See *Speed Controller Set-up Method* (03.017).

| Parameter         | 05.034 Percentage Flux               |                |                  |
|-------------------|--------------------------------------|----------------|------------------|
| Short description | Displays the flux level in the motor |                |                  |
| Mode              | RFC-A                                |                |                  |
| Minimum           | 0.0                                  | Maximum        | 150.0            |
| Default           |                                      | Units          | %                |
| Type              | 16 Bit Volatile                      | Update Rate    | Background write |
| Display Format    | Standard                             | Decimal Places | 1                |
| Coding            | RO, FI, ND, NC, PT                   |                |                  |

*Percentage Flux* (05.034) gives an indication of the flux level in the motor where a value of 100% is equivalent to the rated flux level for the motor.

| Parameter         | 05.035 Auto-switching Frequency Change                      |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines auto-switching frequency control with thermal model |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 2               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text             |
|-------|------------------|
| 0     | Enabled          |
| 1     | Disabled         |
| 2     | No Ripple Detect |

The drive inverter can be damaged if the temperature is too high. The inverter can also be damaged or the lifetime of the power devices reduced, if the temperature ripple of the devices is too high. *Auto-switching Frequency Change* (05.035) defines the action taken if the drive inverter becomes too hot or the temperature ripple becomes too high.

**Enabled:**

If the inverter becomes too hot or the ripple temperature is higher than the level defined by *Maximum Inverter Temperature Ripple* (05.039) the switching frequency is reduced in an attempt to prevent tripping.

**Disabled:**

The switching frequency is not reduced, and so the drive will trip if the inverter is too hot or the temperature ripple is too high.

**No Ripple Detect:**

The switching frequency is reduced if the inverter temperature, but not the temperature ripple is too high. If the temperature ripple exceeds the level defined by *Maximum Inverter Temperature Ripple* (05.039) then the drive will trip.

The switching frequency is changed in steps defined by *Auto-switching Frequency Step Size* (05.036). For example with a switching frequency of 16kHz and a step size of two, the frequency will be reduced to 8kHz, then 4kHz etc. *Minimum Switching Frequency* (05.038) defines the minimum switching frequency that the system will attempt to use. If the switching frequency needs to switch to a lower level, then the drive will trip.

If *Minimum Switching Frequency* is changed the new value will only become active when *Switching Frequency* is at or above the minimum value.

| Parameter         | 05.036 Auto-switching Frequency Step Size    |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Auto-switching frequency reduction step size |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 1  | Maximum        | 2               |
| Default           | 2  | Units          |                 |
| Type              | 8 Bit User Save                              | Update Rate    | Background read |
| Display Format    | Standard                                     | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *Auto-switching Frequency Change* (05.035).

| Parameter         | 05.037 Switching Frequency                                 |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the current switching frequency used by the drive |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 6                |
| Default           |  | Units          | kHz              |
| Type              | 8 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT   |                |                  |

| Value | Text |
|-------|------|
| 0     | 2    |
| 1     | 3    |
| 2     | 4    |
| 3     | 6    |
| 4     | 8    |
| 5     | 12   |
| 6     | 16   |

Shows the actual inverter switching frequency after the auto-change function.

| Parameter         | 05.038 Minimum Switching Frequency |                |                            |
|-------------------|------------------------------------|----------------|----------------------------|
| Short description | Minimum Switching Frequency        |                |                            |
| Mode              | RFC-A                              |                |                            |
| Minimum           | 0                                  | Maximum        | VM_MIN_SWITCHING_FREQUENCY |
| Default           | 0                                  | Units          | kHz                        |
| Type              | 8 Bit User Save                    | Update Rate    | Background Read            |
| Display Format    | Standard                           | Decimal Places | 0                          |
| Coding            | RW, TE, VM                         |                |                            |



| Value | Text |
|-------|------|
| 0     | 2    |
| 1     | 3    |
| 2     | 4    |
| 3     | 6    |
| 4     | 8    |
| 5     | 12   |
| 6     | 16   |

See *Auto-switching Frequency Change* (05.035).

| Parameter         | 05.039 Maximum Inverter Temperature Ripple |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Maximum Inverter Temperature Ripple        |                |                 |
| Mode              | RFC-A                                      |                |                 |
| Minimum           | 20   | Maximum        | 60              |
| Default           | 60   | Units          | °C              |
| Type              | 8 Bit User Save                            | Update Rate    | Background Read |
| Display Format    | Standard                                   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

*Maximum Inverter Temperature Ripple* (05.039) defines the maximum inverter temperature ripple allowed before the switching frequency is reduced. See *Auto-switching Frequency Change* (05.035).

| Parameter         | 05.040 Spin Start Boost  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the level of spin start boost used by the algorithm that detects the speed of a spinning motor |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.0  | Maximum        | 10.0            |
| Default           | 1.0  | Units          |                 |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW   |                |                 |

*Spin Start Boost* (05.040) is used by the algorithm that detects the speed of a spinning motor when the drive is enabled and *Catch A Spinning Motor* (06.009)  $\geq 1$ . This algorithm is not used if position feedback is being used, and so in these applications *Spin Start Boost* (05.040) has no effect. For most motors *Spin Start Boost* (05.040) does not need to be changed from the default value, but for some larger motors *Spin Start Boost* (05.040) may need to be increased. If *Spin Start Boost* (05.040) is too small the drive will detect zero speed whatever the speed of the motor, and if *Spin Start Boost* (05.040) is too large the motor may accelerate away from standstill when the drive is enabled.

| Parameter         | 05.041 Voltage Headroom |                |                 |
|-------------------|-------------------------|----------------|-----------------|
| Short description | Voltage Headroom        |                |                 |
| Mode              | RFC-A                   |                |                 |
| Minimum           | 0                       | Maximum        | 20              |
| Default           | 0                       | Units          | %               |
| Type              | 8 Bit User Save         | Update Rate    | Background Read |
| Display Format    | Standard                | Decimal Places | 0               |
| Coding            | RW                      |                |                 |

The voltage applied to the motor is always limited by *Rated Voltage* (05.009). When *Voltage Headroom* (05.041) is set to its default value of zero the output voltage of the inverter is also limited to a level equivalent to full modulation, which is the supply voltage minus voltage drops within the inverter itself. Depending on the relative values of the supply voltage and *Rated Voltage* (05.009) there may be some headroom between the rated voltage limit and the maximum possible voltage from the inverter to allow the current control system to give good dynamic performance. In some applications it is useful to enforce some headroom between the maximum allowed motor voltage and the inherent limit imposed by the inverter. If the supply voltage is known this can be done by setting *Rated Voltage* (05.009) to a suitable value below the supply voltage level, however, it is more convenient to set *Rated Voltage* (05.009) to the actual rated voltage of the motor, and to use *Voltage Headroom* (05.041) to enforce the voltage headroom. This parameter can be used to increase the headroom between the maximum modulation limit and the maximum motor voltage from zero up to 20% of the maximum modulation limit. For example, if the supply voltage is 400V then a value of 10% will give a voltage headroom of approximately 40V.

| Parameter         | 05.042 Reverse Output Phase Sequence                  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to reverse the sequence on the output phases |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save                                       | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

If *Reverse Output Phase Sequence* (05.042) = 0 the output phase sequence is U-V-W when *Output Frequency* (05.001) is positive and W-V-U when *Output Frequency* (05.001) is negative. If *Reverse Output Phase Sequence* (05.042) = 1 the output phase sequence is reversed so that the phase sequence in W-V-U for positive frequencies and U-V-W for negative frequencies.

| Parameter         | 05.044 Stator Temperature Source             |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the source of the stator temperature |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 6               |
| Default           | 1  | Units          |                 |
| Type              | 8 Bit User Save                              | Update Rate    | Background read |
| Display Format    | Standard                                     | Decimal Places | 0               |
| Coding            | RW, TE                                       |                |                 |

| Value | Text     |
|-------|----------|
| 0     | An In 3  |
| 1     | User     |
| 2     | P1 Drive |
| 3     | P1 Slot1 |
| 4     | P1 Slot2 |
| 5     | P1 Slot3 |
| 6     | P1 Slot4 |

The stator temperature can be used to compensate for changes in stator resistance. See *Stator Temperature Coefficient* (05.047). *Stator Temperature Source* (05.044) is used to select the source for the stator temperature measurement.

| Stator Temperature Source (05.044) | Source   | Comments  |
|------------------------------------|--|---|
| 0                                  | Analog Input 3 Thermistor Temperature (07.050) | Analog input 3 must be set up for the correct temperature feedback device   |
| 1                                  | User Stator Temperature (05.045)               | The user can provide a stator temperature value. If an alternative feedback device is to be used or the user provides an algorithm to model the stator temperature. |
| 2                                  | P1 Thermistor Temperature (03.122)             | P1 position feedback interface must be set up for the correct temperature feedback device   |
| 3-6                                | Option slot P1 Thermistor Temperature (xx.122) | A position feedback category option module must be fitted and the P1 position feedback must be set up for the correct temperature feedback device                   |

| Parameter         | 05.045 User Stator Temperature                    |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the stator temperature as set by the user |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | -50   | Maximum        | 300             |
| Default           | 0   | Units          | °C              |
| Type              | 16 Bit Volatile                                   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Stator Temperature Source* (05.044).

| Parameter         | 05.046 Stator Temperature                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the temperature of the motor stator |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | -50  | Maximum        | 300              |
| Default           |  | Units          | °C               |
| Type              | 16 Bit Volatile                              | Update Rate    | Background write |
| Display Format    | Standard                                     | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                               |                |                  |

See *Stator Temperature Source* (05.044).

| Parameter         | 05.047 Stator Temperature Coefficient   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the coefficient used to calculate the temperature of the motor stator |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.00000   | Maximum        | 0.10000         |
| Default           | 0.00390   | Units          | 1/°C            |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 5               |
| Coding            | RW  |                |                 |

*Temperature Compensated Stator Resistance* (05.050) shows the stator resistance from the active motor that is being used by the drive for motor

control. If *Enable Stator Compensation* (05.049) = 0 and motor 1 is selected then *Temperature Compensated Stator Resistance* (05.050) is equal to *Stator Resistance* (05.017). If *Enable Stator Compensation* (05.049) = 1 the value of *Stator Resistance* (05.017) is not changed, but *Temperature Compensated Stator Resistance* (05.050) is derived as follows:

$\alpha$  = *Stator Temperature Coefficient* (05.047) and this is the temperature coefficient for the stator winding at 20°C as a proportion of the resistance per degree C.

$$\text{Temperature Compensated Stator Resistance (05.050)} = \text{Stator Resistance (05.017)} \times [1 + (\text{Stator Temperature (05.046)} - 20^\circ\text{C}) \times \alpha] / [1 + (\text{Stator Base Temperature (05.048)} - 20^\circ\text{C}) \times \alpha]$$

*Stator Resistance* (05.017) and *Stator Base Temperature* (05.048) can be set up by the user with the stator resistance at a given temperature. The preferred method is for the *Stator Resistance* (05.017) to be measured and set up using the auto-tuning system (See *Auto-tune* (05.012)). If *Enable Stator Compensation* (05.049) = 1 when the auto-tuning is carried out the *Stator Base Temperature* (05.048) will be updated automatically with *Stator Temperature* (05.046).

The temperature compensation system can only function correctly if the *Stator Temperature Coefficient* (05.047) is set up correctly. The default value is suitable for copper or aluminium windings and should not need to be adjusted for these materials provided the temperature measurement is a reasonable measure of the winding temperature. If the temperature measurement is not closely coupled to the winding it may be necessary to adjust *Stator Temperature Coefficient* (05.047) for correct compensation.

| Parameter         | 05.048 Stator Base Temperature   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the base temperature used to calculate the temperature of the motor stator |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | -50  | Maximum        | 300             |
| Default           | 0  | Units          | °C              |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *Stator Temperature Coefficient* (05.047).

| Parameter         | 05.049 Enable Stator Compensation      |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to enable stator compensation |                |                 |
| Mode              | RFC-A                                  |                |                 |
| Minimum           | 0                                      | Maximum        | 1               |
| Default           | 0                                      | Units          |                 |
| Type              | 1 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                               | Decimal Places | 0               |
| Coding            | RW                                     |                |                 |

See *Stator Temperature Coefficient* (05.047).

| Parameter         | 05.050 Temperature Compensated Stator Resistance                                   |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Final stator resistance value used by the drive including temperature compensation |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000000   | Maximum        | 1000.000000      |
| Default           |  | Units          |                  |
| Type              | 32 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 6                |
| Coding            | RO, ND, NC, PT   |                |                  |

*Temperature Compensated Stator Resistance* (05.050) shows the stator resistance value for the active motor that is being used by the drive including the effect of temperature compensation.

| Parameter         | 05.051 Rotor Temperature Source             |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the source of the rotor temperature |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0   | Maximum        | 6               |
| Default           | 1   | Units          |                 |
| Type              | 8 Bit User Save                             | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 0               |
| Coding            | RW, TE                                      |                |                 |

| Value | Text     |
|-------|----------|
| 0     | An In 3  |
| 1     | User     |
| 2     | P1 Drive |
| 3     | P1 Slot1 |
| 4     | P1 Slot2 |
| 5     | P1 Slot3 |
| 6     | P1 Slot4 |

The rotor temperature can be used to compensate for changes in rotor resistance that affects the motor slip and hence the rated speed in Open-loop or RFC-A mode, or the magnet flux that affects motor torque in RFC-S mode. See *Rotor Temperature Coefficient* (05.054) for details. *Rotor Temperature Source* (05.051) is used to select the source for the rotor temperature measurement.

| <b>Rotor Temperature Source (05.051)</b> | <b>Source</b>                                  | <b>Comments</b>   |
|--|--|---|
| 0  | Analog Input 3 Thermistor Temperature (07.050) | Analog input 3 must be set up for the correct temperature feedback device   |
| 1  | User Rotor Temperature (05.052)                | The user can provide a rotor temperature value if an alternative feedback device is to be used or the user provides an algorithm to model the rotor temperature |
| 2  | P1 Thermistor Temperature (03.122)             | P1 position feedback interface must be set up for the correct temperature feedback device   |
| 3-6                                      | Option Slot P1 Thermistor Temperature (xx.122) | A position feedback category option module must be fitted and the P1 position feedback must be set up for the correct temperature feedback device               |

| <b>Parameter</b>  | <b>05.052 User Rotor Temperature</b>                    |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the temperature of the motor as set by the user |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | -50   | Maximum        | 300             |
| Default           | 0   | Units          | °C              |
| Type              | 16 Bit Volatile   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Rotor Temperature Source* (05.051).

| <b>Parameter</b>  | <b>05.053 Rotor Temperature</b>             |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the temperature of the motor rotor |                |                  |
| Mode              | RFC-A                                       |                |                  |
| Minimum           | -50   | Maximum        | 300              |
| Default           |   | Units          | °C               |
| Type              | 16 Bit Volatile                             | Update Rate    | Background write |
| Display Format    | Standard                                    | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                              |                |                  |

See *Rotor Temperature Source* (05.051).

| <b>Parameter</b>  | <b>05.054 Rotor Temperature Coefficient</b>                            |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the coefficient used to calculate the temperature of the rotor |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.00000  | Maximum        | 0.10000         |
| Default           | 0.00390  | Units          | 1/°C            |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 5               |
| Coding            | RW   |                |                 |

The slip of an induction motor is proportional to the rotor resistance, and so as the motor becomes hotter the slip increases. Therefore the rated speed of a motor, which is used by the drive control algorithm, changes with rotor temperature. To avoid less than optimal control the rated speed value used by the drive should be modified with changing rotor temperature. *Temperature compensated rated speed* (05.057) shows the rated speed from the active motor that is being used by the drive control system. If *Enable Rotor Compensation* (05.056) = 0 and motor 1 is selected (i.e. *Motor 2 Active* (21.015) = 0) then *Temperature compensated rated speed* (05.057) is equal to *Rated Speed* (05.008). If *Enable Rotor Compensation* (05.056) = 1 then *Temperature compensated rated speed* (05.057) is calculated as follows:

Uncompensated Rated Slip = Synchronous Speed - *Rated Speed* (05.008) = (*Rated Frequency* (05.006) x 60 / *Number Of Motor Poles* (05.011)) - *Rated Speed* (05.008)

$\alpha$  = *Rotor Temperature Coefficient* (05.054) and this is the rotor winding temperature coefficient at 20°C as a proportion of the resistance per degree C.

Compensated Rated Slip = Uncompensated Rated Slip x [1 + (*Rotor Temperature* (05.053) - 20°C) x  $\alpha$ ] / [1 + (*Rotor Base Temperature* (05.055) - 20°C) x  $\alpha$ ]

*Temperature compensated rated speed* (05.057) = (*Rated Frequency* (05.006) x 60 / *Number Of Motor Poles* (05.011)) - Compensated Rated Slip

If sensorless mode is not being used (i.e. *Sensorless Mode Active* (03.078) = 0) then an adaptive system is provided to adjust the *Rated Speed* (05.008) value (see *Rated Speed Optimisation Select* (05.016)). The adaptive control system cannot operate at low speeds or light loads, and so the rated speed may be incorrect if the motor runs under these conditions for a long period of time. If adaptive control is selected (i.e. *Rated Speed Optimisation Select* (05.016) > 0) and *Enable Rotor Compensation* (05.056) = 1 then *Rotor Base Temperature* (05.055) is updated with *Rotor Temperature* (05.053) while the adaptive controller is active, and so the rotor compensation system has no effect. When the adaptive

controller changes to the inactive state because of the speed and load conditions, the *Rotor Base Temperature* (05.055) is no longer updated and the difference between this and the *Rotor Temperature* (05.053) is used to adjust the *Rated Speed* (05.008). When the adaptive controller becomes active again the rotor compensation system is disabled and *Rated Speed* (05.008) is again adjusted by the adaptive controller. Therefore the rotor compensation system provides the necessary adjustment of the rated speed when the adaptive controller cannot operate. To give a smooth change when the adaptive controller becomes active *Temperature compensated rated speed* (05.057) is copied to the rated speed parameter for the active motor once during the transition.

| Parameter         | 05.055 Rotor Base Temperature   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the base temperature used to calculate the temperature of the rotor |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | -50   | Maximum        | 300             |
| Default           | 0   | Units          | °C              |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Rotor Temperature Coefficient* (05.054).

| Parameter         | 05.056 Enable Rotor Compensation      |                |                 |
|-------------------|---------------------------------------|----------------|-----------------|
| Short description | Set to 1 to enable rotor compensation |                |                 |
| Mode              | RFC-A                                 |                |                 |
| Minimum           | 0                                     | Maximum        | 1               |
| Default           | 0                                     | Units          |                 |
| Type              | 1 Bit User Save                       | Update Rate    | Background read |
| Display Format    | Standard                              | Decimal Places | 0               |
| Coding            | RW                                    |                |                 |

See *Rotor Temperature Coefficient* (05.054).

| Parameter         | 05.057 Temperature compensated rated speed                                   |                |            |
|-------------------|--|----------------|------------|
| Short description | Final rated speed value used by the drive including temperature compensation |                |            |
| Mode              | RFC-A  |                |            |
| Minimum           | 0.00   | Maximum        | 33000.00   |
| Default           |  | Units          | rpm        |
| Type              | 32 Bit Volatile  | Update Rate    | Background |
| Display Format    | Standard   | Decimal Places | 2          |
| Coding            | RO, ND, NC, PT   |                |            |

*Temperature compensated rated speed* (05.057) shows the rated speed value for the active motor that is being used by the drive including the effect of temperature compensation.

| Parameter         | 05.059 Maximum Deadtime Compensation   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Shows the deadtime compensation used to compensate for dead-time effects in the inverter |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000  | Maximum        | 10.000          |
| Default           | 0.000  | Units          | µs              |
| Type              | 16 Bit User Save   | Update Rate    | Background Read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RO, NC, PT   |                |                 |

*Maximum Deadtime Compensation* (05.059) is the deadtime compensation used to compensate for dead-time effects in the inverter. This level of compensation is used when the drive output current is above *Current At Maximum Deadtime Compensation* (05.060). Both of these values related to dead-time compensation are measured during auto-tuning and cannot be set by the user. It should be noted that if the auto-tuning test is not performed and *Maximum Deadtime Compensation* (05.059) = 0 then dead-time compensation is disabled. Although it is not recommended, it is possible to disable dead-time compensation by setting *Disable Deadtime Compensation* (05.061) = 1.

| Parameter         | 05.060 Current At Maximum Deadtime Compensation           |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Current at which maximum deadtime compensation is applied |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.00  | Maximum        | 100.00          |
| Default           | 0.00  | Units          | %               |
| Type              | 16 Bit User Save  | Update Rate    | Background Read |
| Display Format    | Standard  | Decimal Places | 2               |
| Coding            | RO, NC, PT  |                |                 |

See *Maximum Deadtime Compensation* (05.059).

| Parameter         | 05.061 <i>Disable Deadtime Compensation</i> |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Disable Deadtime Compensation               |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save                             | Update Rate    | Background Read |
| Display Format    | Standard                                    | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Maximum Deadtime Compensation* (05.059).

| Parameter         | 05.062 <i>Saturation Breakpoint 2</i>                                |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines Saturation Breakpoint 2 within the saturation characteristic |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.0  | Maximum        | 100.0           |
| Default           | 0.0  | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW   |                |                 |

See *Saturation Breakpoint 1* (05.029).

| Parameter         | 05.063 <i>Saturation Breakpoint 4</i>                                |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines Saturation Breakpoint 4 within the saturation characteristic |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.0  | Maximum        | 100.0           |
| Default           | 0.0  | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW   |                |                 |

See *Saturation Breakpoint 1* (05.029).

# Menu 6 Single Line Descriptions – *Sequencer and Clock*

Mode: RFC-A

| Parameter |                                      | Range  | Default  | Type |      |    |    |    |    |
|-----------|--------------------------------------|--|--|------|------|----|----|----|----|
| 06.001    | Stop Mode                            | Coast (0), Ramp (1), No Ramp (2)   | Ramp (1)   | RW   | Txt  |    |    |    | US |
| 06.002    | Limit Switch Stop Mode               | Stop (0), Ramp (1)   | Stop (0)   | RW   | Txt  |    |    |    | US |
| 06.003    | Supply Loss Mode                     | Disable (0), Ramp Stop (1), Ride Thru (2), Limit Stop (3)                                  | Disable (0)  | RW   | Txt  |    |    |    | US |
| 06.008    | Hold Zero Speed                      | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    | US |
| 06.009    | Catch A Spinning Motor               | Disable (0), Enable (1), Fwd Only (2), Rev Only (3)  | Enable (1)   | RW   | Txt  |    |    |    | US |
| 06.010    | Enable Conditions                    | 000000000000 to 111111111111   |  | RO   | Bin  | ND | NC | PT |    |
| 06.011    | Sequencer State Machine Inputs       | 000000 to 111111   |  | RO   | Bin  | ND | NC | PT |    |
| 06.012    | Enable Stop Key                      | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    | US |
| 06.013    | Enable Auxiliary Key                 | Disabled (0), Forward/Reverse (1), Run Reverse (2)   | Disabled (0)   | RW   | Txt  |    |    |    | US |
| 06.015    | Drive Enable                         | Off (0) or On (1)  | On (1)   | RW   | Bit  |    |    |    | US |
| 06.016    | Date                                 | 00-00-00 to 31-12-99   |  | RW   | Date | ND | NC | PT |    |
| 06.017    | Time                                 | 00:00:00 to 23:59:59   |  | RW   | Time | ND | NC | PT |    |
| 06.018    | Day Of Week                          | Sunday (0), Monday (1), Tuesday (2), Wednesday (3), Thursday (4), Friday (5), Saturday (6) |  | RO   | Txt  | ND | NC | PT |    |
| 06.019    | Date/Time Selector                   | Set (0), Powered (1), Running (2), Acc Powered (3), Local Keypad (4), Remote Keypad (5)    | Powered (1)  | RW   | Txt  |    |    |    | US |
| 06.020    | Date Format                          | Std (0), US (1)  | Std (0)  | RW   | Txt  |    |    |    | US |
| 06.021    | Time Between Filter Changes          | 0 to 30000 Hours   | 0 Hours  | RW   | Num  |    |    |    | US |
| 06.022    | Filter Change Required / Change Done | Off (0) or On (1)  |  | RW   | Bit  | ND | NC |    |    |
| 06.023    | Time Before Filter Change Due        | 0 to 30000 Hours   |  | RO   | Num  | ND | NC | PT | PS |
| 06.024    | Reset Energy Meter                   | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    |    |
| 06.025    | Energy Meter: MWh                    | ±999.9 MWh   |  | RO   | Num  | ND | NC | PT | PS |
| 06.026    | Energy Meter: kWh                    | ±99.99 kWh   |  | RO   | Num  | ND | NC | PT | PS |
| 06.027    | Energy Cost Per kWh                  | 0.0 to 600.0   | 0.0  | RW   | Num  |    |    |    | US |
| 06.028    | Running Cost                         | ±32000   |  | RO   | Num  | ND | NC | PT |    |
| 06.029    | Hardware Enable                      | Off (0) or On (1)  |  | RO   | Bit  | ND | NC | PT |    |
| 06.030    | Run Forward                          | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    | NC |    |    |
| 06.031    | Jog                                  | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    | NC |    |    |
| 06.032    | Run Reverse                          | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    | NC |    |    |
| 06.033    | Forward/Reverse                      | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    | NC |    |    |
| 06.034    | Run                                  | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    | NC |    |    |
| 06.035    | Forward Limit Switch                 | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    | NC |    |    |
| 06.036    | Reverse Limit Switch                 | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    | NC |    |    |
| 06.037    | Jog Reverse                          | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    | NC |    |    |
| 06.039    | Not Stop                             | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    | NC |    |    |
| 06.040    | Enable Sequencer Latching            | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    | US |
| 06.041    | Drive Event Flags                    | 00 to 11   | 00   | RW   | Bin  |    | NC |    |    |
| 06.042    | Control Word                         | 0000000000000000 to 1111111111111111   | 0000000000000000   | RW   | Bin  |    | NC |    |    |
| 06.043    | Control Word Enable                  | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    | US |
| 06.044    | Active Supply                        | Off (0) or On (1)  |  | RO   | Bit  | ND | NC | PT |    |
| 06.045    | Cooling Fan control                  | -10 to 11  | 10   | RW   | Num  |    |    |    | US |
| 06.046    | Cooling Fan Speed                    | 0 to 10  |  | RO   | Num  | ND | NC | PT |    |
| 06.047    | Input Phase Loss Detection Mode      | Full (0), Ripple Only (1), Disabled (2)  | Full (0)   | RW   | Txt  |    |    |    | US |
| 06.048    | Supply Loss Detection Level          | ±VM_SUPPLY_LOSS_LEVEL V  | 200V drive: 205 V<br>400V drive: 410 V<br>575V drive: 540 V<br>690V drive: 540 V | RW   | Num  |    | RA |    | US |
| 06.051    | Hold Supply Loss Active              | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    | NC |    |    |
| 06.052    | Motor Pre-heat Current Magnitude     | 0 to 100 %   | 0 %  | RW   | Num  |    |    |    | US |
| 06.053    | Sleep / Wake Threshold               | ±VM_SPEED_FREQ_REF_UNIPOLAR  | 0.0  | RW   | Num  |    |    |    | US |
| 06.054    | Sleep Time                           | 0.0 to 250.0 s   | 10.0 s   | RW   | Num  |    |    |    | US |
| 06.055    | Wake Time                            | 0.0 to 250.0 s   | 10.0 s   | RW   | Num  |    |    |    | US |
| 06.056    | Sleep Required                       | Off (0) or On (1)  |  | RO   | Bit  | ND | NC | PT |    |
| 06.057    | Sleep Active                         | Off (0) or On (1)  |  | RO   | Bit  | ND | NC | PT |    |
| 06.058    | Output Phase Loss Detection Time     | 0.5s (0), 1.0s (1), 2.0s (2), 4.0s (3)   | 0.5s (0)   | RW   | Txt  |    |    |    | US |
| 06.059    | Output Phase Loss Detection Enable   | Disabled (0), Phases (1), Devices (2)  | Disabled (0)   | RW   | Txt  |    |    |    | US |
| 06.060    | Standby Mode Enable                  | Off (0) or On (1)  | Off (0)  | RW   | Bit  |    |    |    | US |
| 06.061    | Standby Mode Mask                    | 0000000 to 1111111   | 0000000  | RW   | Bin  |    |    |    | US |
| 06.065    | Standard Under Voltage Threshold     | ±VM_STD_UNDER_VOLTS V  | 200V drive: 175 V<br>400V drive: 330 V<br>575V drive: 435 V                      | RW   | Num  |    | RA |    | US |



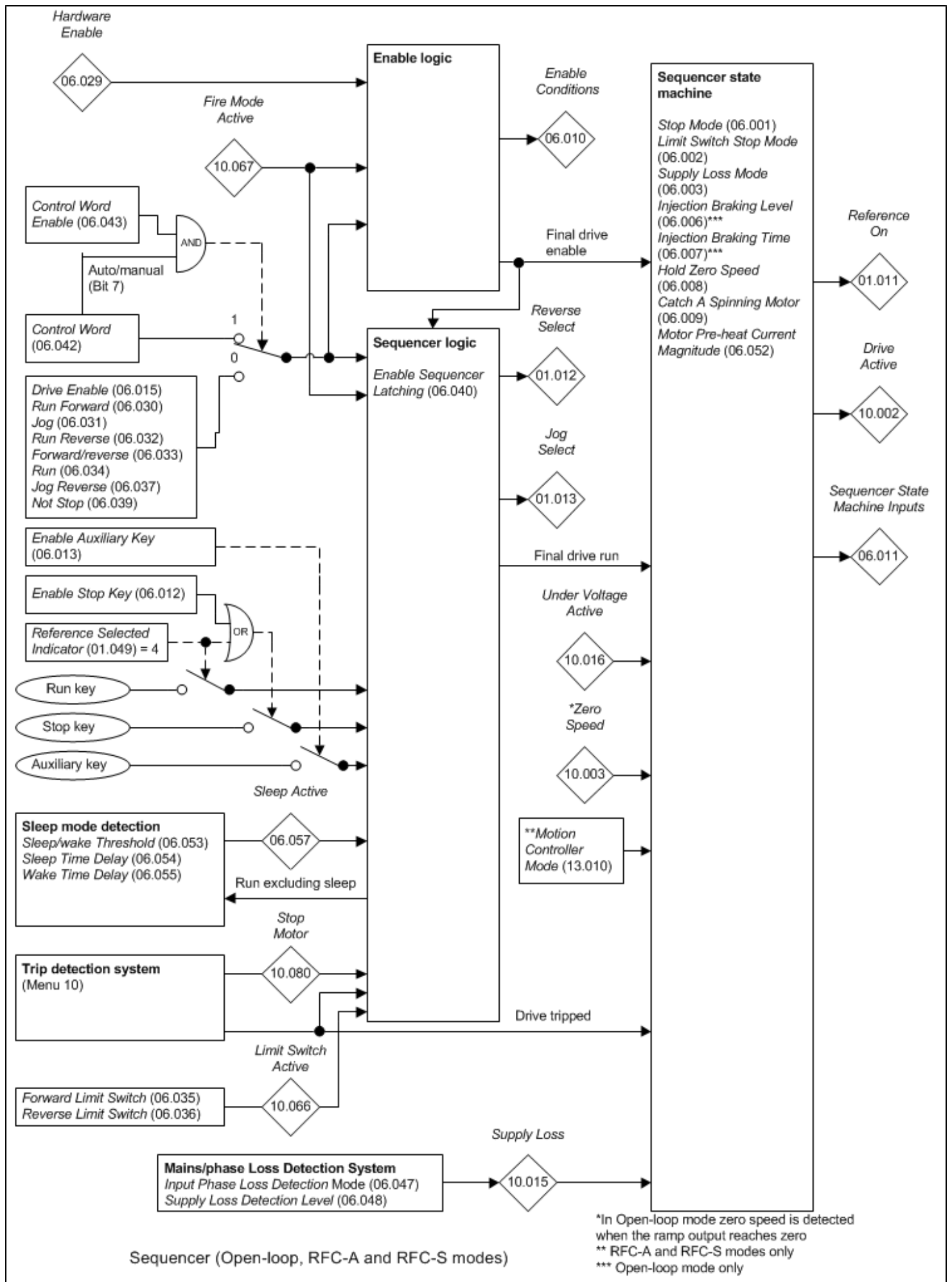
|        |   |  |                       |   |    |     |    |    |    |  |  |    |
|--------|---|--|-----------------------|---|----|-----|----|----|----|--|--|----|
|        |   |  |                       | 690V drive: 435 V   |    |     |    |    |    |  |  |    |
| 06.066 | Low Under Voltage Threshold               |  | ±VM_LOW_UNDER_VOLTS V | 200V drive: 175 V<br>400V drive: 330 V<br>575V drive: 435 V<br>690V drive: 435 V  | RW | Num |    | RA |    |  |  | US |
| 06.067 | Low Under Voltage Threshold Select        |  | Off (0) or On (1)     | Off (0)   | RW | Bit |    |    |    |  |  | US |
| 06.068 | Backup Supply Mode Enable                 |  | Off (0) or On (1)     | Off (0)   | RW | Bit |    |    |    |  |  | US |
| 06.069 | Under-voltage System Contactor Close      |  | Off (0) or On (1)     |   | RO | Bit | ND | NC | PT |  |  |    |
| 06.070 | Under-voltage System Contactor Closed     |  | Off (0) or On (1)     | Off (0)   | RW | Bit |    |    |    |  |  |    |
| 06.071 | Slow Rectifier Charge Rate Enable         |  | Off (0) or On (1)     | Off (0)   | RW | Bit |    |    |    |  |  | US |
| 06.072 | User Supply Select                        |  | Off (0) or On (1)     | Off (0)   | RW | Bit |    |    |    |  |  | US |
| 06.073 | Braking IGBT Lower Threshold              |  | ±VM_DC_VOLTAGE_SET V  | 200V drive: 390 V<br>400V drive: 780 V<br>575V drive: 930 V<br>690V drive: 1120 V | RW | Num |    | RA |    |  |  | US |
| 06.074 | Braking IGBT Upper Threshold              |  | ±VM_DC_VOLTAGE_SET V  | 200V drive: 390 V<br>400V drive: 780 V<br>575V drive: 930 V<br>690V drive: 1120 V | RW | Num |    | RA |    |  |  | US |
| 06.075 | Low Voltage Braking IGBT Threshold        |  | ±VM_DC_VOLTAGE_SET V  | 0 V   | RW | Num |    | RA |    |  |  | US |
| 06.076 | Low Voltage Braking IGBT Threshold Select |  | Off (0) or On (1)     | Off (0)   | RW | Bit |    |    |    |  |  |    |
| 06.084 | Date And Time Offset                      |  | ±12.00 Hours          | 0.00 Hours  | RW | Num |    |    |    |  |  | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 6 – Sequencer and Clock

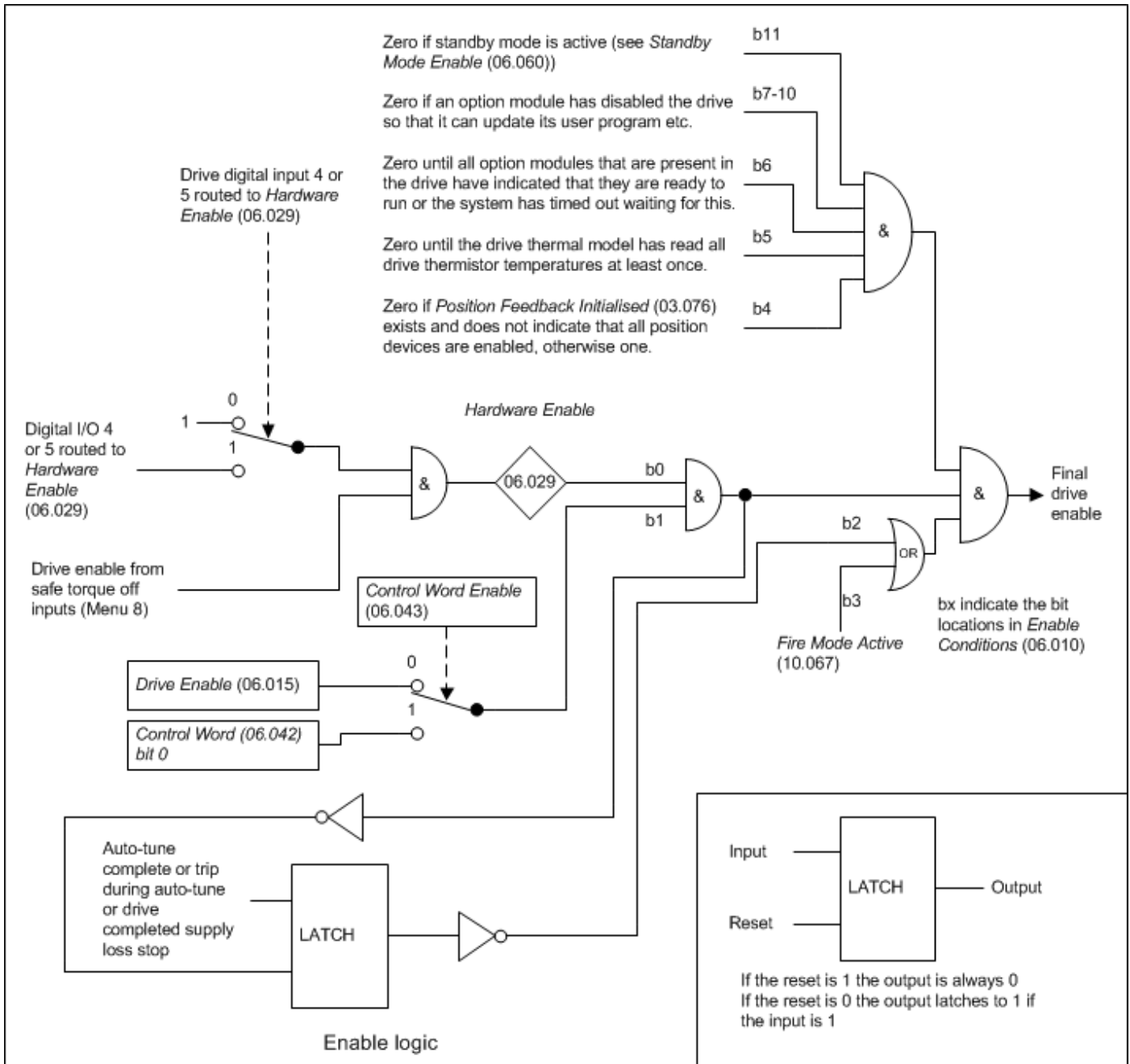
Mode: RFC-A

The diagram below shows the sequencer for RFC-A and RFC-S modes.



The sequencer, which provides overall control of the drive, is implemented in two stages. The first stage includes the enable logic and sequencer logic

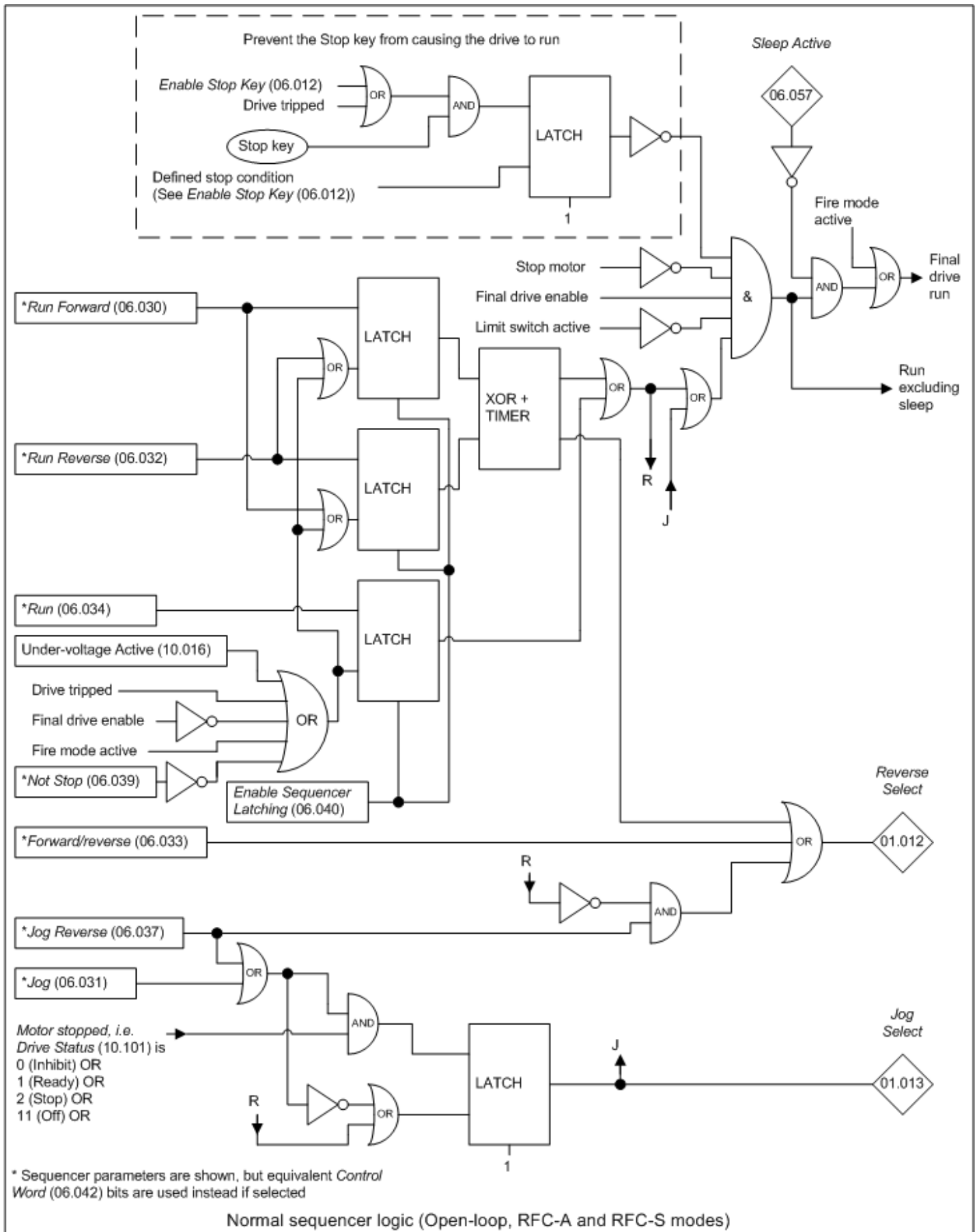
and consists of static logic elements. The second stage is a state machine with internal states.



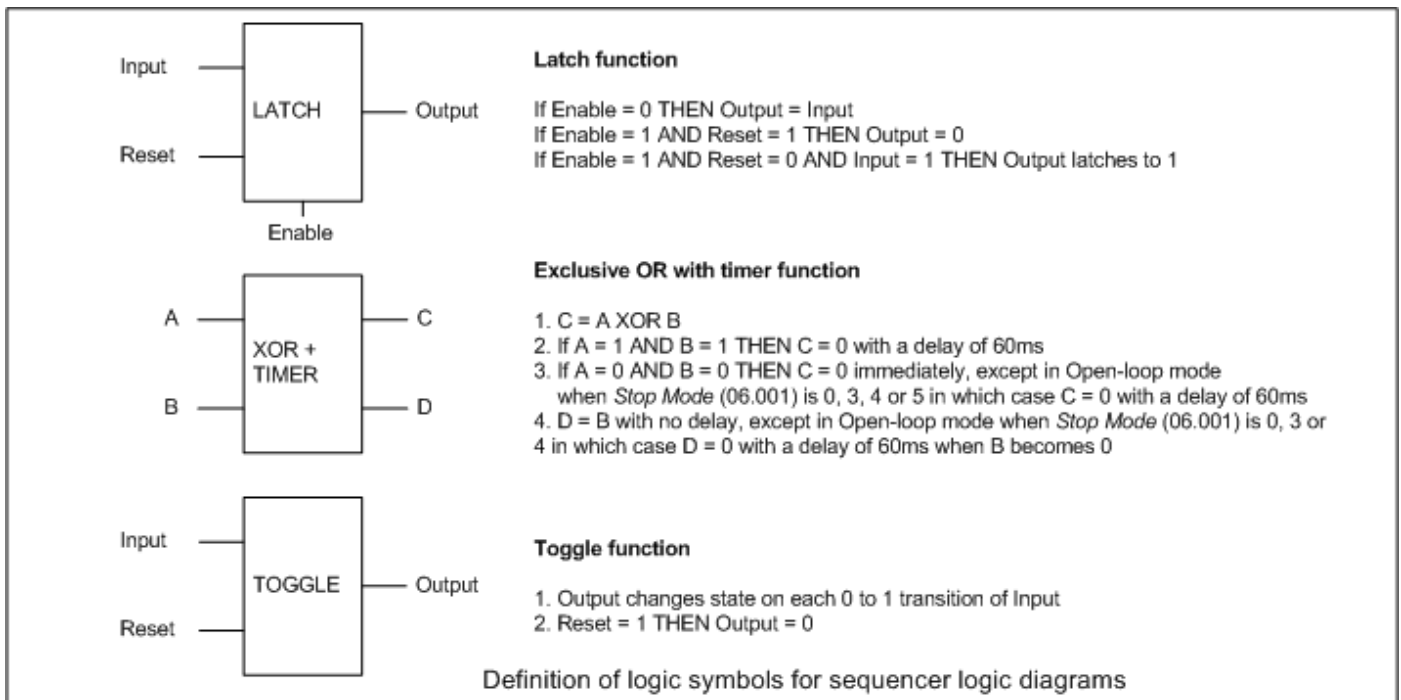
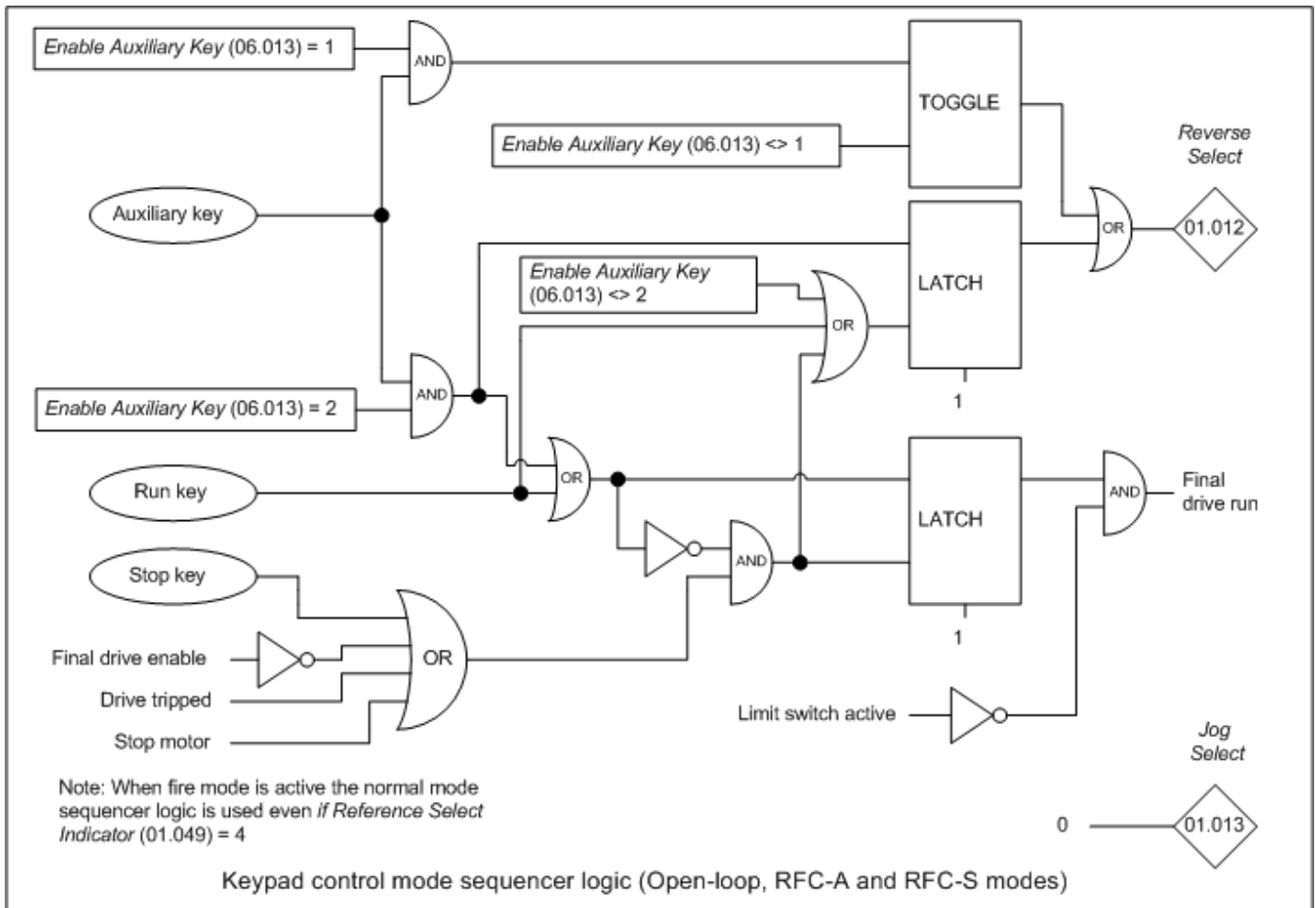
*Hardware Enable* (06.029) follows the safe torque off enable signal provided none of the digital inputs that are integral to the drive are routed to the *Hardware Enable* (06.029). The safe torque off hardware includes a delay in detecting a change from the enable to disable state of up to 20ms, but for most applications this is not a problem. However, a faster disable time can be achieved (600us) if digital input 4 or 5 on the drive is routed to the *Hardware Enable* (06.029).

If the safety function of the safe torque off input is required, then there must not be a direct connection between the safe torque off input and any other digital I/O on the drive. If the safety function of the safe torque off input and a fast disable function are required together, then the drive should be given two separate independent enable input signals. A signal from a safe source should be connected to the safe torque off input on the drive. A second enable should be connected to the digital I/O selected for the fast disable function. The circuit must be arranged so that a fault which causes the fast input to be forced high cannot cause the safe torque off input to be forced high as well, including the case where a component such as a blocking diode has failed.

The diagram below shows the sequencer logic when *Reference Selected Indicator* (01.049) is not equal to 4 (i.e. keypad control mode is not selected). The definition of the logic symbols is given below.



The diagram below shows the sequencer logic when Reference Selected Indicator (01.049) = 4 (i.e. keypad control mode is selected). The definition of the logic symbols is given below.



| Parameter         | 06.001 Stop Mode  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines how the motor is controlled when the run signal is removed from the drive |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 2               |
| Default           | 1   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text    |
|-------|---------|
| 0     | Coast   |
| 1     | Ramp    |
| 2     | No Ramp |

There is only one phase during the stopping sequence as shown in the table below for each of the possible values of *Stop Mode* (06.001).

| Stop Mode (06.001) | Action            |
|--------------------|-------------------|
| 0: Coast           | Inverter disabled |
| 1: Ramp            | Stop with ramp    |
| 2: No ramp         | Stop with no ramp |

The following should be noted:

1. If *Stop Mode* (06.001) = 0 (Coast) the inverter is inhibited immediately when the Final drive run is de-activated. If however, *Hold Zero Speed* (06.008) = 1, then the inverter will be re-enabled to hold zero speed. The result is that the inverter is disabled for one sample and then enabled to ramp the motor to a stop. Therefore, if coast stop is required *Hold Zero Speed* (06.008) should be set to 0.
2. If *Stop Mode* (06.001) = 1 (stop with ramp) the relevant ramp rate is used to stop the motor even if *Ramp Enable* (02.002) = 0.
3. The motor can be stopped with position orientation after stopping. This mode is selected with *Standard Motion Controller Mode* (13.010). When orientation stop is selected *Stop Mode* (06.001) has no effect.

| Parameter         | 06.002 Limit Switch Stop Mode                                    |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the behaviour of the drive when a limit switch is active |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text |
|-------|------|
| 0     | Stop |
| 1     | Ramp |

If *Limit Switch Stop Mode* (06.002) = 0 then when Limit switch active is activated the motor is stopped without ramps.

If *Limit Switch Stop Mode* (06.002) = 1 then the motor is stopped with the stop mode defined by *Stop Mode* (06.001). Therefore, if the limit switch is required to stop the motor with a ramp then *Stop Mode* (06.001) must be set to 1 (Ramp). The motor will then stop with the currently selected ramp rate.

| Parameter         | 06.003 Supply Loss Mode   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the behaviour of the drive when the supply voltage is reduced |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 3               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text       |
|-------|------------|
| 0     | Disable    |
| 1     | Ramp Stop  |
| 2     | Ride Thru  |
| 3     | Limit Stop |

If *Supply Loss Mode* (06.003) > 0 and the *D.c. Bus Voltage* (05.005) falls below *Supply Loss Detection Level* (06.048) - 0.05 x VM\_SUPPLY\_LOSS\_LEVEL[MIN] then the supply loss condition is detected and *Supply Loss* (10.015) = 1. If the supply subsequently rises above *Supply Loss Detection Level* (06.048) + 0.05 x VM\_SUPPLY\_LOSS\_LEVEL[MIN] then the supply loss condition is no longer active and *Supply Loss* (10.015) = 0.

#### 0: Disable

No supply loss detection is provided by monitoring the *D.c. Bus Voltage* (05.005). The drive will continue to operate normally unless the under voltage condition is detected.

#### 1: Ramp Stop

The action taken by the drive is the same as for ride through mode, except that the ramp down rate is at least as fast as the currently selected deceleration ramp and the drive will continue to decelerate and stop even if the supply is re-applied. Once the sequencer state machine has reached the DISABLE state, it will be necessary to disable and re-enable the drive for it to run again because bit 2 of *Enable Conditions* (06.010) is set when the sequencer state machine changes from the DECELERATION state. It should be noted that even if S ramps are enabled (i.e. *S Ramp Enable* (02.006) = 1) this is ignored while the drive is stopping in this mode, and a linear ramp is always used.

#### 2: Ride through

The drive attempts to control the d.c. link voltage to take energy from the motor and load inertia to ride through the Supply loss condition for as long as possible.

#### 3: Limit Stop

The speed reference is set to zero and the ramps are disabled allowing the drive to decelerate the motor to a stop under current limit. If the supply is re-applied while the motor is stopping any run signal is ignored until the motor has stopped. If the current limit value is set at a very low level the drive may enter the Under Voltage state before the motor has stopped. Once the sequencer state machine has reached the DISABLE state, it will be necessary to disable and re-enable the drive for it to run again because bit 2 of *Enable Conditions* (06.010) is set when the sequencer state machine changes from the DECELERATION state.

| Parameter         | 06.008 Hold Zero Speed                   |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to 1 to hold the motor at zero speed |                |          |
| Mode              | RFC-A                                    |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save                          | Update Rate    | 4ms read |
| Display Format    | Standard                                 | Decimal Places | 0        |
| Coding            | RW                                       |                |          |

If *Hold Zero Speed* (06.008) = 0 the sequencer state machine goes to the DISABLE state and the inverter is disabled when the Final drive run is de-activated and the motor reaches standstill.

If *Hold Zero Speed* (06.008) = 1 and *Motor Pre-heat Current Magnitude* (06.052) = 0% the sequencer state machine goes to the STOP state when the Final drive run is de-activated and the motor reaches standstill. The drive remains enabled with a frequency or speed reference of zero. If *Motor Pre-heat Current Magnitude* (06.052) is set to a non-zero value it defines the current in the motor when the sequencer state machine is in the STOP state. This is intended for applications where there is no motor load at standstill, but motor current is required to prevent condensation in the motor when it is stopped. If the motor is not force cooled the motor cooling is less effective at standstill than when the motor is rotating, and so care should be taken not to damage the motor by leaving it at standstill for prolonged periods with a high level of current.

| Parameter         | 06.009 Catch A Spinning Motor  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the behaviour of the drive when the drive is enabled whilst the motor is not at zero speed |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 3               |
| Default           | 1  | Units          |                 |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text     |
|-------|----------|
| 0     | Disable  |
| 1     | Enable   |
| 2     | Fwd Only |
| 3     | Rev Only |

When the drive is enabled the ramp output can be set up so that the initial speed reference (i.e. combination of the ramp output and the hard speed reference if enabled) matches the speed of the motor, so that there is no transient speed change on enable. To do this *Post Ramp Reference* (02.001) is pre-loaded with *Speed Feedback* (03.002) - *Hard Speed Reference* (03.022) if the hard speed reference is enabled, or with *Speed Feedback* (03.002) if not. If *Catch A Spinning Motor* (06.009) = 1 then the ramp output is reloaded in this way, however different settings of *Catch A Spinning Motor* (06.009) can be used to restrict the initial speed reference if required as given in the table below. If the initial speed reference is forced to zero then *Post Ramp Reference* (02.001) is pre-loaded with *Speed Feedback* (03.002) - *Hard Speed Reference* (03.022) if the hard speed reference is enabled, or with zero if not.

| Catch A Spinning Motor (06.009) | Initial speed reference |
|---------------------------------|-------------------------|
| 0                               | Always zero             |
| 1                               | In either direction     |
| 2                               | Zero or positive        |
| 3                               | Zero or negative        |

#### RFC-A mode

If sensorless mode is being used then it is recommended that catch a spinning motor is disabled if the motor will always be stationary when the drive is enabled as this gives a smooth start and avoids unwanted transient movement of the motor on starting. If catch a spinning motor is enabled, but the motor is at standstill or rotating slowly it is likely that some unwanted movement will occur. This can be reduced by reducing *Magnetising Current Limit* (04.049), however if this is reduced too much, especially with larger motors, and over-current trip may occur on starting. It is possible, although not likely, that the drive does not correctly detect the speed of the motor when sensorless control is active. If this is the case *Spin Start Boost* (05.040) can be increased to correct this.

#### RFC-S mode

If sensorless mode is being used then it is recommended that catch a spinning motor is disabled if the motor will always be stationary when the drive is enabled as this gives a smooth start and avoids unwanted transient movement of the motor on starting. It should be noted that catch a spinning motor will not operate correctly if the speed of the motor is high enough that the open-circuit voltage is larger than the a.c. supply voltage to the drive. As part of the speed detection it is possible for the d.c link voltage to rise, and the increase in voltage is higher when the motor is spinning at higher speeds. Even if standard ramp is being used (*Ramp Mode* (02.004)=1), when the motor is spinning at high speed the increase in d.c. link voltage may be enough to cause d.c. link over-voltage trips. If this is the case then a braking resistor will be required that can absorb the transient energy.



| Parameter         | 06.010 <i>Enable Conditions</i>  |                |                                 |
|-------------------|--|----------------|---------------------------------|
| Short description | Displays all the conditions needed to change the state of the final drive enable |                |                                 |
| Mode              | RFC-A  |                |                                 |
| Minimum           | 0<br>(Display: 000000000000)   | Maximum        | 4095<br>(Display: 111111111111) |
| Default           |  | Units          |                                 |
| Type              | 16 Bit Volatile  | Update Rate    | 2ms write                       |
| Display Format    | Binary   | Decimal Places | 0                               |
| Coding            | RO, ND, NC, PT   |                |                                 |

The Final drive enable is a combination of the *Hardware Enable* (06.029), *Drive Enable* (06.015) and other conditions that can prevent the drive from being enabled. All of these conditions are shown as bits in *Enable Conditions* (06.010) as given in the table below.

| Enable Conditions (06.010) bits | Enable condition   |
|---------------------------------|--|
| 0                               | <i>Hardware Enable</i> (06.029)  |
| 1                               | <i>Drive Enable</i> (06.015)   |
| 2                               | 0 if auto-tune completed or trip during auto-tune, or if the drive stops when supply loss stop is active, but the drive needs to be disabled and re-enabled. (Always 1 in Regen mode). |
| 3                               | 1 if fire mode is active.  |
| 4                               | Zero if <i>Position Feedback Initialized</i> (03.076) is present and all devices are not indicated as initialised, otherwise one.  |
| 5                               | Zero until the drive thermal model has obtained temperatures from all drive thermistors at least once.   |
| 6                               | Zero until all option modules that are present in the drive have indicated that they are ready to run or the system has timed out waiting for this.                                    |
| 7-10                            | Zero if an option module has forced the drive to be disabled if for example it is updating its user program. Bit 7 corresponds to slot 1, bit 8 to slot 2, etc.                        |
| 11                              | Zero if the drive is in standby mode. See <i>Standby Mode Enable</i> (06.060)  |

| Parameter         | 06.011 <i>Sequencer State Machine Inputs</i>                   |                |                         |
|-------------------|--|----------------|-------------------------|
| Short description | Displays the states of inputs into the sequencer state machine |                |                         |
| Mode              | RFC-A  |                |                         |
| Minimum           | 0<br>(Display: 000000)   | Maximum        | 63<br>(Display: 111111) |
| Default           |  | Units          |                         |
| Type              | 8 Bit Volatile   | Update Rate    | 2ms write               |
| Display Format    | Binary   | Decimal Places | 0                       |
| Coding            | RO, ND, NC, PT   |                |                         |

The bits in *Sequencer State Machine Inputs* (06.011) show the state of the inputs to the sequencer state machine as given in the tables below.

| Sequencer State Machine Inputs (06.011) | Signal                               | Indicates                                      |
|---|--------------------------------------|--|
| 0                                       | Final drive enable                   | The drive inverter is allowed to be enabled.   |
| 1                                       | Final drive run                      | The motor can move away from standstill.       |
| 2                                       | <i>Under Voltage Active</i> (10.016) | The under voltage condition has been detected. |
| 3                                       | <i>Zero Speed</i> (10.003)           | Indicated when the motor has stopped.          |
| 4                                       | Drive tripped                        | The drive is tripped.                          |
| 5                                       | <i>Supply Loss</i> (10.015)          | Supply loss condition has been detected.       |

| Parameter         | 06.012 <i>Enable Stop Key</i>              |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to enable the use of the stop key |                |                 |
| Mode              | RFC-A                                      |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

The Stop key can be used to stop the drive if *Enable Stop Key* (06.012) = 1 or *Reference Selected Indicator* (01.049) = 4. The Stop key is also used to reset the drive from the keypad. If *Enable Stop Key* (06.012) = 0 and *Reference Selected Indicator* (01.049) is not equal to 4 the Stop key is not active and can be used to initiate a drive reset and without stopping the drive from running. If *Enable Stop Key* (06.012) = 1 or *Reference Selected Indicator* (01.049) = 4 the drive reset can be initiated without stopping the drive by holding the Run key and then pressing the Stop key.

It should be noted that if the drive is tripped and is then reset from any source other than the keypad Stop key then the drive may start immediately under the following conditions:

*Enable Sequencer Latching* (06.040) = 0, the Final drive enable is active and one of the sequencer bits (*Run Forward* (06.030), *Run Reverse*

(06.032) or *Run* (06.034) is active.

*Enable Sequencer Latching* (06.040) = 1, the Final drive enable is active, *Not Stop* (06.039) is active and one of the sequencer bits (*Run Forward* (06.030), *Run Reverse* (06.032) or *Run* (06.034) is active.

The drive sequencer has been designed so that pressing the Stop key, whatever the value of *Enable Stop Key* (06.012) or *Reference Selected Indicator* (01.049), does not make the drive state change from stopped to running. As pressing the Stop key could reset a drive trip which could then restart the drive, the run output from the sequencer is held off until the following conditions are met when the drive is tripped and the Stop key is pressed.

(*Run Forward* (06.030) = 0 and *Run Reverse* (06.032) = 0 and *Run* (06.034) = 0 and *Not Stop* (06.039) = 0\*

OR (*Run Forward* (06.030) = 1 and *Run Reverse* (06.032) = 1 for at least 60ms\*

OR The *Hardware Enable* (06.029) = 0 or software enable is zero+

OR The sequencer is in the UNDER\_VOLTAGE state

\**Not Stop* (06.039) is only used with latching logic (i.e. *Enable Sequencer Latching* (06.040) = 1). When latching logic is not used then *Not Stop* (06.039) is normally zero, and so it does not affect the conditions required to reapply the drive run.

+The software enable is either *Drive Enable* (06.015) or the enable from *Control Word* (06.042) as selected by *Control Word Enable* (06.043).

Once the necessary conditions have been met the drive can then be restarted by activating the necessary bits for a normal start.

| Parameter         |  |                 |  | 06.013 Enable Auxiliary Key   |  |                 |  |
|-------------------|--|-----------------|--|---|--|-----------------|--|
| Short description |  |                 |  | Defines the behaviour of the drive when the auxiliary button is pressed |  |                 |  |
| Mode              |  |                 |  | RFC-A   |  |                 |  |
| Minimum           |  | 0               |  | Maximum   |  | 2               |  |
| Default           |  | 0               |  | Units   |  |                 |  |
| Type              |  | 8 Bit User Save |  | Update Rate   |  | Background read |  |
| Display Format    |  | Standard        |  | Decimal Places  |  | 0               |  |
| Coding            |  |                 |  | RW, TE  |  |                 |  |

| Value | Text            |
|-------|-----------------|
| 0     | Disabled        |
| 1     | Forward/Reverse |
| 2     | Run Reverse     |

If Hand/Off/Auto mode is active (see *Hand/Off/Auto Operating Mode* (01.052)) then *Enable Auxiliary Key* (06.013) has no effect. Otherwise if *Reference Selected Indicator* (01.049) = 4 then *Enable Auxiliary Key* (06.013) can be used to enable the Auxiliary key as a reverse key. If *Enable Auxiliary Key* (06.013) = 1 then each time the Auxiliary key is pressed *Reverse Select* (01.012) is toggled. If *Enable Auxiliary Key* (06.013) = 2 then the Auxiliary key behaves in a similar way to the Run key except that the drive runs in the reverse direction when it is pressed.

| Parameter         |  |                 |  | 06.015 Drive Enable          |  |          |  |
|-------------------|--|-----------------|--|------------------------------|--|----------|--|
| Short description |  |                 |  | Set to 1 to enable the drive |  |          |  |
| Mode              |  |                 |  | RFC-A                        |  |          |  |
| Minimum           |  | 0               |  | Maximum                      |  | 1        |  |
| Default           |  | 1               |  | Units                        |  |          |  |
| Type              |  | 1 Bit User Save |  | Update Rate                  |  | 2ms read |  |
| Display Format    |  | Standard        |  | Decimal Places               |  | 0        |  |
| Coding            |  |                 |  | RW, BU                       |  |          |  |

*Drive Enable* (06.015) must be active for the drive to be enabled. See description of enable logic.

| Parameter         |  |                          |  | 06.016 Date               |  |                               |  |
|-------------------|--|--------------------------|--|---------------------------|--|-------------------------------|--|
| Short description |  |                          |  | Displays the current date |  |                               |  |
| Mode              |  |                          |  | RFC-A                     |  |                               |  |
| Minimum           |  | 0<br>(Display: 00-00-00) |  | Maximum                   |  | 311299<br>(Display: 31-12-99) |  |
| Default           |  |                          |  | Units                     |  |                               |  |
| Type              |  | 32 Bit Volatile          |  | Update Rate               |  | Background read/write         |  |
| Display Format    |  | Date                     |  | Decimal Places            |  | 0                             |  |
| Coding            |  |                          |  | RW, ND, NC, PT            |  |                               |  |

*Date* (06.016), *Time* (06.017) and *Day Of Week* (06.018) show the date and time as selected by *Date/Time Selector* (06.019). *Date* (06.016) stores the date in dd.mm.yy format regardless of the setting made in *Date Format* (06.020) however if the parameter is viewed using a keypad the date will be displayed in the format selected in *Date Format* (06.020). If a real time clock is selected from an option module then the days, months and years are from the real time clock and the day of the week is displayed in *Day Of Week* (06.018). Otherwise the days have a minimum value of 0 and roll over after 30, the months have a minimum value of 0 and roll over after 11, and *Day Of Week* (06.018) is always 0 (Sunday).

If when setting the date/time this parameter is being written via comms or from an applications module then the value should be written in standard dd/mm/yy format as described below.

The value of this parameter as seen over comms or to an applications module is as follows.

Value = (day[1..31] x 10000) + (month[1..12] x 100) + year[0..99]

| Parameter         |                           | 06.017 Time    |                               |
|-------------------|---------------------------|----------------|-------------------------------|
| Short description | Displays the current time |                |                               |
| Mode              | RFC-A                     |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)  | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |                           | Units          |                               |
| Type              | 32 Bit Volatile           | Update Rate    | Background read/write         |
| Display Format    | Time                      | Decimal Places | 0                             |
| Coding            | RW, ND, NC, PT            |                |                               |

See *Date* (06.016).

The value of this parameter as seen over comms or to an applications module is as follows.

Value = (hour[0..23] x 10000) + (minute[0..59] x 100) + seconds[0..59]

| Parameter         |                                      | 06.018 Day Of Week |                  |
|-------------------|--------------------------------------|--------------------|------------------|
| Short description | Displays the current day of the week |                    |                  |
| Mode              | RFC-A                                |                    |                  |
| Minimum           | 0                                    | Maximum            | 6                |
| Default           |                                      | Units              |                  |
| Type              | 8 Bit Volatile                       | Update Rate        | Background write |
| Display Format    | Standard                             | Decimal Places     | 0                |
| Coding            | RO, TE, ND, NC, PT                   |                    |                  |

| Value | Text      |
|-------|-----------|
| 0     | Sunday    |
| 1     | Monday    |
| 2     | Tuesday   |
| 3     | Wednesday |
| 4     | Thursday  |
| 5     | Friday    |
| 6     | Saturday  |

See *Date* (06.016).

| Parameter         |   | 06.019 Date/Time Selector |                 |
|-------------------|---|---------------------------|-----------------|
| Short description | Defines which clock is used to display the current time, date and day of the week |                           |                 |
| Mode              | RFC-A   |                           |                 |
| Minimum           | 0   | Maximum                   | 5               |
| Default           | 1   | Units                     |                 |
| Type              | 8 Bit User Save   | Update Rate               | Background read |
| Display Format    | Standard  | Decimal Places            | 0               |
| Coding            | RW, TE  |                           |                 |

| Value | Text          |
|-------|---------------|
| 0     | Set           |
| 1     | Powered       |
| 2     | Running       |
| 3     | Acc Powered   |
| 4     | Local Keypad  |
| 5     | Remote Keypad |

*Date/Time Selector* (06.019) is used to select the drive date and time as shown in the table below.

| <i>Date/Time Selector</i> (06.019) | Date/Time Source   |
|------------------------------------|--|
| 0: Set                             | Date and time parameters can be written by the user.   |
| 1: Power                           | Time since the drive was powered up.   |
| 2: Running                         | Accumulated drive running time since the drive was manufactured.   |
| 3: Acc Power                       | Accumulated powered-up time since the drive was manufactured.  |
| 4: Local Keypad                    | If a keypad fitted to the front of the drive includes a real-time clock then the date/time from this clock is displayed, otherwise the date/time is set to zero.                       |
| 5: Remote Keypad                   | If a keypad connected to the user comms port of a drive with a 485 includes a real-time clock then the date/time from this clock is displayed, otherwise the date/time is set to zero. |

When *Date/Time Selector* (06.019) = 0 the *Date* (06.016) and *Time* (06.017) can be written by the user and the values in these parameters are transferred to the real time clocks in keypads that support this feature that are fitted to the drive. When *Date/Time Selector* (06.019) is changed to any other value, the real time clocks are allowed to run normally again. When *Date/Time Selector* (06.019) is changed from any value to 0 the date and time from a real time clock, if present, is automatically loaded into *Date* (06.016) and *Time* (06.017), so that this date and time is used as the initial value for editing. If more than one real time clock is present the date/time from the local keypad is used, if present.

*Date* (06.016) and *Time* (06.017) are used by the timers in Menu 09 and for time stamping trips. These features will continue to use the originally selected clock even if *Date/Time Selector* (06.019) is changed until a drive reset is initiated. If *Date/Time Selector* (06.019) has been changed and a reset is initiated *Timer 1 Repeat Function* (09.039) and *Timer 2 Repeat Function* (09.049) are set to zero to disable the timers, and the trip dates and times (10.041 to 10.060) are reset to zero.

| <b>Parameter</b>          |  |                |                 |
|---------------------------|--|----------------|-----------------|
| <b>06.020 Date Format</b> |  |                |                 |
| Short description         | Defines if the US date format is used or not |                |                 |
| Mode                      | RFC-A  |                |                 |
| Minimum                   | 0  | Maximum        | 1               |
| Default                   | 0  | Units          |                 |
| Type                      | 8 Bit User Save                              | Update Rate    | Background read |
| Display Format            | Standard                                     | Decimal Places | 0               |
| Coding                    | RW, TE                                       |                |                 |

| <b>Value</b> | <b>Text</b> |
|--------------|-------------|
| 0            | Std         |
| 1            | US          |

*Date Format* (06.020) selects the display style for *Date* (06.016), *Timer 1 Start Date* (09.035), *Timer 1 Stop Date* (09.037), *Timer 2 Start Date* (09.045), *Timer 2 Stop Date* (09.047), and for the trip time stamping date parameters (10.041, 10.043, 10.045, 10.047, 10.049, 10.051, 10.053, 10.055, 10.057 and 10.059) when displayed on a keypad connected to the drive. The format selection made in this parameter does not affect the value of these parameters if they are read using comms or by an applications program.

If *Date Format* (06.020) is 0 then standard format is used and the date is displayed on the keypad as dd.mm.yy and if *Date Format* (06.020) is 1 then US format is used and the date is displayed on the keypad as mm.dd.yy.

| <b>Parameter</b>                          |   |                |                 |
|---|---|----------------|-----------------|
| <b>06.021 Time Between Filter Changes</b> |   |                |                 |
| Short description                         | Defines the time between filter changes |                |                 |
| Mode                                      | RFC-A                                   |                |                 |
| Minimum                                   | 0                                       | Maximum        | 30000           |
| Default                                   | 0                                       | Units          | Hours           |
| Type                                      | 16 Bit User Save                        | Update Rate    | Background read |
| Display Format                            | Standard                                | Decimal Places | 0               |
| Coding                                    | RW                                      |                |                 |

*Time Between Filter Changes* (06.021) should be set to a non-zero value to enable the filter change timer system. Each time *Filter Change Required / Change Done* (06.022) is changed by the user from 1 to 0 the value of *Time Between Filter Changes* (06.021) is copied to *Time Before Filter Change Due* (06.023). For each hour while *Drive Active* (10.002) = 1 the *Time Before Filter Change Due* (06.023) is reduced by 1 until it reaches zero. When *Time Before Filter Change Due* (06.023) reaches 0 *Filter Change Required / Change Done* (06.022) is set to 1 to indicate that a filter change is required. The filter should be changed and the system reset again by resetting *Filter Change Required / Change Done* (06.022) to 0.

When a non-zero value is written to *Time Between Filter Changes* (06.021) to enable the system, *Filter Change Required / Change Done* (06.022) should be set to 1 and then back to 0 to transfer the required time to *Time Before Filter Change Due* (06.023) and to enable the count down.

| <b>Parameter</b>                                   |   |                |                       |
|--|---|----------------|-----------------------|
| <b>06.022 Filter Change Required / Change Done</b> |   |                |                       |
| Short description                                  | Set to 0 when a filter change has taken place |                |                       |
| Mode   | RFC-A   |                |                       |
| Minimum  | 0   | Maximum        | 1                     |
| Default  |   | Units          |                       |
| Type   | 1 Bit Volatile                                | Update Rate    | Background read/write |
| Display Format                                     | Standard                                      | Decimal Places | 0                     |
| Coding   | RW, ND, NC                                    |                |                       |

See *Time Between Filter Changes* (06.021).

| <b>Parameter</b>                            |  |                |                  |
|---|--|----------------|------------------|
| <b>06.023 Time Before Filter Change Due</b> |  |                |                  |
| Short description                           | Displays the time before a filter change is required |                |                  |
| Mode  | RFC-A  |                |                  |
| Minimum                                     | 0  | Maximum        | 30000            |
| Default                                     |  | Units          | Hours            |
| Type  | 16 Bit Power Down Save                               | Update Rate    | Background write |
| Display Format                              | Standard   | Decimal Places | 0                |
| Coding                                      | RO, ND, NC, PT                                       |                |                  |

See *Time Between Filter Changes* (06.021).

| Parameter         | 06.024 Reset Energy Meter          |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Set to 1 to reset the energy meter |                |                 |
| Mode              | RFC-A                              |                |                 |
| Minimum           | 0                                  | Maximum        | 1               |
| Default           | 0                                  | Units          |                 |
| Type              | 1 Bit Volatile                     | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW                                 |                |                 |

*Energy Meter: MWh* (06.025) and *Energy Meter: kWh* (06.026) accumulate the energy transferred through the drive. If *Reset Energy Meter* (06.024) = 1 then *Energy Meter: MWh* (06.025) and *Energy Meter: kWh* (06.026) are held at zero. If *Reset Energy Meter* (06.024) = 0 then the energy meter is enabled and will accumulate the energy flow. If the maximum or minimum of *Energy Meter: MWh* (06.025) is reached the parameter does not rollover and is instead clamped at the maximum or minimum value. For Open-loop, RFC-A and RFC-S modes a positive energy flow indicates that power is flowing out of the a.c. motor terminals. For Regen mode a positive energy flow indicates that power is flowing from the supply to the a.c. drive terminals.

| Parameter         | 06.025 Energy Meter: MWh                                    |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the energy accumulated by through the drive in MWh |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | -999.9  | Maximum        | 999.9            |
| Default           |   | Units          | MWh              |
| Type              | 16 Bit Power Down Save                                      | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 1                |
| Coding            | RO, ND, NC, PT  |                |                  |

See *Reset Energy Meter* (06.024).

| Parameter         | 06.026 Energy Meter: kWh                                    |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the energy accumulated by through the drive in kWh |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | -99.99  | Maximum        | 99.99            |
| Default           |   | Units          | kWh              |
| Type              | 16 Bit Power Down Save                                      | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 2                |
| Coding            | RO, ND, NC, PT  |                |                  |

See *Reset Energy Meter* (06.024).

| Parameter         | 06.027 Energy Cost Per kWh         |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Defines the cost of energy per kWh |                |                 |
| Mode              | RFC-A                              |                |                 |
| Minimum           | 0.0                                | Maximum        | 600.0           |
| Default           | 0.0                                | Units          |                 |
| Type              | 16 Bit User Save                   | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 1               |
| Coding            | RW                                 |                |                 |

*Running Cost* (06.028) is derived from the *Output Power* (05.003) and the *Energy Cost Per kWh* (06.027) in cost per hour. The sign of *Running Cost* (06.028) is the same as the sign of *Output Power* (05.003).

| Parameter         | 06.028 Running Cost                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the running cost of the drive |                |                  |
| Mode              | RFC-A                                  |                |                  |
| Minimum           | -32000                                 | Maximum        | 32000            |
| Default           |  | Units          |                  |
| Type              | 16 Bit Volatile                        | Update Rate    | Background write |
| Display Format    | Standard                               | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                         |                |                  |

See *Energy Cost Per kWh* (06.027).

| Parameter         | 06.029 Hardware Enable                       |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to 1 to enable the hardware of the drive |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           |  | Units          |          |
| Type              | 1 Bit Volatile                               | Update Rate    | 2ms read |
| Display Format    | Standard                                     | Decimal Places | 0        |
| Coding            | RO, ND, NC, PT                               |                |          |

*Hardware Enable* (06.029) normally shows the hardware enable state based on the state of the safe torque off system. However, drive I/O can be routed to *Hardware Enable* (06.029) to reduce the disable time. See description of the enable logic for more details.

| <b>Parameter</b>          |   |                |          |
|---------------------------|---|----------------|----------|
| <b>06.030 Run Forward</b> |   |                |          |
| Short description         | Set to 1 to give the drive a run forward signal |                |          |
| Mode                      | RFC-A   |                |          |
| Minimum                   | 0   | Maximum        | 1        |
| Default                   | 0   | Units          |          |
| Type                      | 1 Bit Volatile                                  | Update Rate    | 2ms read |
| Display Format            | Standard  | Decimal Places | 0        |
| Coding                    | RW, NC  |                |          |

If *Reference Selected Indicator* (01.049) is not equal to 4 then *Run Forward* (06.030) can be used to make the Final drive run active and *Reverse Select* (01.012) = 0, i.e. to make the drive run in the forward direction. See description of sequencer logic for more details.

| <b>Parameter</b>  |   |                |          |
|-------------------|---|----------------|----------|
| <b>06.031 Jog</b> |   |                |          |
| Short description | Set to 1 to give the drive a jog signal |                |          |
| Mode              | RFC-A                                   |                |          |
| Minimum           | 0                                       | Maximum        | 1        |
| Default           | 0                                       | Units          |          |
| Type              | 1 Bit Volatile                          | Update Rate    | 2ms read |
| Display Format    | Standard                                | Decimal Places | 0        |
| Coding            | RW, NC                                  |                |          |

If *Reference Selected Indicator* (01.049) is not equal to 4 then *Jog* (06.031) can be used to make the Final drive run active and *Jog Select* (01.013) = 1, i.e. to make the drive run using the jog reference and jog ramps rates. The jog function is disabled if the run is made active through the normal running sequencing bits. See description of sequencer logic for more details.

| <b>Parameter</b>          |   |                |          |
|---------------------------|---|----------------|----------|
| <b>06.032 Run Reverse</b> |   |                |          |
| Short description         | Set to 1 to give the drive a run reverse signal |                |          |
| Mode                      | RFC-A   |                |          |
| Minimum                   | 0   | Maximum        | 1        |
| Default                   | 0   | Units          |          |
| Type                      | 1 Bit Volatile                                  | Update Rate    | 2ms read |
| Display Format            | Standard  | Decimal Places | 0        |
| Coding                    | RW, NC  |                |          |

If *Reference Selected Indicator* (01.049) is not equal to 4 then *Run Reverse* (06.032) can be used to make the Final drive run active and *Reverse Select* (01.012) = 1, i.e. to make the drive run in the reverse direction. See description of sequencer logic for more details.

| <b>Parameter</b>              |  |                |          |
|-------------------------------|--|----------------|----------|
| <b>06.033 Forward/Reverse</b> |  |                |          |
| Short description             | Set to 1 to reverse the direction of the motor |                |          |
| Mode                          | RFC-A  |                |          |
| Minimum                       | 0  | Maximum        | 1        |
| Default                       | 0  | Units          |          |
| Type                          | 1 Bit Volatile                                 | Update Rate    | 2ms read |
| Display Format                | Standard                                       | Decimal Places | 0        |
| Coding                        | RW, NC   |                |          |

If *Reference Selected Indicator* (01.049) is not equal to 4 then *Forward/Reverse* (06.033) can be used to force the state of *Reverse Select* (01.012). If *Forward/Reverse* (06.033) = 1 then *Reverse Select* (01.012) = 1. If *Forward/Reverse* (06.033) = 0 then *Forward/Reverse* (06.033) = 0 unless it is set to 1 by the rest of the normal run or jog logic. See description of sequencer logic for more details.

| <b>Parameter</b>  |   |                |          |
|-------------------|---|----------------|----------|
| <b>06.034 Run</b> |   |                |          |
| Short description | Set to 1 to give the drive a run signal |                |          |
| Mode              | RFC-A                                   |                |          |
| Minimum           | 0                                       | Maximum        | 1        |
| Default           | 0                                       | Units          |          |
| Type              | 1 Bit Volatile                          | Update Rate    | 2ms read |
| Display Format    | Standard                                | Decimal Places | 0        |
| Coding            | RW, NC                                  |                |          |

If *Reference Selected Indicator* (01.049) is not equal to 4 then *Run* (06.034) can be used to make the Final drive run active, but not to affect the state of *Reverse Select* (01.012). Normally *Run* (06.034) would be used in conjunction with *Forward/Reverse* (06.033) if control of the direction is required. See description of sequencer logic for more details.

| Parameter         | 06.035 Forward Limit Switch   |                |                   |
|-------------------|---|----------------|-------------------|
| Short description | Set to 1 to activate the forward limit switch and remove the final drive run signal |                |                   |
| Mode              | RFC-A   |                |                   |
| Minimum           | 0   | Maximum        | 1                 |
| Default           | 0   | Units          |                   |
| Type              | 1 Bit Volatile  | Update Rate    | 2ms or 250µs read |
| Display Format    | Standard  | Decimal Places | 0                 |
| Coding            | RW, NC  |                |                   |

*Forward Limit Switch* (06.035) and *Reverse Limit Switch* (06.036) can be used to activate *Limit Switch Active* (10.066) and remove the Final drive run signal. When *Limit Switch Active* (10.066) is active and *Limit Switch Stop Mode* (06.002) = 0 the motor is stopped without ramps, otherwise it is stopped with the currently selected ramp rate. If digital input 4 or 5 are routed to *Forward Limit Switch* (06.035) or *Reverse Limit Switch* (06.036) the maximum delay is approximately 600µs. The limit switches are direction dependant as shown below, so that the motor can rotate in a direction that allows the system to move away from the limit switch.

| Condition   | Forward Limit Switch (06.035) | Reverse Limit Switch (06.036) |
|---|-------------------------------|-------------------------------|
| <i>Pre-ramp Reference</i> (01.003) + <i>Hard Speed Reference</i> (03.022) > 0.0 | Enabled                       | Not enabled                   |
| <i>Pre-ramp Reference</i> (01.003) + <i>Hard Speed Reference</i> (03.022) < 0.0 | Not enabled                   | Enabled                       |
| <i>Pre-ramp Reference</i> (01.003) + <i>Hard Speed Reference</i> (03.022) = 0.0 | Enabled                       | Enabled                       |

Note that if *Hard Speed Reference Select* (03.023) = 0 then the *Hard Speed Reference* (03.022) is taken as 0.

| Parameter         | 06.036 Reverse Limit Switch   |                |                   |
|-------------------|---|----------------|-------------------|
| Short description | Set to 1 to activate the reverse limit switch and remove the final drive run signal |                |                   |
| Mode              | RFC-A   |                |                   |
| Minimum           | 0   | Maximum        | 1                 |
| Default           | 0   | Units          |                   |
| Type              | 1 Bit Volatile  | Update Rate    | 2ms or 250µs read |
| Display Format    | Standard  | Decimal Places | 0                 |
| Coding            | RW, NC  |                |                   |

See *Forward Limit Switch* (06.035).

| Parameter         | 06.037 Jog Reverse                              |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to 1 to give the drive a jog reverse signal |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile                                  | Update Rate    | 2ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

If *Reference Selected Indicator* (01.049) is not equal to 4 then *Jog Reverse* (06.037) can be used to make the Final drive run active, *Jog Select* (01.013) = 1 and *Reverse Select* (01.012) = 1, i.e. to make the drive run using the jog reference and jog ramps rates in the reverse direction. The jog function is disabled if the run is made active through the normal running sequencing bits. See description of sequencer logic for more details.

| Parameter         | 06.039 Not Stop   |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to 1 to reset the latched sequencer bits if sequencer latching is enabled |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile  | Update Rate    | 2ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

If *Enable Sequencer Latching* (06.040) = 1 then the sequencer bits can be latched. *Not Stop* (06.039) should be used to reset the latched sequencer bits. If *Not Stop* (06.039) = 1 then the sequencer bits can be latched. If *Not Stop* (06.039) = 0 then the latches are cleared and their outputs are forced to zero which will de-activate the Final drive run. See description of sequencer logic for more details.

| Parameter         | 06.040 <i>Enable Sequencer Latching</i> |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to 1 to enable sequencer latching   |                |          |
| Mode              | RFC-A                                   |                |          |
| Minimum           | 0                                       | Maximum        | 1        |
| Default           | 0                                       | Units          |          |
| Type              | 1 Bit User Save                         | Update Rate    | 2ms read |
| Display Format    | Standard                                | Decimal Places | 0        |
| Coding            | RW                                      |                |          |

See *Not Stop* (06.039).

| Parameter         | 06.041 <i>Drive Event Flags</i>                            |                |                    |
|-------------------|--|----------------|--------------------|
| Short description | Displays if certain actions have occurred within the drive |                |                    |
| Mode              | RFC-A  |                |                    |
| Minimum           | 0<br>(Display: 00)   | Maximum        | 3<br>(Display: 11) |
| Default           | 0<br>(Display: 00)   | Units          |                    |
| Type              | 8 Bit Volatile   | Update Rate    | Background write   |
| Display Format    | Binary   | Decimal Places | 0                  |
| Coding            | RW, NC   |                |                    |

*Drive Event Flags* (06.041) indicates that certain actions have occurred within the drive as described below.

| Bit | Corresponding event |
|-----|---------------------|
| 0   | Defaults loaded     |
| 1   | Drive mode changed  |

#### Bit 0: Defaults loaded

The drive sets bit 0 when defaults have been loaded and the associated parameter save has been completed. The drive does not reset this flag except at power-up.

#### Bit 1: Drive mode changed

The drive sets bit 1 when the drive mode has changed and the associated parameter save has been completed. The drive does not reset this flag except at power-up.

| Parameter         | 06.042 <i>Control Word</i>   |                |  |
|-------------------|--|----------------|--|
| Short description | Controls the sequencer state machine inputs if the control word is enabled |                |  |
| Mode              | RFC-A  |                |  |
| Minimum           | 0<br>(Display: 0000000000000000)   | Maximum        | 32767<br>(Display: 1111111111111111)                 |
| Default           | 0<br>(Display: 0000000000000000)   | Units          |  |
| Type              | 16 Bit Volatile  | Update Rate    | Bits 9,7-0: 2ms read. Other bits:<br>Background read |
| Display Format    | Binary   | Decimal Places | 0  |
| Coding            | RW, NC   |                |  |

If *Control Word Enable* (06.043) = 0 then *Control Word* (06.042) has no effect. If *Control Word Enable* (06.043) = 1 the bits in *Control Word* (06.042) are used instead of their corresponding parameters or to initiate drive functions as shown in the table below.

| Bit | Corresponding parameter or function |
|-----|-------------------------------------|
| 0   | <i>Drive Enable</i> (06.015)        |
| 1   | <i>Run Forward</i> (06.030)         |
| 2   | <i>Jog</i> (06.031)                 |
| 3   | <i>Run Reverse</i> (06.032)         |
| 4   | <i>Forward/Reverse</i> (06.033)     |
| 5   | <i>Run</i> (06.034)                 |
| 6   | <i>Not Stop</i> (06.039)            |
| 7   | Auto/manual                         |
| 8   | Analogue/Preset reference           |
| 9   | <i>Jog Reverse</i> (06.037)         |
| 10  | Not used                            |
| 11  | Not used                            |
| 12  | Trip drive                          |
| 13  | <i>Drive Reset</i> (10.033)         |
| 14  | Watchdog                            |

#### Bits 0-7 and bit 9: Sequencer control

When Auto/manual bit (bit7) = 1 then bits 0 to 6 and bit 9 of the *Control Word* (06.042) become active. The equivalent parameters are not modified by these bits, but become inactive when the equivalent bits in the *Control Word* (06.042) are active. When the bits are active they replace the functions of the equivalent parameters.



**Bit 8: Analogue/preset reference**

The state of Analogue/Preset Reference (bit 8) is written continuously to *Reference Select Flag 2* (01.042). With default drive settings (i.e. *Reference Selector* (01.014) = 0) this selects *Analog Reference 1* (01.036) when bit 8 = 0 or *Preset Reference 1* (01.021) when bit8 = 1. If any other drive parameters are routed to *Reference Select Flag 2* (01.042) the value of this parameter is undefined.

**Bit 10 and bit 11: Not used**

The values of these bits have no effect on the drive.

**Bit 12: Trip drive**

If bit 12 = 1 then a *Control Word* trip is repeatedly initiated. The trip cannot be cleared until bit 12 = 0.

**Bit 13: Reset drive**

If bit 13 is changed from 0 to 1 a drive reset is initiated. Bit 13 does not modify *Drive Reset* (10.033).

**Bit 14: Watchdog**

A watchdog system can be enabled or serviced each time bit 14 is changed from 0 to 1. Once bit 14 has been changed from 0 to 1 to enable the watchdog, this must be repeated every 1s or else a *Watchdog* trip will be initiated. The watchdog is disabled when the trip occurs and must be re-enabled if required when the trip is reset.

| Parameter         | 06.043 Control Word Enable          |                |          |
|-------------------|-------------------------------------|----------------|----------|
| Short description | Set to 1 to enable the control word |                |          |
| Mode              | RFC-A                               |                |          |
| Minimum           | 0                                   | Maximum        | 1        |
| Default           | 0                                   | Units          |          |
| Type              | 1 Bit User Save                     | Update Rate    | 2ms read |
| Display Format    | Standard                            | Decimal Places | 0        |
| Coding            | RW                                  |                |          |

See *Control Word* (06.042).

| Parameter         | 06.044 Active Supply  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates when the backup supply mode is enabled and the dc link voltage is below the upper under voltage threshold |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

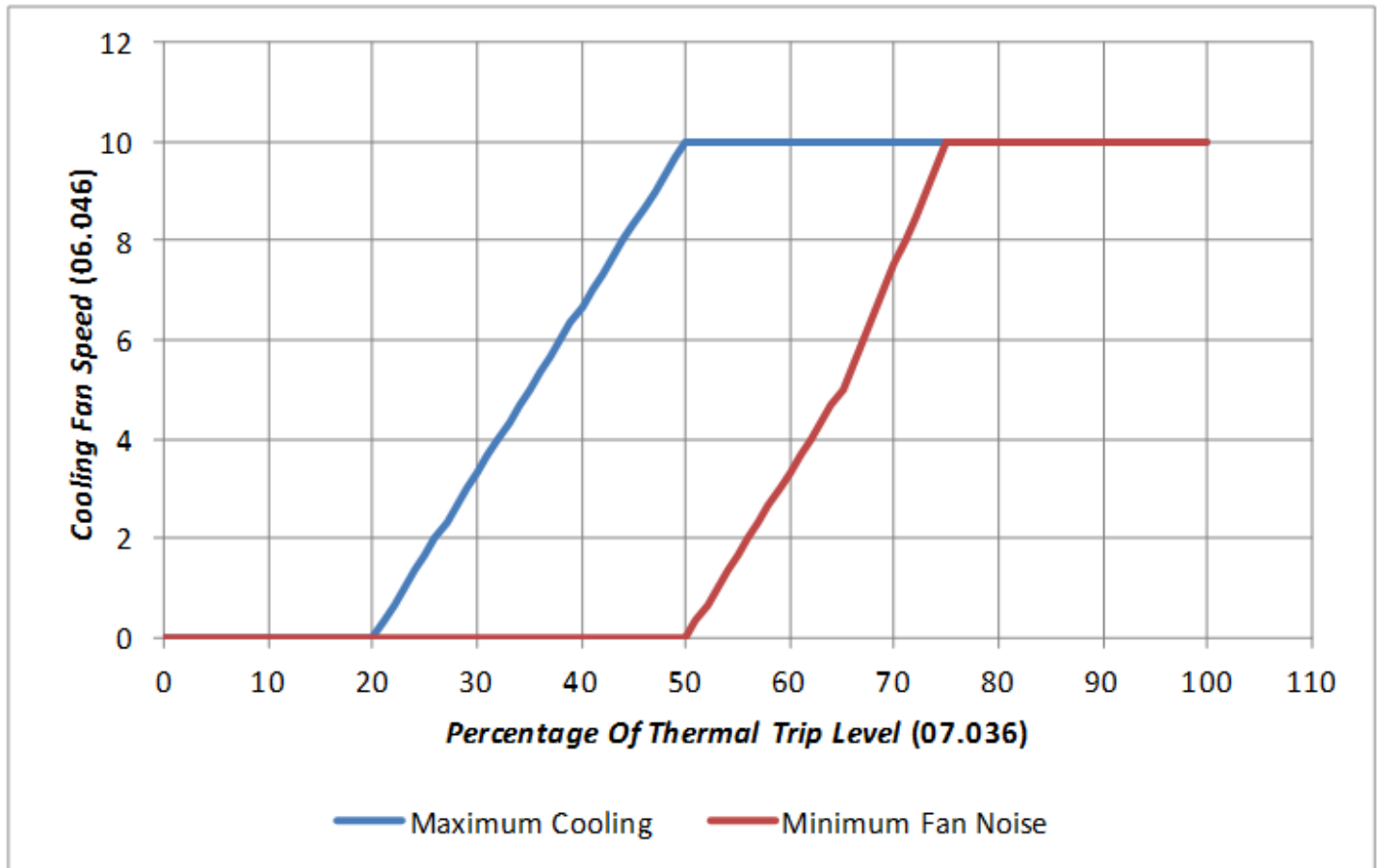
If *Backup Supply Mode Enable* (06.068) = 0 then *Active Supply* (06.044) = 0. If *Backup Supply Mode Enable* (06.068) = 1 then *Active Supply* (06.044) = 0 when the d.c. link voltage is above the upper under-voltage threshold otherwise it is one. In Regen mode *Active Supply* (06.044) is always zero.

| Parameter         | 06.045 Cooling Fan control                         |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the maximum speed of the drive cooling fan |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | -10  | Maximum        | 11              |
| Default           | 10   | Units          |                 |
| Type              | 8 Bit User Save                                    | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

*Cooling Fan control* (06.045) can be used to select various fan control functions as shown in the table below. The actual control speed of the fan(s) is given in *Cooling Fan Speed* (06.046). There are 10 control speeds for the fan(s) in the drive, however the actual hardware control is more coarse than this, and so there may not be an actual change of fan speed as *Cooling Fan Speed* (06.046) changes from one value to the next. The default value for *Cooling Fan control* (06.045) is 10, which gives maximum cooling and does not limit the fan speed below its maximum. It should be noted that if the speed is limited, by setting a lower value, then the drive may trip prematurely under load.

| Cooling Fan control (06.045) | Function Selected  |
|------------------------------|--|
| -10 to -1                    | Minimum fan noise function with fan speed limited to the value of <i>Cooling Fan control</i> (06.045). |
| 0                            | Fan does not run.  |
| 1 to 10                      | Maximum cooling with fan speed limited to the modulus of <i>Cooling Fan control</i> (06.045).          |
| 11                           | Fan runs continuously at full speed.   |

The two possible control characteristics are shown in the diagram below.



The fan speed is derived from *Percentage Of Drive Thermal Trip Level (07.036)* which shows the percentage to the trip level of the hottest monitored point in the drive. The "Maximum Cooling" characteristic brings the fan(s) on at a relatively low temperature to give maximum cooling. The "Minimum Fan Noise" characteristic does not switch on the fan(s) until the drive temperature has risen significantly, and the characteristic has a lower gradient. Therefore with lighter continuous loads the fan noise is kept to a minimum. This characteristic also prevents the fan(s) from coming on when the drive is disabled and operating in a high ambient. With both characteristics a filter is applied to *Percentage Of Drive Thermal Trip Level (07.036)* to avoid the fans switching on and off during short high transient loads. The "Minimum Fan Noise" characteristic also includes a hysteresis band of 15% that is applied to the percentage of drive thermal trip level at the input to the control algorithm to prevent the feedback from changing the speed back again. This reduces the chance of the fan repetitively changing speed under constant load conditions.

| Parameter         | 06.046 Cooling Fan Speed |                |                  |
|-------------------|--------------------------|----------------|------------------|
| Short description | Cooling Fan Speed        |                |                  |
| Mode              | RFC-A                    |                |                  |
| Minimum           | 0                        | Maximum        | 10               |
| Default           |                          | Units          |                  |
| Type              | 8 Bit Volatile           | Update Rate    | Background Write |
| Display Format    | Standard                 | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT           |                |                  |

See *Cooling Fan control (06.045)*.

| Parameter         | 06.047 Input Phase Loss Detection Mode       |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines how the input phase loss is detected |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 2               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                              | Update Rate    | Background read |
| Display Format    | Standard                                     | Decimal Places | 0               |
| Coding            | RW, TE                                       |                |                 |

| Value | Text        |
|-------|-------------|
| 0     | Full        |
| 1     | Ripple Only |
| 2     | Disabled    |

Input phase loss is detected by monitoring the d.c. link voltage ripple which increases with load. When compared to normal operation, if an input phase is missing or there is excessive input phase imbalance the d.c. link the ripple level is higher. For frame sizes 07 and above additional input phase loss detection is provided by direct monitoring of the supply voltages. Unlike the d.c. voltage ripple based detection which can only operate when the drive is enabled and on load, the additional input phase loss detection can operate whether the drive is enabled or not. *Input Phase Loss Detection Mode (06.047)* defines the methods used for input phase loss detection provided by the drive.

| <b>Input Phase Loss Detection Mode (06.047)</b> | <b>Drive Active (10.002) = 0</b>   | <b>Drive Active (10.002) = 1</b>   |
|---|------------------------------------|--|
| 0   | *Direct input phase loss detection | *Direct input phase loss detection<br>D.c. link voltage ripple detection |
| 1   | No input phase loss detection      | D.c. link voltage ripple detection                                       |
| 2   | No input phase loss detection      | No input phase loss detection  |

\*Frame sizes 07 and above

Input phase loss detection can be disabled when the drive is required to operate from a d.c. supply connected to the d.c. link or from a single phase supply. If the drive operates from a single phase supply or a supply with high levels of phase imbalance under load the input stage and d.c. link thermal protection system may produce an *OHt dc bus* trip.

When frame sizes 10 and above are operated with parallel power modules a trip is initiated if the supply is completely removed from the input to any of the parallel modules. This additional detection is disabled if *Input Phase Loss Detection Mode (06.047) > 0*.

| <b>Parameter</b>  | <b>06.048 Supply Loss Detection Level</b>                                       |                |                      |
|-------------------|---|----------------|----------------------|
| Short description | Defines the threshold for indicating when the supply loss condition is detected |                |                      |
| Mode              | RFC-A   |                |                      |
| Minimum           | -VM_SUPPLY_LOSS_LEVEL   | Maximum        | VM_SUPPLY_LOSS_LEVEL |
| Default           | See exceptions below  | Units          | V                    |
| Type              | 16 Bit User Save  | Update Rate    | Background read      |
| Display Format    | Standard  | Decimal Places | 0                    |
| Coding            | RW, VM, RA  |                |                      |

| <b>Voltage</b> | <b>Default Value</b> |
|----------------|----------------------|
| 200V           | 205                  |
| 400V           | 410                  |
| 575V           | 540                  |
| 690V           | 540                  |

See *Supply Loss Mode (06.003)*.

| <b>Parameter</b>  | <b>06.051 Hold Supply Loss Active</b> |                |          |
|-------------------|---------------------------------------|----------------|----------|
| Short description | Hold Supply Loss Active               |                |          |
| Mode              | RFC-A                                 |                |          |
| Minimum           | 0                                     | Maximum        | 1        |
| Default           | 0                                     | Units          |          |
| Type              | 1 Bit Volatile                        | Update Rate    | 2ms Read |
| Display Format    | Standard                              | Decimal Places | 0        |
| Coding            | RW, NC                                |                |          |

If supply loss is detected (i.e. *Supply Loss (10.015) = 1*) or *Hold Supply Loss Active (06.051) = 1* the supply loss indication and the action taken on supply loss will be active. For example, *Hold Supply Loss Active (06.051)* can be controlled by an external rectifier or a Regen system (via a digital input) to prevent power from being taken from the supply if supply loss ride-through mode is being used until the input system is ready to provide power. For example, this can allow a charge system in an external rectifier to complete the charging of the d.c. link and become inactive before power is taken from the supply. A Regen system connected between the supply and the drive can operate in auto-synchronisation mode for a short time when the supply is removed. *Hold Supply Loss Active (06.051)* can be used to make the supply loss state persist for a short time after the supply is reapplied while the Regen system recovers. See *Disable Charge System / Close Contactor (03.007)* for more details.

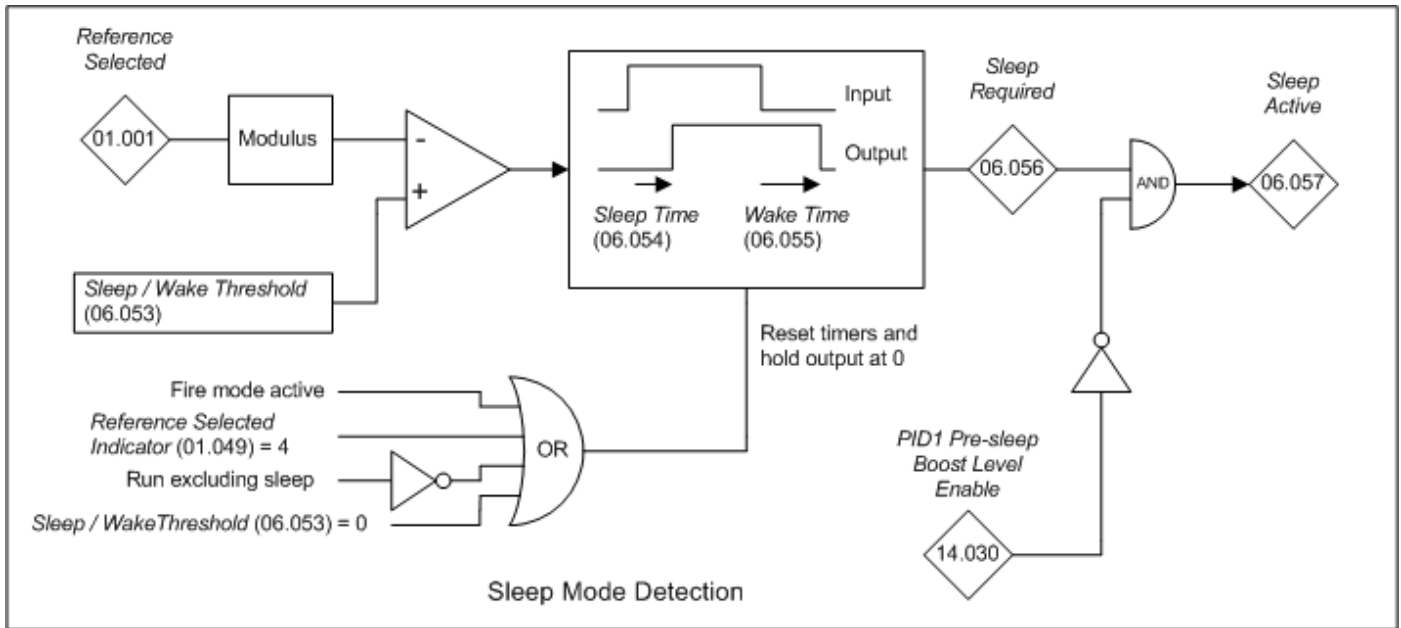
| <b>Parameter</b>  | <b>06.052 Motor Pre-heat Current Magnitude</b>                               |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the current in the motor when the state machine is in the stop state |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 100             |
| Default           | 0  | Units          | %               |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *Hold Zero Speed (06.008)*.

| <b>Parameter</b>  | <b>06.053 Sleep / Wake Threshold</b>                            |                |                            |
|-------------------|---|----------------|----------------------------|
| Short description | Defines the threshold used for enabling the sleep/wake function |                |                            |
| Mode              | RFC-A   |                |                            |
| Minimum           | -VM_SPEED_FREQ_REF_UNIPOLAR                                     | Maximum        | VM_SPEED_FREQ_REF_UNIPOLAR |
| Default           | 0.0   | Units          |                            |
| Type              | 32 Bit User Save  | Update Rate    | Background Read            |
| Display Format    | Standard  | Decimal Places | 1                          |
| Coding            | RW, VM  |                |                            |

The diagram below shows the sleep mode detection system. If Fire mode active = 1, *Reference Selected Indicator (01.049) = 4*, the Run excluding sleep = 0 or *Sleep / Wake Threshold (06.053) = 0* then the sleep mode system is disabled, and so *Sleep Required (06.056)* and *Sleep Active (06.057)* are held

at zero.



The sleep mode system will stop the motor if  $|Reference\ Selected\ (01.001)| < Sleep\ / \ Wake\ Threshold\ (06.053)$  for a time equal to *Sleep Time* (06.054) and restart the motor if  $|Reference\ Selected\ (01.001)| \geq Sleep\ / \ Wake\ Threshold\ (06.053)$  for a time equal to *Wake Time* (06.055). If *Bipolar Reference Enable* (01.010) = 0 (i.e. unipolar mode is being used) then negative values of *Reference Selected* (01.001) are treated as zero. It is possible for the PID controller (Menu 14) to hold off sleep mode by setting *PID1 Pre-sleep Boost Level Enable* (14.028) to 1.

| Parameter         | 06.054 Sleep Time   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the time that the drive will stop the motor if the sleep function is active |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.0   | Maximum        | 250.0           |
| Default           | 10.0  | Units          | s               |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW  |                |                 |

See *Sleep / Wake Threshold* (06.053).

| Parameter         | 06.055 Wake Time  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the time that the drive will restart the motor if the wake function is active |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.0   | Maximum        | 250.0           |
| Default           | 10.0  | Units          | s               |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW  |                |                 |

See *Sleep / Wake Threshold* (06.053).

| Parameter         | 06.056 Sleep Required  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates if the pre-requisites of the sleep mode system are in the state to enable the sleep function |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

See *Sleep / Wake Threshold* (06.053).

| Parameter         | 06.057 Sleep Active                               |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays if the sleep function has been activated |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile                                    | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                    |                |                  |

See *Sleep / Wake Threshold* (06.053).

| Parameter         | 06.058 Output Phase Loss Detection Time |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Output Phase Loss Detection Time        |                |                 |
| Mode              | RFC-A                                   |                |                 |
| Minimum           | 0                                       | Maximum        | 3               |
| Default           | 0                                       | Units          |                 |
| Type              | 8 Bit User Save                         | Update Rate    | Background Read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW, TE                                  |                |                 |

| Value | Text |
|-------|------|
| 0     | 0.5s |
| 1     | 1.0s |
| 2     | 2.0s |
| 3     | 4.0s |

See *Output Phase Loss Detection Enable* (06.059). This parameter has no effect in RFC-S mode.

| Parameter         | 06.059 Output Phase Loss Detection Enable                   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to non-zero value to enable output phase loss detection |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 2               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text     |
|-------|----------|
| 0     | Disabled |
| 1     | Phases   |
| 2     | Devices  |

Output phase loss detection can be used to detect a disconnected motor phase or a failed power device if *Output Phase Loss Detection Enable* (06.059) is set to a non-zero value.

#### 0: Disabled

Output phase loss detection is not active.

#### 1: Phases

A test is carried out each time the drive is enabled to run to check if all three phases are connected. If the test fails an *Out Phase Loss.X* trip is initiated where X indicates which phase is not connected (1 = U, 2 = V, 3 = W). It should be noted that this test is not carried out in Open-loop mode if "catch a spinning motor" is enabled (i.e. *Catch A Spinning Motor* (06.009) > 0). A test is also carried out while the drive is running. If the drive output frequency is above 4Hz and a phase is disconnected for the time specified by *Output Phase Loss Detection Time* (06.058) then a *Out Phase Loss.4* trip is initiated. It should be noted that if the motor is operating at high speed and flux weakening is active so that the magnetising current is below half the rated level then output phase loss will not be detected. If the motor is heavily loaded when a phase is disconnected it is likely that the motor will stall and the drive output frequency may fall below 4Hz before output phase loss is detected.

#### 2: Devices

This test is similar to the "Phases" test above except that additional tests are carried out when the drive is enabled to run which can detect if a either the positive or negative power device has failed in each phase. If a phase is disconnected or the positive power device has failed then an *Out Phase Loss.X* trip is initiated where X is between 1 and 3 and indicates the phase that is not connected or has a failed positive device (1 = U, 2 = V, 3 = W). If X is between 5 and 7 it indicates that the negative power device in a phase has failed (5 = U, 6 = V, 7 = W).

The "Phases" test requires that 1/2 rated motor current flows to indicate that the phase is connected. The "Devices" test only requires 1/8 of rated current, and so it produces much less acoustic noise on starting. In either mode the tests take approximately 50ms. The "Devices" test is the preferred test as it tests all the power devices and produces less acoustic noise. The "Phases" test is provided for legacy reasons.

| Parameter         | 06.060 Standby Mode Enable   |                |                 |
|-------------------|------------------------------|----------------|-----------------|
| Short description | Set to 1 enable standby mode |                |                 |
| Mode              | RFC-A                        |                |                 |
| Minimum           | 0                            | Maximum        | 1               |
| Default           | 0                            | Units          |                 |
| Type              | 1 Bit User Save              | Update Rate    | Background read |
| Display Format    | Standard                     | Decimal Places | 0               |
| Coding            | RW                           |                |                 |

If *Standby Mode Enable* (06.060) = 1 then the drive will go into the standby power state whenever *Drive Active* (10.002) = 0 with a delay of 30s. In this state the LED on the front of the drive flashes 0.5s on and 5s off, the drive cannot be enabled and the following actions are taken as defined by the *Standby Mode Mask* (06.061). Actions are enabled by setting the appropriate bit to 1. Once standby mode has become active it will remain active, even if an attempt is made subsequently to enable the drive, until *Standby Mode Enable* (06.060) is set to 0.

| Standby Mode Mask (06.061) bits | Action  |
|---------------------------------|---|
| 0                               | Turn off the drive position feedback power supply. On leaving standby mode the drive position feedback interfaces will be re-initialised. |
| 1                               | Turn off the power supply to a keypad fitted to the drive.  |
| 2                               | Turn off the drive 24V output.  |
| 3                               | Request that the option module in option slot 1 to go into the standby power mode   |
| 4                               | Request that the option module in option slot 2 to go into the standby power mode   |
| 5                               | Request that the option module in option slot 3 to go into the standby power mode   |
| 6                               | Request that the option module in option slot 4 to go into the standby power mode   |

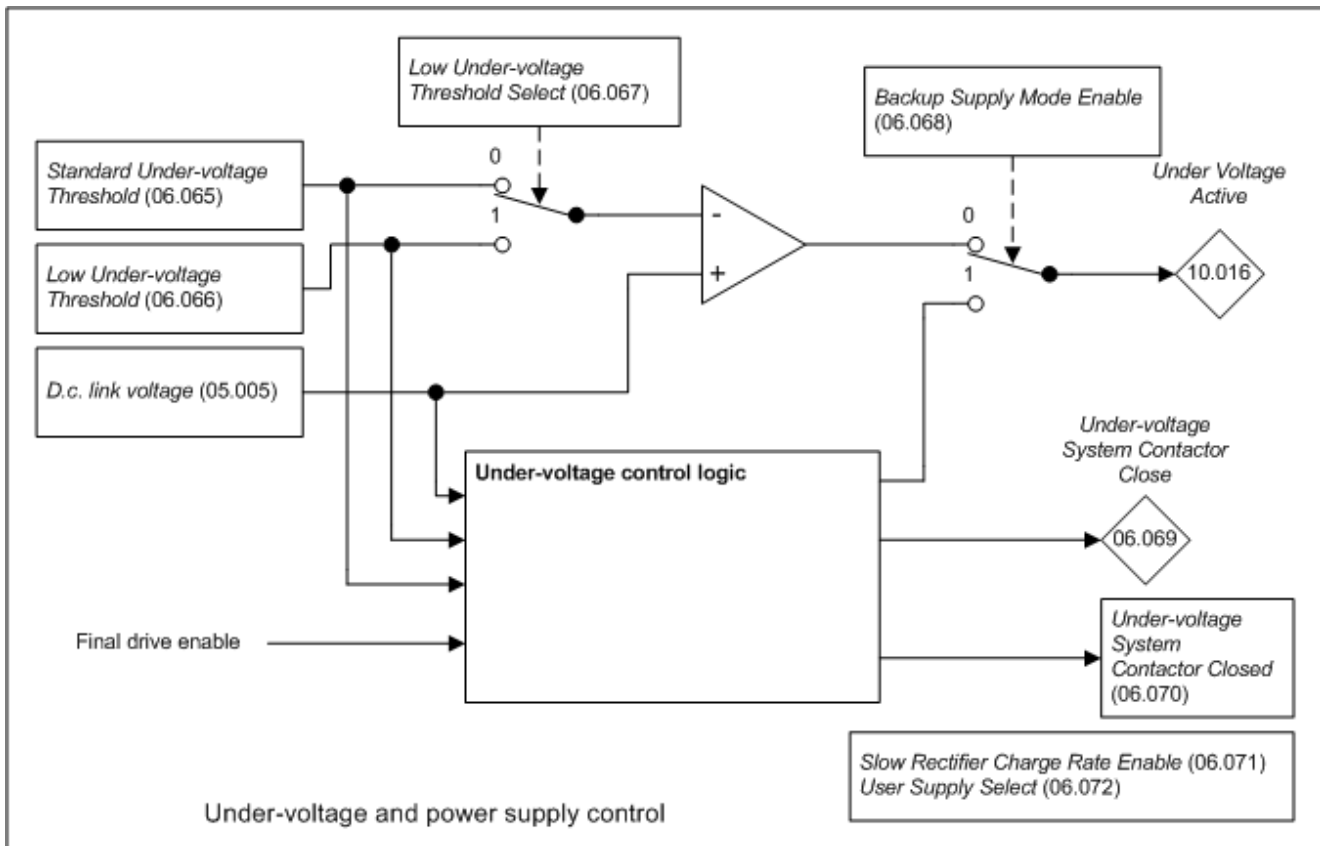
| Parameter         | 06.061 Standby Mode Mask                                      |                |                           |
|-------------------|---|----------------|---------------------------|
| Short description | Defines the actions of the drive with standby mode is enabled |                |                           |
| Mode              | RFC-A   |                |                           |
| Minimum           | 0<br>(Display: 0000000)                                       | Maximum        | 127<br>(Display: 1111111) |
| Default           | 0<br>(Display: 0000000)                                       | Units          |                           |
| Type              | 8 Bit User Save   | Update Rate    | Background read           |
| Display Format    | Binary  | Decimal Places | 0                         |
| Coding            | RW  |                |                           |

See *Standby Mode Enable* (06.060).

| Parameter         | 06.065 Standard Under Voltage Threshold      |                |                    |
|-------------------|--|----------------|--------------------|
| Short description | Defines the standard under voltage threshold |                |                    |
| Mode              | RFC-A  |                |                    |
| Minimum           | -VM_STD_UNDER_VOLTS                          | Maximum        | VM_STD_UNDER_VOLTS |
| Default           | See exceptions below                         | Units          | V                  |
| Type              | 16 Bit User Save                             | Update Rate    | Background read    |
| Display Format    | Standard                                     | Decimal Places | 0                  |
| Coding            | RW, VM, RA                                   |                |                    |

| Voltage | Default Value |
|---------|---------------|
| 200V    | 175           |
| 400V    | 330           |
| 575V    | 435           |
| 690V    | 435           |

#### Under-voltage and power supply control



### Under-voltage system

The under-voltage system controls the state of *Under Voltage Active* (10.016) which is then used by the sequencer state machine. Normally one detector is used to detect when the under-voltage state is active, unless back-up mode is being used with smaller drives (see below). The detector(s) include 5% hysteresis subject to a minimum of 5V. If *D.c. Bus Voltage* (05.005) is below the threshold *Under Voltage Active* (10.016) = 0. If *D.c. Bus Voltage* (05.005) is above the threshold, but below the threshold plus the 5% hysteresis there is no change of state. If *D.c. Bus Voltage* (05.005) is above the threshold plus 5% hysteresis *Under Voltage Active* (10.016) changes to one with a delay of 250ms. The delay is provided to allow the d.c. link voltage to stop rising before the charging system is disabled.

When *Under Voltage Active* (10.016) = 1 the sequencer state machine will change to the UNDER\_VOLTAGE state and when the UNDER\_VOLTAGE state is active it is not possible to enable the drive inverter. The under-voltage system operates in different ways depending on the setting of *Backup Supply Mode Enable* (06.068).

If the low under-voltage threshold is used or if back-up supply mode is selected the internal drive power supplies are normally powered from the 24V supply input (i.e. Digital I/O 13). See *User Supply Select* (06.072) for details. (It should be noted that in Regen mode *Backup Supply Mode Enable* (06.068) is not present, and so back-up supply mode cannot be selected.)

Drive frame sizes 06 and below use a charging system based on a charge resistor and shorting relay. For larger drive frame sizes a thyristor based charge system is used. The type of charge system does not alter the operation of the drive except for the times allowed for soft-start state changes and the method used for back-up supply mode. The setting for the under-voltage level is used to detect the under-voltage condition based on the d.c. link voltage. If a thyristor charging system is used this level is also passed to the thyristor rectifier system so that it is fully deactivated (i.e. the thyristors are phased forwards so that the drive can take power from the supply) by the time the d.c. link voltage reaches the under-voltage level and allows the drive inverter to become active. It should be noted that the under-voltage threshold used with a thyristor based charge system and the charging rate (*Slow Rectifier Charge Rate Enable* (06.071)) are automatically saved within the rectifier units each time the value is changed because these will be required at the next power-up before the drive control system is active. These values will be retained when they are changed 128 times. If any more changes are made between power-up and power-down the new values are not retained.

#### Standard mode: Backup Supply Mode Enable (06.068) = 0

If *Low Under Voltage Threshold Select* (06.067) = 0 then the under voltage threshold is defined by *Standard Under Voltage Threshold* (06.065). If *Low Under Voltage Threshold Select* (06.067) = 1 then the under voltage threshold is defined by *Low Under Voltage Threshold* (06.066). For drives which have a d.c. link charge system based on a charge resistor and shorting contactor, the charge system is normally active (contactor open) when *Under Voltage Active* (10.016) = 1, and inactive when *Under Voltage Active* (10.016) = 0. The exception is that there is a delay of 50ms while the contactor changes state and during these periods *Under Voltage Active* (10.016) = 1.

If the d.c. link voltage is above the under-voltage threshold and *Under Voltage Active* (10.016) = 0 a large surge of current can occur if the a.c. supply is removed and then reapplied to the drive. For a given level of supply voltage the worst case surge occurs when the supply is applied at the point where one of the line voltages is at its peak. The surge is proportional to the difference between the d.c. link voltage before the supply is reconnected and the magnitude of the supply voltage. The minimum setting and default for *Standard Under Voltage Threshold* (06.065) corresponds to the lowest d.c. link voltage level where the maximum allowed a.c. supply voltage can be applied without damaging the drive or rupturing the recommended supply fuses. Therefore it is safe to adjust the under-voltage threshold using the *Standard Under Voltage Threshold* (06.065). If the under-voltage threshold needs to be lower than the minimum of *Standard Under Voltage Threshold* (06.065), then the *Low Under Voltage Threshold* (06.066) should be used. It is important that the difference between the under-voltage threshold level and the peak of the supply voltage is never larger than the difference between the minimum *Standard Under Voltage Threshold* (06.065) and the peak of the maximum allowed a.c. supply voltage for the drive. For example:

The minimum *Standard Under Voltage Threshold* (06.065) for a 400V drive is 330V

The maximum allowed supply voltage for this drive is 480V + 10%

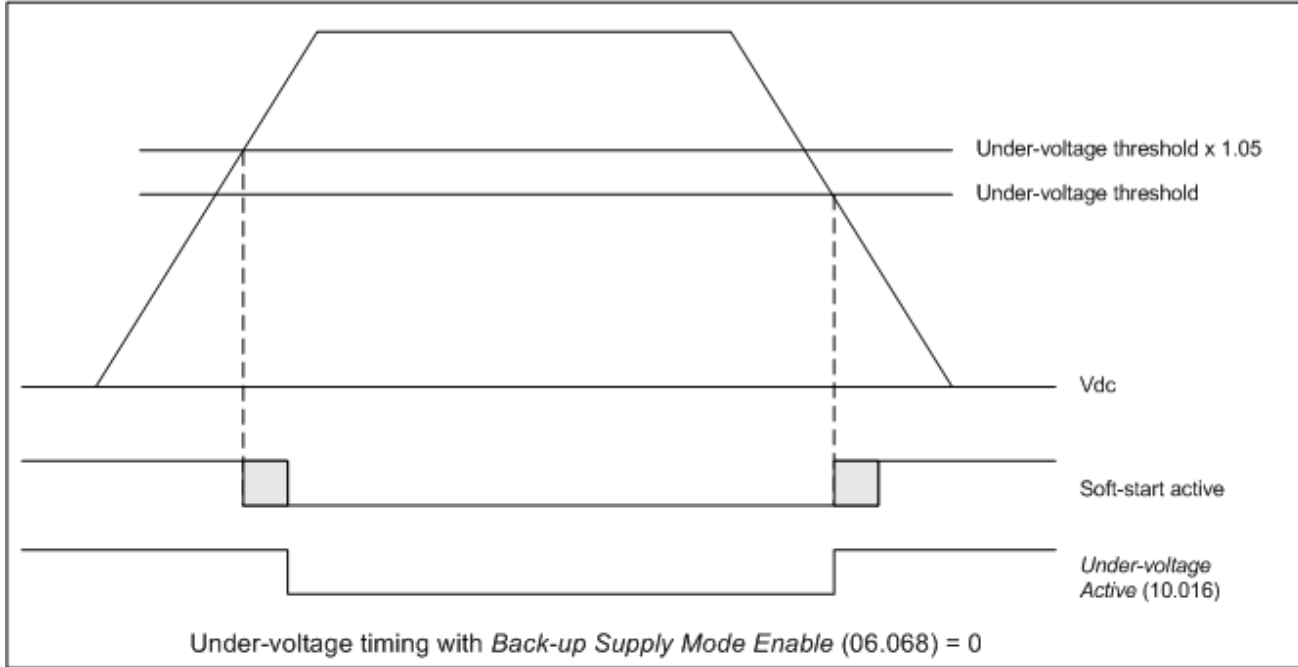
The peak of the maximum allowed supply voltage =  $480 \times 1.1 \times \sqrt{2} = 747\text{V}$

The difference between the under-voltage threshold and the peak supply voltage =  $747 - 330 = 417\text{V}$

Therefore for this drive voltage rating the peak line to line voltage must never be higher than *Low Under Voltage Threshold* (06.066) + 417V.

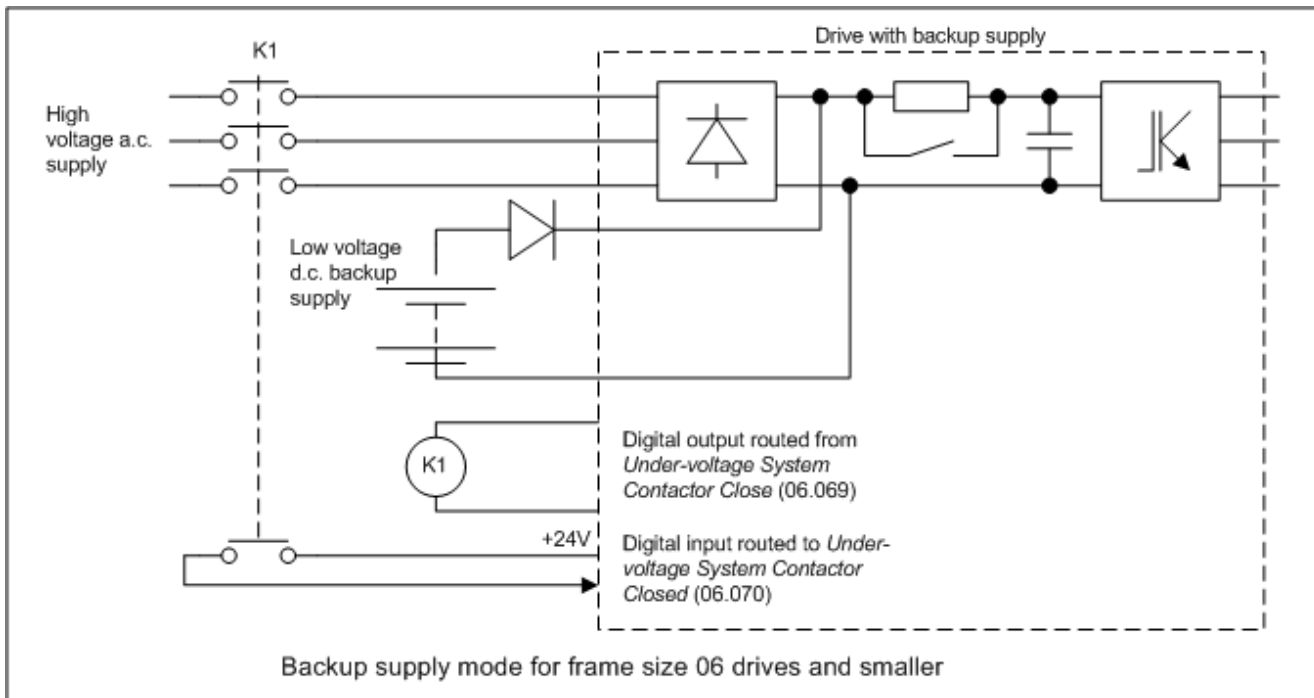
If *Low Under Voltage Threshold Select* (06.067) is set to one and *Low Under Voltage Threshold* (06.066) is reduced below the variable maximum level VM\_STD\_UNDER\_VOLTAGE[MIN], or if *Backup Supply Mode Enable* (06.068) is set to one, an indication is stored in *Potential Drive Damage Conditions* (10.106) that cannot be cleared by the user. This marks the drive, so that if it is damaged as a result of an input current surge, this can be detected by service personnel.

For frame size 07 drives and larger, which use a d.c. link charge system based on a half controlled thyristor input bridge, the charge system is activated based on the level of the voltage at the a.c. supply terminals of the drive. The threshold for the charge system is set so that the rectified supply will give the required under-voltage threshold level. The under-voltage system operates in exactly the same way as for smaller drives except that the delay during the transition out of the under-voltage state is extended. For single power module drive the delay is 1.0s to allow the thyristor charge system to charge the d.c. link. For parallel power modules the delay is extended to 2.5s to ensure that all modules power up correctly.



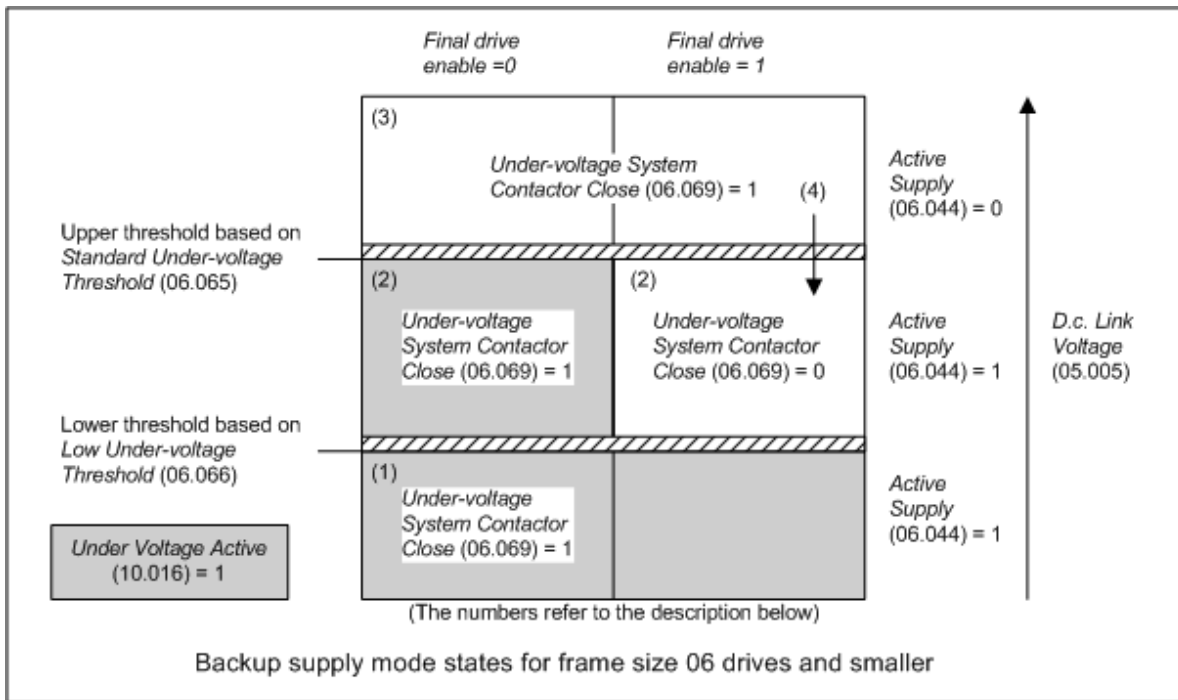
**Backup Supply Mode for frame size 06 drives and smaller: Backup Supply Mode Enable (06.068) = 1**

Backup supply mode is intended to provide a smooth transition, without disabling the drive, from a high voltage a.c. supply to a low voltage d.c. backup supply. It is necessary to disable the drive for the transition back to the high voltage a.c. supply. The following diagram is a simple representation of the power circuit required. This does not include the necessary circuit protection components or possible battery charger, etc.



The diagram below shows the state of *Under Voltage Active* (10.016), the control signal to the external contactor (*Under-voltage System Contactor Close* (06.069) and *Active Supply* (06.044). When *Backup Supply Mode Enable* (06.068) is set to one the maximum applied to *Low Under Voltage Threshold* (06.066) prevents this from being increased above *Standard Under Voltage Threshold* (06.065) / 1.1 so that the 5% hysteresis band on the low under-voltage threshold does not overlap the standard under-voltage threshold.



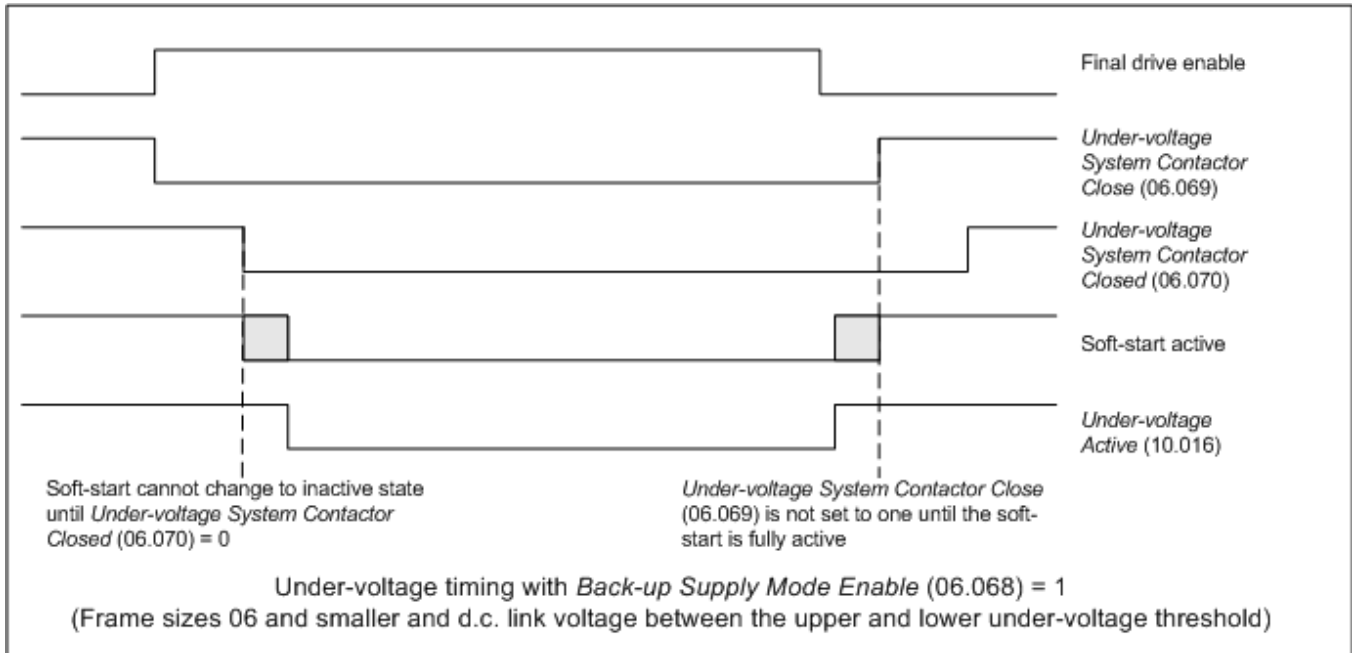


The numbers below correspond to the numbers shown in the diagram:

1. If the *D.c. Bus Voltage* (05.005) is below the Lower Threshold the drive is in the under-voltage state and the internal charge system is active to limit the charging current either from the low voltage d.c. backup supply or the high voltage a.c. supply. *Under-voltage System Contactor Close* (06.069) = 1, and so it is possible for the high voltage a.c. supply to charge the d.c. link.
2. If the *D.c. Bus Voltage* (05.005) is above the Lower Threshold, but below the Upper Threshold, there are two possible states depending on whether the Final drive enable is 0 or 1. If Final drive enable = 0 then *Under Voltage Active* (10.016) = 1, the internal charge system is active and *Under-voltage System Contactor Close* (06.069) = 1, so that the d.c. link can be charged by the high voltage a.c. supply. If Final drive enable = 1 then *Under Voltage Active* (10.016) = 0 and the internal charge system is inactive so that the drive can run from the low voltage d.c. backup supply. *Under-voltage System Contactor Close* (06.069) = 0, so that it is not possible for the high voltage a.c. supply to charge the d.c. link.
3. If the *D.c. Bus Voltage* (05.005) is above the Upper Threshold then *Under Voltage Active* (10.016) = 0 and *Under-voltage System Contactor Close* (06.069) = 1, so the drive can run from the high voltage a.c. supply.
4. If the *D.c. Bus Voltage* (05.005) subsequently falls below the Upper Threshold and the Final drive enable = 1, the drive can continue to run, but *Under-voltage System Contactor Close* (06.069) is set to zero to open the high voltage a.c. supply contactor. The d.c. link voltage will fall until it reaches the low voltage d.c. backup supply level. This gives a smooth changeover to the backup supply without stopping the motor.

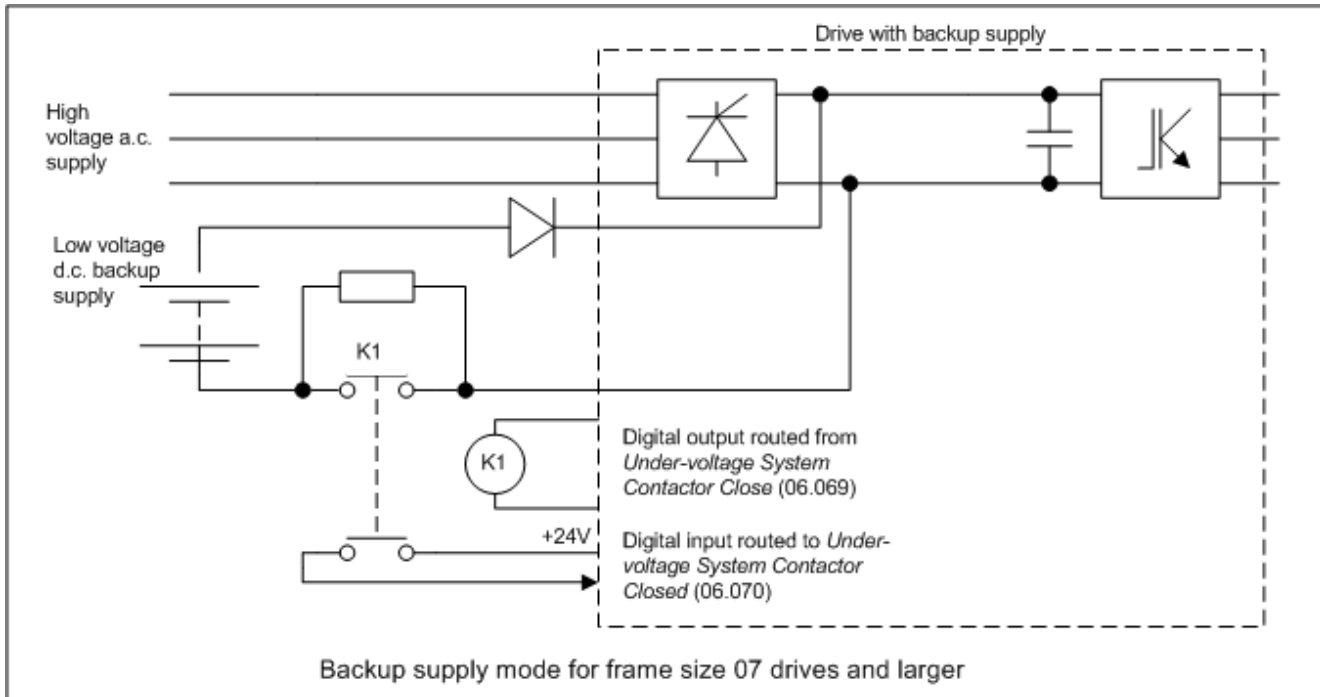
To ensure that the soft-start is in the correct state to protect the drive the following additional restrictions are applied:

1. The soft-start cannot change to the inactive state (i.e. internal soft-start relay closed) unless the d.c. link voltage is above the upper under-voltage threshold or *Under-voltage System Contactor Closed* (06.070) = 0. This is shown in the diagram below which shows the drive operation when the d.c. link voltage is between the upper and lower thresholds. When the Final Drive Enable becomes active the external contactor is opened to disconnect the supply because the drive is intended to run from the back-up supply. The soft-start should not be deactivated until the external contactor is opened because it is providing protection against surge currents due to the supply being reapplied. Once it is open the soft-start is deactivated (relay closed) and the drive can run. A side effect of this additional condition occurs when the d.c. link voltage falls and crosses the upper threshold when the drive is running. There should be a smooth transition, but the delay between disabling the external contactor (*Under-voltage System Contactor Close* (06.069) = 0) and confirmation of this (*Under-voltage System Contactor Closed* (06.070) = 0) when the d.c. link voltage crosses the threshold will cause the soft-start to activate transiently giving a period with under-voltage active. To prevent this problem the indication that the d.c. link voltage has fallen and crossed the upper threshold is delayed by 200ms.
2. *Under-voltage System Contactor Close* (06.069) is not set to one until the soft-start is fully active (relay open) because the soft-start is required to prevent current surges from the supply being applied. This is also shown in the diagram below.

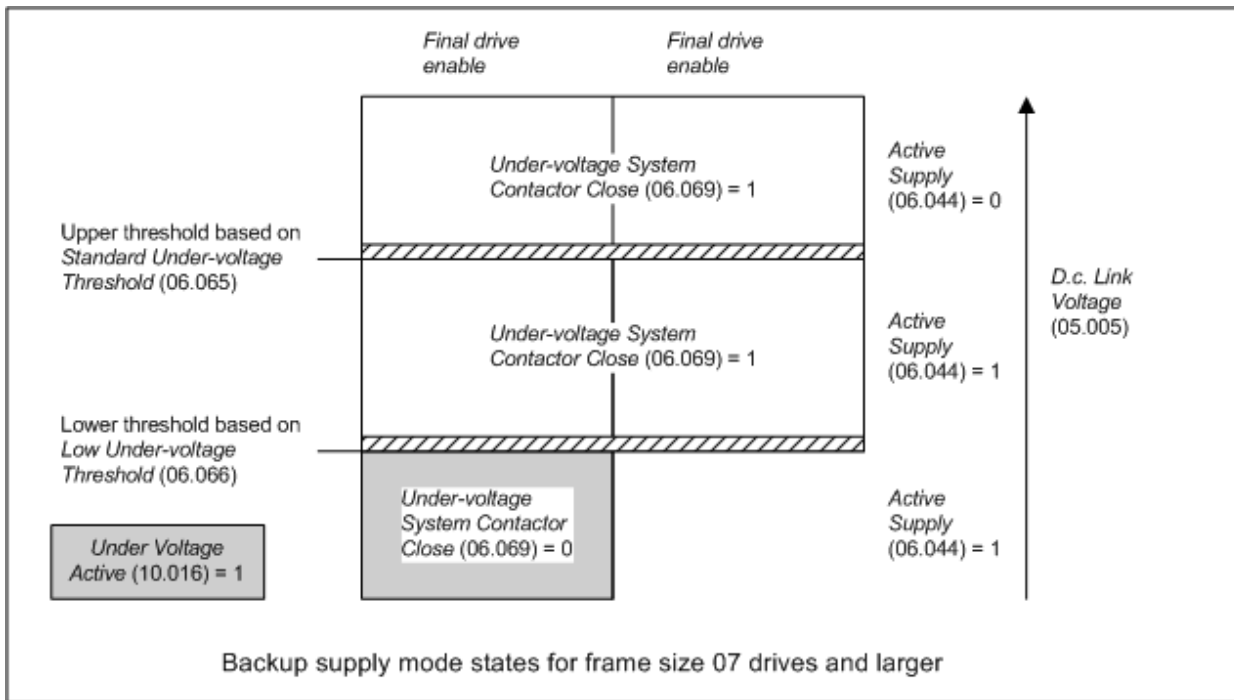


**Backup Supply Mode for frame size 07 drives and larger: (Backup Supply Mode Enable (06.068) = 1)**

Backup supply mode is intended to provide a smooth transition, without disabling the drive, from a high voltage a.c. supply to a low voltage d.c. backup supply and vice versa. The following diagram is a simple representation of the power circuit required. This does not include the necessary circuit protection components or possible battery charger, etc.



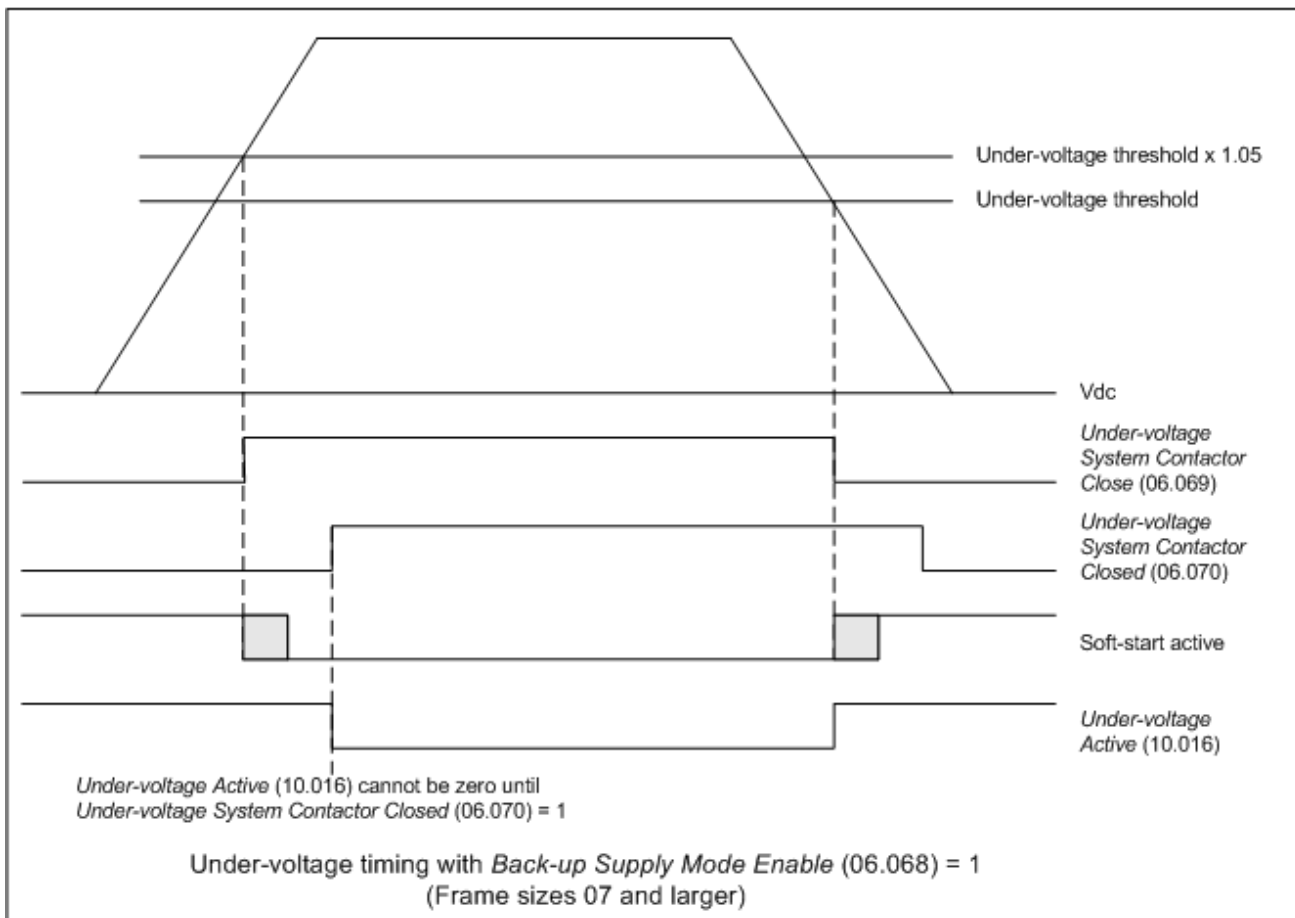
The diagram below shows the state of Under Voltage Active (10.016) and the control signal to the external contactor (Under-voltage System Contactor Close (06.069)).



The backup supply system contactor is used to provide the charge system for the low voltage d.c. backup supply. The charge system for the high voltage a.c. supply is provided by the half controlled thyristor input bridge within the drive. The system operates in a similar way to standard mode (i.e. back-up mode not enabled) with the following differences.

1. The thyristor charge system always uses a threshold voltage related to the upper under-voltage threshold.
2. *Under-voltage System Contactor Close* (06.069) is set to one when the d.c. link voltage is above the lower under-voltage threshold.
3. *Under Voltage Active* (10.016) cannot be zero to allow the drive to be enabled if *Under-voltage System Contactor Closed* (06.070) is zero. This prevents power from being taken from the back-up supply if the mains supply is not present when the external soft-start system contactor is open.

The following diagram shows how these differences apply to the system operation.



| Parameter         | 06.066 Low Under Voltage Threshold      |                |                    |
|-------------------|---|----------------|--------------------|
| Short description | Defines the low under voltage threshold |                |                    |
| Mode              | RFC-A                                   |                |                    |
| Minimum           | -VM_LOW_UNDER_VOLTS                     | Maximum        | VM_LOW_UNDER_VOLTS |
| Default           | See exceptions below                    | Units          | V                  |
| Type              | 16 Bit User Save                        | Update Rate    | Background read    |
| Display Format    | Standard                                | Decimal Places | 0                  |
| Coding            | RW, VM, RA                              |                |                    |

| Voltage | Default Value |
|---------|---------------|
| 200V    | 175           |
| 400V    | 330           |
| 575V    | 435           |
| 690V    | 435           |

See *Standard Under Voltage Threshold* (06.065).

| Parameter         | 06.067 Low Under Voltage Threshold Select       |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to use the low under voltage threshold |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save                                 | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Standard Under Voltage Threshold* (06.065). Also see *User Supply Select* (06.072) for details of when and how drive parameters can be saved, and when a *User 24V* trip can occur.

| Parameter         | 06.068 Backup Supply Mode Enable          |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to enable the backup supply mode |                |                 |
| Mode              | RFC-A                                     |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save                           | Update Rate    | Background read |
| Display Format    | Standard                                  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Standard Under Voltage Threshold* (06.065). Also see *User Supply Select* (06.072) for details of when and how drive parameters can be saved, and when a *User 24V* trip can occur.

| Parameter         | 06.069 Under-voltage System Contactor Close   |                |           |
|-------------------|---|----------------|-----------|
| Short description | Should be used as the source of a digital output to control an external supply contactor when using low voltage operation |                |           |
| Mode              | RFC-A   |                |           |
| Minimum           | 0   | Maximum        | 1         |
| Default           |   | Units          |           |
| Type              | 1 Bit Volatile  | Update Rate    | 4ms write |
| Display Format    | Standard  | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT  |                |           |

See *Standard Under Voltage Threshold* (06.065).

| Parameter         | 06.070 Under-voltage System Contactor Closed   |                |          |
|-------------------|--|----------------|----------|
| Short description | Should be the destination of a digital input that indicates the state of an external supply contactor when using low voltage operation |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit Volatile   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW   |                |          |

See *Standard Under Voltage Threshold* (06.065).

| Parameter         | 06.071 <i>Slow Rectifier Charge Rate Enable</i>    |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to reduce the charge rate of the d.c. bus |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save                                    | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

For frame size 07 drives and larger, which use a d.c. link charge system based on a half controlled thyristor input bridge, the rate at which the d.c. bus is charged can be reduced by setting *Slow Rectifier Charge Rate Enable* (06.071) to one. This will reduce the charging current which may be required if significant additional capacitance is added to the d.c. link to prevent rupturing of input fuses.

| Parameter         | 06.072 <i>User Supply Select</i>                      |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to select the supply from the user 24V input |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save                                       | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

The power for the drive control system is either taken from the user 24V power supply or the main supply (i.e. derived from the power circuit d.c. link). If *Low Under Voltage Threshold Select* (06.067) = 0 and *Backup Supply Mode Enable* (06.068) = 0 and *User Supply Select* (06.072) = 0 then the supply used is determined as follows for drive sizes 5 and below. (For drive sizes 6 and above a diode OR system is used to select the required power supply, and so this is done automatically in hardware.)

1. When the drive first powers up it tries to use the main supply or the user 24V supply in turn until the drive starts up, beginning with the main supply.
2. If the main supply is active and the d.c. link voltage (*D.c. Bus Voltage* (05.005)) falls to a level where it is no longer possible to communicate with the power stage then the drive attempts to switch over to the user 24V supply. If the user 24V supply is not present then the drive will power down, otherwise it will continue to run off the user 24V supply. The level at which the power stage powers down depends on whether the user 24V supply is present or not. However this is maybe below half the minimum for *Standard Under Voltage Threshold* (06.065) depending on the drive power supply loading from option modules, encoders, I/O etc.
3. If the user 24V supply is being used and the d.c. link voltage (*D.c. Bus Voltage* (05.005)) rises above 95% of the minimum for *Standard Under Voltage Threshold* (06.065) then the drive attempts to switch to the main supply.

The following should be noted:

1. Parameters can be saved by setting *Parameter mm.000* (mm.000) to 1000 (not in under-voltage state), or to 1 or 1001 (in any state) and initiating a drive reset. Power-down save parameters are saved when the under-voltage state becomes active.
2. If the drive is powered from the user 24V supply and then the main supply is activated but is not above 95% of the minimum for *Standard Under Voltage Threshold* (06.065) then the drive will continue to be powered from the user 24V supply. If the user 24V supply is subsequently removed the drive will power down, but then if the main supply is high enough will power up again on the main supply.
3. Although the drive can run off power derived from its d.c. link at a level well below the minimum for *Standard Under Voltage Threshold* (06.065) the level down to which it will operate depends on the loading applied by option modules, position feedback devices and I/O. For reliable operation it is advisable that the d.c. link voltage is above 90% of the minimum for *Standard Under Voltage Threshold* (06.065) when the 24V supply is not present.
4. It is possible to initiate saving power-down save parameters by forcing the drive into the under-voltage state by changing *Low Under Voltage Threshold Select* (06.067) from 1 to 0 when the d.c. link voltage is below 90% of the minimum of *Standard Under Voltage Threshold* (06.065). This is not advisable because failure of the 24V supply or the main supply at this point could result in corruption of the drive parameters saved in non-volatile memory.

If *Low Under Voltage Threshold Select* (06.067) = 1 or *Backup Supply Mode Enable* (06.068) = 1 or *User Supply Select* (06.072) = 1 then the 24V user supply is always selected. If the user 24V supply is not present then a *User 24V* is initiated. The following should be noted:

1. The drive will still power-up on the main supply even if the user 24V supply is not present because the drive tries each supply in turn to power up, however the drive will remain in the tripped state until the user 24V supply is activated.
2. Parameters can only be saved by setting *Parameter mm.000* (mm.000) to 1001 and initiating a drive reset. Power-down save parameters are not saved when the under-voltage state becomes active.

| Parameter         | 06.073 <i>Braking IGBT Lower Threshold</i>   |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the lowest level of the d.c. bus voltage where the braking IGBT becomes active |                |                   |
| Mode              | RFC-A  |                |                   |
| Minimum           | -VM_DC_VOLTAGE_SET   | Maximum        | VM_DC_VOLTAGE_SET |
| Default           | See exceptions below   | Units          | V                 |
| Type              | 16 Bit User Save   | Update Rate    | 4ms read          |
| Display Format    | Standard   | Decimal Places | 0                 |
| Coding            | RW, VM, RA   |                |                   |

| Voltage | Default Value |
|---------|---------------|
| 200V    | 390           |
| 400V    | 780           |
| 575V    | 930           |
| 690V    | 1120          |

*Braking IGBT Lower Threshold* (06.073) defines the lowest level of *D.c. Bus Voltage* (05.005) where the braking IGBT will become active and *Braking IGBT Upper Threshold* (06.074) defines the level of *D.c. Bus Voltage* (05.005) where the braking IGBT will be on continuously. When the braking IGBT is turned on it will remain on for at least 1ms. The braking IGBT on-time is defined by the thresholds and the d.c. link voltage as given in the table below where L = *Braking IGBT Lower Threshold* (06.073) and U = *Braking IGBT Upper Threshold* (06.074).

| D.c. link voltage level                   | On-time   |
|---|---|
| <i>D.c. Bus Voltage</i> (05.005)          | 0%  |
| $L \leq \text{D.c. Bus Voltage (05.005)}$ | $[(\text{D.c. Bus Voltage (05.005)} - L) / (U - L)] \times 100\%$ |
| $\text{D.c. Bus Voltage (05.005)} \geq U$ | 100%  |

As the *D.c. Bus Voltage* (05.005) rises above the lower threshold the braking IGBT is active with an on/off ratio of 1/100. As the voltage rises further, the on/off ratio increases until at the upper threshold the braking IGBT is on continuously. The upper and lower voltage threshold can be set up so that braking resistors in drives with parallel connected d.c. links will share the braking load.

If *Braking IGBT Lower Threshold* (06.073)  $\geq$  *Braking IGBT Upper Threshold* (06.074) then the braking IGBT is off when *D.c. Bus Voltage* (05.005)  $<$  *Braking IGBT Upper Threshold* (06.074) and on if *D.c. Bus Voltage* (05.005)  $\geq$  *Braking IGBT Upper Threshold* (06.074). This method of control is the same as that used in Unidrive SP and the default values for the braking thresholds are equal to the braking thresholds in Unidrive SP.

Unless sharing between braking resistors is required the braking thresholds do not normally need to be adjusted. Care should be taken when reducing the thresholds because if either threshold is below the maximum value of the peak rectified supply voltage the braking resistor could take power from the supply.

The list below gives conditions that will disable the braking IGBT:

1. *Braking IGBT Upper Threshold* (06.074) = 0, or *Low Voltage Braking IGBT Threshold Select* (06.076) = 1 and *Low Voltage Braking IGBT Threshold* (06.075) = 0.
2. The drive is in the under-voltage state.
3. A priority 1, 2 or 3 trip is active (see *Trip 0* (10.020)).
4. One of the following trips is active or would be active if another trip is not already active: *OI Brake*, *PSU*, *Th Brake Res* or *Oht Inverter*.
5. *Percentage Of Drive Thermal Trip Level* (07.036) = 100%. This is an indication that some part of the drive is too hot and is used to indicate if an internally fitted braking resistor is too hot.
6. *Brake R Too Hot* is active or the system has been set up to disable the braking IGBT based on the braking resistor temperature and the resistor is too hot (i.e. bit 2 of *Action On Trip Detection* (10.037) is set).

| Parameter         | 06.074 <i>Braking IGBT Upper Threshold</i>   |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the level of the d.c. bus voltage where the braking IGBT will be on continuously |                |                   |
| Mode              | RFC-A  |                |                   |
| Minimum           | -VM_DC_VOLTAGE_SET   | Maximum        | VM_DC_VOLTAGE_SET |
| Default           | See exceptions below   | Units          | V                 |
| Type              | 16 Bit User Save   | Update Rate    | 4ms read          |
| Display Format    | Standard   | Decimal Places | 0                 |
| Coding            | RW, VM, RA   |                |                   |

| Voltage | Default Value |
|---------|---------------|
| 200V    | 390           |
| 400V    | 780           |
| 575V    | 930           |
| 690V    | 1120          |

See *Braking IGBT Lower Threshold* (06.073).

| Parameter         | 06.075 <i>Low Voltage Braking IGBT Threshold</i>   |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the threshold used for low voltage braking |                |                   |
| Mode              | RFC-A  |                |                   |
| Minimum           | -VM_DC_VOLTAGE_SET                                 | Maximum        | VM_DC_VOLTAGE_SET |
| Default           | 0  | Units          | V                 |
| Type              | 16 Bit User Save                                   | Update Rate    | 4ms read          |
| Display Format    | Standard   | Decimal Places | 0                 |
| Coding            | RW, VM, RA   |                |                   |

If *Low Voltage Braking IGBT Threshold Select* (06.076) = 0 the normal thresholds are used. If *Low Voltage Braking IGBT Threshold Select* (06.076) = 1 then *Low Voltage Braking IGBT Threshold* (06.075) is used, so that the braking IGBT is on with a minimum on time of 1ms is the d.c. link voltage is above this level, or off if the d.c. link voltage is below this level.

| Parameter         | 06.076 Low Voltage Braking IGBT Threshold Select |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to 1 enable low voltage IGBT braking         |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit Volatile                                   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW   |                |          |

See *Low Voltage Braking IGBT Threshold* (06.075).

| Parameter         | 06.084 Date And Time Offset |                |                 |
|-------------------|-----------------------------|----------------|-----------------|
| Short description | Date And Time Offset        |                |                 |
| Mode              | RFC-A                       |                |                 |
| Minimum           | -12.00                      | Maximum        | 12.00           |
| Default           | 0.00                        | Units          | Hours           |
| Type              | 16 Bit User Save            | Update Rate    | Background Read |
| Display Format    | Standard                    | Decimal Places | 2               |
| Coding            | RW                          |                |                 |

*Date And Time Offset* (06.084) is an offset, specified in hours, that can be applied to the *Time* (06.017). If the offset applied causes the time to roll-over midnight then the *Date* (06.016) and *Day Of Week* (06.018) are also modified. The offset is only applied when the clock source is a clock derived from a keypad, i.e. *Date/Time Selector* (06.019) > 3. The offset can be used for time zone offsets or daylight saving time etc.

## Menu 7 Single Line Descriptions – Analog I/O

Mode: RFC-A

| Parameter |  | Range  | Default       | Type |     |    |    |    |    |
|-----------|--|--|---------------|------|-----|----|----|----|----|
| 07.003    | Analog Input 3                             | ±100.00 %  |               | RO   | Num | ND | NC | PT | FI |
| 07.004    | Monitored Temperature 1                    | ±250 °C  |               | RO   | Num | ND | NC | PT |    |
| 07.005    | Monitored Temperature 2                    | ±250 °C  |               | RO   | Num | ND | NC | PT |    |
| 07.006    | Monitored Temperature 3                    | ±250 °C  |               | RO   | Num | ND | NC | PT |    |
| 07.015    | Analog Input 3 Mode                        | Therm Short Cct (7),<br>Thermistor (8),<br>Therm No Trip (9),<br>Disabled (10) | Disabled (10) | RW   | Txt |    |    |    | US |
| 07.033    | Power Output                               | ±100.0 %   |               | RO   | Num | ND | NC | PT |    |
| 07.034    | Inverter Temperature                       | ±250 °C  |               | RO   | Num | ND | NC | PT |    |
| 07.035    | Percentage Of d.c. Link Thermal Trip Level | 0 to 100 %   |               | RO   | Num | ND | NC | PT |    |
| 07.036    | Percentage Of Drive Thermal Trip Level     | 0 to 100 %   |               | RO   | Num | ND | NC | PT |    |
| 07.037    | Temperature Nearest To Trip Level          | 0 to 20999   |               | RO   | Num | ND | NC | PT |    |
| 07.038    | Temperature Monitor Select 1               | 0 to 1999  | 1001          | RW   | Num |    |    |    | US |
| 07.039    | Temperature Monitor Select 2               | 0 to 1999  | 1002          | RW   | Num |    |    |    | US |
| 07.046    | Analog Input 3 Thermistor Type             | DIN44082 (0), KTY84 (1)  | DIN44082 (0)  | RW   | Txt |    |    |    | US |
| 07.047    | Analog Input 3 Thermistor Feedback         | 0 to 5000 Ω  |               | RO   | Num | ND | NC | PT |    |
| 07.048    | Analog Input 3 Thermistor Trip Threshold   | 0 to 5000 Ω  | 3300 Ω        | RW   | Num |    |    |    | US |
| 07.049    | Analog Input 3 Thermistor Reset Threshold  | 0 to 5000 Ω  | 1800 Ω        | RW   | Num |    |    |    | US |
| 07.050    | Analog Input 3 Thermistor Temperature      | -50 to 300 °C  |               | RO   | Num | ND | NC | PT |    |
| 07.052    | Temperature Monitor Select 3               | 0 to 1999  | 1             | RW   | Num |    |    |    | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |



## Menu 7 – Analog I/O

Mode: RFC-A

### Analog Outputs

The update rate for analog outputs is 250µs; although the output will only change at the update rate defined by the source parameter for the input. The following exceptions apply:

1. *Speed Feedback* (03.002) has an update rate of 4ms and includes a 16ms window filter. If this parameter is selected as a source for output 2 the update rate of the source changes to 250us and the only filter applied is the window filter associated with the position feedback interface (i.e. *P1 Feedback Filter* (03.042) for the P1 interface). It should be noted that this feature is only provided when the position feedback is from a drive interface and not from an option module.
2. If either analogue output is set up for current mode then the update rate for both analogue outputs is 4ms.

### Analog Inputs

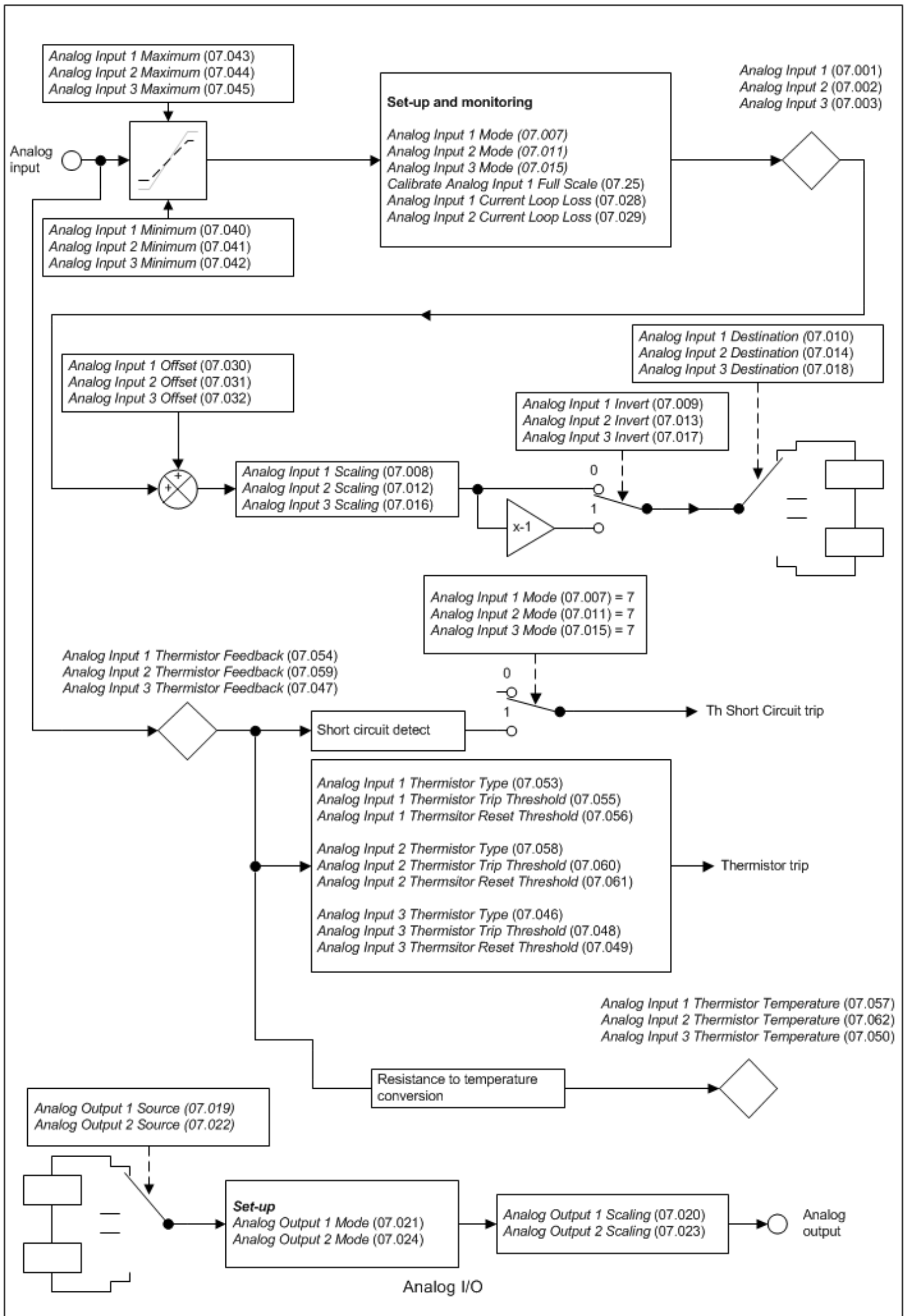
The normal sample rate for the analog inputs is 4ms, however this is increased to 250us for analogue inputs 1 and 2 under the following conditions:

1. The maximum and the minimum for the input are at their default values of 100.00% and -100.00% respectively.
2. The input is set to voltage mode.
3. One of the destinations given in the table below must be selected.
4. If the destination is *Analog Reference 1* (01.036) or *Analog Reference 2* (01.037) the reference system must not be in uinpolar mode, i.e. *Bipolar Reference Enable* (01.010) must be one.

Note that *Analog Input 1 Fast Update Active* (07.026) and *Analog Input 2 Fast Update Active* (07.027) indicate if fast updating is active for each input.

| Parameter   | Drive modes     | Comment   |
|---|-----------------|---|
| <i>Analog Reference 1</i> (01.036)  | RFC-A,<br>RFC-S | The data from <i>Analog Reference 1</i> (01.036) is processed in the 250us task so that the reference to the speed controller is updated every 250us. |
| <i>Analog Reference 2</i> (01.037)  | RFC-A,<br>RFC-S | The data from <i>Analog Reference 2</i> (01.037) is processed in the 250us task so that the reference to the speed controller is updated every 250us. |
| <i>Hard Speed Reference</i> (03.022)  | RFC-A,<br>RFC-S |   |
| <i>Torque Reference</i> (04.008)  | RFC-A,<br>RFC-S |   |
| <i>Power Input 1</i> (03.010)<br><i>Power Input 2</i> (03.013)<br><i>Power Input 3</i> (03.014) | Regen           |   |

The diagram below shows the parameter structure for each I/O. See *Internal I/O Identifier* (11.068) for details of which I/O is present for different I/O options.



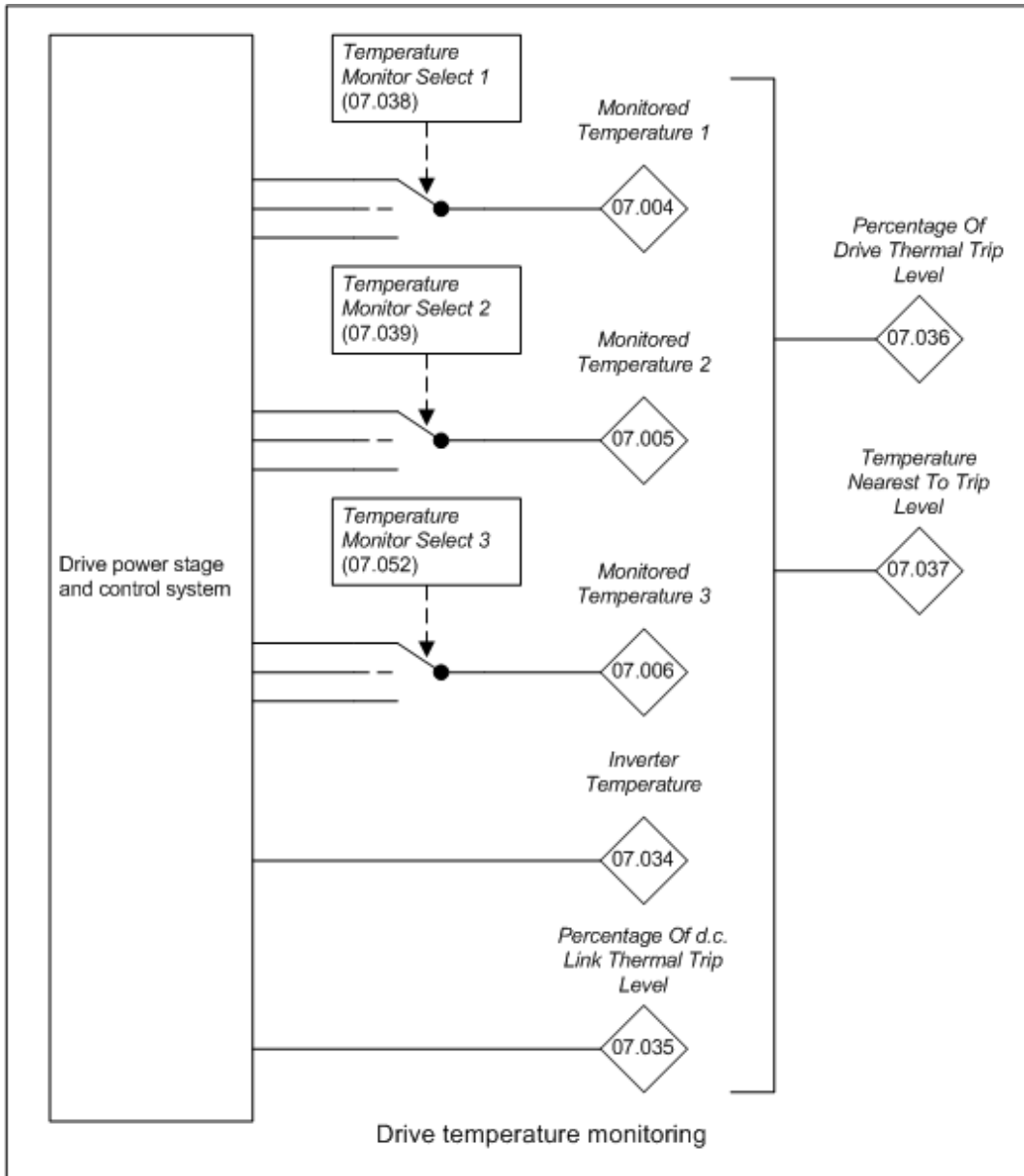
| Parameter         | 07.003 Analog Input 3                |                |           |
|-------------------|--------------------------------------|----------------|-----------|
| Short description | Displays the value of analog input 3 |                |           |
| Mode              | RFC-A                                |                |           |
| Minimum           | -100.00                              | Maximum        | 100.00    |
| Default           |                                      | Units          | %         |
| Type              | 16 Bit Volatile                      | Update Rate    | 4ms write |
| Display Format    | Standard                             | Decimal Places | 2         |
| Coding            | RO, FI, ND, NC, PT                   |                |           |

See *Analog Input 1* (07.001).

| Parameter         | 07.004 Monitored Temperature 1                                  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the temperature set up by Temperature Monitor Select 1 |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | -250  | Maximum        | 250              |
| Default           |   | Units          | °C               |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

Thermal monitoring is provided within the drive to protect the power stage and the control system from over temperature.

*Monitored Temperature 1* (07.004), *Monitored Temperature 2* (07.005) and *Monitored Temperature 3* (07.006) give an indication of the temperature of three selected monitoring points within the drive power system or control system. The required monitoring points can be selected using *Temperature Monitor Select 1* (07.038), *Temperature Monitor Select 2* (07.039) and *Temperature Monitor Select 3* (07.052) respectively. The default values give two monitoring points in the power system in *Monitored Temperature 1* (07.004) and *Monitored Temperature 2* (07.005), and control board temperature 1 in *Monitored Temperature 3* (07.006).



| Parameter         | 07.005 Monitored Temperature 2                                  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the temperature set up by Temperature Monitor Select 2 |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | -250  | Maximum        | 250              |
| Default           |   | Units          | °C               |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

See *Monitored Temperature 1* (07.004) for details.

| Parameter         | 07.006 Monitored Temperature 3                                  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the temperature set up by Temperature Monitor Select 3 |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | -250  | Maximum        | 250              |
| Default           |   | Units          | °C               |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

See *Monitored Temperature 1* (07.004) for details.

| Parameter         | 07.015 Analog Input 3 Mode         |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Defines the mode of analog input 3 |                |                 |
| Mode              | RFC-A                              |                |                 |
| Minimum           | 7                                  | Maximum        | 10              |
| Default           | 10                                 | Units          |                 |
| Type              | 8 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW, TE                             |                |                 |

| Value | Text            | Description   |
|-------|-----------------|---|
| 7     | Therm Short Cct | Temperature measurement input with short circuit detection  |
| 8     | Thermistor      | Temperature measurement without short circuit detection   |
| 9     | Therm No Trip   | Temperature measurement input with no trips   |
| 10    | Disabled        | Input always zero. This mode is used to disable the current source as the input is on a shared connection with Digital Input 5. |

This parameter defines the possible input modes for analog input 3.

| Parameter         | 07.033 Power Output  |                |             |
|-------------------|----------------------|----------------|-------------|
| Short description | Instant output power |                |             |
| Mode              | RFC-A                |                |             |
| Minimum           | -100.0               | Maximum        | 100.0       |
| Default           |                      | Units          | %           |
| Type              | 16 Bit Volatile      | Update Rate    | 250µs write |
| Display Format    | Standard             | Decimal Places | 1           |
| Coding            | RO, ND, NC, PT       |                |             |

This is an instantaneous power output with fast update rate that is primarily intended to be used as a power feed-forward for applications with a Regen system front end. The full scale (100.0%) value is equal to a power of  $3 \times (VM\_DC\_VOLTAGE[MAX] / 2\sqrt{2}) \times Full\ Scale\ Current\ Kc$  (11.061). This is compatible with the power output provided in Unidrive SP and is directly compatible with *Power Input 1* (03.010) (and the other power feed-forward parameters) in Regen mode. The scaling is intended to cover the maximum range of likely power in the drive. For example with a 400V 7.5kW drive the full scale d.c. link voltage is 831V and  $Kc=38.222A$ , and so the full scale value of this parameter is  $3 \times (831 / 2\sqrt{2}) \times 38.222 = 33.689kW$ . For Open-loop, RFC-A and RFC-S modes a positive value of power indicates power flowing from the drive to motor. For Regen mode a positive value of power indicates power flowing from the supply to the regen drive.

| Parameter         | 07.034 Inverter Temperature   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the estimated junction temperature of the hottest power device within the drive inverter |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | -250  | Maximum        | 250              |
| Default           |   | Units          | °C               |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Inverter Temperature* (07.034) shows the estimated junction temperature of the hottest power device within the drive inverter. If this temperature exceeds the switch down threshold defined for the power stage the switching frequency is reduced provided this feature has not been disabled (see *Auto-switching Frequency Change* (05.035)).

| Parameter         | 07.035 Percentage Of d.c. Link Thermal Trip Level  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the percentage of the maximum allowed temperature as estimated by the thermal model of the d.c. link components |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 100              |
| Default           |  | Units          | %                |
| Type              | 8 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*Percentage Of d.c. Link Thermal Trip Level* (07.035) gives the percentage of the maximum allowed temperature as estimated by the thermal model of the d.c. link components.

| Parameter         | 07.036 Percentage Of Drive Thermal Trip Level   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the percentage of the thermal trip level of the temperature monitoring point or thermal model in the drive that is highest |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 100              |
| Default           |   | Units          | %                |
| Type              | 8 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Percentage Of Drive Thermal Trip Level* (07.036) gives the percentage of the thermal trip level of the temperature monitoring point or thermal model in the drive that is highest. This includes all thermal monitoring points (not just those selected by *Monitored Temperature 1* (07.004), *Monitored Temperature 2* (07.005) and *Monitored Temperature 3* (07.006)), *Inverter Temperature* (07.034) and *Percentage Of d.c. Link Thermal Trip Level* (07.035).

*Percentage Of d.c. Link Thermal Trip Level* (07.035) is used directly to give *Percentage Of Drive Thermal Trip Level* (07.036), but for all other monitored values which are temperatures this is given by Percentage of thermal trip level = (Temperature - 40°C) / (Trip temperature - 40°C) x 100%

The location of the measurement or the thermal model that is related to this temperature is given in *Temperature Nearest To Trip Level* (07.037). If *Percentage Of Drive Thermal Trip Level* (07.036) exceeds 90% *Drive Over-temperature Alarm* (10.018) is set to one. If *Percentage Of Drive Thermal Trip Level* (07.036) reaches 100% one of the trips given in the table below is initiated. The trip can be reset when the percentage of thermal trip level fall below 95%.

| Temperature  | Trip         |
|--|--------------|
| <i>Inverter Temperature</i> (07.034)                       | Oht Inverter |
| Power system temperature                                   | Oht Power    |
| <i>Percentage Of d.c. Link Thermal Trip Level</i> (07.035) | Oht dc Link  |
| Control system temperature                                 | Oht Control  |

| Parameter         | 07.037 Temperature Nearest To Trip Level  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the thermistor location or the model that corresponds to the value shown in Percentage Of Drive Thermal Trip Level |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 20999            |
| Default           |   | Units          |                  |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Temperature Nearest To Trip Level* (07.037) shows the thermistor location or the model that corresponds to the value shown in *Percentage Of Drive Thermal Trip Level* (07.036) in the form xxyzz as shown in the table below.

| Source         | xx | y                | zz   |
|----------------|----|------------------|--|
| Control system | 00 | 0                | 01: Control board thermistor 1   |
| Control system | 00 | 0                | 02: Control board thermistor 2   |
| Control system | 00 | 0                | 03: I/O board thermistor (or internal braking resistor in servo Drive) |
| Control system | 00 | 1                | 00: Inverter thermal model   |
| Control system | 00 | 2                | 00: D.c. link thermal model  |
| Control system | 00 | 3                | 00: Braking IGBT thermal model   |
| Power system   | 01 | 0                | zz: Thermistor location defined by zz in the power system              |
| Power system   | 01 | Rectifier number | zz: Thermistor location defined by zz in the rectifier                 |

| Parameter         | 07.038 Temperature Monitor Select 1                                |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the temperature to be monitored in Monitored Temperature 1 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1999            |
| Default           | 1001   | Units          |                 |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

*Temperature Monitor Select 1* (07.038) selects the temperature to be monitored in *Monitored Temperature 1* (07.004) using the format given for *Temperature Nearest To Trip Level* (07.037). If the monitoring point selected does not exist then the monitored temperature is always zero. The table below shows the monitoring points that can be selected.

| Source         | xx | y                | zz   |
|----------------|----|------------------|--|
| Control system | 00 | 0                | 01: Control board thermistor 1   |
| Control system | 00 | 0                | 02: Control board thermistor 2   |
| Control system | 00 | 0                | 03: I/O board thermistor (or internal braking resistor in Servo Drive) |
| Control system | 00 | 1                | 00: Inverter thermal model   |
| Control system | 00 | 3                | 00: Braking IGBT thermal model   |
| Control system | 00 | 4                | 00: Rectifier thermal model  |
| Power system   | 01 | 0                | zz: Thermistor location defined by zz in the power system              |
| Power system   | 01 | Rectifier number | zz: Thermistor location defined by zz in the rectifier                 |

For a multi-module power system the power system measurement that can be selected is shown in the table below. It should be noted that the specific power module cannot be selected and that the highest temperature from each of the power modules is given.

| Source       | xx | y | zz                                  |
|--------------|----|---|-------------------------------------|
| Power system | 01 | 0 | 01: U phase power device thermistor |
| Power system | 01 | 0 | 02: V phase power device thermistor |
| Power system | 01 | 0 | 03: W phase power device thermistor |
| Power system | 01 | 0 | 04: General rectifier thermistors   |
| Power system | 01 | 0 | 05: General power system thermistor |

| Parameter         | 07.039 Temperature Monitor Select 2                                |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the temperature to be monitored in Monitored Temperature 2 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1999            |
| Default           | 1002   | Units          |                 |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *Temperature Monitor Select 1* (07.038).

| Parameter         | 07.046 Analog Input 3 Thermistor Type          |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the thermistor type for analog input 3 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                                | Update Rate    | Background read |
| Display Format    | Standard                                       | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

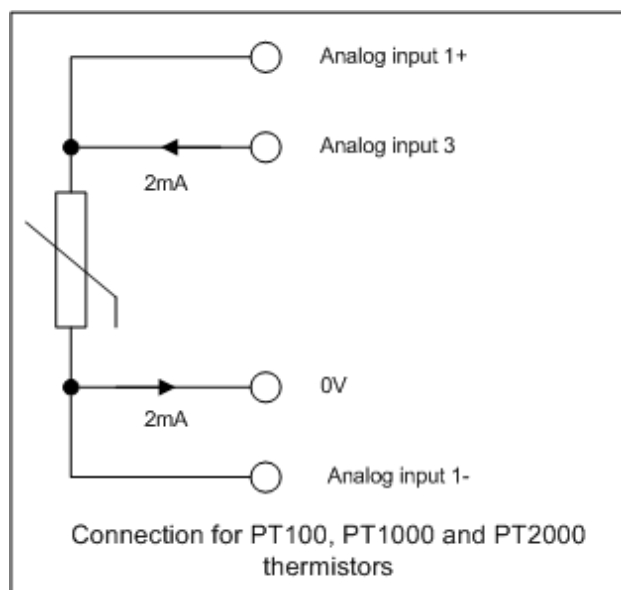
| Value | Text     |
|-------|----------|
| 0     | DIN44082 |
| 1     | KTY84    |

*Analog Input 3 Thermistor Type* (07.046) defines the operation of the temperature feedback interface for analog input 3 when *Analog Input 3 Mode* (07.015) is set up for a temperature feedback mode. When a temperature feedback mode is selected a 2mA current source is connected to analog input 3 to supply the temperature feedback device that is connected to the input.

| <i>Analog Input 3 Thermistor Type</i> (07.046) | Compatible devices  |
|--|---|
| 0: DIN44082                                    | Three thermistors in series as specified in DIN44082 standard                       |
| 1: KTY84                                       | KTY84 PTC thermistor  |
| 2: PT100 (4W)                                  | PT100 PTC thermistor with 4 wire connection   |
| 3: PT1000 (4W)                                 | PT1000 PTC thermistor with 4 wire connection  |
| 4: PT2000 (4W)                                 | PT2000 PTC thermistor with 4 wire connection  |
| 5: 2.0mA (4W)                                  | Any device. Full scale equivalent to a resistance of 5k Ohms with 4 wire connection |
| 6: PT100 (2W)                                  | PT100 PTC thermistor with 2 wire connection   |
| 7: PT1000 (2W)                                 | PT1000 PTC thermistor with 2 wire connection  |
| 8: PT2000 (2W)                                 | PT2000 PTC thermistor with 2 wire connection  |
| 9: 2.0mA (2W)                                  | Any device. Full scale equivalent to a resistance of 5k Ohms with 2 wire connection |

DIN44082 and KTY84 devices should always be connected directly to analog input 3. The other devices can be connected directly to analog input 3 if the 2 wire connection option is selected. Alternatively these devices can be used with a 4 wire connection to remove the effect of voltage drops due to the 2mA supply current via the path shown below. If a 4 wire connection is selected analog input 1 is disabled and *Analog Input 1* (07.001) always reads

as 0.0%. It should be noted that the input system takes account of the input impedance of analogue input 3 when 2 wire mode is used, and of both analogue input 1 and analogue input 3 when 4 wire mode is used. For this reason it is important that 2 wire mode is selected when the connection between Analogue Input 1+ and Analogue input 3 is not present, and that 4 wire mode is selected if the connection is present.



| Parameter         | <b>07.047 Analog Input 3 Thermistor Feedback</b>   |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the measured resistance of analog input 3 |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 5000             |
| Default           |  | Units          | Ω                |
| Type              | 16 Bit Volatile                                    | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                     |                |                  |

*Analog Input 3 Thermistor Feedback* (07.047) shows the measured resistance.

| Parameter         | <b>07.048 Analog Input 3 Thermistor Trip Threshold</b>   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the thermistor trip threshold for analog input 3 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 5000            |
| Default           | 3300   | Units          | Ω               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

Over-temperature detection becomes active for input 3 if *Analog Input 3 Thermistor Feedback* (07.047) > *Analog Input 3 Thermistor Trip Threshold* (07.048). Over-temperature becomes inactive for input 3 if *Analog Input 3 Thermistor Feedback* (07.047) < *Analog Input 3 Thermistor Reset Threshold* (07.049). If *Analog Input 3 Mode* (07.015) is 7 or 8 (i.e. tripping is enabled) an *Thermistor.003* trip is initiated. The default values for *Analog Input 3 Thermistor Trip Threshold* (07.048) and *Analog Input 3 Thermistor Reset Threshold* (07.049) are the levels specified in the DIN 44082 standard.

| Parameter         | <b>07.049 Analog Input 3 Thermistor Reset Threshold</b>   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the thermistor reset threshold for analog input 3 |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 5000            |
| Default           | 1800  | Units          | Ω               |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Analog Input 3 Thermistor Trip Threshold* (07.048).



| Parameter         | 07.050 <i>Analog Input 3 Thermistor Temperature</i>   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the temperature of the device based on the resistance to temperature characteristic for the specified device |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | -50   | Maximum        | 300              |
| Default           |   | Units          | °C               |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

If a KTY84, PT100, PT1000 or PT2000 type device is selected for temperature feedback then *Analog Input 3 Thermistor Temperature* (07.050) shows the temperature of the device based on the resistance to temperature characteristic specified for this device. Otherwise *Analog Input 3 Thermistor Temperature* (07.050) = 0.0.

| Parameter         | 07.052 <i>Temperature Monitor Select 3</i>                         |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the temperature to be monitored in Monitored Temperature 3 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1999            |
| Default           | 1  | Units          |                 |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *Temperature Monitor Select 1* (07.038).

## Menu 8 Single Line Descriptions – Digital I/O

Mode: RFC-A

| Parameter |                                       | Range  | Default          | Type |     |    |    |    |    |
|-----------|---------------------------------------|--|------------------|------|-----|----|----|----|----|
| 08.001    | Digital Output 01 State               | Off (0) or On (1)  |                  | RO   | Bit | ND | NC | PT |    |
| 08.002    | Digital Output 02 State               | Off (0) or On (1)  |                  | RO   | Bit | ND | NC | PT |    |
| 08.004    | Digital Input 04 State                | Off (0) or On (1)  |                  | RO   | Bit | ND | NC | PT |    |
| 08.005    | Digital Input 05 State                | Off (0) or On (1)  |                  | RO   | Bit | ND | NC | PT |    |
| 08.007    | Relay Output State                    | Off (0) or On (1)  |                  | RO   | Bit | ND | NC | PT |    |
| 08.008    | 24V Supply Output State               | Off (0) or On (1)  |                  | RO   | Bit | ND | NC | PT |    |
| 08.009    | STO Input 01 State                    | Off (0) or On (1)  |                  | RO   | Bit | ND | NC | PT |    |
| 08.010    | External Trip Mode                    | Disable (0), STO 1 (1), STO 2 (2),<br>STO 1 OR STO 2 (3) | Disable (0)      | RW   | Txt |    |    |    | US |
| 08.011    | Digital Output 01 Invert              | Not Invert (0), Invert (1)                               | Not Invert (0)   | RW   | Txt |    |    |    | US |
| 08.012    | Digital Output 02 Invert              | Not Invert (0), Invert (1)                               | Not Invert (0)   | RW   | Txt |    |    |    | US |
| 08.014    | Digital Input 04 Invert               | Not Invert (0), Invert (1)                               | Not Invert (0)   | RW   | Txt |    |    |    | US |
| 08.015    | Digital Input 05 Invert               | Not Invert (0), Invert (1)                               | Not Invert (0)   | RW   | Txt |    |    |    | US |
| 08.017    | Relay Invert                          | Not Invert (0), Invert (1)                               | Not Invert (0)   | RW   | Txt |    |    |    | US |
| 08.018    | 24V Supply Output Invert              | Not Invert (0), Invert (1)                               | Invert (1)       | RW   | Txt |    |    |    | US |
| 08.020    | Digital I/O Read Word                 | 0 to 511   |                  | RO   | Num | ND | NC | PT |    |
| 08.021    | Digital Output 01 Source              | 0.000 to 59.999  | 10.003           | RW   | Num | DE |    | PT | US |
| 08.022    | Digital Output 02 Source              | 0.000 to 59.999  | 0.000            | RW   | Num | DE |    | PT | US |
| 08.024    | Digital Input 04 Destination          | 0.000 to 59.999  | 6.030            | RW   | Num | DE |    | PT | US |
| 08.025    | Digital Input 05 Destination          | 0.000 to 59.999  | 6.032            | RW   | Num | DE |    | PT | US |
| 08.027    | Relay Output Source                   | 0.000 to 59.999  | 10.001           | RW   | Num |    |    | PT | US |
| 08.028    | 24V Supply Output Source              | 0.000 to 59.999  | 0.000            | RW   | Num |    |    | PT | US |
| 08.040    | STO Input 02 State                    | Off (0) or On (1)  |                  | RO   | Bit | ND | NC | PT |    |
| 08.041    | Keypad Run Button State               | Off (0) or On (1)  |                  | RO   | Bit | ND | NC | PT |    |
| 08.042    | Keypad Auxiliary Button State         | Off (0) or On (1)  |                  | RO   | Bit | ND | NC | PT |    |
| 08.043    | 24V Supply Input State                | Off (0) or On (1)  |                  | RO   | Bit | ND | NC | PT |    |
| 08.044    | Keypad Stop Button State              | Off (0) or On (1)  |                  | RO   | Bit | ND | NC | PT |    |
| 08.051    | Keypad Run Button Invert/Toggle       | Not Invert (0), Invert (1), Toggle (2)                   | Not Invert (0)   | RW   | Txt |    |    |    | US |
| 08.052    | Keypad Auxiliary Button Invert/Toggle | Not Invert (0), Invert (1), Toggle (2)                   | Not Invert (0)   | RW   | Txt |    |    |    | US |
| 08.053    | 24V Supply Input Invert               | Not Invert (0), Invert (1)                               | Not Invert (0)   | RW   | Txt |    |    |    | US |
| 08.061    | Keypad Run Button Destination         | 0.000 to 59.999  | 0.000            | RW   | Num | DE |    | PT | US |
| 08.062    | Keypad Auxiliary Button Destination   | 0.000 to 59.999  | 0.000            | RW   | Num | DE |    | PT | US |
| 08.063    | 24V Supply Input Destination          | 0.000 to 59.999  | 0.000            | RW   | Num | DE |    | PT | US |
| 08.071    | Digital I/O Output Enable Register 1  | 0000000000000000 to 1111111111111111                     | 0000000000000000 | RW   | Bin |    |    | PT | US |
| 08.072    | Digital I/O Input Register 1          | 0000000000000000 to 1111111111111111                     |                  | RO   | Bin | ND | NC | PT |    |
| 08.073    | Digital I/O Output Register 1         | 0000000000000000 to 1111111111111111                     | 0000000000000000 | RW   | Bin |    |    | PT |    |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 8 – Digital I/O

Mode: RFC-A

## Digital I/O Interface

The normal sample rate for the digital I/O system is 2ms, however it is possible to obtain a faster update rate for some parameters with certain inputs as described below. (Note that the keypad buttons and the rest button are always updated at the background rate and cannot be used for fast updating.)

## Direction, read and write register parameters

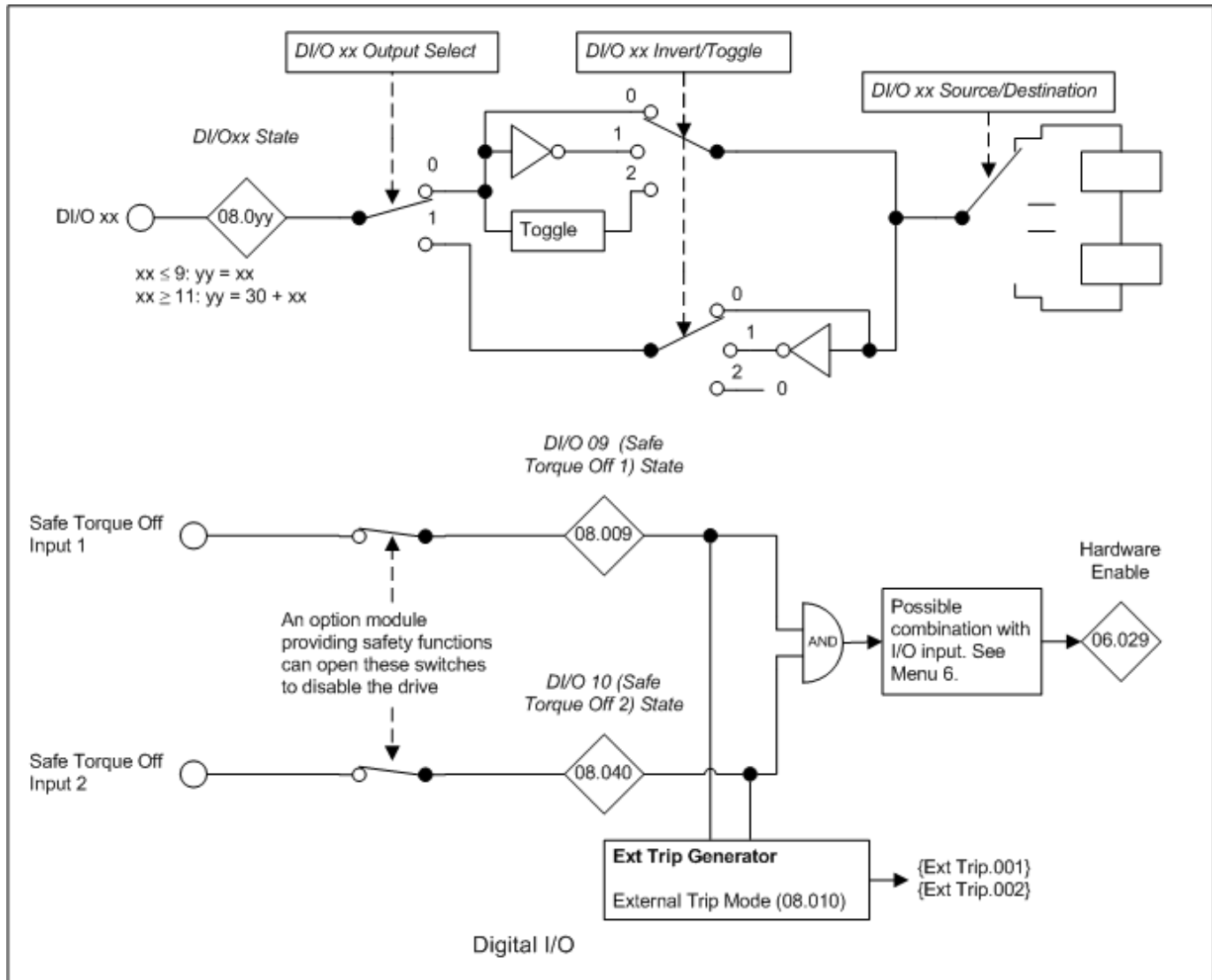
Digital I/O Output Enable Register 1 (08.071), Digital I/O Input Register 1 (08.072) and Digital I/O Output Register 1 (08.073) provide direct access to read/control the digital I/O that is integral to the drive.

## Limit Switches

If digital inputs 4 or 5 are routed to either the Forward Limit Switch (06.035) or Reverse Limit Switch (06.036) in RFC-A or RFC-S modes the update rate is 250us.

## Parameters

The parameter structure for each digital I/O is shown in the diagram below.



The table below covers all the possible digital I/O parameters. See *Internal I/O Identifier* (11.068) for details of which I/O is present for different I/O options.

| DI/O | Function                | State  | Invert/Toggle | Source/Destination | Output Select |
|------|-------------------------|--------|---------------|--------------------|---------------|
| 1    | Input/Output            | 08.001 | 08.011        | 08.021             | 08.031        |
| 2    | Input/Output            | 08.002 | 08.012        | 08.022             | 08.032        |
| 3    | Input/Output            | 08.003 | 08.013        | 08.023             | 08.033        |
| 4    | Input                   | 08.004 | 08.014        | 08.024             |               |
| 5    | Input                   | 08.005 | 08.015        | 08.025             |               |
| 6    | Input                   | 08.006 | 08.016        | 08.026             |               |
| 7    | Relay Output            | 08.007 | 08.017        | 08.027             |               |
| 8    | 24V Supply Output       | 08.008 | 08.018        | 08.028             |               |
| 9    | Safe Torque Off 1       | 08.009 |               |                    |               |
| 10   | Safe Torque Off 2       | 08.040 |               |                    |               |
| 11   | Keypad Run Button       | 08.041 | 08.051        | 08.061             |               |
| 12   | Keypad Auxiliary Button | 08.042 | 08.052        | 08.062             |               |
| 13   | 24V Supply Input        | 08.043 | 08.053        | 08.063             |               |
| 14   | Keypad Stop Button      | 08.044 |               |                    |               |
| 15   | Relay 2 Output          | 08.045 | 08.055        | 08.065             |               |
| 16   | Drive Reset button      | 08.046 |               |                    |               |

| Parameter         | 08.001 Digital Output 01 State          |                |           |  |
|-------------------|---|----------------|-----------|--|
| Short description | Displays the state for digital output 1 |                |           |  |
| Mode              | RFC-A                                   |                |           |  |
| Minimum           | 0                                       | Maximum        | 1         |  |
| Default           |   |                | Units     |  |
| Type              | 1 Bit Volatile                          | Update Rate    | 2ms write |  |
| Display Format    | Standard                                | Decimal Places | 0         |  |
| Coding            | RO, ND, NC, PT                          |                |           |  |

The Digital I/O State parameter shows the state of digital I/O on the drive. All I/O except Digital Input 11 (Keypad Run Button), Digital Input 12 (Keypad Auxiliary Button), Digital Input 13 (24V Supply Input) and Digital Input 14 (Keypad Stop Button) use IEC61131-2 logic levels. As default the inputs use positive logic, and so the state parameter is 0 if the digital I/O is low or 1 if the digital I/O is high. *Input Logic Polarity* (08.029) can be set to zero to change the logic for Digital I/O1-6 to negative logic, so that the state parameter is 0 if the digital I/O is high or 1 if the digital I/O is low. The state parameter represents the digital I/O state whether it is an input or an output. If the digital I/O is configured as an output to be controlled using the *Digital I/O Output Register 1* (08.073) then the state parameter will still show the state of the output even though the route source is zero and the invert parameter has no effect.

Digital Input 11 (Keypad Run Button), Digital Input 12 (Keypad Auxiliary Button) and Digital Input 14 (Keypad Stop Button) represent the state of the Run, Auxiliary and Stop buttons on any keypad fitted to the drive; the input state is determined by ORing the state of the button on each keypad connected to the drive, if the button is pressed the state parameter is one otherwise it is zero. If a keypad is not fitted the state parameters are zero.

Digital Input 13 (24V Supply Input) is an external 24V supply input that is monitored and can be used as a 24V digital input if an external 24V supply is not required. The state parameter is low for the voltage range from 0V to 17V and high for the voltage range above 18V. As the input is a power supply it will consume significant current if the level is taken above 24V when the drive is running from its internal power supply, or at any voltage level if this input is the only power supply to the drive.

Digital Input 09 (STO input 1) and Digital Input 10 (STO input 2) correspond to two safe torque off channels within the drive. Both channels must be in the high state for the drive to be enabled. The state parameters are 0 if the digital input is low, or 1 if the digital input is high. If option slot 3 does not contain an option module providing safety functions then both safe torque off channels are connected to their state parameters and the safe torque off input can enable/disable the drive. If an option module providing safety functions is fitted in option slot 3 then the option module can disable the drive by breaking the path of either one or both safe torque off channels. See Menu 6 for details of the drive enable system.

| Parameter         | 08.002 Digital Output 02 State          |                |           |  |
|-------------------|---|----------------|-----------|--|
| Short description | Displays the state for digital output 2 |                |           |  |
| Mode              | RFC-A                                   |                |           |  |
| Minimum           | 0                                       | Maximum        | 1         |  |
| Default           |   |                | Units     |  |
| Type              | 1 Bit Volatile                          | Update Rate    | 2ms write |  |
| Display Format    | Standard                                | Decimal Places | 0         |  |
| Coding            | RO, ND, NC, PT                          |                |           |  |

See *Digital Output 01 State* (08.001).

| Parameter         | 08.004 Digital Input 04 State          |                |           |  |
|-------------------|--|----------------|-----------|--|
| Short description | Displays the state for digital input 4 |                |           |  |
| Mode              | RFC-A                                  |                |           |  |
| Minimum           | 0                                      | Maximum        | 1         |  |
| Default           |  |                | Units     |  |
| Type              | 1 Bit Volatile                         | Update Rate    | 2ms write |  |
| Display Format    | Standard                               | Decimal Places | 0         |  |
| Coding            | RO, ND, NC, PT                         |                |           |  |

See *Digital Output 01 State* (08.001).

| Parameter         | 08.005 Digital Input 05 State          |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the state for digital input 5 |                |           |
| Mode              | RFC-A                                  |                |           |
| Minimum           | 0                                      | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile                         | Update Rate    | 2ms write |
| Display Format    | Standard                               | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                         |                |           |

See *Digital Output 01 State* (08.001).

| Parameter         | 08.007 Relay Output State           |                |           |
|-------------------|-------------------------------------|----------------|-----------|
| Short description | Displays the state for relay output |                |           |
| Mode              | RFC-A                               |                |           |
| Minimum           | 0                                   | Maximum        | 1         |
| Default           |                                     | Units          |           |
| Type              | 1 Bit Volatile                      | Update Rate    | 2ms write |
| Display Format    | Standard                            | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                      |                |           |

See *Digital Output 01 State* (08.001).

| Parameter         | 08.008 24V Supply Output State           |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the state for 24V supply output |                |           |
| Mode              | RFC-A                                    |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile                           | Update Rate    | 2ms write |
| Display Format    | Standard                                 | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                           |                |           |

See *Digital Output 01 State* (08.001).

| Parameter         | 08.009 STO Input 01 State                      |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the state for Safe Torque Off 1 input |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile                                 | Update Rate    | 2ms write |
| Display Format    | Standard                                       | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                                 |                |           |

See *Digital Output 01 State* (08.001).

| Parameter         | 08.010 External Trip Mode                  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines behaviour of drive if STOs are low |                |                 |
| Mode              | RFC-A                                      |                |                 |
| Minimum           | 0  | Maximum        | 3               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                   | Decimal Places | 0               |
| Coding            | RW, TE                                     |                |                 |

| Value | Text           |
|-------|----------------|
| 0     | Disable        |
| 1     | STO 1          |
| 2     | STO 2          |
| 3     | STO 1 OR STO 2 |

If *External Trip Mode* (08.010) = 0 the safe torque off inputs simply enable or disable the drive. If *External Trip Mode* (08.010) > 0 it is possible to enable the following trip functions.

| <b>External Trip Mode (08.010)</b> | <b>Actions</b>   |
|------------------------------------|--|
| 0                                  | Safe torque off inputs do not initiate trips   |
| 1                                  | <i>External Trip.001</i> if Safe Torque Off Input 1 is low   |
| 2                                  | <i>External Trip.002</i> if Safe Torque Off Input 2 is low   |
| 3                                  | <i>External Trip.001</i> if Safe Torque Off is low<br>OR<br><i>External Trip.002</i> if Safe Torque Off Input 2 is low |

| <b>Parameter</b>  | <b>08.011 Digital Output 01 Invert</b> |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to invert Digital Output 01        |                |                 |
| Mode              | RFC-A                                  |                |                 |
| Minimum           | 0                                      | Maximum        | 1               |
| Default           | 0                                      | Units          |                 |
| Type              | 8 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                               | Decimal Places | 0               |
| Coding            | RW, TE                                 |                |                 |

| <b>Value</b> | <b>Text</b> |
|--------------|-------------|
| 0            | Not Invert  |
| 1            | Invert      |

A value of 0 or 1 allows the digital I/O to be non-inverted or inverted respectively.

| <b>Parameter</b>  | <b>08.012 Digital Output 02 Invert</b> |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to invert Digital Output 02        |                |                 |
| Mode              | RFC-A                                  |                |                 |
| Minimum           | 0                                      | Maximum        | 1               |
| Default           | 0                                      | Units          |                 |
| Type              | 8 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                               | Decimal Places | 0               |
| Coding            | RW, TE                                 |                |                 |

| <b>Value</b> | <b>Text</b> |
|--------------|-------------|
| 0            | Not Invert  |
| 1            | Invert      |

See *Digital Output 01 Invert* (08.011).

| <b>Parameter</b>  | <b>08.014 Digital Input 04 Invert</b> |                |                 |
|-------------------|---------------------------------------|----------------|-----------------|
| Short description | Set to invert Digital Input 04        |                |                 |
| Mode              | RFC-A                                 |                |                 |
| Minimum           | 0                                     | Maximum        | 1               |
| Default           | 0                                     | Units          |                 |
| Type              | 8 Bit User Save                       | Update Rate    | Background read |
| Display Format    | Standard                              | Decimal Places | 0               |
| Coding            | RW, TE                                |                |                 |

| <b>Value</b> | <b>Text</b> |
|--------------|-------------|
| 0            | Not Invert  |
| 1            | Invert      |

See *Digital Output 01 Invert* (08.011).

| <b>Parameter</b>  | <b>08.015 Digital Input 05 Invert</b> |                |                 |
|-------------------|---------------------------------------|----------------|-----------------|
| Short description | Set to invert Digital Input 05        |                |                 |
| Mode              | RFC-A                                 |                |                 |
| Minimum           | 0                                     | Maximum        | 1               |
| Default           | 0                                     | Units          |                 |
| Type              | 8 Bit User Save                       | Update Rate    | Background read |
| Display Format    | Standard                              | Decimal Places | 0               |
| Coding            | RW, TE                                |                |                 |

| Value | Text       |
|-------|------------|
| 0     | Not Invert |
| 1     | Invert     |

See *Digital Output 01 Invert* (08.011).

| Parameter         | 08.017 Relay Invert            |                |                 |
|-------------------|--------------------------------|----------------|-----------------|
| Short description | Set to invert the Relay Output |                |                 |
| Mode              | RFC-A                          |                |                 |
| Minimum           | 0                              | Maximum        | 1               |
| Default           | 0                              | Units          |                 |
| Type              | 8 Bit User Save                | Update Rate    | Background read |
| Display Format    | Standard                       | Decimal Places | 0               |
| Coding            | RW, TE                         |                |                 |

| Value | Text       |
|-------|------------|
| 0     | Not Invert |
| 1     | Invert     |

See *Digital Output 01 Invert* (08.011).

| Parameter         | 08.018 24V Supply Output Invert |                |                 |
|-------------------|---------------------------------|----------------|-----------------|
| Short description | Set to invert 24V Supply Output |                |                 |
| Mode              | RFC-A                           |                |                 |
| Minimum           | 0                               | Maximum        | 1               |
| Default           | 1                               | Units          |                 |
| Type              | 8 Bit User Save                 | Update Rate    | Background read |
| Display Format    | Standard                        | Decimal Places | 0               |
| Coding            | RW, TE                          |                |                 |

| Value | Text       |
|-------|------------|
| 0     | Not Invert |
| 1     | Invert     |

See *Digital Output 01 Invert* (08.011).

| Parameter         | 08.020 Digital I/O Read Word               |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the states for digital I/O 1 to 8 |                |                  |
| Mode              | RFC-A                                      |                |                  |
| Minimum           | 0  | Maximum        | 511              |
| Default           |  | Units          |                  |
| Type              | 16 Bit Volatile                            | Update Rate    | Background write |
| Display Format    | Standard                                   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                             |                |                  |

*Digital I/O Read Word* (08.020) reflects the state of digital input/output 1 to STO input 1 as given below. Each bit matches the value of the state parameter for the respective digital input or output.

| Digital I/O Read Word (08.020) bit | Digital I/O     |
|------------------------------------|-----------------|
| 0                                  | Digital I/O 1   |
| 1                                  | Digital I/O 2   |
| 2                                  | Digital I/O 3   |
| 3                                  | Digital Input 4 |
| 4                                  | Digital Input 5 |
| 5                                  | Digital Input 6 |
| 6                                  | Relay           |
| 7                                  | 24V Output      |
| 8                                  | STO Input 1     |

| Parameter         | 08.021 Digital Output 01 Source                   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the source parameter for Digital Output 1 |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.000   | Maximum        | 59.999           |
| Default           | 10.003  | Units          |                  |
| Type              | 16 Bit User Save                                  | Update Rate    | Drive Reset Read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                    |                |                  |

The Digital I/O Source/Destination parameters provide the routing for the source and/or destination for the digital I/O.

| Parameter         | 08.022 Digital Output 02 Source                   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the source parameter for Digital Output 2 |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.000   | Maximum        | 59.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save                                  | Update Rate    | Drive Reset Read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                    |                |                  |

See *Digital Output 01 Source* (08.021).

| Parameter         | 08.024 Digital Input 04 Destination                   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the destination parameter for Digital Input 4 |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.000   | Maximum        | 59.999           |
| Default           | 6.030   | Units          |                  |
| Type              | 16 Bit User Save                                      | Update Rate    | Drive Reset Read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU  |                |                  |

See *Digital Output 01 Source* (08.021).

| Parameter         | 08.025 Digital Input 05 Destination                   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the destination parameter for Digital Input 5 |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.000   | Maximum        | 59.999           |
| Default           | 6.032   | Units          |                  |
| Type              | 16 Bit User Save                                      | Update Rate    | Drive Reset Read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU  |                |                  |

See *Digital Output 01 Source* (08.021).

| Parameter         | 08.027 Relay Output Source                        |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the source parameter for the Relay Output |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.000   | Maximum        | 59.999           |
| Default           | 10.001  | Units          |                  |
| Type              | 16 Bit User Save                                  | Update Rate    | Drive Reset Read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, PT, BU  |                |                  |

See *Digital Output 01 Source* (08.021).

| Parameter         | 08.028 24V Supply Output Source                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the source parameter for 24V Supply Output |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                   | Update Rate    | Drive Reset Read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, PT, BU   |                |                  |

See *Digital Output 01 Source* (08.021).

| Parameter         | 08.040 STO Input 02 State                          |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the state for the Safe Torque Off 2 input |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile                                     | Update Rate    | 2ms write |
| Display Format    | Standard   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                                     |                |           |

See *Digital Output 01 State* (08.001).



| Parameter         | 08.041 Keypad Run Button State                       |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the state for the Keypad Run Forward button |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                                       | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                       |                |                  |

See *Digital Output 01 State* (08.001).

| Parameter         | 08.042 Keypad Auxiliary Button State               |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the state for the Keypad Auxiliary button |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                                     | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                     |                |                  |

See *Digital Output 01 State* (08.001).

| Parameter         | 08.043 24V Supply Input State               |                |           |
|-------------------|---|----------------|-----------|
| Short description | Displays the state for the 24V Supply Input |                |           |
| Mode              | RFC-A                                       |                |           |
| Minimum           | 0   | Maximum        | 1         |
| Default           |   | Units          |           |
| Type              | 1 Bit Volatile                              | Update Rate    | 2ms write |
| Display Format    | Standard                                    | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                              |                |           |

See *Digital Output 01 State* (08.001).

| Parameter         | 08.044 Keypad Stop Button State               |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the state for the Keypad Stop button |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile                                | Update Rate    | Background write |
| Display Format    | Standard                                      | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                |                |                  |

See *Digital Output 01 State* (08.001).

| Parameter         | 08.051 Keypad Run Button Invert/Toggle |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to invert/toggle Keypad Run Button |                |                 |
| Mode              | RFC-A                                  |                |                 |
| Minimum           | 0                                      | Maximum        | 2               |
| Default           | 0                                      | Units          |                 |
| Type              | 8 Bit User Save                        | Update Rate    | Background Read |
| Display Format    | Standard                               | Decimal Places | 0               |
| Coding            | RW, TE                                 |                |                 |

| Value | Text       |
|-------|------------|
| 0     | Not Invert |
| 1     | Invert     |
| 2     | Toggle     |

A value of 0 or 1 allows the input state to be non-inverted or inverted respectively. An additional toggle function is provided for Keypad Run button inputs. The toggle function output changes state on each rising edge (0 to 1 change) at its input.

| Parameter         | 08.052 Keypad Auxiliary Button Invert/Toggle |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to invert/toggle Keypad Auxiliary Button |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 2               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                              | Update Rate    | Background Read |
| Display Format    | Standard                                     | Decimal Places | 0               |
| Coding            | RW, TE                                       |                |                 |

| Value | Text       |
|-------|------------|
| 0     | Not Invert |
| 1     | Invert     |
| 2     | Toggle     |

A value of 0 or 1 allows the input state to be non-inverted or inverted respectively. An additional toggle function is provided for Keypad Auxiliary button inputs. The toggle function output changes state on each rising edge (0 to 1 change) at its input.

| Parameter         | 08.053 24V Supply Input Invert        |                |                 |
|-------------------|---------------------------------------|----------------|-----------------|
| Short description | Set to invert/toggle 24V Supply Input |                |                 |
| Mode              | RFC-A                                 |                |                 |
| Minimum           | 0                                     | Maximum        | 1               |
| Default           | 0                                     | Units          |                 |
| Type              | 8 Bit User Save                       | Update Rate    | Background Read |
| Display Format    | Standard                              | Decimal Places | 0               |
| Coding            | RW, TE                                |                |                 |

| Value | Text       |
|-------|------------|
| 0     | Not Invert |
| 1     | Invert     |

See *Digital Output 01 Source* (08.021).

| Parameter         | 08.061 Keypad Run Button Destination                        |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the destination parameter for the keypad run button |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.000   | Maximum        | 59.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save  | Update Rate    | Drive Reset Read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU  |                |                  |

See *Digital Output 01 Source* (08.021).

| Parameter         | 08.062 Keypad Auxiliary Button Destination                        |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the destination parameter for the keypad auxiliary button |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.000   | Maximum        | 59.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save  | Update Rate    | Drive Reset Read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU  |                |                  |

See *Digital Output 01 Source* (08.021).

| Parameter         | 08.063 24V Supply Input Destination                 |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the destination parameter for the 24V input |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.000   | Maximum        | 59.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save                                    | Update Rate    | Drive Reset Read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                      |                |                  |

See *Digital Output 01 Source* (08.021).

| Parameter         | 08.071 Digital I/O Output Enable Register 1                 |                |                                      |
|-------------------|---|----------------|--------------------------------------|
| Short description | Displays the binary form of the DI/O output enable register |                |                                      |
| Mode              | RFC-A   |                |                                      |
| Minimum           | 0<br>(Display: 0000000000000000)                            | Maximum        | 65535<br>(Display: 1111111111111111) |
| Default           | 0<br>(Display: 0000000000000000)                            | Units          |                                      |
| Type              | 16 Bit User Save  | Update Rate    | Background read                      |
| Display Format    | Binary  | Decimal Places | 0                                    |
| Coding            | RW, PT, BU  |                |                                      |

The bits in the *Digital I/O Output Enable Register 1* (08.071), *Digital I/O Input Register 1* (08.072) and *Digital I/O Output Register 1* (08.073) each correspond with one digital I/O as shown below. The update rate of the individual bits in these registers differs depending upon the I/O.

| DI/O | Bit | Function                | Bit update rate |                 |                        |
|------|-----|-------------------------|-----------------|-----------------|------------------------|
|      |     |                         | Input Register  | Output Register | Output Enable Register |
| 1    | 0   | Digital Input/Output    | 2ms             | 250µs           | Background             |
| 2    | 1   | Digital Input/Output    | 2ms             | 250µs           | Background             |
| 3    | 2   | Digital Input/Output    | 2ms             | 2ms             | Background             |
| 4    | 3   | Digital Input           | 250µs           | Not applicable  | Not applicable         |
| 5    | 4   | Digital Input           | 250µs           | Not applicable  | Not applicable         |
| 6    | 5   | Digital Input           | 2ms             | Not applicable  | Not applicable         |
| 7    | 6   | Relay Output            | Bit always 0    | 2ms             | Background             |
| 8    | 7   | 24V Supply Output       | Bit always 0    | 2ms             | Background             |
| 9    | 8   | Safe Torque Off 1       | 2ms             | Not applicable  | Not applicable         |
| 10   | 9   | Safe Torque Off 2       | 2ms             | Not applicable  | Not applicable         |
| 11   | 10  | Keypad Run Button       | Background      | Not applicable  | Not applicable         |
| 12   | 11  | Keypad Auxiliary Button | Background      | Not applicable  | Not applicable         |
| 13   | 12  | 24V Supply Input        | 2ms             | Not applicable  | Not applicable         |
| 14   | 13  | Keypad Stop Button      | Background      | Not applicable  | Not applicable         |
| 15   | 14  | Relay 2 Output          | Bit always 0    | 2ms             | Background             |
| 16   | 15  | Drive Reset Button      | Background      | Not applicable  | Not applicable         |

The *Digital I/O Input Register 1* (08.072) is always active and shows the value in the Digital I/O State parameter for all digital I/O configured as inputs. Bits in the *Digital I/O Output Register 1* (08.073) can be used to control the digital I/O directly. The bits control the output directly and are not modified by the corresponding Digital I/O Invert/Toggle function. The bits in the *Digital I/O Output Register 1* (08.073) only control the corresponding digital output if all the conditions below are met:

1. The corresponding bit in the *Digital I/O Output Enable Register 1* (08.071) must be set to 1.
2. The digital I/O must be an output, or it must be an input/output and the corresponding Digital I/O Output Select parameter must be one.
3. The corresponding Digital I/O Source/Destination parameter is not as valid source (e.g. 0.000) and the drive has been powered-up or reset since it was first selected.

If the above conditions are not met, the digital output is controlled by the normal logic.

| Parameter         | 08.072 Digital I/O Input Register 1                 |                |                                      |
|-------------------|---|----------------|--------------------------------------|
| Short description | Displays the binary form of the DI/O input register |                |                                      |
| Mode              | RFC-A   |                |                                      |
| Minimum           | 0<br>(Display: 0000000000000000)                    | Maximum        | 65535<br>(Display: 1111111111111111) |
| Default           |   | Units          |                                      |
| Type              | 16 Bit Volatile                                     | Update Rate    | 250µs write                          |
| Display Format    | Binary  | Decimal Places | 0                                    |
| Coding            | RO, ND, NC, PT, BU                                  |                |                                      |

See *Digital I/O Output Enable Register 1* (08.071).

| Parameter         | 08.073 Digital I/O Output Register 1                 |                |                                      |
|-------------------|--|----------------|--------------------------------------|
| Short description | Displays the binary form of the DI/O output register |                |                                      |
| Mode              | RFC-A  |                |                                      |
| Minimum           | 0<br>(Display: 0000000000000000)                     | Maximum        | 65535<br>(Display: 1111111111111111) |
| Default           | 0<br>(Display: 0000000000000000)                     | Units          |                                      |
| Type              | 16 Bit Volatile                                      | Update Rate    | 250µs read                           |
| Display Format    | Binary   | Decimal Places | 0                                    |
| Coding            | RW, PT, BU   |                |                                      |

See *Digital I/O Output Enable Register 1* (08.071).

## Menu 9 Single Line Descriptions – *User Functions 1*

Mode: RFC-A

| Parameter | Range                            | Default   | Type       |     |      |    |    |    |    |
|-----------|----------------------------------|---|------------|-----|------|----|----|----|----|
|           |                                  |   | RO         | Bit | ND   | NC | PT |    |    |
| 09.001    | Logic Function 1 Output          | Off (0) or On (1)   |            | RO  | Bit  | ND | NC | PT |    |
| 09.002    | Logic Function 2 Output          | Off (0) or On (1)   |            | RO  | Bit  | ND | NC | PT |    |
| 09.003    | Motorised Pot Output             | ±100.00 %   |            | RO  | Num  | ND | NC | PT | PS |
| 09.004    | Logic Function 1 Source 1        | 0.000 to 59.999   | 0.000      | RW  | Num  |    |    | PT | US |
| 09.005    | Logic Function 1 Source 1 Invert | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    |    |    | US |
| 09.006    | Logic Function 1 Source 2        | 0.000 to 59.999   | 0.000      | RW  | Num  |    |    | PT | US |
| 09.007    | Logic Function 1 Source 2 Invert | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    |    |    | US |
| 09.008    | Logic Function 1 Output Invert   | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    |    |    | US |
| 09.009    | Logic Function 1 Delay           | ±25.0 s   | 0.0 s      | RW  | Num  |    |    |    | US |
| 09.010    | Logic Function 1 Destination     | 0.000 to 59.999   | 0.000      | RW  | Num  | DE |    | PT | US |
| 09.014    | Logic Function 2 Source 1        | 0.000 to 59.999   | 0.000      | RW  | Num  |    |    | PT | US |
| 09.015    | Logic Function 2 Source 1 Invert | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    |    |    | US |
| 09.016    | Logic Function 2 Source 2        | 0.000 to 59.999   | 0.000      | RW  | Num  |    |    | PT | US |
| 09.017    | Logic Function 2 Source 2 Invert | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    |    |    | US |
| 09.018    | Logic Function 2 Output Invert   | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    |    |    | US |
| 09.019    | Logic Function 2 Delay           | ±25.0 s   | 0.0 s      | RW  | Num  |    |    |    | US |
| 09.020    | Logic Function 2 Destination     | 0.000 to 59.999   | 0.000      | RW  | Num  | DE |    | PT | US |
| 09.021    | Motorised Pot Mode               | 0 to 4  | 0          | RW  | Num  |    |    |    | US |
| 09.022    | Motorised Pot Bipolar Select     | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    |    |    | US |
| 09.023    | Motorised Pot Rate               | 0 to 250 s  | 20 s       | RW  | Num  |    |    |    | US |
| 09.024    | Motorised Pot Scaling            | 0.000 to 4.000  | 1.000      | RW  | Num  |    |    |    | US |
| 09.025    | Motorised Pot Destination        | 0.000 to 59.999   | 0.000      | RW  | Num  | DE |    | PT | US |
| 09.026    | Motorised Pot Up                 | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    | NC |    |    |
| 09.027    | Motorised Pot Down               | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    | NC |    |    |
| 09.028    | Motorised Pot Reset              | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    | NC |    |    |
| 09.029    | Binary Sum Ones                  | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    | NC |    |    |
| 09.030    | Binary Sum Twos                  | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    | NC |    |    |
| 09.031    | Binary Sum Fours                 | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    | NC |    |    |
| 09.032    | Binary Sum Output                | 0 to 255  |            | RO  | Num  | ND | NC | PT |    |
| 09.033    | Binary Sum Destination           | 0.000 to 59.999   | 0.000      | RW  | Num  | DE |    | PT | US |
| 09.034    | Binary Sum Offset                | 0 to 248  | 0          | RW  | Num  |    |    |    | US |
| 09.035    | Timer 1 Start Date               | 00-00-00 to 31-12-99  | 00-00-00   | RW  | Date |    |    |    | US |
| 09.036    | Timer 1 Start Time               | 00:00:00 to 23:59:59  | 00:00:00   | RW  | Time |    |    |    | US |
| 09.037    | Timer 1 Stop Date                | 00-00-00 to 31-12-99  | 00-00-00   | RW  | Date |    |    |    | US |
| 09.038    | Timer 1 Stop Time                | 00:00:00 to 23:59:59  | 00:00:00   | RW  | Time |    |    |    | US |
| 09.039    | Timer 1 Repeat Function          | None (0), Hour (1), Day (2),<br>Week (3), Month (4), Year (5),<br>One off (6), Minute (7) | None (0)   | RW  | Txt  |    |    |    | US |
| 09.040    | Timer 1 Enable                   | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    |    |    | US |
| 09.041    | Timer 1 Invert                   | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    |    |    | US |
| 09.042    | Timer 1 Output                   | Off (0) or On (1)   |            | RO  | Bit  | ND | NC | PT |    |
| 09.043    | Timer 1 Destination              | 0.000 to 59.999   | 0.000      | RW  | Num  | DE |    | PT | US |
| 09.045    | Timer 2 Start Date               | 00-00-00 to 31-12-99  | 00-00-00   | RW  | Date |    |    |    | US |
| 09.046    | Timer 2 Start Time               | 00:00:00 to 23:59:59  | 00:00:00   | RW  | Time |    |    |    | US |
| 09.047    | Timer 2 Stop Date                | 00-00-00 to 31-12-99  | 00-00-00   | RW  | Date |    |    |    | US |
| 09.048    | Timer 2 Stop Time                | 00:00:00 to 23:59:59  | 00:00:00   | RW  | Time |    |    |    | US |
| 09.049    | Timer 2 Repeat Function          | None (0), Hour (1), Day (2),<br>Week (3), Month (4), Year (5),<br>One off (6), Minute (7) | None (0)   | RW  | Txt  |    |    |    | US |
| 09.050    | Timer 2 Enable                   | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    |    |    | US |
| 09.051    | Timer 2 Invert                   | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    |    |    | US |
| 09.052    | Timer 2 Output                   | Off (0) or On (1)   |            | RO  | Bit  | ND | NC | PT |    |
| 09.053    | Timer 2 Destination              | 0.000 to 59.999   | 0.000      | RW  | Num  | DE |    | PT | US |
| 09.055    | Scope Trace 1 Source             | 0.000 to 59.999   | 0.000      | RW  | Num  |    |    | PT | US |
| 09.056    | Scope Trace 2 Source             | 0.000 to 59.999   | 0.000      | RW  | Num  |    |    | PT | US |
| 09.057    | Scope Trace 3 Source             | 0.000 to 59.999   | 0.000      | RW  | Num  |    |    | PT | US |
| 09.058    | Scope Trace 4 Source             | 0.000 to 59.999   | 0.000      | RW  | Num  |    |    | PT | US |
| 09.059    | Scope Trigger                    | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    |    |    |    |
| 09.060    | Scope Trigger Source             | 0.000 to 59.999   | 0.000      | RW  | Num  |    |    | PT | US |
| 09.061    | Scope Trigger Threshold          | -2147483648 to 2147483647   | 0          | RW  | Num  |    |    |    | US |
| 09.062    | Scope Trigger Invert             | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    |    |    | US |
| 09.063    | Scope Mode                       | Single (0), Normal (1), Auto (2)  | Single (0) | RW  | Txt  |    |    |    | US |
| 09.064    | Scope Arm                        | Off (0) or On (1)   | Off (0)    | RW  | Bit  |    | NC |    |    |
| 09.065    | Scope Data Not Ready             | Off (0) or On (1)   |            | RO  | Bit  | ND | NC | PT |    |

|        |                             |   |              |    |     |    |    |    |    |
|--------|-----------------------------|---|--------------|----|-----|----|----|----|----|
| 09.066 | Scope Saving Data           | Off (0) or On (1)                                 |              | RO | Bit | ND | NC | PT |    |
| 09.067 | Scope Sample Time           | 1 to 200  | 1            | RW | Num |    |    |    | US |
| 09.068 | Scope Trigger Delay         | 0 to 100 %  | 0 %          | RW | Num |    |    |    | US |
| 09.069 | Scope Time Period           | 0.00 to 200000.00 ms                              |              | RO | Num | ND | NC | PT |    |
| 09.070 | Scope Auto-save Mode        | Disabled (0), Overwrite (1), Keep (2)             | Disabled (0) | RW | Txt |    |    |    | US |
| 09.071 | Scope Auto-save File Number | 0 to 99   | 0            | RO | Num |    | NC |    | PS |
| 09.072 | Scope Auto-save Reset       | Off (0) or On (1)                                 | Off (0)      | RW | Bit |    |    |    |    |
| 09.073 | Scope Auto-save Status      | Disabled (0), Active (1), Stopped (2), Failed (3) | Disabled (0) | RO | Txt |    | NC |    | PS |

|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 9 – *User Functions 1*

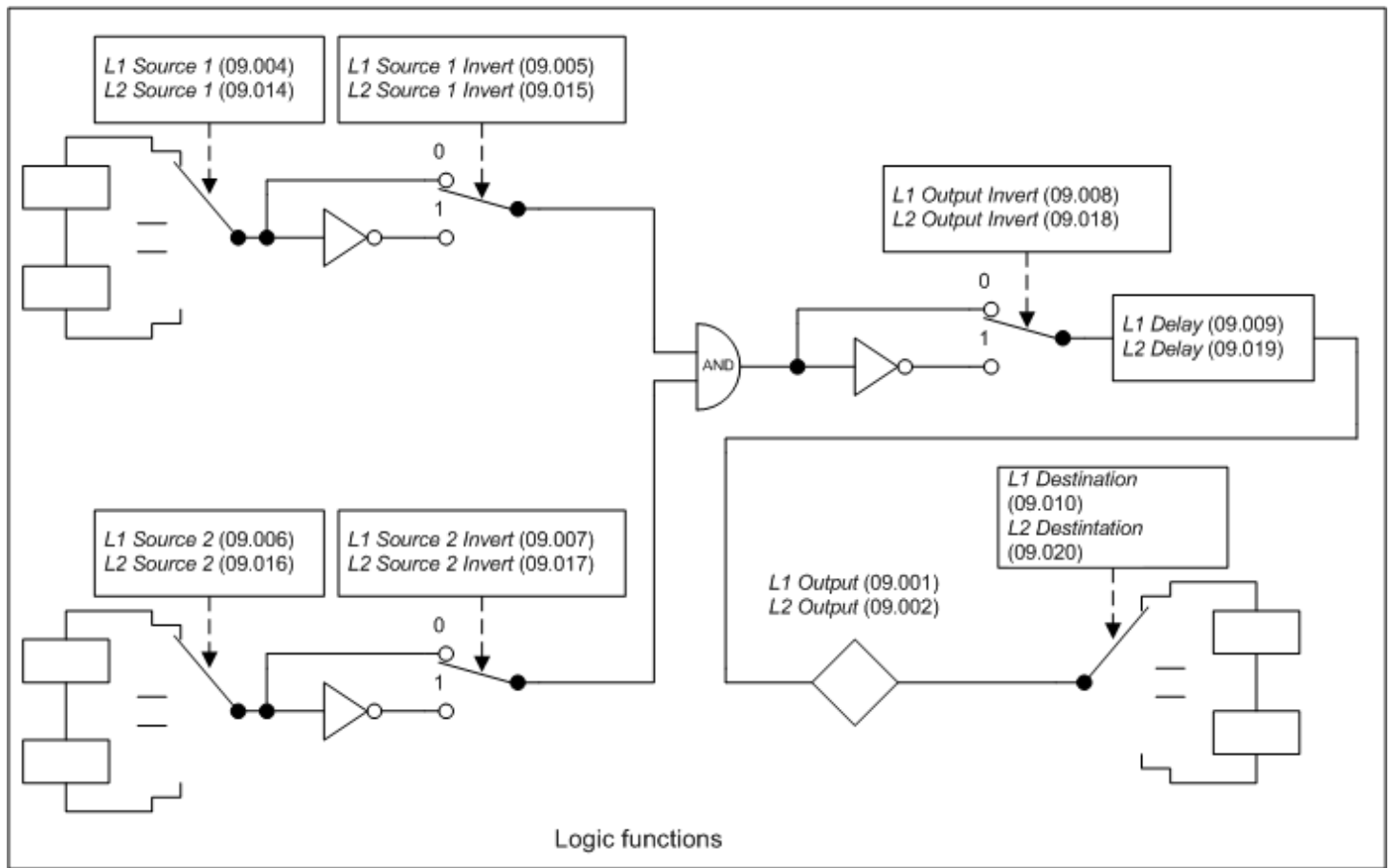
Mode: RFC-A

Menu 9 provides the parameters for the following features:

1. Logic functions
2. Motorised Pot
3. Binary Sum
4. Timers
5. Scope function

## Logic functions

The logic functions are always active even if the sources and destinations are not routed to valid parameters. If the sources are not valid parameters then the source values are taken as 0. The update rate for each of the logic functions is always 4ms.

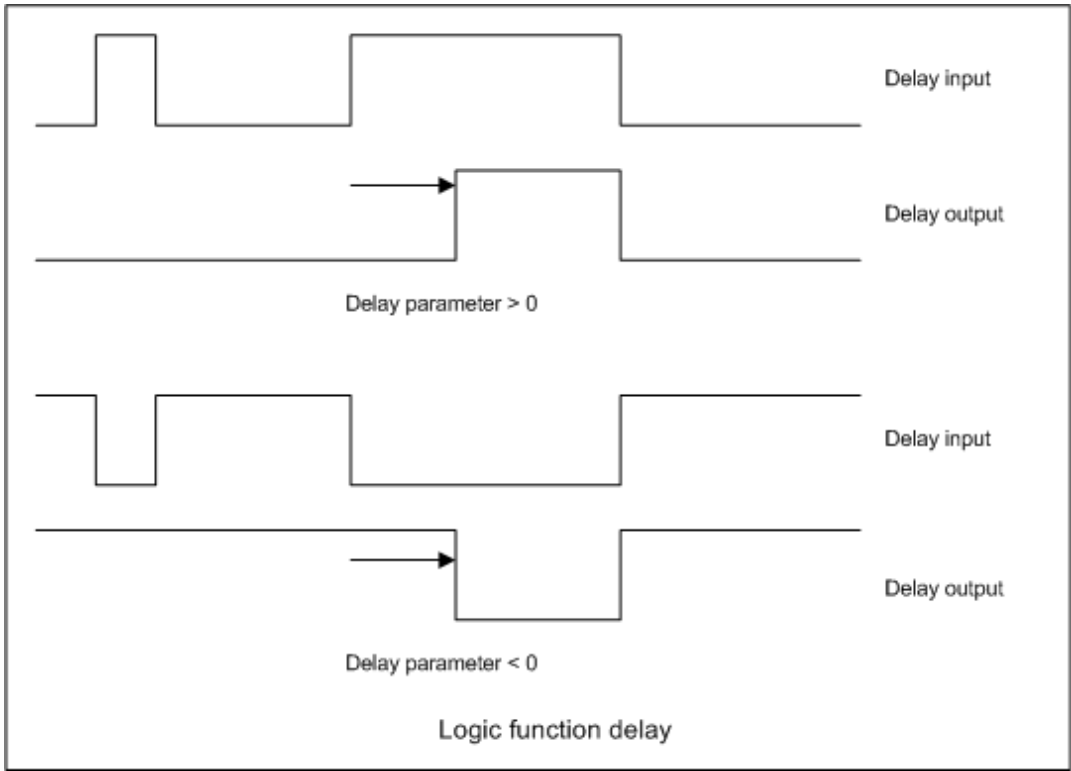


The logic function consists of an AND gate with inverters on each input and an inverter on the output. Some of the other standard logic functions can be produced as shown in the table below.

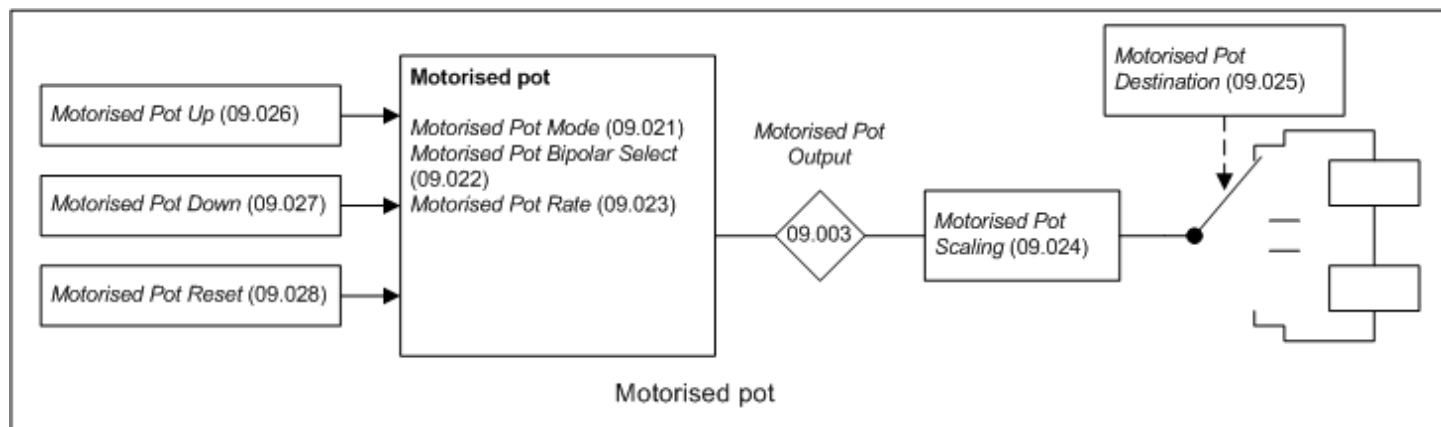
| Logic function | Source 1 Invert | Source 2 Invert | Output Invert |
|----------------|-----------------|-----------------|---------------|
| AND            | 0               | 0               | 0             |
| NAND           | 0               | 0               | 1             |
| OR             | 1               | 1               | 1             |
| NOR            | 1               | 1               | 0             |

A delay function is provided at the output of the logic functions. If *Logic Function 1 Delay* (09.009) or *Logic Function 2 Delay* (09.019) is positive then the output does not become 1 until the input to the delay has been at 1 for the delay time. If *Logic Function 1 Delay* (09.009) or *Logic Function 2 Delay* (09.019) is negative then the output remains at 1 until the input to the delay has been 0 for the delay time.





## Motorised pot



If *Motorised Pot Reset* (09.028) = 1 then the motorised pot is disabled and held in its reset state with *Motorised Pot Output* (09.003) = 0.0%. If *Motorised Pot Reset* (09.028) = 0 the motorised pot is enabled even if *Motorised Pot Destination* (09.025) is not routed to a valid parameter. The sample rate of the motorised pot is always 4ms.

When the motorised pot is active *Motorised Pot Output* (09.003) can be increased or decreased by setting *Motorised Pot Up* (09.026) or *Motorised Pot Down* (09.027) to 1 respectively. If both *Motorised Pot Up* (09.026) and *Motorised Pot Down* (09.027) are 1 then *Motorised Pot Output* (09.003) is increased. The rate of change of *Motorised Pot Output* (09.003) is defined by *Motorised Pot Rate* (09.023) which gives the time to change from 0 to 100%. The time to change from -100% to 100% is *Motorised Pot Rate* (09.023) x 2. If *Motorised Pot Bipolar Select* (09.022) = 0 then *Motorised Pot Output* (09.003) is limited in the range 0.00% to 100.00%, otherwise it is allowed to change in the range from -100.00% to 100.00%.

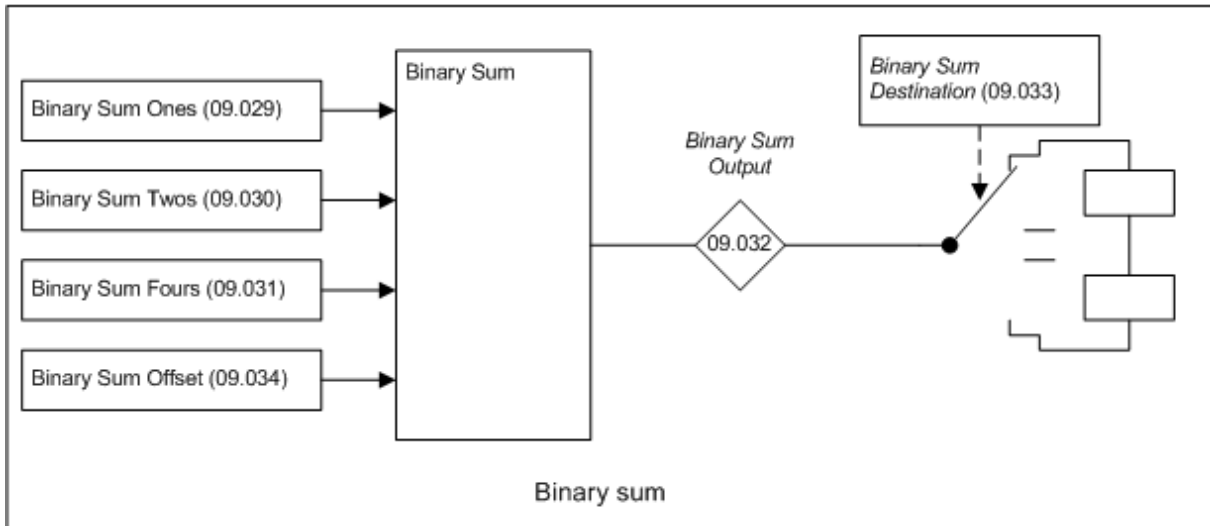
*Motorised Pot Mode* (09.021) defines the mode of operation as given in the table below.

| <i>Motorised Pot Mode</i> (09.021) | <i>Motorised Pot Output</i> (09.003)                                | <i>Motorised Pot Up</i> (09.026) and <i>Motorised Pot Down</i> (09.027) active |
|------------------------------------|---|--|
| 0                                  | Reset to zero at power-up   | Always   |
| 1                                  | Set to power-down value at power-up                                 | Always   |
| 2                                  | Reset to zero at power-up   | When <i>Drive Active</i> (10.002) = 1  |
| 3                                  | Set to power-down value at power-up                                 | When <i>Drive Active</i> (10.002) = 1  |
| 4                                  | Reset to zero at power-up and when <i>Drive Active</i> (10.002) = 0 | When <i>Drive Active</i> (10.002) = 1  |

*Motorised Pot Scaling* (09.024) introduces a scaling factor at the output of the motorised pot before the output is routed to the destination. If *Motorised Pot Scaling* (09.024) *Motorised Pot Scaling* (09.024) > 1.000 the output will exceed the range of the destination parameter, and so the destination parameter will be at its maximum or minimum before the output of the motorised pot reaches the limits of its range.

## Binary sum function

The binary sum function is always active even if the destination is not routed to valid a parameter. The update rate for the binary sum is always 4ms.



The output of the binary sum block is given by:

$$\text{Binary Sum Output (09.032)} = \text{Binary Sum Offset (09.034)} + (\text{Binary Sum Ones (09.029)} \times 1) + (\text{Binary Sum Twos (09.030)} \times 2) + (\text{Binary Sum Fours (09.031)} \times 4)$$

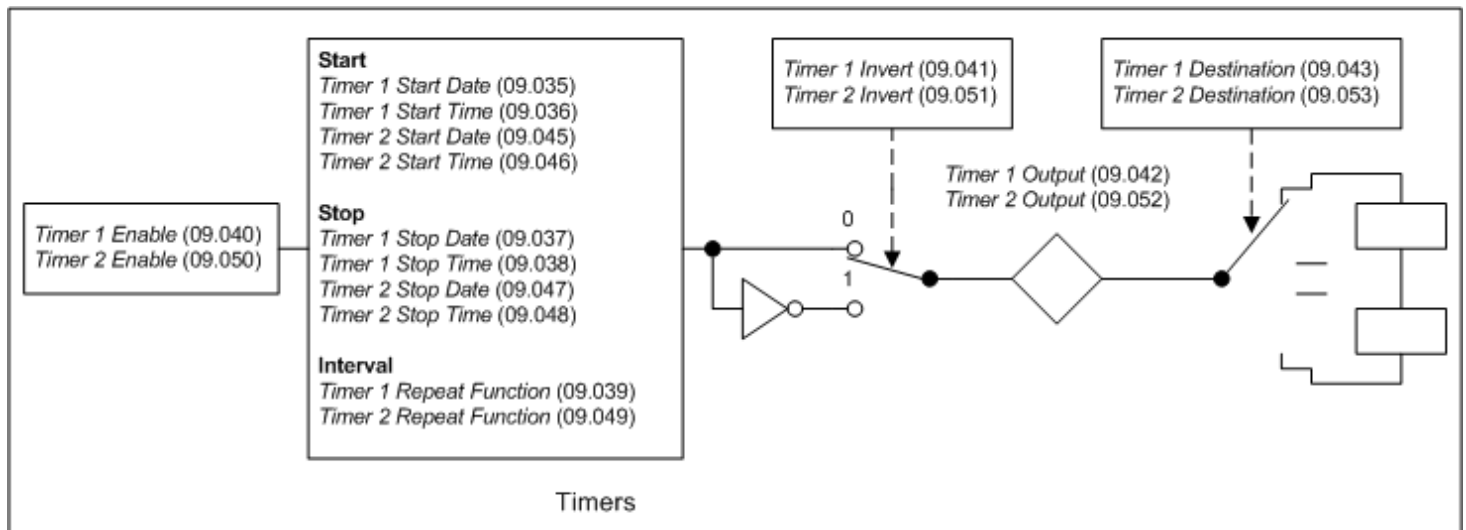
*Binary Sum Destination (09.033)* defines the destination for the binary sum output. The routing for this destination is special if the maximum of the destination parameter  $\leq 7 + \text{Binary Sum Offset (09.034)}$  as follows:

Destination parameter = *Binary Sum Output (09.032)*, subject to the parameter minimum.

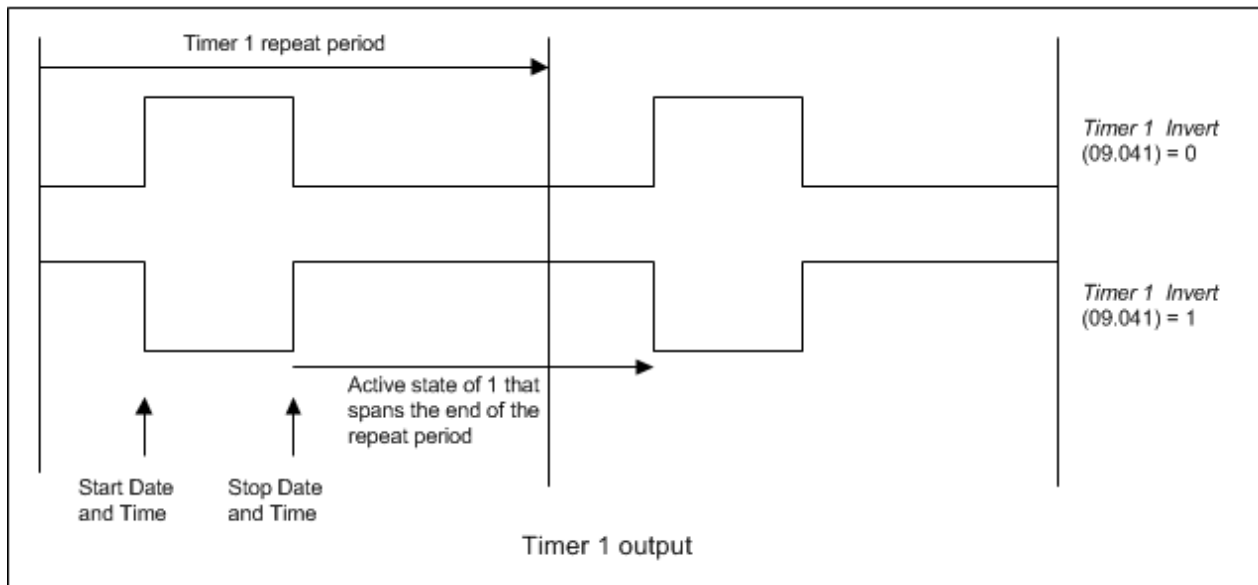
If the maximum of the destination parameter  $> 7 + \text{Binary Sum Offset (09.034)}$ , *Binary Sum Output (09.032)* is routed in the same way as any other destination where the destination target is at its full scale value when the *Binary Sum Output (09.032) = 7 + Binary Sum Offset (09.034)*.

## Timers

If the enable input to a timer is active and the repeat function is set to a non-zero value then the timer is active even if the destination is not routed to valid a parameter. The timers are updated in the background task and have a resolution of 1s.



The following is a description of Timer 1, but Timer 2 behaves in the same way. If *Timer 1 Invert* (09.041) = 0 then *Timer 1 Output* (09.042) is inactive before the *Timer 1 Start Date* (09.035) / *Timer 1 Start Time* (09.036), active between this date/time and *Timer 1 Stop Date* (09.037) / *Timer 1 Stop Time* (09.038) and then inactive after the stop time/date within the timer 1 repeat period as shown in the diagram below.



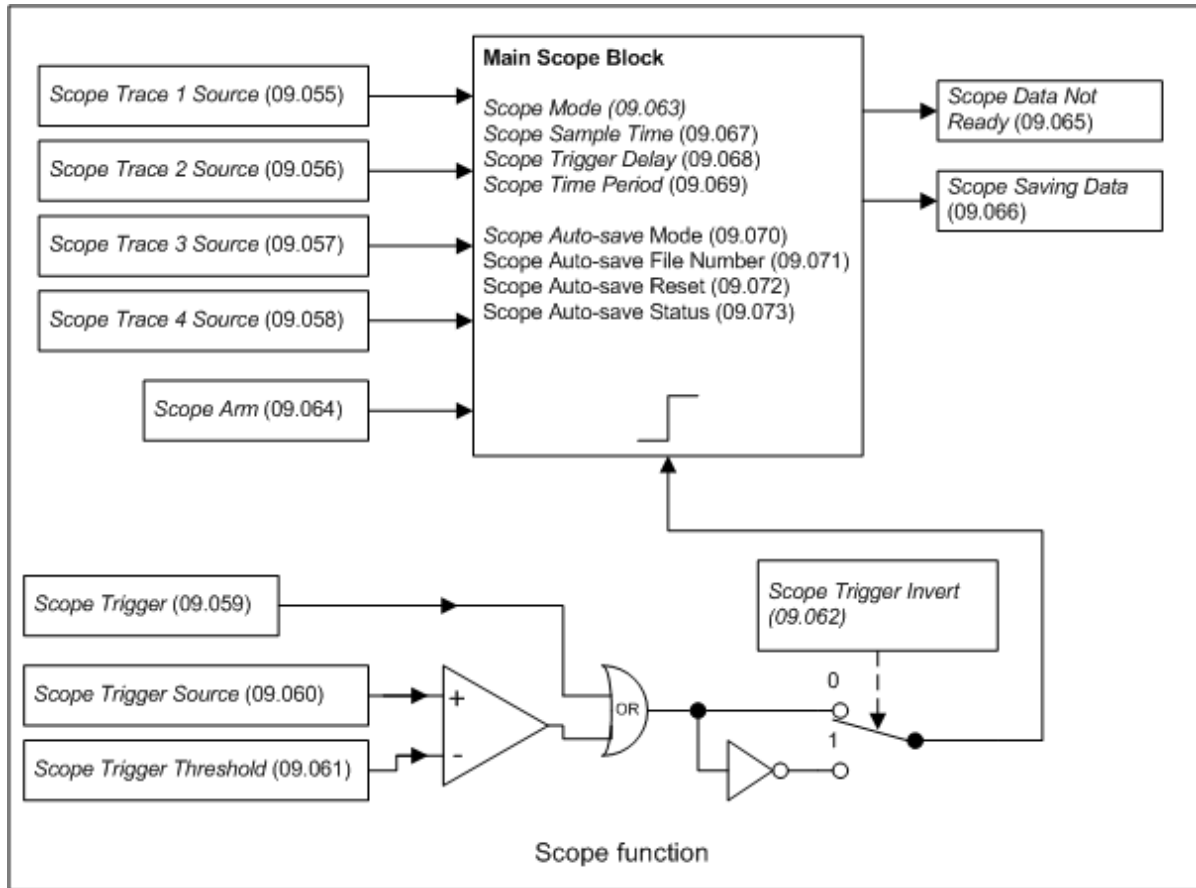
*Timer 1 Repeat Function* (09.039) defines the length of the repeat period. For example, if *Timer 1 Repeat Function* (09.039) = 2 then the repeat period is one day. The output is inactive until the time reaches the hour, minute and second defined in *Timer 1 Start Time* (09.036), and remains active until the time reaches the hour, minute and second defined in *Timer 1 Stop Time* (09.038). Different repeat periods may be selected as given in the table below. The table shows the constituent parts of the date and time that are used to determine the start and stop events. If the repeat period is set to every week then *Timer 1 Start Date* (09.035) and *Timer 1 Stop Date* (09.037) define the day of the week and not the date (i.e. 00.00.00 = Sunday, 00.00.01 = Monday, etc.). The week repeat period starts at 00.00.00 on Sunday morning and ends at 23.59.59 on Saturday night. If the stop time event is set to occur at or before the start time event or the *Timer 1 Repeat Function* (09.039) = 0 or *Timer 1 Enable* (09.040) = 0 the output remains inactive at all times (i.e. *Timer 1 Output* (09.042) = 0 if *Timer 1 Invert* (09.041) = 0).

| <i>Timer 1 Repeat Function</i> (09.039) | Repeat period | Second | Minute | Hour | Day | Month | Year | Day of week |
|---|---------------|--------|--------|------|-----|-------|------|-------------|
| 0                                       | None          |        |        |      |     |       |      |             |
| 1                                       | Hour          | .      | .      |      |     |       |      |             |
| 2                                       | Day           | .      | .      | .    |     |       |      |             |
| 3                                       | Week          | .      | .      | .    |     |       |      | .           |
| 4                                       | Month         | .      | .      | .    | .   |       |      |             |
| 5                                       | Year          | .      | .      | .    | .   | .     |      |             |
| 6                                       | One off       | .      | .      | .    | .   | .     | .    |             |
| 7                                       | Minute        | .      |        |      |     |       |      |             |

As *Timer 1 Invert* (09.041) inverts the timer output it can be used to give an active state of 0 instead of 1. Alternatively it can be used to give an active state of 1, but for a time period that spans the ends of the repeat period as shown in the example above. It should be noted that if this method is used to allow the active period to span the ends of the repeat period then if the timer is disabled the output of the timer block before the invert becomes 0, and so the final output of the timer after the invert is 1.

If *Date/Time Selector* (06.019) is changed and the drive is reset then the source for the timers will change, therefore *Timer 1 Repeat Function* (09.039) and *Timer 2 Repeat Function* (09.049) are reset to 0 to disable the timers, and the date and time entries in the trip log are cleared.

## Scope function



| Parameter         | 09.001 Logic Function 1 Output             |                |           |
|-------------------|--|----------------|-----------|
| Short description | Shows the output state of logic function 1 |                |           |
| Mode              | RFC-A                                      |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile                             | Update Rate    | 4ms write |
| Display Format    | Standard                                   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                             |                |           |

Logic Function 1 Output (09.001) shows the output of logic function 1.

| Parameter         | 09.002 Logic Function 2 Output             |                |           |
|-------------------|--|----------------|-----------|
| Short description | Shows the output state of logic function 2 |                |           |
| Mode              | RFC-A                                      |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile                             | Update Rate    | 4ms write |
| Display Format    | Standard                                   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                             |                |           |

Logic Function 2 Output (09.002) shows the output of logic function 2.

| Parameter         | 09.003 Motorised Pot Output                          |                |           |
|-------------------|--|----------------|-----------|
| Short description | Shows the output level of the motorised pot function |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | -100.00  | Maximum        | 100.00    |
| Default           |  | Units          | %         |
| Type              | 16 Bit Power Down Save                               | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT                                       |                |           |

Motorised Pot Output (09.003) shows the output of the motorised pot function.

| Parameter         | 09.004 Logic Function 1 Source 1           |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines input source 1 of logic function 1 |                |                  |
| Mode              | RFC-A                                      |                |                  |
| Minimum           | 0.000                                      | Maximum        | 59.999           |
| Default           | 0.000                                      | Units          |                  |
| Type              | 16 Bit User Save                           | Update Rate    | Drive reset read |
| Display Format    | Standard                                   | Decimal Places | 3                |
| Coding            | RW, PT, BU                                 |                |                  |

Logic Function 1 Source 1 (09.004) defines input source 1 of logic function 1.

| Parameter         | 09.005 Logic Function 1 Source 1 Invert   |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to invert input 1 of logic function 1 |                |          |
| Mode              | RFC-A                                     |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit User Save                           | Update Rate    | 4ms read |
| Display Format    | Standard                                  | Decimal Places | 0        |
| Coding            | RW  |                |          |

Setting Logic Function 1 Source 1 Invert (09.005) inverts input 1 of logic function 1.

| Parameter         | 09.006 Logic Function 1 Source 2           |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines input source 2 of logic function 1 |                |                  |
| Mode              | RFC-A                                      |                |                  |
| Minimum           | 0.000                                      | Maximum        | 59.999           |
| Default           | 0.000                                      | Units          |                  |
| Type              | 16 Bit User Save                           | Update Rate    | Drive reset read |
| Display Format    | Standard                                   | Decimal Places | 3                |
| Coding            | RW, PT, BU                                 |                |                  |

Logic Function 1 Source 2 (09.006) defines input source 2 of logic function 1.

| Parameter         | 09.007 Logic Function 1 Source 2 Invert   |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to invert input 2 of logic function 1 |                |          |
| Mode              | RFC-A                                     |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit User Save                           | Update Rate    | 4ms read |
| Display Format    | Standard                                  | Decimal Places | 0        |
| Coding            | RW  |                |          |

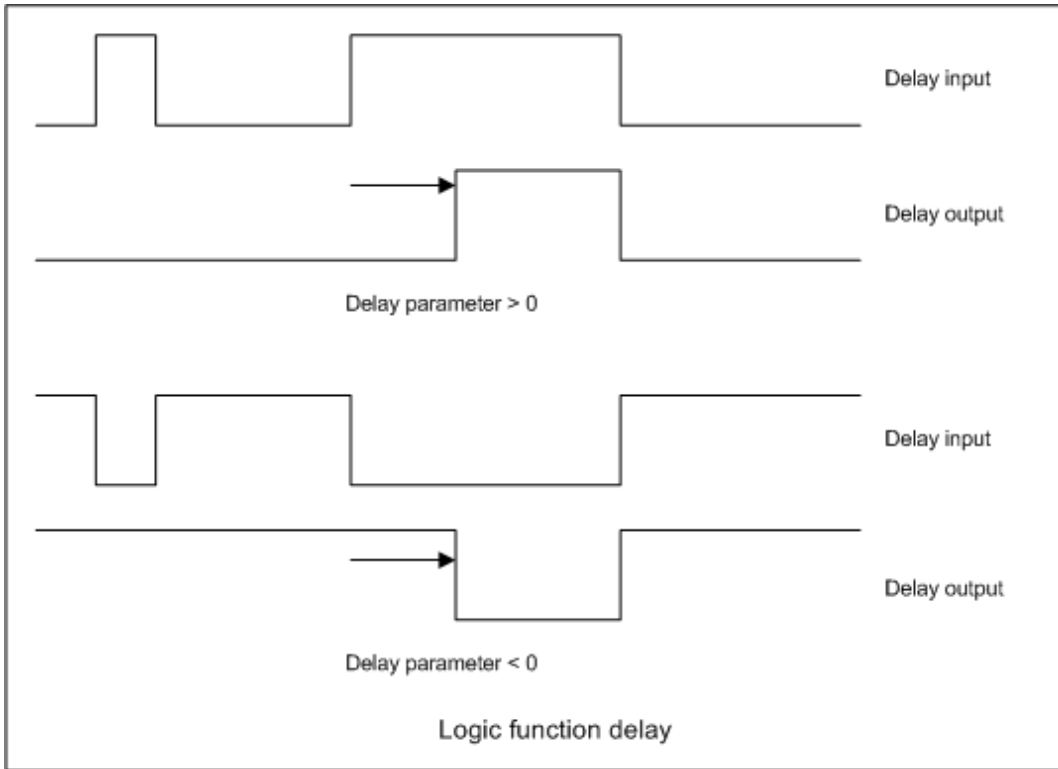
Setting Logic Function 1 Source 2 Invert (09.007) inverts input 2 of logic function 1.

| Parameter         | 09.008 Logic Function 1 Output Invert        |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to invert the output of logic function 1 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save                              | Update Rate    | 4ms read |
| Display Format    | Standard                                     | Decimal Places | 0        |
| Coding            | RW   |                |          |

Setting Logic Function 1 Output Invert (09.008) inverts the output of logic function 1.

| Parameter         | 09.009 Logic Function 1 Delay                |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the output delay of logic function 1 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | -25.0  | Maximum        | 25.0     |
| Default           | 0.0  | Units          | s        |
| Type              | 16 Bit User Save                             | Update Rate    | 4ms read |
| Display Format    | Standard                                     | Decimal Places | 1        |
| Coding            | RW   |                |          |

Logic Function 1 Delay (09.009) defines the delay at the output of logic function 1. If Logic Function 1 Delay (09.009) is positive then the output does not become 1 until the input to the delay has been at 1 for the delay time. If Logic Function 1 Delay (09.009) is negative then the output remains at 1 until the input to the delay has been 0 for the delay time.



| Parameter         | 09.010 Logic Function 1 Destination                |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the output destination of logic function 1 |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                     |                |                  |

Logic Function 1 Destination (09.010) defines the output destination of logic function 1.

| Parameter         | 09.014 Logic Function 2 Source 1           |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines input source 1 of logic function 2 |                |                  |
| Mode              | RFC-A                                      |                |                  |
| Minimum           | 0.000                                      | Maximum        | 59.999           |
| Default           | 0.000                                      | Units          |                  |
| Type              | 16 Bit User Save                           | Update Rate    | Drive reset read |
| Display Format    | Standard                                   | Decimal Places | 3                |
| Coding            | RW, PT, BU                                 |                |                  |

Logic Function 2 Source 1 (09.014) defines input source 1 of logic function 2.

| Parameter         | 09.015 Logic Function 2 Source 1 Invert   |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to invert input 1 of logic function 2 |                |          |
| Mode              | RFC-A                                     |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit User Save                           | Update Rate    | 4ms read |
| Display Format    | Standard                                  | Decimal Places | 0        |
| Coding            | RW  |                |          |

Setting Logic Function 2 Source 1 Invert (09.015) inverts input 1 of logic function 2.



| Parameter         | 09.016 Logic Function 2 Source 2           |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines input source 2 of logic function 2 |                |                  |
| Mode              | RFC-A                                      |                |                  |
| Minimum           | 0.000                                      | Maximum        | 59.999           |
| Default           | 0.000                                      | Units          |                  |
| Type              | 16 Bit User Save                           | Update Rate    | Drive reset read |
| Display Format    | Standard                                   | Decimal Places | 3                |
| Coding            | RW, PT, BU                                 |                |                  |

Logic Function 2 Source 2 (09.016) defines input source 2 of logic function 2.

| Parameter         | 09.017 Logic Function 2 Source 2 Invert   |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to invert input 2 of logic function 2 |                |          |
| Mode              | RFC-A                                     |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit User Save                           | Update Rate    | 4ms read |
| Display Format    | Standard                                  | Decimal Places | 0        |
| Coding            | RW  |                |          |

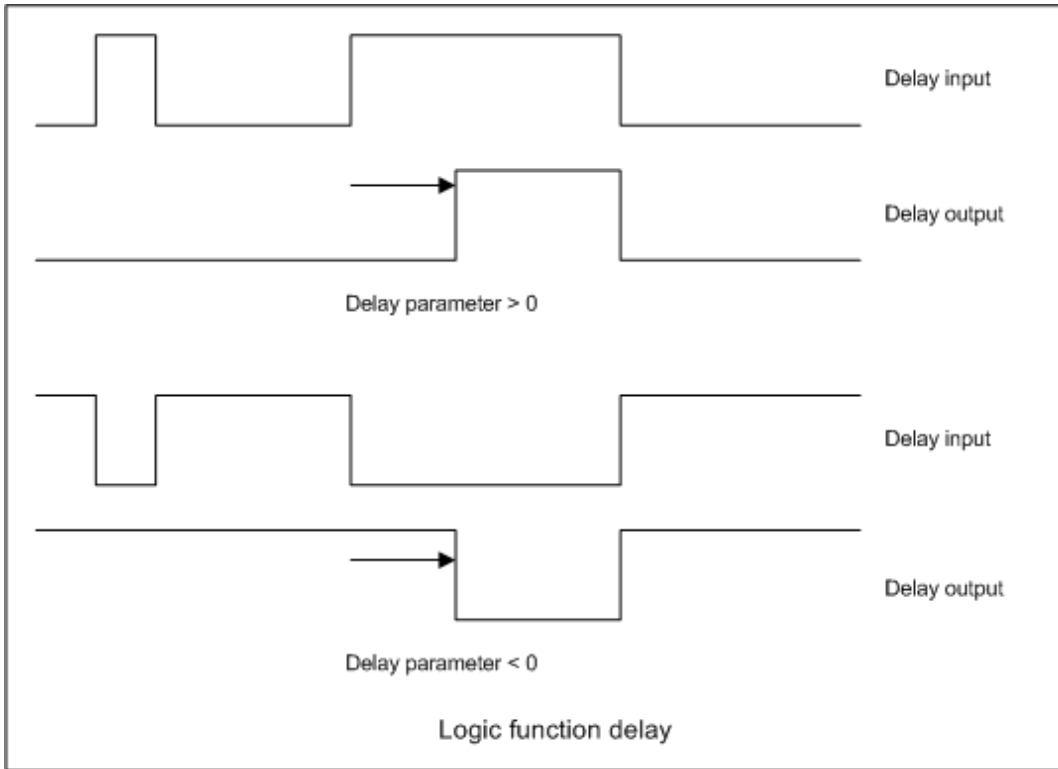
Setting Logic Function 2 Source 2 Invert (09.017) inverts input 2 of logic function 2.

| Parameter         | 09.018 Logic Function 2 Output Invert        |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to invert the output of logic function 2 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save                              | Update Rate    | 4ms read |
| Display Format    | Standard                                     | Decimal Places | 0        |
| Coding            | RW   |                |          |

Setting Logic Function 2 Output Invert (09.018) inverts the output of logic function 2.

| Parameter         | 09.019 Logic Function 2 Delay                |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the output delay of logic function 2 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | -25.0  | Maximum        | 25.0     |
| Default           | 0.0  | Units          | s        |
| Type              | 16 Bit User Save                             | Update Rate    | 4ms read |
| Display Format    | Standard                                     | Decimal Places | 1        |
| Coding            | RW   |                |          |

Logic Function 2 Delay (09.019) defines the delay at the output of logic function 1. If Logic Function 2 Delay (09.019) is positive then the output does not become 1 until the input to the delay has been at 1 for the delay time. If Logic Function 2 Delay (09.019) is negative then the output remains at 1 until the input to the delay has been 0 for the delay time.



| Parameter         | 09.020 Logic Function 2 Destination                |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the output destination of logic function 2 |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                     |                |                  |

Logic Function 2 Destination (09.020) defines the output destination of logic function 2.

| Parameter         | 09.021 Motorised Pot Mode      |                |                 |
|-------------------|--------------------------------|----------------|-----------------|
| Short description | Defines the motorised pot mode |                |                 |
| Mode              | RFC-A                          |                |                 |
| Minimum           | 0                              | Maximum        | 4               |
| Default           | 0                              | Units          |                 |
| Type              | 8 Bit User Save                | Update Rate    | Background read |
| Display Format    | Standard                       | Decimal Places | 0               |
| Coding            | RW                             |                |                 |

Motorised Pot Mode (09.021) defines the mode of operation as given in the table below.

| Motorised Pot Mode (09.021) | Motorised Pot Output (09.003)                                | Motorised Pot Up (09.026) and Motorised Pot Down (09.027) active |
|-----------------------------|--|--|
| 0                           | Reset to zero at power-up                                    | Always   |
| 1                           | Set to power-down value at power-up                          | Always   |
| 2                           | Reset to zero at power-up                                    | When Drive Active (10.002) = 1                                   |
| 3                           | Set to power-down value at power-up                          | When Drive Active (10.002) = 1                                   |
| 4                           | Reset to zero at power-up and when Drive Active (10.002) = 0 | When Drive Active (10.002) = 1                                   |

| Parameter         | 09.022 Motorised Pot Bipolar Select                  |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to enable bipolar operation of the motorised pot |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save                                      | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW   |                |          |

If Motorised Pot Bipolar Select (09.022) = 0 then Motorised Pot Output (09.003) is limited in the range 0.00% to 100.00%, otherwise it is allowed to

change in the range from -100.00% to 100.00%.

| Parameter         | 09.023 Motorised Pot Rate                              |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines the rate of change of the motorised pot output |                |            |
| Mode              | RFC-A  |                |            |
| Minimum           | 0  | Maximum        | 250        |
| Default           | 20   | Units          | s          |
| Type              | 8 Bit User Save  | Update Rate    | Background |
| Display Format    | Standard   | Decimal Places | 0          |
| Coding            | RW, BU   |                |            |

The rate of change of *Motorised Pot Output* (09.003) is defined by *Motorised Pot Rate* (09.023) which gives the time to change from 0 to 100%. The time to change from -100% to 100% is *Motorised Pot Rate* (09.023) x 2.

| Parameter         | 09.024 Motorised Pot Scaling                            |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling factor for the motorised pot output |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0.000   | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

*Motorised Pot Scaling* (09.024) introduces a scaling factor at the output of the motorised pot before the output is routed to the destination. If *Motorised Pot Scaling* (09.024) *Motorised Pot Scaling* (09.024) > 1.000 the output will exceed the range of the destination parameter, and so the destination parameter will be at its maximum or minimum before the output of the motorised pot reaches the limits of its range.

| Parameter         | 09.025 Motorised Pot Destination                    |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the output destination of the motorised pot |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.000   | Maximum        | 59.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save                                    | Update Rate    | Drive reset read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                      |                |                  |

*Logic Function 2 Destination* (09.020) defines the output destination of the motorised pot function.

| Parameter         | 09.026 Motorised Pot Up                  |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to increase the motorised pot output |                |          |
| Mode              | RFC-A                                    |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit Volatile                           | Update Rate    | 4ms read |
| Display Format    | Standard                                 | Decimal Places | 0        |
| Coding            | RW, NC                                   |                |          |

If *Motorised Pot Up* (09.026) = 1, then the *Motorised Pot Output* (09.003) will increase.

| Parameter         | 09.027 Motorised Pot Down                |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to decrease the motorised pot output |                |          |
| Mode              | RFC-A                                    |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit Volatile                           | Update Rate    | 4ms read |
| Display Format    | Standard                                 | Decimal Places | 0        |
| Coding            | RW, NC                                   |                |          |

If *Motorised Pot Down* (09.027) = 1, then the *Motorised Pot Output* (09.003) will decrease.

| Parameter         | 09.028 Motorised Pot Reset                    |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to reset the motorised pot output to zero |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile                                | Update Rate    | 4ms read |
| Display Format    | Standard                                      | Decimal Places | 0        |
| Coding            | RW, NC  |                |          |

If *Motorised Pot Reset* (09.028) = 1 then the motorised pot is disabled and held in its reset state with *Motorised Pot Output* (09.003) = 0.0%. If *Motorised Pot Reset* (09.028) = 0 the motorised pot is enabled even if *Motorised Pot Destination* (09.025) is not routed to a valid parameter.

| Parameter         | 09.029 Binary Sum Ones                  |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to add one to the binary sum output |                |          |
| Mode              | RFC-A                                   |                |          |
| Minimum           | 0                                       | Maximum        | 1        |
| Default           | 0                                       | Units          |          |
| Type              | 1 Bit Volatile                          | Update Rate    | 4ms read |
| Display Format    | Standard                                | Decimal Places | 0        |
| Coding            | RW, NC                                  |                |          |

See *Binary Sum Output* (09.032).

| Parameter         | 09.030 Binary Sum Twos                  |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to add two to the binary sum output |                |          |
| Mode              | RFC-A                                   |                |          |
| Minimum           | 0                                       | Maximum        | 1        |
| Default           | 0                                       | Units          |          |
| Type              | 1 Bit Volatile                          | Update Rate    | 4ms read |
| Display Format    | Standard                                | Decimal Places | 0        |
| Coding            | RW, NC                                  |                |          |

See *Binary Sum Output* (09.032).

| Parameter         | 09.031 Binary Sum Fours                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to add three to the binary sum output |                |          |
| Mode              | RFC-A                                     |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile                            | Update Rate    | 4ms read |
| Display Format    | Standard                                  | Decimal Places | 0        |
| Coding            | RW, NC                                    |                |          |

See *Binary Sum Output* (09.032).

| Parameter         | 09.032 Binary Sum Output                 |                |           |
|-------------------|--|----------------|-----------|
| Short description | Shows the output level of the binary sum |                |           |
| Mode              | RFC-A                                    |                |           |
| Minimum           | 0  | Maximum        | 255       |
| Default           |  | Units          |           |
| Type              | 8 Bit Volatile                           | Update Rate    | 4ms write |
| Display Format    | Standard                                 | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT, BU                       |                |           |

The output of the binary sum block is given by:

$$\text{Binary Sum Output (09.032)} = \text{Binary Sum Offset (09.034)} + (\text{Binary Sum Ones (09.029)} \times 1) + (\text{Binary Sum Twos (09.030)} \times 2) + (\text{Binary Sum Fours (09.031)} \times 4)$$

*Binary Sum Destination* (09.033) defines the destination for the binary sum output. The routing for this destination is special if the maximum of the destination parameter  $\leq 7 + \text{Binary Sum Offset (09.034)}$  as follows:

$$\text{Destination parameter} = \text{Binary Sum Output (09.032)}, \text{ subject to the parameter minimum.}$$

If the maximum of the destination parameter  $> 7 + \text{Binary Sum Offset (09.034)}$ , *Binary Sum Output* (09.032) is routed in the same way as any other destination where the destination target is at its full scale value when the *Binary Sum Output* (09.032) =  $7 + \text{Binary Sum Offset (09.034)}$ .

| Parameter         | 09.033 Binary Sum Destination                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the output destination of the binary sum |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                 | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                   |                |                  |

*Binary Sum Destination* (09.033) defines the destination for the binary sum output.

See *Binary Sum Output* (09.032) for more information.

| Parameter         | 09.034 Binary Sum Offset                                 |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the offset added to the output of the binary sum |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 248      |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, BU   |                |          |

See *Binary Sum Output* (09.032).

| Parameter         | 09.035 Timer 1 Start Date          |                |                               |
|-------------------|------------------------------------|----------------|-------------------------------|
| Short description | Defines the start date for timer 1 |                |                               |
| Mode              | RFC-A                              |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)           | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           | 0<br>(Display: 00-00-00)           | Units          |                               |
| Type              | 32 Bit User Save                   | Update Rate    | Background read               |
| Display Format    | Date                               | Decimal Places | 0                             |
| Coding            | RW                                 |                |                               |

*Timer 1 Start Date* (09.035) defines the start date within the repeat period of timer 1.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.036 Timer 1 Start Time          |                |                               |
|-------------------|------------------------------------|----------------|-------------------------------|
| Short description | Defines the start time for timer 1 |                |                               |
| Mode              | RFC-A                              |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)           | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           | 0<br>(Display: 00:00:00)           | Units          |                               |
| Type              | 32 Bit User Save                   | Update Rate    | Background read               |
| Display Format    | Time                               | Decimal Places | 0                             |
| Coding            | RW                                 |                |                               |

*Timer 1 Start Time* (09.036) defines the start time within the repeat period of timer 1.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.037 Timer 1 Stop Date          |                |                               |
|-------------------|-----------------------------------|----------------|-------------------------------|
| Short description | Defines the stop date for timer 1 |                |                               |
| Mode              | RFC-A                             |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)          | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           | 0<br>(Display: 00-00-00)          | Units          |                               |
| Type              | 32 Bit User Save                  | Update Rate    | Background read               |
| Display Format    | Date                              | Decimal Places | 0                             |
| Coding            | RW                                |                |                               |

*Timer 1 Stop Date* (09.037) defines the stop date within the repeat period of timer 1.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.038 Timer 1 Stop Time          |                |                               |
|-------------------|-----------------------------------|----------------|-------------------------------|
| Short description | Defines the stop time for timer 1 |                |                               |
| Mode              | RFC-A                             |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)          | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           | 0<br>(Display: 00:00:00)          | Units          |                               |
| Type              | 32 Bit User Save                  | Update Rate    | Background read               |
| Display Format    | Time                              | Decimal Places | 0                             |
| Coding            | RW                                |                |                               |

Timer 1 Stop Time (09.038) defines the stop time within the repeat period of timer 1.

See Timer 1 Repeat Function (09.039) for more information.

| Parameter         | 09.039 Timer 1 Repeat Function          |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the length of the repeat period |                |                 |
| Mode              | RFC-A                                   |                |                 |
| Minimum           | 0                                       | Maximum        | 7               |
| Default           | 0                                       | Units          |                 |
| Type              | 8 Bit User Save                         | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW, TE                                  |                |                 |

| Value | Text    |
|-------|---------|
| 0     | None    |
| 1     | Hour    |
| 2     | Day     |
| 3     | Week    |
| 4     | Month   |
| 5     | Year    |
| 6     | One off |
| 7     | Minute  |

Timer 1 Repeat Function (09.039) defines the length of the repeat period. For example, if Timer 1 Repeat Function (09.039) = 2 then the repeat period is one day. The result is inactive until the time reaches the hour, minute and second defined in Timer 1 Start Time (09.036), and remains active until the time reaches the hour, minute and second defined in Timer 1 Stop Time (09.038). Different repeat periods may be selected as given in the table below. The table shows the constituent parts of the date and time that are used to determine the start and stop events. If the repeat period is set to every week then Timer 1 Start Date (09.035) and Timer 1 Stop Date (09.037) define the day of the week and not the date (i.e. 00.00.00 = Sunday, 00.00.01 = Monday, etc.). If the stop time event is set to occur at or before the start time event or the Timer 1 Repeat Function (09.039) = 0 or Timer 1 Enable (09.040) = 0 the result remains inactive at all times (i.e. Timer 1 Output (09.042) = 0 if Timer 1 Invert (09.041) = 0).

| Timer 1 Repeat Function (09.039) | Repeat period | Second | Minute | Hour | Day | Month | Year | Day of week |
|----------------------------------|---------------|--------|--------|------|-----|-------|------|-------------|
| 0                                | None          |        |        |      |     |       |      |             |
| 1                                | Hour          | .      | .      |      |     |       |      |             |
| 2                                | Day           | .      | .      | .    |     |       |      |             |
| 3                                | Week          | .      | .      | .    |     |       |      | .           |
| 4                                | Month         | .      | .      | .    | .   |       |      |             |
| 5                                | Year          | .      | .      | .    | .   | .     |      |             |
| 6                                | One off       | .      | .      | .    | .   | .     | .    |             |
| 7                                | Minute        | .      |        |      |     |       |      |             |

| Parameter         | 09.040 Timer 1 Enable              |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Set to enable the timer 1 function |                |                 |
| Mode              | RFC-A                              |                |                 |
| Minimum           | 0                                  | Maximum        | 1               |
| Default           | 0                                  | Units          |                 |
| Type              | 1 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW                                 |                |                 |

Timer 1 Enable (09.040) enables the timer 1 function. If Timer 1 Enable (09.040) = 0, then the output of the timer is always inactive, i.e. Timer 1 Output (09.042) = 0.

| Parameter         | 09.041 Timer 1 Invert               |                |                 |
|-------------------|-------------------------------------|----------------|-----------------|
| Short description | Set to invert the output of timer 1 |                |                 |
| Mode              | RFC-A                               |                |                 |
| Minimum           | 0                                   | Maximum        | 1               |
| Default           | 0                                   | Units          |                 |
| Type              | 1 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                            | Decimal Places | 0               |
| Coding            | RW                                  |                |                 |

*Timer 1 Invert* (09.041) inverts the timer output to give an active state of 0 instead of 1. Alternatively it can be used to give an active state of 1, but for a time period that spans the ends of the repeat period as shown in the example above. It should be noted that if this method is used to allow the active period to span the ends of the repeat period then if the timer is disabled the output of the timer block before the invert becomes 0, and so the final output of the timer after the invert is 1.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.042 Timer 1 Output                      |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Shows the output state of timer function 1 |                |                  |
| Mode              | RFC-A                                      |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                             | Update Rate    | Background write |
| Display Format    | Standard                                   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                             |                |                  |

*Timer 1 Output* (09.042) shows the output of timer function 1.

| Parameter         | 09.043 Timer 1 Destination                         |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the output destination of timer function 1 |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                     |                |                  |

*Timer 1 Destination* (09.043) defines the output destination of timer function 1.

| Parameter         | 09.045 Timer 2 Start Date          |                |                               |
|-------------------|------------------------------------|----------------|-------------------------------|
| Short description | Defines the start date for timer 2 |                |                               |
| Mode              | RFC-A                              |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)           | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           | 0<br>(Display: 00-00-00)           | Units          |                               |
| Type              | 32 Bit User Save                   | Update Rate    | Background read               |
| Display Format    | Date                               | Decimal Places | 0                             |
| Coding            | RW                                 |                |                               |

*Timer 2 Start Date* (09.045) defines the start date within the repeat period of timer 2.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.046 Timer 2 Start Time          |                |                               |
|-------------------|------------------------------------|----------------|-------------------------------|
| Short description | Defines the start time for timer 2 |                |                               |
| Mode              | RFC-A                              |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)           | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           | 0<br>(Display: 00:00:00)           | Units          |                               |
| Type              | 32 Bit User Save                   | Update Rate    | Background read               |
| Display Format    | Time                               | Decimal Places | 0                             |
| Coding            | RW                                 |                |                               |

*Timer 2 Start Time* (09.046) defines the start time within the repeat period of timer 2.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.047 Timer 2 Stop Date          |                |                               |
|-------------------|-----------------------------------|----------------|-------------------------------|
| Short description | Defines the stop date for timer 2 |                |                               |
| Mode              | RFC-A                             |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)          | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           | 0<br>(Display: 00-00-00)          | Units          |                               |
| Type              | 32 Bit User Save                  | Update Rate    | Background read               |
| Display Format    | Date                              | Decimal Places | 0                             |
| Coding            | RW                                |                |                               |

Timer 2 Stop Date (09.047) defines the stop date within the repeat period of timer 2.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.048 Timer 2 Stop Time          |                |                               |
|-------------------|-----------------------------------|----------------|-------------------------------|
| Short description | Defines the stop time for timer 2 |                |                               |
| Mode              | RFC-A                             |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)          | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           | 0<br>(Display: 00:00:00)          | Units          |                               |
| Type              | 32 Bit User Save                  | Update Rate    | Background read               |
| Display Format    | Time                              | Decimal Places | 0                             |
| Coding            | RW                                |                |                               |

Timer 2 Stop Time (09.048) defines the stop time within the repeat period of timer 2.

See *Timer 1 Repeat Function* (09.039) for more information.

| Parameter         | 09.049 Timer 2 Repeat Function          |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the length of the repeat period |                |                 |
| Mode              | RFC-A                                   |                |                 |
| Minimum           | 0                                       | Maximum        | 7               |
| Default           | 0                                       | Units          |                 |
| Type              | 8 Bit User Save                         | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW, TE                                  |                |                 |

| Value | Text    |
|-------|---------|
| 0     | None    |
| 1     | Hour    |
| 2     | Day     |
| 3     | Week    |
| 4     | Month   |
| 5     | Year    |
| 6     | One off |
| 7     | Minute  |

See *Timer 1 Repeat Function* (09.039).

| Parameter         | 09.050 Timer 2 Enable              |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Set to enable the timer 2 function |                |                 |
| Mode              | RFC-A                              |                |                 |
| Minimum           | 0                                  | Maximum        | 1               |
| Default           | 0                                  | Units          |                 |
| Type              | 1 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW                                 |                |                 |

Timer 2 Enable (09.050) enables the timer 2 function. If *Timer 2 Enable* (09.050) = 0, then the output of the timer is always inactive, i.e. *Timer 2 Output* (09.052) = 0.



| Parameter         | 09.051 <i>Timer 2 Invert</i>        |                |                 |
|-------------------|-------------------------------------|----------------|-----------------|
| Short description | Set to invert the output of timer 2 |                |                 |
| Mode              | RFC-A                               |                |                 |
| Minimum           | 0                                   | Maximum        | 1               |
| Default           | 0                                   | Units          |                 |
| Type              | 1 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                            | Decimal Places | 0               |
| Coding            | RW                                  |                |                 |

*Timer 2 Invert* (09.051) inverts the timer output to give an active state of 0 instead of 1.

See *Timer 1 Invert* (09.041) for more information.

| Parameter         | 09.052 <i>Timer 2 Output</i>               |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Shows the output state of timer function 2 |                |                  |
| Mode              | RFC-A                                      |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                             | Update Rate    | Background write |
| Display Format    | Standard                                   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                             |                |                  |

*Timer 2 Output* (09.052) shows the output of timer function 2.

| Parameter         | 09.053 <i>Timer 2 Destination</i>                  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the output destination of timer function 2 |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                                     |                |                  |

*Timer 2 Destination* (09.053) defines the output destination of timer function 2.

| Parameter         | 09.055 <i>Scope Trace 1 Source</i>  |                |                  |
|-------------------|-------------------------------------|----------------|------------------|
| Short description | Defines the source of scope trace 1 |                |                  |
| Mode              | RFC-A                               |                |                  |
| Minimum           | 0.000                               | Maximum        | 59.999           |
| Default           | 0.000                               | Units          |                  |
| Type              | 16 Bit User Save                    | Update Rate    | Drive reset read |
| Display Format    | Standard                            | Decimal Places | 3                |
| Coding            | RW, PT, BU                          |                |                  |

Up to four scope sources can be selected using *Scope Trace 1 Source* (09.055) to *Scope Trace 4 Source* (09.058). If the source value is set to 0.000, or the source parameter does not exist or is non-visible, then no source is selected. The sources do not operate in the same way as normal source parameters in that the input to the scope is the actual value of the parameter and not a value scaled to a percentage based on the range of the parameter. If a scope trace source parameter is modified the actual change is not effective until the drive is reset.

| Parameter         | 09.056 <i>Scope Trace 2 Source</i>  |                |                  |
|-------------------|-------------------------------------|----------------|------------------|
| Short description | Defines the source of scope trace 2 |                |                  |
| Mode              | RFC-A                               |                |                  |
| Minimum           | 0.000                               | Maximum        | 59.999           |
| Default           | 0.000                               | Units          |                  |
| Type              | 16 Bit User Save                    | Update Rate    | Drive reset read |
| Display Format    | Standard                            | Decimal Places | 3                |
| Coding            | RW, PT, BU                          |                |                  |

See *Scope Trace 1 Source* (09.055).

| Parameter         | 09.057 Scope Trace 3 Source         |                |                  |
|-------------------|-------------------------------------|----------------|------------------|
| Short description | Defines the source of scope trace 3 |                |                  |
| Mode              | RFC-A                               |                |                  |
| Minimum           | 0.000                               | Maximum        | 59.999           |
| Default           | 0.000                               | Units          |                  |
| Type              | 16 Bit User Save                    | Update Rate    | Drive reset read |
| Display Format    | Standard                            | Decimal Places | 3                |
| Coding            | RW, PT, BU                          |                |                  |

See *Scope Trace 1 Source* (09.055).

| Parameter         | 09.058 Scope Trace 4 Source         |                |                  |
|-------------------|-------------------------------------|----------------|------------------|
| Short description | Defines the source of scope trace 4 |                |                  |
| Mode              | RFC-A                               |                |                  |
| Minimum           | 0.000                               | Maximum        | 59.999           |
| Default           | 0.000                               | Units          |                  |
| Type              | 16 Bit User Save                    | Update Rate    | Drive reset read |
| Display Format    | Standard                            | Decimal Places | 3                |
| Coding            | RW, PT, BU                          |                |                  |

See *Scope Trace 1 Source* (09.055).

| Parameter         | 09.059 Scope Trigger              |                |            |
|-------------------|-----------------------------------|----------------|------------|
| Short description | Set to trigger the scope function |                |            |
| Mode              | RFC-A                             |                |            |
| Minimum           | 0                                 | Maximum        | 1          |
| Default           | 0                                 | Units          |            |
| Type              | 1 Bit Volatile                    | Update Rate    | 250µs read |
| Display Format    | Standard                          | Decimal Places | 0          |
| Coding            | RW                                |                |            |

The scope is triggered by a rising edge at the input to the main scope block. If *Scope Trigger Source* (09.060) is set at its default value of 0.000 then the output of the trigger threshold comparator is 0, and so the scope can be triggered with *Scope Trigger* (09.059). *Scope Trigger Invert* (09.062) can be used to invert the trigger signal.

| Parameter         | 09.060 Scope Trigger Source             |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the source of the scope trigger |                |                 |
| Mode              | RFC-A                                   |                |                 |
| Minimum           | 0.000                                   | Maximum        | 59.999          |
| Default           | 0.000                                   | Units          |                 |
| Type              | 16 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 3               |
| Coding            | RW, PT, BU                              |                |                 |

If *Scope Trigger* (09.059) = 0, the scope can be triggered based on the level of a parameter defined by *Scope Trigger Source* (09.060) and the *Scope Trigger Threshold* (09.061). This source operates in the same way as the trace sources and a direct comparison is made between the actual parameter value and the threshold. Decimal places are ignored. The threshold detector output is 1 when the value from the scope trigger source is greater than *Scope Trigger Threshold* (09.061). If *Scope Trigger Source* (09.060) = 0.000, or it is used to select a parameter that does not exist or is non-visible, then the output of the threshold detector is 0.

| Parameter         | 09.061 Scope Trigger Threshold      |                |                 |
|-------------------|-------------------------------------|----------------|-----------------|
| Short description | Defines the scope trigger threshold |                |                 |
| Mode              | RFC-A                               |                |                 |
| Minimum           | -2147483648                         | Maximum        | 2147483647      |
| Default           | 0                                   | Units          |                 |
| Type              | 32 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                            | Decimal Places | 0               |
| Coding            | RW                                  |                |                 |

See *Scope Trigger Source* (09.060).

| Parameter         | 09.062 Scope Trigger Invert     |                |                 |
|-------------------|---------------------------------|----------------|-----------------|
| Short description | Set to invert the scope trigger |                |                 |
| Mode              | RFC-A                           |                |                 |
| Minimum           | 0                               | Maximum        | 1               |
| Default           | 0                               | Units          |                 |
| Type              | 1 Bit User Save                 | Update Rate    | Background read |
| Display Format    | Standard                        | Decimal Places | 0               |
| Coding            | RW                              |                |                 |

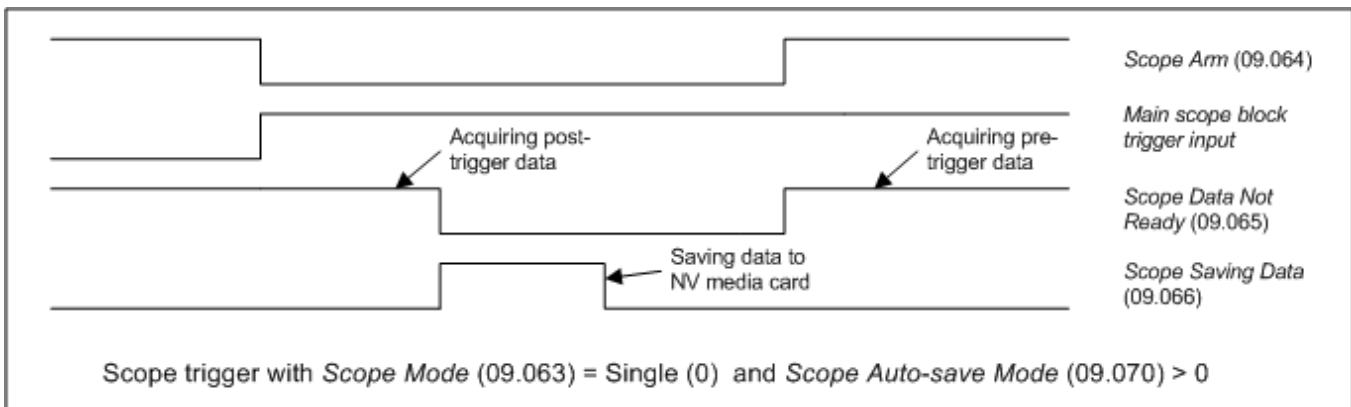
See *Scope Trigger* (09.059).

| Parameter         | 09.063 Scope Mode             |                |                 |
|-------------------|-------------------------------|----------------|-----------------|
| Short description | Defines the mode of the scope |                |                 |
| Mode              | RFC-A                         |                |                 |
| Minimum           | 0                             | Maximum        | 2               |
| Default           | 0                             | Units          |                 |
| Type              | 8 Bit User Save               | Update Rate    | Background read |
| Display Format    | Standard                      | Decimal Places | 0               |
| Coding            | RW, TE                        |                |                 |

| Value | Text   |
|-------|--------|
| 0     | Single |
| 1     | Normal |
| 2     | Auto   |

#### Single (0):

If *Scope Arm* (09.064) is set to 1 the scope starts to acquire pre-trigger data (i.e. enough data to provide information for the pre-trigger period) and *Scope Data Not Ready* (09.065) is set to 1. The scope can then be triggered on the next trigger event (i.e. a rising edge on the trigger input of the main scope block). Note that the scope can only be triggered once the required amount of pre-trigger data has been sampled. Failure to do this will result in the scope function not triggering correctly. When the trigger event occurs *Scope Arm* (09.064) is set to 0, and when the post-trigger data has been stored *Scope Data Not Ready* (09.065) is set to 0. If *Scope Auto-save Mode* (09.070) is non-zero, the data in the scope trace buffer is saved to a non-volatile media card fitted in the drive. When the save is complete (or data cannot be saved, i.e. no card fitted or no space left) the scope is ready again to receive data. If *Scope Arm* (09.064) is set to 1 the scope will start to acquire data again.



It is possible to read scope files via comms or into an option module. However, scope file transfer can only be initiated when *Scope Arm* (09.064) = 0, *Scope Data Not Ready* (09.065) = 0, *Scope Saving Data* (09.066) = 0 and at least one trace has been set up. While the file transfer is in progress *Scope Saving Data* (09.066) is set to 1.

The scope system is reset under any of the following conditions:

1. At power-up.
2. If the drive is reset when *Scope Trace 1 Source* (09.055) to *Scope Trace 4 Source* (09.058) have been modified.
3. The drive mode is changed.
4. If *Scope Mode* (09.063), *Scope Sample Time* (09.067) or *Scope Trigger Delay* (09.068) are modified.

When the scope is reset *Scope Arm* (09.064) is reset to 0 and the trace data is all cleared to 0..

#### Normal (1):

The scope operates in the same way as single mode except that *Scope Arm* (09.064) is automatically set back to 1 after a time delay of 1s once the post-trigger data has been acquired, and the scope data has been saved to a non-volatile media card if *Scope Auto-save Mode* (09.070) > 0.

#### Auto (2):

After the scope system is reset *Scope Data Not Ready* (09.065) is set to 1 and the scope begins to acquire data. Once the buffer is full *Scope Data Not Ready* (09.065) is set to 0 and the scope continues to acquire data. *Scope Arm* (09.064) has no effect on data acquisition. Provided *Scope Data Not Ready* (09.065) = 0 and *Scope Saving Data* (09.066) = 0 it is possible to read the data from the scope buffer as a scope file. Data acquisition is stopped when the file transfer begins. When the file transfer is complete, data acquisition begins again and *Scope Data Not Ready* (09.065) is set to 1 for a period that is long enough to fill the scope buffer with new data.

| Parameter         | 09.064 Scope Arm     |                |            |
|-------------------|----------------------|----------------|------------|
| Short description | Set to arm the scope |                |            |
| Mode              | RFC-A                |                |            |
| Minimum           | 0                    | Maximum        | 1          |
| Default           | 0                    | Units          |            |
| Type              | 1 Bit Volatile       | Update Rate    | 250µs read |
| Display Format    | Standard             | Decimal Places | 0          |
| Coding            | RW, NC               |                |            |

See *Scope Mode* (09.063).

| Parameter         | 09.065 Scope Data Not Ready   |                |             |
|-------------------|---|----------------|-------------|
| Short description | Shows that the data in the scope buffer is not ready to be read out |                |             |
| Mode              | RFC-A   |                |             |
| Minimum           | 0   | Maximum        | 1           |
| Default           |   | Units          |             |
| Type              | 1 Bit Volatile  | Update Rate    | 250µs write |
| Display Format    | Standard  | Decimal Places | 0           |
| Coding            | RO, ND, NC, PT  |                |             |

See *Scope Mode* (09.063).

| Parameter         | 09.066 Scope Saving Data            |                |                  |
|-------------------|-------------------------------------|----------------|------------------|
| Short description | Shows when the scope is saving data |                |                  |
| Mode              | RFC-A                               |                |                  |
| Minimum           | 0                                   | Maximum        | 1                |
| Default           |                                     | Units          |                  |
| Type              | 1 Bit Volatile                      | Update Rate    | Background write |
| Display Format    | Standard                            | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                      |                |                  |

See *Scope Mode* (09.063).

| Parameter         | 09.067 Scope Sample Time             |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description | Defines the sample time of the scope |                |                 |
| Mode              | RFC-A                                |                |                 |
| Minimum           | 1                                    | Maximum        | 200             |
| Default           | 1                                    | Units          |                 |
| Type              | 8 Bit User Save                      | Update Rate    | Background read |
| Display Format    | Standard                             | Decimal Places | 0               |
| Coding            | RW, BU                               |                |                 |

*Scope Sample Time* (09.067) defines the sample rate of the scope function for all traces in 250µs units (i.e. if *Scope Sample Time* (09.067) = 4, the sample time is 1ms).

| Parameter         | 09.068 Scope Trigger Delay                               |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines how much pre-trigger data is stored by the scope |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 100             |
| Default           | 0  | Units          | %               |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

*Scope Trigger Delay* (09.068) defines how much data is stored before and after the scope is triggered. If *Scope Trigger Delay* (09.068) = 0% then no data is stored before the trigger and all the data is after the trigger. If *Scope Trigger Delay* (09.068) = 100% then no data is stored after the trigger, but all the data is before the trigger.

| Parameter         | 09.069 Scope Time Period                          |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Shows the time period covered by the scope buffer |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.00  | Maximum        | 200000.00        |
| Default           |   | Units          | ms               |
| Type              | 32 Bit Volatile                                   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 2                |
| Coding            | RO, ND, NC, PT                                    |                |                  |

The scope function can capture up to 4000 bytes of parameter data. The *Scope Time Period* (09.069) gives the length of the time period covered by the scope buffer in milliseconds which depends on the number of traces stored, the sample time and the size of the parameters used as trace sources.

Sample time in milliseconds =  $(250 \times 10^{-6} \times \text{Scope Sample Time (09.067)}) \times 1000$

Size of trace data is the sum of the number of bytes in each of the trace sources selected by *Scope Trace 1 Source* (09.055) to *Scope Trace 4 Source* (09.058).

*Scope Time Period* (09.069) (ms) =  $4000 \times \text{Sample time in milliseconds} / \text{Size of trace data}$

| Parameter         | 09.070 Scope Auto-save Mode                                       |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the mode for auto-saving scope files to the NV media card |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 2               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text      |
|-------|-----------|
| 0     | Disabled  |
| 1     | Overwrite |
| 2     | Keep      |

Auto-save mode can be used to store a scope file on a non-volatile media card at each trigger event. The auto-save system is held in reset if *Scope Auto-save Reset* (09.072) = 1. When the auto-save system is reset all the scope files in scope file folder on the NV media card are deleted, *Scope Auto-save File Number* (09.071) is reset to 0 and the auto-save system is inactive. If any of the file operations fail during reset *Scope Auto-save Status* (09.073) is 3 (Failed) when the reset is removed.

The following conditions must be met for auto-saving to be active:

1. *Scope Auto-save Mode* (09.070) is non-zero
2. *Scope Auto-save Reset* (09.072) = 0
3. *Scope Auto-save Status* (09.073) = 1 (Active)
4. *Scope Mode* (09.063) = 0 (Single) or 1 (Normal)

If auto-saving is active an attempt is made to copy the scope file to a non-volatile media card fitted to the drive each time the post-trigger data has been acquired. The file name is SCP00XY.DAT, where XY is defined by *Scope Auto-save File Number* (09.071). If *Scope Auto-save Mode* (09.070) = 1 (Overwrite) then a file is over-written if it already exists. If *Scope Auto-save Mode* (09.070) = 2 (Keep) then if the file already exists the auto-save process is aborted. *Scope Auto-save File Number* (09.071) is incremented after a file is saved successfully and rolls over to 0 if it exceeds its maximum value.

If *Scope Auto-save Status* (09.073) = 0 (Disabled) and all the other conditions listed above for auto-saving to be active are met, then *Scope Auto-save Status* (09.073) changes to 1 (Active), so that auto-saving becomes active. If the scope file cannot be saved because the file exists and *Scope Auto-save Mode* (09.070) = 2 (Keep) then *Scope Auto-save Status* (09.073) is set to 2 (Stopped). If the scope file cannot be saved for any other reason then *Scope Auto-save Status* (09.073) is set to 3 (Failed). If *Scope Auto-save Status* (09.073) is no longer 1 (Active), auto-saving is aborted. Auto-saving can be made active again by setting *Scope Auto-save Reset* (09.072) to 1 and then to 0. If *Scope Auto-save Mode* (09.070) = 0 (Disabled) then *Scope Auto-save Status* (09.073) is set to 0 (Disabled), or if *Scope Auto-save Mode* (09.070) is non-zero then *Scope Auto-save Status* (09.073) is set to 1 (Active). It should be noted that *Scope Auto-save Status* (09.073) is a power-down save parameter, and so auto-save will remain inactive if *Scope Auto-save Status* (09.073) is 2 or 3 even if the drive is powered down and then powered up again.

| Parameter         | 09.071 Scope Auto-save File Number                                  |                |                       |
|-------------------|---|----------------|-----------------------|
| Short description | Shows the file number to be used for the next auto-saved scope file |                |                       |
| Mode              | RFC-A   |                |                       |
| Minimum           | 0   | Maximum        | 99                    |
| Default           | 0   | Units          |                       |
| Type              | 8 Bit Power Down Save   | Update Rate    | Background read/write |
| Display Format    | Standard  | Decimal Places | 0                     |
| Coding            | RO, NC  |                |                       |

See *Scope Auto-save Mode* (09.070).

| Parameter         | 09.072 Scope Auto-save Reset              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to reset the scope auto-save function |                |                 |
| Mode              | RFC-A                                     |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit Volatile                            | Update Rate    | Background read |
| Display Format    | Standard                                  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Scope Auto-save Mode* (09.070).

| Parameter         | 09.073 Scope Auto-save Status                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Shows the status of the scope auto-save function |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 3                |
| Default           | 0  | Units          |                  |
| Type              | 8 Bit Power Down Save                            | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, TE, NC                                       |                |                  |

| Value | Text     |
|-------|----------|
| 0     | Disabled |
| 1     | Active   |
| 2     | Stopped  |
| 3     | Failed   |

See *Scope Auto-save Mode* (09.070).

# Menu 10 Single Line Descriptions – *Status and Trips*

Mode: RFC-A

| Parameter |  | Range   | Default  | Type |      |    |    |    |    |
|-----------|--|---|----------|------|------|----|----|----|----|
| 10.001    | Drive Healthy                          | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.002    | Drive Active                           | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.003    | Zero Speed                             | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.004    | Running At Or Below Minimum Speed      | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.005    | Below Set Speed                        | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.006    | At Speed                               | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.007    | Above Set Speed                        | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.008    | Rated Load Reached                     | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.009    | Current Limit Active                   | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.010    | Regenerating                           | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.011    | Braking IGBT Active                    | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.012    | Braking Resistor Alarm                 | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.013    | Reverse Direction Commanded            | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.014    | Reverse Direction Running              | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.015    | Supply Loss                            | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.016    | Under Voltage Active                   | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.017    | Motor Overload Alarm                   | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.018    | Drive Over-temperature Alarm           | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.019    | Drive Warning                          | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |
| 10.020    | Trip 0                                 | 0 to 255  |          | RO   | Txt  | ND | NC | PT | PS |
| 10.021    | Trip 1                                 | 0 to 255  |          | RO   | Txt  | ND | NC | PT | PS |
| 10.022    | Trip 2                                 | 0 to 255  |          | RO   | Txt  | ND | NC | PT | PS |
| 10.023    | Trip 3                                 | 0 to 255  |          | RO   | Txt  | ND | NC | PT | PS |
| 10.024    | Trip 4                                 | 0 to 255  |          | RO   | Txt  | ND | NC | PT | PS |
| 10.025    | Trip 5                                 | 0 to 255  |          | RO   | Txt  | ND | NC | PT | PS |
| 10.026    | Trip 6                                 | 0 to 255  |          | RO   | Txt  | ND | NC | PT | PS |
| 10.027    | Trip 7                                 | 0 to 255  |          | RO   | Txt  | ND | NC | PT | PS |
| 10.028    | Trip 8                                 | 0 to 255  |          | RO   | Txt  | ND | NC | PT | PS |
| 10.029    | Trip 9                                 | 0 to 255  |          | RO   | Txt  | ND | NC | PT | PS |
| 10.030    | Braking Resistor Rated Power           | 0.000 to 99999.999 kW                                     | 0.000 kW | RW   | Num  |    |    |    | US |
| 10.031    | Braking Resistor Thermal Time Constant | 0.000 to 1500.000 s                                       | 0.000 s  | RW   | Num  |    |    |    | US |
| 10.032    | External Trip                          | Off (0) or On (1)   | Off (0)  | RW   | Bit  |    | NC |    |    |
| 10.033    | Drive Reset                            | Off (0) or On (1)   | Off (0)  | RW   | Bit  |    | NC |    |    |
| 10.034    | Number Of Auto-reset Attempts          | None (0), 1 (1), 2 (2), 3 (3), 4 (4), 5 (5), Infinite (6) | None (0) | RW   | Txt  |    |    |    | US |
| 10.035    | Auto-reset Delay                       | 1.0 to 600.0 s  | 1.0 s    | RW   | Num  |    |    |    | US |
| 10.036    | Auto-reset Hold Drive Healthy          | Off (0) or On (1)   | Off (0)  | RW   | Bit  |    |    |    | US |
| 10.037    | Action On Trip Detection               | 00000 to 11111  | 00000    | RW   | Bin  |    |    |    | US |
| 10.038    | User Trip                              | 0 to 255  |          | RW   | Num  | ND | NC |    |    |
| 10.039    | Braking Resistor Thermal Accumulator   | 0.0 to 100.0 %  |          | RO   | Num  | ND | NC | PT |    |
| 10.040    | Status Word                            | 0000000000000000 to 1111111111111111                      |          | RO   | Bin  | ND | NC | PT |    |
| 10.041    | Trip 0 Date                            | 00-00-00 to 31-12-99                                      |          | RO   | Date | ND | NC | PT | PS |
| 10.042    | Trip 0 Time                            | 00:00:00 to 23:59:59                                      |          | RO   | Time | ND | NC | PT | PS |
| 10.043    | Trip 1 Date                            | 00-00-00 to 31-12-99                                      |          | RO   | Date | ND | NC | PT | PS |
| 10.044    | Trip 1 Time                            | 00:00:00 to 23:59:59                                      |          | RO   | Time | ND | NC | PT | PS |
| 10.045    | Trip 2 Date                            | 00-00-00 to 31-12-99                                      |          | RO   | Date | ND | NC | PT | PS |
| 10.046    | Trip 2 Time                            | 00:00:00 to 23:59:59                                      |          | RO   | Time | ND | NC | PT | PS |
| 10.047    | Trip 3 Date                            | 00-00-00 to 31-12-99                                      |          | RO   | Date | ND | NC | PT | PS |
| 10.048    | Trip 3 Time                            | 00:00:00 to 23:59:59                                      |          | RO   | Time | ND | NC | PT | PS |
| 10.049    | Trip 4 Date                            | 00-00-00 to 31-12-99                                      |          | RO   | Date | ND | NC | PT | PS |
| 10.050    | Trip 4 Time                            | 00:00:00 to 23:59:59                                      |          | RO   | Time | ND | NC | PT | PS |
| 10.051    | Trip 5 Date                            | 00-00-00 to 31-12-99                                      |          | RO   | Date | ND | NC | PT | PS |
| 10.052    | Trip 5 Time                            | 00:00:00 to 23:59:59                                      |          | RO   | Time | ND | NC | PT | PS |
| 10.053    | Trip 6 Date                            | 00-00-00 to 31-12-99                                      |          | RO   | Date | ND | NC | PT | PS |
| 10.054    | Trip 6 Time                            | 00:00:00 to 23:59:59                                      |          | RO   | Time | ND | NC | PT | PS |
| 10.055    | Trip 7 Date                            | 00-00-00 to 31-12-99                                      |          | RO   | Date | ND | NC | PT | PS |
| 10.056    | Trip 7 Time                            | 00:00:00 to 23:59:59                                      |          | RO   | Time | ND | NC | PT | PS |
| 10.057    | Trip 8 Date                            | 00-00-00 to 31-12-99                                      |          | RO   | Date | ND | NC | PT | PS |
| 10.058    | Trip 8 Time                            | 00:00:00 to 23:59:59                                      |          | RO   | Time | ND | NC | PT | PS |
| 10.059    | Trip 9 Date                            | 00-00-00 to 31-12-99                                      |          | RO   | Date | ND | NC | PT | PS |
| 10.060    | Trip 9 Time                            | 00:00:00 to 23:59:59                                      |          | RO   | Time | ND | NC | PT | PS |
| 10.061    | Braking Resistor Resistance            | 0.00 to 10000.00 Ω  | 0.00 Ω   | RW   | Num  |    |    |    | US |
| 10.062    | Low Load Detected Alarm                | Off (0) or On (1)   |          | RO   | Bit  | ND | NC | PT |    |

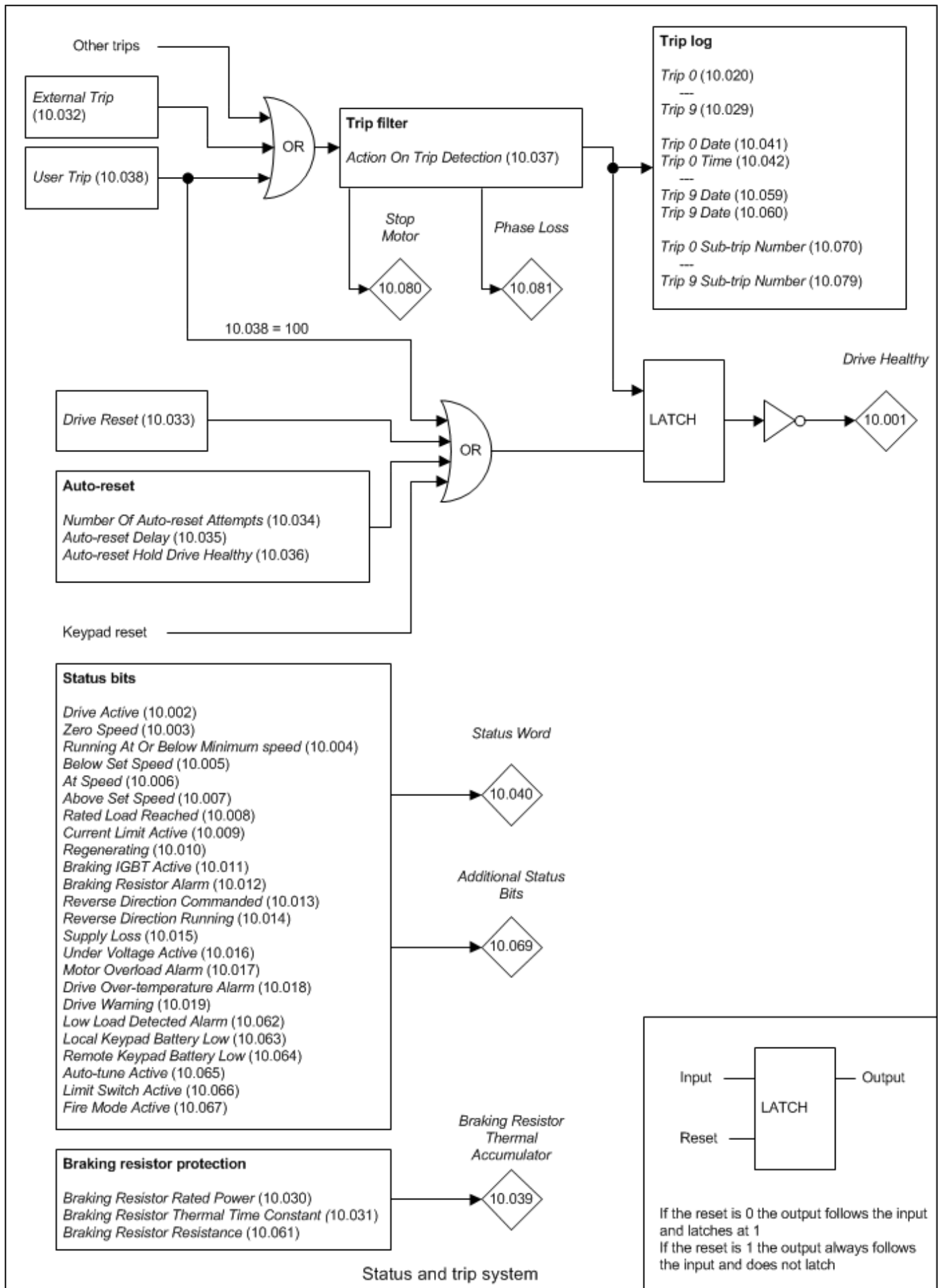


|        |                                     |  |   |         |    |     |    |    |    |    |
|--------|-------------------------------------|--|---|---------|----|-----|----|----|----|----|
| 10.063 | Local Keypad Battery Low            |  | Off (0) or On (1)   |         | RO | Bit | ND | NC | PT |    |
| 10.064 | Remote Keypad Battery Low           |  | Off (0) or On (1)   |         | RO | Bit | ND | NC | PT |    |
| 10.065 | Auto-tune Active                    |  | Off (0) or On (1)   |         | RO | Bit | ND | NC | PT |    |
| 10.066 | Limit Switch Active                 |  | Off (0) or On (1)   |         | RO | Bit | ND | NC | PT |    |
| 10.067 | Fire Mode Active                    |  | Off (0) or On (1)   |         | RO | Bit | ND | NC | PT |    |
| 10.068 | Hold Drive Healthy on Under Voltage |  | Off (0) or On (1)   | Off (0) | RW | Bit |    |    |    | US |
| 10.069 | Additional Status Bits              |  | 0000000000 to 1111111111  |         | RO | Bin | ND | NC | PT |    |
| 10.070 | Trip 0 Sub-trip Number              |  | 0 to 65535  |         | RO | Num | ND | NC | PT | PS |
| 10.071 | Trip 1 Sub-trip Number              |  | 0 to 65535  |         | RO | Num | ND | NC | PT | PS |
| 10.072 | Trip 2 Sub-trip Number              |  | 0 to 65535  |         | RO | Num | ND | NC | PT | PS |
| 10.073 | Trip 3 Sub-trip Number              |  | 0 to 65535  |         | RO | Num | ND | NC | PT | PS |
| 10.074 | Trip 4 Sub-trip Number              |  | 0 to 65535  |         | RO | Num | ND | NC | PT | PS |
| 10.075 | Trip 5 Sub-trip Number              |  | 0 to 65535  |         | RO | Num | ND | NC | PT | PS |
| 10.076 | Trip 6 Sub-trip Number              |  | 0 to 65535  |         | RO | Num | ND | NC | PT | PS |
| 10.077 | Trip 7 Sub-trip Number              |  | 0 to 65535  |         | RO | Num | ND | NC | PT | PS |
| 10.078 | Trip 8 Sub-trip Number              |  | 0 to 65535  |         | RO | Num | ND | NC | PT | PS |
| 10.079 | Trip 9 Sub-trip Number              |  | 0 to 65535  |         | RO | Num | ND | NC | PT | PS |
| 10.080 | Stop Motor                          |  | Off (0) or On (1)   |         | RO | Bit | ND | NC | PT |    |
| 10.081 | Phase Loss                          |  | Off (0) or On (1)   |         | RO | Bit | ND | NC | PT |    |
| 10.082 | Miscellaneous Status Flags          |  | 0000000000000000 to 1111111111111111  |         | RO | Bin | ND | NC | PT |    |
| 10.101 | Drive Status                        |  | Inhibit (0), Ready (1), Stop (2), Scan (3), Run (4), Supply Loss (5), Deceleration (6), dc Injection (7), Position (8), Trip (9), Active (10), Off (11), Hand (12), Auto (13), Heat (14), Under Voltage (15), Phasing (16)          |         | RO | Txt | ND | NC | PT |    |
| 10.102 | Trip Reset Source                   |  | 0 to 1023   |         | RO | Num | ND | NC | PT | PS |
| 10.103 | Trip Time Identifier                |  | -2147483648 to 2147483647 ms  |         | RO | Num | ND | NC | PT |    |
| 10.104 | Active Alarm                        |  | None (0), Brake Resistor (1), Motor Overload (2), Ind Overload (3), Drive Overload (4), Auto Tune (5), Limit Switch (6), Fire Mode (7), Low Load (8), Option Slot 1 (9), Option Slot 2 (10), Option Slot 3 (11), Option Slot 4 (12) |         | RO | Txt | ND | NC | PT |    |
| 10.105 | Hand Off Auto State                 |  | Not Active (0), Off (1), Hand (2), Auto (3)   |         | RO | Txt | ND | NC | PT | PS |
| 10.106 | Potential Drive Damage Conditions   |  | 0000 to 1111  |         | RO | Bin | ND | NC | PT | PS |
| 10.107 | Auto-tune State                     |  | Not Active (0), Resistance (1), pLs (2), Ls (3), Flux (4), Flux Repeat (5), Ld Lq No-load (6), Lq (7), Ke (8), Inertia (9)  |         | RO | Txt | ND | NC | PT |    |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 10 – *Status and Trips*

Mode: RFC-A



| Parameter         | 10.001 Drive Healthy                |                |                  |
|-------------------|-------------------------------------|----------------|------------------|
| Short description | Indicates that the drive is healthy |                |                  |
| Mode              | RFC-A                               |                |                  |
| Minimum           | 0                                   | Maximum        | 1                |
| Default           |                                     | Units          |                  |
| Type              | 1 Bit Volatile                      | Update Rate    | Background write |
| Display Format    | Standard                            | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                      |                |                  |

*Drive Healthy* (10.001) indicates that the drive is not in the trip or the under voltage state if it is set to one. If *Auto-reset Hold Drive Healthy* (10.036) = 1 and auto-reset is being used, *Drive Healthy* (10.001) is not cleared until all auto-resets have been attempted and the next trip occurs. The LED on the front of the drive gives an indication of the drive state as shown in the table below.

| Drive State  | LED                            |
|--|--------------------------------|
| Normal power and <i>Drive Healthy</i> (10.001) = 1 | On continuously                |
| Normal power and <i>Drive Healthy</i> (10.001) = 0 | Flashing: 0.5s on and 0.5s off |
| Standby power state                                | Flashing: 0.5s on and 7.5s off |

| Parameter         | 10.002 Drive Active                   |                |           |
|-------------------|---------------------------------------|----------------|-----------|
| Short description | Indicates that the inverter is active |                |           |
| Mode              | RFC-A                                 |                |           |
| Minimum           | 0                                     | Maximum        | 1         |
| Default           |                                       | Units          |           |
| Type              | 1 Bit Volatile                        | Update Rate    | 2ms write |
| Display Format    | Standard                              | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                        |                |           |

If the drive inverter is active *Drive Active* (10.002) is set to one, otherwise it is zero.

| Parameter         | 10.003 Zero Speed  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that the speed is below the zero speed threshold |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*Zero Speed* (10.003) is set to one under the zero speed conditions, otherwise it is zero. See *Zero Speed Threshold* (03.005).

| Parameter         | 10.004 Running At Or Below Minimum Speed                          |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the drive is running at or below the minimum speed |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

If *Bipolar Reference Enable* (01.010) = 1 then *Running At Or Below Minimum Speed* (10.004) operates in the same way as *Zero Speed* (10.003). If *Bipolar Reference Enable* (01.010) = 0 then *Running At Or Below Minimum Speed* (10.004) is set if the following conditions are true:

$Speed\ Feedback\ (03.002) \leq Minimum\ Reference\ Clamp\ (01.007) + 5rpm$

If motor map 2 is active then *M2 Minimum Reference Clamp* (21.002) is used instead of *Minimum Reference Clamp* (01.007). If *Linear Speed Select* (01.055) = 1 then  $5mm\ s^{-1}$  is used instead of 5rpm.

| Parameter         | 10.005 Below Set Speed                                  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the drive is running below the set speed |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

See *At Speed Lower Limit* (03.006).

| Parameter         | 10.006 <i>At Speed</i>                               |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that the drive is running at the set speed |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                                       | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                       |                |                  |

See *At Speed Lower Limit* (03.006).

| Parameter         | 10.007 <i>Above Set Speed</i>                           |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the drive is running above the set speed |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

See *At Speed Lower Limit* (03.006).

| Parameter         | 10.008 <i>Rated Load Reached</i>           |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that rated load has been reached |                |                  |
| Mode              | RFC-A                                      |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                             | Update Rate    | Background write |
| Display Format    | Standard                                   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                             |                |                  |

*Rated Load Reached* (10.008) is set to one when the torque producing current is at or above its rated level. This condition is detected when the modulus of *Percentage Load* (04.020) is greater or equal to 100.0%. It should be noted that this is an indication based on the level of current and not torque, which means that if field weakening is active a value of one in *Rated Load Reached* (10.008) does not necessarily mean that the motor is producing rated torque.

| Parameter         | 10.009 <i>Current Limit Active</i>         |                |           |
|-------------------|--|----------------|-----------|
| Short description | Indicates that the current limit is active |                |           |
| Mode              | RFC-A                                      |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile                             | Update Rate    | 4ms write |
| Display Format    | Standard                                   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                             |                |           |

*Current Limit Active* (10.009) is set to one if the current limit is active. It should be noted that the current limit system is used in RFC-A and RFC-S modes when standard ramp control is active (*Ramp Mode* (02.004)), or supply loss control is in ramp stop or limit stop mode (*Supply Loss Mode* (06.003)). Therefore *Current Limit Active* (10.009) is likely to change to one under these conditions, even if the user defined current limits are not active.

| Parameter         | 10.010 <i>Regenerating</i>  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that power is being transferred from the motor to the drive |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Regenerating* (10.010) is set to one if power is being transferred from the motor to the drive.

| Parameter         | 10.011 <i>Braking IGBT Active</i>         |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the braking IGBT is active |                |                  |
| Mode              | RFC-A                                     |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile                            | Update Rate    | Background write |
| Display Format    | Standard                                  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                            |                |                  |

*Braking IGBT Active* (10.011) is set to one if the braking IGBT is active. As the braking IGBT active periods may be short, each time the braking IGBT is switched on *Braking IGBT Active* (10.011) is set to one and remains at one for at least 0.5s.

| Parameter         | 10.012 <i>Braking Resistor Alarm</i>   |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that the braking IGBT is active and the braking resistor thermal accumulator is greater than 75% |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*Braking Resistor Alarm* (10.012) is set when the braking IGBT is active and *Braking Resistor Thermal Accumulator* (10.039) is greater than 75.0%. As the braking IGBT on periods may be short *Braking Resistor Alarm* (10.012) is always held on for at least 0.5s.

| Parameter         | 10.013 <i>Reverse Direction Commanded</i>               |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the reverse direction has been commanded |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Reverse Direction Commanded* (10.013) indicates the reference direction at the input to the ramp system. If the *Pre-ramp Reference* (01.003) is negative *Reverse Direction Commanded* (10.013) is one otherwise *Reverse Direction Commanded* (10.013) is zero.

| Parameter         | 10.014 <i>Reverse Direction Running</i>                      |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that the drive is running in the reverse direction |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*Reverse Direction Running* (10.014) is set to one if the *Speed Feedback* (03.002) is negative otherwise it is set to zero.

| Parameter         | 10.015 <i>Supply Loss</i>                            |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that the drive is in the supply loss state |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                                       | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                       |                |                  |

*Supply Loss* (10.015) indicates that the drive is in the supply loss state. This condition can only occur if supply loss detection is enabled, i.e. *Supply Loss Mode* (06.003) is set to a non-zero value. In the supply loss state the drive will attempt to stop the motor.

| Parameter         | 10.016 Under Voltage Active                            |                |           |
|-------------------|--|----------------|-----------|
| Short description | Indicates that the drive is in the under voltage state |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile   | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT   |                |           |

*Under Voltage Active* (10.016) indicates that the drive is in the under voltage state. See *Standard Under Voltage Threshold* (06.065) for more details.

| Parameter         | 10.017 Motor Overload Alarm   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the motor overload accumulator is above 75% and the output current is high |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Motor Overload Alarm* (10.017) is set if the drive output current is higher than the level that will eventually cause a *Motor Too Hot* trip and the *Motor Protection Accumulator* (04.019) is higher than 75.0%. See *Motor Thermal Time Constant 1* (04.015) for more details.

| Parameter         | 10.018 Drive Over-temperature Alarm                       |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the drive over-temperature alarm is active |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Drive Over-temperature Alarm* (10.018) is set if *Percentage Of Drive Thermal Trip Level* (07.036) is greater than 90%.

| Parameter         | 10.019 Drive Warning  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that one or more of the drive warning alarms are active |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Drive Warning* (10.019) is set to one if any of the drive warnings is active, and is defined as:

*Drive Warning* (10.019) = *Braking Resistor Alarm* (10.012) OR *Motor Overload Alarm* (10.017) OR *Drive Over-temperature Alarm* (10.018) OR *Low Load Detected Alarm* (10.062)

| Parameter         | 10.020 Trip 0                                   |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the current or last trip to have occurred |                |               |
| Mode              | RFC-A   |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                           | Update Rate    | Write on trip |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                          |                |               |

[Click here to view trips in numerical order.](#)

| <b>Value</b> | <b>Text</b>      |
|--------------|------------------|
| 28           | An Input 1 Loss  |
| 29           | An Input 2 Loss  |
| 219          | An Output Calib  |
| 217          | App Menu Changed |
| 11           | Autotune 1       |
| 12           | Autotune 2       |
| 13           | Autotune 3       |
| 14           | Autotune 4       |
| 15           | Autotune 5       |
| 16           | Autotune 6       |
| 17           | Autotune 7       |
| 18           | Autotune Stopped |
| 19           | Brake R Too Hot  |
| 99           | CAM              |
| 185          | Card Access      |
| 177          | Card Boot        |
| 178          | Card Busy        |
| 188          | Card Compare     |
| 179          | Card Data Exists |
| 187          | Card Drive Mode  |
| 182          | Card Error       |
| 184          | Card Full        |
| 183          | Card No Data     |
| 180          | Card Option      |
| 175          | Card Product     |
| 186          | Card Rating      |
| 181          | Card Read Only   |
| 174          | Card Slot        |
| 102          | Cloning          |
| 111          | Configuration    |
| 35           | Control Word     |
| 225          | Current Offset   |
| 97           | Data Changing    |
| 247          | Derivative ID    |
| 248          | Derivative Image |
| 199          | Destination      |
| 224          | Drive Size       |
| 31           | EEPROM Fail      |
| 189          | Encoder 1        |
| 190          | Encoder 2        |
| 191          | Encoder 3        |
| 192          | Encoder 4        |
| 193          | Encoder 5        |
| 194          | Encoder 6        |
| 195          | Encoder 7        |
| 196          | Encoder 8        |
| 197          | Encoder 9        |
| 162          | Encoder 12       |
| 163          | Encoder 13       |
| 164          | Encoder 14       |
| 6            | External Trip    |
| 26           | I/O Overload     |
| 8            | Inductance       |
| 93           | Inductor Too Hot |
| 103          | Inter-connect    |
| 160          | Island           |
| 34           | Keypad Mode      |
| 39           | Line Sync        |
| 38           | Low Load         |
| 20           | Motor Too Hot    |
| 176          | Name Plate       |
| 0            | None             |
| 101          | OHT Brake        |



|     |                  |
|-----|------------------|
| 23  | Oht Control      |
| 27  | Oht dc bus       |
| 21  | Oht Inverter     |
| 22  | Oht Power        |
| 3   | OI ac            |
| 4   | OI Brake         |
| 109 | OI dc            |
| 92  | OI Snubber       |
| 215 | Option Disable   |
| 98  | Out Phase Loss   |
| 7   | Over Speed       |
| 2   | Over Volts       |
| 32  | Phase Loss       |
| 198 | Phasing Error    |
| 90  | Power Comms      |
| 220 | Power Data       |
| 37  | Power Down Save  |
| 5   | PSU              |
| 9   | PSU 24V          |
| 223 | Rating Mismatch  |
| 94  | Rectifier Set-up |
| 1   | Reserved 001     |
| 95  | Reserved 095     |
| 104 | Reserved 104     |
| 105 | Reserved 105     |
| 106 | Reserved 106     |
| 107 | Reserved 107     |
| 108 | Reserved 108     |
| 161 | Reserved 161     |
| 165 | Reserved 165     |
| 166 | Reserved 166     |
| 167 | Reserved 167     |
| 168 | Reserved 168     |
| 170 | Reserved 170     |
| 171 | Reserved 171     |
| 172 | Reserved 172     |
| 173 | Reserved 173     |
| 222 | Reserved 222     |
| 228 | Reserved 228     |
| 229 | Reserved 229     |
| 230 | Reserved 230     |
| 231 | Reserved 231     |
| 232 | Reserved 232     |
| 233 | Reserved 233     |
| 234 | Reserved 234     |
| 235 | Reserved 235     |
| 236 | Reserved 236     |
| 237 | Reserved 237     |
| 238 | Reserved 238     |
| 239 | Reserved 239     |
| 240 | Reserved 240     |
| 241 | Reserved 241     |
| 242 | Reserved 242     |
| 243 | Reserved 243     |
| 244 | Reserved 244     |
| 245 | Reserved 245     |
| 246 | Reserved 246     |
| 100 | Reset            |
| 255 | Reset Logs       |
| 33  | Resistance       |
| 204 | Slot1 Different  |
| 202 | Slot1 Error      |
| 200 | Slot1 HF         |
| 203 | Slot1 Not Fitted |
| 201 | Slot1 Watchdog   |

|     |                  |
|-----|------------------|
| 209 | Slot2 Different  |
| 207 | Slot2 Error      |
| 205 | Slot2 HF         |
| 208 | Slot2 Not Fitted |
| 206 | Slot2 Watchdog   |
| 214 | Slot3 Different  |
| 212 | Slot3 Error      |
| 210 | Slot3 HF         |
| 213 | Slot3 Not Fitted |
| 211 | Slot3 Watchdog   |
| 254 | Slot4 Different  |
| 252 | Slot4 Error      |
| 250 | Slot4 HF         |
| 253 | Slot4 Not Fitted |
| 251 | Slot4 Watchdog   |
| 216 | Slot App Menu    |
| 226 | Soft Start       |
| 221 | Stored HF        |
| 227 | Sub-array RAM    |
| 218 | Temp Feedback    |
| 10  | Th Brake Res     |
| 25  | Th Short Circuit |
| 24  | Thermistor       |
| 110 | Undefined        |
| 91  | User 24V         |
| 96  | User Prog Trip   |
| 249 | User Program     |
| 36  | User Save        |
| 40  | User Trip 40     |
| 41  | User Trip 41     |
| 42  | User Trip 42     |
| 43  | User Trip 43     |
| 44  | User Trip 44     |
| 45  | User Trip 45     |
| 46  | User Trip 46     |
| 47  | User Trip 47     |
| 48  | User Trip 48     |
| 49  | User Trip 49     |
| 50  | User Trip 50     |
| 51  | User Trip 51     |
| 52  | User Trip 52     |
| 53  | User Trip 53     |
| 54  | User Trip 54     |
| 55  | User Trip 55     |
| 56  | User Trip 56     |
| 57  | User Trip 57     |
| 58  | User Trip 58     |
| 59  | User Trip 59     |
| 60  | User Trip 60     |
| 61  | User Trip 61     |
| 62  | User Trip 62     |
| 63  | User Trip 63     |
| 64  | User Trip 64     |
| 65  | User Trip 65     |
| 66  | User Trip 66     |
| 67  | User Trip 67     |
| 68  | User Trip 68     |
| 69  | User Trip 69     |
| 70  | User Trip 70     |
| 71  | User Trip 71     |
| 72  | User Trip 72     |
| 73  | User Trip 73     |
| 74  | User Trip 74     |
| 75  | User Trip 75     |
| 76  | User Trip 76     |

|     |               |
|-----|---------------|
| 77  | User Trip 77  |
| 78  | User Trip 78  |
| 79  | User Trip 79  |
| 80  | User Trip 80  |
| 81  | User Trip 81  |
| 82  | User Trip 82  |
| 83  | User Trip 83  |
| 84  | User Trip 84  |
| 85  | User Trip 85  |
| 86  | User Trip 86  |
| 87  | User Trip 87  |
| 88  | User Trip 88  |
| 89  | User Trip 89  |
| 112 | User Trip 112 |
| 113 | User Trip 113 |
| 114 | User Trip 114 |
| 115 | User Trip 115 |
| 116 | User Trip 116 |
| 117 | User Trip 117 |
| 118 | User Trip 118 |
| 119 | User Trip 119 |
| 120 | User Trip 120 |
| 121 | User Trip 121 |
| 122 | User Trip 122 |
| 123 | User Trip 123 |
| 124 | User Trip 124 |
| 125 | User Trip 125 |
| 126 | User Trip 126 |
| 127 | User Trip 127 |
| 128 | User Trip 128 |
| 129 | User Trip 129 |
| 130 | User Trip 130 |
| 131 | User Trip 131 |
| 132 | User Trip 132 |
| 133 | User Trip 133 |
| 134 | User Trip 134 |
| 135 | User Trip 135 |
| 136 | User Trip 136 |
| 137 | User Trip 137 |
| 138 | User Trip 138 |
| 139 | User Trip 139 |
| 140 | User Trip 140 |
| 141 | User Trip 141 |
| 142 | User Trip 142 |
| 143 | User Trip 143 |
| 144 | User Trip 144 |
| 145 | User Trip 145 |
| 146 | User Trip 146 |
| 147 | User Trip 147 |
| 148 | User Trip 148 |
| 149 | User Trip 149 |
| 150 | User Trip 150 |
| 151 | User Trip 151 |
| 152 | User Trip 152 |
| 153 | User Trip 153 |
| 154 | User Trip 154 |
| 155 | User Trip 155 |
| 156 | User Trip 156 |
| 157 | User Trip 157 |
| 158 | User Trip 158 |
| 159 | User Trip 159 |
| 169 | Voltage Range |
| 30  | Watchdog      |

*Trip 0* (10.020) to *Trip 9* (10.029) store the most recent 10 trips that have occurred where *Trip 0* (10.020) is the most recent and *Trip 9* (10.029) is the

oldest. When a new trip occurs it is written to *Trip 0* (10.020) and all the other trips move down the log, with oldest being lost. The date and time when each trip occurs are also stored in the date and time log, i.e. *Trip 0 Date* (10.041) to *Trip 9 Time* (10.060). The date and time are taken from *Date* (06.016) and *Time* (06.017). Some trips have sub-trip numbers which give more detail about the reason for the trip. If a trip has a sub-trip number its value is stored in the sub-trip log, i.e. *Trip 0 Sub-trip Number* (10.070) to *Trip 9 Sub-trip Number* (10.079). If the trip does not have a sub-trip number then zero is stored in the sub-trip log.

#### Trip categories and priorities

Trips are grouped into the categories given in the table below. A trip can only occur when the drive is not tripped, or if it is already tripped and the new trip has a higher priority than the active trip (i.e. lower priority number). Unless otherwise stated a trip cannot be reset until 1.0s after it has been initiated.

| Priority | Category  | Trips   | Comments  |
|----------|---|---|---|
| 1        | Internal faults                                   | <i>HF01 – HF20</i>  | These are fatal problems that cannot be reset. All drive features are inactive after any of these trips occur. If a basic keypad is fitted it will show the trip, but the keypad will not function. These trips are not stored in the trip log.                                       |
| 1        | Stored HF trip                                    | <i>Stored HF</i>  | This trip cannot be cleared unless 1299 is entered into <i>Parameter mm.000</i> (mm.000) and a reset is initiated.  |
| 2        | Non-resettable trips                              | Trip numbers 218 to 247, <i>Slot1 HF</i> , <i>Slot2 HF</i> , <i>Slot3 HF</i> or <i>Slot4 HF</i> | These trips cannot be reset.  |
| 3        | Volatile memory failure                           | <i>EEPROM Fail</i>  | This can only be reset if <i>Parameter mm.000</i> (mm.000) is set to 1233 or 1244, or if <i>Load Defaults</i> (11.043) is set to a non-zero value.  |
| 4        | Internal 24V power supply                         | <i>PSU 24V</i>  |   |
| 5        | Non-volatile media trips                          | Trip numbers 174, 175 and 177 to 188  | These trips are priority 6 during power-up.   |
| 5        | Position feedback interface power supply          | <i>Encoder 1</i>  | This trip can override <i>Encoder 2</i> to <i>Encoder 6</i> trips.  |
| 6        | Trips with extended reset times                   | <i>OI ac</i> , <i>OI Brake</i> , and <i>OI dc</i>   | These trips cannot be reset until 10s after the trip was initiated.   |
| 6        | Phase loss and d.c. link power circuit protection | <i>Phase Loss</i> and <i>OHT dc bus</i>   | The drive will attempt to stop the motor before tripping if a <i>Phase Loss.000</i> trip occurs unless this feature has been disabled (see <i>Action On Trip Detection</i> (10.037)). The drive will always attempt to stop the motor before tripping if an <i>OHT dc bus</i> occurs. |
| 6        | Standard trips                                    | All other trips   |   |

#### Internal faults

Trips {*HF01*} to {*HF20*} are internal faults that do not have trip numbers. If one of these trips occurs, the main drive processor has detected an irrecoverable error. All drive functions are stopped and the trip message will be displayed on the drive keypad. The error can only be reset by powering the drive down and up again. The table below gives the reasons for internal faults and their corresponding trip.

| Trip   | Reason   |
|--------|--|
| {HF01} | CPU has detected an address error  |
| {HF02} | CPU DMAC has detected an address error   |
| {HF03} | CPU has detected an Illegal opcode   |
| {HF04} | CPU has detected an Illegal slot instruction   |
| {HF05} | An interrupt has occurred that does not have a defined function (Undefined exception)  |
| {HF06} | An interrupt has occurred which is reserved (Reserved exception)   |
| {HF07} | Watchdog failure   |
| {HF08} | CPU Interrupt crash  |
| {HF09} | Free store overflow  |
| {HF10} | Parameter routing system error   |
| {HF11} | Non-volatile memory comms error  |
| {HF12} | Stack overflow. Sub-trip is shown to indicate which stack:<br>1 – background tasks<br>2 – timed tasks<br>3 – main system interrupts  |
| {HF13} | The control hardware is not compatible with the firmware. The sub-trip number gives the actual ID code of the control board hardware.  |
| {HF14} | CPU register bank error  |
| {HF15} | CPU divide error   |
| {HF16} | RTOS error (the background task has returned)  |
| {HF17} | The clock supplied to the control board logic is out of specification  |
| {HF18} | The internal flash memory has failed when writing option module parameter data.<br>Sub-trip is shown to indicate which failure:<br>1 - Programming error while writing menu in flash<br>2 - Erase flash block containing setup menus failed<br>3 - Erase flash block containing application menus failed |
| {HF19} | Invalid main application firmware CRC. Reprogramming required.   |
| {HF20} | The ASIC is not compatible with the firmware. The sub-trip number displayed is the ASIC version.   |
| {HF23} | If this trip occurs please consult the drive supplier.   |
| {HF24} | If this trip occurs please consult the drive supplier.   |
| {HF25} | If this trip occurs please consult the drive supplier.   |

When the drive is subsequently powered up a *Stored HF* trip is initiated where the sub-trip number is the number of the HF trip that last occurred. This trip will occur at every power-up until it is reset. The trip can only be reset by first entering 1299 into *Parameter mm.000* (mm.000). If the drive is powered up and a *Stored HF* trip occurs, *Onboard User Program: Enable* (11.047) is reset to zero to prevent the on-board user program from running. This ensures that the user program can be changed or erased in case it causes an HF trip at every power-up. Once the *Stored HF* is cleared, it is necessary to power cycle the drive or to re-download the user program to allow the program to restart.

#### Similar trips that can be initiated by the control system or the power system

Trips shown in the table below can be generated either from the drive control system or from the power system. The sub-trip number which is in the form *xyzz* is used to identify the source of the trip. The digits *xx* are 00 for a trip generated by the control system or the number of a power module if generated by the power system. If the drive is not a multi-power module drive then *xx* will always have a value of 1 the trip is related to the power system. The *y* digit is used to identify the location of a trip which is generated by a rectifier module connected to a power module. Where the *y* digit is relevant it will have a value of 1 or more, otherwise it will be 0. The *zz* digits give the reason for the trip and are defined in each trip description.

|              |               |
|--------------|---------------|
| Over Volts   | Oht dc bus    |
| OI ac        | Phase Loss    |
| OI Brake     | Power Comms   |
| PSU          | OI Snubber    |
| Oht Inverter | Cloning       |
| Oht Power    | Temp Feedback |
| Oht Control  | Power Data    |

#### Braking IGBT

The list below gives conditions that will disable the braking IGBT:

1. *Braking IGBT Upper Threshold* (06.074) = 0, or *Low Voltage Braking IGBT Threshold Select* (06.076) = 1 and *Low Voltage Braking IGBT Threshold* (06.075) = 0.
2. The drive is in the under-voltage state.
3. A priority 1, 2 or 3 trip is active (see *Trip 0* (10.020)).
4. One of the following trips is active or would be active if another trip is not already active: *OI Brake*, *PSU*, *Th Brake Res* or *Oht Inverter*.
5. *Percentage Of Drive Thermal Trip Level* (07.036) = 100%. This is an indication that some part of the drive is too hot and is used to indicate if an internally fitted braking resistor is too hot.
6. *Brake R Too Hot* is active or the system has been set up to disable the braking IGBT based on the braking resistor temperature and the resistor is too hot (i.e. bit 2 of *Action On Trip Detection* (10.037) is set).

Note that the braking IGBT over-current trip cannot be reset until 10s after it is initiated. This period consists of a 9s period after the trip where the braking IGBT cannot be switched on again and the *OI Brake* trip is held active and cannot be reset. This 9s period is followed by the normal 1s delay, that is present for other trips, before the trip can be reset. During this 1s period it is possible for the braking IGBT to switch on again. If the conditions

are still present that caused the trip then the trip will be initiated again with a further 9s hold-off period etc.

| Parameter         | 10.021 Trip 1                                 |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the 2nd from last trip to have occurred |                |               |
| Mode              | RFC-A   |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Write on trip |
| Display Format    | Standard                                      | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                        |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.022 Trip 2                                 |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the 3rd from last trip to have occurred |                |               |
| Mode              | RFC-A   |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Write on trip |
| Display Format    | Standard                                      | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                        |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.023 Trip 3                                 |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the 4th from last trip to have occurred |                |               |
| Mode              | RFC-A   |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Write on trip |
| Display Format    | Standard                                      | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                        |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.024 Trip 4                                 |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the 5th from last trip to have occurred |                |               |
| Mode              | RFC-A   |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Write on trip |
| Display Format    | Standard                                      | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                        |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.025 Trip 5                                 |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the 6th from last trip to have occurred |                |               |
| Mode              | RFC-A   |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Write on trip |
| Display Format    | Standard                                      | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                        |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.026 Trip 6                                 |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the 7th from last trip to have occurred |                |               |
| Mode              | RFC-A   |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Write on trip |
| Display Format    | Standard                                      | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                        |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.027 Trip 7                                 |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the 8th from last trip to have occurred |                |               |
| Mode              | RFC-A   |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Write on trip |
| Display Format    | Standard                                      | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                        |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.028 Trip 8                                 |                |               |
|-------------------|---|----------------|---------------|
| Short description | Shows the 9th from last trip to have occurred |                |               |
| Mode              | RFC-A   |                |               |
| Minimum           | 0   | Maximum        | 255           |
| Default           |   | Units          |               |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Write on trip |
| Display Format    | Standard                                      | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                        |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.029 Trip 9                                  |                |               |
|-------------------|--|----------------|---------------|
| Short description | Shows the 10th from last trip to have occurred |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | 0  | Maximum        | 255           |
| Default           |  | Units          |               |
| Type              | 8 Bit Power Down Save                          | Update Rate    | Write on trip |
| Display Format    | Standard                                       | Decimal Places | 0             |
| Coding            | RO, TE, ND, NC, PT, BU                         |                |               |

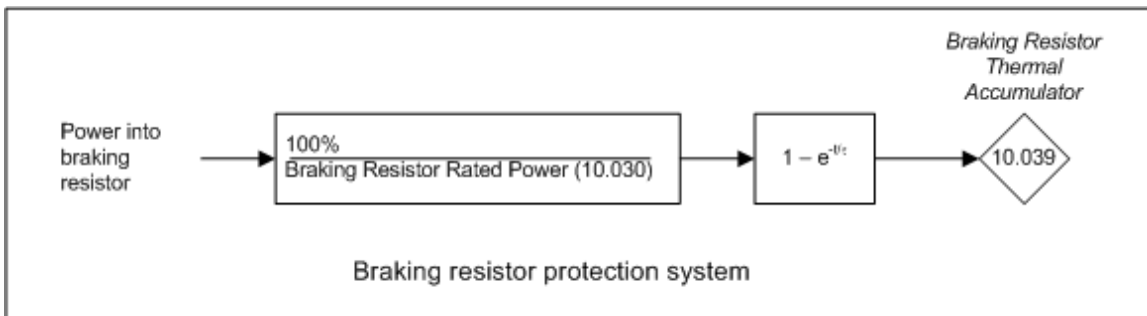
See *Trip 0* (10.020).

| Parameter         | 10.030 Braking Resistor Rated Power            |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to the rated power of the braking resistor |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000  | Maximum        | 99999.999       |
| Default           | 0.000  | Units          | kW              |
| Type              | 32 Bit User Save                               | Update Rate    | Background read |
| Display Format    | Standard                                       | Decimal Places | 3               |
| Coding            | RW   |                |                 |

A thermal protection system is provided for the braking resistor. If *Braking Resistor Rated Power* (10.030) is set to zero this protection system is disabled and the *Braking Resistor Thermal Accumulator* (10.039) is held at zero. If braking resistor thermal protection is required the *Braking Resistor Rated Power* (10.030), *Braking Resistor Thermal Time Constant* (10.031) and *Braking Resistor Resistance* (10.061) should be set up with the braking resistor parameters. The thermal time constant of the resistor can be calculated from the single pulse energy rating (E) and continuous power rating (P) of the resistor.

$$\text{Braking Resistor Thermal Time Constant (10.031)} = \tau = E / P$$

The braking resistor is protected with a single time constant model as shown below.



The drive monitors the power flowing into the braking resistor and updates the *Braking Resistor Thermal Accumulator* (10.039). If bit 1 of *Action On Trip Detection* (10.037) = 0 and the accumulator reaches 100% an *Brake R Too Hot* trip is initiated. If bit 1 of *Action On Trip Detection* (10.037) = 1 and the accumulator reaches 100% the braking IGBT is disabled until the accumulator falls below 95.0%.

| Parameter         | 10.031 <i>Braking Resistor Thermal Time Constant</i>     |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to the thermal time constant of the braking resistor |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000  | Maximum        | 1500.000        |
| Default           | 0.000  | Units          | s               |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW   |                |                 |

See *Braking Resistor Rated Power* (10.030).

| Parameter         | 10.032 <i>External Trip</i>      |                |                 |
|-------------------|----------------------------------|----------------|-----------------|
| Short description | Set to initiate an external trip |                |                 |
| Mode              | RFC-A                            |                |                 |
| Minimum           | 0                                | Maximum        | 1               |
| Default           | 0                                | Units          |                 |
| Type              | 1 Bit Volatile                   | Update Rate    | Background read |
| Display Format    | Standard                         | Decimal Places | 0               |
| Coding            | RW, NC                           |                |                 |

If *External Trip* (10.032) is set to one an *External Trip.003* is initiated. A digital input can be routed to *External Trip* (10.032) to provide an external trip input function.

| Parameter         | 10.033 <i>Drive Reset</i>     |                |                 |
|-------------------|-------------------------------|----------------|-----------------|
| Short description | Set to initiate a drive reset |                |                 |
| Mode              | RFC-A                         |                |                 |
| Minimum           | 0                             | Maximum        | 1               |
| Default           | 0                             | Units          |                 |
| Type              | 1 Bit Volatile                | Update Rate    | Background read |
| Display Format    | Standard                      | Decimal Places | 0               |
| Coding            | RW, NC                        |                |                 |

A 0 to 1 transition in *Drive Reset* (10.033) causes a drive reset. If a drive reset terminal is required a digital input should be routed to *Drive Reset* (10.033).

| Parameter         | 10.034 <i>Number Of Auto-reset Attempts</i>       |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to the number of required auto-reset attempts |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 6               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                                   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text     |
|-------|----------|
| 0     | None     |
| 1     | 1        |
| 2     | 2        |
| 3     | 3        |
| 4     | 4        |
| 5     | 5        |
| 6     | Infinite |

If *Number Of Auto-reset Attempts* (10.034) = 0 then no auto-reset attempts are made. Any other value will cause the drive to automatically reset following a trip for the number of times programmed after a delay defined by *Auto-reset Delay* (10.035) subject to the minimum reset time allowed for the type of trip. Note that for some trips the minimum is 10s. The auto-reset count is only incremented when the trip is the same as the previous trip otherwise it is reset to 0. When the auto-reset count reaches the programmed value, any further trip of the same value will not cause an auto-reset. If the number of auto-reset attempts defined by *Number Of Auto-reset Attempts* (10.034) has not been reached and there has been no trip for 5 minutes then the auto-reset count is cleared. Auto reset will not occur after any trips with priority levels 1, 2 or 3 as defined in *Trip 0* (10.020). When a manual reset occurs the auto-reset counter is reset to zero.

If *Number Of Auto-reset Attempts* (10.034) = 6 the auto-reset counter is held at zero, and so there is no limit on the number of auto-reset attempts.



| Parameter         | 10.035 Auto-reset Delay              |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description | Set to the required auto-reset delay |                |                 |
| Mode              | RFC-A                                |                |                 |
| Minimum           | 1.0                                  | Maximum        | 600.0           |
| Default           | 1.0                                  | Units          | s               |
| Type              | 16 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                             | Decimal Places | 1               |
| Coding            | RW                                   |                |                 |

See *Number Of Auto-reset Attempts* (10.034).

| Parameter         | 10.036 Auto-reset Hold Drive Healthy                                  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to hold drive healthy if further auto-reset attempts are possible |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

If *Auto-reset Hold Drive Healthy* (10.036) = 0 then *Drive Healthy* (10.001) is cleared every time the drive trips regardless of any auto-reset that may occur. If *Auto-reset Hold Drive Healthy* (10.036) = 1 then *Drive Healthy* (10.001) is not cleared on a trip if any further auto-reset attempts are possible. Note that if the under voltage state becomes active *Drive Healthy* (10.001) will be set to zero unless *Hold Drive Healthy on Under Voltage* (10.068) = 1.

| Parameter         | 10.037 Action On Trip Detection                        |                |                        |
|-------------------|--|----------------|------------------------|
| Short description | Defines the action of the drive on detection of a trip |                |                        |
| Mode              | RFC-A  |                |                        |
| Minimum           | 0<br>(Display: 00000)                                  | Maximum        | 31<br>(Display: 11111) |
| Default           | 0<br>(Display: 00000)                                  | Units          |                        |
| Type              | 8 Bit User Save  | Update Rate    | Background read        |
| Display Format    | Binary   | Decimal Places | 0                      |
| Coding            | RW   |                |                        |

The bits in *Action On Trip Detection* (10.037) are defined as follows:

**Bit 0: Stop on defined non-important trips**

If bit 0 is set to one the drive will attempt to stop before tripping if any of the following trip conditions are detected: *I/O Overload*, *An Input 1 Loss*, *An Input 2 Loss* or *Keypad Mode*. (This bit has no effect in Regen mode.)

**Bit 1: Disable braking resistor overload detection**

See *Braking Resistor Rated Power* (10.030).

**Bit 2: Disable phase loss stop**

Normally the drive will stop when the input phase loss condition is detected. If this bit is set to 1 the drive will continue to run and will only trip when the drive is brought to a stop by the user. (This bit has no effect in Regen mode.)

**Bit 3: Not Used**

**Bit 4: Disable parameter freeze on trip**

If this bit is 0 then the parameters listed below are frozen on trip until the trip is cleared. If this bit is 1 then this feature is disabled.

| Open-loop mode                        | RFC-A or RFC-S modes                  | Regen                      |
|---------------------------------------|---------------------------------------|----------------------------|
| Reference Selected (01.001)           | Reference Selected (01.001)           |                            |
| Pre-skip Filter Reference (01.002)    | Pre-skip Filter Reference (01.002)    |                            |
| Pre-ramp Reference (01.003)           | Pre-ramp Reference (01.003)           |                            |
| Post Ramp Reference (02.001)          | Post Ramp Reference (02.001)          |                            |
| Frequency Slaving Demand (03.001)     | Final Speed Reference (03.001)        | Reactive Power (03.001)    |
|                                       | Speed Feedback (03.002)               |                            |
|                                       | Speed Error (03.003)                  |                            |
|                                       | Speed Controller Output (03.004)      |                            |
| Current Magnitude (04.001)            | Current Magnitude (04.001)            | Current Magnitude (04.001) |
| Iq, Torque Producing Current (04.002) | Iq, Torque Producing Current (04.002) | Active Current (04.002)    |
| Id, Magnetising Current (04.017)      | Id, Magnetising Current (04.017)      | Reactive Current (04.017)  |
| Output Frequency (05.001)             | Output Frequency (05.001)             | Output Frequency (05.001)  |
| Output Voltage (05.002)               | Output Voltage (05.002)               | Output Voltage (05.002)    |
| Output Power (05.003)                 | Output Power (05.003)                 | Output Power (05.003)      |
| D.c. Bus Voltage (05.005)             | D.c. Bus Voltage (05.005)             | D.c. Bus Voltage (05.005)  |
| Analog Input 1 (07.001)               | Analog Input 1 (07.001)               | Analog Input 1 (07.001)    |
| Analog Input 2 (07.002)               | Analog Input 2 (07.002)               | Analog Input 2 (07.002)    |
| Analog Input 3 (07.003)               | Analog Input 3 (07.003)               | Analog Input 3 (07.003)    |

| Parameter         | 10.038 User Trip                            |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Can be used to generate a trip on the drive |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0   | Maximum        | 255             |
| Default           |   | Units          |                 |
| Type              | 8 Bit Volatile                              | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 0               |
| Coding            | RW, ND, NC, BU                              |                |                 |

When a value other than zero is written to the *User Trip* (10.038) the actions described in the following table are performed. The drive immediately writes the value back to zero. If the value is not included in the table, then the action is the same as if the trip with the same number (with sub-trip zero) occurred provided the drive is not already tripped.

| Action   | User Trip (10.038)                                 |
|--|--|
| No action  | Numbers corresponding to priority 1, 2 or 3 trips. |
| Drive reset  | 100  |
| Clear trip logs (parameters 10.020 to 10.029, 10.041 to 10.060 and 10.070 to 10.079) | 255  |

| Parameter         | 10.039 Braking Resistor Thermal Accumulator                 |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Shows the level of the braking resistor thermal accumulator |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.0   | Maximum        | 100.0            |
| Default           |   | Units          | %                |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 1                |
| Coding            | RO, ND, NC, PT  |                |                  |

See *Braking Resistor Rated Power* (10.030).

| Parameter         | 10.040 Status Word                  |                |                                      |
|-------------------|-------------------------------------|----------------|--------------------------------------|
| Short description | Shows the status word for the drive |                |                                      |
| Mode              | RFC-A                               |                |                                      |
| Minimum           | 0<br>(Display: 0000000000000000)    | Maximum        | 32767<br>(Display: 1111111111111111) |
| Default           |                                     | Units          |                                      |
| Type              | 16 Bit Volatile                     | Update Rate    | Background write                     |
| Display Format    | Binary                              | Decimal Places | 0                                    |
| Coding            | RO, ND, NC, PT                      |                |                                      |

The bits in *Status Word* (10.040) mirror the status bit parameters as shown below. Where the parameters do not exist in any mode the bit remains at zero.

| Bit | Status parameter                                  |
|-----|---|
| 0   | <i>Drive Healthy</i> (10.001)                     |
| 1   | <i>Drive Active</i> (10.002)                      |
| 2   | <i>Zero Speed</i> (10.003)                        |
| 3   | <i>Running At Or Below Minimum Speed</i> (10.004) |
| 4   | <i>Below Set Speed</i> (10.005)                   |
| 5   | <i>At Speed</i> (10.006)                          |
| 6   | <i>Above Set Speed</i> (10.007)                   |
| 7   | <i>Rated Load Reached</i> (10.008)                |
| 8   | <i>Current Limit Active</i> (10.009)              |
| 9   | <i>Regenerating</i> (10.010)                      |
| 10  | <i>Braking IGBT Active</i> (10.011)               |
| 11  | <i>Braking Resistor Alarm</i> (10.012)            |
| 12  | <i>Reverse Direction Commanded</i> (10.013)       |
| 13  | <i>Reverse Direction Running</i> (10.014)         |
| 14  | <i>Supply Loss</i> (10.015)                       |

| Parameter         | 10.041 Trip 0 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 0 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.042 Trip 0 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 0 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.043 Trip 1 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 1 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.044 Trip 1 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 1 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.045 Trip 2 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 2 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.046 Trip 2 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 2 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.047 Trip 3 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 3 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.048 Trip 3 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 3 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.049 Trip 4 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 4 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.050 Trip 4 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 4 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.051 Trip 5 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 5 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.052 Trip 5 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 5 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.053 Trip 6 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 6 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.054 Trip 6 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 6 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.055 Trip 7 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 7 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.056 Trip 7 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 7 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.057 Trip 8 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 8 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.058 Trip 8 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 8 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.059 Trip 9 Date                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the date at which trip 9 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00-00-00)                | Maximum        | 311299<br>(Display: 31-12-99) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Date                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.060 Trip 9 Time                      |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Shows the time at which trip 9 occurred |                |                               |
| Mode              | RFC-A                                   |                |                               |
| Minimum           | 0<br>(Display: 00:00:00)                | Maximum        | 235959<br>(Display: 23:59:59) |
| Default           |   | Units          |                               |
| Type              | 32 Bit Power Down Save                  | Update Rate    | Write on trip                 |
| Display Format    | Time                                    | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                          |                |                               |

See *Trip 0* (10.020).

| Parameter         | 10.061 Braking Resistor Resistance               |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set the resistance value of the braking resistor |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.00   | Maximum        | 10000.00        |
| Default           | 0.00   | Units          | Ω               |
| Type              | 32 Bit User Save                                 | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

See *Braking Resistor Rated Power* (10.030).

| Parameter         | 10.062 Low Load Detected Alarm              |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the low load alarm is active |                |                  |
| Mode              | RFC-A                                       |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile                              | Update Rate    | Background write |
| Display Format    | Standard                                    | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                              |                |                  |

*Low Load Detected Alarm* (10.062) is set to one when the low load alarm is active. See *Low Load Detection Level* (04.027).

| Parameter         | 10.063 Local Keypad Battery Low                                       |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the real time clock battery in the local keypad is low |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Local Keypad Battery Low* (10.063) is set to one when a keypad is fitted to the front of the drive with an internal real-time clock and the battery is not fitted or the voltage is below the minimum threshold.

| Parameter         | 10.064 Remote Keypad Battery Low                                       |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that the real time clock battery in the remote keypad is low |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*Remote Keypad Battery Low* (10.064) is set to one when a keypad is connected to the drive user comms port with an internal real-time clock and the battery is not fitted or the voltage is below the minimum threshold.

| Parameter         | 10.065 Auto-tune Active                        |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that an auto-tune sequence is active |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                                 | Update Rate    | Background write |
| Display Format    | Standard                                       | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                 |                |                  |

*Auto-tune Active* (10.065) is set to one while an auto-tune sequence is active.

| Parameter         | 10.066 <i>Limit Switch Active</i>                   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that a limit switch is enabled and active |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile                                      | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                      |                |                  |

*Limit Switch Active* (10.066) is set to one when a limit switch is enabled and active.

| Parameter         | 10.067 <i>Fire Mode Active</i>                 |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that fire mode is enabled and active |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                                 | Update Rate    | Background write |
| Display Format    | Standard                                       | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                 |                |                  |

*Fire Mode Active* (10.067) is set to one when fire mode is enabled and active.

| Parameter         | 10.068 <i>Hold Drive Healthy on Under Voltage</i>                    |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to hold drive healthy if the drive is in the under voltage state |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

*Hold Drive Healthy on Under Voltage* (10.068) can be used to hold the drive healthy active (*Drive Healthy* (10.001) = 1 and not flash the status LED on the front of the drive) when the drive is in the under voltage state (*Under Voltage Active* (10.016) = 1).

If *Hold Drive Healthy on Under Voltage* (10.068) = 0 and *Under Voltage Active* (10.016) = 1, then *Drive Healthy* (10.001) will be set to 0 and the status LED on the front of the drive will flash.

If *Hold Drive Healthy on Under Voltage* (10.068) = 1, *Under Voltage Active* (10.016) = 1 and the drive is not tripped (i.e. *Drive Status* (10.101) does not equal 9), then *Drive Healthy* (10.001) will be set to 1 and the status LED on the front of the drive will not flash.

If the drive is tripped then *Drive Healthy* (10.001) will be set to 0 and the status LED will flash independent of what *Hold Drive Healthy on Under Voltage* (10.068) is set to.

| Parameter         | 10.069 <i>Additional Status Bits</i>           |                |                               |
|-------------------|--|----------------|-------------------------------|
| Short description | Shows the additional status bits for the drive |                |                               |
| Mode              | RFC-A  |                |                               |
| Minimum           | 0<br>(Display: 0000000000)                     | Maximum        | 1023<br>(Display: 1111111111) |
| Default           |  | Units          |                               |
| Type              | 16 Bit Volatile                                | Update Rate    | Background write              |
| Display Format    | Binary   | Decimal Places | 0                             |
| Coding            | RO, ND, NC, PT                                 |                |                               |

The bits in *Additional Status Bits* (10.069) mirror the status bits parameters as shown below. Where the parameters do not exist in any mode the bit remains at zero.

| Bit | Status parameter  |
|-----|---|
| 0   | <i>Under Voltage Active</i> (10.016)  |
| 1   | <i>Motor Overload Alarm</i> (10.017) or <i>Inductor Overload Alarm</i> (10.017) |
| 2   | <i>Drive Over-temperature Alarm</i> (10.018)                                    |
| 3   | <i>Drive Warning</i> (10.019)   |
| 4   | <i>Low Load Detected Alarm</i> (10.062)   |
| 5   | <i>Local Keypad Battery Low</i> (10.063)  |
| 6   | <i>Remote Keypad Battery Low</i> (10.064)                                       |
| 7   | <i>Auto-tune Active</i> (10.065)  |
| 8   | <i>Limit Switch Active</i> (10.066)   |
| 9   | <i>Fire Mode Active</i> (10.067)  |



| Parameter         | 10.070 Trip 0 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 0 |                |               |
| Mode              | RFC-A                                |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.071 Trip 1 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 1 |                |               |
| Mode              | RFC-A                                |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.072 Trip 2 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 2 |                |               |
| Mode              | RFC-A                                |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.073 Trip 3 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 3 |                |               |
| Mode              | RFC-A                                |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.074 Trip 4 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 4 |                |               |
| Mode              | RFC-A                                |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.075 Trip 5 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 5 |                |               |
| Mode              | RFC-A                                |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.076 Trip 6 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 6 |                |               |
| Mode              | RFC-A                                |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.077 Trip 7 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 7 |                |               |
| Mode              | RFC-A                                |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.078 Trip 8 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 8 |                |               |
| Mode              | RFC-A                                |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.079 Trip 9 Sub-trip Number        |                |               |
|-------------------|--------------------------------------|----------------|---------------|
| Short description | Shows the sub-trip number for trip 9 |                |               |
| Mode              | RFC-A                                |                |               |
| Minimum           | 0                                    | Maximum        | 65535         |
| Default           |                                      | Units          |               |
| Type              | 16 Bit Power Down Save               | Update Rate    | Write on trip |
| Display Format    | Standard                             | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                   |                |               |

See *Trip 0* (10.020).

| Parameter         | 10.080 Stop Motor  |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Indicates that the motor is being stopped before the drive trips |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

It is possible for some trips to cause the motor to stop before the trip is initiated (see *Action On Trip Detection* (10.037)). During the period while the motor is being stopped before the trip is initiated *Stop Motor* (10.080) is set to one. Once the motor stops *Stop Motor* (10.080) is set back to zero.

| Parameter         | 10.081 Phase Loss   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates that the drive has detected an input phase loss |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

If phase loss or imbalance is detected that would initiate a phase loss trip with sub-trip 0, i.e. *Phase Loss.000*, then *Phase Loss* (10.081) is set to one. Either the motor will be stopped and the drive tripped or the drive will continue to operate normally until the user stops the motor and the drive trips (see

*Action On Trip Detection* (10.037)). In either case *Phase Loss* (10.081) is set to one when the phase loss condition is detected and remains set until the drive trips.

| Parameter         | 10.082 <i>Miscellaneous Status Flags</i> |                |                                      |
|-------------------|--|----------------|--------------------------------------|
| Short description | Shows additional status flags            |                |                                      |
| Mode              | RFC-A                                    |                |                                      |
| Minimum           | 0<br>(Display: 0000000000000000)         | Maximum        | 65535<br>(Display: 1111111111111111) |
| Default           |  | Units          |                                      |
| Type              | 16 Bit Volatile                          | Update Rate    | Background Write                     |
| Display Format    | Binary                                   | Decimal Places | 0                                    |
| Coding            | RO, ND, NC, PT, BU                       |                |                                      |

This parameter provides miscellaneous status flags that are not included as individual parameters.

**Open-loop and RFC-A mode:**

All flags are unused.

**RFC-S Mode:**

| Bit  | Status Indication  |
|------|--|
| 0    | Indicates when the motor torque limit is active. This is a limit defined by the motor parameters, <i>Rated Voltage</i> (05.009) and the frequency being applied to the motor. The drive attempts to prevent loss of control which would occur by exceeding the maximum torque limit of the motor by imposing a limit at a level slightly below the actual limit of the motor. This limit is only active if <i>Enable High Speed Mode</i> (05.022) is set to -2 or 2. |
| 1-15 | Unused.  |

| Parameter         | 10.101 <i>Drive Status</i>            |                |                  |
|-------------------|---------------------------------------|----------------|------------------|
| Short description | Shows the present status of the drive |                |                  |
| Mode              | RFC-A                                 |                |                  |
| Minimum           | 0                                     | Maximum        | 16               |
| Default           |                                       | Units          |                  |
| Type              | 8 Bit Volatile                        | Update Rate    | Background write |
| Display Format    | Standard                              | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT, BU                |                |                  |

| Value | Text          |
|-------|---------------|
| 0     | Inhibit       |
| 1     | Ready         |
| 2     | Stop          |
| 3     | Scan          |
| 4     | Run           |
| 5     | Supply Loss   |
| 6     | Deceleration  |
| 7     | dc Injection  |
| 8     | Position      |
| 9     | Trip          |
| 10    | Active        |
| 11    | Off           |
| 12    | Hand          |
| 13    | Auto          |
| 14    | Heat          |
| 15    | Under Voltage |
| 16    | Phasing       |

*Drive Status* (10.101) shows the present status of the drive. The strings from this parameter are also used by the basic keypad to provide the status display text.

| Parameter         | 10.102 Trip Reset Source                                 |                |               |
|-------------------|--|----------------|---------------|
| Short description | Indicates whether a trip in the trip log has been reset. |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | 0  | Maximum        | 1023          |
| Default           |  | Units          |               |
| Type              | 16 Bit Power Down Save                                   | Update Rate    | Write on trip |
| Display Format    | Standard   | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT, BU                                       |                |               |

The bits in *Trip Reset Source* (10.102) correspond to each of the trips in the trip log (i.e. bit 0 corresponds to trip 0, bit 1 corresponds to trip 1, etc.). When a trip occurs, bit 0 is set to one and the other bits corresponding to the trips already in the trip log are shifted left one bit. If the trip is reset then bit 0 is set back to zero, otherwise if a higher priority trip occurs bit 0 is shifted left by one bit. The result is that each of the bits in *Trip Reset Source* (10.102) show whether trips in the trip log were reset or moved up the trip log by a higher priority trip.

| Parameter         | 10.103 Trip Time Identifier  |                |               |
|-------------------|--|----------------|---------------|
| Short description | Shows time in milliseconds since the drive powered up when a trip occurred |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | -2147483648  | Maximum        | 2147483647    |
| Default           |  | Units          | ms            |
| Type              | 32 Bit Volatile  | Update Rate    | Write on trip |
| Display Format    | Standard   | Decimal Places | 0             |
| Coding            | RO, ND, NC, PT   |                |               |

When a trip occurs the time in milliseconds since the drive powered up is stored in *Trip Time Identifier* (10.103). The time rolls-over when it reaches  $2^{31} - 1$ , but if the time is 0 a value of 1 is written. *Trip Time Identifier* (10.103) can be used to determine when a new trip has occurred as the value will change (unless there were exactly  $2^{32}$ ms between trips) and will be non-zero.

| Parameter         | 10.104 Active Alarm                 |                |                  |
|-------------------|-------------------------------------|----------------|------------------|
| Short description | Shows the value of the active alarm |                |                  |
| Mode              | RFC-A                               |                |                  |
| Minimum           | 0                                   | Maximum        | 12               |
| Default           |                                     | Units          |                  |
| Type              | 8 Bit Volatile                      | Update Rate    | Background write |
| Display Format    | Standard                            | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT, BU              |                |                  |

| Value | Text           |
|-------|----------------|
| 0     | None           |
| 1     | Brake Resistor |
| 2     | Motor Overload |
| 3     | Ind Overload   |
| 4     | Drive Overload |
| 5     | Auto Tune      |
| 6     | Limit Switch   |
| 7     | Fire Mode      |
| 8     | Low Load       |
| 9     | Option Slot 1  |
| 10    | Option Slot 2  |
| 11    | Option Slot 3  |
| 12    | Option Slot 4  |

If there is no alarm then *Active Alarm* (10.104) = 0. If one alarm is active then *Active Alarm* (10.104) shows the value of the alarm. If more than one alarm is active then *Active Alarm* (10.104) shows the active alarm with the lowest value. The strings from this parameter are also used by the basic keypad to provide the status display text except for option slot warnings where the option module may supply the string.

| Parameter         | 10.105 Hand Off Auto State                  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Shows the state of the hand/off/auto system |                |                  |
| Mode              | RFC-A                                       |                |                  |
| Minimum           | 0   | Maximum        | 3                |
| Default           |   | Units          |                  |
| Type              | 8 Bit Power Down Save                       | Update Rate    | Background write |
| Display Format    | Standard                                    | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT                          |                |                  |

| Value | Text       |
|-------|------------|
| 0     | Not Active |
| 1     | Off        |
| 2     | Hand       |
| 3     | Auto       |

See *Hand/Off/Auto Operating Mode* (01.052) for details of the hand/off/auto system. *Hand Off Auto State* (10.105) shows the state of this system and is used at power-up to restore the previous state if required.

| Parameter         | 10.106 Potential Drive Damage Conditions   |                |                       |
|-------------------|--|----------------|-----------------------|
| Short description | Indicates that the user has put the drive in a condition that could potentially damage the drive |                |                       |
| Mode              | RFC-A  |                |                       |
| Minimum           | 0<br>(Display: 0000)   | Maximum        | 15<br>(Display: 1111) |
| Default           |  | Units          |                       |
| Type              | 8 Bit Power Down Save  | Update Rate    | Background write      |
| Display Format    | Binary   | Decimal Places | 0                     |
| Coding            | RO, ND, NC, PT, BU   |                |                       |

The bits in **Potential Drive Damage Conditions (10.106)** are set under the conditions shown in the table below to indicate that the user has put the drive in a condition that could potentially damage the drive. The bits in this parameter cannot be cleared by users.

| Potential Drive Damage Conditions (10.106) bit | Condition  |
|--|--|
| 0  | Fire mode has been active. See <i>Fire Mode Reference</i> (01.053).                  |
| 1  | <i>Low Under Voltage Threshold</i> (06.066) has been reduced from its default value. |
| 2  | High speed RFC-S mode has been used. See <i>Enable High Speed Mode</i> (05.022).     |
| 3  | Not used.  |

| Parameter         | 10.107 Auto-tune State             |                |                  |
|-------------------|------------------------------------|----------------|------------------|
| Short description | Shows progress through auto-tuning |                |                  |
| Mode              | RFC-A                              |                |                  |
| Minimum           | 0                                  | Maximum        | 9                |
| Default           |                                    | Units          |                  |
| Type              | 8 Bit Volatile                     | Update Rate    | Background write |
| Display Format    | Standard                           | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT                 |                |                  |

| Value | Text          |
|-------|---------------|
| 0     | Not Active    |
| 1     | Resistance    |
| 2     | pLs           |
| 3     | Ls            |
| 4     | Flux          |
| 5     | Flux Repeat   |
| 6     | Ld Lq No-load |
| 7     | Lq            |
| 8     | Ke            |
| 9     | Inertia       |

*Auto-tune State* (10.107) is zero unless an auto-tune is active when it shows the current state of the auto-tune sequence as follows:

| Parameter value | Auto-tune state                  |
|-----------------|----------------------------------|
| 1               | Stator resistance measurement    |
| 2               | Transient inductance measurement |
| 3               | Stator inductance measurement    |
| 9               | Inertia measurement              |

# Menu 11 Single Line Descriptions – *Miscellaneous*

Mode: RFC-A

| Parameter |   | Range  | Default     | Type |     |    |    |    |    |    |
|-----------|---|--|-------------|------|-----|----|----|----|----|----|
| 11.001    | Option Synchronisation Select                       | Not Active (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4), Automatic (5)  | Slot 4 (4)  | RW   | Txt |    |    |    |    | US |
| 11.002    | Option synchronisation Active                       | Not Active (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4)   |             | RO   | Txt | ND | NC | PT |    |    |
| 11.018    | Status Mode Parameter 1                             | 0.000 to 59.999  | 0.000       | RW   | Num |    |    | PT |    | US |
| 11.019    | Status Mode Parameter 2                             | 0.000 to 59.999  | 0.000       | RW   | Num |    |    | PT |    | US |
| 11.021    | Parameter 00.030 Scaling                            | 0.000 to 10.000  | 1.000       | RW   | Num |    |    |    |    | US |
| 11.022    | Parameter Displayed At Power-up                     | 0.000 to 0.080   | 0.010       | RW   | Num |    |    | PT |    | US |
| 11.028    | Drive Derivative                                    | 0 to 255   |             | RO   | Num | ND | NC | PT |    |    |
| 11.029    | Software Version                                    | 0 to 99999999  |             | RO   | Num | ND | NC | PT |    |    |
| 11.030    | User Security Code                                  | 0 to 2147483647  |             | RW   | Num | ND | NC | PT |    | US |
| 11.031    | User Drive Mode                                     | Open-loop (1), RFC-A (2), RFC-S (3), Regen (4)   |             | RW   | Txt | ND | NC | PT |    |    |
| 11.032    | Maximum Heavy Duty Rating                           | 0.000 to 99999.999 A   |             | RO   | Num | ND | NC | PT |    |    |
| 11.033    | Drive Rated Voltage                                 | 200V (0), 400V (1), 575V (2), 690V (3)   |             | RO   | Txt | ND | NC | PT |    |    |
| 11.034    | Software Sub-version                                | 0 to 99  |             | RO   | Num | ND | NC | PT |    |    |
| 11.035    | Number Of Power Modules Test                        | -1 to 20   | -1          | RW   | Num |    |    |    |    | US |
| 11.036    | NV Media Card File Previously Loaded                | 0 to 999   | 0           | RO   | Num |    | NC | PT |    |    |
| 11.037    | NV Media Card File Number                           | 0 to 999   | 0           | RW   | Num |    |    |    |    |    |
| 11.038    | NV Media Card File Type                             | None (0), Open-loop (1), RFC-A (2), RFC-S (3), Regen (4), User Prog (5)  |             | RO   | Txt | ND | NC | PT |    |    |
| 11.039    | NV Media Card File Version                          | 0 to 9999  |             | RO   | Num | ND | NC | PT |    |    |
| 11.040    | NV Media Card File Checksum                         | -2147483648 to 2147483647  |             | RO   | Num | ND | NC | PT |    |    |
| 11.042    | Parameter Cloning                                   | None (0), Read (1), Program (2), Auto (3), Boot (4)  | None (0)    | RW   | Txt |    | NC |    |    | US |
| 11.043    | Load Defaults                                       | None (0), Standard (1), US (2)   | None (0)    | RW   | Txt |    | NC |    |    |    |
| 11.044    | User Security Status                                | Menu 0 (0), All Menus (1), Read-only Menu 0 (2), Read-only (3), Status Only (4), No Access (5)   |             | RW   | Txt | ND |    | PT |    |    |
| 11.045    | Select Motor 2 Parameters                           | Motor 1 (0), Motor 2 (1)   | Motor 1 (0) | RW   | Txt |    |    |    |    | US |
| 11.046    | Defaults Previously Loaded                          | 0 to 2000  |             | RO   | Num | ND | NC | PT |    | US |
| 11.047    | Onboard User Program: Enable                        | Reset And Run (-1), Stop (0), Run (1)  | Run (1)     | RW   | Txt |    |    |    |    | US |
| 11.048    | Onboard User Program: Status                        | -2147483648 to 2147483647  |             | RO   | Num | ND | NC | PT |    |    |
| 11.049    | Onboard User Program: Programming Events            | 0 to 65535   |             | RO   | Num | ND | NC | PT |    |    |
| 11.050    | Onboard User Program: FreewheelingTasks Per Second  | 0 to 65535   |             | RO   | Num | ND | NC | PT |    |    |
| 11.051    | Onboard User Program: Clock Task Time Used          | 0.0 to 100.0 %   |             | RO   | Num | ND | NC | PT |    |    |
| 11.052    | Serial Number LS                                    | 000000000 to 999999999   |             | RO   | Num | ND | NC | PT |    |    |
| 11.053    | Serial Number MS                                    | 0 to 999999999   |             | RO   | Num | ND | NC | PT |    |    |
| 11.054    | Drive Date Code                                     | 0 to 65535   |             | RO   | Num | ND | NC | PT |    |    |
| 11.055    | Onboard User Program: Clock Task Scheduled Interval | 0 to 262140 ms   |             | RO   | Num | ND | NC | PT |    |    |
| 11.056    | Option Slot Identifiers                             | 1234 (0), 1243 (1), 1324 (2), 1342 (3), 1423 (4), 1432 (5), 4123 (6), 3124 (7), 4132 (8), 2134 (9), 3142 (10), 2143 (11), 3412 (12), 4312 (13), 2413 (14), 4213 (15), 2314 (16), 3214 (17), 2341 (18), 2431 (19), 3241 (20), 3421 (21), 4231 (22), 4321 (23) | 1234 (0)    | RW   | Txt |    |    |    | PT |    |
| 11.060    | Maximum Rated Current                               | 0.000 to 99999.999 A   |             | RO   | Num | ND | NC | PT |    |    |
| 11.061    | Full Scale Current Kc                               | 0.000 to 99999.999 A   |             | RO   | Num | ND | NC | PT |    |    |
| 11.062    | Power Board Software Version Number                 | 0.00 to 99.99  |             | RO   | Num | ND | NC | PT |    |    |
| 11.063    | Product Type  | 0 to 255   |             | RO   | Num | ND | NC | PT |    |    |
| 11.064    | Product Identifier Characters                       | 1295462450 to 2147483647   |             | RO   | Num | ND | NC | PT |    |    |
| 11.065    | Drive Rating And Configuration                      | 00000000 to 99999999   |             | RO   | Num | ND | NC | PT |    |    |
| 11.066    | Power Stage Identifier                              | 0 to 255   |             | RO   | Num | ND | NC | PT |    |    |
| 11.067    | Control Board Identifier                            | 0.000 to 65.535  |             | RO   | Num | ND | NC | PT |    |    |
| 11.068    | Internal I/O Identifier                             | 0 to 255   |             | RO   | Num | ND | NC | PT |    |    |
| 11.069    | Position Feedback Interface Identifier              | 0 to 255   |             | RO   | Num | ND | NC | PT |    |    |
| 11.070    | Core Parameter Database Version                     | 0.00 to 99.99  |             | RO   | Num | ND | NC | PT |    |    |
| 11.071    | Number Of Power Modules Detected                    | 0 to 20  |             | RO   | Num | ND | NC | PT |    | US |
| 11.072    | NV Media Card Create Special File                   | 0 to 1   | 0           | RW   | Num |    | NC |    |    |    |

|        |  |   |   |    |     |    |    |    |    |
|--------|--|---|---|----|-----|----|----|----|----|
| 11.073 | NV Media Card Type                     | None (0), SMART Card (1), SD Card (2)                   |   | RO | Txt | ND | NC | PT |    |
| 11.075 | NV Media Card Read-only Flag           | Off (0) or On (1)                                       |   | RO | Bit | ND | NC | PT |    |
| 11.076 | NV Media Card Warning Suppression Flag | Off (0) or On (1)                                       |   | RO | Bit | ND | NC | PT |    |
| 11.077 | NV Media Card File Required Version    | 0 to 9999   |   | RW | Num | ND | NC | PT |    |
| 11.079 | Drive Name Characters 1-4              | -2147483648 to 2147483647                               | 0 | RW | Num |    |    | PT | US |
| 11.080 | Drive Name Characters 5-8              | -2147483648 to 2147483647                               | 0 | RW | Num |    |    | PT | US |
| 11.081 | Drive Name Characters 9-12             | -2147483648 to 2147483647                               | 0 | RW | Num |    |    | PT | US |
| 11.082 | Drive Name Characters 13-16            | -2147483648 to 2147483647                               | 0 | RW | Num |    |    | PT | US |
| 11.084 | Drive Mode                             | Open-loop (1), RFC-A (2), RFC-S (3), Regen (4)          |   | RO | Txt | ND | NC | PT | US |
| 11.085 | Security Status                        | None (0), Read-only (1), Status-only (2), No Access (3) |   | RO | Txt | ND | NC | PT | PS |
| 11.086 | Menu Access Status                     | Menu 0 (0), All Menus (1)                               |   | RO | Txt | ND | NC | PT | PS |
| 11.090 | Keypad Port Serial Address             | 1 to 16   | 1 | RW | Num |    |    |    | US |
| 11.091 | Additional Identifier Characters 1     | -2147483648 to 2147483647                               |   | RO | Num | ND | NC | PT |    |
| 11.092 | Additional Identifier Characters 2     | -2147483648 to 2147483647                               |   | RO | Num | ND | NC | PT |    |
| 11.093 | Additional Identifier Characters 3     | -2147483648 to 2147483647                               |   | RO | Num | ND | NC | PT |    |
| 11.095 | Number Of Rectifiers Detected          | 0 to 9  |   | RO | Num | ND | NC | PT |    |
| 11.096 | Number Of Rectifiers Expected          | 0 to 9  | 0 | RW | Num |    |    |    | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |



# Menu 11 – Miscellaneous

Mode: RFC-A

Menu 11 provides parameters for the following features:

1. General drive set-up and identification
2. Serial communications interface
3. Non-volatile media card access
4. Onboard user programming

## Non-Volatile Media Card Support

The drive supports two types of non-volatile media cards; smart cards and FAT formatted SD cards.

The NV Media Card can be used for:

- Parameter copying between drives
- Saving drive parameter sets
- Saving an onboard user program
- Storing of onboard scope data (SD card only)

The NV Media Card can be used to store drive parameter sets and/or PLC programs set from the drive in data blocks 001 to 499 on the card.

The Unidrive M is compatible with a Unidrive SP smart card and is able to read and translate the Unidrive SP parameter set into a compatible parameter set for Unidrive M. This is only possible if the Unidrive SP parameter set was transferred to the smart card using the difference from defaults transfer method (i.e. 4yyy transfer). The Unidrive M is not able to read any other type of Unidrive SP data block on the card. Although it is possible to transfer difference from default data blocks from a Unidrive SP into the Unidrive M, the following should be noted:

1. If a parameter from the source drive does not exist in the target drive then no data is transferred for that parameter.
2. If the data for the parameter in the target drive is out of range then the data is limited to the range of the target parameter.
3. If the target drive has a different rating to the source drive then the normal rules for this type of transfer apply.

## SD Card File system layout

The folder <MCDF/> ("Motor Control Data Files") must be present on a FAT-formatted SD card. Other folders can be added, but this folder and its contents must not be altered. This folder structure is created when a *Card Error* trip is reset. The drive will place files in a <MCDF/> folder in the card root. When individual items are saved by the drive (e.g. drive parameters or a user program), this will generate a numbered file in the root of this folder; the number is that specified in the triggering command, and this number must be specified in the command used to restore the item from the file. This is equivalent functionality to that provided on a smart card. When saving a parameter file, in addition to the drive parameters, the drive will also read the option parameters from each of the installed options, and include those that have changed in the parameter file.

## **Changing the drive mode**

If the source drive mode is different from the target drive mode then the mode will be changed to the source drive mode before the parameters are transferred. If the required drive mode is outside the allowed range for the target then a *Card Drive Mode* trip is initiated and no data is transferred.

## **Different voltage ratings**

If the voltage rating of the source and target drives is different then all parameters except those that are rating dependent are transferred to the target drive. The rating dependent parameters are left at their default values. After the parameters have been transferred and saved to non-volatile memory a *Card Rating* trip is given as a warning. The table below gives a list of the rating dependent parameters.

| Parameters  |
|---|
| Standard Ramp Voltage (02.008)  |
| Voltage Set-point (03.005)  |
| Reactive Power Input kVAR (03.020)  |
| Regen Supply Loss a.c. Level (03.023)                                     |
| Regen Minimum Voltage (03.026)  |
| Regen Maximum Voltage (03.027)  |
| Supply Voltage (03.028)   |
| Motoring Current Limit / Power From Supply Current Limit (04.005)         |
| M2 Motoring Current Limit / M2 Power From Supply Current Limit (21.027)   |
| Regenerating Current Limit / Power To Supply Current Limit (04.006)       |
| M2 Regenerating Current Limit / M2 Power To Supply Current Limit (21.028) |
| Symmetrical Current Limit (04.007)  |
| M2 Symmetrical Current Limit (21.029)                                     |
| User Current Maximum Scaling (04.024)                                     |
| Rated Current (05.007)  |
| M2 Rated Current (21.007)   |
| Rated Voltage (05.009)  |
| M2 Rated Voltage (21.009)   |
| Rated Power Factor (05.010)   |
| M2 Rated Power Factor (21.010)  |
| Stator Resistance (05.017)  |
| M2 Stator Resistance (21.012)   |
| Maximum Switching Frequency (05.018)                                      |
| Transient Inductance /Ld (05.024)   |
| M2 Transient Inductance /Ld (21.014)                                      |
| Stator Inductance (05.025)  |
| M2 Stator Inductance (21.024)   |
| No-load Lq (05.068)   |
| M2 No-load Lq (21.041)  |
| Rated Load Lq (05.069)  |
| M2 Rated Load Lq (21.042)   |
| No-load Phase Offset (05.070)   |
| M2 No-load Phase Offset (21.043)  |
| Rated Load Phase Offset (05.071)  |
| M2 Rated Load Phase Offset (21.044)                                       |
| Maximum Low Speed Sensorless Mode Current (05.072)                        |
| M2 Maximum Low Speed Sensorless Mode Current (05.045)                     |
| Injection Braking Level (06.006)  |
| Supply Loss Detection Level (06.048)                                      |
| Braking IGBT Lower Threshold (06.073)                                     |
| Braking IGBT Upper Threshold (06.074)                                     |
| Low Voltage Braking IGBT Threshold (06.075)                               |

#### Different option modules fitted

If the *Option ID Code* (MM.001) is different for any option module fitted to the source drive compared to the destination drive then the parameters for the set-up and application menus for that option module are not transferred, but the parameters are set to their default values. After the parameters have been transferred and saved to non-volatile memory a {Card Option} trip is given as a warning

#### Different current ratings

If any of the current rating parameters (*Maximum Heavy Duty Rating* (11.032), *Maximum Rated Current* (11.060) or *Full Scale Current Kc* (11.061)) are different between the source and target then all parameters are still written to the target drive, but some may be limited by their allowed range. To give similar performance in the target compared to the source drive the speed and current controller gains are modified as shown below.

| Gains  | Multiplier  |
|--|---|
| Speed Controller Proportional Gain Kp1 (03.010)<br>Speed Controller Integral Gain Ki1 (03.011)<br>Speed Controller Proportional Gain Kp2 (03.013)<br>Speed Controller Integral Gain Ki2 (03.014) | [Source Full Scale Current Kc (11.061)] / [Target Full Scale Current Kc (11.061)] |
| M2 Speed Controller Proportional Gain Kp (21.017)<br>M2 Speed Controller Integral Gain Ki (21.018)   |   |
| Current Controller Kp Gain (04.013)<br>Current Controller Ki Gain (04.014)   | [Target Full Scale Current Kc (11.061)] / [Source Full Scale Current Kc (11.061)] |
| M2 Current Controller Kp Gain (21.022)<br>M2 Current Controller Ki Gain (21.023)   |   |

#### Different variable maximums

It should be noted that if ratings of the source and target drives are different, or the option modules fitted to the source and target drives are different, it is possible that some parameters with variable maximums may be limited and not have the same values as in the source drive.

## Macro files

Macro files are created in the same way as parameter files except that *NV Media Card Create Special File* (11.072) must be set to 1 before the file is created on the NV media card. *NV Media Card Create Special File* (11.072) is set to zero after the file has been created or the transfer fails. When a macro file is transferred to a drive the drive mode is not changed even if the actual mode is different to that in the file and defaults are not loaded before the parameters are copied from the file to the drive. The first three identification bytes at the start of a macro file are "MAC".

## Onboard user program files

Onboard user program files are created with *Parameter mm.000* (mm.000) = 5xxx and the onboard user program image is transferred to the NV media card. The onboard user program image can be loaded from an onboard user program file with *Parameter mm.000* (mm.000) = 6xxx. If the drive does not have an onboard user program loaded when the onboard user program file is created then a file is created with an empty image. If this file is then transferred to a drive with an onboard user program loaded, the onboard user program will be erased.

## Option module applications file

An option module applications file is intended to hold user program from an applications module. An option module applications file from the option module in slot 1 can be created with *Parameter mm.000* (mm.000) = 15xxx. An option module applications file can be transferred from an option module in slot 1 to an option module applications file with *Parameter mm.000* (mm.000) = 18xxx. If the transfer fails because the option module does not respond correctly a *Card Slot* trip is initiated where the sub-trip number is 1 (i.e. the option module slot number). Transfer to and from other option slots are initiated with other codes in *Parameter mm.000* (mm.000) as defined previously.

| Parameter         | 11.001 Option Synchronisation Select |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description | Option Synchronisation Select        |                |                 |
| Mode              | RFC-A                                |                |                 |
| Minimum           | 0                                    | Maximum        | 5               |
| Default           | 4                                    | Units          |                 |
| Type              | 8 Bit User Save                      | Update Rate    | Background Read |
| Display Format    | Standard                             | Decimal Places | 0               |
| Coding            | RW, TE                               |                |                 |

| Value | Text       |
|-------|------------|
| 0     | Not Active |
| 1     | Slot 1     |
| 2     | Slot 2     |
| 3     | Slot 3     |
| 4     | Slot 4     |
| 5     | Automatic  |

*Option Synchronisation Select* (11.001) is used to select and enable timing synchronisation between the communications system associated with an option module fitted to the drive and the drive control system. If "Not Active" is selected then the drive control system operates using its own processor crystal for control sample timing. If one of the option modules is selected and is making a request to provide synchronisation then the drive control sample timing will be synchronised to the communication system. *Option synchronisation Active* (11.002) shows the synchronisation source, where "Not Active" indicates that the drive is providing the timing for the control system. Any other value indicates if an option module is providing synchronisation. If required the synchronisation source can be selected automatically by setting *Option Synchronisation Select* (11.001) to "Automatic". In this case the option module in the lowest numbered slot that is making a request to provide synchronisation will be selected.

| Parameter         | 11.002 Option synchronisation Active |                |                  |
|-------------------|--------------------------------------|----------------|------------------|
| Short description | Option synchronisation Active        |                |                  |
| Mode              | RFC-A                                |                |                  |
| Minimum           | 0                                    | Maximum        | 4                |
| Default           |                                      | Units          |                  |
| Type              | 8 Bit Volatile                       | Update Rate    | Background Write |
| Display Format    | Standard                             | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT                   |                |                  |

| Value | Text       |
|-------|------------|
| 0     | Not Active |
| 1     | Slot 1     |
| 2     | Slot 2     |
| 3     | Slot 3     |
| 4     | Slot 4     |

See *Option Synchronisation Select* (11.001).

| Parameter         | 11.018 Status Mode Parameter 1   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the parameter displayed on the upper row of the keypad when in status mode |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000  | Maximum        | 59.999          |
| Default           | 0.000  | Units          |                 |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW, PT, BU   |                |                 |

See *Parameter Displayed At Power-up* (11.022).

| Parameter         | 11.019 Status Mode Parameter 2   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the parameter displayed on the lower row of the keypad when in status mode |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000  | Maximum        | 59.999          |
| Default           | 0.000  | Units          |                 |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW, PT, BU   |                |                 |

See *Parameter Displayed At Power-up* (11.022).

| Parameter         | 11.021 Parameter 00.030 Scaling   |                |                 |
|-------------------|-----------------------------------|----------------|-----------------|
| Short description | Defines the scaling for Pr 00.030 |                |                 |
| Mode              | RFC-A                             |                |                 |
| Minimum           | 0.000                             | Maximum        | 10.000          |
| Default           | 1.000                             | Units          |                 |
| Type              | 16 Bit User Save                  | Update Rate    | Background read |
| Display Format    | Standard                          | Decimal Places | 3               |
| Coding            | RW                                |                |                 |

*Parameter 00.030 Scaling* (11.021) defines the scaling applied to parameter 00.030 when it is displayed on a basic keypad. The scaling is only applied in the status and view modes. If the parameter is edited via the keypad it reverts to its unscaled value during editing.

| Parameter         | 11.022 Parameter Displayed At Power-up           |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines which parameter is displayed at power-up |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000  | Maximum        | 0.080           |
| Default           | 0.010  | Units          |                 |
| Type              | 8 Bit User Save                                  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW, PT   |                |                 |

If *Status Mode Parameter 1* (11.018) and *Status Mode Parameter 2* (11.019) are set to zero, then *Parameter Displayed At Power-up* (11.022) defines which Menu 0 parameter is initially displayed at power-up. If *Status Mode Parameter 1* (11.018) or *Status Mode Parameter 2* (11.019) are set to valid parameter numbers, then *Parameter Displayed At Power-up* (11.022) defines the active parameter at power-up, i.e. the parameter first displayed when going in to parameter view mode on the keypad. *Status Mode Parameter 1* (11.018) and *Status Mode Parameter 2* (11.019) define the parameter values to be displayed on the upper and lower rows of the keypad respectively, when in status mode. If only one of these parameters is set correctly the other row will display the value of the current active parameter. If both *Status Mode Parameter 1* (11.018) and *Status Mode Parameter 2* (11.019) are set to the same parameter number then the parameter value is displayed as double height characters.

| Parameter         | 11.028 Drive Derivative                  |                |                |
|-------------------|--|----------------|----------------|
| Short description | Displays the drive derivative identifier |                |                |
| Mode              | RFC-A                                    |                |                |
| Minimum           | 0  | Maximum        | 255            |
| Default           |  | Units          |                |
| Type              | 8 Bit Volatile                           | Update Rate    | Power-up write |
| Display Format    | Standard                                 | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT, BU                       |                |                |

*Drive Derivative* (11.028) shows the derivative identifier.

| Parameter         | 11.029 Software Version                    |                |                |
|-------------------|--|----------------|----------------|
| Short description | Displays the software version in the drive |                |                |
| Mode              | RFC-A                                      |                |                |
| Minimum           | 0  | Maximum        | 99999999       |
| Default           |  | Units          |                |
| Type              | 32 Bit Volatile                            | Update Rate    | Power-up write |
| Display Format    | Version                                    | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT                             |                |                |

*Software Version* (11.029) displays the drive software version number as a decimal number wwxxyyzz. A keypad will display the value in this parameter as ww.xx.yy.zz.

| Parameter         | 11.030 User Security Code                   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the user security code of the drive |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0   | Maximum        | 2147483647      |
| Default           |   | Units          |                 |
| Type              | 32 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 0               |
| Coding            | RW, ND, NC, PT                              |                |                 |

See *User Security Status* (11.044).

| Parameter         | 11.031 User Drive Mode        |                |                 |
|-------------------|-------------------------------|----------------|-----------------|
| Short description | Defines the mode of the drive |                |                 |
| Mode              | RFC-A                         |                |                 |
| Minimum           | 1                             | Maximum        | 4               |
| Default           |                               | Units          |                 |
| Type              | 8 Bit Volatile                | Update Rate    | Background read |
| Display Format    | Standard                      | Decimal Places | 0               |
| Coding            | RW, TE, ND, NC, PT            |                |                 |

| Value | Text      |
|-------|-----------|
| 1     | Open-loop |
| 2     | RFC-A     |
| 3     | RFC-S     |
| 4     | Regen     |

*User Drive Mode* (11.031) is set to the current drive mode at power-up. The user can change the drive mode as follows:

1. Set *Parameter mm.000* (mm.000) to 1253, 1254, 1255 or 1256
2. Change *User Drive Mode* (11.031) to the required mode
3. Initiate a drive reset

Provided *Drive Active* (10.002) = 0 the drive will change to the new drive mode, and then load and save parameters to non-volatile memory. If *Parameter mm.000* (mm.000) is not set to one of the specified values then the drive mode does not change on drive reset. The value in *Parameter mm.000* (mm.000) determines which defaults are loaded as follows.

| Parameter mm.000 (mm.000) | Defaults loaded   |
|---------------------------|---|
| 1253                      | 50Hz defaults to all menus                              |
| 1254                      | 60Hz defaults to all menus                              |
| 1255                      | 50Hz defaults to all menus except 15 to 20 and 24 to 28 |
| 1256                      | 60Hz defaults to all menus except 15 to 20 and 24 to 28 |

| Parameter         | 11.032 Maximum Heavy Duty Rating                            |                |                |
|-------------------|---|----------------|----------------|
| Short description | Displays the maximum heavy duty current rating of the drive |                |                |
| Mode              | RFC-A   |                |                |
| Minimum           | 0.000   | Maximum        | 99999.999      |
| Default           |   | Units          | A              |
| Type              | 32 Bit Volatile   | Update Rate    | Power-up write |
| Display Format    | Standard  | Decimal Places | 3              |
| Coding            | RO, ND, NC, PT  |                |                |

*Maximum Heavy Duty Rating* (11.032) defines the maximum setting for *Rated Current* (05.007) that gives heavy duty operation. If *Maximum Heavy Duty Rating* (11.032) = 0.000 then heavy duty operation is not possible. If *Maximum Heavy Duty Rating* (11.032) = VM\_RATED\_CURRENT[MAX] then normal duty operation is not possible.

| Parameter         | 11.033 Drive Rated Voltage               |                |                |
|-------------------|--|----------------|----------------|
| Short description | Displays the voltage rating of the drive |                |                |
| Mode              | RFC-A                                    |                |                |
| Minimum           | 0  | Maximum        | 3              |
| Default           |  | Units          |                |
| Type              | 8 Bit Volatile                           | Update Rate    | Power-up write |
| Display Format    | Standard                                 | Decimal Places | 0              |
| Coding            | RO, TE, ND, NC, PT                       |                |                |

| Value | Text |
|-------|------|
| 0     | 200V |
| 1     | 400V |
| 2     | 575V |
| 3     | 690V |

*Drive Rated Voltage* (11.033) shows the voltage rating of the drive.

| Parameter         | 11.034 Software Sub-version |                |                |
|-------------------|-----------------------------|----------------|----------------|
| Short description | Software Sub-version        |                |                |
| Mode              | RFC-A                       |                |                |
| Minimum           | 0                           | Maximum        | 99             |
| Default           |                             | Units          |                |
| Type              | 8 Bit Volatile              | Update Rate    | Power-up Write |
| Display Format    | Standard                    | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT              |                |                |

For legacy applications *Software Sub-version* (11.034) shows the yy part of *Software Version* (11.029).

| Parameter         | 11.035 Number Of Power Modules Test                |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Tests the number of power modules within the drive |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | -1   | Maximum        | 20              |
| Default           | -1   | Units          |                 |
| Type              | 8 Bit User Save                                    | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

*Number Of Power Modules Detected* (11.071) shows the number of power modules detected in the drive when communications with the power system is established. The number of modules can be checked and a trip initiated depending on the value of *Number Of Power Modules Test* (11.035) as follows:

| Number Of Power Modules Test (11.035) | Test  | Trip if test fails   |
|---------------------------------------|---|--|
| -1                                    | The number of modules detected is compared to the value in <i>Number Of Power Modules Detected</i> (11.071) before it is updated with the number of modules present | <i>Configuration.mmm</i> where mmm is the value of <i>Number Of Power Modules Detected</i> (11.071) before it is updated |
| 0                                     | None  | None   |
| >0                                    | The number of modules detected is compared to the value in <i>Number Of Power Modules Test</i> (11.035)   | <i>Configuration.mmm</i> where mmm is the value of <i>Number Of Power Modules Test</i> (11.035)                          |

If *Number Of Power Modules Test* (11.035) = -1 a test is being carried out to see if the number of modules detected has changed. *Number Of Power Modules Detected* (11.071) is a user save parameter, and so on power-up the number of modules can be compared with the number last saved when the system last powered up correctly.

If *Number Of Power Modules Test* (11.035) > 0 the expected number of modules are stored in *Number Of Power Modules Test* (11.035), and if the number powering up successfully changes then this can be detected.

The sub-trip number always indicates the expected number of power modules. The actual number detected can always be seen in *Number Of Power Modules Detected* (11.071).

| Parameter         | 11.036 NV Media Card File Previously Loaded   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the number of the last parameter file transferred from an NV Media Card to the drive |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 999              |
| Default           | 0   | Units          |                  |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, NC, PT  |                |                  |

*NV Media Card File Previously Loaded* (11.036) shows the number of the last parameter file transferred from an NV Media Card to the drive. If defaults are subsequently reloaded *NV Media Card File Previously Loaded* (11.036) is set to 0.

| Parameter         | 11.037 NV Media Card File Number                 |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Selects a file by its file identification number |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 999             |
| Default           | 0  | Units          |                 |
| Type              | 16 Bit Volatile                                  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

NV Media Card File Number (11.037) is used to select a file by its file identification number. When NV Media Card File Number (11.037) corresponds to the number of a file the following data about the file is shown.

| Parameter                            |
|--------------------------------------|
| NV Media Card File Type (11.038)     |
| NV Media Card File Version (11.039)  |
| NV Media Card File Checksum (11.040) |

The actions of erasing a card, erasing a file, creating a new file, changing a Menu 0 parameter or removing a card resets NV Media Card File Number (11.037) to 0.

| Parameter         | 11.038 NV Media Card File Type              |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the file type of the file selected |                |                  |
| Mode              | RFC-A                                       |                |                  |
| Minimum           | 0   | Maximum        | 5                |
| Default           |   | Units          |                  |
| Type              | 8 Bit Volatile                              | Update Rate    | Background write |
| Display Format    | Standard                                    | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT                          |                |                  |

| Value | Text      |
|-------|-----------|
| 0     | None      |
| 1     | Open-loop |
| 2     | RFC-A     |
| 3     | RFC-S     |
| 4     | Regen     |
| 5     | User Prog |

NV Media Card File Type (11.038) shows the file type of the file selected with NV Media Card File Number (11.037) as shown in the table below.

| NV Media Card File Type (11.038) | File                          |
|----------------------------------|-------------------------------|
| 0                                | No file selected              |
| 1                                | Open-loop mode parameter file |
| 2                                | RFC-A mode parameter file     |
| 3                                | RFC-S mode parameter file     |
| 4                                | Regen mode parameter file     |
| 5                                | Onboard user program file     |

| Parameter         | 11.039 NV Media Card File Version                         |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the version number stored with the file selected |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 9999             |
| Default           |   | Units          |                  |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

NV Media Card File Version (11.039) shows the version number stored with the file selected with NV Media Card File Number (11.037).

To set a file version number on a NV media card, the number required must be set in NV Media Card File Required Version (11.077) and then the data must be written to the NV media card. Failure to do this will result in no version number being displayed when selecting the NV media card file number in NV Media Card File Number (11.037).

| Parameter         | 11.040 NV Media Card File Checksum           |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the checksum from the file selected |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | -2147483648                                  | Maximum        | 2147483647       |
| Default           |  | Units          |                  |
| Type              | 32 Bit Volatile                              | Update Rate    | Background write |
| Display Format    | Standard                                     | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                               |                |                  |

*NV Media Card File Checksum* (11.040) shows the checksum from the file selected with *NV Media Card File Number* (11.037). If the media file is a Unidrive SP SMARTCARD file, the checksum is the sum of all bytes except the checksum modulo 65536. If the file was generated by a Unidrive M, a value of zero will be displayed.

| Parameter         | 11.042 Parameter Cloning  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Can be used to initiate a data transfer to or from an NV media card |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 4                |
| Default           | 0   | Units          |                  |
| Type              | 8 Bit User Save   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RW, TE, NC  |                |                  |

| Value | Text    |
|-------|---------|
| 0     | None    |
| 1     | Read    |
| 2     | Program |
| 3     | Auto    |
| 4     | Boot    |

\* Only a value of 3 or 4 in this parameter is saved.

*Parameter Cloning* (11.042) can also be used to initiate data transfer to or from an NV media card as described below for each possible value of this parameter.

#### 1: Read

Provided a parameter file with file identification number 1 exists on the NV media card then setting *Parameter Cloning* (11.042) = 1 and initiating a drive reset will transfer the parameter data to the drive (i.e. the same action as writing 6001 to *Parameter mm.000* (mm.000)). When the action is complete *Parameter Cloning* (11.042) is automatically reset to zero.

#### 2: Program

Setting *Parameter Cloning* (11.042) = 2 and initiating a drive reset will transfer the parameter data from the drive to a parameter file with file identification number 1. This is the same action as writing 4001 to *Parameter mm.000* (mm.000) except that the file will be overwritten if it already exists. When the action is complete *Parameter Cloning* (11.042) is automatically reset to zero.

#### 3: Auto

Setting *Parameter Cloning* (11.042) = 3 and initiating a drive reset will transfer the parameter data from the drive to a parameter file with file identification number 1. This is the same action as writing 4001 to *Parameter mm.000* (mm.000) except that the file will be overwritten if it already exists. When the action is complete *Parameter Cloning* (11.042) remains at 3. It should be noted that if the drive is to remain in Auto mode after power-down and subsequent power-up a parameter save is required, unless *Parameter Cloning* (11.042) is being accessed from Menu 0, in which case it will be saved automatically.

If the card is removed when *Parameter Cloning* (11.042) = 3, then Parameter *Parameter Cloning* (11.042) is set to 0, which forces the user to change *Parameter Cloning* (11.042) back to 3 if auto mode is still required. The user will need to set *Parameter Cloning* (11.042) = 3 and initiate a drive reset to write the complete parameter set to the new card.

When a parameter in Menu zero is changed via the keypad and *Parameter Cloning* (11.042) = 3 the parameter is saved both to the drive non-volatile memory and to the parameter file with identification number 1 on the card. Only the new value of the modified parameter, and not the value of all the other drive parameters, is stored each time. If the drive did not automatically clear *Parameter Cloning* (11.042) when a card is removed, then when a new card is inserted that contains a parameter file with identification number 1 the modified parameter would be written to the existing file on the new card and the rest of the parameters in this file may not be the same as those in the drive.

When *Parameter Cloning* (11.042) = 3 and the drive parameters are saved to non-volatile memory, the file on the card is also updated, therefore this file becomes a copy of the drive parameters. At power up, if *Parameter Cloning* (11.042) = 3, the drive will save its complete parameter set to the card. This is done to ensure that if a card is inserted whilst the drive is powered down the new card will have the correct data after the drive is powered up again.

#### 4: Boot

When *Parameter Cloning* (11.042) = 4 the drive operates in a similar way to *Parameter Cloning* (11.042) = 3 and automatically creates a copy of its parameters on the NV Media card. The NC (not clonable) attribute for *Parameter Cloning* (11.042) is 1, and so it does not have a value stored in the parameter file on the card in the normal way. However, the value of *Parameter Cloning* (11.042) is held in the parameter file header. If *Parameter Cloning* (11.042) = 4 in the parameter file with a file identification value of 1 on an NV media card fitted to a drive at power-up then the parameters from the parameter file with file identification number 1 are transferred to the drive and then saved in non-volatile memory. *Parameter Cloning* (11.042) is then set to 0 after the data transfer is complete.

It is possible to create a bootable parameter file by setting *Parameter mm.000* (mm.000) = 2001 and initiating a drive reset. This file is created in one operation and is not updated when further parameter changes are made.

When the drive is powered up it detects which option modules are fitted before loading parameters from an NV media card which has been set up for boot mode. If a new option module has been fitted since the last time the drive was powered up, a *Slot1 Different* trip is initiated and then the parameters are transferred from the card. If the parameter file includes the parameters for the newly fitted option module then these are also transferred



to the drive and the *Slot1 Different* trip is reset. If the parameter file does not include the parameters for the newly fitted option module then the drive does not reset the *Slot1 Different* trip. Once the transfer is complete the drive parameters are saved to non-volatile memory. The trip can be reset either by initiating a drive reset or by powering down and then powering up again.

| Parameter         | 11.043 Load Defaults                                   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines which defaults are to be loaded into the drive |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 2               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit Volatile   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE, NC   |                |                 |

| Value | Text     |
|-------|----------|
| 0     | None     |
| 1     | Standard |
| 2     | US       |

If *Load Defaults* (11.043) is non-zero and a drive reset is initiated then the drive will load and save default parameters. If *Load Defaults* (11.043) = 1 then 50Hz defaults are loaded and if *Load Defaults* (11.043) = 2 then 60Hz defaults are loaded. This parameter has priority over actions defined by *Parameter mm.000* (mm.000) and *Parameter Cloning* (11.042). If *Load Defaults* (11.043) is used to initiate loading defaults the it is cleared along with *Parameter mm.000* (mm.000) and *Parameter Cloning* (11.042) when the action is completed.

| Parameter         | 11.044 User Security Status                 |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | defines the security level within the drive |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0   | Maximum        | 5               |
| Default           |   | Units          |                 |
| Type              | 8 Bit Volatile                              | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 0               |
| Coding            | RW, TE, ND, PT                              |                |                 |

| Value | Text             |
|-------|------------------|
| 0     | Menu 0           |
| 1     | All Menus        |
| 2     | Read-only Menu 0 |
| 3     | Read-only        |
| 4     | Status Only      |
| 5     | No Access        |

## Security

The drive provides a number of different levels of security that can be set by the user via *User Security Status* (11.044); these are shown in the table below.

| Security Level   | Description  | User Security Status (11.044) |
|------------------|--|-------------------------------|
| Menu 0           | All writable parameters are available to be edited but only parameters in Menu 0 are visible.  | 0                             |
| All menus        | All writable parameters are visible and available to be edited.  | 1                             |
| Read-only Menu 0 | All parameters are read-only. Access is limited to Menu 0 parameters only.   | 2                             |
| Read-only        | All parameters are read-only however all menus and parameters are visible.   | 3                             |
| Status only      | The keypad remains in status mode and no parameters can be viewed or edited  | 4                             |
| No access        | The keypad remains in status mode and no parameters can be viewed or edited. Drive parameters cannot be accessed via a comms/fieldbus interface in the drive or any option module. | 5                             |

When security has been set up the drive can either be in the locked or unlocked state. In the locked state the security level that has been set up applies. In the unlocked state the security is not active, but when the drive is powered down and powered up again the drive will be in the locked state. The drive may be relocked without powering down by selecting the required security level with the *User Security Status* (11.044) and initiating a drive reset.

Security can be set up as follows:

1. The *User Security Code* (11.030) should be set to the desired security unlock code (not zero). For security to remain set after power down then a parameter save should be performed to retain the set value.
2. If no further action is taken when the drive is powered down and then powered up read-only security will be set up and locked.
3. If at any time the *User Security Status* (11.044) is set to a value corresponding the one of the security levels shown in the table above and a drive reset is performed the security level is changed to that level. The desired security level is automatically saved and retained after power down, the keypad state changes to status mode and security is locked. (The security level that is active, provided *User Security Code* (11.030) has been saved as a non-zero value, if shown in *Security Status* (11.085).)

When security is set up and locked:

1. Parameter access is restricted as shown in the table above.

2. *User Security Code* (11.030) reads as zero except in parameter edit mode. Therefore it is not possible to read the value of the security code when any level of security is active and locked.

Security can be unlocked as follows:

1. If read-only security is set and locked then any attempt to edit any read/write parameter causes "Security code" to be displayed on the first row of the display. When the Up or Down keys are pressed the second row shows the code being adjusted. On setting the code the user presses the Enter key. If the correct code has been entered then the drive switches to Parameter edit mode on the parameter the user selected to edit, but if the correct code has not been entered the notification "Incorrect security code" is displayed for 2s and the drive returns to Parameter view mode.
2. If Status only or No access security is set and locked then any attempt to leave status mode causes the security code to be requested as per the process described above. If the security code entered must be correct for the keypad state machine to switch to the Parameter view mode. It is then possible to access all parameters normally.

Security can be cleared as follows:

1. Security must be unlocked.
2. The *User Security Code* (11.030) should be set to zero. For security to remain cleared after power down then a parameter save should be performed.

At any time *Security Status* (11.085) can be changed between 0 and 1 to restrict access to Menu 0 alone or to all menus. If the change is made by a keypad the new value becomes active on leaving parameter edit mode.

It should be that *Security Status* (11.085) is a volatile parameter and that the actual state of the security system is stored in *Security Status* (11.085) and *Menu Access Status* (11.086), which are both power-down save parameters. Therefore the security status will be stored when the drive goes into the under-voltage state. If the drive is already in the under-voltage state the security state should be saved by writing 1001 to *Parameter mm.000* (mm.000) and initiating a reset.

| Parameter         | 11.045 Select Motor 2 Parameters      |                |                 |
|-------------------|---------------------------------------|----------------|-----------------|
| Short description | Set to 1 to select motor 2 parameters |                |                 |
| Mode              | RFC-A                                 |                |                 |
| Minimum           | 0                                     | Maximum        | 1               |
| Default           | 0                                     | Units          |                 |
| Type              | 8 Bit User Save                       | Update Rate    | Background read |
| Display Format    | Standard                              | Decimal Places | 0               |
| Coding            | RW, TE                                |                |                 |

| Value | Text    |
|-------|---------|
| 0     | Motor 1 |
| 1     | Motor 2 |

*Select Motor 2 Parameters* (11.045) is used to select the motor map 2 parameters from Menu 21 to be substituted for the standard motor parameters. If *Select Motor 2 Parameters* (11.045) is modified when *Drive Active* (10.002) = 1 the change only becomes effective when *Drive Active* (10.002) = 0. When *Select Motor 2 Parameters* (11.045) = 1 the results from auto-tuning are written to the motor map 2 parameters in Menu 21 instead of to the standard parameters. Each time *Select Motor 2 Parameters* (11.045) is changed *Motor Protection Accumulator* (04.019) is reset to zero. *Select Motor 2 Parameters* (11.045) operates in the same way in Regen mode, but *Inductor Protection Accumulator* (04.019) is reset to zero each time the value is changed. *Motor 2 Active* (21.015) shows the motor map that is active.

| Parameter         | 11.046 Defaults Previously Loaded                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the defaults previously loaded in the drive |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 2000             |
| Default           |  | Units          |                  |
| Type              | 16 Bit User Save                                     | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                       |                |                  |

*Defaults Previously Loaded* (11.046) shows the value used to load the previously loaded defaults (i.e. 1233 for 50Hz defaults, or 1244 for 60Hz defaults).

| Parameter         | 11.047 Onboard User Program: Enable |                |                 |
|-------------------|-------------------------------------|----------------|-----------------|
| Short description | Enables the onboard user program    |                |                 |
| Mode              | RFC-A                               |                |                 |
| Minimum           | -1                                  | Maximum        | 1               |
| Default           | 1                                   | Units          |                 |
| Type              | 8 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                            | Decimal Places | 0               |
| Coding            | RW, TE                              |                |                 |

| Value | Text          |
|-------|---------------|
| -1    | Reset And Run |
| 0     | Stop          |
| 1     | Run           |

Onboard user programming provided a background task that loops continuously and a timed task that is executed each time at a defined rate. *Onboard User Program: Enable* (11.047) allows the onboard user program to be controlled as follows:

**-1: Reset And Run**

The onboard user program will run. If *Onboard User Program: Enable* (11.047) is changed from 0 (Stop) to -1 (Reset And Run) all variables will be reset to their initial values and the user program will run from the start.

**0: Stop**

The onboard user program is stopped.

**1: Run**

The onboard user program will run. If *Onboard User Program: Enable* (11.047) is changed from 0 (Stop) to 1 (Run) all variables will be unchanged and the user program will run from the start.

The effect of the above is as follows:

- If the drive powers up with *Onboard User Program: Enable* (11.047) set to either 1 or -1 then all variables will be reset to their initial values before the user program starts.
- If the drive powers up with *Onboard User Program: Enable* (11.047) set to 0, and then *Onboard User Program: Enable* (11.047) is changed to either 1 or -1 then all variables will be reset to their initial values before the user program starts.
- If *Onboard User Program: Enable* (11.047) is set to 0 and then to -1 then all variables will be reset to their initial values before the user program starts.
- If *Onboard User Program: Enable* (11.047) is set to 0 and then to 1 then all variables will be left at their previous values before the user program starts.

| Parameter         | 11.048 Onboard User Program: Status             |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the status of the onboard user program |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | -2147483648                                     | Maximum        | 2147483647       |
| Default           |   | Units          |                  |
| Type              | 32 Bit Volatile                                 | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                  |                |                  |

*Onboard User Program: Status* (11.048) shows the status of the onboard user program.

| Value | Description                              |
|-------|--|
| 0     | A user program is present but is stopped |
| 1     | The user program is running              |
| 2     | The user program has an exception        |
| 3     | No user program is present               |

| Parameter         | 11.049 Onboard User Program: Programming Events                       |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the number of programming events of the onboard user program |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 65535            |
| Default           |   | Units          |                  |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT, BU  |                |                  |

*Onboard User Program: Programming Events* (11.049) = 0 when the drive is manufactured and is incremented each time an onboard user program image is written to the drive. If an onboard user program image is written more than 65535 times *Onboard User Program: Programming Events* (11.049) = 65535. *Onboard User Program: Programming Events* (11.049) shows how many times the flash memory within the drive has been reprogrammed.

| Parameter         | 11.050 Onboard User Program: FreewheelingTasks Per Second           |                |                             |
|-------------------|---|----------------|-----------------------------|
| Short description | Displays the rate of freewheeling tasks of the onboard user program |                |                             |
| Mode              | RFC-A   |                |                             |
| Minimum           | 0   | Maximum        | 65535                       |
| Default           |   | Units          |                             |
| Type              | 16 Bit Volatile   | Update Rate    | One Second Background Write |
| Display Format    | Standard  | Decimal Places | 0                           |
| Coding            | RO, ND, NC, PT, BU  |                |                             |

During each scan in a freewheeling task it is possible to give an indication to the drive that the scan loop is starting. If this indication is given then *Onboard User Program: FreewheelingTasks Per Second* (11.050) will give the number of times this indication is given per second. It should be noted that this parameter is updated once per second. Because the background time slot for the user program background task occurs every 64ms (15.625 times per second) either 15 or 16 time slots could have been allocated over the monitoring period. Therefore the value given by this parameter can step between two values, one corresponding to the number of updates for 15 slots, and the one corresponding to the number of updates for 16 slots.

| Parameter         | 11.051 Onboard User Program: Clock Task Time Used   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the percentage of the available time used by the onboard user program clock task |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.0   | Maximum        | 100.0            |
| Default           |   | Units          | %                |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 1                |
| Coding            | RO, ND, NC, PT  |                |                  |

*Onboard User Program: Clock Task Time Used* (11.051) shows the percentage of the available time used by the onboard user program clock task.

| Parameter         | 11.052 Serial Number LS   |                |                                   |
|-------------------|---|----------------|-----------------------------------|
| Short description | Shows the least significant 9 decimal digits of the drive serial number |                |                                   |
| Mode              | RFC-A   |                |                                   |
| Minimum           | 0<br>(Display: 000000000)   | Maximum        | 999999999<br>(Display: 999999999) |
| Default           |   | Units          |                                   |
| Type              | 32 Bit Volatile   | Update Rate    | Power-up write                    |
| Display Format    | Lead Zero Pad   | Decimal Places | 0                                 |
| Coding            | RO, ND, NC, PT  |                |                                   |

The drive serial number is available as a pair of 32 bit values where *Serial Number LS* (11.052) provides the least significant 9 decimal digits and *Serial Number MS* (11.053) provides the most significant 9 decimal digits. The reconstructed serial number is  $((11.053 * 100000000) + 11.052)$ .

Example 1

Serial number "1234567898765" would be stored as 11.053 = 1234, 11.052 = 567898765.

Example 2

Serial number "1234000056789" would be stored as 11.053 = 1234, 11.052 = 56789. *Serial Number LS* (11.052) will be shown on the keypad as 000056789 (i.e. including the leading zeros).

| Parameter         | 11.053 Serial Number MS  |                |                |
|-------------------|--|----------------|----------------|
| Short description | Shows the most significant 9 decimal digits of the drive serial number |                |                |
| Mode              | RFC-A  |                |                |
| Minimum           | 0  | Maximum        | 999999999      |
| Default           |  | Units          |                |
| Type              | 32 Bit Volatile  | Update Rate    | Power-up write |
| Display Format    | Standard   | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT   |                |                |

See *Serial Number LS* (11.052).

| Parameter         | 11.054 Drive Date Code    |                |                  |
|-------------------|---------------------------|----------------|------------------|
| Short description | Shows the drive date code |                |                  |
| Mode              | RFC-A                     |                |                  |
| Minimum           | 0                         | Maximum        | 65535            |
| Default           |                           | Units          |                  |
| Type              | 16 Bit Volatile           | Update Rate    | Background write |
| Display Format    | Standard                  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT, BU        |                |                  |

*Drive Date Code* (11.054) is a four-digit number in the form yyww where yy is the year and ww the week number.

| Parameter         | 11.055 Onboard User Program: Clock Task Scheduled Interval       |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the interval at which the clock task is scheduled in ms |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 262140           |
| Default           |  | Units          | ms               |
| Type              | 32 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*Onboard User Program: Clock Task Scheduled Interval* (11.055) shows the interval at which the clock task is scheduled to run at in ms.

| Parameter         | 11.056 <i>Option Slot Identifiers</i>                     |                |                               |
|-------------------|---|----------------|-------------------------------|
| Short description | Defines the order that option slots are used by the drive |                |                               |
| Mode              | RFC-A   |                |                               |
| Minimum           | 0   | Maximum        | 23                            |
| Default           | 0   | Units          |                               |
| Type              | 8 Bit Volatile  | Update Rate    | Power-up and drive reset read |
| Display Format    | Standard  | Decimal Places | 0                             |
| Coding            | RW, TE, PT  |                |                               |

| Value | Text |
|-------|------|
| 0     | 1234 |
| 1     | 1243 |
| 2     | 1324 |
| 3     | 1342 |
| 4     | 1423 |
| 5     | 1432 |
| 6     | 4123 |
| 7     | 3124 |
| 8     | 4132 |
| 9     | 2134 |
| 10    | 3142 |
| 11    | 2143 |
| 12    | 3412 |
| 13    | 4312 |
| 14    | 2413 |
| 15    | 4213 |
| 16    | 2314 |
| 17    | 3214 |
| 18    | 2341 |
| 19    | 2431 |
| 20    | 3241 |
| 21    | 3421 |
| 22    | 4231 |
| 23    | 4321 |

If *Option Slot Identifiers* (11.056) is set to its default value of 0 each option module is assigned the same slot number as its physical slot. For example the module in physical slot 1 appears in slot 1 to all drive and option module software systems (i.e. it uses Menu 15 as its set-up menu and Menu 25 as its application menu etc.). This arrangement can be changed by selecting a different value for *Option Slot Identifiers* (11.056). Although *Option Slot Identifiers* (11.056) is a volatile parameter its value is saved in non-volatile memory when parameters are saved. If *Option Slot Identifiers* (11.056) is changed the drive must be powered down and then powered up again for the change to take effect.

| Parameter         | 11.060 <i>Maximum Rated Current</i>                                   |                |                |
|-------------------|---|----------------|----------------|
| Short description | Displays the maximum rated current or normal duty rating of the drive |                |                |
| Mode              | RFC-A   |                |                |
| Minimum           | 0.000   | Maximum        | 99999.999      |
| Default           |   | Units          | A              |
| Type              | 32 Bit Volatile   | Update Rate    | Power-up write |
| Display Format    | Standard  | Decimal Places | 3              |
| Coding            | RO, ND, NC, PT  |                |                |

*Maximum Rated Current* (11.060) defines the variable maximum VM\_RATED\_CURRENT[MAX] which defines the maximum *Rated Current* (05.007). Therefore *Maximum Rated Current* (11.060) is the maximum rated current for normal duty operation (if normal duty operation is allowed).

| Parameter         | 11.061 <i>Full Scale Current Kc</i> |                |                |
|-------------------|-------------------------------------|----------------|----------------|
| Short description | Displays the full scale current Kc  |                |                |
| Mode              | RFC-A                               |                |                |
| Minimum           | 0.000                               | Maximum        | 99999.999      |
| Default           |                                     | Units          | A              |
| Type              | 32 Bit Volatile                     | Update Rate    | Power-up write |
| Display Format    | Standard                            | Decimal Places | 3              |
| Coding            | RO, ND, NC, PT                      |                |                |

*Full Scale Current Kc* (11.061) shows the full scale current in r.m.s. Amps. If the drive current exceeds this level it will cause an over current trip.

| Parameter         | 11.062 Power Board Software Version Number |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Power Board Software Version Number        |                |                  |
| Mode              | RFC-A                                      |                |                  |
| Minimum           | 0.00                                       | Maximum        | 99.99            |
| Default           |  | Units          |                  |
| Type              | 16 Bit Volatile                            | Update Rate    | Background Write |
| Display Format    | Standard                                   | Decimal Places | 2                |
| Coding            | RO, ND, NC, PT                             |                |                  |

*Power Board Software Version Number* (11.062) gives the version for the power board connected to the control board or the power board in node 1 of a multi-power module drive.

| Parameter         | 11.063 Product Type            |                |                |
|-------------------|--------------------------------|----------------|----------------|
| Short description | Displays the core product type |                |                |
| Mode              | RFC-A                          |                |                |
| Minimum           | 0                              | Maximum        | 255            |
| Default           |                                | Units          |                |
| Type              | 8 Bit Volatile                 | Update Rate    | Power-up write |
| Display Format    | Standard                       | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT, BU             |                |                |

*Product Type* (11.063) shows the core product type as given in the table below. The drive could be the basic product or a derivative of the basic product as defined by *Drive Derivative* (11.028).

| Product Type (11.063) | Core product range |
|-----------------------|--------------------|
| 0                     | Unidrive M         |

| Parameter         | 11.064 Product Identifier Characters       |                |                |
|-------------------|--|----------------|----------------|
| Short description | Displays the product identifier characters |                |                |
| Mode              | RFC-A                                      |                |                |
| Minimum           | 1295462450                                 | Maximum        | 2147483647     |
| Default           |  | Units          |                |
| Type              | 32 Bit Volatile                            | Update Rate    | Power-up write |
| Display Format    | String                                     | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT                             |                |                |

The drive model and rating can be identified as AAAA B nnnnnnnn CCCC DD EE FFF where each section of the model identifier is taken from a parameter. AAAA, B, CCCC, DDDD, EE and FFF are alpha-numeric characters. nnnnnnnn are decimal digits.

| Section of Identifier | Parameter  |
|-----------------------|--|
| AAAA                  | <i>Product Identifier Characters</i> (11.064)      |
| nnnnnnnn              | <i>Drive Rating And Configuration</i> (11.065)     |
| CCCC                  | <i>Additional Identifier Characters 1</i> (11.091) |
| DDEE                  | <i>Additional Identifier Characters 2</i> (11.092) |
| FFFB                  | <i>Additional Identifier Characters 3</i> (11.093) |

*Drive Rating And Configuration* (11.065) is split into a number of fields as defined in the table below.

| Digits  | Meaning  |
|---------|--|
| 7 and 6 | Frame size   |
| 5       | Voltage code (2 = 200V, 4 = 400V, 5 = 575V, 6 = 690V)  |
| 4 and 0 | Current rating multiplied by 10. If the drive has a heavy and normal duty rating (i.e. <i>Maximum Heavy Duty Rating</i> (11.032) > 0 and <i>Maximum Rated Current</i> (11.060) > <i>Maximum Heavy Duty Rating</i> (11.032)), or the drive only has a heavy duty rating (i.e. <i>Maximum Heavy Duty Rating</i> (11.032) = <i>Maximum Rated Current</i> (11.060)), then the current rating is derived from <i>Maximum Heavy Duty Rating</i> (11.032). Otherwise if the drive only has a normal duty rating (i.e. <i>Maximum Heavy Duty Rating</i> (11.032) = 0) then the current rating is derived from <i>Maximum Rated Current</i> (11.060). |

#### Example

The model number M700-03400078 A001 00 AB100 would be displayed in parameters as follows

| Parameter  | Value    |
|--|----------|
| <i>Product Identifier Characters</i> (11.064)      | M700     |
| <i>Drive Rating And Configuration</i> (11.065)     | 03400078 |
| <i>Additional Identifier Characters 1</i> (11.091) | A001     |
| <i>Additional Identifier Characters 2</i> (11.092) | 00AB     |
| <i>Additional Identifier Characters 3</i> (11.093) | 100-     |

| Parameter         | 11.065 Drive Rating And Configuration       |                |                                 |
|-------------------|---|----------------|---------------------------------|
| Short description | Displays the drive rating and configuration |                |                                 |
| Mode              | RFC-A                                       |                |                                 |
| Minimum           | 0<br>(Display: 00000000)                    | Maximum        | 99999999<br>(Display: 99999999) |
| Default           |   | Units          |                                 |
| Type              | 32 Bit Volatile                             | Update Rate    | Power-up write                  |
| Display Format    | Lead Zero Pad                               | Decimal Places | 0                               |
| Coding            | RO, ND, NC, PT                              |                |                                 |

See *Product Identifier Characters* (11.064).

| Parameter         | 11.066 Power Stage Identifier                         |                |                |
|-------------------|---|----------------|----------------|
| Short description | Displays the power stage identifiers within the drive |                |                |
| Mode              | RFC-A   |                |                |
| Minimum           | 0   | Maximum        | 255            |
| Default           |   | Units          |                |
| Type              | 8 Bit Volatile  | Update Rate    | Power-up write |
| Display Format    | Standard  | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT, BU                                    |                |                |

*Power Stage Identifier* (11.066) is used to show power stages that require changes to the drive user parameters (i.e. visibility, range or defaults). It should be noted that this parameter does not identify the rating of the power stage.

| Power Stage Identifier (11.066) | Power Stage                     |
|---------------------------------|---------------------------------|
| 0                               | Standard Unidrive M             |
| 1                               | Unidrive M with no braking IGBT |
| 2                               | Servo drive                     |

| Parameter         | 11.067 Control Board Identifier                         |                |                |
|-------------------|---|----------------|----------------|
| Short description | Displays the control board identifiers within the drive |                |                |
| Mode              | RFC-A   |                |                |
| Minimum           | 0.000   | Maximum        | 65.535         |
| Default           |   | Units          |                |
| Type              | 16 Bit Volatile   | Update Rate    | Power-up write |
| Display Format    | Standard  | Decimal Places | 3              |
| Coding            | RO, ND, NC, PT, BU                                      |                |                |

*Control Board Identifier* (11.067) identifies the control board hardware in the form A.BBB. BBB is the hardware identifier from the control board and A indicates whether this is a standard or high speed product as given in the table below.

| A | BBB        | Control Board           |
|---|------------|-------------------------|
| 0 | 002 or 003 | Unidrive M - Standard   |
| 1 | 002 or 003 | Unidrive M - High Speed |
| 0 | 004        | Servo                   |

| Parameter         | 11.068 Internal I/O Identifier                         |                |                |
|-------------------|--|----------------|----------------|
| Short description | Displays the internal I/O identifiers within the drive |                |                |
| Mode              | RFC-A  |                |                |
| Minimum           | 0  | Maximum        | 255            |
| Default           |  | Units          |                |
| Type              | 8 Bit Volatile   | Update Rate    | Power-up write |
| Display Format    | Standard   | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT, BU                                     |                |                |

*Internal I/O Identifier* (11.068) identifies the internally fitted I/O option as given in the table below.

| Internal I/O Identifier (11.068) | Internal I/O                                 |
|----------------------------------|--|
| 0                                | Analog and digital I/O                       |
| 1                                | Digital only I/O                             |
| 2                                | Analog and digital I/O with additional relay |
| 3                                | Servo drive I/O                              |

The tables below show which I/O functions are available for each of the internally fitted I/O options.

| AI/O              | 0                   | 1                   | 2                  | 3       |
|-------------------|---------------------|---------------------|--------------------|---------|
| Analogue Input 1  | All except Disable  |                     | All except Disable | Voltage |
| Analogue Input 2  | All except Disable  |                     | All except Disable |         |
| Analogue Input 3  | Voltage, Thermistor | Thermistor, Disable | Voltage            |         |
| Analogue Output 1 | Voltage             |                     | All                |         |
| Analogue Output 2 | Voltage             |                     | All                |         |

| D/I/O | Function                | 0                  | 1      | 2                  | 3      |
|-------|-------------------------|--------------------|--------|--------------------|--------|
| 1     | Input/Output            | Input/Output       | Output | Input/Output       | Output |
| 2     | Input/Output            | Input/Output       | Output | Input/Output       | Output |
| 3     | Input/Output            | Input/Output       |        | Input/Output       |        |
| 4     | Input                   | Input              | Input  | Input              | Input  |
| 5     | Input                   | Input              | Input  | Input              | Input  |
| 6     | Input                   | Input              |        | Input              |        |
| 7     | Relay Output            | Output             | Output | Output             |        |
| 8     | 24V Supply Output       | Output             | Output | Output             | Output |
| 9     | Safe Torque Off 1       | Input              | Input  | Input              | Input  |
| 10    | Safe Torque Off 2       | Input <sup>1</sup> | Input  | Input <sup>1</sup> | Input  |
| 11    | Keypad Run Button       | Input              | Input  | Input              |        |
| 12    | Keypad Auxiliary Button | Input              | Input  | Input              |        |
| 13    | 24V Supply Input        | Input              | Input  | Input              |        |
| 14    | Keypad Stop Button      | Input              | Input  | Input              |        |
| 15    | Relay 2 Output          |                    |        | Output             |        |
| 16    | Reset button            |                    |        |                    | Input  |

1 Only one hardware input is provided which is shared by STO1 and STO2.

| Parameter         | 11.069 Position Feedback Interface Identifier                        |                |                |
|-------------------|--|----------------|----------------|
| Short description | Displays the position feedback interface identifier within the drive |                |                |
| Mode              | RFC-A  |                |                |
| Minimum           | 0  | Maximum        | 255            |
| Default           |  | Units          |                |
| Type              | 8 Bit Volatile   | Update Rate    | Power-up write |
| Display Format    | Standard   | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT, BU   |                |                |

Position Feedback Interface Identifier (11.069) identifies the type of interface fitted in the position feedback interface option location as given in the table below.

| Position Feedback Interface Identifier (11.069) | Position feedback interface |
|---|-----------------------------|
| 0   | Standard Position Feedback  |
| 1   | None                        |
| 2   | User Comms Module           |

| Parameter         | 11.070 Core Parameter Database Version                        |                |                |
|-------------------|---|----------------|----------------|
| Short description | Displays the core parameter database version within the drive |                |                |
| Mode              | RFC-A   |                |                |
| Minimum           | 0.00  | Maximum        | 99.99          |
| Default           |   | Units          |                |
| Type              | 16 Bit Volatile   | Update Rate    | Power-up write |
| Display Format    | Standard  | Decimal Places | 2              |
| Coding            | RO, ND, NC, PT  |                |                |

Core Parameter Database Version (11.070) gives the version number of the parameter database used to define the core parameter menus in the drive (Menu 1 to 14 and 21 to 23) in 2 digit BCD format. All other menus are customisable and if these menus are changed their default values are automatically loaded. However, if the drive software is changed it may be necessary to load defaults for all menus, although this will only be required rarely. Defaults for all menus are loaded when the most significant digit of Core Parameter Database Version (11.070) changes. Therefore if the drive firmware is modified and the most significant digit of the core database version has changed an EEPROM Fail.001 trip is initiated and default parameters are loaded.



| Parameter         | 11.071 Number Of Power Modules Detected                    |                |                                 |
|-------------------|--|----------------|---------------------------------|
| Short description | Displays the number of power modules detected in the drive |                |                                 |
| Mode              | RFC-A  |                |                                 |
| Minimum           | 0  | Maximum        | 20                              |
| Default           |  | Units          |                                 |
| Type              | 8 Bit User Save  | Update Rate    | Write on power system detection |
| Display Format    | Standard   | Decimal Places | 0                               |
| Coding            | RO, ND, NC, PT   |                |                                 |

*Number Of Power Modules Detected* (11.071) shows the number of power modules detected in a drive. See *Number Of Power Modules Test* (11.035) for details.

| Parameter         | 11.072 NV Media Card Create Special File                               |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines if a parameter file is created as a macro file during transfer |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit Volatile   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, NC   |                |                 |

If *NV Media Card Create Special File* (11.072) = 1 when a parameter file is transferred to an NV media card the file is created as a macro file. *NV Media Card Create Special File* (11.072) is reset to 0 after the file is created or the transfer fails.

| Parameter         | 11.073 NV Media Card Type                               |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the type of the currently fitted NV media card |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 2                |
| Default           |   | Units          |                  |
| Type              | 8 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT                                      |                |                  |

| Value | Text       | Description                               |
|-------|------------|---|
| 0     | None       | No media card has been inserted           |
| 1     | SMART Card | A SMART Card has been inserted            |
| 2     | SD Card    | A FAT formatted SD card has been inserted |

*NV Media Card File Type* (11.038) shows the type of non-volatile media card inserted in the drive.

| Parameter         | 11.075 NV Media Card Read-only Flag                                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the state of the read-only flag for the currently fitted card |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

*NV Media Card Read-only Flag* (11.075) shows the state of the read-only flag for the currently fitted card.

| Parameter         | 11.076 NV Media Card Warning Suppression Flag                        |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Displays the state of the warning flag for the currently fitted card |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard   | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT   |                |                  |

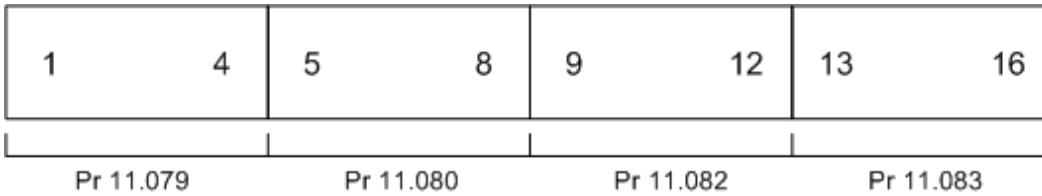
*NV Media Card Warning Suppression Flag* (11.076) shows the state of the warning flag for the currently fitted card.

| Parameter         | 11.077 NV Media Card File Required Version                                    |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the version number for a file when it is created on an NV media card |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 9999             |
| Default           |   | Units          |                  |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RW, ND, NC, PT  |                |                  |

The value of *NV Media Card File Required Version* (11.077) is used as the version number for a file when it is created on an NV media card. *NV Media Card File Required Version* (11.077) is reset to 0 when the file is created or the transfer fails.

| Parameter         | 11.079 Drive Name Characters 1-4   |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines characters 1-4 of a string which can be used to identify the drive |                |            |
| Mode              | RFC-A  |                |            |
| Minimum           | -2147483648  | Maximum        | 2147483647 |
| Default           | 0  | Units          |            |
| Type              | 32 Bit User Save   | Update Rate    | N/A        |
| Display Format    | String   | Decimal Places | 0          |
| Coding            | RW, PT   |                |            |

*Drive Name Characters 1-4* (11.079) to *Drive Name Characters 13-16* (11.082) can be used to store a 16 character string which can be used to identify the drive. The string is arranged as shown below.



This uses the standard ASCII character set.

| Parameter         | 11.080 Drive Name Characters 5-8   |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines characters 5-8 of a string which can be used to identify the drive |                |            |
| Mode              | RFC-A  |                |            |
| Minimum           | -2147483648  | Maximum        | 2147483647 |
| Default           | 0  | Units          |            |
| Type              | 32 Bit User Save   | Update Rate    | N/A        |
| Display Format    | String   | Decimal Places | 0          |
| Coding            | RW, PT   |                |            |

See *Drive Name Characters 1-4* (11.079).

| Parameter         | 11.081 Drive Name Characters 9-12   |                |            |
|-------------------|---|----------------|------------|
| Short description | Defines characters 9-12 of a string which can be used to identify the drive |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit User Save  | Update Rate    | N/A        |
| Display Format    | String  | Decimal Places | 0          |
| Coding            | RW, PT  |                |            |

See *Drive Name Characters 1-4* (11.079).

| Parameter         | 11.082 Drive Name Characters 13-16   |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines characters 13-16 of a string which can be used to identify the drive |                |            |
| Mode              | RFC-A  |                |            |
| Minimum           | -2147483648  | Maximum        | 2147483647 |
| Default           | 0  | Units          |            |
| Type              | 32 Bit User Save   | Update Rate    | N/A        |
| Display Format    | String   | Decimal Places | 0          |
| Coding            | RW, PT   |                |            |

See *Drive Name Characters 1-4* (11.079).

| Parameter         | 11.084 Drive Mode                           |                |                       |
|-------------------|---|----------------|-----------------------|
| Short description | Defines and displays the current drive mode |                |                       |
| Mode              | RFC-A                                       |                |                       |
| Minimum           | 1   | Maximum        | 4                     |
| Default           |   | Units          |                       |
| Type              | 8 Bit User Save                             | Update Rate    | Background read/write |
| Display Format    | Standard                                    | Decimal Places | 0                     |
| Coding            | RO, TE, ND, NC, PT                          |                |                       |

| Value | Text      |
|-------|-----------|
| 1     | Open-loop |
| 2     | RFC-A     |
| 3     | RFC-S     |
| 4     | Regen     |

*Drive Mode* (11.084) is used to hold the currently active drive mode.

| Parameter         | 11.085 Security Status                        |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the security status within the drive |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 3                |
| Default           |   | Units          |                  |
| Type              | 8 Bit Power Down Save                         | Update Rate    | Background write |
| Display Format    | Standard                                      | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT                            |                |                  |

| Value | Text        |
|-------|-------------|
| 0     | None        |
| 1     | Read-only   |
| 2     | Status-only |
| 3     | No Access   |

*Security Status* (11.085) shows the security that will apply when security is enabled by setting a non-zero value for *User Security Code* (11.030).

| Parameter         | 11.086 Menu Access Status                                   |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the amount of access of the menus within the drive |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 8 Bit Power Down Save                                       | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT  |                |                  |

| Value | Text      |
|-------|-----------|
| 0     | Menu 0    |
| 1     | All Menus |

If *Menu Access Status* (11.086) = 0 then only Menu 0 can be accessed with a keypad. If *Menu Access Status* (11.086) = 1 then all menus can be accessed with a keypad.

| Parameter         | 11.090 Keypad Port Serial Address                                   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the node address for the keypad port serial comms interface |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 1   | Maximum        | 16              |
| Default           | 1   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

*Keypad Port Serial Address* (11.090) defines the node address for the keypad port serial comms interface. Normally the default value of 1 is used, but this can be changed if required. The keypad attached to the port will sense the address automatically.

| Parameter         | 11.091 Additional Identifier Characters 1     |                |                |
|-------------------|---|----------------|----------------|
| Short description | Displays the additional identifier characters |                |                |
| Mode              | RFC-A   |                |                |
| Minimum           | -2147483648                                   | Maximum        | 2147483647     |
| Default           |   | Units          |                |
| Type              | 32 Bit Volatile                               | Update Rate    | Power-up write |
| Display Format    | String  | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT                                |                |                |

See *Product Identifier Characters* (11.064).

| Parameter         | 11.092 Additional Identifier Characters 2     |                |                |
|-------------------|---|----------------|----------------|
| Short description | Displays the additional identifier characters |                |                |
| Mode              | RFC-A   |                |                |
| Minimum           | -2147483648                                   | Maximum        | 2147483647     |
| Default           |   | Units          |                |
| Type              | 32 Bit Volatile                               | Update Rate    | Power-up write |
| Display Format    | String  | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT                                |                |                |

See *Product Identifier Characters* (11.064).

| Parameter         | 11.093 Additional Identifier Characters 3     |                |                |
|-------------------|---|----------------|----------------|
| Short description | Displays the additional identifier characters |                |                |
| Mode              | RFC-A   |                |                |
| Minimum           | -2147483648                                   | Maximum        | 2147483647     |
| Default           |   | Units          |                |
| Type              | 32 Bit Volatile                               | Update Rate    | Power-up write |
| Display Format    | String  | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT                                |                |                |

See *Product Identifier Characters* (11.064).

| Parameter         | 11.095 Number Of Rectifiers Detected |                |                  |
|-------------------|--------------------------------------|----------------|------------------|
| Short description | Number Of Rectifiers Detected        |                |                  |
| Mode              | RFC-A                                |                |                  |
| Minimum           | 0                                    | Maximum        | 9                |
| Default           |                                      | Units          |                  |
| Type              | 8 Bit Volatile                       | Update Rate    | Background Write |
| Display Format    | Standard                             | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                       |                |                  |

Indicates how many controlled rectifiers connected to the drive have been detected. See *Number Of Rectifiers Expected* (11.096).

| Parameter         | 11.096 Number Of Rectifiers Expected              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Number of rectifiers expected on each power stage |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 9               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                                   | Update Rate    | Background Read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

*Number Of Rectifiers Expected* (11.096) defines how many controlled rectifiers are expected on each power module. Within a complete drive with a diode input stage there are no controlled rectifiers. Within a complete drive with a controlled rectifier input stage there is one controlled rectifier. For a drive where external rectifiers are used the system can register up to nine controlled rectifiers. If *Number Of Rectifiers Expected* (11.096) = 0 then the rectifier monitoring system is disabled and the drive does not check how many controlled rectifiers are present. This is the default setting and should be used for complete drives with internal rectifiers because the monitoring function is not necessary. If *Number Of Rectifiers Expected* (11.096) is set to a non-zero value a check is made to ensure that at least this number of external rectifiers are connected to each power module. If there are less external rectifiers than defined by *Number Of Rectifiers Expected* (11.096) then a *Configuration* is initiated with the sub-trip indicating how many rectifiers should be present. See *Trip 0* (10.020).

# Menu 12 Single Line Descriptions – User Functions 2 and Brake Control

Mode: RFC-A

| Parameter |   | Range  | Default     | Type |     |    |    |    |    |
|-----------|---|--|-------------|------|-----|----|----|----|----|
| 12.001    | Threshold Detector 1 Output                                 | Off (0) or On (1)  |             | RO   | Bit | ND | NC | PT |    |
| 12.002    | Threshold Detector 2 Output                                 | Off (0) or On (1)  |             | RO   | Bit | ND | NC | PT |    |
| 12.003    | Threshold Detector 1 Source                                 | 0.000 to 59.999  | 0.000       | RW   | Num |    |    | PT | US |
| 12.004    | Threshold Detector 1 Level                                  | 0.00 to 100.00 %   | 0.00 %      | RW   | Num |    |    |    | US |
| 12.005    | Threshold Detector 1 Hysteresis                             | 0.00 to 25.00 %  | 0.00 %      | RW   | Num |    |    |    | US |
| 12.006    | Threshold Detector 1 Output Invert                          | Off (0) or On (1)  | Off (0)     | RW   | Bit |    |    |    | US |
| 12.007    | Threshold Detector 1 Destination                            | 0.000 to 59.999  | 0.000       | RW   | Num | DE |    | PT | US |
| 12.008    | Variable Selector 1 Source 1                                | 0.000 to 59.999  | 0.000       | RW   | Num |    |    | PT | US |
| 12.009    | Variable Selector 1 Source 2                                | 0.000 to 59.999  | 0.000       | RW   | Num |    |    | PT | US |
| 12.010    | Variable Selector 1 Mode                                    | Input 1 (0), Input 2 (1), Add (2), Subtract (3), Multiply (4), Divide (5), Time Const (6), Ramp (7), Modulus (8), Powers (9), Sectional (10) | Input 1 (0) | RW   | Txt |    |    |    | US |
| 12.011    | Variable Selector 1 Destination                             | 0.000 to 59.999  | 0.000       | RW   | Num | DE |    | PT | US |
| 12.012    | Variable Selector 1 Output                                  | ±100.00 %  |             | RO   | Num | ND | NC | PT |    |
| 12.013    | Variable Selector 1 Source 1 Scaling                        | ±4.000   | 1.000       | RW   | Num |    |    |    | US |
| 12.014    | Variable Selector 1 Source 2 Scaling                        | ±4.000   | 1.000       | RW   | Num |    |    |    | US |
| 12.015    | Variable Selector 1 Control                                 | 0.00 to 100.00   | 0.00        | RW   | Num |    |    |    | US |
| 12.016    | Variable Selector 1 Enable                                  | Off (0) or On (1)  | On (1)      | RW   | Bit |    |    |    | US |
| 12.023    | Threshold Detector 2 Source                                 | 0.000 to 59.999  | 0.000       | RW   | Num |    |    | PT | US |
| 12.024    | Threshold Detector 2 Level                                  | 0.00 to 100.00 %   | 0.00 %      | RW   | Num |    |    |    | US |
| 12.025    | Threshold Detector 2 Hysteresis                             | 0.00 to 25.00 %  | 0.00 %      | RW   | Num |    |    |    | US |
| 12.026    | Threshold Detector 2 Output Invert                          | Off (0) or On (1)  | Off (0)     | RW   | Bit |    |    |    | US |
| 12.027    | Threshold Detector 2 Destination                            | 0.000 to 59.999  | 0.000       | RW   | Num | DE |    | PT | US |
| 12.028    | Variable Selector 2 Source 1                                | 0.000 to 59.999  | 0.000       | RW   | Num |    |    | PT | US |
| 12.029    | Variable Selector 2 Source 2                                | 0.000 to 59.999  | 0.000       | RW   | Num |    |    | PT | US |
| 12.030    | Variable Selector 2 Mode                                    | Input 1 (0), Input 2 (1), Add (2), Subtract (3), Multiply (4), Divide (5), Time Const (6), Ramp (7), Modulus (8), Powers (9), Sectional (10) | Input 1 (0) | RW   | Txt |    |    |    | US |
| 12.031    | Variable Selector 2 Destination                             | 0.000 to 59.999  | 0.000       | RW   | Num | DE |    | PT | US |
| 12.032    | Variable Selector 2 Output                                  | ±100.00 %  |             | RO   | Num | ND | NC | PT |    |
| 12.033    | Variable Selector 2 Source 1 Scaling                        | ±4.000   | 1.000       | RW   | Num |    |    |    | US |
| 12.034    | Variable Selector 2 Source 2 Scaling                        | ±4.000   | 1.000       | RW   | Num |    |    |    | US |
| 12.035    | Variable Selector 2 Control                                 | 0.00 to 100.00   | 0.00        | RW   | Num |    |    |    | US |
| 12.036    | Variable Selector 2 Enable                                  | Off (0) or On (1)  | On (1)      | RW   | Bit |    |    |    | US |
| 12.040    | Brake Control: Brake Release                                | Off (0) or On (1)  |             | RO   | Bit | ND | NC | PT |    |
| 12.041    | Brake Control: Enable                                       | Off (0) or On (1)  | Off (0)     | RW   | Bit |    |    |    | US |
| 12.043    | Brake Control: Lower Current Threshold                      | 0 to 200 %   | 10 %        | RW   | Num |    |    |    | US |
| 12.044    | Brake Control: Brake Release Speed                          | 0 to 200   | 10          | RW   | Num |    |    |    | US |
| 12.045    | Brake Control: Brake Apply Speed                            | 0 to 200   | 5           | RW   | Num |    |    |    | US |
| 12.046    | Brake Control: Brake Delay                                  | 0.0 to 25.0 s  | 1.0 s       | RW   | Num |    |    |    | US |
| 12.047    | Brake Control: Post-brake Release Delay                     | 0.0 to 25.0 s  | 1.0 s       | RW   | Num |    |    |    | US |
| 12.048    | Brake Control: Brake Apply Delay                            | 0.0 to 25.0 s  | 1.0 s       | RW   | Num |    |    |    | US |
| 12.049    | Brake Control: Enable Position Control During Brake Release | Off (0) or On (1)  | Off (0)     | RW   | Bit |    |    |    | US |
| 12.050    | Brake Control: Initial Direction                            | Ref (0), Forward (1), Reverse (2)  | Ref (0)     | RW   | Txt |    |    |    | US |
| 12.051    | Brake Control: Brake Apply Through Zero Threshold           | 0 to 200   | 5           | RW   | Num |    |    |    | US |
| 12.052    | Brake Control: Mode   | Off (0) or On (1)  | Off (0)     | RW   | Bit |    |    |    | US |
| 12.054    | External Brake Released Indicator                           | Off (0) or On (1)  | Off (0)     | RW   | Bit |    | NC |    |    |
| 12.055    | Brake Release Source  | Off (0) or On (1)  | Off (0)     | RW   | Bit |    |    |    | US |

|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| Fl  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 12 – User Functions 2 and Brake Control

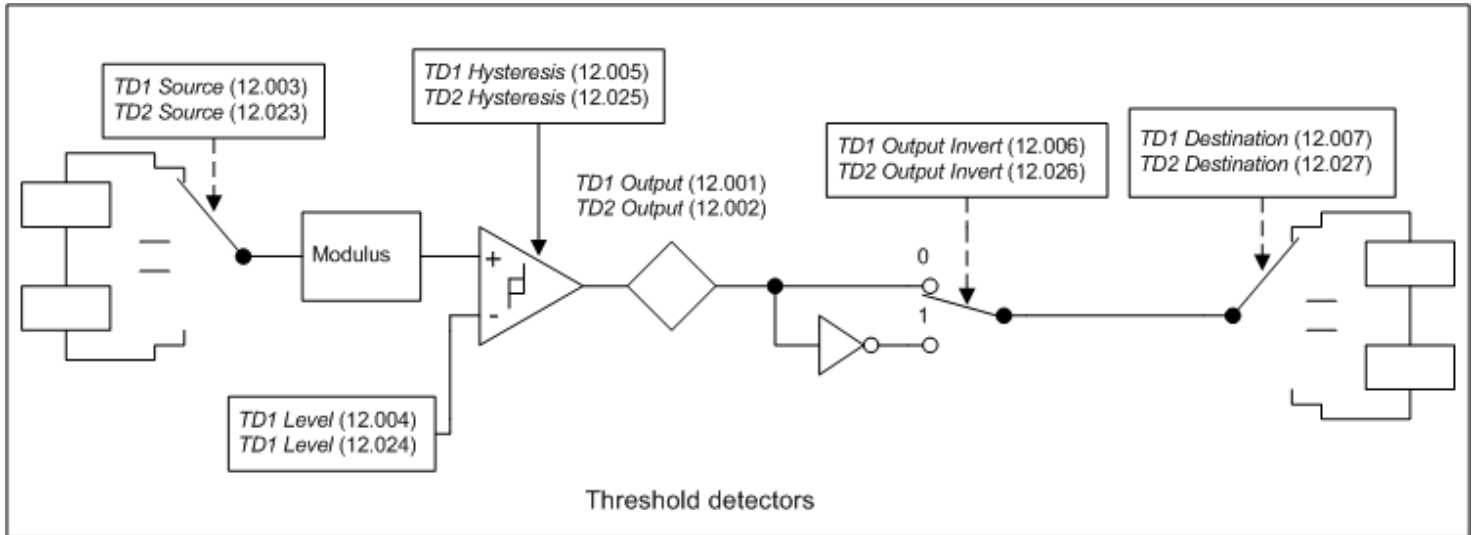
Mode: RFC-A

Menu 12 provides parameters for the following features:

1. Threshold detectors
2. Variable selectors
3. Mechanical brake controller

| Parameter         | 12.001 Threshold Detector 1 Output          |                |           |
|-------------------|---|----------------|-----------|
| Short description | Displays the output of threshold detector 1 |                |           |
| Mode              | RFC-A                                       |                |           |
| Minimum           | 0   | Maximum        | 1         |
| Default           |   | Units          |           |
| Type              | 1 Bit Volatile                              | Update Rate    | 4ms write |
| Display Format    | Standard                                    | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                              |                |           |

The threshold detector functions are always active even if the source and destination are not routed to valid parameters. If the source is not a valid parameter then the source value is taken as 0. The update rate for each of the threshold detector functions is always 4ms.



The following description is for threshold detector 1, but threshold detector 2 operates in the same way. The level of the parameter defined by *Threshold Detector 1 Source* (12.003) is converted to a percentage and compared to *Threshold Detector 1 Level* (12.004) with hysteresis to give *Threshold Detector 1 Output* (12.001) as follows:

| Source                   | Threshold Detector 1 Output (12.001) |
|--------------------------|--------------------------------------|
| Source                   | 0                                    |
| Lower threshold ≤ Source | No change of state                   |
| Source ≥ Upper threshold | 1                                    |

Lower threshold = *Threshold Detector 1 Level* (12.004) - *Threshold Detector 1 Hysteresis* (12.005)  
 Upper threshold = *Threshold Detector 1 Level* (12.004) + *Threshold Detector 1 Hysteresis* (12.005)

The output value can then be inverted with *Threshold Detector 1 Output Invert* (12.006) before being routed to the destination defined by *Threshold Detector 1 Destination* (12.007).

| Parameter         | 12.002 Threshold Detector 2 Output          |                |           |
|-------------------|---|----------------|-----------|
| Short description | Displays the output of threshold detector 1 |                |           |
| Mode              | RFC-A                                       |                |           |
| Minimum           | 0   | Maximum        | 1         |
| Default           |   | Units          |           |
| Type              | 1 Bit Volatile                              | Update Rate    | 4ms write |
| Display Format    | Standard                                    | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                              |                |           |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.003 <i>Threshold Detector 1 Source</i>             |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the source parameter for threshold detector 1 |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.000   | Maximum        | 59.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save                                      | Update Rate    | Drive reset read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, PT, BU  |                |                  |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.004 <i>Threshold Detector 1 Level</i>             |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the reference level for threshold detector 1 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0.00   | Maximum        | 100.00   |
| Default           | 0.00   | Units          | %        |
| Type              | 16 Bit User Save                                     | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 2        |
| Coding            | RW   |                |          |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.005 <i>Threshold Detector 1 Hysteresis</i>   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the hysteresis for threshold detector 1 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0.00  | Maximum        | 25.00    |
| Default           | 0.00  | Units          | %        |
| Type              | 16 Bit User Save                                | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 2        |
| Coding            | RW  |                |          |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.006 <i>Threshold Detector 1 Output Invert</i>      |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to 1 to invert the output of threshold detector 1 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit User Save                                       | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW  |                |          |

See *Threshold Detector 1 Output* (12.001).

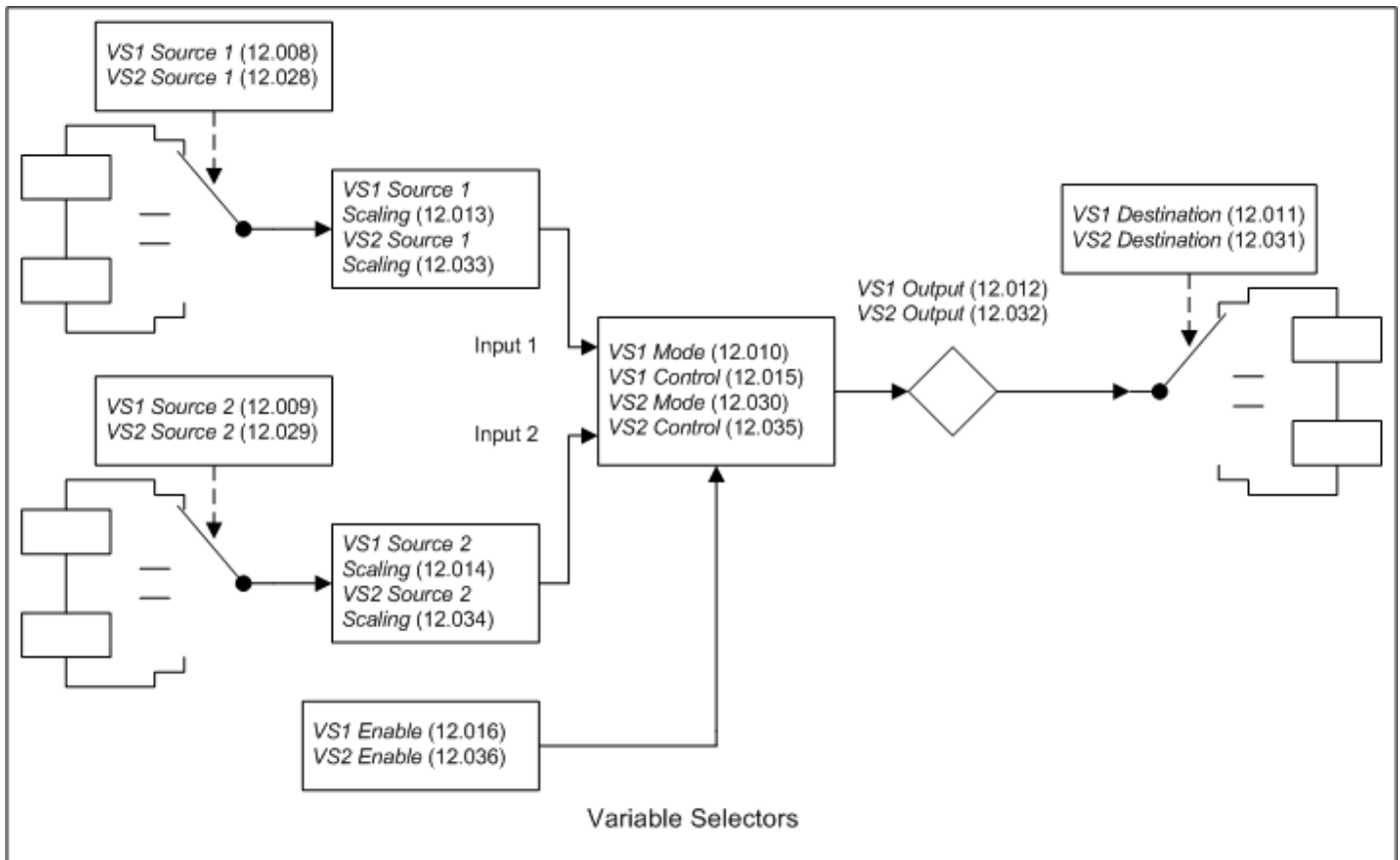
| Parameter         | 12.007 <i>Threshold Detector 1 Destination</i>             |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the destination parameter for threshold detector 1 |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU   |                |                  |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.008 <i>Variable Selector 1 Source 1</i>               |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the 1st source parameter for variable selector 1 |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, PT, BU   |                |                  |

The variable selector functions are always active even if the source and destination are not routed to valid parameters. If a source is not a valid parameter then the source value is taken as 0. The update rate for each of the variable selector functions is always 4ms.





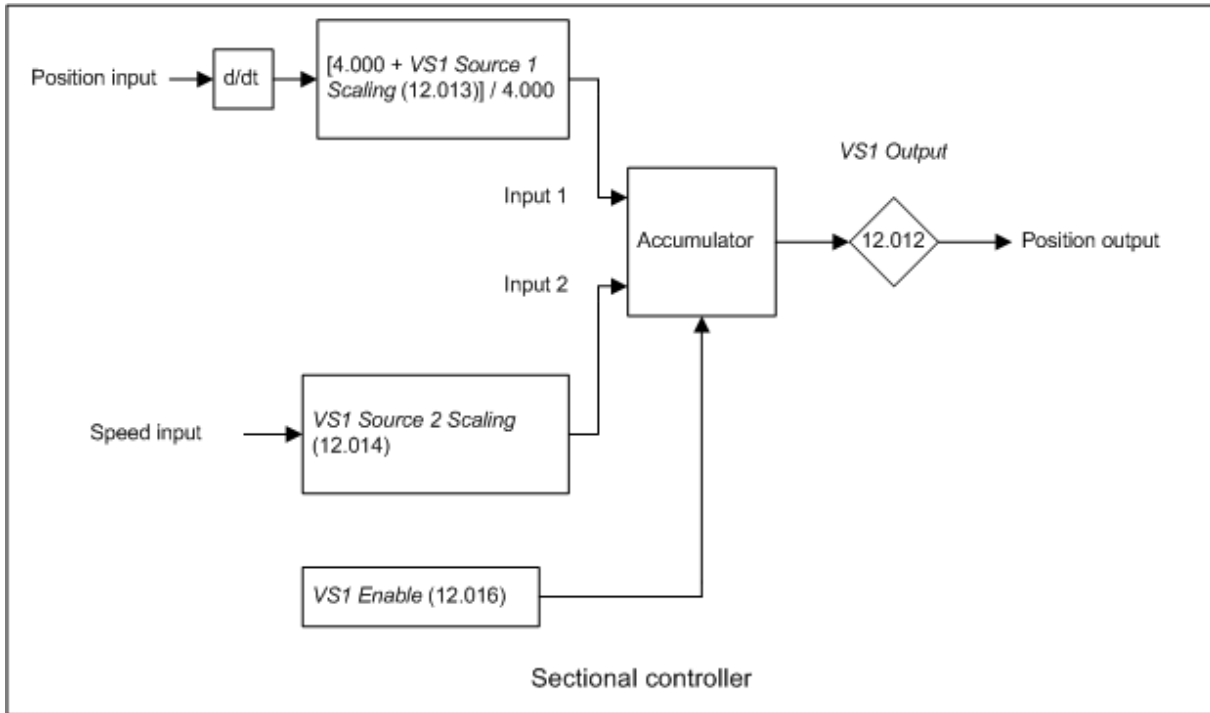
The following description is for variable selector 1, but variable selector 2 operates in the same way. The source parameters selected with *Variable Selector 1 Source 1* (12.008) and *Variable Selector 1 Source 2* (12.009) are converted to a percentage value, scaled with *Variable Selector 1 Source 1 Scaling* (12.013) and *Variable Selector 1 Source 2 Scaling* (12.014) respectively and then combined with a function defined by *Variable Selector 1 Mode* (12.010) to give *Variable Selector 1 Output* (12.012) as a percentage value. If *Variable Selector 1 Enable* (12.016) = 1 then the function operates normally. If *Variable Selector 1 Enable* (12.016) = 0 then *Variable Selector 1 Output* (12.012) = 0.00% and any states within the function are reset (i.e. the time constant function accumulator is held at zero). If the value of *Variable Selector 1 Mode* (12.010) is changed then all internal function state are also reset.

The table below shows the functions that can be selected with *Variable Selector 1 Mode* (12.010).

| <b>Variable Selector 1 Mode (12.010)</b> | <b>Variable Selector 1 Output (12.012)</b>  |
|--|---|
| 0: Input 1                               | Input 1   |
| 1: Input 2                               | Input 2   |
| 2: Add                                   | Input 1 + Input 2   |
| 3: Subtract                              | Input 1 - Input 2   |
| 4: Multiply                              | (Input 1 x Input 2) / 100.00%   |
| 5: Divide                                | (Input 1 x 100.00%) / Input 2   |
| 6: Time Const                            | Input 1 / (1 + τs) where τ = <i>Variable Selector 1 Control</i> (12.015) seconds  |
| 7: Ramp                                  | Input 1 as an input to a linear ramp function where the time to ramp from 0.00% to 100.00% is defined by <i>Variable Selector 1 Control</i> (12.015) seconds  |
| 8: Modulus                               | Input1  |
| 9: Powers                                | If <i>Variable Selector 1 Control</i> (12.015) = 0.02 then Input <sup>2</sup> / 100.00%<br>Else if <i>Variable Selector 1 Control</i> (12.015) = 0.03 then Input <sup>3</sup> / 100.00%<br>Else Input 1 |
| 10: Sectional                            | See description below   |

### Sectional Controller

If *Variable Selector 1 Mode* (12.010) = 10 then the variable selector can be used to provide a sectional control function. (Variable selector 2 operates in the same way.) The sectional control function is intended to apply scaling and a speed offset to a 16 bit position value to generate a new 16 bit position value. The output can be used as an input to the Standard motion controller (Menu 13) and to generate an encoder simulation output (Menu 3).



The position input is selected with *Variable Selector 1 Source 1* (12.008) and can be derived from any parameter. However, it is intended to be used with a position value that has a range from 0 to 65535 (e.g. *P1 Position* (03.029)). The input is scaled so that as *Variable Selector 1 Source 1 Scaling* (12.013) is changed between -4.000 and 4.000 so the proportion of the input position change added to the accumulator varies from 0.000 to 2.000 (i.e. the change of position input value is added without scaling if *Variable Selector 1 Source 1 Scaling* (12.013) = 0.000). The remainder from the scaling division is stored and then added at the next sample to maintain an exact ratio between the position input and the position output, provided the speed from source 2 is zero. The controller only takes the change of position from the input source parameter, and not the absolute value, so that when the controller is first made active the output does not jump to the source position, but only moves with any changes of source position after that point in time.

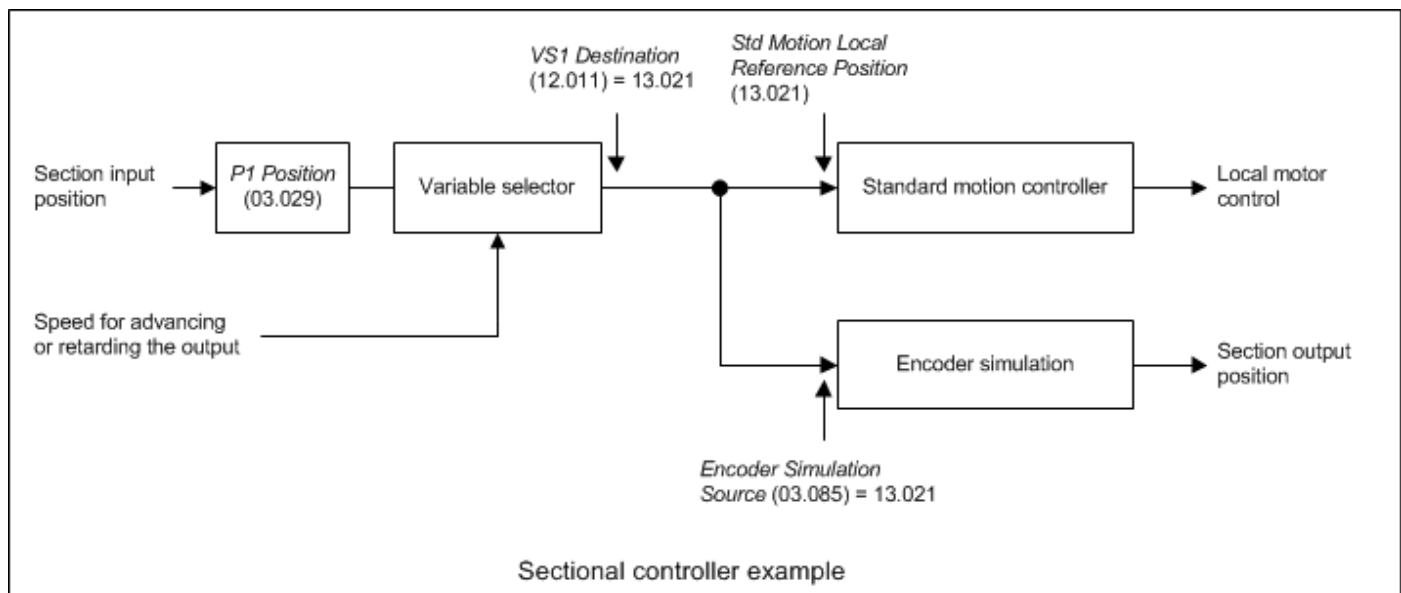
Although the sectional controller is intended to use a source parameter with a range from 0 to 65535, it is possible to use parameters with a different range provided the maximum is a power of two minus 1, i.e.  $2^{31} - 1$ . It should be noted that the change of position is scaled based on the maximum of the parameter, and so a signed position value such as *P1 Normalised Position* (03.058) which has a maximum that corresponds to half its range will give twice the change of position when compared to *P1 Position* (03.029). To counteract this effect the scaling applied to the change of position in the sectional controller should be set to 0.5.

The range of *Variable Selector 1 Output* (12.012) is 0.00% and 100.00%. Unlike other functions the value is not simply limited, but rolls under or over respectively. Although the output destination can be any parameter it is intended to be used with a position value that has a range from 0 to 65535.

The speed input defines a speed offset with a resolution of 0.1rpm. Full scale of the source parameter corresponds to 1000.0rpm. Scaling may be applied using *Variable Selector 1 Source 2 Scaling* (12.014) to give a full scale value up to 4000.0rpm. The speed input is added to the accumulator to move the output position forwards or backwards with respect to the position input.

The sample time for the variable selector is 4ms and the input or output position must not change by more than half a revolution over this time. Therefore the input or output speed must not exceed 7500rpm.

The diagram below shows an example of how the sectional controller function could be configured. The section input position is provided from the previous section via the P1 position feedback interface. The destination of the variable selector is the *Standard Motion Local Reference Position* (13.021) in the standard motion controller which is used to provide the speed reference and to control the local motor attached to the drive. The encoder simulation system is used to generate the section output to be fed into the next drive. The source for the encoder simulation is *Standard Motion Local Reference Position* (13.021).



| Parameter         | 12.009 Variable Selector 1 Source 2                      |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the 2nd source parameter for variable selector 1 |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, PT, BU   |                |                  |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.010 Variable Selector 1 Mode          |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the mode for variable selector 1 |                |                 |
| Mode              | RFC-A                                    |                |                 |
| Minimum           | 0  | Maximum        | 10              |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                          | Update Rate    | Background read |
| Display Format    | Standard                                 | Decimal Places | 0               |
| Coding            | RW, TE                                   |                |                 |

| Value | Text       |
|-------|------------|
| 0     | Input 1    |
| 1     | Input 2    |
| 2     | Add        |
| 3     | Subtract   |
| 4     | Multiply   |
| 5     | Divide     |
| 6     | Time Const |
| 7     | Ramp       |
| 8     | Modulus    |
| 9     | Powers     |
| 10    | Sectional  |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.011 Variable Selector 1 Destination                    |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the destination parameter for variable selector 1 |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.000   | Maximum        | 59.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save  | Update Rate    | Drive reset read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU  |                |                  |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.012 Variable Selector 1 Output          |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the output of variable selector 1 |                |           |
| Mode              | RFC-A                                      |                |           |
| Minimum           | -100.00                                    | Maximum        | 100.00    |
| Default           |  | Units          | %         |
| Type              | 16 Bit Volatile                            | Update Rate    | 4ms write |
| Display Format    | Standard                                   | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT                             |                |           |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.013 Variable Selector 1 Source 1 Scaling                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling for the 1st input for variable selector 1 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | -4.000  | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.014 Variable Selector 1 Source 2 Scaling                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling for the 2nd input for variable selector 1 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | -4.000  | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.015 Variable Selector 1 Control          |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the control for variable selector 1 |                |          |
| Mode              | RFC-A                                       |                |          |
| Minimum           | 0.00  | Maximum        | 100.00   |
| Default           | 0.00  | Units          |          |
| Type              | 16 Bit User Save                            | Update Rate    | 4ms read |
| Display Format    | Standard                                    | Decimal Places | 2        |
| Coding            | RW  |                |          |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.016 Variable Selector 1 Enable |                |          |
|-------------------|-----------------------------------|----------------|----------|
| Short description | Enables variable selector 1       |                |          |
| Mode              | RFC-A                             |                |          |
| Minimum           | 0                                 | Maximum        | 1        |
| Default           | 1                                 | Units          |          |
| Type              | 1 Bit User Save                   | Update Rate    | 4ms read |
| Display Format    | Standard                          | Decimal Places | 0        |
| Coding            | RW, BU                            |                |          |

See *Variable Selector 1 Source 1* (12.008) for more details.

*Variable Selector 1 Enable* (12.016) and *Variable Selector 2 Enable* (12.036) have a default of 1 so that if these parameters are not used the variable selectors will still function.

| Parameter         | 12.023 Threshold Detector 2 Source                    |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the source parameter for threshold detector 2 |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.000   | Maximum        | 59.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save                                      | Update Rate    | Drive reset read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, PT, BU  |                |                  |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.024 Threshold Detector 2 Level                    |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the reference level for threshold detector 2 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0.00   | Maximum        | 100.00   |
| Default           | 0.00   | Units          | %        |
| Type              | 16 Bit User Save                                     | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 2        |
| Coding            | RW   |                |          |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.025 Threshold Detector 2 Hysteresis          |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the hysteresis for threshold detector 2 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0.00  | Maximum        | 25.00    |
| Default           | 0.00  | Units          | %        |
| Type              | 16 Bit User Save                                | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 2        |
| Coding            | RW  |                |          |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.026 Threshold Detector 2 Output Invert             |                |          |
|-------------------|---|----------------|----------|
| Short description | Set to 1 to invert the output of threshold detector 2 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit User Save                                       | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW  |                |          |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.027 Threshold Detector 2 Destination                    |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the destination parameter for threshold detector 2 |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU   |                |                  |

See *Threshold Detector 1 Output* (12.001).

| Parameter         | 12.028 Variable Selector 2 Source 1                      |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the 1st source parameter for variable selector 2 |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, PT, BU   |                |                  |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.029 Variable Selector 2 Source 2                      |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the 2nd source parameter for variable selector 2 |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, PT, BU   |                |                  |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.030 Variable Selector 2 Mode          |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the mode for variable selector 2 |                |                 |
| Mode              | RFC-A                                    |                |                 |
| Minimum           | 0  | Maximum        | 10              |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                          | Update Rate    | Background read |
| Display Format    | Standard                                 | Decimal Places | 0               |
| Coding            | RW, TE                                   |                |                 |

| Value | Text       |
|-------|------------|
| 0     | Input 1    |
| 1     | Input 2    |
| 2     | Add        |
| 3     | Subtract   |
| 4     | Multiply   |
| 5     | Divide     |
| 6     | Time Const |
| 7     | Ramp       |
| 8     | Modulus    |
| 9     | Powers     |
| 10    | Sectional  |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.031 Variable Selector 2 Destination                    |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the destination parameter for variable selector 2 |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.000   | Maximum        | 59.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save  | Update Rate    | Drive reset read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU  |                |                  |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.032 Variable Selector 2 Output          |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the output of variable selector 2 |                |           |
| Mode              | RFC-A                                      |                |           |
| Minimum           | -100.00                                    | Maximum        | 100.00    |
| Default           |  | Units          | %         |
| Type              | 16 Bit Volatile                            | Update Rate    | 4ms write |
| Display Format    | Standard                                   | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT                             |                |           |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.033 Variable Selector 2 Source 1 Scaling                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling for the 1st input for variable selector 2 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | -4.000  | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.034 Variable Selector 2 Source 2 Scaling                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling for the 2nd input for variable selector 2 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | -4.000  | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

| Parameter         | 12.035 Variable Selector 2 Control          |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the control for variable selector 2 |                |          |
| Mode              | RFC-A                                       |                |          |
| Minimum           | 0.00  | Maximum        | 100.00   |
| Default           | 0.00  | Units          |          |
| Type              | 16 Bit User Save                            | Update Rate    | 4ms read |
| Display Format    | Standard                                    | Decimal Places | 2        |
| Coding            | RW  |                |          |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.036 Variable Selector 2 Enable |                |          |
|-------------------|-----------------------------------|----------------|----------|
| Short description | Enables variable selector 2       |                |          |
| Mode              | RFC-A                             |                |          |
| Minimum           | 0                                 | Maximum        | 1        |
| Default           | 1                                 | Units          |          |
| Type              | 1 Bit User Save                   | Update Rate    | 4ms read |
| Display Format    | Standard                          | Decimal Places | 0        |
| Coding            | RW, BU                            |                |          |

See *Variable Selector 1 Source 1* (12.008).

| Parameter         | 12.040 Brake Control: Brake Release |                |           |
|-------------------|-------------------------------------|----------------|-----------|
| Short description | Enables the brake release function  |                |           |
| Mode              | RFC-A                               |                |           |
| Minimum           | 0                                   | Maximum        | 1         |
| Default           |                                     | Units          |           |
| Type              | 1 Bit Volatile                      | Update Rate    | 4ms write |
| Display Format    | Standard                            | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                      |                |           |

The mechanical brake control function can be used to control an electro-mechanical brake via digital I/O. *Brake Control: Brake Release* (12.040) = 0 when the brake should be applied and 1 when the brake should be released. Normally this should be routed to a digital output to control the mechanical brake. See *Brake Control: Enable* (12.041) for details.

| Parameter         | 12.041 Brake Control: Enable       |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Enables the brake control function |                |                 |
| Mode              | RFC-A                              |                |                 |
| Minimum           | 0                                  | Maximum        | 1               |
| Default           | 0                                  | Units          |                 |
| Type              | 1 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW                                 |                |                 |

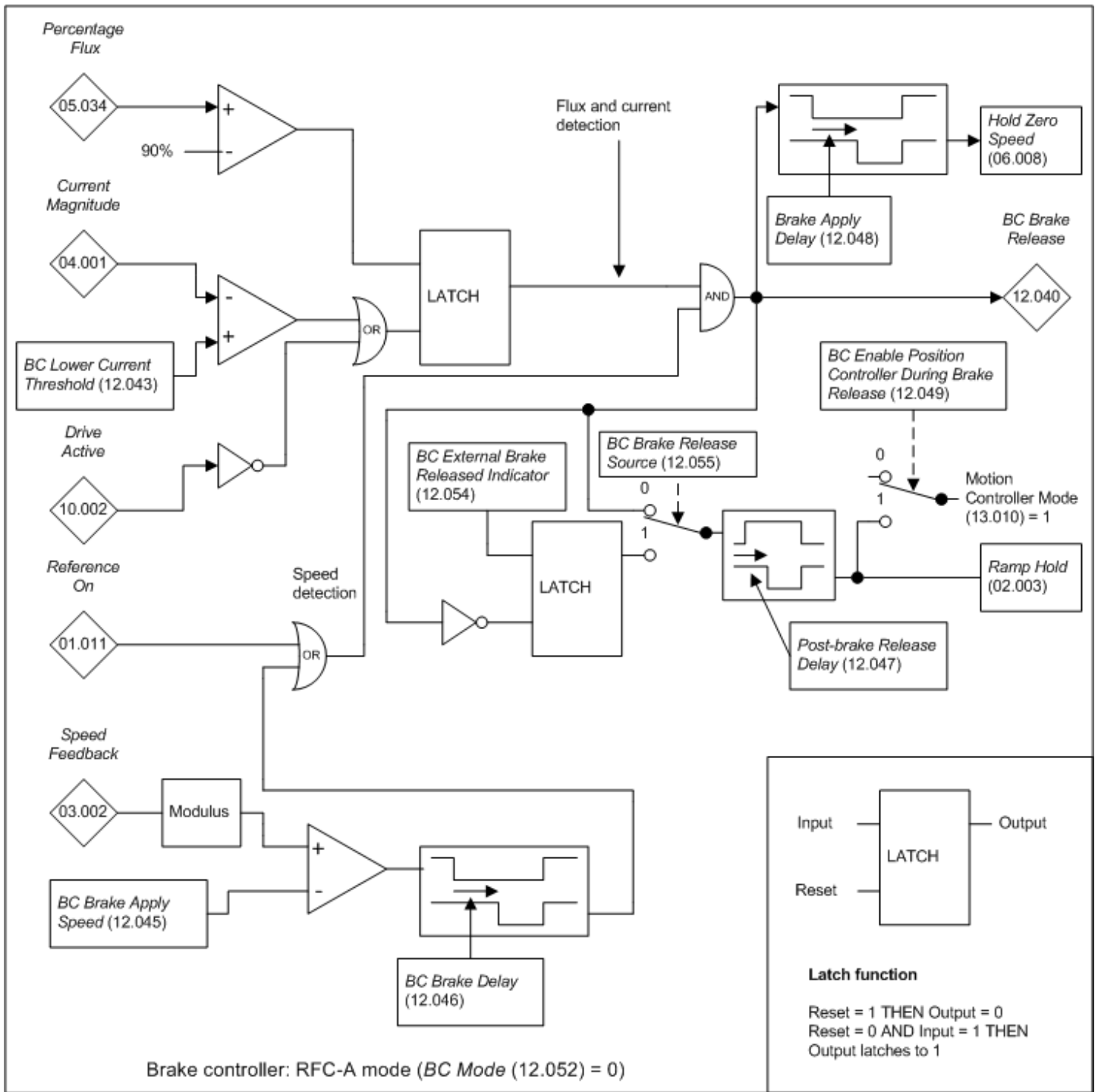
If *Brake Control: Enable* (12.041) = 0 then the brake controller is disabled. The following parameters which are used by the brake controller to operate the drive are reset to 0 on the transition of *Brake Control: Enable* (12.041) from 1 to 0.

| Parameter  | <i>Brake Control: Mode</i> (12.052) = 0 | <i>Brake Control: Mode</i> (12.052) = 1 |
|--|---|---|
| <i>Force Reference Direction</i> (01.057)          |   | x                                       |
| <i>Ramp Hold</i> (02.003)                          | x                                       | x                                       |
| <i>Hold Zero Speed</i> (06.008)                    | x                                       | x                                       |
| <i>Standard Motion Reference Source</i> (13.004) * | *x                                      | *x                                      |
| <i>Standard Motion Controller Mode</i> (13.010) *  | *x                                      | *x                                      |

\* If *Brake Control: Enable Position Control During Brake Release* (12.049) = 1

**RFC-A mode (*Brake Control: Mode* (12.052) = 0)**

In RFC-A mode with *Brake Control: Mode* (12.052) = 0 the following brake controller is provided.



**Flux and current detection**

The flux and current detection signal is made active to allow the brake to be released when the motor flux exceeds 90% of its rated level. The flux and current detection signal remains active unless the motor current falls below *Brake Control: Lower Current Threshold* (12.043) or the drive is disabled. *Brake Control: Lower Current Threshold* (12.043) is used to detect if the motor has been disconnected from the drive and should be set to a suitable level to detect this condition. In RFC-S mode the flux and current detection signal follows the drive active signal, and so it is not possible to detect if the motor is disconnected from the drive.

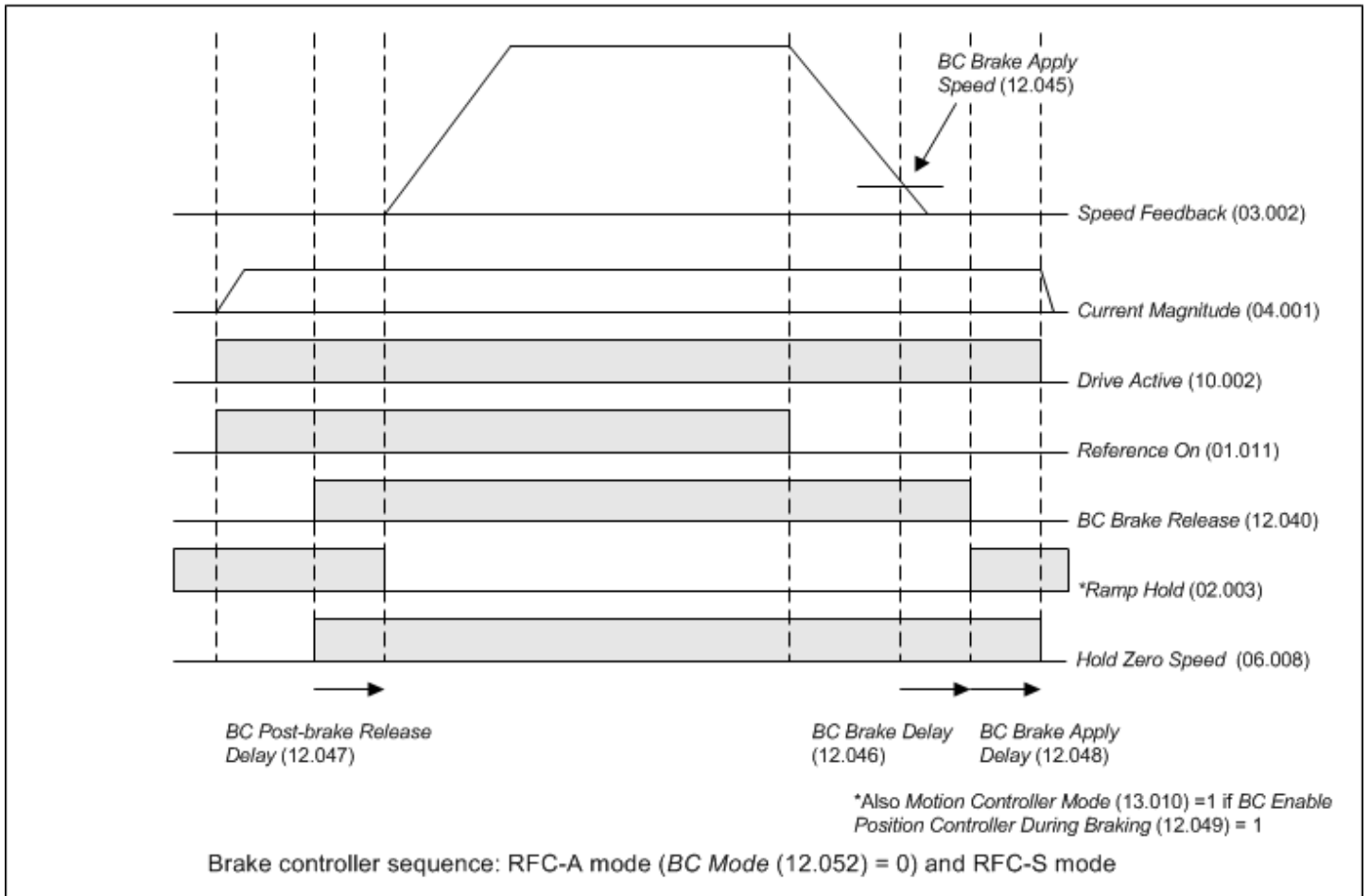
**Speed detection**

If *Reference On* (01.011) = 1 then the speed detection signal is active. When *Reference On* (01.011) is de-activated the speed detection signal is not de-activated until the modulus of *Speed Feedback* (03.002) falls below *Brake Control: Brake Apply Speed* (12.045) and an additional delay defined by *Brake Control: Brake Delay* (12.046).

**Brake controller sequence**

The brake controller sequence is shown for forward movement in the diagram below.



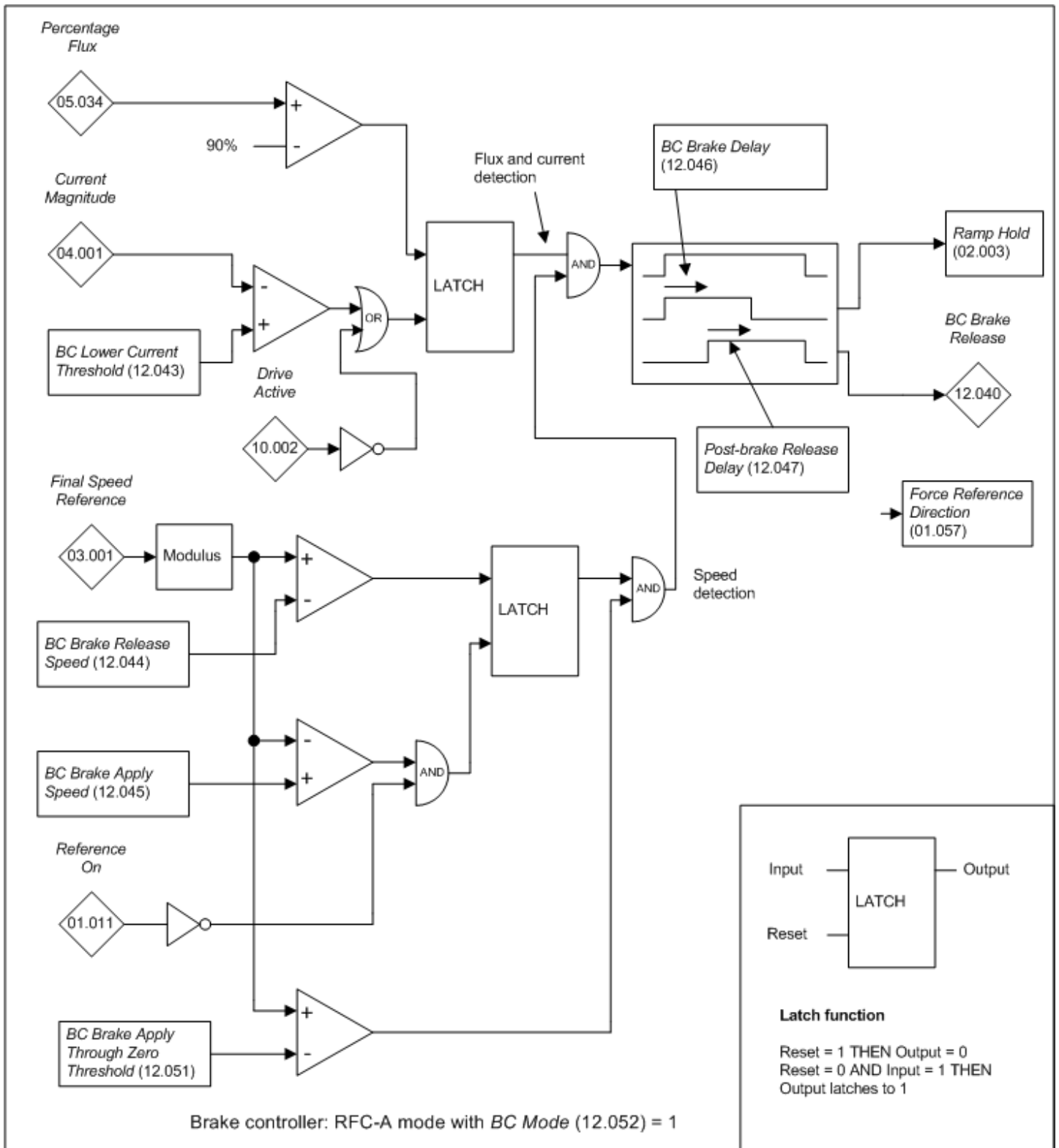


The brake is released when flux and current detection, and speed detection are active and then the ramp hold is released after a further delay to allow the motor to accelerate away from standstill. When the *Speed Feedback* (03.002) subsequently falls below *Brake Control: Brake Apply Speed* (12.045) and *Reference On* (01.011) = 0 (i.e. the motor is required to stop) then the brake is applied after a delay defined by *Brake Control: Brake Delay* (12.046). The motor is held at zero speed for a further delay to allow the brake to apply, i.e. *Brake Control: Brake Apply Delay* (12.048). *Ramp Hold* (02.003) is held at 1 while the brake is being applied in case the reference is reapplied during this period to prevent the motor running against the brake. Also *Ramp Hold* (02.003) will already be active when the drive restarts to hold the speed reference at zero. It is also possible for the Standard motion controller to be active during this period to help prevent the motor from moving even under load after the brake has been released by setting *Brake Control: Enable Position Control During Brake Release* (12.049) = 1.

If required, an input can be routed to *External Brake Released Indicator* (12.054) to delay the the motor from starting until an external indication is given that the brake has released. To use an external indication *Brake Release Source* (12.055) should be set to one.

**RFC-A mode (*Brake Control: Mode* (12.052) = 1)**

In RFC-A mode without position feedback is used (i.e. *Sensorless Mode Active* (03.078) = 1) the torque produced may reduce as the speed passes through zero. If *Brake Control: Mode* (12.052) = 1 a brake controller similar to the one used for Open-loop mode is provided for applications using RFC-A mode without position feedback as shown in the diagram below.



The brake controller operates in the same way as the Open-loop mode brake controller except for the following differences.

1. *Final Speed Reference* (03.001) is used instead of *Output Frequency* (05.001).
2. The frequency thresholds are replaced with speed thresholds.
3. Current detection is replaced with flux and current detection as described below.

#### Flux and current detection

The flux and current detection signal is made active to allow the brake to be released when the motor flux exceeds 90% of its rated level. The flux and current detection signal remains active unless the motor current falls below *Brake Control: Lower Current Threshold* (12.043) or the drive is disabled. *Brake Control: Lower Current Threshold* (12.043) is used to detect if the motor has been disconnected from the drive and should be set to a suitable level to detect this condition.

| Parameter         | 12.043 Brake Control: Lower Current Threshold |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the lower current limit for the brake |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 200      |
| Default           | 10  | Units          | %        |
| Type              | 8 Bit User Save                               | Update Rate    | 4ms read |
| Display Format    | Standard                                      | Decimal Places | 0        |
| Coding            | RW, BU  |                |          |

See *Brake Control: Enable* (12.041).

| Parameter         | 12.044 Brake Control: Brake Release Speed |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the release speed of the brake    |                |          |
| Mode              | RFC-A                                     |                |          |
| Minimum           | 0   | Maximum        | 200      |
| Default           | 10  | Units          |          |
| Type              | 8 Bit User Save                           | Update Rate    | 4ms read |
| Display Format    | Standard                                  | Decimal Places | 0        |
| Coding            | RW, BU                                    |                |          |

See *Brake Control: Enable* (12.041).

| Parameter         | 12.045 Brake Control: Brake Apply Speed |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the apply speed of the brake    |                |          |
| Mode              | RFC-A                                   |                |          |
| Minimum           | 0                                       | Maximum        | 200      |
| Default           | 5                                       | Units          |          |
| Type              | 8 Bit User Save                         | Update Rate    | 4ms read |
| Display Format    | Standard                                | Decimal Places | 0        |
| Coding            | RW, BU                                  |                |          |

See *Brake Control: Enable* (12.041).

| Parameter         | 12.046 Brake Control: Brake Delay   |                |          |
|-------------------|-------------------------------------|----------------|----------|
| Short description | Defines the pre-brake release delay |                |          |
| Mode              | RFC-A                               |                |          |
| Minimum           | 0.0                                 | Maximum        | 25.0     |
| Default           | 1.0                                 | Units          | s        |
| Type              | 8 Bit User Save                     | Update Rate    | 4ms read |
| Display Format    | Standard                            | Decimal Places | 1        |
| Coding            | RW, BU                              |                |          |

See *Brake Control: Enable* (12.041).

| Parameter         | 12.047 Brake Control: Post-brake Release Delay |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the post-brake release delay           |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0.0  | Maximum        | 25.0     |
| Default           | 1.0  | Units          | s        |
| Type              | 8 Bit User Save                                | Update Rate    | 4ms read |
| Display Format    | Standard                                       | Decimal Places | 1        |
| Coding            | RW, BU   |                |          |

See *Brake Control: Enable* (12.041).

| Parameter         | 12.048 Brake Control: Brake Apply Delay  |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the delay for applying the brake |                |          |
| Mode              | RFC-A                                    |                |          |
| Minimum           | 0.0                                      | Maximum        | 25.0     |
| Default           | 1.0                                      | Units          | s        |
| Type              | 8 Bit User Save                          | Update Rate    | 4ms read |
| Display Format    | Standard                                 | Decimal Places | 1        |
| Coding            | RW, BU                                   |                |          |

See *Brake Control: Enable* (12.041)

| Parameter         | 12.049 Brake Control: Enable Position Control During Brake Release |                |          |
|-------------------|--|----------------|----------|
| Short description | Enables position control during brake release                      |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW   |                |          |

See *Brake Control: Enable* (12.041)

| Parameter         | 12.050 Brake Control: Initial Direction    |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the initial direction of the brake |                |          |
| Mode              | RFC-A                                      |                |          |
| Minimum           | 0  | Maximum        | 2        |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save                            | Update Rate    | 4ms read |
| Display Format    | Standard                                   | Decimal Places | 0        |
| Coding            | RW, TE                                     |                |          |

| Value | Text    |
|-------|---------|
| 0     | Ref     |
| 1     | Forward |
| 2     | Reverse |

See *Brake Control: Enable* (12.041).

| Parameter         | 12.051 Brake Control: Brake Apply Through Zero Threshold |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines if the brake is applied through zero threshold   |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 200      |
| Default           | 5  | Units          |          |
| Type              | 8 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, BU   |                |          |

See *Brake Control: Enable* (12.041).

| Parameter         | 12.052 Brake Control: Mode            |                |                 |
|-------------------|---------------------------------------|----------------|-----------------|
| Short description | Defines the mode of the brake control |                |                 |
| Mode              | RFC-A                                 |                |                 |
| Minimum           | 0                                     | Maximum        | 1               |
| Default           | 0                                     | Units          |                 |
| Type              | 1 Bit User Save                       | Update Rate    | Background read |
| Display Format    | Standard                              | Decimal Places | 0               |
| Coding            | RW                                    |                |                 |

If *Brake Control: Mode* (12.052) = 1 then the brake controller for RFC-A mode without position feedback is selected.

| Parameter         | 12.054 External Brake Released Indicator |                |          |
|-------------------|--|----------------|----------|
| Short description | External Brake Released Indicator        |                |          |
| Mode              | RFC-A                                    |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit Volatile                           | Update Rate    | 4ms Read |
| Display Format    | Standard                                 | Decimal Places | 0        |
| Coding            | RW, NC                                   |                |          |

See *Brake Control: Enable* (12.041).

| Parameter         | 12.055 Brake Release Source |                |                 |
|-------------------|-----------------------------|----------------|-----------------|
| Short description | Brake Release Source        |                |                 |
| Mode              | RFC-A                       |                |                 |
| Minimum           | 0                           | Maximum        | 1               |
| Default           | 0                           | Units          |                 |
| Type              | 1 Bit User Save             | Update Rate    | Background Read |
| Display Format    | Standard                    | Decimal Places | 0               |
| Coding            | RW                          |                |                 |

See *Brake Control: Enable* (12.041).

# Menu 13 Single Line Descriptions – Standard Motion Controller

Mode: RFC-A

| Parameter |  | Range   | Default        | Type |     |    |    |    |    |
|-----------|--|---|----------------|------|-----|----|----|----|----|
| 13.001    | Standard Motion Revolutions Error                  | -32768 to 32767 Revs  |                | RO   | Num | ND | NC | PT |    |
| 13.002    | Standard Motion Position Error                     | -32768 to 32767   |                | RO   | Num | ND | NC | PT |    |
| 13.003    | Standard Motion Fine Position Error                | -32768 to 32767   |                | RO   | Num | ND | NC | PT |    |
| 13.004    | Standard Motion Reference Source                   | P1 Drive (0), P2 Drive (1), P1 Slot1 (2), P2 Slot1 (3), P1 Slot2 (4), P2 Slot2 (5), P1 Slot3 (6), P2 Slot3 (7), Local (10)      | P1 Drive (0)   | RW   | Txt |    |    |    | US |
| 13.005    | Standard Motion Feedback Source                    | P1 Drive (0), P2 Drive (1), P1 Slot1 (2), P2 Slot1 (3), P1 Slot2 (4), P2 Slot2 (5), P1 Slot3 (6), P2 Slot3 (7), Sensorless (10) | P1 Drive (0)   | RW   | Txt |    |    |    | US |
| 13.006    | Standard Motion Reference Invert                   | Off (0) or On (1)   | Off (0)        | RW   | Bit |    |    |    | US |
| 13.007    | Standard Motion Ratio Numerator                    | 0.000 to 10.000   | 1.000          | RW   | Num |    |    |    | US |
| 13.008    | Standard Motion Ratio Denominator                  | 0.000 to 4.000  | 1.000          | RW   | Num |    |    |    | US |
| 13.009    | Standard Motion Proportional Gain Kp               | 0.00 to 100.00  | 25.00          | RW   | Num |    |    |    | US |
| 13.010    | Standard Motion Controller Mode                    | Disabled (0), Rigid Spd FF (1), Rigid (2), Non-rigid Spd FF (3), Non-rigid (4), Orientate Stop (5), Orientate (6)               | Disabled (0)   | RW   | Txt |    |    |    | US |
| 13.011    | Standard Motion Absolute Mode Enable               | Off (0) or On (1)   | Off (0)        | RW   | Bit |    |    |    | US |
| 13.012    | Standard Motion Speed Clamp                        | 0 to 250 rpm  | 150 rpm        | RW   | Num |    |    |    | US |
| 13.013    | Standard Motion Orientation Position Reference     | 0 to 65535  | 0              | RW   | Num |    |    |    | US |
| 13.014    | Standard Motion Orientation Acceptance Window      | 0 to 4096   | 256            | RW   | Num |    |    |    | US |
| 13.015    | Standard Motion Orientation Complete               | Off (0) or On (1)   |                | RO   | Bit | ND | NC | PT |    |
| 13.016    | Standard Motion Position Error Reset               | Off (0) or On (1)   | Off (0)        | RW   | Bit |    | NC |    |    |
| 13.017    | Standard Motion Relative Jog Reference             | 0.0 to 4000.0 rpm   | 0.0 rpm        | RW   | Num |    |    |    | US |
| 13.018    | Standard Motion Relative Jog Enable                | Off (0) or On (1)   | Off (0)        | RW   | Bit |    | NC |    |    |
| 13.019    | Standard Motion Relative Jog Reverse               | Off (0) or On (1)   | Off (0)        | RW   | Bit |    | NC |    |    |
| 13.020    | Standard Motion Local Reference Revolutions        | 0 to 65535 Revs   | 0 Revs         | RW   | Num |    | NC |    |    |
| 13.021    | Standard Motion Local Reference Position           | 0 to 65535  | 0              | RW   | Num |    | NC |    |    |
| 13.022    | Standard Motion Local Reference Fine Position      | 0 to 65535  | 0              | RW   | Num |    | NC |    |    |
| 13.023    | Standard Motion Local Reference Disable            | Off (0) or On (1)   | Off (0)        | RW   | Bit |    | NC |    |    |
| 13.024    | Standard Motion Ignore Local Reference Revolutions | Off (0) or On (1)   | Off (0)        | RW   | Bit |    |    |    | US |
| 13.026    | Standard Motion Sample Rate                        | Not Active (0), 4ms (1)   | Not Active (0) | RO   | Txt |    | NC |    | US |

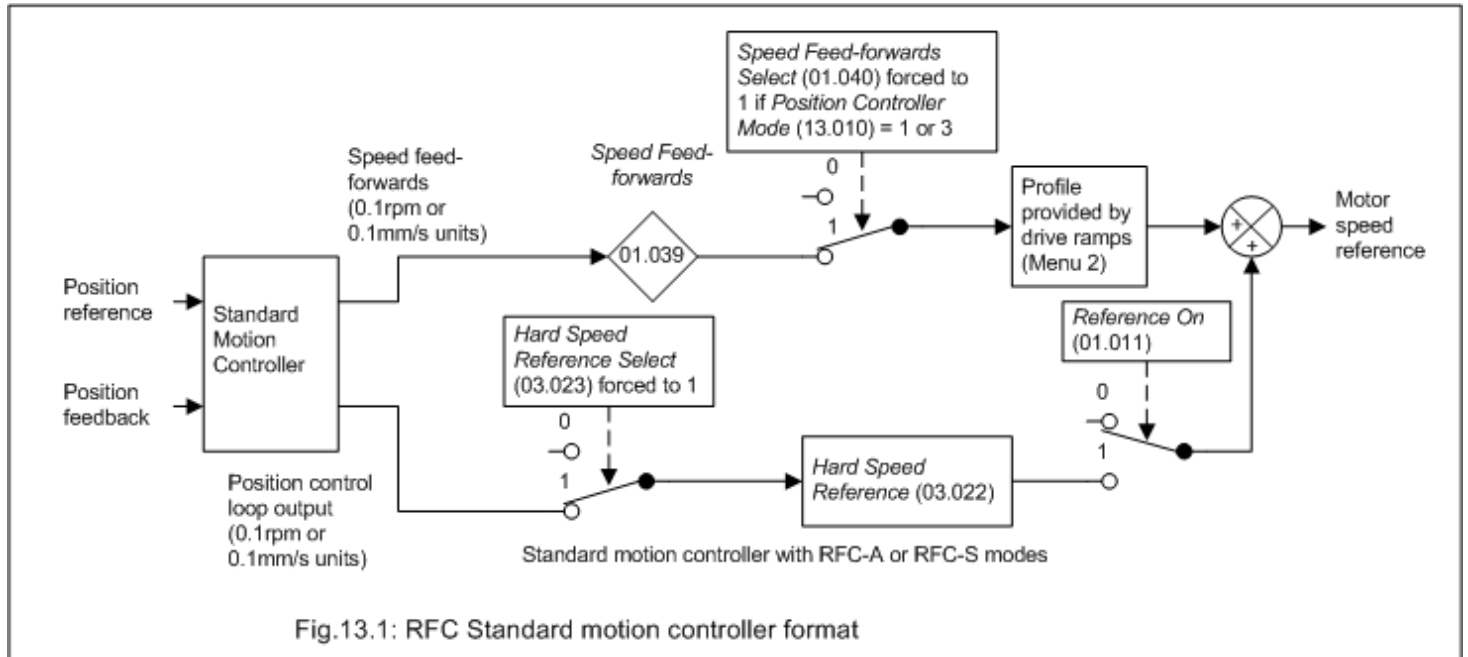
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 13 – Standard Motion Controller

Mode: RFC-A

## Motion controller format

The diagram below shows the format and interface for the standard motion controller.



## Standard motion controller

The standard motion controller outputs are speed feed-forwards and position control loop output both in 0.1rpm or 0.1mm/s units that can be used directly by the drive. The conversion to the output speed is based on the set-up parameters of the position feedback selected to control the motor. The position control loop output is always fed into the *Hard Speed Reference* (03.022). The speed feed-forwards from the motion controller can be used as a profile input, with the drive ramp system as the profile generator, by setting *Standard Motion Controller Mode* (13.010) to a value of 1 or 3. Alternatively the speed feed-forwards can be derived from the speed reference if required.

Changing *Standard Motion Controller Mode* (13.010) affects other drive parameters as shown in the table below.

| Standard Motion Controller Mode (13.010) | Action   |
|--|--|
| 0  | On changing from any value to 0:<br><i>Speed Feed-forwards</i> (01.039) = 0<br><i>Speed Feed-forwards Select</i> (01.040) = 0<br><i>Hard Speed Reference</i> (03.022) = 0<br><i>Hard Speed Reference Select</i> (03.023) = 0         |
| 1 or 3                                   | <i>Speed Feed-forwards</i> (01.039) = speed feed-forward<br><i>Speed Feed-forwards Select</i> (01.040) = 1<br><i>Hard Speed Reference</i> (03.022) = position control loop output<br><i>Hard Speed Reference Select</i> (03.023) = 1 |
| 2,4,5 or 6                               | <i>Speed Feed-forwards</i> (01.039) = 0<br><i>Speed Feed-forwards Select</i> (01.040) = 0<br><i>Hard Speed Reference</i> (03.022) = position control loop output<br><i>Hard Speed Reference Select</i> (03.023) = 1                  |

## Standard motion controller

The standard motion controller is compatible with the motion controller in Unidrive SP with a sample rate of 4ms. The drive ramp system (Menu 2) operates normally when the standard motion controller is enabled.

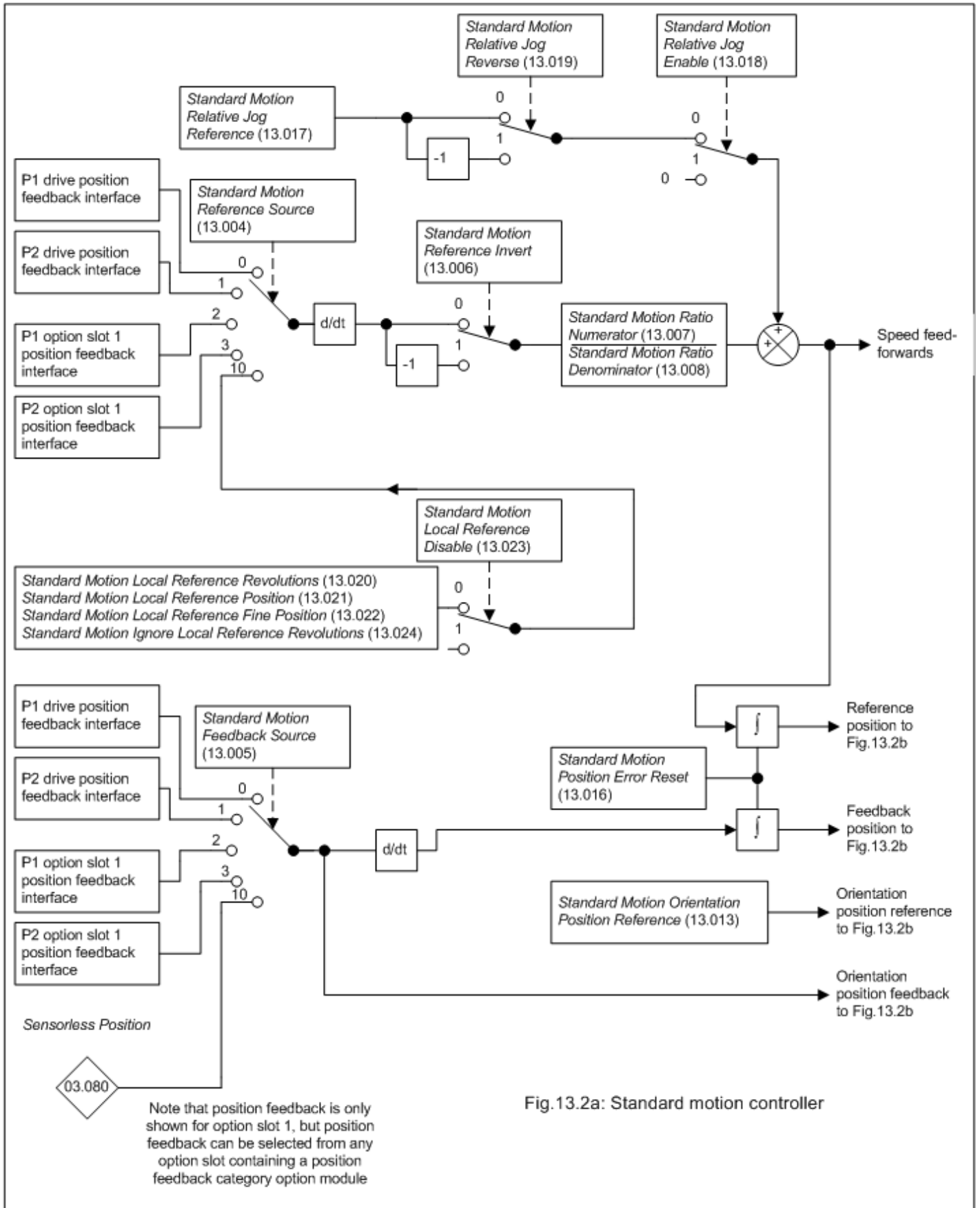


Fig.13.2a: Standard motion controller

Note that position feedback is only shown for option slot 1, but position feedback can be selected from any option slot containing a position feedback category option module



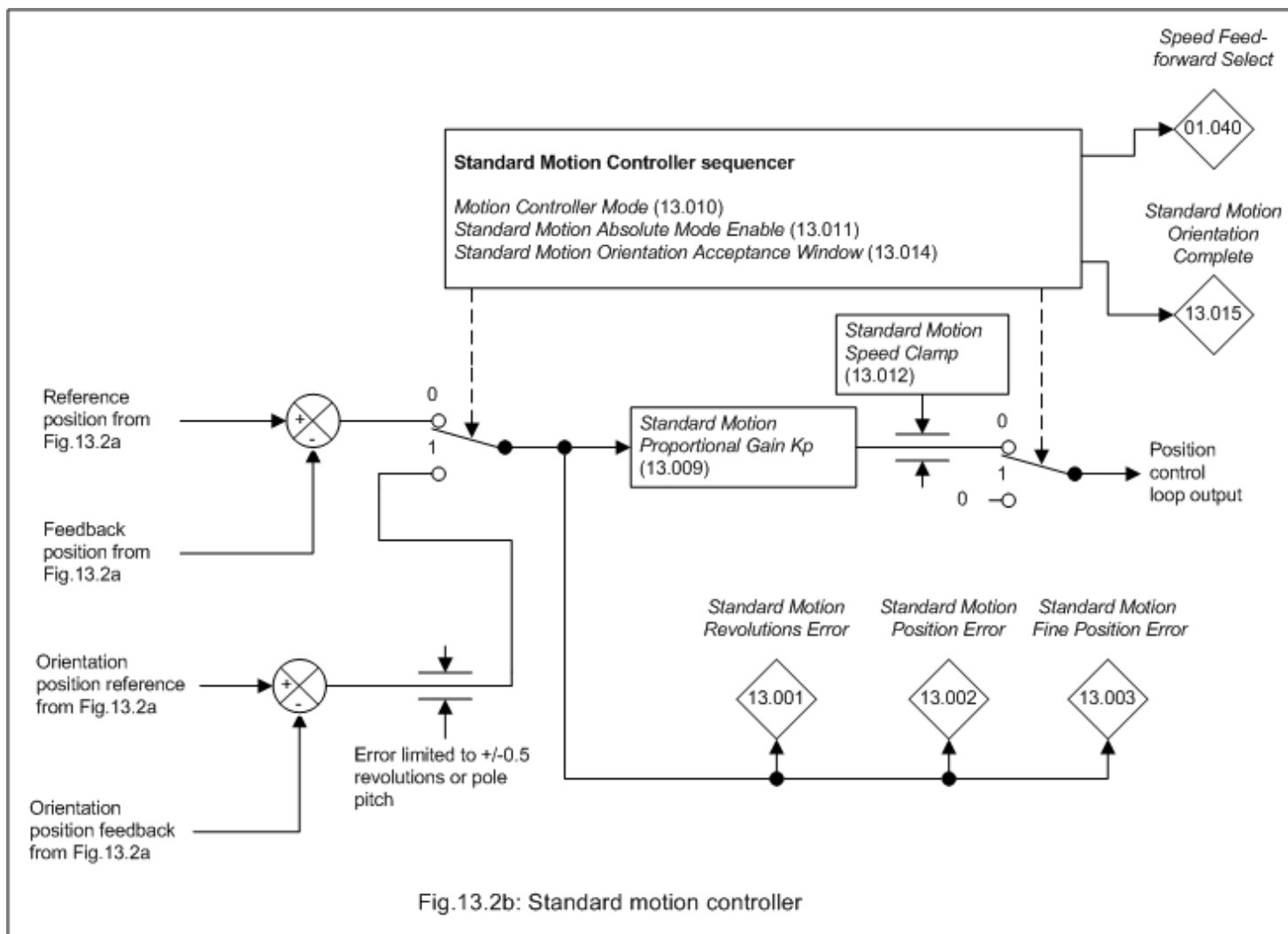


Fig.13.2b: Standard motion controller

The Standard Motion Controller uses the full 48 bit position feedback from the position feedback interfaces (Turns, Position and Fine Position), and so it is not affected by the number of turns bits selected to normalise the position for the selected position feedback interface. If *Sensorless Position* (03.080) is used for the feedback position the 16 fine position bits are zero. The motion controller outputs are converted from the internal speed units of the motion controller into a speed in rpm or mm/s (see *Linear Speed Select* (01.055)).

| Parameter         | 13.001 Standard Motion Revolutions Error                          |                |             |
|-------------------|---|----------------|-------------|
| Short description | Displays the revolutions error for the Standard Motion Controller |                |             |
| Mode              | RFC-A   |                |             |
| Minimum           | -32768  | Maximum        | 32767       |
| Default           |   | Units          | Revs        |
| Type              | 16 Bit Volatile   | Update Rate    | 250µs write |
| Display Format    | Standard  | Decimal Places | 0           |
| Coding            | RO, ND, NC, PT  |                |             |

*Standard Motion Revolutions Error* (13.001), *Standard Motion Position Error* (13.002) and *Standard Motion Fine Position Error* (13.003) show the difference between the accumulated reference and feedback positions. The integrators are large enough to guarantee that the position controller can operate with a position error from -32768 to 32767 turns before rolling over. For orientation mode the error between the orientation position and the feedback position is shown in *Standard Motion Position Error* (13.002) only.

| Parameter         | 13.002 Standard Motion Position Error                          |                |             |
|-------------------|--|----------------|-------------|
| Short description | Displays the position error for the Standard Motion Controller |                |             |
| Mode              | RFC-A  |                |             |
| Minimum           | -32768   | Maximum        | 32767       |
| Default           |  | Units          |             |
| Type              | 16 Bit Volatile  | Update Rate    | 250µs write |
| Display Format    | Standard   | Decimal Places | 0           |
| Coding            | RO, ND, NC, PT   |                |             |

See *Standard Motion Revolutions Error* (13.001).

| Parameter         | 13.003 Standard Motion Fine Position Error                          |                |             |
|-------------------|---|----------------|-------------|
| Short description | Displays the fine position error for the Standard Motion Controller |                |             |
| Mode              | RFC-A   |                |             |
| Minimum           | -32768  | Maximum        | 32767       |
| Default           |   | Units          |             |
| Type              | 16 Bit Volatile   | Update Rate    | 250µs write |
| Display Format    | Standard  | Decimal Places | 0           |
| Coding            | RO, ND, NC, PT  |                |             |

See *Standard Motion Revolutions Error* (13.001).

| Parameter         | 13.004 Standard Motion Reference Source                               |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the input source for the Standard Motion Controller reference |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 10              |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text     |
|-------|----------|
| 0     | P1 Drive |
| 1     | P2 Drive |
| 2     | P1 Slot1 |
| 3     | P2 Slot1 |
| 4     | P1 Slot2 |
| 5     | P2 Slot2 |
| 6     | P1 Slot3 |
| 7     | P2 Slot3 |
| 10    | Local    |

The reference source can be selected from one of the drive position feedback interfaces, a position feedback interface in an option module or from the local reference. If the selected position feedback interface does not exist then it will not be possible to enable the motion controller.

| Parameter         | 13.005 Standard Motion Feedback Source                               |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the input source for the Standard Motion Controller feedback |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 10              |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text       |
|-------|------------|
| 0     | P1 Drive   |
| 1     | P2 Drive   |
| 2     | P1 Slot1   |
| 3     | P2 Slot1   |
| 4     | P1 Slot2   |
| 5     | P2 Slot2   |
| 6     | P1 Slot3   |
| 7     | P2 Slot3   |
| 10    | Sensorless |

The feedback source can be selected from one of the drive position feedback interfaces, a position feedback interface in an option module or from the *Sensorless Position* (03.080). If the selected position feedback interface does not exist or *Sensorless Position* (03.080) is selected, but sensorless mode is not active then it will not be possible to enable the motion controller.

| Parameter         | 13.006 Standard Motion Reference Invert                     |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to invert the Standard Motion Controller reference |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

If *Standard Motion Reference Invert* (13.006) = 1 the reference position direction is reversed.

| Parameter         | 13.007 <i>Standard Motion Ratio Numerator</i>                  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the numerator for the Standard Motion Controller ratio |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000  | Maximum        | 10.000          |
| Default           | 1.000  | Units          |                 |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW   |                |                 |

A ratio of *Standard Motion Ratio Numerator* (13.007) / *Standard Motion Ratio Denominator* (13.008) can be applied to the change of reference position. The ratio cannot be changed when the drive is enabled without causing abrupt changes of position. Although it is possible to set up ratios with a high gain or even with a denominator of zero, the drive limits the resultant gain of the ratio block to 10.000.

| Parameter         | 13.008 <i>Standard Motion Ratio Denominator</i>                  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the denominator for the Standard Motion Controller ratio |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000  | Maximum        | 4.000           |
| Default           | 1.000  | Units          |                 |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 3               |
| Coding            | RW   |                |                 |

See *Standard Motion Ratio Numerator* (13.007).

| Parameter         | 13.009 <i>Standard Motion Proportional Gain Kp</i>         |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the Kp gain used by the Standard Motion Controller |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.00   | Maximum        | 100.00          |
| Default           | 25.00  | Units          |                 |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

The gain of the position control loop is specified in position units/s / position unit. The speed units used in the drive (rpm or mm/s) are dependent on the type of feedback device used and the value of *Linear Speed Select* (01.055). If rpm are used then the gain units are rev/s / rev (60 x rpm / rev), or if mm/s are used then the gain units are mm/s / mm.

| Parameter         | 13.010 <i>Standard Motion Controller Mode</i>      |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the mode of the Standard Motion Controller |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 6               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                                    | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text             |
|-------|------------------|
| 0     | Disabled         |
| 1     | Rigid Spd FF     |
| 2     | Rigid            |
| 3     | Non-rigid Spd FF |
| 4     | Non-rigid        |
| 5     | Orientate Stop   |
| 6     | Orientate        |

#### 0: Disabled

The Standard Motion Controller is disabled if *Standard Motion Controller Mode* (13.010) = 0. The Standard Motion Controller is also disabled if *Reference On* (01.011) = 0 (except for orientation control), or if the reference or feedback sources are not valid. When *Standard Motion Controller Mode* (13.010) is changed the Standard Motion Controller is disabled for one sample after the change.

#### 1: Rigid lock with speed feed-forwards

The diagram below shows the effect of rigid lock. Once the motion controller has been started it will always try to match the position and speed of the reference source. If for example the slave shaft is slowed down due to excessive load, the target position will eventually be recovered by running at a higher speed when the load is removed.

The motion controller generates a speed feed-forward term from the speed of the reference source. This value is passed through Menu 1, and so the ramps (Menu 2) may be included if required. As the motion controller only has a proportional gain, it is necessary to use speed feed-forwards to prevent a constant position error.

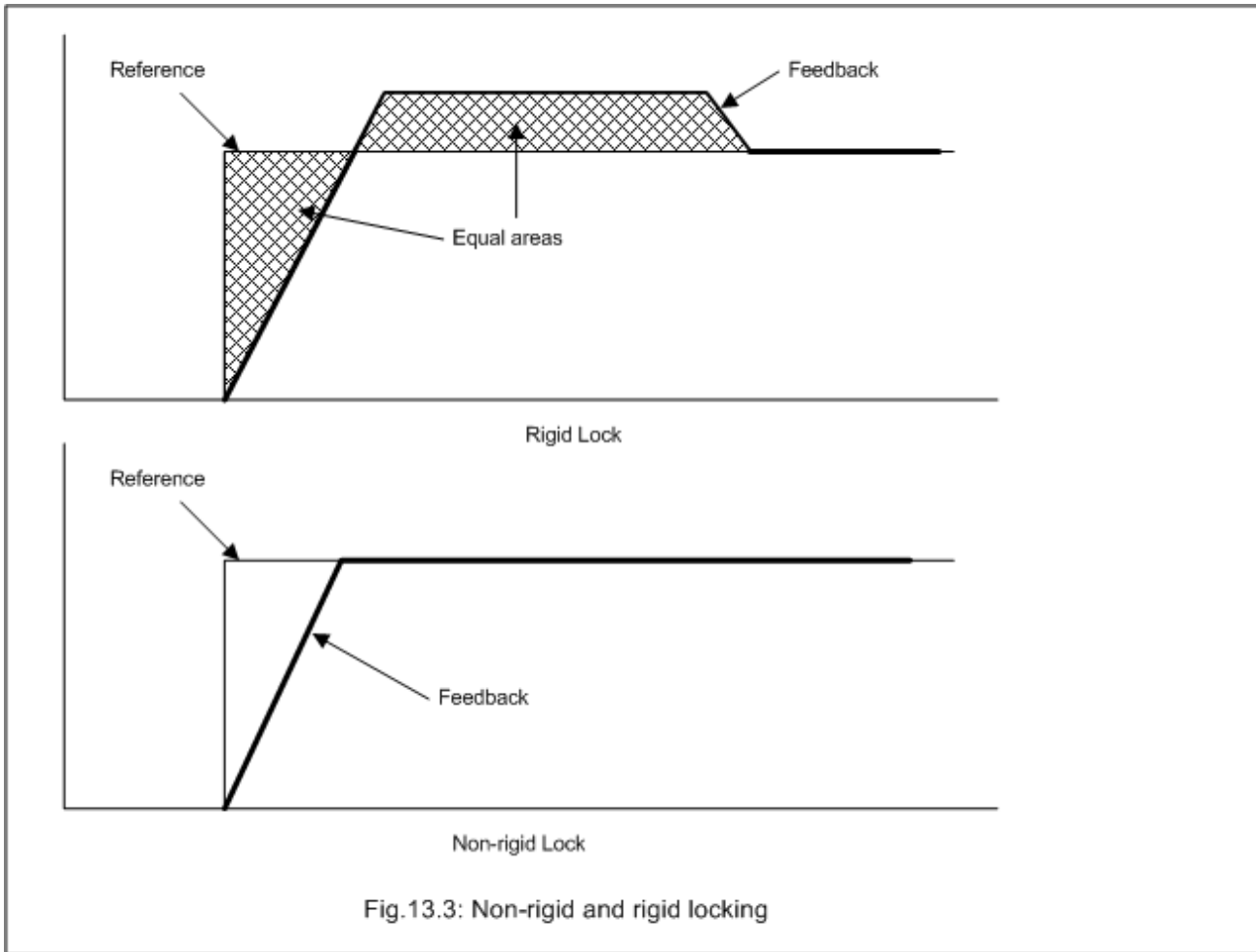


Fig.13.3: Non-rigid and rigid locking

## 2: Rigid lock without speed feed-forwards

Rigid lock without speed feed-forwards operates in the same way as rigid lock with speed feed-forwards except that the speed feed-forwards from the reference source is not provided. If speed feed-forwards is required then this should be supplied via Menu 1.

## 3: Non-rigid lock with speed feed-forwards

The position control loop is only active when *At Speed* (10.006) = 1. See *At Speed Lower Limit* (03.006) for details. This provides position locking once the feedback speed is close to the reference speed. Speed feed-forwards is generated from the reference source speed.

## 4: Non-rigid lock without speed feed-forwards

Non-rigid lock without speed feed-forwards operates in the same way as non-rigid lock with speed feed-forwards except that the speed feed-forwards from the reference source is not provided. If speed feed-forwards is required then this should be supplied via Menu 1.

## 5: Orientation on stop

The motion controller orientates the motor following a stop command. If hold zero speed is enabled (*Hold Zero Speed* (06.008) = 1) the drive remains in position control when orientation is complete and holds the orientation position. If hold zero speed is not enabled the drive is disabled when orientation is complete.

When orientating from a stop command the drive goes through the following sequence:

1. The motor is decelerated or accelerated to the speed defined by the *Standard Motion Speed Clamp* (13.012), using ramps if these are enabled, in the direction the motor was previously running.
2. When the ramp output reaches the set speed, ramps are disabled and the motor continues to rotate until the position is found to be close to the target position (i.e. within 1/32 of a turn). At this point the speed demand is set to 0 and the position loop is closed.
3. When the position is within the *Standard Motion Orientation Acceptance Window* (13.014) the orientation complete indication is given by setting *Standard Motion Orientation Complete* (13.015) to 1.

The stop mode selected by *Stop Mode* (06.001) has no effect if orientation is enabled.

## 6: Orientation on stop and when the drive is enabled

This mode is the same as orientation on stop, except that orientation is performed whenever the drive is enabled and not just when a stop is required.

| Parameter         | 13.011 <i>Standard Motion Absolute Mode Enable</i>           |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Enables the Absolute mode for the Standard Motion Controller |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

If *Standard Motion Absolute Mode Enable* (13.011) = 0 the reference and feedback integrators are held at 0 while the motion controller is disabled, and

so the controller operates in incremental mode when it is enabled. If *Standard Motion Absolute Mode Enable* (13.011) = 1 the reference and feedback integrators are preset with the position from the reference and feedback sources, and so the controller operates in absolute mode when it is enabled. It should be noted that *Standard Motion Reference Invert* (13.006), *Standard Motion Ratio Numerator* (13.007) and *Standard Motion Ratio Denominator* (13.008) are not applied to the value stored in the reference integrator. Therefore the inversion should not be applied and a ratio of unity should be used in absolute mode.

| Parameter         | 13.012 <i>Standard Motion Speed Clamp</i>                            |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the limit applied to the output of the position control loop |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 250             |
| Default           | 150  | Units          | rpm             |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, BU   |                |                 |

*Standard Motion Speed Clamp* (13.012) is the limit applied to the output of the position control loop.

| Parameter         | 13.013 <i>Standard Motion Orientation Position Reference</i>                             |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the orientation position within a turn with a resolution of 1/65536ths of a turn |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 65535           |
| Default           | 0  | Units          |                 |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, BU   |                |                 |

*Standard Motion Orientation Position Reference* (13.013) defines the orientation position within a turn with a resolution of 1/216 of a turn. *Standard Motion Orientation Acceptance Window* (13.014) defines the acceptance window with a resolution of 1/216 of a turn. The orientation is complete when:

$Standard\ Motion\ Orientation\ Position\ Reference\ (13.013) - Standard\ Motion\ Orientation\ Acceptance\ Window\ (13.014) \leq feedback\ position \leq Standard\ Motion\ Orientation\ Position\ Reference\ (13.013) + Standard\ Motion\ Orientation\ Acceptance\ Window\ (13.014)$

| Parameter         | 13.014 <i>Standard Motion Orientation Acceptance Window</i>             |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the acceptance window with a resolution of 1/65536ths of a turn |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 4096            |
| Default           | 256   | Units          |                 |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *Standard Motion Orientation Position Reference* (13.013).

| Parameter         | 13.015 <i>Standard Motion Orientation Complete</i>                                 |                |           |
|-------------------|--|----------------|-----------|
| Short description | Shows when the orientation sequence is complete for the Standard Motion Controller |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile   | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT   |                |           |

*Standard Motion Orientation Complete* (13.015) is set to 1 when the orientation sequence is complete.

| Parameter         | 13.016 <i>Standard Motion Position Error Reset</i> |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Resets the reference and feedback integrators      |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit Volatile                                     | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, NC   |                |                 |

If *Standard Motion Position Error Reset* (13.016) = 1 the reference and feedback integrators are held at their reset values (See *Standard Motion Absolute Mode Enable* (13.011)).

| Parameter         | 13.017 Standard Motion Relative Jog Reference             |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the speed that the reference position is moved at |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.0   | Maximum        | 4000.0          |
| Default           | 0.0   | Units          | rpm             |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW, BU  |                |                 |

If *Standard Motion Relative Jog Enable* (13.018) = 1 the reference position is moved at the speed defined by *Standard Motion Relative Jog Reference* (13.017) and in the direction defined by *Standard Motion Relative Jog Reverse* (13.019). The relative jog is forwards if *Standard Motion Relative Jog Reverse* (13.019) = 0 and reverse if it is 1.

| Parameter         | 13.018 Standard Motion Relative Jog Enable    |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Enables the use of the relative jog reference |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit Volatile                                | Update Rate    | Background read |
| Display Format    | Standard                                      | Decimal Places | 0               |
| Coding            | RW, NC  |                |                 |

See *Standard Motion Relative Jog Reference* (13.017).

| Parameter         | 13.019 Standard Motion Relative Jog Reverse      |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Sets the direction of the relative jog reference |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit Volatile                                   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, NC   |                |                 |

See *Standard Motion Relative Jog Reference* (13.017).

| Parameter         | 13.020 Standard Motion Local Reference Revolutions |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines the revolutions for the local reference    |                |            |
| Mode              | RFC-A  |                |            |
| Minimum           | 0  | Maximum        | 65535      |
| Default           | 0  | Units          | Revs       |
| Type              | 16 Bit Volatile                                    | Update Rate    | 250µs read |
| Display Format    | Standard   | Decimal Places | 0          |
| Coding            | RW, NC, BU   |                |            |

The local reference (*Standard Motion Local Reference Revolutions* (13.020), *Standard Motion Local Reference Position* (13.021) and *Standard Motion Local Reference Fine Position* (13.022)) can be used as the reference position. If *Standard Motion Local Reference Disable* (13.023) = 1 then the previously written value is used. This allows all three parts of the local reference position to be changed without data skew problems.

| Parameter         | 13.021 Standard Motion Local Reference Position |                |            |
|-------------------|---|----------------|------------|
| Short description | Defines the position for the local reference    |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | 0   | Maximum        | 65535      |
| Default           | 0   | Units          |            |
| Type              | 16 Bit Volatile                                 | Update Rate    | 250µs read |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW, NC, BU                                      |                |            |

See *Standard Motion Local Reference Revolutions* (13.020).

| Parameter         | 13.022 Standard Motion Local Reference Fine Position |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines the fine position for the local reference    |                |            |
| Mode              | RFC-A  |                |            |
| Minimum           | 0  | Maximum        | 65535      |
| Default           | 0  | Units          |            |
| Type              | 16 Bit Volatile                                      | Update Rate    | 250µs read |
| Display Format    | Standard   | Decimal Places | 0          |
| Coding            | RW, NC, BU   |                |            |

See *Standard Motion Local Reference Revolutions* (13.020).

| Parameter         | 13.023 <i>Standard Motion Local Reference Disable</i> |                |            |
|-------------------|---|----------------|------------|
| Short description | Disables the use of the local reference               |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | 0   | Maximum        | 1          |
| Default           | 0   | Units          |            |
| Type              | 1 Bit Volatile  | Update Rate    | 250µs read |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW, NC  |                |            |

See *Standard Motion Local Reference Revolutions* (13.020).

| Parameter         | 13.024 <i>Standard Motion Ignore Local Reference Revolutions</i> |                |            |
|-------------------|--|----------------|------------|
| Short description | Disables the use of the local reference revolutions              |                |            |
| Mode              | RFC-A  |                |            |
| Minimum           | 0  | Maximum        | 1          |
| Default           | 0  | Units          |            |
| Type              | 1 Bit User Save  | Update Rate    | 250µs read |
| Display Format    | Standard   | Decimal Places | 0          |
| Coding            | RW   |                |            |

If *Standard Motion Ignore Local Reference Revolutions* (13.024) = 0 all three parts of the local reference are used. If *Std Standard Motion Ignore Local Reference Revolutions* (13.024) = 1 and *Standard Motion Absolute Mode Enable* (13.011) = 0 only the position and fine position parts of the local reference are used as a 32 bit roll-over counter to define the local reference position.

| Parameter         | 13.026 <i>Standard Motion Sample Rate</i> |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Standard Motion Sample Rate               |                |                  |
| Mode              | RFC-A                                     |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           | 0   | Units          |                  |
| Type              | 8 Bit User Save                           | Update Rate    | Background Write |
| Display Format    | Standard                                  | Decimal Places | 0                |
| Coding            | RO, TE, NC                                |                |                  |

| Value | Text       |
|-------|------------|
| 0     | Not Active |
| 1     | 4ms        |

*Standard Motion Sample Rate* (13.026) indicates whether the Standard Motion Controller is active or not, and the sample rate being used. The sample rate for the Standard Motion Controller is not selectable and will always be 4ms if the controller is active. It should be noted that both the Advanced and Standard motion controllers cannot be active at the same time. If both are selected at power-up then only the Advanced Motion Controller becomes active. If one controller is active and the other is subsequently enabled without disabling the active controller then the active controller remains active until the drive is powered down and back up again.

## Menu 14 Single Line Descriptions – *User PID Controller*

Mode: RFC-A



| Parameter |                                     | Range  | Default   | Type |     |    |    |    |    |
|-----------|-------------------------------------|--|-----------|------|-----|----|----|----|----|
| 14.001    | PID1 Output                         | ±100.00 %  |           | RO   | Num | ND | NC | PT |    |
| 14.002    | PID1 Feed-forwards Reference Source | 0.000 to 59.999  | 0.000     | RW   | Num |    |    | PT | US |
| 14.003    | PID1 Reference Source               | 0.000 to 59.999  | 0.000     | RW   | Num |    |    | PT | US |
| 14.004    | PID1 Feedback Source                | 0.000 to 59.999  | 0.000     | RW   | Num |    |    | PT | US |
| 14.005    | PID1 Reference Invert               | Off (0) or On (1)  | Off (0)   | RW   | Bit |    |    |    | US |
| 14.006    | PID1 Feedback Invert                | Off (0) or On (1)  | Off (0)   | RW   | Bit |    |    |    | US |
| 14.007    | PID1 Reference Slew Rate            | 0.0 to 3200.0 s  | 0.0 s     | RW   | Num |    |    |    | US |
| 14.008    | PID1 Enable                         | Off (0) or On (1)  | Off (0)   | RW   | Bit |    |    |    | US |
| 14.009    | PID1 Enable Source 1                | 0.000 to 59.999  | 0.000     | RW   | Num |    |    | PT | US |
| 14.010    | PID1 Proportional Gain              | 0.000 to 4.000   | 1.000     | RW   | Num |    |    |    | US |
| 14.011    | PID1 Integral Gain                  | 0.000 to 4.000   | 0.500     | RW   | Num |    |    |    | US |
| 14.012    | PID1 Differential Gain              | 0.000 to 4.000   | 0.000     | RW   | Num |    |    |    | US |
| 14.013    | PID1 Output Upper Limit             | 0.00 to 100.00 %   | 100.00 %  | RW   | Num |    |    |    | US |
| 14.014    | PID1 Output Lower Limit             | ±100.00 %  | -100.00 % | RW   | Num |    |    |    | US |
| 14.015    | PID1 Output Scaling                 | 0.000 to 4.000   | 1.000     | RW   | Num |    |    |    | US |
| 14.016    | PID1 Destination                    | 0.000 to 59.999  | 0.000     | RW   | Num | DE |    | PT | US |
| 14.017    | PID1 Integral Hold                  | Off (0) or On (1)  | Off (0)   | RW   | Bit |    |    |    |    |
| 14.018    | PID1 Symmetrical Limit Enable       | Off (0) or On (1)  | Off (0)   | RW   | Bit |    |    |    | US |
| 14.019    | PID1 Feed-forwards Reference        | ±100.00 %  |           | RO   | Num | ND | NC | PT |    |
| 14.020    | PID1 Reference                      | ±100.00 %  |           | RO   | Num | ND | NC | PT |    |
| 14.021    | PID1 Feedback                       | ±100.00 %  |           | RO   | Num | ND | NC | PT |    |
| 14.022    | PID1 Error                          | ±100.00 %  |           | RO   | Num | ND | NC | PT |    |
| 14.023    | PID1 Reference Scaling              | 0.000 to 4.000   | 1.000     | RW   | Num |    |    |    | US |
| 14.024    | PID1 Feedback Scaling               | 0.000 to 4.000   | 1.000     | RW   | Num |    |    |    | US |
| 14.025    | PID1 Digital Reference              | ±100.00 %  | 0.00 %    | RW   | Num |    |    |    | US |
| 14.026    | PID1 Digital Feedback               | ±100.00 %  | 0.00 %    | RW   | Num |    |    |    | US |
| 14.027    | PID1 Enable Source 2                | 0.000 to 59.999  | 0.000     | RW   | Num |    |    | PT | US |
| 14.028    | PID1 Pre-sleep Boost Level          | 0.00 to 100.00 %   | 0.00 %    | RW   | Num |    |    |    | US |
| 14.029    | PID1 Maximum Boost Time             | 0.0 to 250.0 s   | 0.0 s     | RW   | Num |    |    |    | US |
| 14.030    | PID1 Pre-sleep Boost Level Enable   | Off (0) or On (1)  |           | RO   | Bit | ND | NC | PT |    |
| 14.031    | PID2 Output                         | ±100.00 %  |           | RO   | Num | ND | NC | PT |    |
| 14.032    | PID2 Feed-forwards Reference Source | 0.000 to 59.999  | 0.000     | RW   | Num |    |    | PT | US |
| 14.033    | PID2 Reference Source               | 0.000 to 59.999  | 0.000     | RW   | Num |    |    | PT | US |
| 14.034    | PID2 Feedback Source                | 0.000 to 59.999  | 0.000     | RW   | Num |    |    | PT | US |
| 14.035    | PID2 Reference Invert               | Off (0) or On (1)  | Off (0)   | RW   | Bit |    |    |    | US |
| 14.036    | PID2 Feedback Invert                | Off (0) or On (1)  | Off (0)   | RW   | Bit |    |    |    | US |
| 14.037    | PID2 Reference Slew Rate Limit      | 0.0 to 3200.0 s  | 0.0 s     | RW   | Num |    |    |    | US |
| 14.038    | PID2 Enable                         | Off (0) or On (1)  | Off (0)   | RW   | Bit |    |    |    | US |
| 14.039    | PID2 Enable Source 1                | 0.000 to 59.999  | 0.000     | RW   | Num |    |    | PT | US |
| 14.040    | PID2 Proportional Gain              | 0.000 to 4.000   | 1.000     | RW   | Num |    |    |    | US |
| 14.041    | PID2 Integral Gain                  | 0.000 to 4.000   | 0.500     | RW   | Num |    |    |    | US |
| 14.042    | PID2 Differential Gain              | 0.000 to 4.000   | 0.000     | RW   | Num |    |    |    | US |
| 14.043    | PID2 Output Upper Limit             | 0.00 to 100.00 %   | 100.00 %  | RW   | Num |    |    |    | US |
| 14.044    | PID2 Output Lower Limit             | ±100.00 %  | -100.00 % | RW   | Num |    |    |    | US |
| 14.045    | PID2 Output Scaling                 | 0.000 to 4.000   | 1.000     | RW   | Num |    |    |    | US |
| 14.046    | PID2 Destination                    | 0.000 to 59.999  | 0.000     | RW   | Num | DE |    | PT | US |
| 14.047    | PID2 Integral Hold                  | Off (0) or On (1)  | Off (0)   | RW   | Bit |    |    |    |    |
| 14.048    | PID2 Symmetrical Limit Enable       | Off (0) or On (1)  | Off (0)   | RW   | Bit |    |    |    | US |
| 14.049    | PID2 Feed-forwards Reference        | ±100.00 %  |           | RO   | Num | ND | NC | PT |    |
| 14.050    | PID2 Reference                      | ±100.00 %  |           | RO   | Num | ND | NC | PT |    |
| 14.051    | PID2 Feedback                       | ±100.00 %  |           | RO   | Num | ND | NC | PT |    |
| 14.052    | PID2 Error                          | ±100.00 %  |           | RO   | Num | ND | NC | PT |    |
| 14.053    | PID2 Reference Scaling              | 0.000 to 4.000   | 1.000     | RW   | Num |    |    |    | US |
| 14.054    | PID2 Feedback Scaling               | 0.000 to 4.000   | 1.000     | RW   | Num |    |    |    | US |
| 14.055    | PID2 Digital Reference              | ±100.00 %  | 0.00 %    | RW   | Num |    |    |    | US |
| 14.056    | PID2 Digital Feedback               | ±100.00 %  | 0.00 %    | RW   | Num |    |    |    | US |
| 14.057    | PID2 Enable Source 2                | 0.000 to 59.999  | 0.000     | RW   | Num |    |    | PT | US |
| 14.058    | PID1 Feedback Output Scaling        | 0.000 to 4.000   | 1.000     | RW   | Num |    |    |    | US |
| 14.059    | PID1 Mode Selector                  | Fbk1 (0), Fbk2 (1),<br>Fbk1 + Fbk2 (2), Min Fbk (3),<br>Max Fbk (4), Av Fbk (5),<br>Min Error (6), Max Error (7) | Fbk1 (0)  | RW   | Txt |    |    |    | US |

|        |                                    |                   |         |    |     |  |  |  |    |
|--------|------------------------------------|-------------------|---------|----|-----|--|--|--|----|
| 14.060 | PID1 Feedback Square Root Enable 1 | Off (0) or On (1) | Off (0) | RW | Bit |  |  |  | US |
| 14.061 | PID2 Feedback Square Root Enable   | Off (0) or On (1) | Off (0) | RW | Bit |  |  |  | US |
| 14.062 | PID1 Feedback Square Root Enable 2 | Off (0) or On (1) | Off (0) | RW | Bit |  |  |  | US |

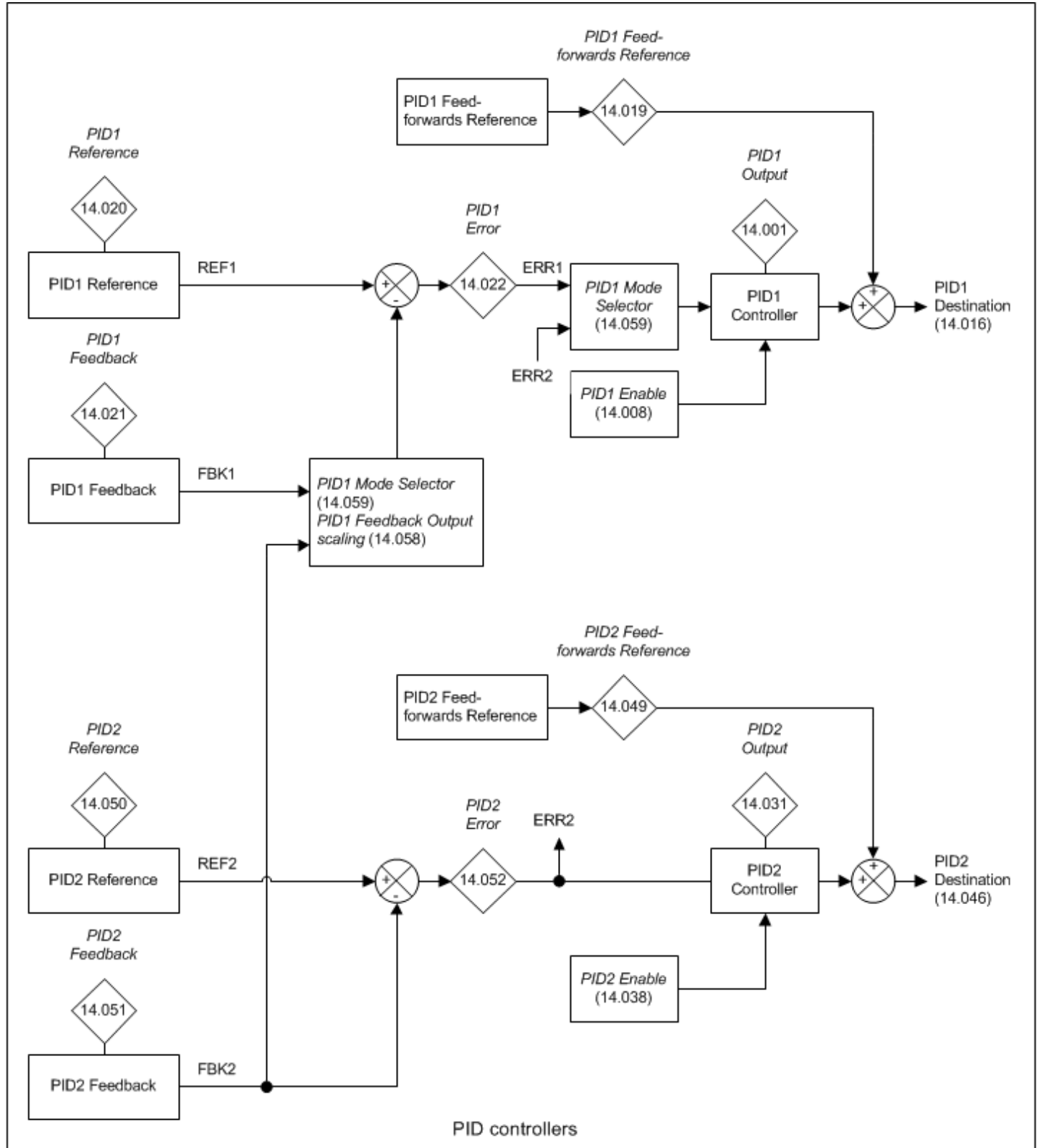
|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

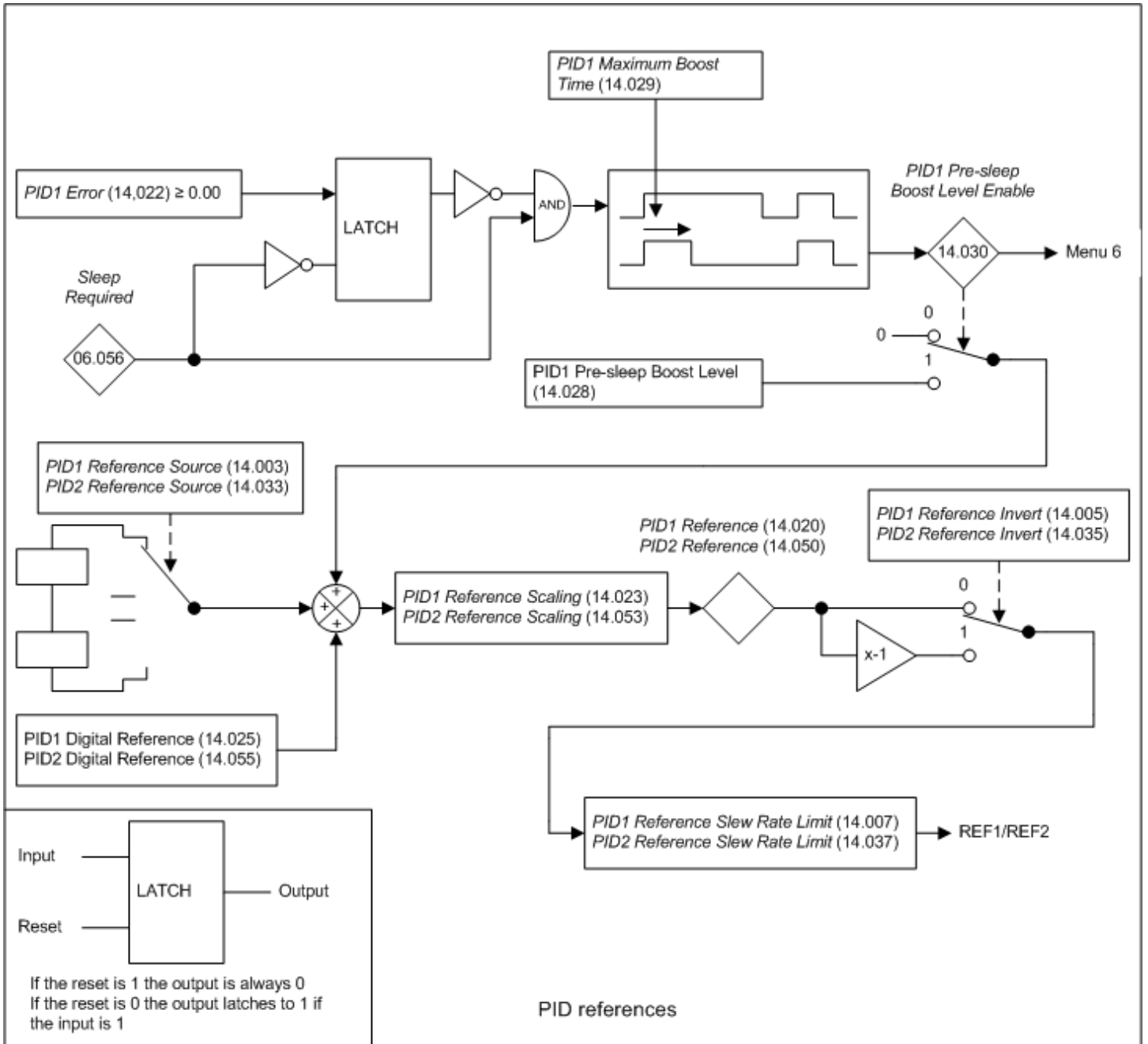
# Menu 14 – User PID Controller

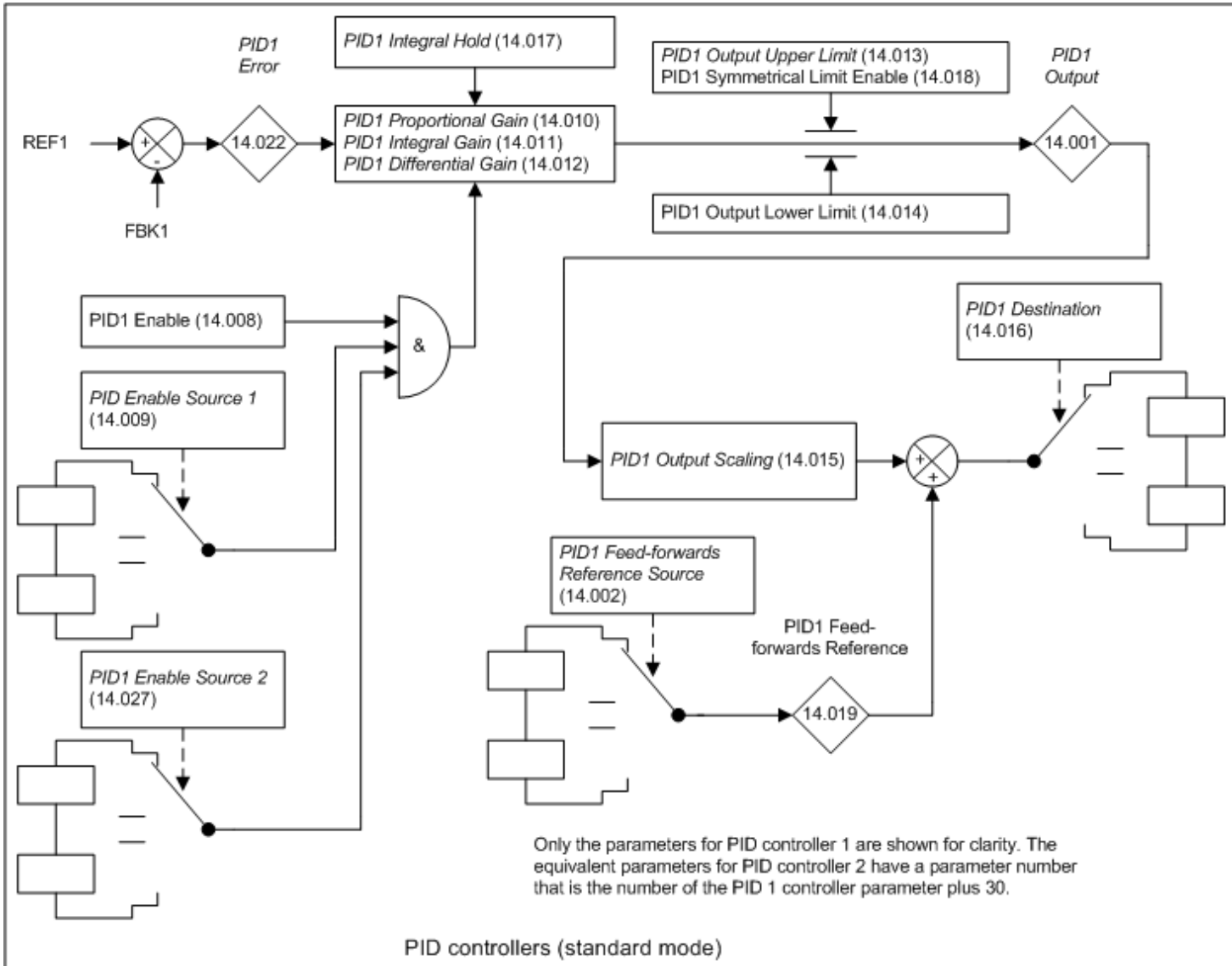
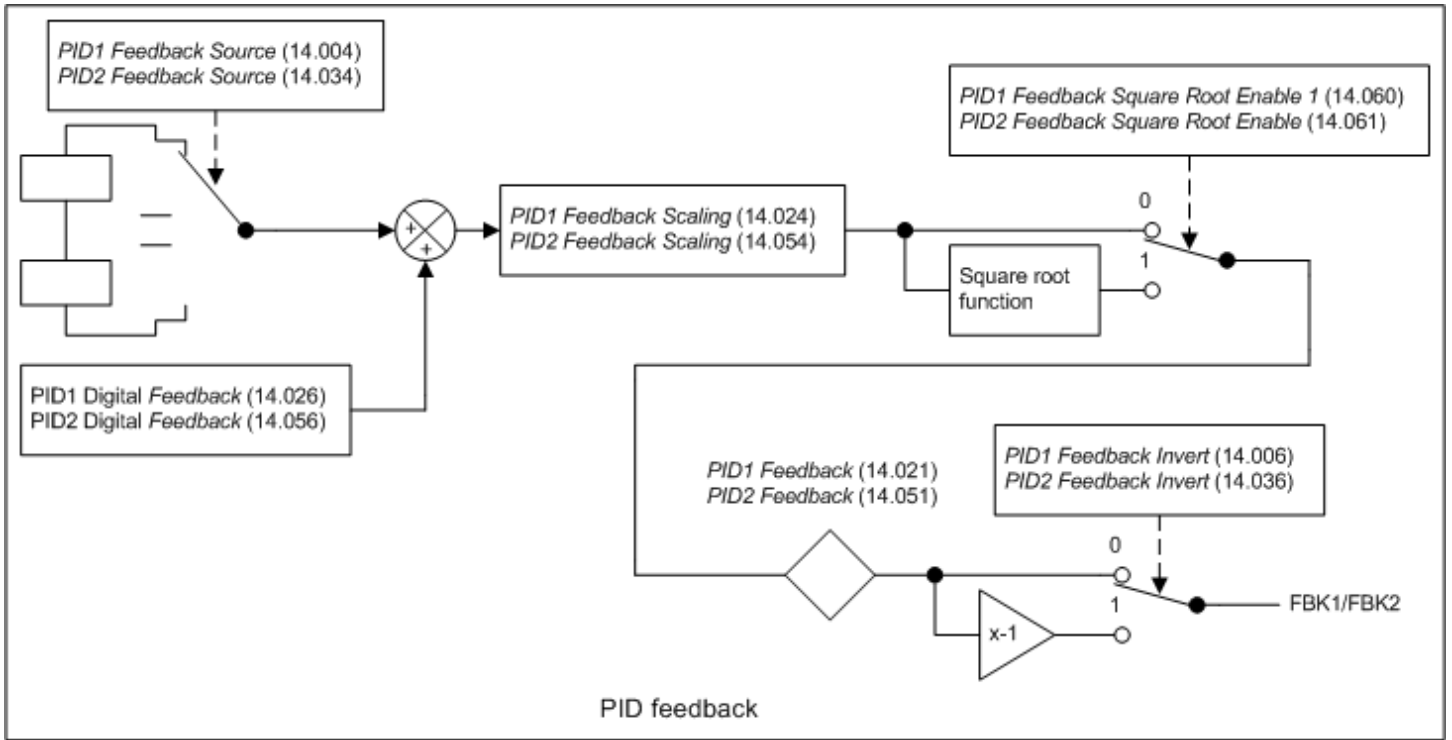
Mode: RFC-A

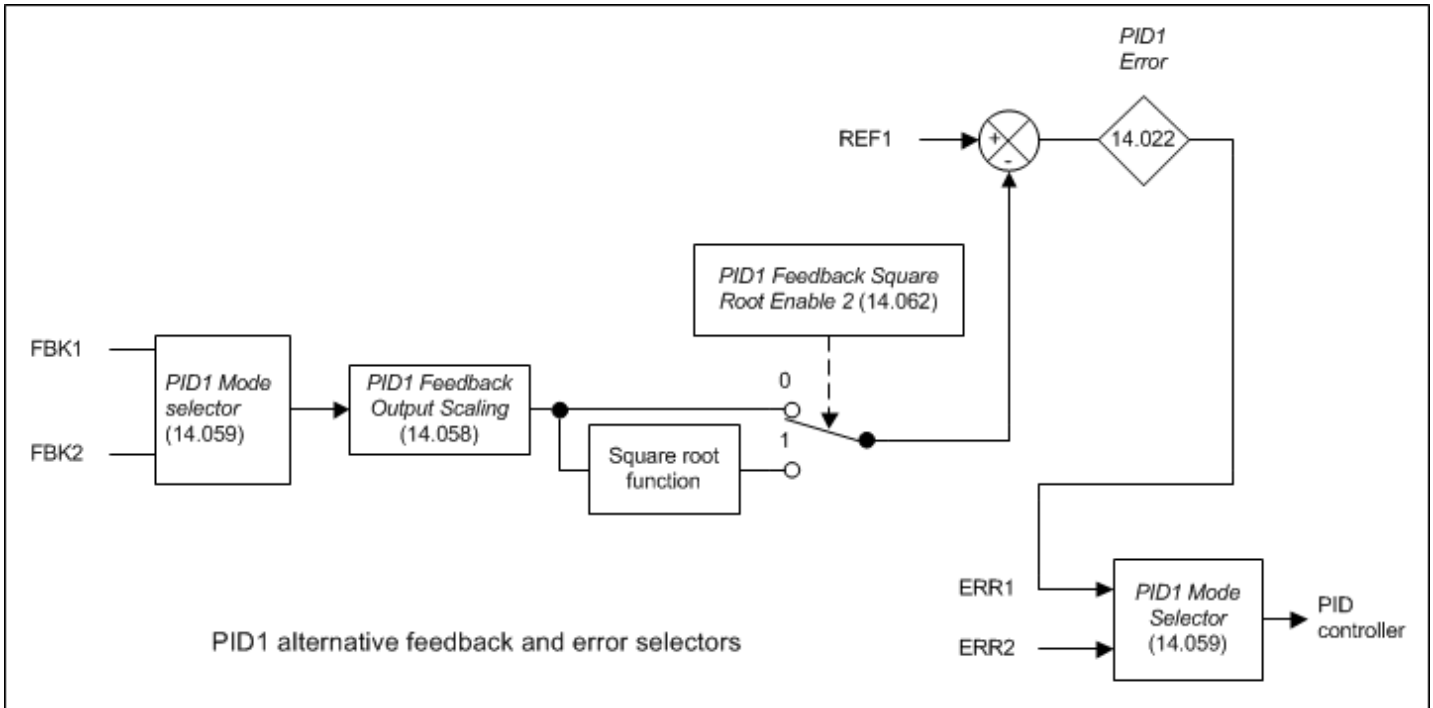
## PID controllers

Two general purpose PID controllers are provided as shown in the diagram below. Both operate in the same way except that PID controller 2 does not include a pre-sleep boost reference or alternative feedback and error selection. In the following sections a description is given for PID controller 1. The descriptions also apply to PID controller 2 except where stated. The sample rate for the PID controllers is always 4ms.









| Parameter         | 14.001 PID1 Output           |                |           |
|-------------------|------------------------------|----------------|-----------|
| Short description | Displays the output for PID1 |                |           |
| Mode              | RFC-A                        |                |           |
| Minimum           | -100.00                      | Maximum        | 100.00    |
| Default           |                              | Units          | %         |
| Type              | 16 Bit Volatile              | Update Rate    | 4ms write |
| Display Format    | Standard                     | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT               |                |           |

### Controller

The controller section for the PID controllers is shown in the introduction. The structure of PID controller 1 shown in the introduction is when *PID1 Mode Selector* (14.059) = 0, *PID1 Feedback Output Scaling* (14.058) = 1.000, and *PID1 Feedback Square Root Enable 2* (14.062) = 0. The additional features provided by these parameters are not available for PID controller 2, and so this controller always has the structure shown. If the combined enable is inactive then all internal states are held at zero and the destination parameter will be defined by *PID1 Feed-forwards Reference* (14.019) alone. If the enable is active the PID controller is active even if the destination is not routed to a valid parameter or to 0.000. It should be noted that if either of the enable sources is routed to 0.000 or to a non-valid parameter the source value is taken as 1, therefore with default settings, *PID1 Enable Source 1* (14.009) = 0.000 and *PID1 Enable Source 2* (14.027) = 0.000, the PID controller can be enabled by simply setting *PID1 Enable* (14.008).

*PID1 Error* (14.022) is the difference between the reference and feedback produced by the reference and feedback systems described in the previous sections. The PID controller output is defined as follows:

$$PID1\ Output\ (14.001) = PID1\ Error\ (14.022) \times [Kp + Ki/s + sKd/(0.064s + 1)]$$

$$Kp = PID1\ Proportional\ Gain\ (14.010)$$

$$Ki = PID1\ Integral\ Gain\ (14.011)$$

$$Kd = PID1\ Differential\ Gain\ (14.012)$$

Therefore:

1. If *PID1 Error* (14.022) = 100.00% the proportional term gives a value of 100.00% if *PID1 Proportional Gain* (14.010) = 1.000.
2. If *PID1 Error* (14.022) = 100.00% the integral term gives a value that increases linearly by 100.00% per second if *PID1 Integral Gain* (14.011) = 1.000.
3. If *PID1 Error* (14.022) increases linearly by 100.00% per second the differential term gives a value of 100.00% if *PID1 Differential Gain* (14.012) = 1.000. (A filter with a time constant of 64ms is provided on the differential gain to reduce the noise produced by this term.)

The output may be limited to a range that is less than the maximum range of *PID1 Output* (14.001) using *PID1 Output Upper Limit* (14.013) and *PID1 Output Lower Limit* (14.014). If *PID1 Output Lower Limit* (14.014) > *PID1 Output Upper Limit* (14.013) then the output is held at the value defined by *PID1 Output Upper Limit* (14.013). If *PID1 Symmetrical Limit Enable* (14.018) = 1 then the lower limit = -(*PID1 Output Upper Limit* (14.013)). If the output reaches either of these limits the integral term accumulator is frozen until the output moves away from the limit to prevent integral wind-up. The integral hold function can also be enabled by the user by setting *PID1 Integral Hold* (14.017) = 1.

*PID1 Output Scaling* (14.015) can be used to scale the output, which is limited to a range from -100.00% to 100.00% after this function. The output is then added to *PID1 Feed-forwards Reference* (14.019) and is again limited to the range from -100.00% to 100.00% before being routed to the destination defined by *PID1 Destination* (14.016).

| Parameter         | 14.002 <i>PID1 Feed-forwards Reference Source</i>                        |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the input source for the feed-forwards reference source for PID1 |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, PT, BU   |                |                  |

See *PID1 Output* (14.001).

| Parameter         | 14.003 <i>PID1 Reference Source</i>                 |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the input source for the reference for PID1 |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.000   | Maximum        | 59.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save                                    | Update Rate    | Drive reset read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, PT, BU  |                |                  |

The reference section for the PID controllers is shown in the introduction. The pre-sleep boost control is only included in PID controller 1. The reference sections are always active even if the PID controller itself is disabled or the reference sources are not routed to valid parameters. If a reference source is not a valid parameter or is 0.000 then the value is taken as zero.

The reference is the sum of the reference source, the *PID1 Digital Reference* (14.025) and the *PID1 Pre-sleep Boost Level* (14.028) when it is active. The result is multiplied by *PID1 Reference Scaling* (14.023) and then limited to +/-100.00%. The reference can then be inverted if required (*PID1 Reference Invert* (14.005) = 1) and then a slew rate limit is applied with *PID1 Reference Slew Rate* (14.007). This limits the maximum rate of change so that a change from 0.00 to 100.00% takes the time given in *PID1 Reference Slew Rate* (14.007).

Sleep mode is used to stop the motor if the frequency or speed reference falls below a specified level so that the system does not run inefficiently at low speeds (see *Sleep / Wake Threshold* (06.053)). If the frequency or speed reference is controlled by PID controller 1 then the PID controller feedback will fall when sleep mode becomes active because the motor has stopped. The PID controller output will rise again above the sleep/wake threshold and the motor will restart. To minimise the number of transitions into and out of sleep mode the sleep condition can be delayed and an increased reference applied during this period by setting *PID1 Pre-sleep Boost Level* (14.028) to a non-zero value. When *Sleep Required* (06.056) = 1 the *PID1 Pre-sleep Boost Level* (14.028) is added to the reference until *PID1 Error* (14.022) is reduced below zero or until this additional reference has been applied for *PID1 Maximum Boost Time* (14.029). This system is only intended for applications where PID controller 1 alone is used to control the motor frequency or speed via the Menu 1 reference system and the motor rotates in the positive direction under normal conditions. When the PID output first falls below the *Sleep / Wake Threshold* (06.053) it is possible for *PID1 Error* (14.022) to be negative because of a positive value remaining in the integral accumulator. To allow the error to become positive so that the boost period is not terminated immediately, the *PID1 Pre-sleep Boost Level* (14.028) is applied for a minimum of 100ms before the end of the boost period can be terminated because *PID1 Error* (14.022) is greater than or equal to zero.

| Parameter         | 14.004 <i>PID1 Feedback Source</i>                 |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the input source for the feedback for PID1 |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, PT, BU   |                |                  |

## Feedback

The feedback section for the PID controllers is shown in the introduction. The feedback sections are always active even if the PID controller itself is disabled or the feedback sources are not routed to valid parameters. If a reference source is not a valid parameter or is 0.000 then the value is taken as zero.

The feedback is the sum of the feedback source and the *PID1 Digital Feedback* (14.026). The result is multiplied by *PID1 Feedback Scaling* (14.024) and then limited to +/-100.00%. A square root function can be applied (*PID1 Feedback Square Root Enable 1* (14.060) = 1) and the feedback can then be inverted if required (*PID1 Feedback Invert* (14.006) = 1). The square root function is defined as follows.

Square root function output =  $\text{Sign}(\text{Input}) \times 100.00\% \times \sqrt{(|\text{Input}| / 100.00\%)}$

where  $\text{Sign}(\text{Input}) = 1$  if  $\text{Input} \geq 0$  or  $-1$  otherwise

The square root function is useful in applications where the PID controller is operating with air flow as its reference and feedback and the motor is controlling a fan. It is easier to use a pressure transducer than a flow transducer, and so the feedback from the transducer needs to be converted from pressure to flow. As  $\text{flow} = \text{Constant} \times \sqrt{\text{Pressure}}$  the square root function can be used in the conversion.

| Parameter         | 14.005 PID1 Reference Invert      |                |          |
|-------------------|-----------------------------------|----------------|----------|
| Short description | Set to 1 to invert PID1 reference |                |          |
| Mode              | RFC-A                             |                |          |
| Minimum           | 0                                 | Maximum        | 1        |
| Default           | 0                                 | Units          |          |
| Type              | 1 Bit User Save                   | Update Rate    | 4ms read |
| Display Format    | Standard                          | Decimal Places | 0        |
| Coding            | RW                                |                |          |

See *PID1 Reference Source* (14.003).

| Parameter         | 14.006 PID1 Feedback Invert          |                |          |
|-------------------|--------------------------------------|----------------|----------|
| Short description | Set to 1 to invert the PID1 feedback |                |          |
| Mode              | RFC-A                                |                |          |
| Minimum           | 0                                    | Maximum        | 1        |
| Default           | 0                                    | Units          |          |
| Type              | 1 Bit User Save                      | Update Rate    | 4ms read |
| Display Format    | Standard                             | Decimal Places | 0        |
| Coding            | RW                                   |                |          |

See *PID1 Feedback Source* (14.004).

| Parameter         | 14.007 PID1 Reference Slew Rate               |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the rate in change of output for PID1 |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.0   | Maximum        | 3200.0          |
| Default           | 0.0   | Units          | s               |
| Type              | 16 Bit User Save                              | Update Rate    | Background read |
| Display Format    | Standard                                      | Decimal Places | 1               |
| Coding            | RW  |                |                 |

See *PID1 Reference Source* (14.003).

| Parameter         | 14.008 PID1 Enable      |                |          |
|-------------------|-------------------------|----------------|----------|
| Short description | Enables the use of PID1 |                |          |
| Mode              | RFC-A                   |                |          |
| Minimum           | 0                       | Maximum        | 1        |
| Default           | 0                       | Units          |          |
| Type              | 1 Bit User Save         | Update Rate    | 4ms read |
| Display Format    | Standard                | Decimal Places | 0        |
| Coding            | RW                      |                |          |

See *PID1 Output* (14.001).

| Parameter         | 14.009 PID1 Enable Source 1                |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the input source for enabling PID1 |                |                  |
| Mode              | RFC-A                                      |                |                  |
| Minimum           | 0.000                                      | Maximum        | 59.999           |
| Default           | 0.000                                      | Units          |                  |
| Type              | 16 Bit User Save                           | Update Rate    | Drive reset read |
| Display Format    | Standard                                   | Decimal Places | 3                |
| Coding            | RW, PT, BU                                 |                |                  |

See *PID1 Output* (14.001).

| Parameter         | 14.010 PID1 Proportional Gain     |                |                 |
|-------------------|-----------------------------------|----------------|-----------------|
| Short description | Defines the Kp gain used for PID1 |                |                 |
| Mode              | RFC-A                             |                |                 |
| Minimum           | 0.000                             | Maximum        | 4.000           |
| Default           | 1.000                             | Units          |                 |
| Type              | 16 Bit User Save                  | Update Rate    | Background read |
| Display Format    | Standard                          | Decimal Places | 3               |
| Coding            | RW                                |                |                 |

See *PID1 Output* (14.001).



| Parameter         | 14.011 <i>PID1 Integral Gain</i>  |                |                 |
|-------------------|-----------------------------------|----------------|-----------------|
| Short description | Defines the Ki gain used for PID1 |                |                 |
| Mode              | RFC-A                             |                |                 |
| Minimum           | 0.000                             | Maximum        | 4.000           |
| Default           | 0.500                             | Units          |                 |
| Type              | 16 Bit User Save                  | Update Rate    | Background read |
| Display Format    | Standard                          | Decimal Places | 3               |
| Coding            | RW                                |                |                 |

See *PID1 Output* (14.001).

| Parameter         | 14.012 <i>PID1 Differential Gain</i> |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description | Defines the Kd gain used for PID1    |                |                 |
| Mode              | RFC-A                                |                |                 |
| Minimum           | 0.000                                | Maximum        | 4.000           |
| Default           | 0.000                                | Units          |                 |
| Type              | 16 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                             | Decimal Places | 3               |
| Coding            | RW                                   |                |                 |

See *PID1 Output* (14.001).

| Parameter         | 14.013 <i>PID1 Output Upper Limit</i>            |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the maximum value of the output for PID1 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0.00   | Maximum        | 100.00   |
| Default           | 100.00   | Units          | %        |
| Type              | 16 Bit User Save                                 | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 2        |
| Coding            | RW   |                |          |

See *PID1 Output* (14.001).

| Parameter         | 14.014 <i>PID1 Output Lower Limit</i>            |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the minimum value of the output for PID1 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | -100.00  | Maximum        | 100.00   |
| Default           | -100.00  | Units          | %        |
| Type              | 16 Bit User Save                                 | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 2        |
| Coding            | RW   |                |          |

See *PID1 Output* (14.001).

| Parameter         | 14.015 <i>PID1 Output Scaling</i>                 |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling factor of the output for PID1 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0.000   | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save                                  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *PID1 Output* (14.001).

| Parameter         | 14.016 <i>PID1 Destination</i>        |                |                  |
|-------------------|---------------------------------------|----------------|------------------|
| Short description | Defines the output parameter for PID1 |                |                  |
| Mode              | RFC-A                                 |                |                  |
| Minimum           | 0.000                                 | Maximum        | 59.999           |
| Default           | 0.000                                 | Units          |                  |
| Type              | 16 Bit User Save                      | Update Rate    | Drive reset read |
| Display Format    | Standard                              | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                        |                |                  |

See *PID1 Output* (14.001).

| Parameter         | 14.017 PID1 Integral Hold                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Enables the integral hold function for PID1 |                |          |
| Mode              | RFC-A                                       |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile                              | Update Rate    | 4ms read |
| Display Format    | Standard                                    | Decimal Places | 0        |
| Coding            | RW  |                |          |

See *PID1 Output* (14.001).

| Parameter         | 14.018 PID1 Symmetrical Limit Enable   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Enables the symmetrical limit for PID1 |                |                 |
| Mode              | RFC-A                                  |                |                 |
| Minimum           | 0                                      | Maximum        | 1               |
| Default           | 0                                      | Units          |                 |
| Type              | 1 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                               | Decimal Places | 0               |
| Coding            | RW                                     |                |                 |

See *PID1 Output* (14.001).

| Parameter         | 14.019 PID1 Feed-forwards Reference                        |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the value of the feed-forwards reference for PID1 |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | -100.00  | Maximum        | 100.00    |
| Default           |  | Units          | %         |
| Type              | 16 Bit Volatile  | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT   |                |           |

See *PID1 Output* (14.001).

| Parameter         | 14.020 PID1 Reference                        |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the value of the reference for PID1 |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | -100.00                                      | Maximum        | 100.00    |
| Default           |  | Units          | %         |
| Type              | 16 Bit Volatile                              | Update Rate    | 4ms write |
| Display Format    | Standard                                     | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT                               |                |           |

See *PID1 Reference Source* (14.003).

| Parameter         | 14.021 PID1 Feedback                        |                |           |
|-------------------|---|----------------|-----------|
| Short description | Displays the value of the feedback for PID1 |                |           |
| Mode              | RFC-A                                       |                |           |
| Minimum           | -100.00                                     | Maximum        | 100.00    |
| Default           |   | Units          | %         |
| Type              | 16 Bit Volatile                             | Update Rate    | 4ms write |
| Display Format    | Standard                                    | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT                              |                |           |

See *PID1 Feedback Source* (14.004).

| Parameter         | 14.022 PID1 Error                        |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the value of the error for PID1 |                |           |
| Mode              | RFC-A                                    |                |           |
| Minimum           | -100.00                                  | Maximum        | 100.00    |
| Default           |  | Units          | %         |
| Type              | 16 Bit Volatile                          | Update Rate    | 4ms write |
| Display Format    | Standard                                 | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT                           |                |           |

See *PID1 Output* (14.001).

| Parameter         | 14.023 PID1 Reference Scaling                         |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling factor for the reference for PID1 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0.000   | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save                                      | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *PID1 Reference Source* (14.003).

| Parameter         | 14.024 PID1 Feedback Scaling                        |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling factor of the feedback for PID1 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0.000   | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save                                    | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *PID1 Feedback Source* (14.004).

| Parameter         | 14.025 PID1 Digital Reference                       |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the value of the digital reference for PID1 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | -100.00   | Maximum        | 100.00   |
| Default           | 0.00  | Units          | %        |
| Type              | 16 Bit User Save                                    | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 2        |
| Coding            | RW  |                |          |

See *PID1 Reference Source* (14.003).

| Parameter         | 14.026 PID1 Digital Feedback                       |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the value of the digital feedback for PID1 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | -100.00  | Maximum        | 100.00   |
| Default           | 0.00   | Units          | %        |
| Type              | 16 Bit User Save                                   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 2        |
| Coding            | RW   |                |          |

See *PID1 Feedback Source* (14.004).

| Parameter         | 14.027 PID1 Enable Source 2                |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the input source for enabling PID1 |                |                  |
| Mode              | RFC-A                                      |                |                  |
| Minimum           | 0.000                                      | Maximum        | 59.999           |
| Default           | 0.000                                      | Units          |                  |
| Type              | 16 Bit User Save                           | Update Rate    | Drive reset read |
| Display Format    | Standard                                   | Decimal Places | 3                |
| Coding            | RW, PT, BU                                 |                |                  |

See *PID1 Output* (14.001).

| Parameter         | 14.028 PID1 Pre-sleep Boost Level                 |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the level of the pre-sleep boost function |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.00  | Maximum        | 100.00          |
| Default           | 0.00  | Units          | %               |
| Type              | 16 Bit User Save                                  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 2               |
| Coding            | RW  |                |                 |

See *PID1 Reference Source* (14.003).

| Parameter         | 14.029 PID1 Maximum Boost Time                            |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the maximum time that the boost level can be used |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.0   | Maximum        | 250.0           |
| Default           | 0.0   | Units          | s               |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW, BU  |                |                 |

See *PID1 Reference Source* (14.003).

| Parameter         | 14.030 PID1 Pre-sleep Boost Level Enable |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Enables the pre-sleep boost function     |                |                  |
| Mode              | RFC-A                                    |                |                  |
| Minimum           | 0  | Maximum        | 1                |
| Default           |  | Units          |                  |
| Type              | 1 Bit Volatile                           | Update Rate    | Background write |
| Display Format    | Standard                                 | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                           |                |                  |

See *PID1 Reference Source* (14.003).

| Parameter         | 14.031 PID2 Output           |                |           |
|-------------------|------------------------------|----------------|-----------|
| Short description | Displays the output for PID2 |                |           |
| Mode              | RFC-A                        |                |           |
| Minimum           | -100.00                      | Maximum        | 100.00    |
| Default           |                              | Units          | %         |
| Type              | 16 Bit Volatile              | Update Rate    | 4ms write |
| Display Format    | Standard                     | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT               |                |           |

See *PID1 Output* (14.001).

| Parameter         | 14.032 PID2 Feed-forwards Reference Source                               |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the input source for the feed-forwards reference source for PID2 |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, PT, BU   |                |                  |

See *PID1 Feed-forwards Reference Source* (14.002).

| Parameter         | 14.033 PID2 Reference Source                        |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Defines the input source for the reference for PID2 |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.000   | Maximum        | 59.999           |
| Default           | 0.000   | Units          |                  |
| Type              | 16 Bit User Save                                    | Update Rate    | Drive reset read |
| Display Format    | Standard  | Decimal Places | 3                |
| Coding            | RW, PT, BU  |                |                  |

See *PID1 Reference Source* (14.003).

| Parameter         | 14.034 PID2 Feedback Source                        |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the input source for the feedback for PID2 |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | 0.000  | Maximum        | 59.999           |
| Default           | 0.000  | Units          |                  |
| Type              | 16 Bit User Save                                   | Update Rate    | Drive reset read |
| Display Format    | Standard   | Decimal Places | 3                |
| Coding            | RW, PT, BU   |                |                  |

See *PID1 Feedback Source* (14.004).

| Parameter         | 14.035 <i>PID2 Reference Invert</i> |                |          |
|-------------------|-------------------------------------|----------------|----------|
| Short description | Set to 1 to invert PID2 reference   |                |          |
| Mode              | RFC-A                               |                |          |
| Minimum           | 0                                   | Maximum        | 1        |
| Default           | 0                                   | Units          |          |
| Type              | 1 Bit User Save                     | Update Rate    | 4ms read |
| Display Format    | Standard                            | Decimal Places | 0        |
| Coding            | RW                                  |                |          |

See *PID1 Reference Invert* (14.005).

| Parameter         | 14.036 <i>PID2 Feedback Invert</i> |                |          |
|-------------------|------------------------------------|----------------|----------|
| Short description | Set to 1 to invert PID2 feedback   |                |          |
| Mode              | RFC-A                              |                |          |
| Minimum           | 0                                  | Maximum        | 1        |
| Default           | 0                                  | Units          |          |
| Type              | 1 Bit User Save                    | Update Rate    | 4ms read |
| Display Format    | Standard                           | Decimal Places | 0        |
| Coding            | RW                                 |                |          |

See *PID1 Feedback Invert* (14.006).

| Parameter         | 14.037 <i>PID2 Reference Slew Rate Limit</i>  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the rate in change of output for PID2 |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.0   | Maximum        | 3200.0          |
| Default           | 0.0   | Units          | s               |
| Type              | 16 Bit User Save                              | Update Rate    | Background read |
| Display Format    | Standard                                      | Decimal Places | 1               |
| Coding            | RW  |                |                 |

See *PID1 Reference Slew Rate* (14.007).

| Parameter         | 14.038 <i>PID2 Enable</i> |                |          |
|-------------------|---------------------------|----------------|----------|
| Short description | Enables the use of PID2   |                |          |
| Mode              | RFC-A                     |                |          |
| Minimum           | 0                         | Maximum        | 1        |
| Default           | 0                         | Units          |          |
| Type              | 1 Bit User Save           | Update Rate    | 4ms read |
| Display Format    | Standard                  | Decimal Places | 0        |
| Coding            | RW                        |                |          |

See *PID1 Enable* (14.008).

| Parameter         | 14.039 <i>PID2 Enable Source 1</i>         |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the input source for enabling PID2 |                |                  |
| Mode              | RFC-A                                      |                |                  |
| Minimum           | 0.000                                      | Maximum        | 59.999           |
| Default           | 0.000                                      | Units          |                  |
| Type              | 16 Bit User Save                           | Update Rate    | Drive reset read |
| Display Format    | Standard                                   | Decimal Places | 3                |
| Coding            | RW, PT, BU                                 |                |                  |

See *PID1 Enable Source 1* (14.009).

| Parameter         | 14.040 <i>PID2 Proportional Gain</i> |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description | Defines the Kp gain used for PID2    |                |                 |
| Mode              | RFC-A                                |                |                 |
| Minimum           | 0.000                                | Maximum        | 4.000           |
| Default           | 1.000                                | Units          |                 |
| Type              | 16 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                             | Decimal Places | 3               |
| Coding            | RW                                   |                |                 |

See *PID1 Proportional Gain* (14.010).

| Parameter         | 14.041 PID2 Integral Gain         |                |                 |
|-------------------|-----------------------------------|----------------|-----------------|
| Short description | Defines the Ki gain used for PID2 |                |                 |
| Mode              | RFC-A                             |                |                 |
| Minimum           | 0.000                             | Maximum        | 4.000           |
| Default           | 0.500                             | Units          |                 |
| Type              | 16 Bit User Save                  | Update Rate    | Background read |
| Display Format    | Standard                          | Decimal Places | 3               |
| Coding            | RW                                |                |                 |

See *PID1 Integral Gain* (14.011).

| Parameter         | 14.042 PID2 Differential Gain     |                |                 |
|-------------------|-----------------------------------|----------------|-----------------|
| Short description | Defines the Kd gain used for PID2 |                |                 |
| Mode              | RFC-A                             |                |                 |
| Minimum           | 0.000                             | Maximum        | 4.000           |
| Default           | 0.000                             | Units          |                 |
| Type              | 16 Bit User Save                  | Update Rate    | Background read |
| Display Format    | Standard                          | Decimal Places | 3               |
| Coding            | RW                                |                |                 |

See *PID1 Differential Gain* (14.012).

| Parameter         | 14.043 PID2 Output Upper Limit                   |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the maximum value of the output for PID2 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0.00   | Maximum        | 100.00   |
| Default           | 100.00   | Units          | %        |
| Type              | 16 Bit User Save                                 | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 2        |
| Coding            | RW   |                |          |

See *PID1 Output Upper Limit* (14.013).

| Parameter         | 14.044 PID2 Output Lower Limit                   |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the minimum value of the output for PID2 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | -100.00  | Maximum        | 100.00   |
| Default           | -100.00  | Units          | %        |
| Type              | 16 Bit User Save                                 | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 2        |
| Coding            | RW   |                |          |

See *PID1 Output Lower Limit* (14.014).

| Parameter         | 14.045 PID2 Output Scaling                        |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling factor of the output for PID2 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0.000   | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save                                  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *PID1 Output Scaling* (14.015).

| Parameter         | 14.046 PID2 Destination               |                |                  |
|-------------------|---------------------------------------|----------------|------------------|
| Short description | Defines the output parameter for PID2 |                |                  |
| Mode              | RFC-A                                 |                |                  |
| Minimum           | 0.000                                 | Maximum        | 59.999           |
| Default           | 0.000                                 | Units          |                  |
| Type              | 16 Bit User Save                      | Update Rate    | Drive reset read |
| Display Format    | Standard                              | Decimal Places | 3                |
| Coding            | RW, DE, PT, BU                        |                |                  |

See *PID1 Destination* (14.016).

| Parameter         | 14.047 PID2 Integral Hold                   |                |          |
|-------------------|---|----------------|----------|
| Short description | Enables the integral hold function for PID2 |                |          |
| Mode              | RFC-A                                       |                |          |
| Minimum           | 0   | Maximum        | 1        |
| Default           | 0   | Units          |          |
| Type              | 1 Bit Volatile                              | Update Rate    | 4ms read |
| Display Format    | Standard                                    | Decimal Places | 0        |
| Coding            | RW  |                |          |

See *PID1 Integral Hold* (14.017).

| Parameter         | 14.048 PID2 Symmetrical Limit Enable   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Enables the symmetrical limit for PID2 |                |                 |
| Mode              | RFC-A                                  |                |                 |
| Minimum           | 0                                      | Maximum        | 1               |
| Default           | 0                                      | Units          |                 |
| Type              | 1 Bit User Save                        | Update Rate    | Background read |
| Display Format    | Standard                               | Decimal Places | 0               |
| Coding            | RW                                     |                |                 |

See *PID1 Symmetrical Limit Enable* (14.018).

| Parameter         | 14.049 PID2 Feed-forwards Reference                        |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the value of the feed-forwards reference for PID2 |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | -100.00  | Maximum        | 100.00    |
| Default           |  | Units          | %         |
| Type              | 16 Bit Volatile  | Update Rate    | 4ms write |
| Display Format    | Standard   | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT   |                |           |

See *PID1 Feed-forwards Reference* (14.019).

| Parameter         | 14.050 PID2 Reference                        |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the value of the reference for PID2 |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | -100.00                                      | Maximum        | 100.00    |
| Default           |  | Units          | %         |
| Type              | 16 Bit Volatile                              | Update Rate    | 4ms write |
| Display Format    | Standard                                     | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT                               |                |           |

See *PID1 Reference* (14.020).

| Parameter         | 14.051 PID2 Feedback                        |                |           |
|-------------------|---|----------------|-----------|
| Short description | Displays the value of the feedback for PID2 |                |           |
| Mode              | RFC-A                                       |                |           |
| Minimum           | -100.00                                     | Maximum        | 100.00    |
| Default           |   | Units          | %         |
| Type              | 16 Bit Volatile                             | Update Rate    | 4ms write |
| Display Format    | Standard                                    | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT                              |                |           |

See *PID1 Feedback* (14.021).

| Parameter         | 14.052 PID2 Error                        |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays the value of the error for PID2 |                |           |
| Mode              | RFC-A                                    |                |           |
| Minimum           | -100.00                                  | Maximum        | 100.00    |
| Default           |  | Units          | %         |
| Type              | 16 Bit Volatile                          | Update Rate    | 4ms write |
| Display Format    | Standard                                 | Decimal Places | 2         |
| Coding            | RO, ND, NC, PT                           |                |           |

See *PID1 Error* (14.022).

| Parameter         | 14.053 <i>PID2 Reference Scaling</i>                  |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling factor for the reference for PID2 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0.000   | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save                                      | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *PID1 Reference Scaling* (14.023).

| Parameter         | 14.054 <i>PID2 Feedback Scaling</i>                 |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the scaling factor of the feedback for PID2 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0.000   | Maximum        | 4.000    |
| Default           | 1.000   | Units          |          |
| Type              | 16 Bit User Save                                    | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 3        |
| Coding            | RW  |                |          |

See *PID1 Feedback Scaling* (14.024).

| Parameter         | 14.055 <i>PID2 Digital Reference</i>                |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the value of the digital reference for PID2 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | -100.00   | Maximum        | 100.00   |
| Default           | 0.00  | Units          | %        |
| Type              | 16 Bit User Save                                    | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 2        |
| Coding            | RW  |                |          |

See *PID1 Digital Reference* (14.025).

| Parameter         | 14.056 <i>PID2 Digital Feedback</i>                |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the value of the digital feedback for PID2 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | -100.00  | Maximum        | 100.00   |
| Default           | 0.00   | Units          | %        |
| Type              | 16 Bit User Save                                   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 2        |
| Coding            | RW   |                |          |

See *PID1 Digital Feedback* (14.026).

| Parameter         | 14.057 <i>PID2 Enable Source 2</i>         |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the input source for enabling PID2 |                |                  |
| Mode              | RFC-A                                      |                |                  |
| Minimum           | 0.000                                      | Maximum        | 59.999           |
| Default           | 0.000                                      | Units          |                  |
| Type              | 16 Bit User Save                           | Update Rate    | Drive reset read |
| Display Format    | Standard                                   | Decimal Places | 3                |
| Coding            | RW, PT, BU                                 |                |                  |

See *PID1 Enable Source 2* (14.027).

| Parameter         | 14.058 <i>PID1 Feedback Output Scaling</i>                 |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the scaling factor of the output feedback for PID1 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0.000  | Maximum        | 4.000    |
| Default           | 1.000  | Units          |          |
| Type              | 16 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 3        |
| Coding            | RW   |                |          |

#### PID1 alternative feedback and error selection

The description given in *PID1 Output* (14.001) assumed that *PID1 Mode Selector* (14.059) = 0 so that PID controller 1 uses its own feedback (FBK1). It is possible to select alternative configurations that allow various combinations of feedback or error from either PID controller to be used as shown



below.

*PID1 Mode Selector* (14.059) can be used to select the feedback and error as shown in the table below. It should be noted that PID controller 2 will operate normally even when its feedback or error has been selected for PID controller 1. However, if *PID1 Mode Selector* (14.059) is non-zero PID controller 2 enable is controlled directly by the enable state of PID controller 1.

| <b>PID1 Mode Selector (14.059)</b> | <b>Feedback</b>         | <b>Error</b>                              |
|------------------------------------|-------------------------|---|
| 0: Fbk1                            | FBK1                    | ERR1                                      |
| 1: Fbk2                            | FBK2                    | ERR1                                      |
| 2: Fbk1 + Fbk2                     | FBK1 + FBK2             | ERR1                                      |
| 3: Min Fbk                         | Lowest of FBK1 or FBK2  | ERR1                                      |
| 4: Max Fbk                         | Highest of FBK1 or FBK2 | ERR1                                      |
| 5: Av Fbk                          | (FBK1 + FBK2) / 2       | ERR1                                      |
| 6: Min Error                       | FBK1                    | If  ERR1  ≤  ERR2  then ERR1<br>Else ERR2 |
| 7: Max Error                       | FBK1                    | If  ERR1  ≥  ERR2  then ERR1<br>Else ERR2 |

*PID1 Feedback Output Scaling* (14.058) can then be used to scale the results. *PID1 Feedback Square Root Enable 2* (14.062) can be used in converting the output of the combined feedback from pressure to flow. It is easier to use a pressure transducer than a flow transducer, and so the feedback from the transducer needs to be converted from pressure to flow. As flow = Constant × √Pressure the square root function can be used in the conversion.

| <b>Parameter</b>  | <b>14.059 PID1 Mode Selector</b> |                |                 |
|-------------------|----------------------------------|----------------|-----------------|
| Short description | Defines the mode of PID1         |                |                 |
| Mode              | RFC-A                            |                |                 |
| Minimum           | 0                                | Maximum        | 7               |
| Default           | 0                                | Units          |                 |
| Type              | 8 Bit User Save                  | Update Rate    | Background read |
| Display Format    | Standard                         | Decimal Places | 0               |
| Coding            | RW, TE                           |                |                 |

| <b>Value</b> | <b>Text</b> |
|--------------|-------------|
| 0            | Fbk1        |
| 1            | Fbk2        |
| 2            | Fbk1 + Fbk2 |
| 3            | Min Fbk     |
| 4            | Max Fbk     |
| 5            | Av Fbk      |
| 6            | Min Error   |
| 7            | Max Error   |

See *PID1 Feedback Output Scaling* (14.058).

| <b>Parameter</b>  | <b>14.060 PID1 Feedback Square Root Enable 1</b> |                |          |
|-------------------|--|----------------|----------|
| Short description | Enables the square root function of PID1         |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save                                  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW   |                |          |

See *PID1 Feedback Source* (14.004).

| <b>Parameter</b>  | <b>14.061 PID2 Feedback Square Root Enable</b> |                |          |
|-------------------|--|----------------|----------|
| Short description | Enables the square root function of PID2       |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save                                | Update Rate    | 4ms read |
| Display Format    | Standard                                       | Decimal Places | 0        |
| Coding            | RW   |                |          |

See *PID1 Feedback Square Root Enable 1* (14.060)

| Parameter         | 14.062 <i>PID1 Feedback Square Root Enable 2</i> |                |          |
|-------------------|--|----------------|----------|
| Short description | Enables the square root function of PID1         |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save                                  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW   |                |          |

See *PID1 Feedback Output Scaling* (14.058).

# Menu 18 Single Line Descriptions – *Application Menu 1*

Mode: RFC-A

| Parameter |  | Range             | Default | Type |     |    |    |  |    |
|-----------|--|-------------------|---------|------|-----|----|----|--|----|
| 18.001    | Application Menu 1 Power-down Save Integer | -32768 to 32767   | 0       | RW   | Num |    |    |  | PS |
| 18.002    | Application Menu 1 Read-only Integer 2     | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 18.003    | Application Menu 1 Read-only Integer 3     | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 18.004    | Application Menu 1 Read-only Integer 4     | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 18.005    | Application Menu 1 Read-only Integer 5     | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 18.006    | Application Menu 1 Read-only Integer 6     | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 18.007    | Application Menu 1 Read-only Integer 7     | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 18.008    | Application Menu 1 Read-only Integer 8     | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 18.009    | Application Menu 1 Read-only Integer 9     | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 18.010    | Application Menu 1 Read-only Integer 10    | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 18.011    | Application Menu 1 Read-write Integer 11   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.012    | Application Menu 1 Read-write Integer 12   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.013    | Application Menu 1 Read-write Integer 13   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.014    | Application Menu 1 Read-write Integer 14   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.015    | Application Menu 1 Read-write Integer 15   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.016    | Application Menu 1 Read-write Integer 16   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.017    | Application Menu 1 Read-write Integer 17   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.018    | Application Menu 1 Read-write Integer 18   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.019    | Application Menu 1 Read-write Integer 19   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.020    | Application Menu 1 Read-write Integer 20   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.021    | Application Menu 1 Read-write Integer 21   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.022    | Application Menu 1 Read-write Integer 22   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.023    | Application Menu 1 Read-write Integer 23   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.024    | Application Menu 1 Read-write Integer 24   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.025    | Application Menu 1 Read-write Integer 25   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.026    | Application Menu 1 Read-write Integer 26   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.027    | Application Menu 1 Read-write Integer 27   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.028    | Application Menu 1 Read-write Integer 28   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.029    | Application Menu 1 Read-write Integer 29   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.030    | Application Menu 1 Read-write Integer 30   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 18.031    | Application Menu 1 Read-write bit 31       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.032    | Application Menu 1 Read-write bit 32       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.033    | Application Menu 1 Read-write bit 33       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.034    | Application Menu 1 Read-write bit 34       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.035    | Application Menu 1 Read-write bit 35       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.036    | Application Menu 1 Read-write bit 36       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.037    | Application Menu 1 Read-write bit 37       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.038    | Application Menu 1 Read-write bit 38       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.039    | Application Menu 1 Read-write bit 39       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.040    | Application Menu 1 Read-write bit 40       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.041    | Application Menu 1 Read-write bit 41       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.042    | Application Menu 1 Read-write bit 42       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.043    | Application Menu 1 Read-write bit 43       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.044    | Application Menu 1 Read-write bit 44       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.045    | Application Menu 1 Read-write bit 45       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.046    | Application Menu 1 Read-write bit 46       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.047    | Application Menu 1 Read-write bit 47       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 18.048    | Application Menu 1 Read-write bit 48       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |

|        |  |                           |         |    |     |  |  |  |  |    |
|--------|--|---------------------------|---------|----|-----|--|--|--|--|----|
| 18.049 | Application Menu 1 Read-write bit 49               | Off (0) or On (1)         | Off (0) | RW | Bit |  |  |  |  | US |
| 18.050 | Application Menu 1 Read-write bit 50               | Off (0) or On (1)         | Off (0) | RW | Bit |  |  |  |  | US |
| 18.051 | Application Menu 1 Power-down Save Long Integer 51 | -2147483648 to 2147483647 | 0       | RW | Num |  |  |  |  | PS |
| 18.052 | Application Menu 1 Power-down Save Long Integer 52 | -2147483648 to 2147483647 | 0       | RW | Num |  |  |  |  | PS |
| 18.053 | Application Menu 1 Power-down Save Long Integer 53 | -2147483648 to 2147483647 | 0       | RW | Num |  |  |  |  | PS |
| 18.054 | Application Menu 1 Power-down Save Long Integer 54 | -2147483648 to 2147483647 | 0       | RW | Num |  |  |  |  | PS |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 18 – Application Menu 1

Mode: RFC-A

Menus 18-20 are general application menus that can be used by one of the option modules fitted to the drive. These menus are customisable and the following RAM is provided to be shared between all 3 menus. This is based on increasing the RAM provided for Unidrive SP by approximately 20%.

|                        | 1  | 8  | 16 | 32 |
|------------------------|----|----|----|----|
| <b>Volatile</b>        | 0  | 32 | 64 | 32 |
| <b>User save</b>       | 64 | 32 | 48 | 12 |
| <b>Power-down save</b> | 0  | 0  | 2  | 8  |

If no option modules provide customisation tables for these menus then the drive provides the customisation tables to give the following parameters.

| Parameter         | 18.001 Application Menu 1 Power-down Save Integer     |                |       |
|-------------------|---|----------------|-------|
| Short description | General power-down save integer application parameter |                |       |
| Mode              | RFC-A   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           | 0   | Units          |       |
| Type              | 16 Bit Power Down Save                                | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RW  |                |       |

| Parameter         | 18.002 Application Menu 1 Read-only Integer 2   |                |       |
|-------------------|---|----------------|-------|
| Short description | General read-only integer application parameter |                |       |
| Mode              | RFC-A   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           |   | Units          |       |
| Type              | 16 Bit Volatile                                 | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                  |                |       |

| Parameter         | 18.003 Application Menu 1 Read-only Integer 3   |                |       |
|-------------------|---|----------------|-------|
| Short description | General read-only integer application parameter |                |       |
| Mode              | RFC-A   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           |   | Units          |       |
| Type              | 16 Bit Volatile                                 | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                  |                |       |

| Parameter         | 18.004 Application Menu 1 Read-only Integer 4   |                |       |
|-------------------|---|----------------|-------|
| Short description | General read-only integer application parameter |                |       |
| Mode              | RFC-A   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           |   | Units          |       |
| Type              | 16 Bit Volatile                                 | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                  |                |       |

| Parameter         | 18.005 Application Menu 1 Read-only Integer 5   |                |       |
|-------------------|---|----------------|-------|
| Short description | General read-only integer application parameter |                |       |
| Mode              | RFC-A   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           |   | Units          |       |
| Type              | 16 Bit Volatile                                 | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                  |                |       |

| Parameter         | 18.006 Application Menu 1 Read-only Integer 6   |                |       |
|-------------------|---|----------------|-------|
| Short description | General read-only integer application parameter |                |       |
| Mode              | RFC-A   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           |   | Units          |       |
| Type              | 16 Bit Volatile                                 | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                  |                |       |

| Parameter         | 18.007 Application Menu 1 Read-only Integer 7   |                |       |
|-------------------|---|----------------|-------|
| Short description | General read-only integer application parameter |                |       |
| Mode              | RFC-A   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           |   | Units          |       |
| Type              | 16 Bit Volatile                                 | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                  |                |       |

| Parameter         | 18.008 Application Menu 1 Read-only Integer 8   |                |       |
|-------------------|---|----------------|-------|
| Short description | General read-only integer application parameter |                |       |
| Mode              | RFC-A   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           |   | Units          |       |
| Type              | 16 Bit Volatile                                 | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                  |                |       |

| Parameter         | 18.009 Application Menu 1 Read-only Integer 9   |                |       |
|-------------------|---|----------------|-------|
| Short description | General read-only integer application parameter |                |       |
| Mode              | RFC-A   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           |   | Units          |       |
| Type              | 16 Bit Volatile                                 | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                  |                |       |

| Parameter         | 18.010 Application Menu 1 Read-only Integer 10  |                |       |
|-------------------|---|----------------|-------|
| Short description | General read-only integer application parameter |                |       |
| Mode              | RFC-A   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           |   | Units          |       |
| Type              | 16 Bit Volatile                                 | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                  |                |       |

| Parameter         | 18.011 Application Menu 1 Read-write Integer 11  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.012 Application Menu 1 Read-write Integer 12  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.013 Application Menu 1 Read-write Integer 13  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.014 Application Menu 1 Read-write Integer 14  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.015 Application Menu 1 Read-write Integer 15  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.016 Application Menu 1 Read-write Integer 16  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.017 Application Menu 1 Read-write Integer 17  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.018 Application Menu 1 Read-write Integer 18  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.019 Application Menu 1 Read-write Integer 19  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |



| Parameter         | 18.020 Application Menu 1 Read-write Integer 20  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.021 Application Menu 1 Read-write Integer 21  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.022 Application Menu 1 Read-write Integer 22  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.023 Application Menu 1 Read-write Integer 23  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.024 Application Menu 1 Read-write Integer 24  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.025 Application Menu 1 Read-write Integer 25  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.026 Application Menu 1 Read-write Integer 26  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.027 Application Menu 1 Read-write Integer 27  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.028 Application Menu 1 Read-write Integer 28  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.029 Application Menu 1 Read-write Integer 29  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.030 Application Menu 1 Read-write Integer 30  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 18.031 Application Menu 1 Read-write bit 31  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | RFC-A  |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.032 Application Menu 1 Read-write bit 32  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | RFC-A  |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 18.033 Application Menu 1 Read-write bit 33  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | RFC-A  |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.034 Application Menu 1 Read-write bit 34</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.035 Application Menu 1 Read-write bit 35</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.036 Application Menu 1 Read-write bit 36</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.037 Application Menu 1 Read-write bit 37</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.038 Application Menu 1 Read-write bit 38</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.039 Application Menu 1 Read-write bit 39</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.040 Application Menu 1 Read-write bit 40</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.041 Application Menu 1 Read-write bit 41</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.042 Application Menu 1 Read-write bit 42</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.043 Application Menu 1 Read-write bit 43</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.044 Application Menu 1 Read-write bit 44</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.045 Application Menu 1 Read-write bit 45</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.046 Application Menu 1 Read-write bit 46</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.047 Application Menu 1 Read-write bit 47</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.048 Application Menu 1 Read-write bit 48</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.049 Application Menu 1 Read-write bit 49</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>18.050 Application Menu 1 Read-write bit 50</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>   |  |                |            |
|--|--|----------------|------------|
| <b>18.051 Application Menu 1 Power-down Save Long Integer 51</b> |  |                |            |
| Short description  | General power-down save long integer application parameter |                |            |
| Mode   | RFC-A  |                |            |
| Minimum  | -2147483648  | Maximum        | 2147483647 |
| Default  | 0  | Units          |            |
| Type   | 32 Bit Power Down Save                                     | Update Rate    | N/A        |
| Display Format   | Standard   | Decimal Places | 0          |
| Coding   | RW   |                |            |

| <b>Parameter</b>   |  |                |            |
|--|--|----------------|------------|
| <b>18.052 Application Menu 1 Power-down Save Long Integer 52</b> |  |                |            |
| Short description  | General power-down save long integer application parameter |                |            |
| Mode   | RFC-A  |                |            |
| Minimum  | -2147483648  | Maximum        | 2147483647 |
| Default  | 0  | Units          |            |
| Type   | 32 Bit Power Down Save                                     | Update Rate    | N/A        |
| Display Format   | Standard   | Decimal Places | 0          |
| Coding   | RW   |                |            |

| <b>Parameter</b>   |  |                |            |
|--|--|----------------|------------|
| <b>18.053 Application Menu 1 Power-down Save Long Integer 53</b> |  |                |            |
| Short description  | General power-down save long integer application parameter |                |            |
| Mode   | RFC-A  |                |            |
| Minimum  | -2147483648  | Maximum        | 2147483647 |
| Default  | 0  | Units          |            |
| Type   | 32 Bit Power Down Save                                     | Update Rate    | N/A        |
| Display Format   | Standard   | Decimal Places | 0          |
| Coding   | RW   |                |            |

| <b>Parameter</b>   |  |                |            |
|--|--|----------------|------------|
| <b>18.054 Application Menu 1 Power-down Save Long Integer 54</b> |  |                |            |
| Short description  | General power-down save long integer application parameter |                |            |
| Mode   | RFC-A  |                |            |
| Minimum  | -2147483648  | Maximum        | 2147483647 |
| Default  | 0  | Units          |            |
| Type   | 32 Bit Power Down Save                                     | Update Rate    | N/A        |
| Display Format   | Standard   | Decimal Places | 0          |
| Coding   | RW   |                |            |

## Menu 19 Single Line Descriptions – *Application Menu 2*

Mode: RFC-A

| Parameter |  | Range             | Default | Type |     |    |    |  |    |
|-----------|--|-------------------|---------|------|-----|----|----|--|----|
| 19.001    | Application Menu 2 Power-down Save Integer | -32768 to 32767   | 0       | RW   | Num |    |    |  | PS |
| 19.002    | Application Menu 2 Read-only Integer 2     | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 19.003    | Application Menu 2 Read-only Integer 3     | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 19.004    | Application Menu 2 Read-only Integer 4     | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 19.005    | Application Menu 2 Read-only Integer 5     | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 19.006    | Application Menu 2 Read-only Integer 6     | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 19.007    | Application Menu 2 Read-only Integer 7     | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 19.008    | Application Menu 2 Read-only Integer 8     | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 19.009    | Application Menu 2 Read-only Integer 9     | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 19.010    | Application Menu 2 Read-only Integer 10    | -32768 to 32767   |         | RO   | Num | ND | NC |  |    |
| 19.011    | Application Menu 2 Read-write Integer 11   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.012    | Application Menu 2 Read-write Integer 12   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.013    | Application Menu 2 Read-write Integer 13   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.014    | Application Menu 2 Read-write Integer 14   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.015    | Application Menu 2 Read-write Integer 15   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.016    | Application Menu 2 Read-write Integer 16   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.017    | Application Menu 2 Read-write Integer 17   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.018    | Application Menu 2 Read-write Integer 18   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.019    | Application Menu 2 Read-write Integer 19   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.020    | Application Menu 2 Read-write Integer 20   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.021    | Application Menu 2 Read-write Integer 21   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.022    | Application Menu 2 Read-write Integer 22   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.023    | Application Menu 2 Read-write Integer 23   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.024    | Application Menu 2 Read-write Integer 24   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.025    | Application Menu 2 Read-write Integer 25   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.026    | Application Menu 2 Read-write Integer 26   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.027    | Application Menu 2 Read-write Integer 27   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.028    | Application Menu 2 Read-write Integer 28   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.029    | Application Menu 2 Read-write Integer 29   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.030    | Application Menu 2 Read-write Integer 30   | -32768 to 32767   | 0       | RW   | Num |    |    |  | US |
| 19.031    | Application Menu 2 Read-write bit 31       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.032    | Application Menu 2 Read-write bit 32       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.033    | Application Menu 2 Read-write bit 33       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.034    | Application Menu 2 Read-write bit 34       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.035    | Application Menu 2 Read-write bit 35       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.036    | Application Menu 2 Read-write bit 36       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.037    | Application Menu 2 Read-write bit 37       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.038    | Application Menu 2 Read-write bit 38       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.039    | Application Menu 2 Read-write bit 39       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.040    | Application Menu 2 Read-write bit 40       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.041    | Application Menu 2 Read-write bit 41       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.042    | Application Menu 2 Read-write bit 42       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.043    | Application Menu 2 Read-write bit 43       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.044    | Application Menu 2 Read-write bit 44       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.045    | Application Menu 2 Read-write bit 45       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.046    | Application Menu 2 Read-write bit 46       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.047    | Application Menu 2 Read-write bit 47       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |
| 19.048    | Application Menu 2 Read-write bit 48       | Off (0) or On (1) | Off (0) | RW   | Bit |    |    |  | US |

|        |  |                           |         |    |     |  |  |  |  |    |
|--------|--|---------------------------|---------|----|-----|--|--|--|--|----|
| 19.049 | Application Menu 2 Read-write bit 49               | Off (0) or On (1)         | Off (0) | RW | Bit |  |  |  |  | US |
| 19.050 | Application Menu 2 Read-write bit 50               | Off (0) or On (1)         | Off (0) | RW | Bit |  |  |  |  | US |
| 19.051 | Application Menu 2 Power-down Save Long Integer 51 | -2147483648 to 2147483647 | 0       | RW | Num |  |  |  |  | PS |
| 19.052 | Application Menu 2 Power-down Save Long Integer 52 | -2147483648 to 2147483647 | 0       | RW | Num |  |  |  |  | PS |
| 19.053 | Application Menu 2 Power-down Save Long Integer 53 | -2147483648 to 2147483647 | 0       | RW | Num |  |  |  |  | PS |
| 19.054 | Application Menu 2 Power-down Save Long Integer 54 | -2147483648 to 2147483647 | 0       | RW | Num |  |  |  |  | PS |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |



## Menu 19 – Application Menu 2

Mode: RFC-A

See the introduction to menu 18.

| Parameter         | <b>19.001 Application Menu 2 Power-down Save Integer</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General power-down save integer application parameter    |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit Power Down Save                                   | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | <b>19.002 Application Menu 2 Read-only Integer 2</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-only integer application parameter      |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           |  | Units          |       |
| Type              | 16 Bit Volatile                                      | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                       |                |       |

| Parameter         | <b>19.003 Application Menu 2 Read-only Integer 3</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-only integer application parameter      |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           |  | Units          |       |
| Type              | 16 Bit Volatile                                      | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                       |                |       |

| Parameter         | <b>19.004 Application Menu 2 Read-only Integer 4</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-only integer application parameter      |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           |  | Units          |       |
| Type              | 16 Bit Volatile                                      | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                       |                |       |

| Parameter         | <b>19.005 Application Menu 2 Read-only Integer 5</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-only integer application parameter      |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           |  | Units          |       |
| Type              | 16 Bit Volatile                                      | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                       |                |       |

| Parameter         | <b>19.006 Application Menu 2 Read-only Integer 6</b> |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-only integer application parameter      |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           |  | Units          |       |
| Type              | 16 Bit Volatile                                      | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RO, PR, ND, NC                                       |                |       |

| <b>Parameter</b>                                     |   |                |       |
|--|---|----------------|-------|
| <b>19.007 Application Menu 2 Read-only Integer 7</b> |   |                |       |
| Short description                                    | General read-only integer application parameter |                |       |
| Mode   | RFC-A   |                |       |
| Minimum  | -32768  | Maximum        | 32767 |
| Default  |   | Units          |       |
| Type   | 16 Bit Volatile                                 | Update Rate    | N/A   |
| Display Format                                       | Standard  | Decimal Places | 0     |
| Coding   | RO, PR, ND, NC                                  |                |       |

| <b>Parameter</b>                                     |   |                |       |
|--|---|----------------|-------|
| <b>19.008 Application Menu 2 Read-only Integer 8</b> |   |                |       |
| Short description                                    | General read-only integer application parameter |                |       |
| Mode   | RFC-A   |                |       |
| Minimum  | -32768  | Maximum        | 32767 |
| Default  |   | Units          |       |
| Type   | 16 Bit Volatile                                 | Update Rate    | N/A   |
| Display Format                                       | Standard  | Decimal Places | 0     |
| Coding   | RO, PR, ND, NC                                  |                |       |

| <b>Parameter</b>                                     |   |                |       |
|--|---|----------------|-------|
| <b>19.009 Application Menu 2 Read-only Integer 9</b> |   |                |       |
| Short description                                    | General read-only integer application parameter |                |       |
| Mode   | RFC-A   |                |       |
| Minimum  | -32768  | Maximum        | 32767 |
| Default  |   | Units          |       |
| Type   | 16 Bit Volatile                                 | Update Rate    | N/A   |
| Display Format                                       | Standard  | Decimal Places | 0     |
| Coding   | RO, PR, ND, NC                                  |                |       |

| <b>Parameter</b>                                      |   |                |       |
|---|---|----------------|-------|
| <b>19.010 Application Menu 2 Read-only Integer 10</b> |   |                |       |
| Short description                                     | General read-only integer application parameter |                |       |
| Mode  | RFC-A   |                |       |
| Minimum   | -32768  | Maximum        | 32767 |
| Default   |   | Units          |       |
| Type  | 16 Bit Volatile                                 | Update Rate    | N/A   |
| Display Format  | Standard  | Decimal Places | 0     |
| Coding  | RO, PR, ND, NC                                  |                |       |

| <b>Parameter</b>                                       |  |                |       |
|--|--|----------------|-------|
| <b>19.011 Application Menu 2 Read-write Integer 11</b> |  |                |       |
| Short description                                      | General read-write integer application parameter |                |       |
| Mode   | RFC-A  |                |       |
| Minimum  | -32768   | Maximum        | 32767 |
| Default  | 0  | Units          |       |
| Type   | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format   | Standard   | Decimal Places | 0     |
| Coding   | RW   |                |       |

| <b>Parameter</b>                                       |  |                |       |
|--|--|----------------|-------|
| <b>19.012 Application Menu 2 Read-write Integer 12</b> |  |                |       |
| Short description                                      | General read-write integer application parameter |                |       |
| Mode   | RFC-A  |                |       |
| Minimum  | -32768   | Maximum        | 32767 |
| Default  | 0  | Units          |       |
| Type   | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format   | Standard   | Decimal Places | 0     |
| Coding   | RW   |                |       |

| <b>Parameter</b>                                       |  |                |       |
|--|--|----------------|-------|
| <b>19.013 Application Menu 2 Read-write Integer 13</b> |  |                |       |
| Short description                                      | General read-write integer application parameter |                |       |
| Mode   | RFC-A  |                |       |
| Minimum  | -32768   | Maximum        | 32767 |
| Default  | 0  | Units          |       |
| Type   | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format   | Standard   | Decimal Places | 0     |
| Coding   | RW   |                |       |

| Parameter         | 19.014 Application Menu 2 Read-write Integer 14  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.015 Application Menu 2 Read-write Integer 15  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.016 Application Menu 2 Read-write Integer 16  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.017 Application Menu 2 Read-write Integer 17  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.018 Application Menu 2 Read-write Integer 18  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.019 Application Menu 2 Read-write Integer 19  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.020 Application Menu 2 Read-write Integer 20  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.021 Application Menu 2 Read-write Integer 21  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.022 Application Menu 2 Read-write Integer 22  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.023 Application Menu 2 Read-write Integer 23  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.024 Application Menu 2 Read-write Integer 24  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.025 Application Menu 2 Read-write Integer 25  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.026 Application Menu 2 Read-write Integer 26  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.027 Application Menu 2 Read-write Integer 27  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.028 Application Menu 2 Read-write Integer 28  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.029 Application Menu 2 Read-write Integer 29  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.030 Application Menu 2 Read-write Integer 30  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit User Save                                 | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 19.031 Application Menu 2 Read-write bit 31  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | RFC-A  |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 19.032 Application Menu 2 Read-write bit 32  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | RFC-A  |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 19.033 Application Menu 2 Read-write bit 33  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | RFC-A  |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| Parameter         | 19.034 Application Menu 2 Read-write bit 34  |                |     |
|-------------------|--|----------------|-----|
| Short description | General read-write bit application parameter |                |     |
| Mode              | RFC-A  |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |     |
| Type              | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>19.035 Application Menu 2 Read-write bit 35</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>19.036 Application Menu 2 Read-write bit 36</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>19.037 Application Menu 2 Read-write bit 37</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>19.038 Application Menu 2 Read-write bit 38</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>19.039 Application Menu 2 Read-write bit 39</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>19.040 Application Menu 2 Read-write bit 40</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>19.041 Application Menu 2 Read-write bit 41</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>19.042 Application Menu 2 Read-write bit 42</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>19.043 Application Menu 2 Read-write bit 43</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>19.044 Application Menu 2 Read-write bit 44</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>19.045 Application Menu 2 Read-write bit 45</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>19.046 Application Menu 2 Read-write bit 46</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>19.047 Application Menu 2 Read-write bit 47</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>19.048 Application Menu 2 Read-write bit 48</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>19.049 Application Menu 2 Read-write bit 49</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>                                   |  |                |     |
|--|--|----------------|-----|
| <b>19.050 Application Menu 2 Read-write bit 50</b> |  |                |     |
| Short description                                  | General read-write bit application parameter |                |     |
| Mode   | RFC-A  |                |     |
| Minimum  | 0  | Maximum        | 1   |
| Default  | 0  | Units          |     |
| Type   | 1 Bit User Save                              | Update Rate    | N/A |
| Display Format                                     | Standard                                     | Decimal Places | 0   |
| Coding   | RW   |                |     |

| <b>Parameter</b>   |  |                |            |
|--|--|----------------|------------|
| <b>19.051 Application Menu 2 Power-down Save Long Integer 51</b> |  |                |            |
| Short description  | General power-down save long integer application parameter |                |            |
| Mode   | RFC-A  |                |            |
| Minimum  | -2147483648  | Maximum        | 2147483647 |
| Default  | 0  | Units          |            |
| Type   | 32 Bit Power Down Save                                     | Update Rate    | N/A        |
| Display Format   | Standard   | Decimal Places | 0          |
| Coding   | RW   |                |            |

| <b>Parameter</b>   |  |                |            |
|--|--|----------------|------------|
| <b>19.052 Application Menu 2 Power-down Save Long Integer 52</b> |  |                |            |
| Short description  | General power-down save long integer application parameter |                |            |
| Mode   | RFC-A  |                |            |
| Minimum  | -2147483648  | Maximum        | 2147483647 |
| Default  | 0  | Units          |            |
| Type   | 32 Bit Power Down Save                                     | Update Rate    | N/A        |
| Display Format   | Standard   | Decimal Places | 0          |
| Coding   | RW   |                |            |

| <b>Parameter</b>   |  |                |            |
|--|--|----------------|------------|
| <b>19.053 Application Menu 2 Power-down Save Long Integer 53</b> |  |                |            |
| Short description  | General power-down save long integer application parameter |                |            |
| Mode   | RFC-A  |                |            |
| Minimum  | -2147483648  | Maximum        | 2147483647 |
| Default  | 0  | Units          |            |
| Type   | 32 Bit Power Down Save                                     | Update Rate    | N/A        |
| Display Format   | Standard   | Decimal Places | 0          |
| Coding   | RW   |                |            |

| <b>Parameter</b>   |  |                |            |
|--|--|----------------|------------|
| <b>19.054 Application Menu 2 Power-down Save Long Integer 54</b> |  |                |            |
| Short description  | General power-down save long integer application parameter |                |            |
| Mode   | RFC-A  |                |            |
| Minimum  | -2147483648  | Maximum        | 2147483647 |
| Default  | 0  | Units          |            |
| Type   | 32 Bit Power Down Save                                     | Update Rate    | N/A        |
| Display Format   | Standard   | Decimal Places | 0          |
| Coding   | RW   |                |            |



## Menu 20 Single Line Descriptions – Application Menu 3

Mode: RFC-A

| Parameter |   | Range                     | Default | Type |     |  |  |
|-----------|---|---------------------------|---------|------|-----|--|--|
| 20.001    | Application Menu 3 Read-write Integer 1       | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.002    | Application Menu 3 Read-write Integer 2       | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.003    | Application Menu 3 Read-write Integer 3       | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.004    | Application Menu 3 Read-write Integer 4       | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.005    | Application Menu 3 Read-write Integer 5       | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.006    | Application Menu 3 Read-write Integer 6       | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.007    | Application Menu 3 Read-write Integer 7       | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.008    | Application Menu 3 Read-write Integer 8       | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.009    | Application Menu 3 Read-write Integer 9       | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.010    | Application Menu 3 Read-write Integer 10      | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.011    | Application Menu 3 Read-write Integer 11      | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.012    | Application Menu 3 Read-write Integer 12      | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.013    | Application Menu 3 Read-write Integer 13      | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.014    | Application Menu 3 Read-write Integer 14      | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.015    | Application Menu 3 Read-write Integer 15      | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.016    | Application Menu 3 Read-write Integer 16      | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.017    | Application Menu 3 Read-write Integer 17      | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.018    | Application Menu 3 Read-write Integer 18      | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.019    | Application Menu 3 Read-write Integer 19      | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.020    | Application Menu 3 Read-write Integer 20      | -32768 to 32767           | 0       | RW   | Num |  |  |
| 20.021    | Application Menu 3 Read-write Long Integer 21 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.022    | Application Menu 3 Read-write Long Integer 22 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.023    | Application Menu 3 Read-write Long Integer 23 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.024    | Application Menu 3 Read-write Long Integer 24 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.025    | Application Menu 3 Read-write Long Integer 25 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.026    | Application Menu 3 Read-write Long Integer 26 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.027    | Application Menu 3 Read-write Long Integer 27 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.028    | Application Menu 3 Read-write Long Integer 28 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.029    | Application Menu 3 Read-write Long Integer 29 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.030    | Application Menu 3 Read-write Long Integer 30 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.031    | Application Menu 3 Read-write Long Integer 31 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.032    | Application Menu 3 Read-write Long Integer 32 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.033    | Application Menu 3 Read-write Long Integer 33 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.034    | Application Menu 3 Read-write Long Integer 34 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.035    | Application Menu 3 Read-write Long Integer 35 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.036    | Application Menu 3 Read-write Long Integer 36 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.037    | Application Menu 3 Read-write Long Integer 37 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.038    | Application Menu 3 Read-write Long Integer 38 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.039    | Application Menu 3 Read-write Long Integer 39 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |
| 20.040    | Application Menu 3 Read-write Long Integer 40 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 20 – Application Menu 3

Mode: RFC-A

See the introduction to menu 18.

| Parameter         | <b>20.001 Application Menu 3 Read-write Integer 1</b> |                |       |
|-------------------|---|----------------|-------|
| Short description | General read-write integer application parameter      |                |       |
| Mode              | RFC-A   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           | 0   | Units          |       |
| Type              | 16 Bit Volatile                                       | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RW  |                |       |

| Parameter         | <b>20.002 Application Menu 3 Read-write Integer 2</b> |                |       |
|-------------------|---|----------------|-------|
| Short description | General read-write integer application parameter      |                |       |
| Mode              | RFC-A   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           | 0   | Units          |       |
| Type              | 16 Bit Volatile                                       | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RW  |                |       |

| Parameter         | <b>20.003 Application Menu 3 Read-write Integer 3</b> |                |       |
|-------------------|---|----------------|-------|
| Short description | General read-write integer application parameter      |                |       |
| Mode              | RFC-A   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           | 0   | Units          |       |
| Type              | 16 Bit Volatile                                       | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RW  |                |       |

| Parameter         | <b>20.004 Application Menu 3 Read-write Integer 4</b> |                |       |
|-------------------|---|----------------|-------|
| Short description | General read-write integer application parameter      |                |       |
| Mode              | RFC-A   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           | 0   | Units          |       |
| Type              | 16 Bit Volatile                                       | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RW  |                |       |

| Parameter         | <b>20.005 Application Menu 3 Read-write Integer 5</b> |                |       |
|-------------------|---|----------------|-------|
| Short description | General read-write integer application parameter      |                |       |
| Mode              | RFC-A   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           | 0   | Units          |       |
| Type              | 16 Bit Volatile                                       | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RW  |                |       |

| Parameter         | <b>20.006 Application Menu 3 Read-write Integer 6</b> |                |       |
|-------------------|---|----------------|-------|
| Short description | General read-write integer application parameter      |                |       |
| Mode              | RFC-A   |                |       |
| Minimum           | -32768  | Maximum        | 32767 |
| Default           | 0   | Units          |       |
| Type              | 16 Bit Volatile                                       | Update Rate    | N/A   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RW  |                |       |

| Parameter         | 20.007 Application Menu 3 Read-write Integer 7   |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit Volatile                                  | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 20.008 Application Menu 3 Read-write Integer 8   |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit Volatile                                  | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 20.009 Application Menu 3 Read-write Integer 9   |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit Volatile                                  | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 20.010 Application Menu 3 Read-write Integer 10  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit Volatile                                  | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 20.011 Application Menu 3 Read-write Integer 11  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit Volatile                                  | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 20.012 Application Menu 3 Read-write Integer 12  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit Volatile                                  | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 20.013 Application Menu 3 Read-write Integer 13  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit Volatile                                  | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 20.014 Application Menu 3 Read-write Integer 14  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit Volatile                                  | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 20.015 Application Menu 3 Read-write Integer 15  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit Volatile                                  | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 20.016 Application Menu 3 Read-write Integer 16  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit Volatile                                  | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 20.017 Application Menu 3 Read-write Integer 17  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit Volatile                                  | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 20.018 Application Menu 3 Read-write Integer 18  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit Volatile                                  | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 20.019 Application Menu 3 Read-write Integer 19  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit Volatile                                  | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

| Parameter         | 20.020 Application Menu 3 Read-write Integer 20  |                |       |
|-------------------|--|----------------|-------|
| Short description | General read-write integer application parameter |                |       |
| Mode              | RFC-A  |                |       |
| Minimum           | -32768   | Maximum        | 32767 |
| Default           | 0  | Units          |       |
| Type              | 16 Bit Volatile                                  | Update Rate    | N/A   |
| Display Format    | Standard   | Decimal Places | 0     |
| Coding            | RW   |                |       |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.021 Application Menu 3 Read-write Long Integer 21</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.022 Application Menu 3 Read-write Long Integer 22</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.023 Application Menu 3 Read-write Long Integer 23</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.024 Application Menu 3 Read-write Long Integer 24</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.025 Application Menu 3 Read-write Long Integer 25</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.026 Application Menu 3 Read-write Long Integer 26</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.027 Application Menu 3 Read-write Long Integer 27</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.028 Application Menu 3 Read-write Long Integer 28</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.029 Application Menu 3 Read-write Long Integer 29</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.030 Application Menu 3 Read-write Long Integer 30</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.031 Application Menu 3 Read-write Long Integer 31</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.032 Application Menu 3 Read-write Long Integer 32</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.033 Application Menu 3 Read-write Long Integer 33</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.034 Application Menu 3 Read-write Long Integer 34</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.035 Application Menu 3 Read-write Long Integer 35</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.036 Application Menu 3 Read-write Long Integer 36</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.037 Application Menu 3 Read-write Long Integer 37</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.038 Application Menu 3 Read-write Long Integer 38</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.039 Application Menu 3 Read-write Long Integer 39</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

|                   |   |                |            |
|-------------------|---|----------------|------------|
| <b>Parameter</b>  | <b>20.040 Application Menu 3 Read-write Long Integer 40</b> |                |            |
| Short description | General read-write long integer application parameter       |                |            |
| Mode              | RFC-A   |                |            |
| Minimum           | -2147483648   | Maximum        | 2147483647 |
| Default           | 0   | Units          |            |
| Type              | 32 Bit Volatile   | Update Rate    | N/A        |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RW  |                |            |

# Menu 21 Single Line Descriptions – Motor 2 Parameters

Mode: RFC-A

| Parameter |  | Range   | Default   | Type |     |    |    |    |    |
|-----------|--|---|---|------|-----|----|----|----|----|
| 21.001    | M2 Maximum Reference Clamp                         | ±VM_POSITIVE_REF_CLAMP2   | 50Hz: 1500.0<br>60Hz: 1800.0  | RW   | Num |    |    |    | US |
| 21.002    | M2 Minimum Reference Clamp                         | ±VM_NEGATIVE_REF_CLAMP2   | 0.0   | RW   | Num |    |    |    | US |
| 21.003    | M2 Reference Selector                              | A1 A2 (0), A1 Preset (1),<br>A2 Preset (2), Preset (3), Keypad (4),<br>Precision (5), Keypad Ref (6)                    | Preset (3)  | RW   | Txt |    |    |    | US |
| 21.004    | M2 Acceleration Rate 1                             | ±VM_ACCEL_RATE s  | 2.000 s   | RW   | Num |    |    |    | US |
| 21.005    | M2 Deceleration Rate 1                             | ±VM_ACCEL_RATE s  | 2.000 s   | RW   | Num |    |    |    | US |
| 21.006    | M2 Rated Frequency                                 | 0.0 to 550.0 Hz   | 50Hz: 50.0 Hz<br>60Hz: 60.0 Hz  | RW   | Num |    |    |    | US |
| 21.007    | M2 Rated Current                                   | ±VM_RATED_CURRENT A   | 0.000 A   | RW   | Num |    | RA |    | US |
| 21.008    | M2 Rated Speed                                     | 0.00 to 33000.00 rpm  | 50Hz: 1500.00 rpm<br>60Hz: 1800.00 rpm  | RW   | Num |    |    |    | US |
| 21.009    | M2 Rated Voltage                                   | ±VM_AC_VOLTAGE_SET V  | 200V drive: 230 V<br>400V drive 50Hz: 400 V<br>400V drive 60Hz: 460 V<br>575V drive: 575 V<br>690V drive: 690 V | RW   | Num |    | RA |    | US |
| 21.010    | M2 Rated Power Factor                              | 0.000 to 1.000  | 0.850   | RW   | Num |    | RA |    | US |
| 21.011    | M2 Number Of Motor Poles                           | Automatic (0) to 480 (240) Poles  | Automatic (0) Poles   | RW   | Txt |    |    |    | US |
| 21.012    | M2 Stator Resistance                               | 0.000000 to 1000.000000 Ω   | 0.000000 Ω  | RW   | Num |    | RA |    | US |
| 21.014    | M2 Transient Inductance                            | 0.000 to 500.000 mH   | 0.000 mH  | RW   | Num |    | RA |    | US |
| 21.015    | Motor 2 Active                                     | Off (0) or On (1)   |   | RO   | Bit | ND | NC | PT |    |
| 21.016    | M2 Motor Thermal Time Constant 1                   | 1.0 to 3000.0 s   | 89.0 s  | RW   | Num |    |    |    | US |
| 21.017    | M2 Speed Controller Proportional Gain Kp1          | 0.0000 to 200.0000 s/rad  | 0.0300 s/rad  | RW   | Num |    |    |    | US |
| 21.018    | M2 Speed Controller Integral Gain Ki1              | 0.00 to 655.35 s <sup>2</sup> /rad  | 0.10 s <sup>2</sup> /rad  | RW   | Num |    |    |    | US |
| 21.019    | M2 Speed Controller Differential Feedback Gain Kd1 | 0.00000 to 0.65535 1/rad  | 0.00000 1/rad   | RW   | Num |    |    |    | US |
| 21.021    | M2 Motor Control Feedback Select                   | P1 Drive (0), P2 Drive (1),<br>P1 Slot1 (2), P2 Slot1 (3),<br>P1 Slot2 (4), P2 Slot2 (5),<br>P1 Slot3 (6), P2 Slot3 (7) | P1 Drive (0)  | RW   | Txt |    |    |    | US |
| 21.022    | M2 Current Controller Kp Gain                      | 0 to 30000  | 150   | RW   | Num |    |    |    | US |
| 21.023    | M2 Current Controller Ki Gain                      | 0 to 30000  | 2000  | RW   | Num |    |    |    | US |
| 21.024    | M2 Stator Inductance                               | 0.00 to 5000.00 mH  | 0.00 mH   | RW   | Num |    | RA |    | US |
| 21.025    | M2 Saturation Breakpoint 1                         | 0.0 to 100.0 %  | 50.0 %  | RW   | Num |    |    |    | US |
| 21.026    | M2 Saturation Breakpoint 3                         | 0.0 to 100.0 %  | 75.0 %  | RW   | Num |    |    |    | US |
| 21.027    | M2 Motoring Current Limit                          | ±VM_MOTOR2_CURRENT_LIMIT %  | 175.0 %   | RW   | Num |    | RA |    | US |
| 21.028    | M2 Regenerating Current Limit                      | ±VM_MOTOR2_CURRENT_LIMIT %  | 175.0 %   | RW   | Num |    | RA |    | US |
| 21.029    | M2 Symmetrical Current Limit                       | ±VM_MOTOR2_CURRENT_LIMIT %  | 175.0 %   | RW   | Num |    | RA |    | US |
| 21.032    | M2 Current Reference Filter Time Constant 1        | 0.0 to 25.0 ms  | 0.0 ms  | RW   | Num |    |    |    | US |
| 21.033    | M2 Low Speed Thermal Protection Mode               | 0 to 1  | 0   | RW   | Num |    |    |    | US |
| 21.034    | M2 Current Controller Mode                         | Off (0) or On (1)   | Off (0)   | RW   | Bit |    |    |    | US |
| 21.035    | M2 Notch Filter Centre Frequency                   | 50 to 1000 Hz   | 100 Hz  | RW   | Num |    |    |    | US |
| 21.036    | M2 Notch Filter Bandwidth                          | 0 to 500 Hz   | 0 Hz  | RW   | Num |    |    |    | US |
| 21.039    | M2 Motor Thermal Time Constant 2                   | 1.0 to 3000.0 s   | 89.0 s  | RW   | Num |    |    |    | US |
| 21.040    | M2 Motor Thermal Time Constant 2 Scaling           | 0 to 100 %  | 0 %   | RW   | Num |    |    |    | US |
| 21.041    | M2 Saturation Breakpoint 2                         | 0.0 to 100.0 %  | 0.0 %   | RW   | Num |    |    |    | US |
| 21.042    | M2 Saturation Breakpoint 4                         | 0.0 to 100.0 %  | 0.0 %   | RW   | Num |    |    |    | US |
| 21.043    | M2 Torque Per Amp                                  | 0.00 to 500.00 Nm/A   |   | RO   | Num | ND | NC | PT |    |
| 21.044    | M2 No-load Core Loss                               | 0.000 to 99999.999 kW   | 0.000 kW  | RW   | Num |    |    |    | US |
| 21.045    | M2 Rated Core Loss                                 | 0.000 to 99999.999 kW   | 0.000 kW  | RW   | Num |    |    |    | US |
| 21.046    | M2 Magnetising Current Limit                       | 0.0 to 100.0 %  | 100.0 %   | RW   | Num |    |    |    | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |



## Menu 21 – Motor 2 Parameters

Mode: RFC-A

Contains parameter relative to the set up for motor map 2.

| Parameter         | 21.001 M2 Maximum Reference Clamp                   |                |                        |
|-------------------|---|----------------|------------------------|
| Short description | Defines the maximum reference clamp for motor map 2 |                |                        |
| Mode              | RFC-A   |                |                        |
| Minimum           | -VM_POSITIVE_REF_CLAMP2                             | Maximum        | VM_POSITIVE_REF_CLAMP2 |
| Default           | See exceptions below                                | Units          |                        |
| Type              | 32 Bit User Save                                    | Update Rate    | Background read        |
| Display Format    | Standard  | Decimal Places | 1                      |
| Coding            | RW, VM  |                |                        |

| Region | Default Value |
|--------|---------------|
| 50Hz   | 1500.0        |
| 60Hz   | 1800.0        |

This is the motor map 2 equivalent parameter for *Maximum Reference Clamp* (01.006).

| Parameter         | 21.002 M2 Minimum Reference Clamp                   |                |                        |
|-------------------|---|----------------|------------------------|
| Short description | Defines the minimum reference clamp for motor map 2 |                |                        |
| Mode              | RFC-A   |                |                        |
| Minimum           | -VM_NEGATIVE_REF_CLAMP2                             | Maximum        | VM_NEGATIVE_REF_CLAMP2 |
| Default           | 0.0   | Units          |                        |
| Type              | 32 Bit User Save                                    | Update Rate    | Background read        |
| Display Format    | Standard  | Decimal Places | 1                      |
| Coding            | RW, VM  |                |                        |

This is the motor map 2 equivalent parameter for *Minimum Reference Clamp* (01.007).

| Parameter         | 21.003 M2 Reference Selector                    |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines which reference is used for motor map 2 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 6        |
| Default           | 3   | Units          |          |
| Type              | 8 Bit User Save                                 | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, TE  |                |          |

| Value | Text       |
|-------|------------|
| 0     | A1 A2      |
| 1     | A1 Preset  |
| 2     | A2 Preset  |
| 3     | Preset     |
| 4     | Keypad     |
| 5     | Precision  |
| 6     | Keypad Ref |

This is the motor map 2 equivalent parameter for *Reference Selector* (01.014).

| Parameter         | 21.004 M2 Acceleration Rate 1                      |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the acceleration rate used for motor map 2 |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | -VM_ACCEL_RATE                                     | Maximum        | VM_ACCEL_RATE |
| Default           | 2.000  | Units          | s             |
| Type              | 32 Bit User Save                                   | Update Rate    | 4ms read      |
| Display Format    | Standard   | Decimal Places | 3             |
| Coding            | RW, VM   |                |               |

This is the motor map 2 equivalent parameter for *Acceleration Rate 1* (02.011).

| Parameter         | 21.005 M2 Deceleration Rate 1                      |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the deceleration rate used for motor map 2 |                |               |
| Mode              | RFC-A  |                |               |
| Minimum           | -VM_ACCEL_RATE                                     | Maximum        | VM_ACCEL_RATE |
| Default           | 2.000  | Units          | s             |
| Type              | 32 Bit User Save                                   | Update Rate    | 4ms read      |
| Display Format    | Standard   | Decimal Places | 3             |
| Coding            | RW, VM   |                |               |

This is the motor map 2 equivalent parameter for *Deceleration Rate 1* (02.021).

| Parameter         | 21.006 M2 Rated Frequency                              |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the motor rated frequency used for motor map 2 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.0  | Maximum        | 550.0           |
| Default           | See exceptions below                                   | Units          | Hz              |
| Type              | 16 Bit User Save                                       | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW   |                |                 |

| Region | Default Value |
|--------|---------------|
| 50Hz   | 50.0          |
| 60Hz   | 60.0          |

This is the motor map 2 equivalent parameter for *Rated Frequency* (05.006).

| Parameter         | 21.007 M2 Rated Current                      |                |                  |
|-------------------|--|----------------|------------------|
| Short description | Defines the motor rated used for motor map 2 |                |                  |
| Mode              | RFC-A  |                |                  |
| Minimum           | -VM_RATED_CURRENT                            | Maximum        | VM_RATED_CURRENT |
| Default           | 0.000  | Units          | A                |
| Type              | 32 Bit User Save                             | Update Rate    | Background read  |
| Display Format    | Standard                                     | Decimal Places | 3                |
| Coding            | RW, VM, RA                                   |                |                  |

This is the motor map 2 equivalent parameter for *Rated Current* (05.007).

| Parameter         | 21.008 M2 Rated Speed                              |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the motor rated speed used for motor map 2 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.00   | Maximum        | 33000.00        |
| Default           | See exceptions below                               | Units          | rpm             |
| Type              | 32 Bit User Save                                   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW   |                |                 |

| Region | Default Value |
|--------|---------------|
| 50Hz   | 1500.00       |
| 60Hz   | 1800.00       |

This is the motor map 2 equivalent parameter for *Rated Speed* (05.008).

| Parameter         | 21.009 M2 Rated Voltage                              |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Defines the motor rated voltage used for motor map 2 |                |                   |
| Mode              | RFC-A  |                |                   |
| Minimum           | -VM_AC_VOLTAGE_SET                                   | Maximum        | VM_AC_VOLTAGE_SET |
| Default           | See exceptions below                                 | Units          | V                 |
| Type              | 16 Bit User Save                                     | Update Rate    | 4ms read          |
| Display Format    | Standard   | Decimal Places | 0                 |
| Coding            | RW, VM, RA   |                |                   |

| <b>Voltage</b> | <b>Region</b> | <b>Default Value</b> |
|----------------|---------------|----------------------|
| 200V           | All           | 230                  |
| 400V           | 50Hz          | 400                  |
| 400V           | 60Hz          | 460                  |
| 575V           | All           | 575                  |
| 690V           | All           | 690                  |

This is the motor map 2 equivalent parameter for *Rated Voltage* (05.009).

| <b>Parameter</b>  | <b>21.010 M2 Rated Power Factor</b>                       |                |                       |
|-------------------|---|----------------|-----------------------|
| Short description | Defines the motor rated power factor used for motor map 2 |                |                       |
| Mode              | RFC-A   |                |                       |
| Minimum           | 0.000   | Maximum        | 1.000                 |
| Default           | 0.850   | Units          |                       |
| Type              | 16 Bit User Save  | Update Rate    | Background read/write |
| Display Format    | Standard  | Decimal Places | 3                     |
| Coding            | RW, RA  |                |                       |

This is the motor map 2 equivalent parameter for *Rated Power Factor* (05.010).

| <b>Parameter</b>  | <b>21.011 M2 Number Of Motor Poles</b>                 |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the number of motor poles used for motor map 2 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 240             |
| Default           | 0  | Units          | PolePairs       |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, BU   |                |                 |

This is the motor map 2 equivalent parameter for *Number Of Motor Poles* (05.011).

| <b>Parameter</b>  | <b>21.012 M2 Stator Resistance</b>                 |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the stator resistance used for motor map 2 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.000000   | Maximum        | 1000.000000     |
| Default           | 0.000000   | Units          | $\Omega$        |
| Type              | 32 Bit User Save                                   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 6               |
| Coding            | RW, RA   |                |                 |

This is the motor map 2 equivalent parameter for *Stator Resistance* (05.017).

| <b>Parameter</b>  | <b>21.014 M2 Transient Inductance</b>                 |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the transient inductance used for motor map 2 |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.000   | Maximum        | 500.000         |
| Default           | 0.000   | Units          | mH              |
| Type              | 32 Bit User Save                                      | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 3               |
| Coding            | RW, RA  |                |                 |

This is the motor map 2 equivalent parameter for *Transient Inductance* (05.024).

| <b>Parameter</b>  | <b>21.015 Motor 2 Active</b>                                |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Indicates if motor 2 parameters are being used by the drive |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile  | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

If *Motor 2 Active* (21.015) = 0 then the standard motor set-up parameters are being used or if *Motor 2 Active* (21.015) = 1 then the motor 2 parameters are being used. The motor set-up parameters do not necessarily change immediately when *Select Motor 2 Parameters* (11.045) is changed (i.e. the drive may be enabled). *Motor 2 Active* (21.015) shows the actual motor parameters being used and only changes when the new parameters start being used by the drive.

| Parameter         | 21.016 M2 Motor Thermal Time Constant 1                             |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the thermal time constant of the motor used for motor map 2 |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 1.0   | Maximum        | 3000.0          |
| Default           | 89.0  | Units          | s               |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW  |                |                 |

This is the motor map 2 equivalent parameter for *Motor Thermal Time Constant 1* (04.015).

| Parameter         | 21.017 M2 Speed Controller Proportional Gain Kp1                  |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the Kp value of the speed controller used for motor map 2 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0.0000  | Maximum        | 200.0000 |
| Default           | 0.0300  | Units          | s/rad    |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 4        |
| Coding            | RW  |                |          |

This is the motor map 2 equivalent parameter for *Speed Controller Proportional Gain Kp1* (03.010).

| Parameter         | 21.018 M2 Speed Controller Integral Gain Ki1                      |                |                     |
|-------------------|---|----------------|---------------------|
| Short description | Defines the Ki value of the speed controller used for motor map 2 |                |                     |
| Mode              | RFC-A   |                |                     |
| Minimum           | 0.00  | Maximum        | 655.35              |
| Default           | 0.10  | Units          | s <sup>2</sup> /rad |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read            |
| Display Format    | Standard  | Decimal Places | 2                   |
| Coding            | RW, BU  |                |                     |

This is the motor map 2 equivalent parameter for *Speed Controller Integral Gain Ki1* (03.011).

| Parameter         | 21.019 M2 Speed Controller Differential Feedback Gain Kd1         |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the Kd value of the speed controller used for motor map 2 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0.00000   | Maximum        | 0.65535  |
| Default           | 0.00000   | Units          | 1/rad    |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 5        |
| Coding            | RW, BU  |                |          |

This is the motor map 2 equivalent parameter for *Speed Controller Differential Feedback Gain Kd1* (03.012).

| Parameter         | 21.021 M2 Motor Control Feedback Select                         |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the source for the feedback device used for motor map 2 |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 7               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text     |
|-------|----------|
| 0     | P1 Drive |
| 1     | P2 Drive |
| 2     | P1 Slot1 |
| 3     | P2 Slot1 |
| 4     | P1 Slot2 |
| 5     | P2 Slot2 |
| 6     | P1 Slot3 |
| 7     | P2 Slot3 |

This is the motor map 2 equivalent parameter for *Motor Control Feedback Select* (03.026).

| Parameter         | 21.022 M2 Current Controller Kp Gain                                |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the Kp value of the current controller used for motor map 2 |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 30000           |
| Default           | 150   | Units          |                 |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

This is the motor map 2 equivalent parameter for *Current Controller Kp Gain* (04.013).

| Parameter         | 21.023 M2 Current Controller Ki Gain                                |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the Ki value of the current controller used for motor map 2 |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 30000           |
| Default           | 2000  | Units          |                 |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, BU  |                |                 |

This is the motor map 2 equivalent parameter for *Current Controller Ki Gain* (04.014).

| Parameter         | 21.024 M2 Stator Inductance                                    |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Define the stator inductance of the motor used for motor map 2 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.00   | Maximum        | 5000.00         |
| Default           | 0.00   | Units          | mH              |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 2               |
| Coding            | RW, RA   |                |                 |

This is the motor map 2 equivalent parameter for *Stator Inductance* (05.025).

| Parameter         | 21.025 M2 Saturation Breakpoint 1                                    |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the position of saturation breakpoint 1 used for motor map 2 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.0  | Maximum        | 100.0           |
| Default           | 50.0   | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW   |                |                 |

This is the motor map 2 equivalent parameter for *Saturation Breakpoint 1* (05.029).

| Parameter         | 21.026 M2 Saturation Breakpoint 3                                    |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the position of saturation breakpoint 3 used for motor map 2 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.0  | Maximum        | 100.0           |
| Default           | 75.0   | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW   |                |                 |

This is the motor map 2 equivalent parameter for *Saturation Breakpoint 3* (05.030).

| Parameter         | 21.027 M2 Motoring Current Limit                        |                |                         |
|-------------------|---|----------------|-------------------------|
| Short description | Defines the motoring current limit used for motor map 2 |                |                         |
| Mode              | RFC-A   |                |                         |
| Minimum           | 0.0   | Maximum        | VM_MOTOR2_CURRENT_LIMIT |
| Default           | 175.0   | Units          | %                       |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read                |
| Display Format    | Standard  | Decimal Places | 1                       |
| Coding            | RW, VM, RA, BU  |                |                         |

This is the motor map 2 equivalent parameter for *Motoring Current Limit* (04.005).

| Parameter         | 21.028 M2 Regenerating Current Limit                        |                |                         |
|-------------------|---|----------------|-------------------------|
| Short description | Defines the regenerating current limit used for motor map 2 |                |                         |
| Mode              | RFC-A   |                |                         |
| Minimum           | 0.0   | Maximum        | VM_MOTOR2_CURRENT_LIMIT |
| Default           | 175.0   | Units          | %                       |
| Type              | 16 Bit User Save  | Update Rate    | 4ms read                |
| Display Format    | Standard  | Decimal Places | 1                       |
| Coding            | RW, VM, RA, BU  |                |                         |

This is the motor map 2 equivalent parameter for *Regenerating Current Limit* (04.006).

| Parameter         | 21.029 M2 Symmetrical Current Limit                        |                |                         |
|-------------------|--|----------------|-------------------------|
| Short description | Defines the symmetrical current limit used for motor map 2 |                |                         |
| Mode              | RFC-A  |                |                         |
| Minimum           | 0.0  | Maximum        | VM_MOTOR2_CURRENT_LIMIT |
| Default           | 175.0  | Units          | %                       |
| Type              | 16 Bit User Save   | Update Rate    | 4ms read                |
| Display Format    | Standard   | Decimal Places | 1                       |
| Coding            | RW, VM, RA, BU   |                |                         |

This is the motor map 2 equivalent parameter for *Symmetrical Current Limit* (04.007).

| Parameter         | 21.032 M2 Current Reference Filter Time Constant 1   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the time constant of a first order filter that can be applied to the final current reference for motor map 2 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.0  | Maximum        | 25.0            |
| Default           | 0.0  | Units          | ms              |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW, BU   |                |                 |

This is the motor map 2 equivalent parameter for *Current Reference Filter 1 Time Constant* (04.012).

| Parameter         | 21.033 M2 Low Speed Thermal Protection Mode     |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to enable low speed thermal protection mode |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 8 Bit User Save                                 | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

This is the motor map 2 equivalent parameter for *Low Speed Thermal Protection Mode* (04.025).

| Parameter         | 21.034 M2 Current Controller Mode                      |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to enable high performance current controller mode |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

This is the motor map 2 equivalent parameter for *Current Controller Mode* (04.030).

| Parameter         | 21.035 M2 Notch Filter Centre Frequency  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the centre frequency for a notch filter to cancel a mechanical resonance |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 50   | Maximum        | 1000            |
| Default           | 100  | Units          | Hz              |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

This is the motor map 2 equivalent parameter for *Notch Filter Centre Frequency* (04.031).

| Parameter         | 21.036 M2 Notch Filter Bandwidth  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the bandwidth for a notch filter to cancel a mechanical resonance |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 500             |
| Default           | 0   | Units          | Hz              |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

This is the motor map 2 equivalent parameter for *Notch Filter Bandwidth* (04.032).

| Parameter         | 21.039 M2 Motor Thermal Time Constant 2   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Can be used to define an additional motor thermal time constant for motor map 2 |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 1.0   | Maximum        | 3000.0          |
| Default           | 89.0  | Units          | s               |
| Type              | 16 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW  |                |                 |

This is the motor map 2 equivalent parameter for *Motor Thermal Time Constant 2* (04.037).

| Parameter         | 21.040 M2 Motor Thermal Time Constant 2 Scaling   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the ratio of the contribution to the motor protection accumulator value from each of the time constants for motor map 2 |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 100             |
| Default           | 0   | Units          | %               |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

This is the motor map 2 equivalent parameter for *Motor Thermal Time Constant 2 Scaling* (04.038).

| Parameter         | 21.041 M2 Saturation Breakpoint 2                                    |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the position of saturation breakpoint 2 used for motor map 2 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.0  | Maximum        | 100.0           |
| Default           | 0.0  | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW   |                |                 |

This is the motor map 2 equivalent parameter for *Saturation Breakpoint 2* (05.062).

| Parameter         | 21.042 M2 Saturation Breakpoint 4                                    |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the position of saturation breakpoint 4 used for motor map 2 |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0.0  | Maximum        | 100.0           |
| Default           | 0.0  | Units          | %               |
| Type              | 16 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 1               |
| Coding            | RW   |                |                 |

This is the motor map 2 equivalent parameter for *Saturation Breakpoint 4* (05.063).

| Parameter         | 21.043 M2 Torque Per Amp                                      |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Displays the torque per amp of the motor used for motor map 2 |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0.00  | Maximum        | 500.00           |
| Default           |   | Units          | Nm/A             |
| Type              | 16 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 2                |
| Coding            | RO, ND, NC, PT, BU  |                |                  |

This is the motor map 2 equivalent parameter for *Torque Per Amp* (05.032).

| Parameter         | 21.044 M2 No-load Core Loss |                |                 |
|-------------------|-----------------------------|----------------|-----------------|
| Short description | M2 No-load Core Loss        |                |                 |
| Mode              | RFC-A                       |                |                 |
| Minimum           | 0.000                       | Maximum        | 99999.999       |
| Default           | 0.000                       | Units          | kW              |
| Type              | 32 Bit User Save            | Update Rate    | Background Read |
| Display Format    | Standard                    | Decimal Places | 3               |
| Coding            | RW                          |                |                 |

This is the motor map 2 equivalent parameter for *No-load Core Loss* (04.045).

| Parameter         | 21.045 M2 Rated Core Loss |                |                 |
|-------------------|---------------------------|----------------|-----------------|
| Short description | M2 Rated Core Loss        |                |                 |
| Mode              | RFC-A                     |                |                 |
| Minimum           | 0.000                     | Maximum        | 99999.999       |
| Default           | 0.000                     | Units          | kW              |
| Type              | 32 Bit User Save          | Update Rate    | Background Read |
| Display Format    | Standard                  | Decimal Places | 3               |
| Coding            | RW                        |                |                 |

This is the motor map 2 equivalent parameter for *Rated Core Loss* (04.046).

| Parameter         | 21.046 M2 Magnetising Current Limit |                |                 |
|-------------------|-------------------------------------|----------------|-----------------|
| Short description | M2 Magnetising Current Limit        |                |                 |
| Mode              | RFC-A                               |                |                 |
| Minimum           | 0.0                                 | Maximum        | 100.0           |
| Default           | 100.0                               | Units          | %               |
| Type              | 16 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                            | Decimal Places | 1               |
| Coding            | RW                                  |                |                 |

This is the motor map 2 equivalent parameter for *Magnetising Current Limit* (04.049).



## Menu 22 Single Line Descriptions – *Menu 0 Set-up*

Mode: RFC-A

| Parameter |                         | Range           | Default | Type |     |  |  |    |    |
|-----------|-------------------------|-----------------|---------|------|-----|--|--|----|----|
| 22.001    | Parameter 00.001 Set-up | 0.000 to 59.999 | 1.007   | RW   | Num |  |  | PT | US |
| 22.002    | Parameter 00.002 Set-up | 0.000 to 59.999 | 1.006   | RW   | Num |  |  | PT | US |
| 22.003    | Parameter 00.003 Set-up | 0.000 to 59.999 | 2.011   | RW   | Num |  |  | PT | US |
| 22.004    | Parameter 00.004 Set-up | 0.000 to 59.999 | 2.021   | RW   | Num |  |  | PT | US |
| 22.005    | Parameter 00.005 Set-up | 0.000 to 59.999 | 1.014   | RW   | Num |  |  | PT | US |
| 22.006    | Parameter 00.006 Set-up | 0.000 to 59.999 | 4.007   | RW   | Num |  |  | PT | US |
| 22.007    | Parameter 00.007 Set-up | 0.000 to 59.999 | 3.010   | RW   | Num |  |  | PT | US |
| 22.008    | Parameter 00.008 Set-up | 0.000 to 59.999 | 3.011   | RW   | Num |  |  | PT | US |
| 22.009    | Parameter 00.009 Set-up | 0.000 to 59.999 | 3.012   | RW   | Num |  |  | PT | US |
| 22.010    | Parameter 00.010 Set-up | 0.000 to 59.999 | 3.002   | RW   | Num |  |  | PT | US |
| 22.011    | Parameter 00.011 Set-up | 0.000 to 59.999 | 5.001   | RW   | Num |  |  | PT | US |
| 22.012    | Parameter 00.012 Set-up | 0.000 to 59.999 | 4.001   | RW   | Num |  |  | PT | US |
| 22.013    | Parameter 00.013 Set-up | 0.000 to 59.999 | 4.002   | RW   | Num |  |  | PT | US |
| 22.014    | Parameter 00.014 Set-up | 0.000 to 59.999 | 4.011   | RW   | Num |  |  | PT | US |
| 22.015    | Parameter 00.015 Set-up | 0.000 to 59.999 | 2.004   | RW   | Num |  |  | PT | US |
| 22.016    | Parameter 00.016 Set-up | 0.000 to 59.999 | 2.002   | RW   | Num |  |  | PT | US |
| 22.017    | Parameter 00.017 Set-up | 0.000 to 59.999 | 4.012   | RW   | Num |  |  | PT | US |
| 22.018    | Parameter 00.018 Set-up | 0.000 to 59.999 | 3.123   | RW   | Num |  |  | PT | US |
| 22.019    | Parameter 00.019 Set-up | 0.000 to 59.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.020    | Parameter 00.020 Set-up | 0.000 to 59.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.021    | Parameter 00.021 Set-up | 0.000 to 59.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.022    | Parameter 00.022 Set-up | 0.000 to 59.999 | 1.010   | RW   | Num |  |  | PT | US |
| 22.023    | Parameter 00.023 Set-up | 0.000 to 59.999 | 1.005   | RW   | Num |  |  | PT | US |
| 22.024    | Parameter 00.024 Set-up | 0.000 to 59.999 | 1.021   | RW   | Num |  |  | PT | US |
| 22.025    | Parameter 00.025 Set-up | 0.000 to 59.999 | 1.022   | RW   | Num |  |  | PT | US |
| 22.026    | Parameter 00.026 Set-up | 0.000 to 59.999 | 3.008   | RW   | Num |  |  | PT | US |
| 22.027    | Parameter 00.027 Set-up | 0.000 to 59.999 | 3.034   | RW   | Num |  |  | PT | US |
| 22.028    | Parameter 00.028 Set-up | 0.000 to 59.999 | 6.013   | RW   | Num |  |  | PT | US |
| 22.029    | Parameter 00.029 Set-up | 0.000 to 59.999 | 11.036  | RW   | Num |  |  | PT | US |
| 22.030    | Parameter 00.030 Set-up | 0.000 to 59.999 | 11.042  | RW   | Num |  |  | PT | US |
| 22.031    | Parameter 00.031 Set-up | 0.000 to 59.999 | 11.033  | RW   | Num |  |  | PT | US |
| 22.032    | Parameter 00.032 Set-up | 0.000 to 59.999 | 11.032  | RW   | Num |  |  | PT | US |
| 22.033    | Parameter 00.033 Set-up | 0.000 to 59.999 | 5.016   | RW   | Num |  |  | PT | US |
| 22.034    | Parameter 00.034 Set-up | 0.000 to 59.999 | 11.030  | RW   | Num |  |  | PT | US |
| 22.035    | Parameter 00.035 Set-up | 0.000 to 59.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.036    | Parameter 00.036 Set-up | 0.000 to 59.999 | 0.000   | RW   | Num |  |  | PT | US |
| 22.037    | Parameter 00.037 Set-up | 0.000 to 59.999 | 24.010  | RW   | Num |  |  | PT | US |
| 22.038    | Parameter 00.038 Set-up | 0.000 to 59.999 | 4.013   | RW   | Num |  |  | PT | US |
| 22.039    | Parameter 00.039 Set-up | 0.000 to 59.999 | 4.014   | RW   | Num |  |  | PT | US |
| 22.040    | Parameter 00.040 Set-up | 0.000 to 59.999 | 5.012   | RW   | Num |  |  | PT | US |
| 22.041    | Parameter 00.041 Set-up | 0.000 to 59.999 | 5.018   | RW   | Num |  |  | PT | US |
| 22.042    | Parameter 00.042 Set-up | 0.000 to 59.999 | 5.011   | RW   | Num |  |  | PT | US |
| 22.043    | Parameter 00.043 Set-up | 0.000 to 59.999 | 5.010   | RW   | Num |  |  | PT | US |
| 22.044    | Parameter 00.044 Set-up | 0.000 to 59.999 | 5.009   | RW   | Num |  |  | PT | US |
| 22.045    | Parameter 00.045 Set-up | 0.000 to 59.999 | 5.008   | RW   | Num |  |  | PT | US |
| 22.046    | Parameter 00.046 Set-up | 0.000 to 59.999 | 5.007   | RW   | Num |  |  | PT | US |
| 22.047    | Parameter 00.047 Set-up | 0.000 to 59.999 | 5.006   | RW   | Num |  |  | PT | US |
| 22.048    | Parameter 00.048 Set-up | 0.000 to 59.999 | 11.031  | RW   | Num |  |  | PT | US |

|        |                         |                 |        |    |     |  |  |    |    |
|--------|-------------------------|-----------------|--------|----|-----|--|--|----|----|
| 22.049 | Parameter 00.049 Set-up | 0.000 to 59.999 | 11.044 | RW | Num |  |  | PT | US |
| 22.050 | Parameter 00.050 Set-up | 0.000 to 59.999 | 11.029 | RW | Num |  |  | PT | US |
| 22.051 | Parameter 00.051 Set-up | 0.000 to 59.999 | 10.037 | RW | Num |  |  | PT | US |
| 22.052 | Parameter 00.052 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.053 | Parameter 00.053 Set-up | 0.000 to 59.999 | 4.015  | RW | Num |  |  | PT | US |
| 22.054 | Parameter 00.054 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.055 | Parameter 00.055 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.056 | Parameter 00.056 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.057 | Parameter 00.057 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.058 | Parameter 00.058 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.059 | Parameter 00.059 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.060 | Parameter 00.060 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.061 | Parameter 00.061 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.062 | Parameter 00.062 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.063 | Parameter 00.063 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.064 | Parameter 00.064 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.065 | Parameter 00.065 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.066 | Parameter 00.066 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.067 | Parameter 00.067 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.068 | Parameter 00.068 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.069 | Parameter 00.069 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.070 | Parameter 00.070 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.071 | Parameter 00.071 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.072 | Parameter 00.072 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.073 | Parameter 00.073 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.074 | Parameter 00.074 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.075 | Parameter 00.075 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.076 | Parameter 00.076 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.077 | Parameter 00.077 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.078 | Parameter 00.078 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.079 | Parameter 00.079 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |
| 22.080 | Parameter 00.080 Set-up | 0.000 to 59.999 | 0.000  | RW | Num |  |  | PT | US |

|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| Fl  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 22 – Menu 0 Set-up

Mode: RFC-A

The parameters in this menu are used to set up which parameters are shown in Menu 0.

| Parameter         | 22.001 Parameter 00.001 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.001 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 1.007                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

Each parameter is used to set up the equivalent parameter in Menu 0, for example *Parameter 00.001 Set-up* (22.001) is used to set up which parameter is shown in *Menu 0 Parameter 1* (00.001), etc. 80 selectable Menu 0 parameters (00.001 to 00.080) and equivalent set-up parameters (22.001 to 22.080) are provided. When a Menu 0 set-up parameter is set to 00.000 or a value that is not a valid parameter outside Menu 0, the equivalent Menu 0 parameter is not visible. If a parameter has an equivalent motor 2 parameter in Menu 21 then when *Motor 2 Active* (21.015) = 0 the original parameter is displayed, but when *Motor 2 Active* (21.015) = 1 the equivalent motor 2 parameter from Menu 21 is displayed.

| Parameter         | 22.002 Parameter 00.002 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.002 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 1.006                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.003 Parameter 00.003 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.003 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 2.011                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.004 Parameter 00.004 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.004 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 2.021                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.005 Parameter 00.005 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.005 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 1.014                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.006 Parameter 00.006 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.006 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 4.007                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.007 Parameter 00.007 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.007 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 3.010                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.008 Parameter 00.008 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.008 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 3.011                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.009 Parameter 00.009 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.009 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 3.012                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.010 Parameter 00.010 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.010 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 3.002                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.011 Parameter 00.011 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.011 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 5.001                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.012 Parameter 00.012 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.012 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 4.001                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.013 Parameter 00.013 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.013 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 4.002                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.014 Parameter 00.014 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.014 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 4.011                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.015 Parameter 00.015 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.015 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 2.004                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.016 Parameter 00.016 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.016 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 2.002                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.017 Parameter 00.017 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.017 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 4.012                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.018 Parameter 00.018 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.018 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 3.123                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.019 Parameter 00.019 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.019 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.020 Parameter 00.020 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.020 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.021 Parameter 00.021 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.021 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.022 Parameter 00.022 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.022 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 1.010                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.023 Parameter 00.023 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.023 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 1.005                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.024 Parameter 00.024 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.024 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 1.021                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.025 Parameter 00.025 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.025 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 1.022                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.026 Parameter 00.026 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.026 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 3.008                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.027 Parameter 00.027 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.027 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 3.034                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.028 Parameter 00.028 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.028 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 6.013                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.029 Parameter 00.029 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.029 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 11.036                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).



| Parameter         | 22.030 Parameter 00.030 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.030 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 11.042                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.031 Parameter 00.031 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.031 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 11.033                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.032 Parameter 00.032 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.032 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 11.032                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.033 Parameter 00.033 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.033 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 5.016                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.034 Parameter 00.034 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.034 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 11.030                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.035 Parameter 00.035 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.035 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.036 Parameter 00.036 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.036 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.037 Parameter 00.037 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.037 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 24.010                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.038 Parameter 00.038 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.038 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 4.013                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.039 Parameter 00.039 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.039 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 4.014                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.040 Parameter 00.040 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.040 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 5.012                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.041 Parameter 00.041 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.041 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 5.018                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.042 Parameter 00.042 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.042 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 5.011                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.043 Parameter 00.043 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.043 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 5.010                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.044 Parameter 00.044 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.044 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 5.009                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.045 Parameter 00.045 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.045 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 5.008                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.046 Parameter 00.046 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.046 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 5.007                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.047 Parameter 00.047 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.047 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 5.006                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.048 Parameter 00.048 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.048 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 11.031                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.049 Parameter 00.049 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.049 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 11.044                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.050 Parameter 00.050 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.050 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 11.029                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.051 Parameter 00.051 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.051 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 10.037                                      | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.052 Parameter 00.052 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.052 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.053 Parameter 00.053 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.053 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 4.015                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.054 Parameter 00.054 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.054 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.055 Parameter 00.055 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.055 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.056 Parameter 00.056 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.056 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.057 Parameter 00.057 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.057 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.058 Parameter 00.058 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.058 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.059 Parameter 00.059 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.059 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.060 Parameter 00.060 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.060 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.061 Parameter 00.061 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.061 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.062 Parameter 00.062 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.062 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.063 Parameter 00.063 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.063 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.064 Parameter 00.064 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.064 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.065 Parameter 00.065 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.065 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.066 Parameter 00.066 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.066 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.067 Parameter 00.067 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.067 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.068 Parameter 00.068 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.068 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.069 Parameter 00.069 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.069 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.070 Parameter 00.070 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.070 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.071 Parameter 00.071 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.071 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.072 Parameter 00.072 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.072 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.073 Parameter 00.073 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.073 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.074 Parameter 00.074 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.074 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.075 Parameter 00.075 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.075 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.076 Parameter 00.076 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.076 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.077 Parameter 00.077 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.077 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).



| Parameter         | 22.078 Parameter 00.078 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.078 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.079 Parameter 00.079 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.079 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

| Parameter         | 22.080 Parameter 00.080 Set-up              |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the parameter to be shown in 00.080 |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 59.999          |
| Default           | 0.000                                       | Units          |                 |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, PT, BU                                  |                |                 |

See *Parameter 00.001 Set-up* (22.001).

## Menu 24 Single Line Descriptions – Ethernet Setup

Mode: RFC-A

| Parameter |                   | Range   | Default          | Type |     |    |    |    |  |
|-----------|-------------------|---|------------------|------|-----|----|----|----|--|
| 24.001    | Module ID         | 0 to 65535  |                  | RO   | Num | ND | NC | PT |  |
| 24.002    | Software Version  | 0 to 99999999   |                  | RO   | Num | ND | NC | PT |  |
| 24.003    | Hardware Version  | 0.00 to 99.99   |                  | RO   | Num | ND | NC | PT |  |
| 24.004    | Serial Number LS  | 00000000 to 99999999  |                  | RO   | Num | ND | NC | PT |  |
| 24.005    | Serial Number MS  | 0 to 99999999   |                  | RO   | Num | ND | NC | PT |  |
| 24.006    | Status            | Bootldr - Update (-2), Bootldr - Idle (-1), Initialising (0), OK (1), Config (2), Error (3) |                  | RO   | Txt | ND | NC | PT |  |
| 24.007    | Reset             | Off (0) or On (1)   | Off (0)          | RW   | Bit |    | NC |    |  |
| 24.008    | Default           | Off (0) or On (1)   | Off (0)          | RW   | Bit |    | NC |    |  |
| 24.009    | Active Alarm Bits | 0000000000000000 to 1111111111111111  | 0000000000000000 | RO   | Bin |    | NC |    |  |
| 24.010    | Active IP Address | 128.0.0.0 to 127.255.255.255  | 0.0.0.0          | RO   | IP  |    | NC | PT |  |
| 24.011    | Date Code         | 0 to 65535  |                  | RO   | Num | ND | NC | PT |  |

|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 24 – Ethernet Setup

Mode: RFC-A

Menu 24 is a duplication of slot 4 menu 0. For a description of a particular parameter, click on the relevant slot parameter in the table below.

| <b>Drive Parameter</b>          | <b>Slot Parameter</b>             |
|---------------------------------|-----------------------------------|
| 24.001 <i>Module ID</i>         | 4.00.001 <i>Module ID</i>         |
| 24.002 <i>Software Version</i>  | 4.00.002 <i>Software Version</i>  |
| 24.003 <i>Hardware Version</i>  | 4.00.003 <i>Hardware Version</i>  |
| 24.004 <i>Serial Number LS</i>  | 4.00.004 <i>Serial Number LS</i>  |
| 24.005 <i>Serial Number MS</i>  | 4.00.005 <i>Serial Number MS</i>  |
| 24.006 <i>Status</i>            | 4.00.006 <i>Status</i>            |
| 24.007 <i>Reset</i>             | 4.00.007 <i>Reset</i>             |
| 24.008 <i>Default</i>           | 4.00.008 <i>Default</i>           |
| 24.009 <i>Active Alarm Bits</i> | 4.00.009 <i>Active Alarm Bits</i> |
| 24.010 <i>Active IP Address</i> | 4.00.010 <i>Active IP Address</i> |
| 24.011 <i>Date Code</i>         | 4.00.011 <i>Date Code</i>         |

## Menu 31 Single Line Descriptions – AMC General Set-up

Mode: RFC-A

| Parameter |  | Range  | Default   | Type |     |    |    |    |  |    |
|-----------|--|--|-----------|------|-----|----|----|----|--|----|
| 31.001    | AMC Select   | Off (0) or On (1)  | Off (0)   | RW   | Bit |    |    |    |  | US |
| 31.002    | AMC Absolute Mode Enable                           | Off (0) or On (1)  | Off (0)   | RW   | Bit |    |    |    |  | US |
| 31.003    | AMC Incremental Position Reset Mode                | Off (0) or On (1)  | Off (0)   | RW   | Bit |    |    |    |  | US |
| 31.004    | AMC Master User Units Ratio Numerator              | 1 to 2147483647  | 1000      | RW   | Num |    |    |    |  | US |
| 31.005    | AMC Master User Units Ratio Denominator            | 1 to 2147483647  | 1000      | RW   | Num |    |    |    |  | US |
| 31.006    | AMC Slave User Units Ratio Numerator               | 1 to 2147483647  | 1000      | RW   | Num |    |    |    |  | US |
| 31.007    | AMC Slave User Units Ratio Denominator             | 1 to 2147483647  | 1000      | RW   | Num |    |    |    |  | US |
| 31.008    | AMC Output User Units Ratio Numerator              | 1 to 2147483647  | 1000      | RW   | Num |    |    |    |  | US |
| 31.009    | AMC Output User Units Ratio Denominator            | 1 to 2147483647  | 1000      | RW   | Num |    |    |    |  | US |
| 31.010    | AMC Roll-over Limit                                | 0 to VM_AMC_ROLLOVER UU  | 0 UU      | RW   | Num |    |    |    |  | US |
| 31.011    | AMC Synchronise To Onboard User Program Clock Task | Off (0) or On (1)  | Off (0)   | RW   | Bit |    |    |    |  | US |
| 31.012    | AMC Rate Select                                    | 4ms (1), 2ms (2), 1ms (3),<br>500us (4), 250us (5)                 | 250us (5) | RW   | Txt |    |    |    |  | US |
| 31.013    | AMC Rate Selected                                  | Not Active (0), 4ms (1), 2ms (2),<br>1ms (3), 500us (4), 250us (5) |           | RO   | Txt | ND | NC | PT |  |    |
| 31.014    | AMC Speed Mode Enable                              | Off (0) or On (1)  | Off (0)   | RW   | Bit |    |    |    |  | US |
| 31.015    | AMC Auto Resolution Enable                         | Off (0) or On (1)  | Off (0)   | RW   | Bit |    |    |    |  | US |
| 31.016    | AMC Auto Resolution Scaling                        | 1 to 2147483647  |           | RO   | Num | ND | NC | PT |  |    |

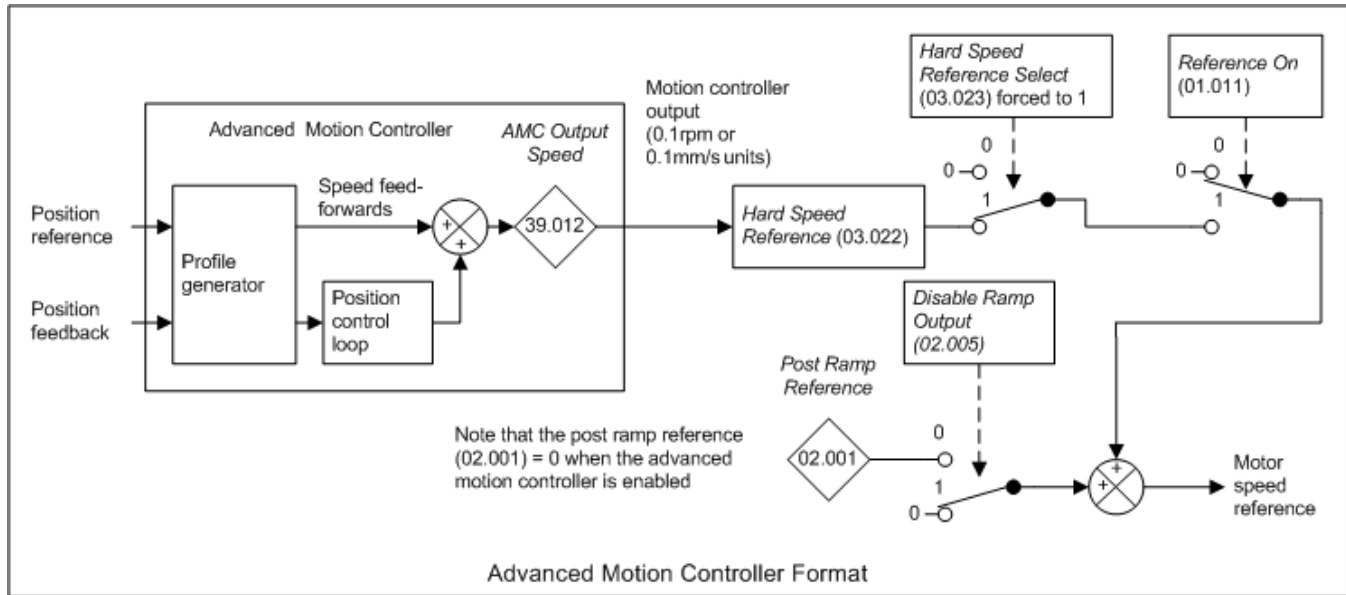
|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 31 – AMC General Set-up

Mode: RFC-A

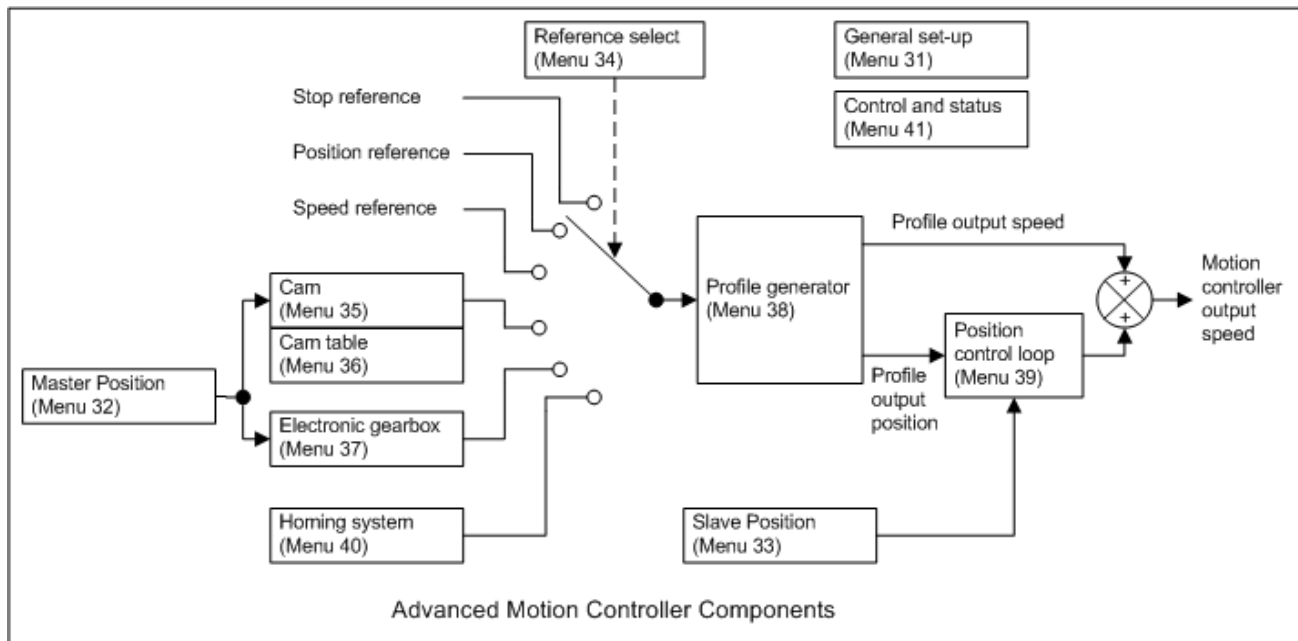
## System components

The diagram below shows the format and interface for the Advance Motion Controller.



The Advanced Motion Controller includes its own profile generator and combines the speed feed-forwards from the profile with the output of its position control loop to give a single speed reference in 0.1rpm or 0.1mm/s units. The conversion to the output speed is based on the set-up parameters of the position feedback selected to control the motor.

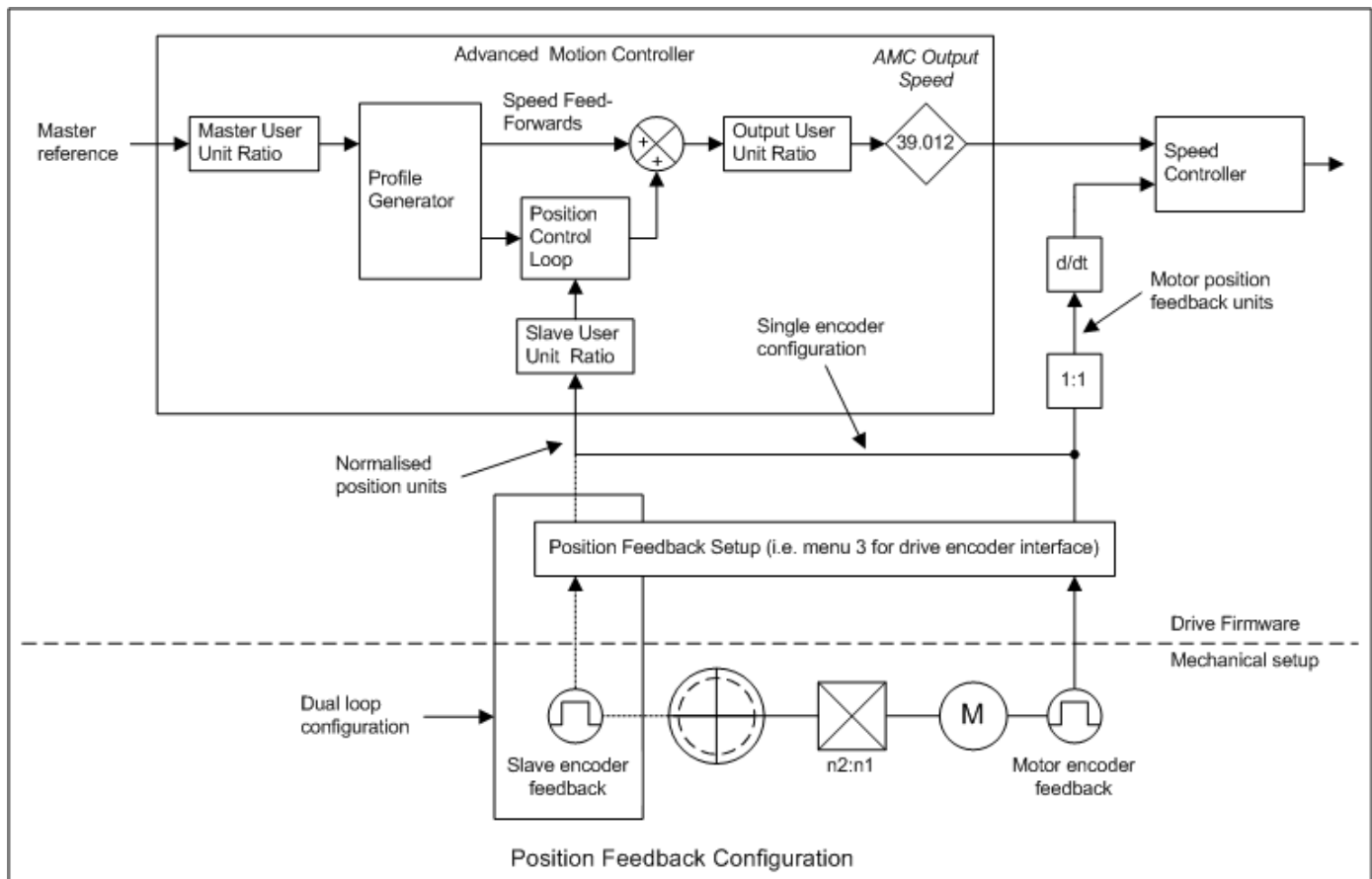
The Advanced Motion Controller is made up from the components shown in the diagram below. Individual menus are provided for each of the components.



| Function              | Description  |
|-----------------------|--|
| Master Position       | The master position can be used as the input to the Cam or electronic gearbox functions and can be derived as follows:<br>From a position feedback interface in the drive or a position feedback interface in an option module.<br>As a speed (normally fixed) so that it can be used to create a time based profile.<br>As a user position value from a parameter.  |
| Slave Position        | The slave position is used as the feedback for the position control loop and can be derived as follows:<br>From a position feedback interface in the drive or a position feedback interface in an option module.<br>As a user position value from a parameter.   |
| Reference selector    | The reference selector is used to select the input to the profile generator. In addition to the output from the Cam or electronic gearbox functions, a position or speed reference can be selected. The stop reference is a position that is constantly updated to provide a target when the system is to stop under the constraints of the profile generator. The homing system can provide a reference at the input to the profile generator during a homing routine.  |
| Cam                   | The Cam function uses a table to define the movement of the slave with respect to the master. The Cam table consists of a number of segments. Interpolation functions are provided to define the type of movement required by the slave within each segment.   |
| Cam Table             | The Cam table is used by the Cam to define the required movement of the slave in response to the movement of the master.   |
| Electronic gearbox    | The electronic gearbox allows the slave to be locked to the master including a gearbox ratio. The profile generator is used during the transition between the unlocked and locked states to control the acceleration of the slave.   |
| Profile generator     | The input to the profile generator is a target that it attempts to attain within the required constraints. These constraints include the maximum linear acceleration/deceleration, jerk and speed. The target for the profile generator can be a position, a speed, or a position and a speed. The outputs of the profile generator include a speed that is used directly as a speed feed-forward term, acceleration that is used to derive the torque or acceleration feed-forward terms and a position that is used as the input to a position control loop. |
| Position control loop | The position control loop modifies the motion controller output speed to correct the slave position and compensate for deviations from the required profile due to control system and load effects.  |
| Homing system         | The homing system can move the slave under the constraints of the profile generator to find the home position. Once the home position is detected the system can be offset so that the required position is seen at the homing point.  |
| Control and status    | The control and status system provides overall control for the motion controller and gives status information with a number of flags.  |

### Position units

Position feedback from a drive or option module position feedback interface is given as a 32 bit signed value (normalised position) including the effect of the marker input for the interface (if relevant). The number of bits that represent turns (for a rotary position feedback device) or motor poles (for a linear position feedback device) can be selected for each position feedback device with a parameter in the set-up menu for that interface. Position is represented in the Advanced Motion Controller as a 32 bit signed value. Conversion ratios can be applied to the master position (*AMC Master User Units Ratio Numerator* (31.004) / *AMC Master User Units Ratio Denominator* (31.005)), the slave position (*AMC Slave User Units Ratio Numerator* (31.006) / *AMC Slave User Units Ratio Denominator* (31.007)) and the motion controller output (*AMC Output User Units Ratio Numerator* (31.008) / *AMC Output User Units Ratio Denominator* (31.009)). The slave position can be provided by the encoder used to control the motor or from an additional encoder attached to the load (i.e. dual loop configuration) as shown below.



The input ratios should be used to convert the normalised master and slave position to the required user units used for position within the motion controller and the output ratio should be setup to convert from user units to the normalised position units for the feedback device used to control the motor. If the slave feedback is derived from the position feedback used to control the motor the output ratio will be the inverse of the slave ratio. In a dual loop configuration the output ratio must be

setup to correct for any differences between the configuration of the normalised units and the speed of the slave (load) and motor feedback, i.e. mechanical gearing. The conversion from position units to user units (input ratio) and from user units back into position units (output ratio) is demonstrated in the following examples. In these examples the parameter references refer to a feedback device connected to the drives P1 or P2 interface but any drive or option module interface can be used.

#### Example 1 - Rotary encoder

Position feedback configuration and user units requirements:

- The normalised position for the slave position feedback has 16 *P1 Normalisation Turns* (03.057) and 16 position bits
- One revolution of the slave gives a movement of 1m
- User units are to represent an item that is 3.57cm long with a resolution of 3 decimal places (1 user unit = 3.57cm/1000 = 35.7µm)

The slave user units ratio can be setup to convert the 32 bit normalised position into 35.7µm units as follows:

- Change of user units over the required range =  $1\text{m} / 35.7^{-6}\text{m} = 10^7 / 357$
- Change of normalised position over the required range =  $2^{\text{Position bits}}$

*AMC Slave User Units Ratio Numerator* (31.006) =  $10^7$

*AMC Slave User Units Ratio Denominator* (31.007) =  $2^{16} \times 357 = 23396352$

The output ratio is the inverse of the input ratio:

*AMC Output User Units Ratio Numerator* (31.008) =  $2^{16} \times 357 = 23396352$

*AMC Output User Units Ratio Denominator* (31.009) =  $10^7$

#### Example 2: Linear Encoder

Position feedback configuration and user units requirements:

- The normalised position for the slave position feedback has 8 *P1 Normalisation Turns* (03.057) and 24 position bits.
- 64 poles correspond to a linear movement of 10m (*P1 Pole Pair Pitch* (03.055) =  $1000 \times 10 / 64 = 156.25\text{ mm}$ ).
- The position units require a resolution of 1µm.

The slave user units ratio can be setup to convert the 32 bit normalised position into 0.001mm units as follows:

- Change of user units over the required range =  $10\text{m} / 10^{-6}\text{m} = 10^7$
- Change of normalised position over the required range =  $64 \times 2^{\text{Position bits}} = 2^{30}$

*AMC Slave User Units Ratio Numerator* (31.006) =  $10^7$

*AMC Slave User Units Ratio Denominator* (31.007) =  $2^{30}$

The output ratio is the inverse of the input ratio:

*AMC Output User Units Ratio Numerator* (31.008) =  $2^{30}$

*AMC Output User Units Ratio Denominator* (31.009) =  $10^7$

#### Example 3 - Rotary encoders with different motor and slave feedback devices (i.e. dual loop configuration)

Position feedback configuration and user units requirements:

- The normalised position for the slave position feedback has 12 *P1 Normalisation Turns* (03.057) and 20 position bits
- The normalised position for the motor feedback has 16 *P2 Normalisation Turns* (03.157) and 16 position bits
- User units are to represent one revolution in degrees with three decimal places (1 revolution = 360000 user units)
- There is a gear ratio of 16:1 between the motor and slave feedback

The slave user units ratio can be setup to convert the 32 bit normalised position into 0.001 degree units as follows:

- Change of user units over the required range = 360000
- Change of normalised position over the required range =  $2^{20}$

*AMC Slave User Units Ratio Numerator* (31.006) = 360000

*AMC Slave User Units Ratio Denominator* (31.007) =  $2^{20}$

In this example the output ratio is setup to convert from user units to the normalised position units for the motor feedback and must include the inverse of the gear ratio to ensure that the required output speed is seen at the slave feedback.

*AMC Output User Units Ratio Numerator* (31.008) =  $2^{16} \times 16$

*AMC Output User Units Ratio Denominator* (31.009) = 360000

#### Speed units

Speed parameters are 32 bit values specified in User units/ms with a range from  $-2^{31}$  to  $2^{31}-1$ . The speed parameters have two decimal places. If PosBits are the number of bits representing the number of counts per revolution for a rotary position feedback device then the speed resolution is calculated as follows:

Speed resolution

$$\begin{aligned}
 &= 0.01 \text{ user units/ms} \\
 &= (0.01 / \text{User units ratio}) \text{ PosBits/ms} \\
 &= (0.01 / 2^{\text{PosBits}} / \text{User units ratio}) \text{ revs/ms} \\
 &= (10 / 2^{\text{PosBits}} / \text{User units ratio}) \text{ revs/s}
 \end{aligned}$$

$$= (600 / 2^{\text{PosBits}} / \text{User units ratio}) \text{ rpm}$$

If PosBits are the number of bits representing the counts per pole pitch (PolePitch) for a linear feedback device then the speed resolution is calculated as follows:

Speed resolution

$$\begin{aligned} &= 0.01 \text{ user units/ms} \\ &= (0.01 / \text{User units ratio}) \text{ PosBits/ms} \\ &= (0.01 / 2^{\text{PosBits}} / \text{User units ratio}) \text{ poles/ms} \\ &= (0.01 \times \text{PolePitch} / 2^{\text{PosBits}} / \text{User units ratio}) \text{ mm/ms} \\ &= (10 \times \text{PolePitch} / 2^{\text{PosBits}} / \text{User units ratio}) \text{ mm/s} \end{aligned}$$

The speed resolution and the maximum speed can be calculated using the equations in the table below.

| Speed  | Calculation   | Units |
|--|---|-------|
| Resolution with rotary position feedback device    | $(600 / 2^{\text{PosBits}}) / \text{User units ratio}$                        | rpm   |
| Maximum speed with rotary position feedback device | Resolution $\times 2^{31}-1$  | rpm   |
| Resolution with linear position feedback device    | $(10 \times \text{PolePitch} / 2^{\text{PosBits}}) / \text{User units ratio}$ | mm/s  |
| Maximum speed with linear position feedback device | Resolution $\times 2^{31}-1$  | mm/s  |

The resolution can be used to relate the parameter value to the speed of the position feedback device as follows.

$$\text{Speed parameter value} = \text{Speed of position feedback device} / \text{Resolution}$$

The table below shows the speed resolution and the maximum possible speed for a rotary application in rpm and for a linear application with a pole pitch of 50mm in mm/s with a user units ratio of unity. A user units ratio of more than unity will not change the resolution, but a user units ratio of less than unity will make the resolution coarser.

| Turns bits | Position bits | Resolution (rpm)      | Maximum speed (rpm) | Resolution (mm/s)     | Maximum speed (mm/s) |
|------------|---------------|-----------------------|---------------------|-----------------------|----------------------|
| 8          | 24            | $3.58 \times 10^{-5}$ | $7.68 \times 10^4$  | $2.98 \times 10^{-5}$ | $6.40 \times 10^4$   |
| 12         | 20            | $5.72 \times 10^{-4}$ | $1.23 \times 10^6$  | $4.77 \times 10^{-4}$ | $1.02 \times 10^6$   |
| 16         | 16            | $9.16 \times 10^{-3}$ | $1.97 \times 10^7$  | $7.63 \times 10^{-3}$ | $1.64 \times 10^7$   |
| 20         | 12            | $1.46 \times 10^{-1}$ | $3.15 \times 10^8$  | $1.22 \times 10^{-1}$ | $2.62 \times 10^8$   |
| 24         | 8             | 2.34                  | $5.03 \times 10^9$  | 1.95                  | $4.19 \times 10^9$   |

To allow the profile generator to work at the minimum acceleration (0.001 user units/ms/ms) the internal speed resolution used by the profile generator is defined by the minimum acceleration unit. When the profile generator is enabled (*AMC Profile Disable* (38.005) = 0) the maximum speed can be limited by the output of the profile generator. As above, the maximum profile speed is calculated from the speed resolution and the internal speed resolution of the profile generator is calculated as follows:

$$\text{Profile speed resolution} = \text{Speed resolution} / 10.24 \times (1\text{ms} / \text{AMC Rate Selected} (31.013))$$

The table below shows the internal profile speed resolution and the maximum speed when *AMC Rate Selected* (31.013) = 250µs.

| Turns bits | Position bits | Profile Internal Resolution (rpm) | Profile Maximum Speed (rpm) | Profile Internal Resolution (mm/s) | Profile Maximum Speed (mm/s) |
|------------|---------------|-----------------------------------|-----------------------------|------------------------------------|------------------------------|
| 8          | 24            | $8.73 \times 10^{-7}$             | $1.87 \times 10^3$          | $7.28 \times 10^{-7}$              | $1.56 \times 10^3$           |
| 12         | 20            | $1.40 \times 10^{-5}$             | $3.00 \times 10^4$          | $1.16 \times 10^{-5}$              | $2.50 \times 10^4$           |
| 16         | 16            | $2.24 \times 10^{-4}$             | $4.80 \times 10^5$          | $1.86 \times 10^{-4}$              | $4.00 \times 10^5$           |
| 20         | 12            | $3.58 \times 10^{-3}$             | $7.68 \times 10^6$          | $2.98 \times 10^{-3}$              | $6.40 \times 10^6$           |
| 24         | 8             | $5.72 \times 10^{-2}$             | $1.23 \times 10^8$          | $4.77 \times 10^{-2}$              | $1.02 \times 10^8$           |

If a higher maximum profile speed is required the resolution can be decreased by using a user unit ratio less than unity or *AMC Rate Selected* (31.013) can be increased.

### Acceleration units

Acceleration parameters are 32 bit values specified in User units/ms/ms with a range from 0 to  $2^{30} - 1$ . The acceleration parameters have 4 decimal places. If PosBits are the number of counts per revolution for a rotary position feedback device then the acceleration resolution is calculated as follows:

Acceleration resolution

$$\begin{aligned} &= 0.001 \text{ user units/ms/ms} \\ &= (0.001 / \text{User units ratio}) \text{ PosBits/ms/ms} \\ &= (0.001 / 2^{\text{PosBits}} / \text{User units ratio}) \text{ revs/ms/ms} \\ &= (1000 / 2^{\text{PosBits}} / \text{User units ratio}) \text{ revs/s/s} \\ &= (60000 / 2^{\text{PosBits}} / \text{User units ratio}) \text{ rpm/s} \end{aligned}$$

If PosBits are the number bits representing the counts per pole pitch (PolePitch) for a linear feedback device then the acceleration resolution is calculated as follows:

Acceleration resolution

$$\begin{aligned} &= 0.001 \text{ user units/ms/ms} \\ &= (0.001 / \text{User units ratio}) \text{ PosBits/ms/ms} \\ &= (0.001 / 2^{\text{PosBits}} / \text{User units ratio}) \text{ poles/ms/ms} \\ &= (0.001 \times \text{PolePitch} / 2^{\text{PosBits}} / \text{User units ratio}) \text{ mm/ms/ms} \\ &= (1000 \times \text{PolePitch} / 2^{\text{PosBits}} / \text{User units ratio}) \text{ mm/s}^2 \end{aligned}$$

The acceleration resolution and the maximum acceleration can be calculated using the equations in the table below.



| Acceleration  | Calculation   | Units             |
|---|---|-------------------|
| Resolution with rotary position feedback device           | $(60000 / 2^{\text{PosBits}}) / \text{User units ratio}$                        | rpm/s             |
| Maximum acceleration with rotary position feedback device | Resolution x $2^{30-1}$   | rpm/s             |
| Resolution with linear position feedback device           | $(1000 \times \text{PolePitch} / 2^{\text{PosBits}}) / \text{User units ratio}$ | mm/s <sup>2</sup> |
| Maximum acceleration with linear position feedback device | Resolution x $2^{30-1}$   | mm/s <sup>2</sup> |

The resolution can be used to relate the parameter value to the acceleration of the position feedback device as follows:

Acceleration parameter value = Acceleration of position feedback device / Resolution

The table below shows the minimum and maximum time that can be set up to acceleration from zero to 3000rpm for a rotary application and zero to 1m/s for a linear application with a user units ratio of unity. A user units ratio of more than unity will not change the resolution, but a user units ratio of less than unity will make the resolution coarser.

| Turns bits | Position bits | Maximum acceleration time to 3000rpm (s) | Minimum acceleration time to 3000rpm (s) | Maximum acceleration time to 1ms <sup>-1</sup> (s) | Minimum acceleration time to 1ms <sup>-1</sup> (s) |
|------------|---------------|--|--|--|--|
| 8          | 24            | 8.39x10 <sup>5</sup>                     | 7.81x10 <sup>-4</sup>                    | 3.36x10 <sup>5</sup>                               | 3.13x10 <sup>-4</sup>                              |
| 12         | 20            | 5.24x10 <sup>4</sup>                     | 4.88x10 <sup>-5</sup>                    | 2.10x10 <sup>4</sup>                               | 1.95x10 <sup>-5</sup>                              |
| 16         | 16            | 3.28x10 <sup>3</sup>                     | 3.05x10 <sup>-6</sup>                    | 1.31x10 <sup>3</sup>                               | 1.22x10 <sup>-6</sup>                              |
| 20         | 12            | 2.05x10 <sup>5</sup>                     | 1.91x10 <sup>-7</sup>                    | 8.19x10 <sup>1</sup>                               | 7.63x10 <sup>-8</sup>                              |
| 24         | 8             | 1.28x10 <sup>1</sup>                     | 1.19x10 <sup>-8</sup>                    | 5.12   | 4.77x10 <sup>-9</sup>                              |

| Parameter         | 31.001 AMC Select   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to write the output of the motion controller to the Hard Speed Reference |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

When the Advanced Motion Controller is selected (i.e. *AMC Select* (31.001) = 1) the output of the motion controller is written to *Hard Speed Reference* (03.022). The table below shows the effect of changing the value of *AMC Select* (31.001).

| AMC Select (31.001) | Action   |
|---------------------|--|
| 0                   | On changing from 1 to 0:<br><i>Hard Speed Reference</i> (03.022) = 0<br><i>Hard Speed Reference Select</i> (03.023) = 0                                |
| 1                   | On changing from 0 to 1:<br><i>Hard Speed Reference</i> (03.022) = <i>AMC Output Speed</i> (39.012)<br><i>Hard Speed Reference Select</i> (03.023) = 1 |

If *Hard Speed Reference Select* (03.023) is turned off after the motion controller has been initialised the motion controller will operate as expected but *AMC Output Speed* (39.012) will not be written to *Hard Speed Reference* (03.022). If the motion controller is not selected (i.e. *AMC Select* (31.001) = 0) none of the functionality in menu 31 to menu 41 is enabled.

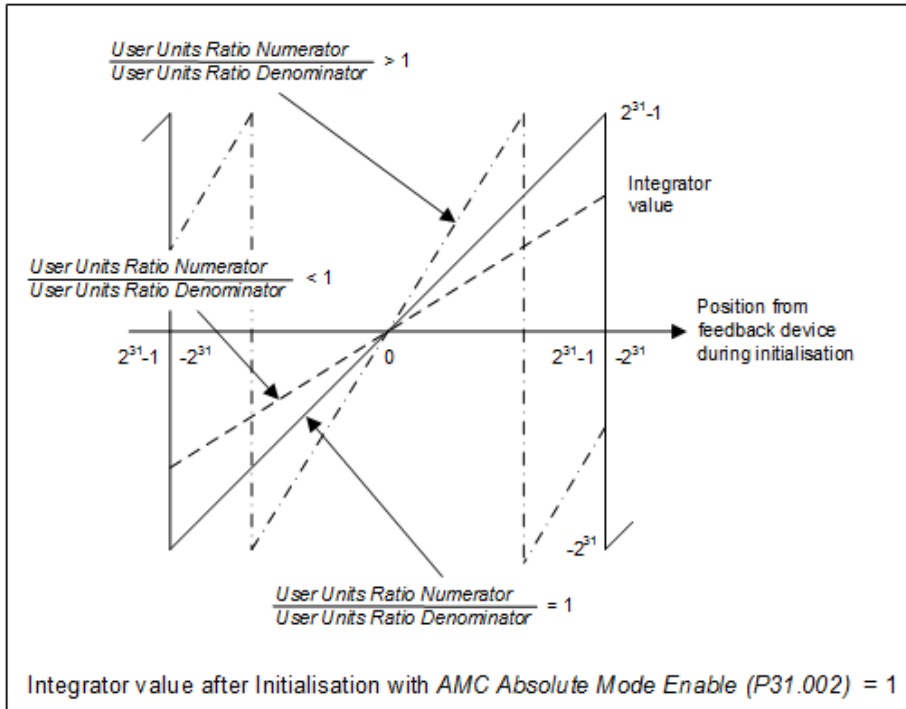
| Parameter         | 31.002 AMC Absolute Mode Enable                                       |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to enable the absolute mode of the advance motion controller |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

*AMC Absolute Mode Enable* (31.002) defines how the position feedback information is transferred to the integrators for the master and slave source positions.

If *AMC Absolute Mode Enable* (31.002) = 0 then the integrators are either held at zero (*AMC Incremental Position Reset Mode* (31.003) = 0), or continue to operate normally (*AMC Incremental Position Reset Mode* (31.003) = 1), when the motion controller is disabled. (See *AMC Enable* (41.001) for details on how to enable or disable the motion controller.) Therefore both the master and slave positions are incremental relative to zero when the motion controller is enabled or when the drive was powered up respectively. When the motion controller is enabled the change of position from the position feedback device is modified by the user unit ratio, and inverted if required, before being accumulated in the integrator.

If *AMC Absolute Mode Enable* (31.002) = 1 then the position is taken from the position feedback device, modified by the user units ratio, inverted if required and then written to the integrator when the motion controller is initialised or any parameter which results in a change of absolute position is modified. After the feedback has

been initialised the change of position from the position feedback device is modified by the user unit ratio, and inverted if required, before being accumulated in the integrator when the motion controller is enabled or disabled. If the user unit ratio is above unity the master and slave position integrators can rollover the boundary during initialisation. When *AMC Roll-over Limit* (31.010) > 0 the initialisation of the slave position is handled differently to allow the position within the rollover limit to be recovered correctly after the normalised position or the internal user position has rolled over a boundary, see *AMC Roll-over Limit* (31.010).



| Parameter         | 31.003 AMC Incremental Position Reset Mode   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | If set to 0 the integrators are held at zero when the AMC is disabled, and if set to 1 the integrators continue to operate normally when the AMC is disabled |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *AMC Absolute Mode Enable* (31.002).

| Parameter         | 31.004 AMC Master User Units Ratio Numerator             |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the numerator of the AMC Master User Units Ratio |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 1  | Maximum        | 2147483647      |
| Default           | 1000   | Units          |                 |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

The master user units ratio (*AMC Master User Units Ratio Numerator* (31.004) / *AMC Master User Units Ratio Denominator* (31.005)) is applied to the master position to convert the feedback position from normalised units to user units. Similar ratios are provided for the slave position and the output of the motion controller. The configuration of these ratios is described in *AMC General Set-up* (31).

| Parameter         | 31.005 AMC Master User Units Ratio Denominator             |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the denominator of the AMC Master User Units Ratio |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 1  | Maximum        | 2147483647      |
| Default           | 1000   | Units          |                 |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *AMC Master User Units Ratio Numerator* (31.004).

| Parameter         | 31.006 AMC Slave User Units Ratio Numerator             |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the numerator of the AMC Slave User Units Ratio |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 1   | Maximum        | 2147483647      |
| Default           | 1000  | Units          |                 |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *AMC Master User Units Ratio Numerator* (31.004).

| Parameter         | 31.007 AMC Slave User Units Ratio Denominator             |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the denominator of the AMC Slave User Units Ratio |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 1   | Maximum        | 2147483647      |
| Default           | 1000  | Units          |                 |
| Type              | 32 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

See *AMC Master User Units Ratio Numerator* (31.004).

| Parameter         | 31.008 AMC Output User Units Ratio Numerator             |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the numerator of the AMC Output User Units Ratio |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 1  | Maximum        | 2147483647      |
| Default           | 1000   | Units          |                 |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *AMC Master User Units Ratio Numerator* (31.004).

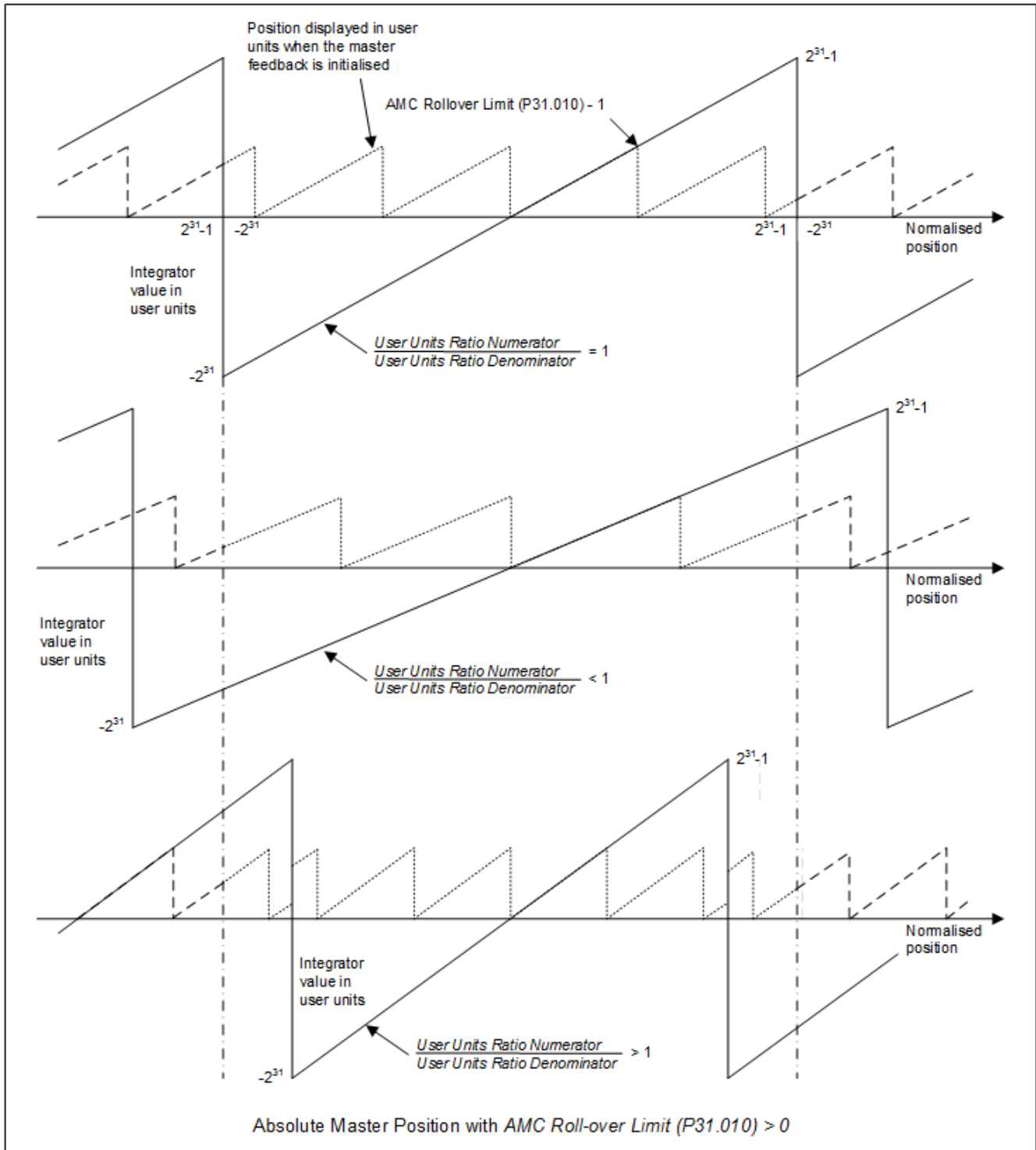
| Parameter         | 31.009 AMC Output User Units Ratio Denominator             |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the denominator of the AMC Output User Units Ratio |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 1  | Maximum        | 2147483647      |
| Default           | 1000   | Units          |                 |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *AMC Master User Units Ratio Numerator* (31.004).

| Parameter         | 31.010 AMC Roll-over Limit |                |                 |
|-------------------|----------------------------|----------------|-----------------|
| Short description |                            |                |                 |
| Mode              | RFC-A                      |                |                 |
| Minimum           | 0                          | Maximum        | VM_AMC_ROLLOVER |
| Default           | 0                          | Units          | UU              |
| Type              | 32 Bit User Save           | Update Rate    | Background read |
| Display Format    | Standard                   | Decimal Places | 0               |
| Coding            | RW, VM                     |                |                 |

If *AMC Roll-over Limit* (31.010) = 0 the motion controller operates over a range from  $-2^{31}$  to  $2^{31}-1$ , i.e.  $VM\_AMC\_POSITION[MIN] = -2^{31}$  and  $VM\_AMC\_POSITION[MAX] = 2^{31}-1$ , and the system can rollover the  $VM\_AMC\_POSITION[MIN]$  and  $VM\_AMC\_POSITION[MAX]$  boundaries without a transient. When *AMC Roll-over Limit* (31.010) is set to a non-zero value the motion controller continues to operate over a range from  $-2^{31}$  to  $2^{31}-1$  internally but the position parameters display a position from zero to *AMC Roll-over Limit* (31.010) - 1, i.e.  $VM\_AMC\_POSITION[MIN] = 0$  and  $VM\_AMC\_POSITION[MAX] = AMC\ Roll-over\ Limit\ (31.010) - 1$ , and the system can rollover the zero or  $VM\_AMC\_POSITION[MAX]$  boundaries without a transient. Note that when *AMC Auto Resolution Enable* (31.015) is enabled  $VM\_AMC\_ROLLOVER[MAX] = 2^{30}-1 / AMC\ Auto\ Resolution\ Scaling\ (31.016)$ .

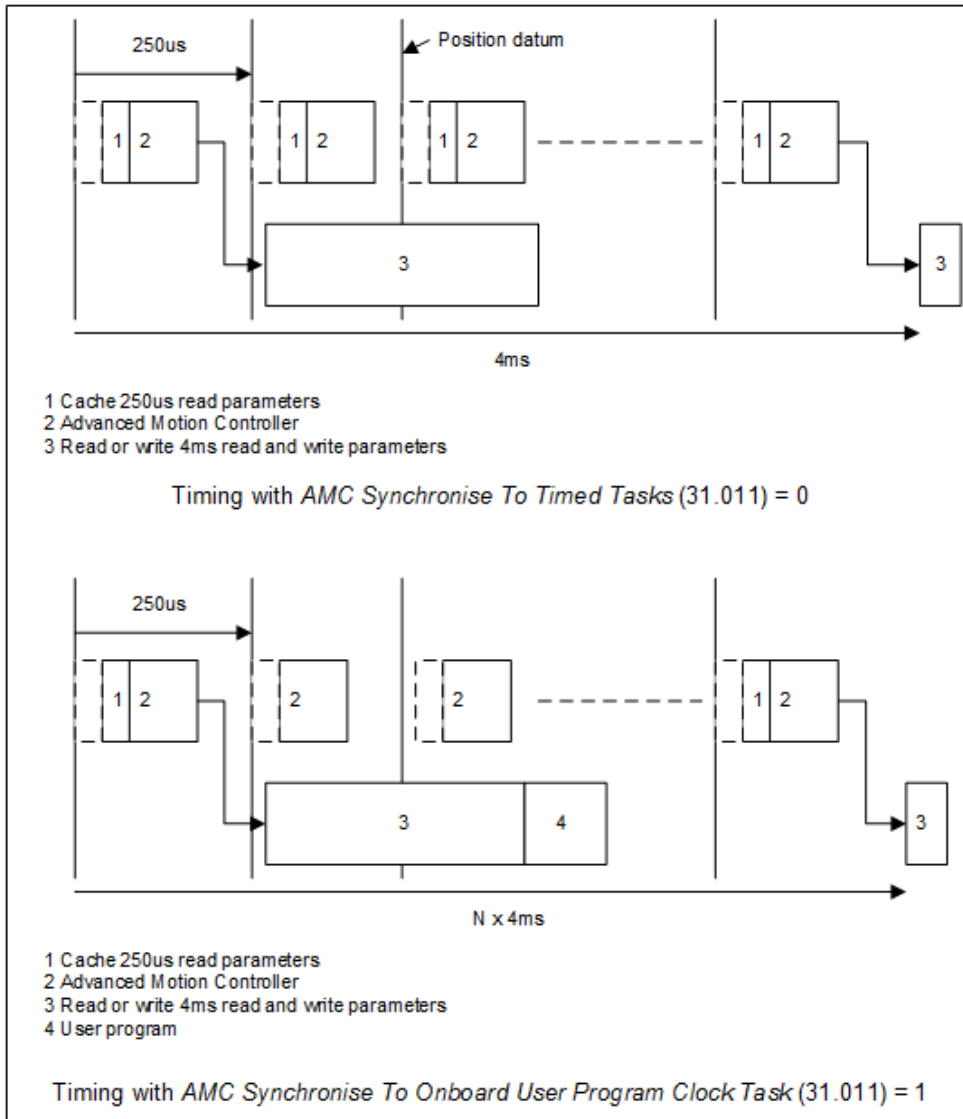
When *AMC Absolute Mode Enable* (31.002) = 0 the position parameters are always set to zero during initialisation. When *AMC Absolute Mode Enable* (31.002) = 1 the absolute slave position is recovered from the user and normalised positions saved on power down. This allows an absolute encoder to be homed once and for the correct position within the rollover limit to be recovered after the internal user position or the normalised position has rolled over the minimum or maximum boundary one or more times. Note that the correct absolute position will only be recovered if the normalised position has moved by less than half of the maximum range when the drive is off and absolute mode is enabled when the motion controller is initialised. Note that when using the control word to configure the absolute mode *AMC Control Word Enable* (41.021) should be set to mode 2 to ensure the absolute position is recovered correctly during initialisation. The master position is always initialised with the absolute position calculated using the normalised position and the master user unit ratio. The initial position (*AMC Master Position* (32.004)) within the rollover limit is derived from this position as shown in the diagram below.



When *AMC Absolute Mode Enable* (31.002) is enabled the slave position is initialised using the same method as the master position, but after the internal user or normalised positions have rolled over one of the boundaries the slave position may no longer be directly related to the normalised position of the feedback device.

| Parameter         | 31.011 AMC Synchronise To Onboard User Program Clock Task                                      |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to allow the AMC to be controlled synchronously by an onboard user program clock task |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

Most time critical parts of the Advanced Motion Controller operate at the sample rate set in *AMC Rate Select* (31.012). The homing function and most parameter access operate at a 4ms rate. The timing of the controller (*AMC Rate Select* (31.012) = 250µs) and parameter reading and writing is shown below with respect to other tasks in the drive.



The following examples show how the Advanced Motion Controller can be controlled in different configurations. Note that *AMC Synchronise To Onboard User Program Clock Task (31.011)* should only be enabled when the onboard user program is writing to one of the parameters updated at the beginning of every motion controller task.

#### Stand-alone motion controller

Most parameters are set up during commissioning and are not time critical. *AMC Action On Event (34.008)* can be used to set up triggered time critical events, or the position and speed references can be controlled via communications from an external controller.

#### Simple position control loop with option module providing the rest of the motion controller

*AMC External Position Reference (39.002)*, *AMC External Speed Reference (39.004)* and *AMC External Acceleration Reference (39.014)* can be used by an option module as the references for a simple position control loop. These values should be updated outside the active period of the motion controller.

#### Motion controller controlled by an option module

*AMC Master User Position Reference (32.009)*, *AMC Slave User Position Reference (33.009)*, *AMC Position Reference (34.003)*, *AMC Speed Reference (34.006)* and *AMC Reference Select (34.007)* can be modified every 250µs and should be updated outside the active period of the motion controller. *AMC Action On Event (34.008)* can be used to set up triggered time critical events.

#### Motion controller controlled by an on-board user program

All 250µs read parameters are cached for use by the motion controller at the start of the thread where the user program timed task will be started and not at the start of every thread in which the motion controller runs. This means that the values that were updated during the previous timed task are read together.

| Parameter         | 31.012 <i>AMC Rate Select</i>      |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Defines the sample rate of the AMC |                |                 |
| Mode              | RFC-A                              |                |                 |
| Minimum           | 1                                  | Maximum        | 5               |
| Default           | 5                                  | Units          |                 |
| Type              | 8 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW, TE                             |                |                 |

| Value | Text  |
|-------|-------|
| 1     | 4ms   |
| 2     | 2ms   |
| 3     | 1ms   |
| 4     | 500us |
| 5     | 250us |

*AMC Rate Selected* (31.013) indicates whether the Advanced Motion Controller is active or not, and the sample rate being used. The sample rate for the Advanced Motion Controller is selected with *AMC Rate Select* (31.012). It should be noted that both the Advanced and Standard motion controllers cannot be active at the same time and can only be enabled or disabled when the drive is in the disabled state. If both motion controllers are selected at power-up the Standard Motion Controller will take priority.

The sample rate of the Advanced Motion Controller is limited in each of conditions shown in the table below. If more than one of the conditions is active the motion controller will operate at the slower of the two update rates, i.e. if an option module is used to provide the position feedback and an s-ramp profile is enabled then *AMC Rate Selected* (31.013) is limited to 1ms.

| Mode  | Description                      | Maximum sample rate |
|---|----------------------------------|---------------------|
| <i>AMC Master Source Select</i> (32.001) ≥ 4    | Option module feedback interface | 500µs               |
| <i>AMC Slave Source Select</i> (33.001) ≥ 4     | Option module feedback interface | 500µs               |
| <i>AMC Roll-over Limit</i> (31.010) > 0         |                                  | 500µs               |
| <i>AMC Profile Jerk 1</i> (38.011) > 0          | S-ramp profile active            | 1ms                 |
| <i>Sensorless Mode Active</i> (03.078) = On (1) |                                  | 4ms                 |

| Parameter         | 31.013 <i>AMC Rate Selected</i>         |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Shows the actual sample rate of the AMC |                |                  |
| Mode              | RFC-A                                   |                |                  |
| Minimum           | 0                                       | Maximum        | 5                |
| Default           |   | Units          |                  |
| Type              | 8 Bit Volatile                          | Update Rate    | Background write |
| Display Format    | Standard                                | Decimal Places | 0                |
| Coding            | RO, TE, ND, NC, PT                      |                |                  |

| Value | Text       |
|-------|------------|
| 0     | Not Active |
| 1     | 4ms        |
| 2     | 2ms        |
| 3     | 1ms        |
| 4     | 500us      |
| 5     | 250us      |

See *AMC Rate Select* (31.012).

| Parameter         | 31.014 <i>AMC Speed Mode Enable</i> |                |                 |
|-------------------|-------------------------------------|----------------|-----------------|
| Short description | Set to 1 to enable speed mode       |                |                 |
| Mode              | RFC-A                               |                |                 |
| Minimum           | 0                                   | Maximum        | 1               |
| Default           | 0                                   | Units          |                 |
| Type              | 1 Bit User Save                     | Update Rate    | Background read |
| Display Format    | Standard                            | Decimal Places | 0               |
| Coding            | RW                                  |                |                 |

Speed mode is active when *AMC Speed Mode Enable* (31.014) = 1 and *AMC Reference Select* (34.007) = 2 (speed reference). When speed mode is active *AMC Profile Maximum Speed* (38.003) is ignored, *AMC Profile Input Position* (38.006) and *AMC Profile Output Position* (38.008) are set to *AMC Slave Position* (33.004) at the beginning of each sample and *AMC Position Error* (39.008) is held at zero. If *AMC Position Error* (39.008) is not zero when speed mode is activated  $AMC Position Error (39.008) \times AMC Position Control Loop Kp Gain (39.007) / 1000$  (clamped by *AMC Output Speed Clamp* (39.011)) is added to *AMC Profile Output Speed* (38.009) to prevent a transient in *AMC Output Speed* (39.012).

| Parameter         | 31.015 <i>AMC Auto Resolution Enable</i>  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to enable auto resolution which can increase the internal resolution used by the AMC |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

When *AMC Auto Resolution Enable* (31.015) = 0 the Advanced Motion Controller works in the resolution of the user units. If the output ratio ( $AMC Output User Units Ratio Numerator (31.008) / AMC Output User Units Ratio Denominator (31.009)$ ) > 1 the resolution of the user units is lower than the resolution of the normalised position of the motor feedback device. For example, if the slave moves 100mm for every revolution of the motor and the motor normalised position has 16 position bits per revolution.

$AMC\ Output\ User\ Units\ Ratio\ Numerator\ (31.008) / AMC\ Output\ User\ Units\ Ratio\ Denominator\ (31.009) = 65536 / 100$

Speed resolution (0.01 User units / ms) =  $0.01 \times 60,000 / 100 = 6\ rpm$

To improve the speed resolution the user unit resolution could be increased from mm to  $\mu m$ . In this condition the output ratio will be less than unity and the resolution of the Advanced Motion Controller is limited by the resolution of the normalised position (0.0091 rpm).

Alternately, when  $AMC\ Auto\ Resolution\ Enable\ (31.015) = 1$  the resolution of the internal units used by the Advanced Motion Controller is automatically increased by an internal scaling factor ( $AMC\ Auto\ Resolution\ Scaling\ (31.016)$ ) which is the largest value (power of two) that maintains the output ratio at or above unity. This ensures that the maximum position reference ( $AMC\ Position\ Reference\ (34.003)$ ) is greater than or equal to the number of normalised turns or poles of the motor feedback device and the internal speed resolution is never less than half the resolution of the normalised units. Note that the maximum value for  $AMC\ Auto\ Resolution\ Scaling\ (31.016)$  is the minimum of  $2^{31}-1/AMC\ Master\ User\ Units\ Ratio\ Numerator\ (31.004)$ ,  $2^{31}-1/AMC\ Slave\ User\ Units\ Ratio\ Numerator\ (31.006)$  and  $2^{31}-1/AMC\ Output\ User\ Units\ Ratio\ Denominator\ (31.009)$ . When this mode is used the internal resolution is increased but all of the user parameters are defined in user units, i.e. mm.

If this mode is enable in the example above (output ratio  $\gg 1$ ) the internal resolution can be increased as shown below.

$AMC\ Output\ User\ Units\ Ratio\ Numerator\ (31.008) / (AMC\ Auto\ Resolution\ Scaling\ (31.016) \times AMC\ Output\ User\ Units\ Ratio\ Denominator\ (31.009)) \geq 1$

$AMC\ Auto\ Resolution\ Scaling\ (31.016) = 512$  (largest power of 2 that satisfies the above requirements, i.e. output ratio  $\geq 1$ )

Speed resolution (0.01 User units / ms) =  $0.01 \times 60,000 / (100 \times 512) = 0.0117\ rpm$

If the output ratio is less than or equal to unity the resolution of the user units is limited by the resolution of the normalised units and  $AMC\ Auto\ Resolution\ Scaling\ (31.016)$  is set to unity.

| Parameter         | 31.016 AMC Auto Resolution Scaling  |                |                  |
|-------------------|---|----------------|------------------|
| Short description | Shows the internal scaling factor used to increase the internal resolution of the AMC when auto resolution is enabled |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 1   | Maximum        | 2147483647       |
| Default           |   | Units          |                  |
| Type              | 32 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT  |                |                  |

See  $AMC\ Auto\ Resolution\ Enable\ (31.015)$ .

## Menu 32 Single Line Descriptions – AMC Master Position

Mode: RFC-A

| Parameter |                                    | Range  | Default      | Type |     |    |    |    |    |    |
|-----------|------------------------------------|--|--------------|------|-----|----|----|----|----|----|
| 32.001    | AMC Master Source Select           | Speed (0), User Position (1),<br>P1 Drive (2), P2 Drive (3),<br>P1 Slot1 (4), P2 Slot1 (5),<br>P1 Slot2 (6), P2 Slot2 (7),<br>P1 Slot3 (8), P2 Slot3 (9) | P2 Drive (3) | RW   | Txt |    |    |    |    | US |
| 32.002    | AMC Master Invert                  | Off (0) or On (1)  | Off (0)      | RW   | Bit |    |    |    |    | US |
| 32.003    | AMC Master Offset                  | ±VM_AMC_POSITION UU  | 0 UU         | RW   | Num |    |    |    |    | US |
| 32.004    | AMC Master Position                | ±VM_AMC_POSITION UU  |              | RO   | Num | ND | NC | PT |    |    |
| 32.005    | AMC Master Speed                   | ±VM_AMC_SPEED UU/ms  |              | RO   | Num | ND | NC | PT | FI |    |
| 32.006    | AMC Master Freeze Position         | ±VM_AMC_POSITION UU  |              | RO   | Num | ND | NC | PT |    |    |
| 32.007    | AMC Master Freeze Select           | Off (0) or On (1)  | Off (0)      | RW   | Bit |    |    |    |    | US |
| 32.008    | AMC Master Speed Reference         | ±VM_AMC_SPEED UU/ms  | 0.00 UU/ms   | RW   | Num |    |    |    |    | US |
| 32.009    | AMC Master User Position Reference | -2147483648 to 2147483647  | 0            | RW   | Num |    | NC |    |    |    |
| 32.010    | AMC Master Freeze Flag             | Off (0) or On (1)  | Off (0)      | RW   | Bit |    | NC |    |    |    |

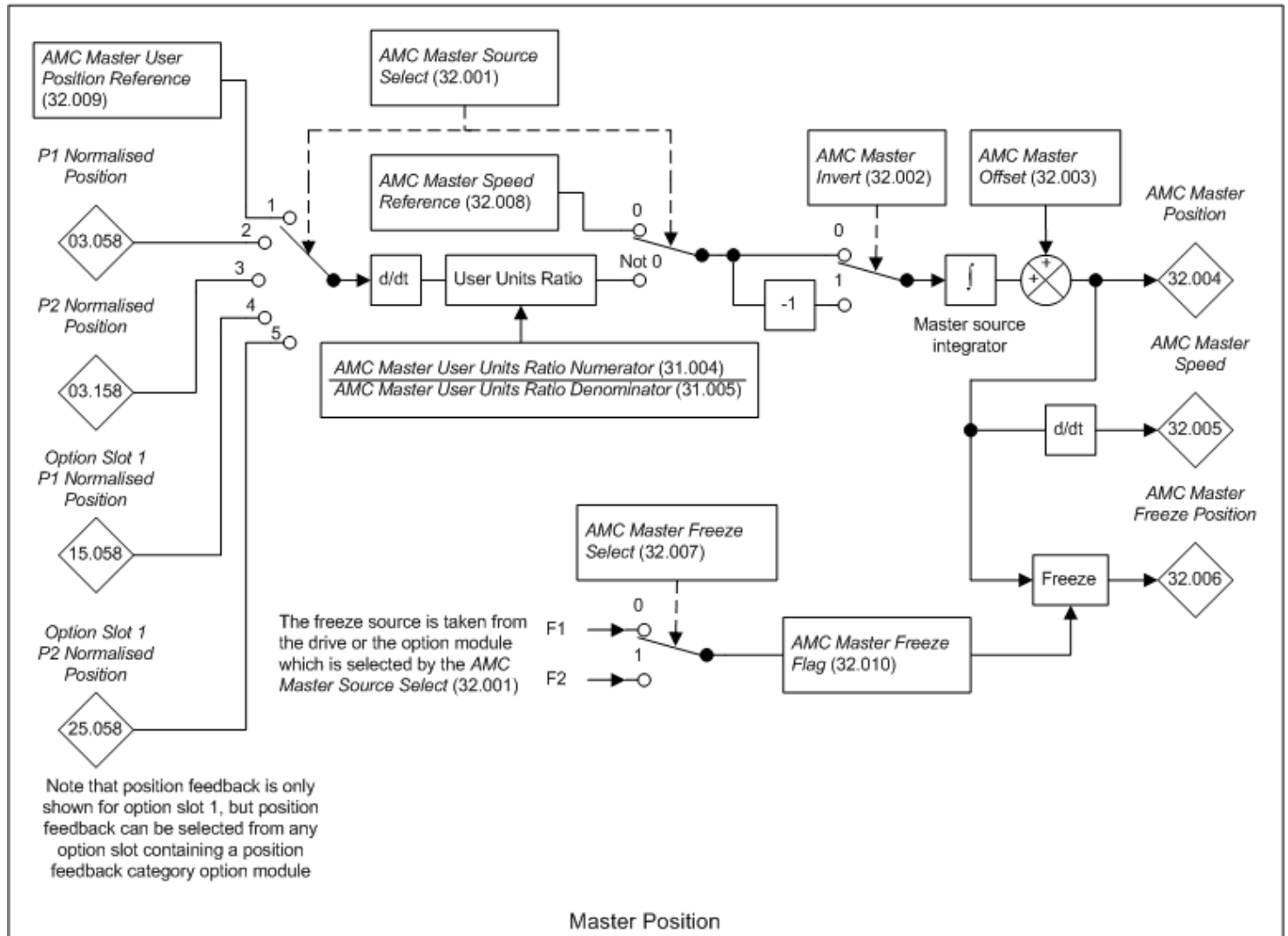
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |



## Menu 32 – AMC Master Position

Mode: RFC-A

### Master position



| Parameter         | 32.001 AMC Master Source Select                                   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the position feedback source used by the master reference |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0   | Maximum        | 9               |
| Default           | 3   | Units          |                 |
| Type              | 8 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, TE  |                |                 |

| Value | Text          |
|-------|---------------|
| 0     | Speed         |
| 1     | User Position |
| 2     | P1 Drive      |
| 3     | P2 Drive      |
| 4     | P1 Slot1      |
| 5     | P2 Slot1      |
| 6     | P1 Slot2      |
| 7     | P2 Slot2      |
| 8     | P1 Slot3      |
| 9     | P2 Slot3      |

AMC Master Source Select (32.001) can be set to a value between 2 and 11 to select a position feedback source as the master reference from the drive position feedback interface or from the position feedback interface in a position feedback category option module. It should be noted that the position includes the effect of the marker function of the position source. If the selected position feedback source does not exist (i.e. it is not present in the drive or option module, or the option module cannot provide position feedback) the source position will remain at zero.

If *AMC Master Source Select* (32.001) is set to 0 then *AMC Master Speed Reference* (32.008) is used as the source and provides a position that changes at a constant rate against time. This allows profiles to be produced with a time base instead of a synchronous profile related to master position.

If *AMC Master Source Select* (32.001) is set to 1 then *AMC Master User Position Reference* (32.009) is used as the source. This allows the master position to be provided by the user, or to be provided from a fieldbus interface.

| Parameter         | 32.002 <i>AMC Master Invert</i>            |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to invert the AMC master position |                |                 |
| Mode              | RFC-A                                      |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

*AMC Master Invert* (32.002) negates the delta position values that are accumulated by the slave source integrator. If *AMC Absolute Mode Enable* (31.002) is enabled the master position is taken from the position feedback device, modified by the user units ratio, inverted if required (*AMC Master Invert* (32.002) = 1) and then written to the slave source integrator. Note that the feedback is initialised on power-up or after any parameter which results in a change to the absolute position is modified.

| Parameter         | 32.003 <i>AMC Master Offset</i>                     |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Defines the offset used for the AMC Master Position |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | -VM_AMC_POSITION                                    | Maximum        | VM_AMC_POSITION |
| Default           | 0   | Units          | UU              |
| Type              | 32 Bit User Save                                    | Update Rate    | 4ms read        |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, VM  |                |                 |

see *AMC Master Position* (32.004).

| Parameter         | 32.004 <i>AMC Master Position</i> |                |                 |
|-------------------|-----------------------------------|----------------|-----------------|
| Short description | Displays the AMC Master Position  |                |                 |
| Mode              | RFC-A                             |                |                 |
| Minimum           | -VM_AMC_POSITION                  | Maximum        | VM_AMC_POSITION |
| Default           |                                   | Units          | UU              |
| Type              | 32 Bit Volatile                   | Update Rate    | 4ms write       |
| Display Format    | Standard                          | Decimal Places | 0               |
| Coding            | RO, VM, ND, NC, PT                |                |                 |

*AMC Master Position* (32.004) is the sum of the position in the master source integrator and *AMC Master Offset* (32.003).

| Parameter         | 32.005 <i>AMC Master Speed</i>                         |                |              |
|-------------------|--|----------------|--------------|
| Short description | Displays the rate of change of the AMC Master Position |                |              |
| Mode              | RFC-A  |                |              |
| Minimum           | -VM_AMC_SPEED  | Maximum        | VM_AMC_SPEED |
| Default           |  | Units          | UU/ms        |
| Type              | 32 Bit Volatile  | Update Rate    | 4ms write    |
| Display Format    | Standard   | Decimal Places | 2            |
| Coding            | RO, FI, VM, ND, NC, PT                                 |                |              |

*AMC Master Speed* (32.005) gives the rate of change of the *AMC Master Position* (32.004).

| Parameter         | 32.006 <i>AMC Master Freeze Position</i> |                |                 |
|-------------------|--|----------------|-----------------|
| Short description |  |                |                 |
| Mode              | RFC-A                                    |                |                 |
| Minimum           | -VM_AMC_POSITION                         | Maximum        | VM_AMC_POSITION |
| Default           |  | Units          | UU              |
| Type              | 32 Bit Volatile                          | Update Rate    | 4ms write       |
| Display Format    | Standard                                 | Decimal Places | 0               |
| Coding            | RO, VM, ND, NC, PT                       |                |                 |

*AMC Master Freeze Select* (32.007) is used to select which freeze source associated with the master should be used to provide *AMC Master Freeze Position* (32.006). For example, if a position interface within the drive is being used as the master source then the F1 or F2 freeze source provided in the drive can be selected. In the sample after a freeze event occurs *AMC Master Position* (32.004) at the point in time when the freeze event occurred is stored in *AMC Master Freeze Position* (32.006). Note that the freeze flag in the position menu is updated every 250µs but *AMC Master Freeze Select* (32.007) is only updated every 4ms. To ensure that *AMC Master Freeze Position* (32.006) has been updated *AMC Master Freeze Flag* (32.010) should be used to indicate when a freeze event has occurred and to clear the master source freeze flag in the position feedback menu.

If an option module is being used as the master source then a freeze source in the option module can be selected. If a freeze source selected in an option module does not exist then *AMC Master Freeze Position* (32.006) will remain at its present value.

| Parameter         | 32.007 AMC Master Freeze Select |                |                 |
|-------------------|---------------------------------|----------------|-----------------|
| Short description |                                 |                |                 |
| Mode              | RFC-A                           |                |                 |
| Minimum           | 0                               | Maximum        | 1               |
| Default           | 0                               | Units          |                 |
| Type              | 1 Bit User Save                 | Update Rate    | Background read |
| Display Format    | Standard                        | Decimal Places | 0               |
| Coding            | RW                              |                |                 |

See AMC Master Freeze Position (32.006).

| Parameter         | 32.008 AMC Master Speed Reference  |                |              |
|-------------------|--|----------------|--------------|
| Short description | Defines the Master Speed Reference that can be used by the AMC Master Source |                |              |
| Mode              | RFC-A  |                |              |
| Minimum           | -VM_AMC_SPEED  | Maximum        | VM_AMC_SPEED |
| Default           | 0.00   | Units          | UU/ms        |
| Type              | 32 Bit User Save   | Update Rate    | 250us read   |
| Display Format    | Standard   | Decimal Places | 2            |
| Coding            | RW, VM   |                |              |

See AMC Master Source Select (32.001).

| Parameter         | 32.009 AMC Master User Position Reference  |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines the Master User Position Reference that can be used by the AMC Master Source |                |            |
| Mode              | RFC-A  |                |            |
| Minimum           | -2147483648  | Maximum        | 2147483647 |
| Default           | 0  | Units          |            |
| Type              | 32 Bit Volatile  | Update Rate    | 250us read |
| Display Format    | Standard   | Decimal Places | 0          |
| Coding            | RW, NC   |                |            |

See AMC Master Source Select (32.001).

| Parameter         | 32.010 AMC Master Freeze Flag |                |           |
|-------------------|-------------------------------|----------------|-----------|
| Short description | Master freeze flag status     |                |           |
| Mode              | RFC-A                         |                |           |
| Minimum           | 0                             | Maximum        | 1         |
| Default           | 0                             | Units          |           |
| Type              | 1 Bit Volatile                | Update Rate    | 4ms write |
| Display Format    | Standard                      | Decimal Places | 0         |
| Coding            | RW, NC                        |                |           |

See AMC Master Source Select (32.001).

## Menu 33 Single Line Descriptions – AMC Slave Position

Mode: RFC-A

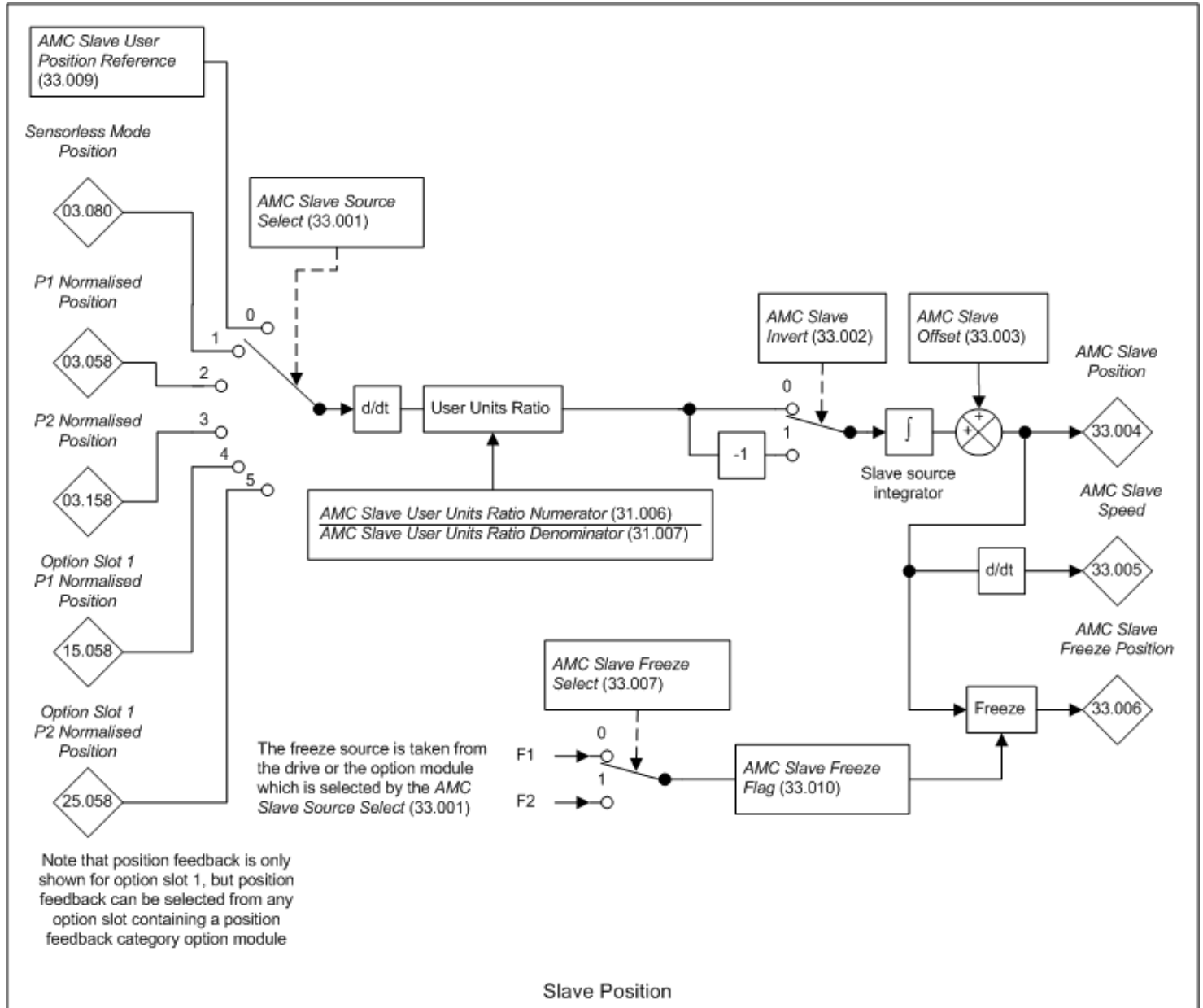
| Parameter |                                   | Range   | Default      | Type |     |    |    |    |    |    |
|-----------|-----------------------------------|---|--------------|------|-----|----|----|----|----|----|
| 33.001    | AMC Slave Source Select           | User Position (0), Sensorless (1),<br>P1 Drive (2), P2 Drive (3),<br>P1 Slot1 (4), P2 Slot1 (5),<br>P1 Slot2 (6), P2 Slot2 (7),<br>P1 Slot3 (8), P2 Slot3 (9) | P1 Drive (2) | RW   | Txt |    |    |    |    | US |
| 33.002    | AMC Slave Invert                  | Off (0) or On (1)   | Off (0)      | RW   | Bit |    |    |    |    | US |
| 33.003    | AMC Slave Offset                  | ±VM_AMC_POSITION UU   | 0 UU         | RW   | Num |    |    |    |    | US |
| 33.004    | AMC Slave Position                | ±VM_AMC_POSITION UU   |              | RO   | Num | ND | NC | PT |    |    |
| 33.005    | AMC Slave Speed                   | ±VM_AMC_SPEED UU/ms   |              | RO   | Num | ND | NC | PT | FI |    |
| 33.006    | AMC Slave Freeze Position         | ±VM_AMC_POSITION UU   |              | RO   | Num | ND | NC | PT |    |    |
| 33.007    | AMC Slave Freeze Select           | Off (0) or On (1)   | Off (0)      | RW   | Bit |    |    |    |    | US |
| 33.009    | AMC Slave User Position Reference | -2147483648 to 2147483647   | 0            | RW   | Num |    | NC |    |    |    |
| 33.010    | AMC Slave Freeze Flag             | Off (0) or On (1)   | Off (0)      | RW   | Bit |    | NC |    |    |    |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 33 – AMC Slave Position

Mode: RFC-A

## Slave position



| Parameter         | 33.001 AMC Slave Source Select                                   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the position feedback source used by the slave reference |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 9               |
| Default           | 2  | Units          |                 |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text          |
|-------|---------------|
| 0     | User Position |
| 1     | Sensorless    |
| 2     | P1 Drive      |
| 3     | P2 Drive      |
| 4     | P1 Slot1      |
| 5     | P2 Slot1      |
| 6     | P1 Slot2      |
| 7     | P2 Slot2      |
| 8     | P1 Slot3      |
| 9     | P2 Slot3      |

The slave position system operates in the same way as the master position system except that if *AMC Slave Source Select* (33.001) = 1 the position is taken from *Sensorless Position* (03.080). The least significant 16bits of *Sensorless Position* (03.080) represents a movement equivalent to one pole of the motor and the most significant 16 bits represent turns where one turn is the movement associated with one pole. To use *Sensorless Position* (03.080) as the slave feedback source *AMC Slave User Units Ratio Denominator* (31.007) must be multiplied by the number of pole pairs so that the least significant 16 bits of the position represents one mechanical revolution.

| Parameter         | 33.002 AMC Slave Invert                   |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to invert the AMC slave position |                |                 |
| Mode              | RFC-A                                     |                |                 |
| Minimum           | 0   | Maximum        | 1               |
| Default           | 0   | Units          |                 |
| Type              | 1 Bit User Save                           | Update Rate    | Background read |
| Display Format    | Standard                                  | Decimal Places | 0               |
| Coding            | RW  |                |                 |

*AMC Slave Invert* (33.002) negates the delta position values that are accumulated by the slave source integrator. If *AMC Absolute Mode Enable* (31.002) is enabled the slave position is taken from the position feedback device, modified by the user units ratio, inverted if required (*AMC Slave Invert* (33.002) = 1) and then written to the slave source integrator. Note that the feedback is initialised on power-up or after any parameter which results in a change to the absolute position is modified.

| Parameter         | 33.003 AMC Slave Offset                             |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Displays the offset used for the AMC Slave Position |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | -VM_AMC_POSITION                                    | Maximum        | VM_AMC_POSITION |
| Default           | 0   | Units          | UU              |
| Type              | 32 Bit User Save                                    | Update Rate    | 4ms read        |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RW, VM  |                |                 |

*AMC Slave Offset* (33.003) is used to add an offset to the value in the slave source integrator and is used during homing to move the alignment of the slave position. When a new value is written to *AMC Slave Offset* (33.003) the profile position integrators are automatically modified with the change of offset position allowing the offset to be adjusted without a transient at the output of the motion controller. If *AMC Slave Offset* (33.003) is changed when the motion controller is enabled and *AMC Reference Select* (34.007) is set to one of the absolute position references (Stop or Position Abs) the slave will move to the absolute position under the constraints of the profile generator. If the slave is stationary when the slave offset is applied the slave will move a relative position equal to - $\Delta$ *AMC Slave Offset* (33.003). Note that the slave offset should not be modified when *AMC Reference Select* (34.007) is set to the home reference because the homing sequence will not be completed correctly and the profile integrators are not automatically modified in this condition.

| Parameter         | 33.004 AMC Slave Position       |                |                 |
|-------------------|---------------------------------|----------------|-----------------|
| Short description | Displays the AMC Slave Position |                |                 |
| Mode              | RFC-A                           |                |                 |
| Minimum           | -VM_AMC_POSITION                | Maximum        | VM_AMC_POSITION |
| Default           |                                 | Units          | UU              |
| Type              | 32 Bit Volatile                 | Update Rate    | 4ms write       |
| Display Format    | Standard                        | Decimal Places | 0               |
| Coding            | RO, VM, ND, NC, PT              |                |                 |

*AMC Slave Position* (33.004) is the sum of the position in the slave source integrator and *AMC Slave Offset* (33.003).

| Parameter         | 33.005 AMC Slave Speed                                |                |              |
|-------------------|---|----------------|--------------|
| Short description | Displays the rate of change of the AMC Slave Position |                |              |
| Mode              | RFC-A   |                |              |
| Minimum           | -VM_AMC_SPEED   | Maximum        | VM_AMC_SPEED |
| Default           |   | Units          | UU/ms        |
| Type              | 32 Bit Volatile                                       | Update Rate    | 4ms write    |
| Display Format    | Standard  | Decimal Places | 2            |
| Coding            | RO, FI, VM, ND, NC, PT                                |                |              |

*AMC Slave Speed* (33.005) gives the rate of change of the *AMC Slave Position* (33.004).

| Parameter         | 33.006 AMC Slave Freeze Position                                  |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Displays the AMC Slave Position after a freeze event has occurred |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | -VM_AMC_POSITION  | Maximum        | VM_AMC_POSITION |
| Default           |   | Units          | UU              |
| Type              | 32 Bit Volatile   | Update Rate    | 4ms write       |
| Display Format    | Standard  | Decimal Places | 0               |
| Coding            | RO, VM, ND, NC, PT  |                |                 |

*AMC Slave Freeze Select* (33.007) is used to select which freeze source associated with the master should be used to provide *AMC Slave Freeze Position* (33.006). For example, if a position interface within the drive is being used as the master source then the F1 or F2 freeze source provided in the drive can be selected. In the sample after a freeze event occurs *AMC Slave Position* (33.004) at the point in time when the freeze event occurred is stored in *AMC Slave Freeze Position* (33.006). Note that the freeze flag in the position menu is updated every 250µs but *AMC Slave Freeze Position* (33.006) is only updated every 4ms. To ensure that *AMC Slave Freeze Position* (33.006) has been updated *AMC Slave Freeze Flag* (33.010) should be used to indicate when a freeze event has occurred and to clear the slave source freeze flag in the position feedback menu.

If an option module is being used as the slave source then a freeze source in the option module can be selected. If a freeze source selected in an option module does not exist then *AMC Slave Freeze Position* (33.006) will remain at its present value.

| Parameter         | 33.007 AMC Slave Freeze Select |                |                 |
|-------------------|--------------------------------|----------------|-----------------|
| Short description |                                |                |                 |
| Mode              | RFC-A                          |                |                 |
| Minimum           | 0                              | Maximum        | 1               |
| Default           | 0                              | Units          |                 |
| Type              | 1 Bit User Save                | Update Rate    | Background read |
| Display Format    | Standard                       | Decimal Places | 0               |
| Coding            | RW                             |                |                 |

See *AMC Slave Freeze Position* (33.006).

| Parameter         | 33.009 AMC Slave User Position Reference   |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines the Slave User Position Reference that can be used by the AMC Slave Source |                |            |
| Mode              | RFC-A  |                |            |
| Minimum           | -2147483648  | Maximum        | 2147483647 |
| Default           | 0  | Units          |            |
| Type              | 32 Bit Volatile  | Update Rate    | 250µs read |
| Display Format    | Standard   | Decimal Places | 0          |
| Coding            | RW, NC   |                |            |

See *AMC Slave Source Select* (33.001).

| Parameter         | 33.010 AMC Slave Freeze Flag |                |           |
|-------------------|------------------------------|----------------|-----------|
| Short description | Slave freeze flag status     |                |           |
| Mode              | RFC-A                        |                |           |
| Minimum           | 0                            | Maximum        | 1         |
| Default           | 0                            | Units          |           |
| Type              | 1 Bit Volatile               | Update Rate    | 4ms write |
| Display Format    | Standard                     | Decimal Places | 0         |
| Coding            | RW, NC                       |                |           |

See *AMC Slave Freeze Position* (33.006).

## Menu 34 Single Line Descriptions – AMC Reference Selector

Mode: RFC-A

| Parameter |                              | Range   | Default     | Type |     |    |    |    |  |    |
|-----------|------------------------------|---|-------------|------|-----|----|----|----|--|----|
| 34.001    | AMC Stop Mode                | Profile (0), No Profile (1), Profile Stop (2), No Profile Stop (3)  | Profile (0) | RW   | Txt |    |    |    |  | US |
| 34.002    | AMC Stop Reference           | ±VM_AMC_POSITION UU   |             | RO   | Num | ND | NC | PT |  |    |
| 34.003    | AMC Position Reference       | ±VM_AMC_POSITION_REF UU   | 0 UU        | RW   | Num |    |    |    |  | US |
| 34.005    | AMC Rotary Mode              | 0 to 6  | 0           | RW   | Num |    |    |    |  | US |
| 34.006    | AMC Speed Reference          | ±VM_AMC_SPEED UU/ms   | 0.00 UU/ms  | RW   | Num |    |    |    |  | US |
| 34.007    | AMC Reference Select         | Stop (0), Position Abs (1), Speed (2), Cam (3), EGB (4), Home (5), Position Rel (6), Position Profile (7) | Stop (0)    | RW   | Txt |    |    |    |  | US |
| 34.008    | AMC Action On Event          | None (0), Cam On Freeze (1), EGB On Freeze (2)  | None (0)    | RW   | Txt |    |    |    |  | US |
| 34.009    | AMC Reference Select Trigger | Stop (0), Position Abs (1), Speed (2), Cam (3), EGB (4), Home (5), Position Rel (6), Position Profile (7) | Stop (0)    | RW   | Txt |    |    |    |  |    |

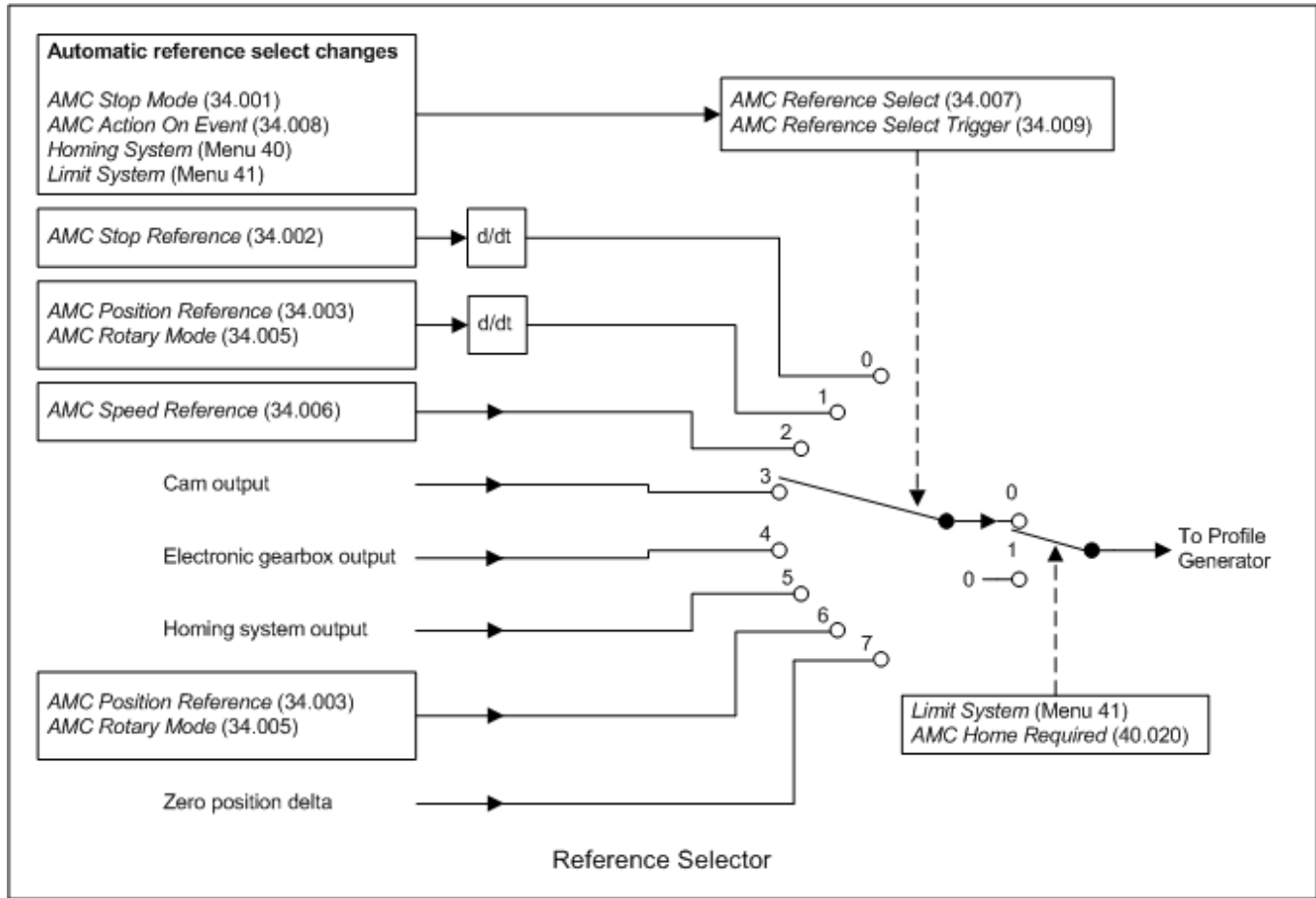
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |



# Menu 34 – AMC Reference Selector

Mode: RFC-A

## Reference selector



| Parameter         | 34.001 AMC Stop Mode                  |                |                 |
|-------------------|---------------------------------------|----------------|-----------------|
| Short description | Defines the stopping mode used by AMC |                |                 |
| Mode              | RFC-A                                 |                |                 |
| Minimum           | 0                                     | Maximum        | 3               |
| Default           | 0                                     | Units          |                 |
| Type              | 8 Bit User Save                       | Update Rate    | Background read |
| Display Format    | Standard                              | Decimal Places | 0               |
| Coding            | RW, TE                                |                |                 |

| Value | Text            |
|-------|-----------------|
| 0     | Profile         |
| 1     | No Profile      |
| 2     | Profile Stop    |
| 3     | No Profile Stop |

AMC Stop Mode (34.001) defines the actions taken when AMC Stop Reference (34.002) is selected. When the motion controller is enabled AMC Stop Reference (34.002) is continuously updated with stop position until the stop reference is selected. AMC Stop Reference (34.002) is then used as the target position for the profile generator.

### 0 (Profile)

When AMC Stop Mode (34.001) = 0 the stop reference is updated with the position at which the profile would reach zero speed based on the current profile constraints and outputs, i.e. AMC Profile Output Position (38.008), AMC Profile Output Speed (38.009) and AMC Profile Output Acceleration (38.010). When AMC Stop Reference (34.002) is set to 0 (stop) the slave will stop under the constraints applied to the profile generator when the stop was requested.

### 1 (No profile)

When AMC Stop Mode (34.001) = 1 the stop reference is updated with AMC Slave Position (33.004). When AMC Stop Reference (34.002) is set to 0 (stop) the profile generator is disabled and the slave will stop as quickly as possible.

### 2 (Profile Stop)

This mode is the same as the profiled stop mode except that *AMC Reference Select* (34.007) is automatically changed to 0 if the following error exceeds the limit defined by *AMC Following Error Window* (41.007).

### 3 (No Profile Stop)

This mode is the same as the no profile stop mode except that *AMC Reference Select* (34.007) is automatically changed to 0 if the following error exceeds the limit defined by *AMC Following Error Window* (41.007).

Note that when a software or hardware limit is active *AMC Stop Reference* (34.002) is updated with the stop position for the stop mode selected in *AMC Hardware Limit Stop Mode* (41.023) or *AMC Software Limit Stop Mode* (41.024).

| Parameter         | 34.002 AMC Stop Reference                                      |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the reference used when the stop reference is selected |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | -VM_AMC_POSITION   | Maximum        | VM_AMC_POSITION |
| Default           |  | Units          | UU              |
| Type              | 32 Bit Volatile  | Update Rate    | 4ms write       |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RO, VM, ND, NC, PT   |                |                 |

See *AMC Stop Mode* (34.001).

| Parameter         | 34.003 AMC Position Reference                            |                |                      |
|-------------------|--|----------------|----------------------|
| Short description | Defines the reference used when AMC Reference Select = 1 |                |                      |
| Mode              | RFC-A  |                |                      |
| Minimum           | -VM_AMC_POSITION_REF                                     | Maximum        | VM_AMC_POSITION_REF  |
| Default           | 0  | Units          | UU                   |
| Type              | 32 Bit User Save   | Update Rate    | AMC sample rate read |
| Display Format    | Standard   | Decimal Places | 0                    |
| Coding            | RW, VM   |                |                      |

See *AMC Reference Select* (34.007).

| Parameter         | 34.005 AMC Rotary Mode |                |                 |
|-------------------|------------------------|----------------|-----------------|
| Short description |                        |                |                 |
| Mode              | RFC-A                  |                |                 |
| Minimum           | 0                      | Maximum        | 6               |
| Default           | 0                      | Units          |                 |
| Type              | 8 Bit User Save        | Update Rate    | Background read |
| Display Format    | Standard               | Decimal Places | 0               |
| Coding            | RW                     |                |                 |

When *AMC Roll-over Limit* (31.010) is set to a non zero value and *AMC Rate Selected* (31.013)  $\geq 500\mu\text{s}$  the change of position added to the input integrator of the profile generator is controlled by *AMC Rotary Mode* (34.005). Although the position parameters are shown with a range from zero to *AMC Roll-over Limit* (31.010) - 1 additional "turns" information is used internally to allow the rotary modes to operate correctly. The maximum number of turns that can be accumulated is given by  $2^{31}-1 / \text{AMC Roll-over Limit}$  (31.010) rounded down to the nearest integer, e.g. if *AMC Roll-over Limit* (31.010) =  $10^6$  then the maximum number of "turns" is limited to  $2^{31}-1/10^6 = 2147$ . For the following modes to operate correctly the difference between the internal value of the profile input integrator, profile output integrator and the slave source integrator in any rotary mode must not exceed this maximum value. If the system does not remain within this limit there will be movement in the opposite direction to that expected.

Note that in relative position mode the change of position is the value in *AMC Position Reference* (34.003) when a relative move is selected and in absolute position mode it is the difference between *AMC Position Reference* (34.003) and *AMC Profile Input Position* (38.006), i.e.  $\Delta = \text{AMC Position Reference}$  (34.003) - *AMC Profile Input Position* (38.006).

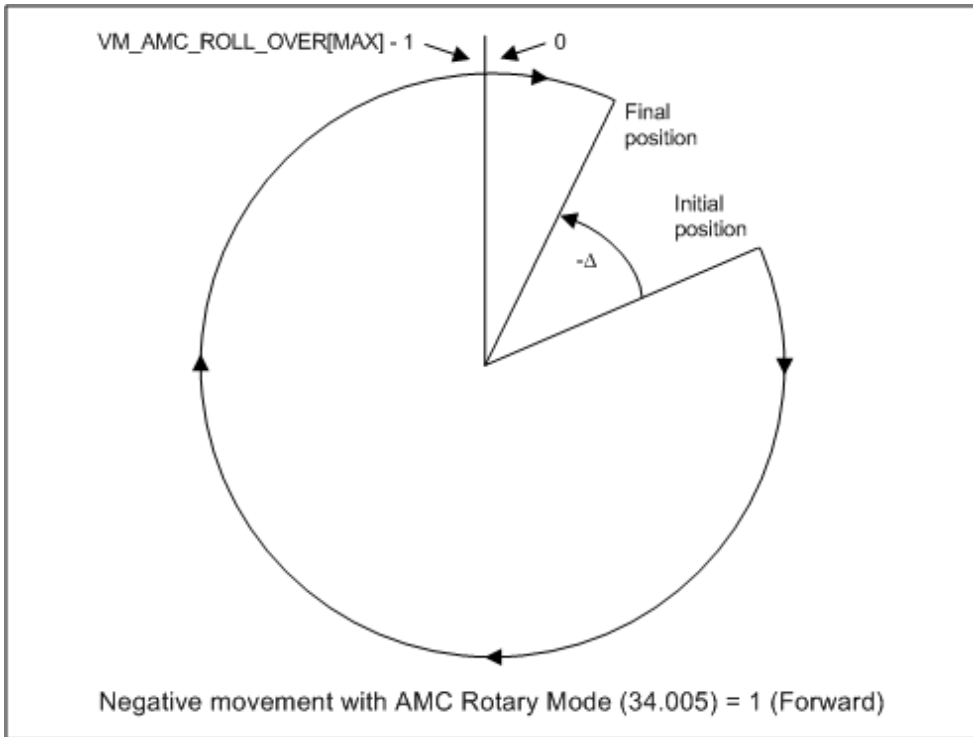
In modes 4, 5 and 6 the variable maximum VM\_AMC\_POSITION\_REF is modified to allow *AMC Position Reference* (34.003) to be positive or negative with a maximum value greater than *AMC Roll-over Limit* (31.010) - 1, i.e. a movement of more than one "turn" can be requested. Note that because *AMC Position Reference* (34.003) can be greater than *AMC Roll-over Limit* (31.010) the change of position in absolute mode is only calculated when *AMC Reference Select* (34.007) is changed to 1 from another reference or when *AMC Reference Select* (34.007) = 1 and a change of *AMC Position Reference* (34.003) is detected. In absolute position mode the number of "turns" moved by the slave is *AMC Position Reference* (34.003) / *AMC Roll-over Limit* (31.010) rounded down to the nearest integer and the final position within the rollover limit is the remainder from this calculation for a positive position reference or the remainder + *AMC Roll-over Limit* (31.010) for a negative position reference.

### 0 (Shortest)

The change of position at the input integrator of the profile generator is limited to  $\pm \text{AMC Roll-over Limit}$  (31.010)/2. In this mode the profile output position will move to the input position by the shortest path and can rollover the zero or *AMC Roll-over Limit* (31.010) - 1 boundary as required.

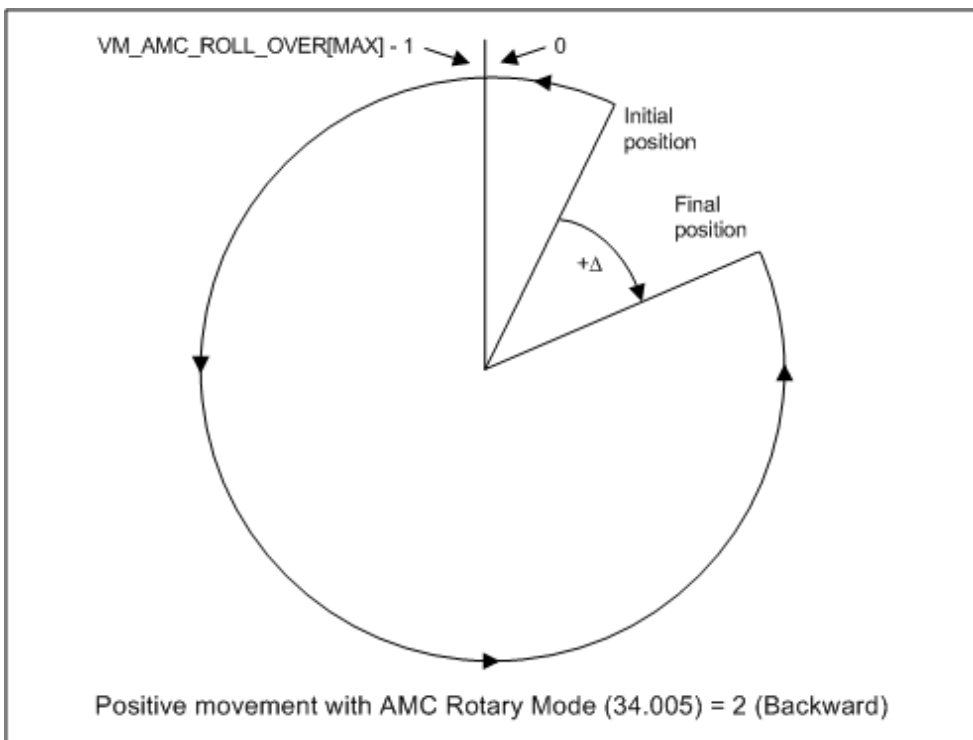
### 1 (Forward)

If the change of position at the input integrator of the profile generator is negative the change of position added to the integrator is modified so that  $-\Delta$  becomes *AMC Roll-over Limit* (31.010) -  $\Delta$ . This has the effect of making any reverse movements into forward movements by forcing the profile to rollover the *AMC Roll-over Limit* (31.010) - 1 boundary as shown below.



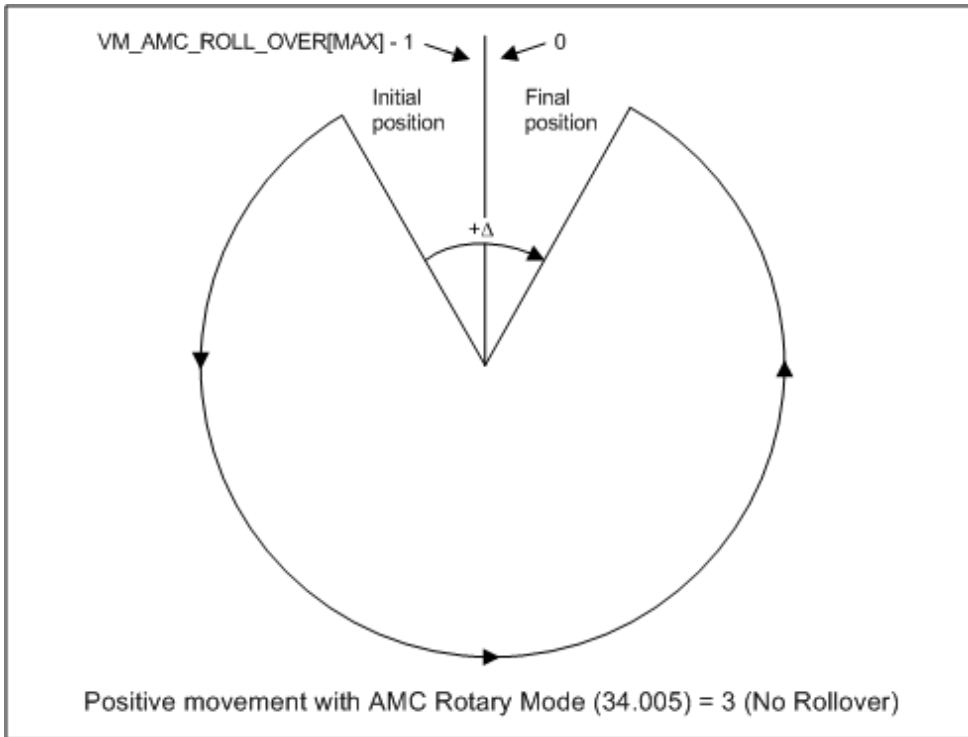
### 2 (Reverse)

If the change of position at the input integrator of the profile generator is positive the change of position added to the integrator is modified so that  $+\Delta$  becomes  $\Delta - \text{AMC Roll-over Limit}$  (31.010). This has the effect of making any forward movements into reverse movements by forcing the profile to rollover the zero boundary as shown below.



### 3 (No Rollover)

If the change of position at the input integrator of the profile generator would cause the integrator to rollover the zero or *AMC Roll-over Limit* (31.010) - 1 boundary the change of position is modified so that  $-\Delta$  (rollover the zero boundary) becomes  $\text{AMC Roll-over Limit}$  (31.010) -  $\Delta$  and  $+\Delta$  (rollover the *AMC Roll-over Limit* (31.010) boundary) becomes  $\Delta - \text{AMC Roll-over Limit}$  (31.010). This has the effect of preventing the profile input position from crossing the zero or *AMC Roll-over Limit* (31.010) - 1 boundary.



Note that if *AMC Rotary Mode* (34.005) is set to 3 when the motion controller is enabled and *AMC Profile Output Speed* (38.009) > 0 it may not be possible to stop the slave under the constraints of the profile generator before it crosses a boundary.

#### 4 (Multiple Turns Forward)

If the change of position at the input integrator of the profile generator is negative and greater than *-AMC Roll-over Limit* (31.010) the change of position added to the integrator is modified so that  $-\Delta$  becomes  $AMC\ Roll-over\ Limit\ (31.010) - \Delta$ . This has the effect of making any reverse movements into forward movements by forcing the profile to rollover the *AMC Roll-over Limit* (31.010) - 1 boundary. The change of position is ignored by the profile if it is less than *-AMC Roll-over Limit* (31.010).

#### 5 (Multiple Turns Reverse)

If the change of position at the input integrator of the profile generator is positive and less than *AMC Roll-over Limit* (31.010) the change of position added to the integrator is modified so that  $+\Delta$  becomes  $\Delta - AMC\ Roll-over\ Limit\ (31.010)$ . This has the effect of making any forward movements into reverse movements by forcing the profile to rollover the zero boundary. The change of position is ignored by the profile if it is greater than *AMC Roll-over Limit* (31.010).

#### 6 (Multiple Turns Delta)

In this mode the change of position is added directly to the input integrator of the profile generator and the direction of movement is defined by the sign of the position change.

| Parameter         | 34.006 AMC Speed Reference                                     |                |                      |
|-------------------|--|----------------|----------------------|
| Short description | Defines the speed reference used when AMC Reference Select = 2 |                |                      |
| Mode              | RFC-A  |                |                      |
| Minimum           | -VM_AMC_SPEED  | Maximum        | VM_AMC_SPEED         |
| Default           | 0.00   | Units          | UU/ms                |
| Type              | 32 Bit User Save   | Update Rate    | AMC sample rate read |
| Display Format    | Standard   | Decimal Places | 2                    |
| Coding            | RW, VM   |                |                      |

*AMC Speed Reference* (34.006) is used as the input to the profile generator when *AMC Reference Select* (34.007) = 2.

| Parameter         | 34.007 AMC Reference Select                |                |                      |
|-------------------|--|----------------|----------------------|
| Short description | Defines the input to the profile generator |                |                      |
| Mode              | RFC-A                                      |                |                      |
| Minimum           | 0  | Maximum        | 7                    |
| Default           | 0  | Units          |                      |
| Type              | 8 Bit User Save                            | Update Rate    | AMC sample rate read |
| Display Format    | Standard                                   | Decimal Places | 0                    |
| Coding            | RW, TE                                     |                |                      |

| Value | Text             |
|-------|------------------|
| 0     | Stop             |
| 1     | Position Abs     |
| 2     | Speed            |
| 3     | Cam              |
| 4     | EGB              |
| 5     | Home             |
| 6     | Position Rel     |
| 7     | Position Profile |

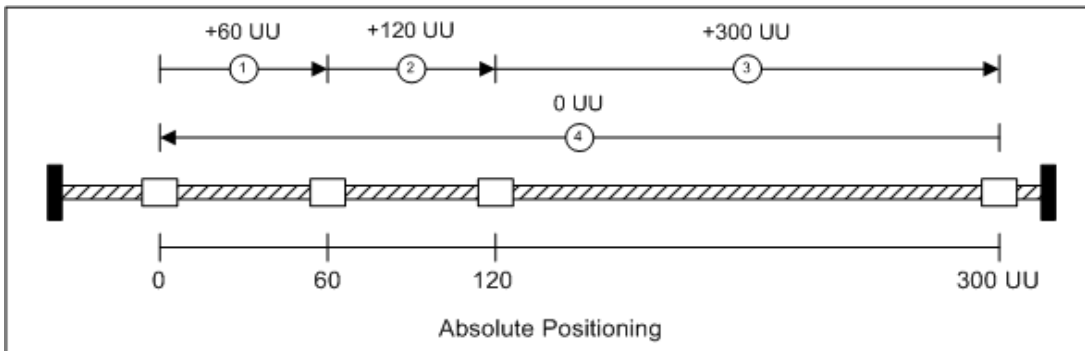
AMC Reference Select (34.007) selects the input to the profile generator as shown below.

| AMC Reference Select (34.007) | Reference                           | Action on select  |
|-------------------------------|-------------------------------------|---|
| 0                             | AMC Stop Reference (34.002)         | AMC Stop Reference (34.002) is no longer updated  |
| 1                             | AMC Position Reference (34.003)     | See position mode below   |
| 2                             | AMC Speed Reference (34.006)        |   |
| 3                             | Cam system output                   | Cam system started from AMC Cam Start Index (35.001) and AMC Cam Start Position In Segment (35.002) |
| 4                             | Electronic gearbox output           | Electronic gearbox is started   |
| 5                             | Homing system output                | Homing sequence is started  |
| 6                             | AMC Position Reference (34.003)     | See position mode below   |
| 7                             | AMC Profile Input Position (38.006) | See position mode below   |

## Position Mode

### Example 1 - Absolute Move

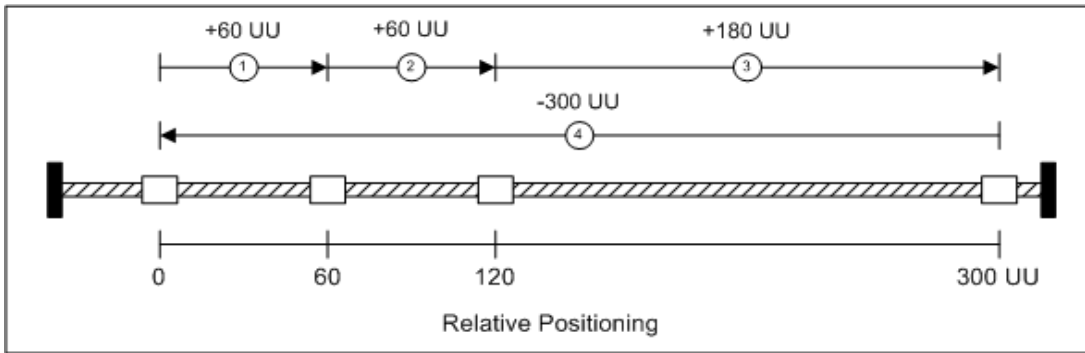
When AMC Reference Select (34.007) is set to 1 the position delta between AMC Position Reference (34.003) and AMC Profile Input Position (38.006) is continuously written to AMC Profile Input Position (38.006) and the slave will move to the reference position.



| Index | AMC Position Reference (34.003) | AMC Reference Select (34.007) |
|-------|---------------------------------|-------------------------------|
| 1     | 60                              | 1                             |
| 2     | 120                             | 1                             |
| 3     | 300                             | 1                             |
| 4     | 0                               | 1                             |

### Example 2 - Relative Move

When AMC Reference Select (34.007) is set to 6 and a change of reference position is detected or when AMC Reference Select (34.007) is changed to 6 from another reference then AMC Position Reference (34.003) is added to AMC Profile Input Position (38.006) and the slave will move relative to AMC Profile Input Position (38.006). If the slave is required to move by the same distance in successive moves then AMC Position Reference (34.003) can be changed to zero and then set to the required reference or AMC Reference Select (34.007) can be toggled between mode 6 and 7. When AMC Reference Select (34.007) is set to 7 (profile position) the AMC Profile Input Position (38.006) is held at the previous value and the slave will continue to move to or remain at the profile input position.



| Index | AMC Position Reference (34.003) | AMC Reference Select (34.007) |
|-------|---------------------------------|-------------------------------|
| 1     | +60                             | 6                             |
| 2     | +60 to 0 to +60                 | 6                             |
| 3     | +120                            | 6                             |
| 4     | -300                            | 6                             |

It should be noted that instead of changing *AMC Position Reference* (34.003) it is possible to toggle *AMC Reference Select* (34.007) between modes 6 and 7 to initiate another relative move of 60 user units for index 2.

### Reference Selector and Trigger

*AMC Reference Select* (34.007) can be automatically changed in the following modes.

| Mode  | Reference after change |
|---|------------------------|
| <i>AMC Stop Mode</i> (34.001) = 2 or 3              | 0                      |
| <i>AMC Action On Event</i> (34.008) = Cam On Freeze | 3                      |
| <i>AMC Action On Event</i> (34.008) = EGB On Freeze | 4                      |
| Homing system (menu 40)                             | 0                      |

*AMC Reference Select Trigger* (34.009) can be used to set *AMC Reference Select* (34.007) on a change of reference. This allows *AMC Reference Select* (34.007) to be changed automatically and a reference to be continuously written to *AMC Reference Select Trigger* (34.009). It should be noted that when *AMC Reference Select* (34.007) and *AMC Reference Select Trigger* (34.009) are changed in the same sample *AMC Reference Select* (34.007) = *AMC Reference Select Trigger* (34.009).

| Parameter         | 34.008 AMC Action On Event   |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the function of the AMC on a positive transition of the master freeze flag |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 2               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

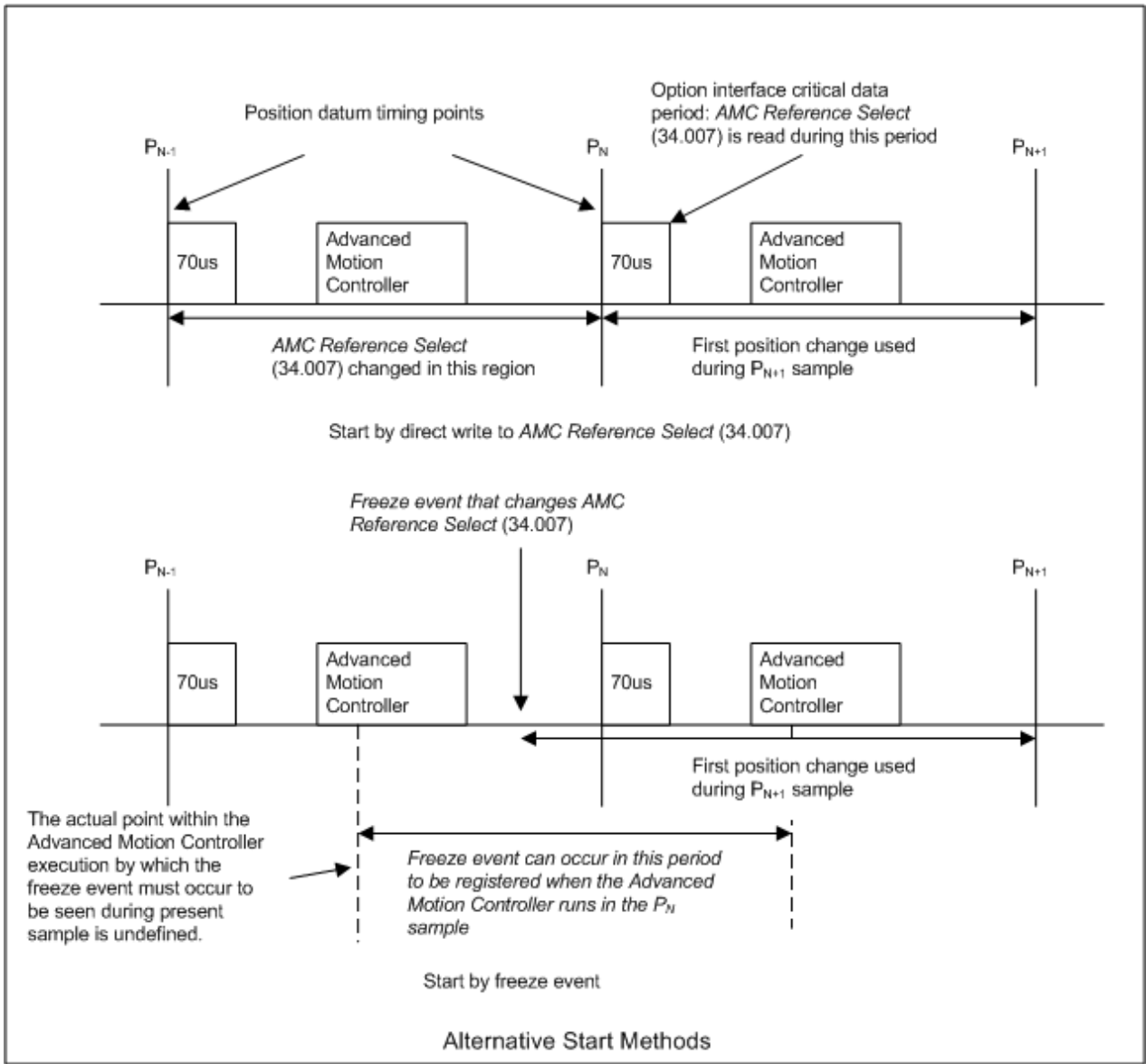
| Value | Text          |
|-------|---------------|
| 0     | None          |
| 1     | Cam On Freeze |
| 2     | EGB On Freeze |

#### 0 (None)

This feature is disabled.

#### 1 (Cam On Freeze)

The cam system is started and *AMC Reference Select* (34.007) is set to 3 when a freeze event is produced by the freeze system (positive transition of the master freeze flag) in the position feedback interface selected by the *AMC Master Source Select* (32.001) and *AMC Master Freeze Select* (32.007). The diagram below shows the effect of selecting the Cam by writing directly to *AMC Reference Select* (34.007) or by using the action on a freeze event.



When *AMC Reference Select* (34.007) is written directly the first position change used by the Cam is taken between position datum  $P_N$  and position datum  $P_{N+1}$ . Therefore the change of position used by the Cam begins at position datum  $P_N$ , which is the first datum after *AMC Reference Select* (34.007) is modified. When the freeze event is used to change *AMC Reference Select* (34.007) the first position change used by the Cam always starts at the point where the freeze event occurred, and so the change of position seen at the input to the Cam is with reference to the position at the freeze event.

**2 (EGB On Freeze)**

The EGB system is started and *AMC Reference Select* (34.007) is set to 4 when a freeze event is produced by the freeze system in the position feedback interface selected by the *AMC Master Source Select* (32.001) and *AMC Master Freeze Select* (32.007). The input position is derived in the same way as described for the Cam.

It should be noted that *AMC Action On Event* (34.008) is disabled when a hardware or software limit is active.

| Parameter         | 34.009 <i>AMC Reference Select Trigger</i>                                       |                |                      |
|-------------------|--|----------------|----------------------|
| Short description | The reference selector is set to the reference trigger when a change is detected |                |                      |
| Mode              | RFC-A  |                |                      |
| Minimum           | 0  | Maximum        | 7                    |
| Default           | 0  | Units          |                      |
| Type              | 8 Bit Volatile   | Update Rate    | AMC sample rate read |
| Display Format    | Standard   | Decimal Places | 0                    |
| Coding            | RW, TE   |                |                      |

| <b>Value</b> | <b>Text</b>      |
|--------------|------------------|
| 0            | Stop             |
| 1            | Position Abs     |
| 2            | Speed            |
| 3            | Cam              |
| 4            | EGB              |
| 5            | Home             |
| 6            | Position Rel     |
| 7            | Position Profile |

See *AMC Reference Select* (34.007).



## Menu 35 Single Line Descriptions – AMC Cam

Mode: RFC-A

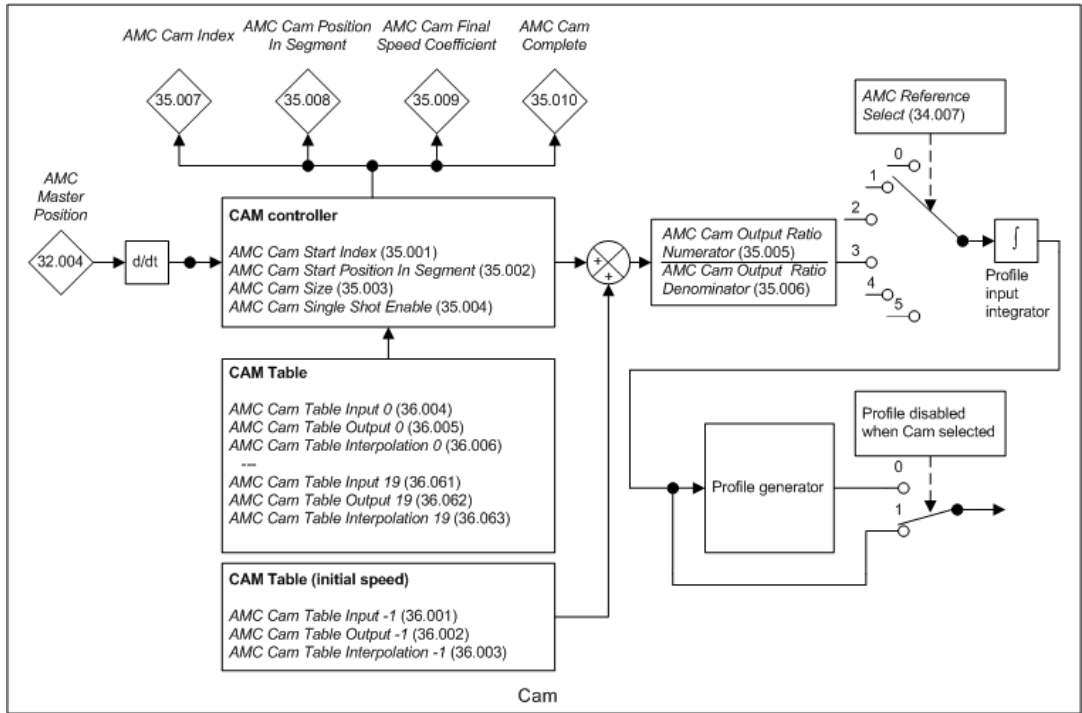
| Parameter |                                   | Range                            | Default | Type |     |    |    |    |    |
|-----------|-----------------------------------|----------------------------------|---------|------|-----|----|----|----|----|
| 35.001    | AMC Cam Start Index               | 0 to 19                          | 0       | RW   | Num |    |    |    | US |
| 35.002    | AMC Cam Start Position In Segment | 0 to VM_AMC_POSITION_UNIPOLAR UU | 0 UU    | RW   | Num |    |    |    | US |
| 35.003    | AMC Cam Size                      | 1 to 20                          | 1       | RW   | Num |    |    |    | US |
| 35.004    | AMC Cam Single Shot Enable        | Off (0) or On (1)                | Off (0) | RW   | Bit |    |    |    | US |
| 35.005    | AMC Cam Output Ratio Numerator    | 1 to 2147483647                  | 1000    | RW   | Num |    |    |    | US |
| 35.006    | AMC Cam Output Ratio Denominator  | 1 to 2147483647                  | 1000    | RW   | Num |    |    |    | US |
| 35.007    | AMC Cam Index                     | 0 to 19                          |         | RO   | Num | ND | NC | PT |    |
| 35.008    | AMC Cam Position In Segment       | 0 to VM_AMC_POSITION_UNIPOLAR UU |         | RO   | Num | ND | NC | PT |    |
| 35.009    | AMC Cam Final Speed Coefficient   | -21474836.48 to 21474836.47 UU   |         | RO   | Num | ND | NC | PT |    |
| 35.010    | AMC Cam Complete                  | Off (0) or On (1)                | Off (0) | RW   | Bit |    |    |    |    |
| 35.011    | AMC Cam Force Repeat              | Off (0) or On (1)                | On (1)  | RW   | Bit |    |    |    | US |
| 35.012    | AMC Cam Mode                      | 0 to 1                           | 0       | RW   | Num |    |    |    | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| Fl  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 35 – AMC Cam

Mode: RFC-A

## Cam



| Parameter         | 35.001 AMC Cam Start Index  |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines which index of the cam table the AMC cam controller starts at |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 19       |
| Default           | 0   | Units          |          |
| Type              | 8 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW  |                |          |

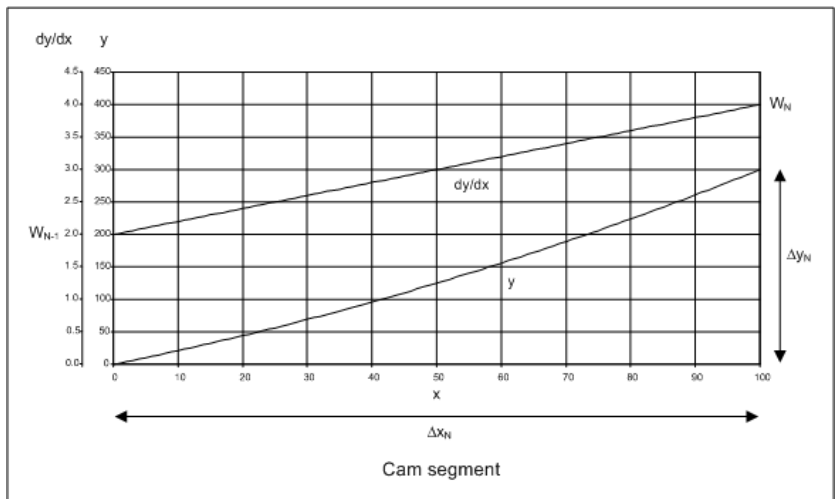
**Cam input**  
 The cam is enabled when the motion controller is enabled and *AMC Reference Select* (34.007) is changed to a value of 3. When enabled *AMC Cam Index* (35.007) and *AMC Cam Position In Segment* (35.008) are set to *AMC Cam Start Index* (35.001) and *AMC Cam Start Position In Segment* (35.002). If *AMC Cam Start Index* (35.001)  $\geq$  *AMC Cam Size* (35.003) or *AMC Cam Position In Segment* (35.008) is larger than the input position for the start segment then a *CAM.001* trip is initiated. This causes the drive to go into the trip state and the motion controller is disabled.

Any change of *AMC Master Position* (32.004) is used to move forwards (positive change of master position) or backwards (negative change of master position) through the cam table. The number of input user units for each segment are defined in the cam table parameters (*AMC Cam Table In 0* (36.004), *AMC Cam Table In 1* (36.007), etc.) and *AMC Cam Table In 0* (36.004) corresponds to segment 0. *AMC Cam Index* (35.007) is incremented when the end of the segment is reached (forwards) or decremented when the beginning of the segment is reached (backwards). When the end of the last segment is reached in the forwards direction the cam index wraps around to the start of the next cam table and when the start of the first segment is reached in the reverse direction the index wraps around to the end of the next cam table. *AMC Cam Mode* (35.012), *AMC Cam Start Index* (35.001) and *AMC Cam Size* (35.003) are used to configure the actions taken when the cam wraps around.

It should be noted that if the change of input position causes *AMC Cam Index* (35.007) to change by more than two segments then a *CAM.002* trip is initiated. In addition, the maximum change of master position is limited to 1,000,000,000 user units and a *CAM.004* trip is initiated if the maximum value is exceeded.

**Cam Output**  
 The cam table parameters provide an output value and an interpolation method for each cam segment. *AMC Cam Table Out 0* (36.005) and *AMC Cam Table Interpolation 0* (36.006) correspond to segment 0, etc. As *AMC Cam Start Position In Segment* (35.002) moves over the range from 0 to *AMC Cam Table In 0* (36.004) the output changes from 0 to *AMC Cam Table Out 0* (36.005). The change of position is fed out of the cam controller, the cam ratio is applied and the result is accumulated in the profile input integrator. Therefore for a given change of input position defined by *AMC Cam Table In 0* (36.004) there is a change of output position defined by *AMC Cam Table Out 0* (36.005) multiplied by the cam output ratio.

The interpolation method for each segment defines the relationship between the input and output positions. The interpolation functions are designed so that there are no speed discontinuities at segment boundaries, and so the rate of change of output position with respect to input position is the same either side of a segment boundary. It is the responsibility of the user to ensure that the rate of change of the output is 0 at the end of the last segment to prevent a speed discontinuity as the cam table wraps around. The diagram below shows an example of interpolation within the Nth segment.



x is *AMC Cam Start Position In Segment* (35.002)  
 y is the output position

$\Delta X_N$  is the cam input table value for the segment

$\Delta Y_N$  is the cam output table value for the segment

$W_N$  is  $dy/dx$  at the end of this segment

$W_{N-1}$  is  $dy/dx$  at the end of the last segment

The following coefficients are calculated for each segment based on the rate of change of position at the end of the previous segment.

$$A_N = W_{N-1} \Delta X_N$$

$$B_N = \Delta Y_N - A_N$$

The output position is calculated using the following function.

$$y = (A_N X) + (B_N f(X))$$

where  $X$  is the input position as a proportion of the total input position over the segment, i.e.  $X = x/\Delta X_N$ . The term  $A_N X$  produces a constant rate of change of output position against input position, and so if the input speed is constant this will provide a constant output speed that is equivalent to the speed at the start of the segment. This term prevents speed discontinuities between segments. The term  $B_N f(X)$  produces the required change of output position  $\Delta Y_N$  over the segment using the required interpolation function  $f(X)$ . Different functions can be used to give different types of interpolation, but  $f(0)$  must be 0 and  $f(1)$  must be 1 to give the correct output position change over the segment. The rate of change of output position with respect to the input position is given by

$$dy/dx = A_N/\Delta X_N + B_N df(X)/dx$$

It should be noted that the rate of change used internally by the motion controller is scaled by 256 and is rounded to the nearest integer. If the magnitude of the rate of change ( $dy/dx$ ) at the end of any segment ( $W_{N-1}$ ) exceeds  $2^{31}/256$  a CAM.003 trip is initiated. This causes the drive to go into the trip state and the Advanced Motion Controller will be disabled.

#### Interpolation functions with no speed change

If  $W_N = W_{N-1}$  then the speed at the start and end of the segment will be the same for a constant input speed. If the whole cam table is filled with segments that use an interpolation method where this is true, then the speed will return to 0 at the end of every segment. Such a function can be selected if the cam table interpolation parameter for a segment is set to 0 (Cos1). The following function is used:

$$f(X) = X - (1/(2\pi)) \sin(2\pi X)$$

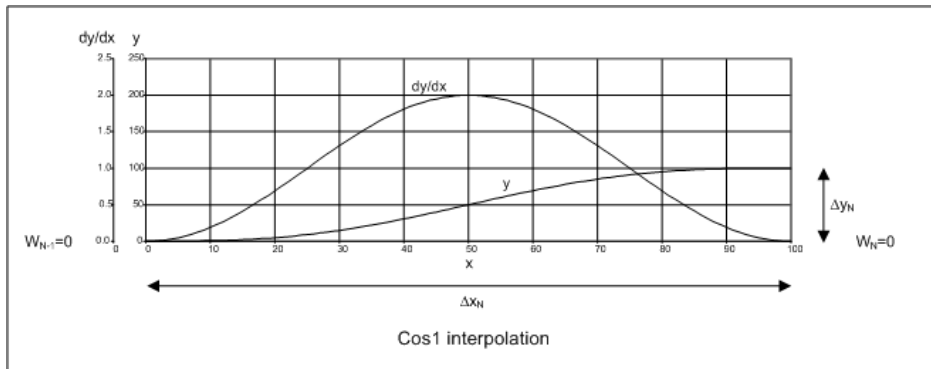
As already defined  $X = x / \Delta X_N$ , and so

$$f(X) = x/\Delta X_N - (1/(2\pi)) \sin(2\pi x / \Delta X_N)$$

Differentiating with respect to  $x$  gives

$$df(X)/dx = (1 - \cos(2\pi X)) / \Delta X_N$$

$df(0)/dx = df(1)/dx = 0$ , and so  $W_N = W_{N-1}$ . The diagram below shows this function where  $W_{N-1} = W_N = 0$ .

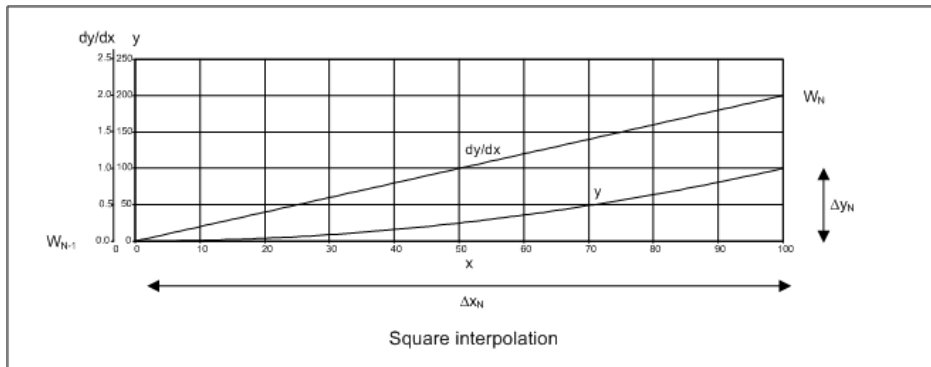


It should be noted that if  $\Delta Y_N = A_N$  then the output will be a constant speed for a constant speed input.

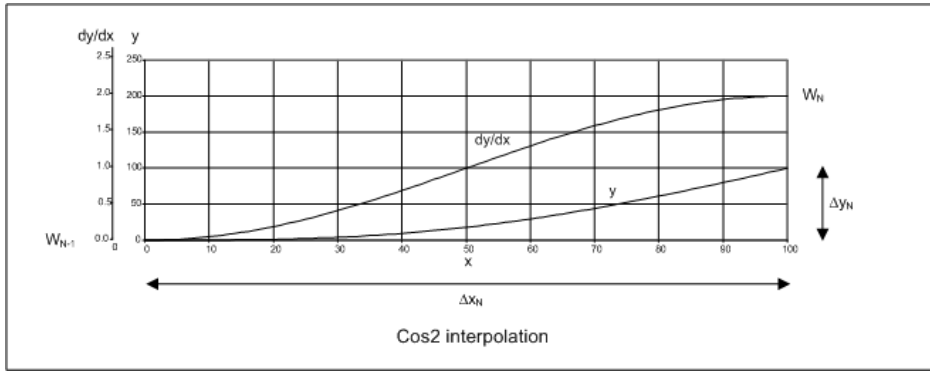
#### Interpolation functions that give a speed change

If it is not a requirement to have the same speed at the start and end of a segment then a function can be used where  $df(0)/dx = 0$  and  $df(1)/dx = 2/\Delta X_N$ . In this case  $W_N = A_N + 2B_N/\Delta X_N$ . One of two functions can be selected by setting the cam table interpolation parameter for a segment to 1 (Square) or 2 (Cos2). These are described below.

For square interpolation  $f(X) = X^2$  which gives a linear change of  $dy/dx$ . The diagram below shows the position and speed for an acceleration from 0. If  $\Delta Y_N / \Delta X_N$  is less than  $W_{N-1}$  at the start of the segment then  $dy/dx$  will fall over the segment and  $W_N$  will be less than  $W_{N-1}$ .



For the Cos2 interpolation  $f(X) = X - (1/\pi) \sin(\pi X)$  which gives sinusoidal changes in  $dy/dx$ . The diagram below shows the position and speed for an acceleration from 0. If  $\Delta Y_N / \Delta X_N$  is less than  $W_{N-1}$  at the start of the segment  $dy/dx$  will fall over the segment and  $W_N$  will be less than  $W_{N-1}$ .



#### Initial speed segment

One cam segment (*AMC Cam Table In -1* (36.001), *AMC Cam Table Out -1* (36.002), *AMC Cam Table Interpolation -1* (36.003)) is provided to give an initial speed to the cam output. When the cam is enabled this segment becomes active and its output is added to the output provided by the main cam table. If *AMC Cam Table Interpolation -1* (36.003) is set for Square or Cos2 interpolation and the end of this segment is passed in the forward direction the output speed is maintained by applying a ratio of  $2\Delta Y / \Delta X$  to the change of *AMC Master Position* (32.004). If the initial master speed is negative the input wraps around the end of the segment and will continue until the start of the segment is reached. Again the output speed is then maintained by applying a ratio of  $2\Delta Y / \Delta X$  to the change of *AMC Master Position* (32.004). *AMC Cam Table Interpolation -1* (36.003) can also be set to linear interpolation, and if this is selected the initial speed segment always applies a ratio of  $\Delta Y / \Delta X$  to the change of *AMC Master Position* (32.004). If *AMC Cam Table In -1* (36.001) is left at its default value of 0 then this initial segment is disabled and no position is added to the main cam system.

| Parameter         | 35.002 AMC Cam Start Position In Segment   |                |                          |
|-------------------|--|----------------|--------------------------|
| Short description | Defines the position in segment that the AMC Cam controller uses when the cam is enabled |                |                          |
| Mode              | RFC-A  |                |                          |
| Minimum           | 0  | Maximum        | VM_AMC_POSITION_UNIPOLAR |
| Default           | 0  | Units          | UU                       |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read                 |
| Display Format    | Standard   | Decimal Places | 0                        |
| Coding            | RW, VM   |                |                          |

See *AMC Cam Start Index* (35.001).

| Parameter         | 35.003 AMC Cam Size   |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the number of segments from the cam table that are used to define the cam profile |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 1   | Maximum        | 20       |
| Default           | 1   | Units          |          |
| Type              | 8 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW  |                |          |

*AMC Cam Size* (35.003) defines the number of segments from the cam table that are used to define the cam profile.

| Parameter         | 35.004 AMC Cam Single Shot Enable                            |                |          |
|-------------------|--|----------------|----------|
| Short description | Set to 1 to disable the cam system from running continuously |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 1        |
| Default           | 0  | Units          |          |
| Type              | 1 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW   |                |          |

When *AMC Cam Single Shot Enable* (35.004) = 0 the cam will run until it is deselected. If *AMC Cam Single Shot Enable* (35.004) = 1 the cam will stop when either end of the cam table is reached. For single shot operation the following apply:

1. The cam function cannot be started unless *AMC Cam Complete* (35.010) = 0. The cam function can be restarted again by clearing *AMC Cam Complete* (35.010). Note that *AMC Cam Complete* (35.010) is cleared automatically when *AMC Cam Single Shot Enable* (35.004) is enabled.
2. Once the cam function has stopped it can be restarted by changing *AMC Reference Select* (34.007) to a value other than 3 (cam) and then back to 3, or by disabling and re-enabling the motion controller.
3. Once the cam function has stopped it can be restarted by a freeze event (see *AMC Action On Event* (34.008)) provided the freeze event occurs in a sample after the one in which the cam function stopped.
4. The cam function is not stopped the first time it wraps around in reverse if it is selected or restarted with *AMC Cam Start Index* (35.001) = 0 and *AMC Cam Start Position In Segment* (35.002) = first segment.

Note that when *AMC Cam Single Shot Enable* (35.004) is enabled the cam will stop at the beginning of the first segment when running forwards or the end of the last segment when running in reverse.

| Parameter         | 35.005 AMC Cam Output Ratio Numerator  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the numerator for the ratio that is applied to the change of output position from the Cam function |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 1  | Maximum        | 2147483647      |
| Default           | 1000   | Units          |                 |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

The Cam output ratio (*AMC Cam Output Ratio Numerator* (35.005) / *AMC Cam Output Ratio Denominator* (35.006)) is applied to the change of output position from the Cam function before it is accumulated by the profile input integrator.

| Parameter         | 35.006 AMC Cam Output Ratio Denominator  |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Defines the denominator for the ratio that is applied to the change of output position from the Cam function |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 1  | Maximum        | 2147483647      |
| Default           | 1000   | Units          |                 |
| Type              | 32 Bit User Save   | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

See *AMC Cam Output Ratio Numerator* (35.005).

|                   |   |                |           |
|-------------------|---|----------------|-----------|
| <b>Parameter</b>  | <b>35.007 AMC Cam Index</b>                                       |                |           |
| Short description | Displays which index in the Cam table the Cam controller is using |                |           |
| Mode              | RFC-A   |                |           |
| Minimum           | 0   | Maximum        | 19        |
| Default           |   | Units          |           |
| Type              | 8 Bit Volatile  | Update Rate    | 4ms write |
| Display Format    | Standard  | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT  |                |           |

See AMC Cam Start Index (35.001).

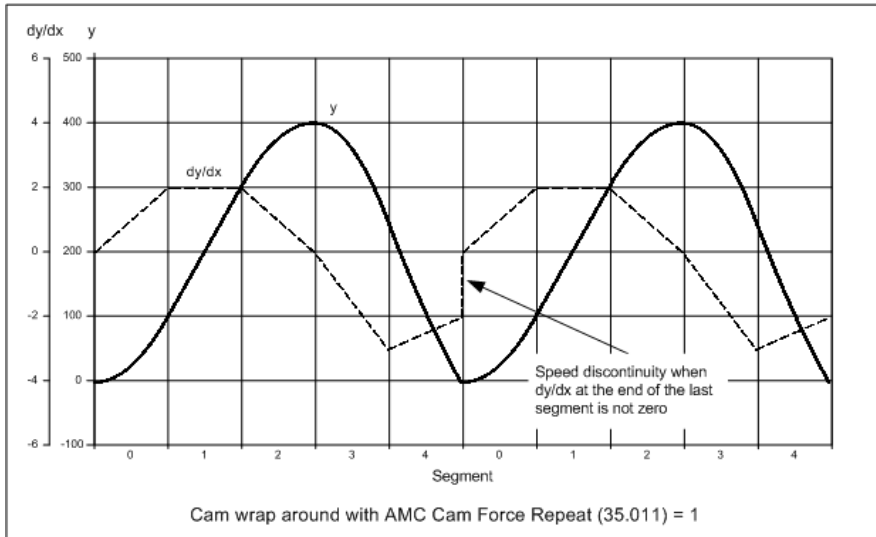
|                   |   |                |                          |
|-------------------|---|----------------|--------------------------|
| <b>Parameter</b>  | <b>35.008 AMC Cam Position In Segment</b>                             |                |                          |
| Short description | Displays the position in the segment that the cam controller is using |                |                          |
| Mode              | RFC-A   |                |                          |
| Minimum           | 0   | Maximum        | VM_AMC_POSITION_UNIPOLAR |
| Default           |   | Units          | UU                       |
| Type              | 32 Bit Volatile   | Update Rate    | 4ms write                |
| Display Format    | Standard  | Decimal Places | 0                        |
| Coding            | RO, VM, ND, NC, PT  |                |                          |

See AMC Cam Start Index (35.001).

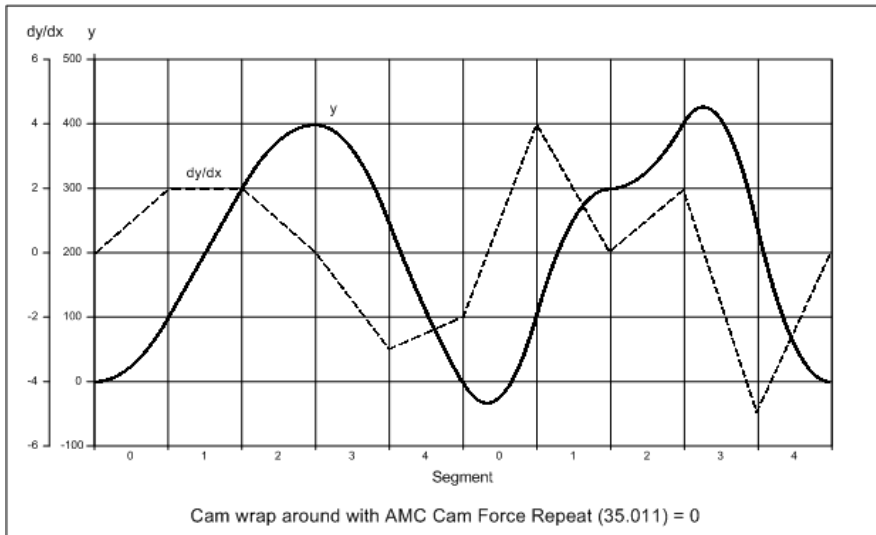
|                   |   |                |                  |
|-------------------|---|----------------|------------------|
| <b>Parameter</b>  | <b>35.009 AMC Cam Final Speed Coefficient</b>                     |                |                  |
| Short description | Displays the Final Speed Coefficient that the cam controller uses |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | -21474836.48  | Maximum        | 21474836.47      |
| Default           |   | Units          | UU               |
| Type              | 32 Bit Volatile   | Update Rate    | Background write |
| Display Format    | Standard  | Decimal Places | 2                |
| Coding            | RO, ND, NC, PT  |                |                  |

AMC Cam Final Speed Coefficient (35.009) shows the value of  $A_K$  which is calculated using the rate of change at the end of the last segment and  $\Delta X_K$ , i.e.  $A_K = W_N \Delta X_K$  where  $N = \text{AMC Cam Size}$  (35.003) and  $K$  is the first segment in the cam table. Note that the first segment is always segment 0 when AMC Cam Mode (35.012) = 0 or AMC Cam Start Index (35.001) when AMC Cam Mode (35.012) = 1.

When AMC Cam Force Repeat (35.011) is enabled the rate of change at the boundary between the first and last segment is set to zero when the cam is running forwards or to the rate of change at the end of the last segment when running backwards. This forces the interpolated output position to be identical when the cam repeats in either direction, but will introduce a speed discontinuity at the boundary of the first and last segment if AMC Cam Final Speed Coefficient (35.009) is not zero. An example of the speed discontinuity which can occur when AMC Cam Force Repeat (35.011) is enabled and the rate of change ( $dy/dx$ ) at the end of the last segment is not zero is shown in the figure below.



If AMC Cam Force Repeat (35.011) is disabled the rate of change calculated at the end of the last segment is used to calculate the interpolated position in the next segment. This removes the discontinuity caused by the rate of change at the end of the last segment but will cause the interpolated position between segment boundaries to change when the cam repeats and the rate of change at the end of the last segment is not zero. The effect of turning AMC Cam Force Repeat (35.011) off is shown in the figure below.



In this example the speed is continuous but the interpolated position between segment boundaries has changed. This is caused by the rate of change used at the beginning of segment 0 in the second cam which is not forced to zero when AMC Cam Force Repeat (35.011) is off. Note that the rate of change used to calculate the position in the first segment of the first cam is always zero. This mode is intended to be used when writing cam table parameters (more than 20 points) from a controller or AMC Cam Mode (35.012) is set to 2 and the rate of change at the end of the last segment is not zero.

| Parameter 35.010 AMC Cam Complete                                 |                |                |           |
|---|----------------|----------------|-----------|
| Short description   |                |                |           |
| Displays when the cam controller reaches the end of the cam table |                |                |           |
| Mode RFC-A  |                |                |           |
| Minimum   | 0              | Maximum        | 1         |
| Default   | 0              | Units          |           |
| Type  | 1 Bit Volatile | Update Rate    | 4ms write |
| Display Format  | Standard       | Decimal Places | 0         |
| Coding RW   |                |                |           |

AMC Cam Complete (35.010) is set to one when the cam function wraps around either end of the cam table. AMC Cam Complete (35.010) is not set the first time the cam wraps around the first segment (running in the reverse direction) if AMC Cam Start Position In Segment (35.002) = 0 and AMC Cam Start Index (35.001) = first segment. Note that the first segment is always set to segment 0 when AMC Cam Mode (35.012) = 0 or AMC Cam Start Index (35.001) when AMC Cam Mode (35.012) = 1.

| Parameter 35.011 AMC Cam Force Repeat |                 |                |          |
|---------------------------------------|-----------------|----------------|----------|
| Short description                     |                 |                |          |
| Mode RFC-A                            |                 |                |          |
| Minimum                               | 0               | Maximum        | 1        |
| Default                               | 1               | Units          |          |
| Type                                  | 1 Bit User Save | Update Rate    | 4ms read |
| Display Format                        | Standard        | Decimal Places | 0        |
| Coding RW, BU                         |                 |                |          |

See AMC Cam Final Speed Coefficient (35.009).

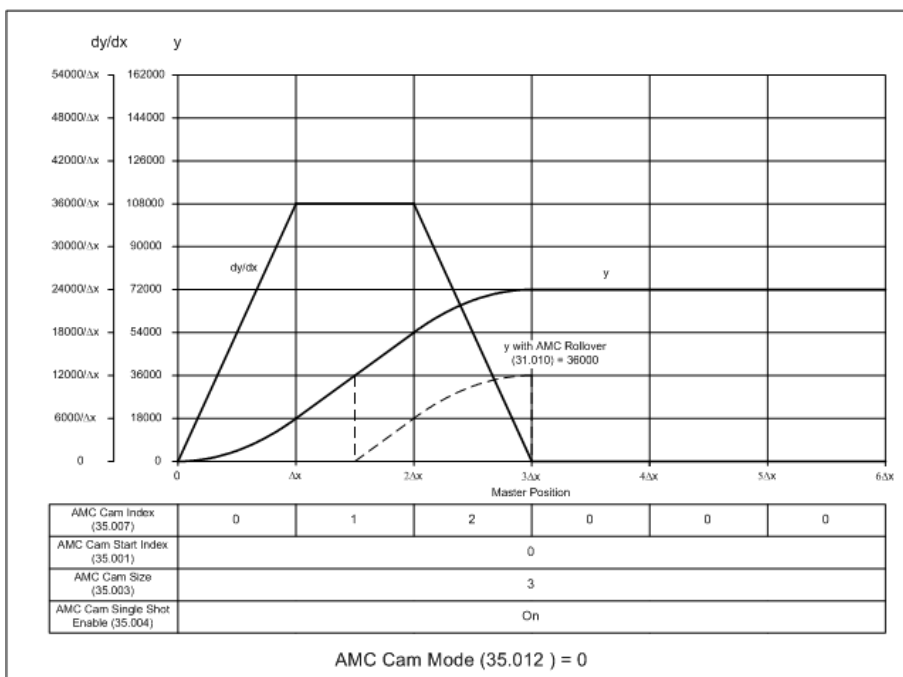
| Parameter 35.012 AMC Cam Mode |                 |                |          |
|-------------------------------|-----------------|----------------|----------|
| Short description             |                 |                |          |
| Mode RFC-A                    |                 |                |          |
| Minimum                       | 0               | Maximum        | 1        |
| Default                       | 0               | Units          |          |
| Type                          | 8 Bit User Save | Update Rate    | 4ms read |
| Display Format                | Standard        | Decimal Places | 0        |
| Coding RW                     |                 |                |          |

AMC Cam Mode (35.012) is used to select between the functionality shown in the table below.

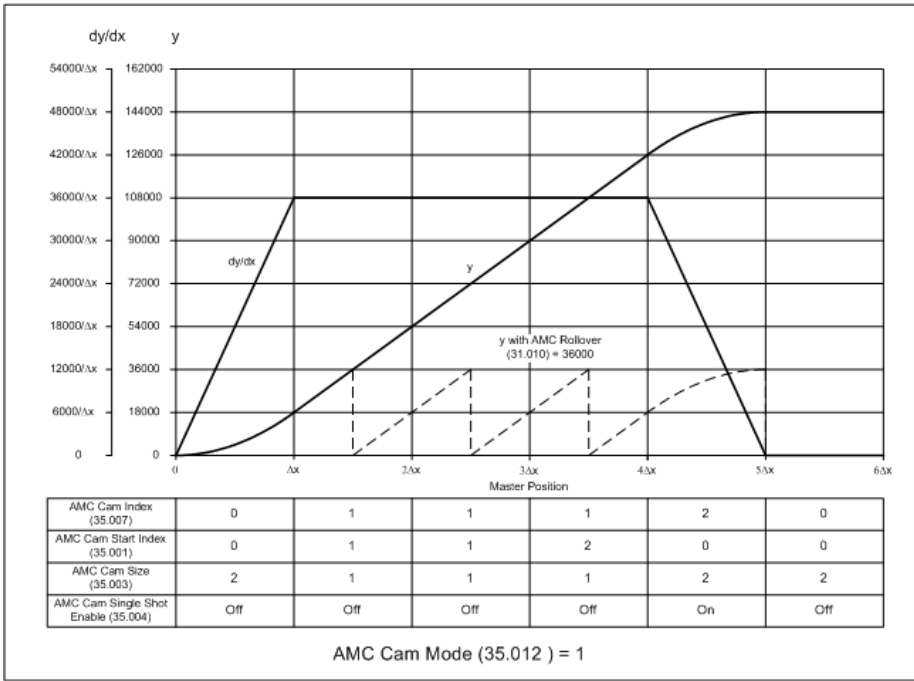
| AMC Cam Mode (35.012) | AMC Cam Index (35.007) when the cam is enabled | AMC Cam Index (35.007) when the cam wraps around the last segment in the forward direction | AMC Cam Index (35.007) when the cam wraps around the first segment in the reverse direction | Parameter update   |
|-----------------------|--|--|---|--|
| 0                     | AMC Cam Start Index (35.001)                   | 0  | AMC Cam Size (35.003) - 1   | AMC Cam Start Index (35.001) and AMC Cam Size (35.003) are updated when the cam is disabled  |
| 1                     | AMC Cam Start Index (35.001)                   | AMC Cam Start Index (35.001)   | AMC Cam Start Index (35.001) + AMC Cam Size (35.003) - 1                                    | AMC Cam Start Index (35.001) and AMC Cam Size (35.003) are updated when the cam is disabled and when the cam wraps around the last segment in either direction |

When AMC Cam Mode (35.012) = 1 the last index in the cam table (AMC Cam Start Index (35.001) + AMC Cam Size (35.003) - 1) is automatically limited to the maximum value (i.e. segment 19). For example, if AMC Cam Start Index (35.001) = 10 and AMC Cam Size (35.003) = 20 the cam would operate between index 10 and 19.

When AMC Cam Mode (35.012) = 0 the cam will run between index 0 and AMC Cam Size (35.003) - 1. The figure below shows a trapezoidal cam with three segments (i.e. ramp in, running and ramp out). In single shot mode the cam runs once and stops at the beginning of the first segment (i.e. AMC Cam Index (35.007) = 0 and AMC Cam Position In Segment (35.008) = 0).



In some applications (e.g. rotary knife) the ramp in and ramp out segments are only required at the beginning and end of a process. When AMC Cam Mode (35.012) = 1 it is possible to change AMC Cam Start Index (35.001), AMC Cam Size (35.003) and AMC Cam Single Shot Enable (35.004) while the cam is running to produce the cam profile shown below, i.e. the cam remains in the running segment until the ramp out is required.



Note that any parameter in *AMC Cam* (35) or *AMC Cam Table* (36) must be updated at least 4ms before the cam enters the segment in which the new value is applied, e.g. when running forwards *AMC Cam Size* (35.003) must be updated 4ms before the end of the last segment is reached.

# Menu 36 Single Line Descriptions – *AMC Cam Table*

Mode: RFC-A



| Parameter |                                | Range                                | Default    | Type |     |  |  |    |
|-----------|--------------------------------|--------------------------------------|------------|------|-----|--|--|----|
| 36.001    | AMC Cam Table In -1            | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.002    | AMC Cam Table Out -1           | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.003    | AMC Cam Table Interpolation -1 | Linear (0), Square (1), Cos2 (2)     | Linear (0) | RW   | Txt |  |  | US |
| 36.004    | AMC Cam Table In 0             | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.005    | AMC Cam Table Out 0            | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.006    | AMC Cam Table Interpolation 0  | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.007    | AMC Cam Table In 1             | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.008    | AMC Cam Table Out 1            | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.009    | AMC Cam Table Interpolation 1  | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.010    | AMC Cam Table In 2             | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.011    | AMC Cam Table Out 2            | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.012    | AMC Cam Table Interpolation 2  | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.013    | AMC Cam Table In 3             | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.014    | AMC Cam Table Out 3            | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.015    | AMC Cam Table Interpolation 3  | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.016    | AMC Cam Table In 4             | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.017    | AMC Cam Table Out 4            | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.018    | AMC Cam Table Interpolation 4  | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.019    | AMC Cam Table In 5             | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.020    | AMC Cam Table Out 5            | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.021    | AMC Cam Table Interpolation 5  | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.022    | AMC Cam Table In 6             | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.023    | AMC Cam Table Out 6            | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.024    | AMC Cam Table Interpolation 6  | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.025    | AMC Cam Table In 7             | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.026    | AMC Cam Table Out 7            | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.027    | AMC Cam Table Interpolation 7  | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.028    | AMC Cam Table In 8             | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.029    | AMC Cam Table Out 8            | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.030    | AMC Cam Table Interpolation 8  | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.031    | AMC Cam Table In 9             | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.032    | AMC Cam Table Out 9            | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.033    | AMC Cam Table Interpolation 9  | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.034    | AMC Cam Table In 10            | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.035    | AMC Cam Table Out 10           | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.036    | AMC Cam Table Interpolation 10 | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.037    | AMC Cam Table In 11            | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.038    | AMC Cam Table Out 11           | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.039    | AMC Cam Table Interpolation 11 | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.040    | AMC Cam Table In 12            | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.041    | AMC Cam Table Out 12           | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.042    | AMC Cam Table Interpolation 12 | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.043    | AMC Cam Table In 13            | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.044    | AMC Cam Table Out 13           | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.045    | AMC Cam Table Interpolation 13 | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.046    | AMC Cam Table In 14            | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.047    | AMC Cam Table Out 14           | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.048    | AMC Cam Table Interpolation 14 | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.049    | AMC Cam Table In 15            | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.050    | AMC Cam Table Out 15           | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.051    | AMC Cam Table Interpolation 15 | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.052    | AMC Cam Table In 16            | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.053    | AMC Cam Table Out 16           | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.054    | AMC Cam Table Interpolation 16 | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.055    | AMC Cam Table In 17            | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.056    | AMC Cam Table Out 17           | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.057    | AMC Cam Table Interpolation 17 | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.058    | AMC Cam Table In 18            | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.059    | AMC Cam Table Out 18           | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.060    | AMC Cam Table Interpolation 18 | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |
| 36.061    | AMC Cam Table In 19            | 0 to VM_AMC_POSITION_CAM_UNIPOLAR UU | 0 UU       | RW   | Num |  |  | US |
| 36.062    | AMC Cam Table Out 19           | ±VM_AMC_POSITION_CAM UU              | 0 UU       | RW   | Num |  |  | US |
| 36.063    | AMC Cam Table Interpolation 19 | Cos1 (0), Square (1), Cos2 (2)       | Cos1 (0)   | RW   | Txt |  |  | US |

|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 36 – AMC Cam Table

Mode: RFC-A

| Parameter         | 36.001 AMC Cam Table In -1   |                |                              |
|-------------------|--|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for the initial start segment |                |                              |
| Mode              | RFC-A  |                |                              |
| Minimum           | 0  | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0  | Units          | UU                           |
| Type              | 32 Bit User Save   | Update Rate    | Read when the cam is enabled |
| Display Format    | Standard   | Decimal Places | 0                            |
| Coding            | RW, VM   |                |                              |

AMC Cam Table In -1 (36.001), AMC Cam Table Out -1 (36.002) and AMC Cam Table Interpolation -1 (36.003) are the cam table entries for the initial start segment.

| Parameter         | 36.002 AMC Cam Table Out -1   |                |                              |
|-------------------|---|----------------|------------------------------|
| Short description | Defines the output entry to the cam table for the initial start segment |                |                              |
| Mode              | RFC-A   |                |                              |
| Minimum           | -VM_AMC_POSITION_CAM  | Maximum        | VM_AMC_POSITION_CAM          |
| Default           | 0   | Units          | UU                           |
| Type              | 32 Bit User Save  | Update Rate    | Read when the cam is enabled |
| Display Format    | Standard  | Decimal Places | 0                            |
| Coding            | RW, VM  |                |                              |

See AMC Cam Table In -1 (36.001).

| Parameter         | 36.003 AMC Cam Table Interpolation -1  |                |                              |
|-------------------|--|----------------|------------------------------|
| Short description | Defines the interpolation entry to the cam table for the initial start segment |                |                              |
| Mode              | RFC-A  |                |                              |
| Minimum           | 0  | Maximum        | 2                            |
| Default           | 0  | Units          |                              |
| Type              | 8 Bit User Save  | Update Rate    | Read when the cam is enabled |
| Display Format    | Standard   | Decimal Places | 0                            |
| Coding            | RW, TE   |                |                              |

| Value | Text   |
|-------|--------|
| 0     | Linear |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In -1 (36.001).

| Parameter         | 36.004 AMC Cam Table In 0                              |                |                              |
|-------------------|--|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 0 |                |                              |
| Mode              | RFC-A  |                |                              |
| Minimum           | 0  | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0  | Units          | UU                           |
| Type              | 32 Bit User Save                                       | Update Rate    | 4ms read                     |
| Display Format    | Standard   | Decimal Places | 0                            |
| Coding            | RW, VM   |                |                              |

AMC Cam Table In 0 (36.004), AMC Cam Table Out 0 (36.005) and AMC Cam Table Interpolation 0 (36.006) are the cam table entries for segment 0. These parameters are read in a 4ms task and transferred to an internal RAM array for use by the cam system.

The parameter numbers for the cam table entries for each of the other segments are calculated using the following, where  $1 \leq X \leq 19$ .

| Entry                         | Parameter Number |
|-------------------------------|------------------|
| AMC Cam Table In X            | 36.004 + 3X      |
| AMC Cam Table Out X           | 36.005 + 3X      |
| AMC Cam Table Interpolation X | 36.006 + 3X      |

| Parameter         | 36.005 AMC Cam Table Out 0                              |                |                     |
|-------------------|---|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 0 |                |                     |
| Mode              | RFC-A   |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                    | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0   | Units          | UU                  |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read            |
| Display Format    | Standard  | Decimal Places | 0                   |
| Coding            | RW, VM  |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.006 AMC Cam Table Interpolation 0                           |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 0 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 2        |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, TE   |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.007 AMC Cam Table In 1                              |                |                              |
|-------------------|--|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 1 |                |                              |
| Mode              | RFC-A  |                |                              |
| Minimum           | 0  | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0  | Units          | UU                           |
| Type              | 32 Bit User Save                                       | Update Rate    | 4ms read                     |
| Display Format    | Standard   | Decimal Places | 0                            |
| Coding            | RW, VM   |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.008 AMC Cam Table Out 1                              |                |                     |
|-------------------|---|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 1 |                |                     |
| Mode              | RFC-A   |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                    | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0   | Units          | UU                  |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read            |
| Display Format    | Standard  | Decimal Places | 0                   |
| Coding            | RW, VM  |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.009 AMC Cam Table Interpolation 1                           |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 1 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 2        |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, TE   |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.010 AMC Cam Table In 2                              |                |                              |
|-------------------|--|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 2 |                |                              |
| Mode              | RFC-A  |                |                              |
| Minimum           | 0  | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0  | Units          | UU                           |
| Type              | 32 Bit User Save                                       | Update Rate    | 4ms read                     |
| Display Format    | Standard   | Decimal Places | 0                            |
| Coding            | RW, VM   |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.011 AMC Cam Table Out 2                              |                |                     |
|-------------------|---|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 2 |                |                     |
| Mode              | RFC-A   |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                    | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0   | Units          | UU                  |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read            |
| Display Format    | Standard  | Decimal Places | 0                   |
| Coding            | RW, VM  |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.012 AMC Cam Table Interpolation 2                           |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 2 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 2        |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, TE   |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.013 AMC Cam Table In 3                              |                |                              |
|-------------------|--|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 3 |                |                              |
| Mode              | RFC-A  |                |                              |
| Minimum           | 0  | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0  | Units          | UU                           |
| Type              | 32 Bit User Save                                       | Update Rate    | 4ms read                     |
| Display Format    | Standard   | Decimal Places | 0                            |
| Coding            | RW, VM   |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.014 AMC Cam Table Out 3                              |                |                     |
|-------------------|---|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 3 |                |                     |
| Mode              | RFC-A   |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                    | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0   | Units          | UU                  |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read            |
| Display Format    | Standard  | Decimal Places | 0                   |
| Coding            | RW, VM  |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.015 AMC Cam Table Interpolation 3                           |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 3 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 2        |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, TE   |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.016 AMC Cam Table In 4                              |                |                              |
|-------------------|--|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 4 |                |                              |
| Mode              | RFC-A  |                |                              |
| Minimum           | 0  | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0  | Units          | UU                           |
| Type              | 32 Bit User Save                                       | Update Rate    | 4ms read                     |
| Display Format    | Standard   | Decimal Places | 0                            |
| Coding            | RW, VM   |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.017 AMC Cam Table Out 4                              |                |                     |
|-------------------|---|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 4 |                |                     |
| Mode              | RFC-A   |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                    | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0   | Units          | UU                  |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read            |
| Display Format    | Standard  | Decimal Places | 0                   |
| Coding            | RW, VM  |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.018 AMC Cam Table Interpolation 4                           |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 4 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 2        |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, TE   |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.019 AMC Cam Table In 5                              |                |                              |
|-------------------|--|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 5 |                |                              |
| Mode              | RFC-A  |                |                              |
| Minimum           | 0  | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0  | Units          | UU                           |
| Type              | 32 Bit User Save                                       | Update Rate    | 4ms read                     |
| Display Format    | Standard   | Decimal Places | 0                            |
| Coding            | RW, VM   |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.020 AMC Cam Table Out 5                              |                |                     |
|-------------------|---|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 5 |                |                     |
| Mode              | RFC-A   |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                    | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0   | Units          | UU                  |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read            |
| Display Format    | Standard  | Decimal Places | 0                   |
| Coding            | RW, VM  |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.021 AMC Cam Table Interpolation 5                           |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 5 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 2        |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, TE   |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.022 AMC Cam Table In 6                              |                |                              |
|-------------------|--|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 6 |                |                              |
| Mode              | RFC-A  |                |                              |
| Minimum           | 0  | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0  | Units          | UU                           |
| Type              | 32 Bit User Save                                       | Update Rate    | 4ms read                     |
| Display Format    | Standard   | Decimal Places | 0                            |
| Coding            | RW, VM   |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.023 AMC Cam Table Out 6                              |                |                     |
|-------------------|---|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 6 |                |                     |
| Mode              | RFC-A   |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                    | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0   | Units          | UU                  |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read            |
| Display Format    | Standard  | Decimal Places | 0                   |
| Coding            | RW, VM  |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.024 AMC Cam Table Interpolation 6                           |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 6 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 2        |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, TE   |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.025 AMC Cam Table In 7                              |                |                              |
|-------------------|--|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 6 |                |                              |
| Mode              | RFC-A  |                |                              |
| Minimum           | 0  | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0  | Units          | UU                           |
| Type              | 32 Bit User Save                                       | Update Rate    | 4ms read                     |
| Display Format    | Standard   | Decimal Places | 0                            |
| Coding            | RW, VM   |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.026 AMC Cam Table Out 7                              |                |                     |
|-------------------|---|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 7 |                |                     |
| Mode              | RFC-A   |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                    | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0   | Units          | UU                  |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read            |
| Display Format    | Standard  | Decimal Places | 0                   |
| Coding            | RW, VM  |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.027 AMC Cam Table Interpolation 7                           |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 7 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 2        |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, TE   |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.028 AMC Cam Table In 8                              |                |                              |
|-------------------|--|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 8 |                |                              |
| Mode              | RFC-A  |                |                              |
| Minimum           | 0  | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0  | Units          | UU                           |
| Type              | 32 Bit User Save                                       | Update Rate    | 4ms read                     |
| Display Format    | Standard   | Decimal Places | 0                            |
| Coding            | RW, VM   |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.029 AMC Cam Table Out 8                              |                |                     |
|-------------------|---|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 8 |                |                     |
| Mode              | RFC-A   |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                    | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0   | Units          | UU                  |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read            |
| Display Format    | Standard  | Decimal Places | 0                   |
| Coding            | RW, VM  |                |                     |

See AMC Cam Table In 0 (36.004).



| Parameter         | 36.030 AMC Cam Table Interpolation 8                           |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 8 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 2        |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, TE   |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.031 AMC Cam Table In 9                              |                |                              |
|-------------------|--|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 9 |                |                              |
| Mode              | RFC-A  |                |                              |
| Minimum           | 0  | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0  | Units          | UU                           |
| Type              | 32 Bit User Save                                       | Update Rate    | 4ms read                     |
| Display Format    | Standard   | Decimal Places | 0                            |
| Coding            | RW, VM   |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.032 AMC Cam Table Out 9                              |                |                     |
|-------------------|---|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 9 |                |                     |
| Mode              | RFC-A   |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                    | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0   | Units          | UU                  |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read            |
| Display Format    | Standard  | Decimal Places | 0                   |
| Coding            | RW, VM  |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.033 AMC Cam Table Interpolation 9                           |                |          |
|-------------------|--|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 9 |                |          |
| Mode              | RFC-A  |                |          |
| Minimum           | 0  | Maximum        | 2        |
| Default           | 0  | Units          |          |
| Type              | 8 Bit User Save  | Update Rate    | 4ms read |
| Display Format    | Standard   | Decimal Places | 0        |
| Coding            | RW, TE   |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.034 AMC Cam Table In 10                              |                |                              |
|-------------------|---|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 10 |                |                              |
| Mode              | RFC-A   |                |                              |
| Minimum           | 0   | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0   | Units          | UU                           |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read                     |
| Display Format    | Standard  | Decimal Places | 0                            |
| Coding            | RW, VM  |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.035 AMC Cam Table Out 10                              |                |                     |
|-------------------|--|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 10 |                |                     |
| Mode              | RFC-A  |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                     | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0  | Units          | UU                  |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read            |
| Display Format    | Standard   | Decimal Places | 0                   |
| Coding            | RW, VM   |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.036 AMC Cam Table Interpolation 10                           |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 10 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 2        |
| Default           | 0   | Units          |          |
| Type              | 8 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, TE  |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.037 AMC Cam Table In 11                              |                |                              |
|-------------------|---|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 11 |                |                              |
| Mode              | RFC-A   |                |                              |
| Minimum           | 0   | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0   | Units          | UU                           |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read                     |
| Display Format    | Standard  | Decimal Places | 0                            |
| Coding            | RW, VM  |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.038 AMC Cam Table Out 11                              |                |                     |
|-------------------|--|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 11 |                |                     |
| Mode              | RFC-A  |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                     | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0  | Units          | UU                  |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read            |
| Display Format    | Standard   | Decimal Places | 0                   |
| Coding            | RW, VM   |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.039 AMC Cam Table Interpolation 11                           |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 11 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 2        |
| Default           | 0   | Units          |          |
| Type              | 8 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, TE  |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.040 AMC Cam Table In 12                              |                |                              |
|-------------------|---|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 12 |                |                              |
| Mode              | RFC-A   |                |                              |
| Minimum           | 0   | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0   | Units          | UU                           |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read                     |
| Display Format    | Standard  | Decimal Places | 0                            |
| Coding            | RW, VM  |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.041 AMC Cam Table Out 12                              |                |                     |
|-------------------|--|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 12 |                |                     |
| Mode              | RFC-A  |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                     | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0  | Units          | UU                  |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read            |
| Display Format    | Standard   | Decimal Places | 0                   |
| Coding            | RW, VM   |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.042 AMC Cam Table Interpolation 12                           |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 12 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 2        |
| Default           | 0   | Units          |          |
| Type              | 8 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, TE  |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.043 AMC Cam Table In 13                              |                |                              |
|-------------------|---|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 13 |                |                              |
| Mode              | RFC-A   |                |                              |
| Minimum           | 0   | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0   | Units          | UU                           |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read                     |
| Display Format    | Standard  | Decimal Places | 0                            |
| Coding            | RW, VM  |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.044 AMC Cam Table Out 13                              |                |                     |
|-------------------|--|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 13 |                |                     |
| Mode              | RFC-A  |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                     | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0  | Units          | UU                  |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read            |
| Display Format    | Standard   | Decimal Places | 0                   |
| Coding            | RW, VM   |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.045 AMC Cam Table Interpolation 13                           |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 13 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 2        |
| Default           | 0   | Units          |          |
| Type              | 8 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, TE  |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.046 AMC Cam Table In 14                              |                |                              |
|-------------------|---|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 14 |                |                              |
| Mode              | RFC-A   |                |                              |
| Minimum           | 0   | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0   | Units          | UU                           |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read                     |
| Display Format    | Standard  | Decimal Places | 0                            |
| Coding            | RW, VM  |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.047 AMC Cam Table Out 14                              |                |                     |
|-------------------|--|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 14 |                |                     |
| Mode              | RFC-A  |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                     | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0  | Units          | UU                  |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read            |
| Display Format    | Standard   | Decimal Places | 0                   |
| Coding            | RW, VM   |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.048 AMC Cam Table Interpolation 14                           |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 14 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 2        |
| Default           | 0   | Units          |          |
| Type              | 8 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, TE  |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.049 AMC Cam Table In 15                              |                |                              |
|-------------------|---|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 15 |                |                              |
| Mode              | RFC-A   |                |                              |
| Minimum           | 0   | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0   | Units          | UU                           |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read                     |
| Display Format    | Standard  | Decimal Places | 0                            |
| Coding            | RW, VM  |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.050 AMC Cam Table Out 15                              |                |                     |
|-------------------|--|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 15 |                |                     |
| Mode              | RFC-A  |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                     | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0  | Units          | UU                  |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read            |
| Display Format    | Standard   | Decimal Places | 0                   |
| Coding            | RW, VM   |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.051 AMC Cam Table Interpolation 15                           |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 15 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 2        |
| Default           | 0   | Units          |          |
| Type              | 8 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, TE  |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.052 AMC Cam Table In 16                              |                |                              |
|-------------------|---|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 16 |                |                              |
| Mode              | RFC-A   |                |                              |
| Minimum           | 0   | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0   | Units          | UU                           |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read                     |
| Display Format    | Standard  | Decimal Places | 0                            |
| Coding            | RW, VM  |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.053 AMC Cam Table Out 16                              |                |                     |
|-------------------|--|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 16 |                |                     |
| Mode              | RFC-A  |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                     | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0  | Units          | UU                  |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read            |
| Display Format    | Standard   | Decimal Places | 0                   |
| Coding            | RW, VM   |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.054 AMC Cam Table Interpolation 16                           |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 16 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 2        |
| Default           | 0   | Units          |          |
| Type              | 8 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, TE  |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.055 AMC Cam Table In 17                              |                |                              |
|-------------------|---|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 17 |                |                              |
| Mode              | RFC-A   |                |                              |
| Minimum           | 0   | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0   | Units          | UU                           |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read                     |
| Display Format    | Standard  | Decimal Places | 0                            |
| Coding            | RW, VM  |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.056 AMC Cam Table Out 17                              |                |                     |
|-------------------|--|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 17 |                |                     |
| Mode              | RFC-A  |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                     | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0  | Units          | UU                  |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read            |
| Display Format    | Standard   | Decimal Places | 0                   |
| Coding            | RW, VM   |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.057 AMC Cam Table Interpolation 17                           |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 17 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 2        |
| Default           | 0   | Units          |          |
| Type              | 8 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, TE  |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.058 AMC Cam Table In 18                              |                |                              |
|-------------------|---|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 18 |                |                              |
| Mode              | RFC-A   |                |                              |
| Minimum           | 0   | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0   | Units          | UU                           |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read                     |
| Display Format    | Standard  | Decimal Places | 0                            |
| Coding            | RW, VM  |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.059 AMC Cam Table Out 18                              |                |                     |
|-------------------|--|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 18 |                |                     |
| Mode              | RFC-A  |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                     | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0  | Units          | UU                  |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read            |
| Display Format    | Standard   | Decimal Places | 0                   |
| Coding            | RW, VM   |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.060 AMC Cam Table Interpolation 18                           |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 18 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 2        |
| Default           | 0   | Units          |          |
| Type              | 8 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, TE  |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.061 AMC Cam Table In 19                              |                |                              |
|-------------------|---|----------------|------------------------------|
| Short description | Defines the input entry to the cam table for segment 19 |                |                              |
| Mode              | RFC-A   |                |                              |
| Minimum           | 0   | Maximum        | VM_AMC_POSITION_CAM_UNIPOLAR |
| Default           | 0   | Units          | UU                           |
| Type              | 32 Bit User Save  | Update Rate    | 4ms read                     |
| Display Format    | Standard  | Decimal Places | 0                            |
| Coding            | RW, VM  |                |                              |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.062 AMC Cam Table Out 19                              |                |                     |
|-------------------|--|----------------|---------------------|
| Short description | Defines the output entry to the cam table for segment 19 |                |                     |
| Mode              | RFC-A  |                |                     |
| Minimum           | -VM_AMC_POSITION_CAM                                     | Maximum        | VM_AMC_POSITION_CAM |
| Default           | 0  | Units          | UU                  |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read            |
| Display Format    | Standard   | Decimal Places | 0                   |
| Coding            | RW, VM   |                |                     |

See AMC Cam Table In 0 (36.004).

| Parameter         | 36.063 AMC Cam Table Interpolation 19                           |                |          |
|-------------------|---|----------------|----------|
| Short description | Defines the interpolation entry to the cam table for segment 19 |                |          |
| Mode              | RFC-A   |                |          |
| Minimum           | 0   | Maximum        | 2        |
| Default           | 0   | Units          |          |
| Type              | 8 Bit User Save   | Update Rate    | 4ms read |
| Display Format    | Standard  | Decimal Places | 0        |
| Coding            | RW, TE  |                |          |

| Value | Text   |
|-------|--------|
| 0     | Cos1   |
| 1     | Square |
| 2     | Cos2   |

See AMC Cam Table In 0 (36.004).

## Menu 37 Single Line Descriptions – AMC Electronic Gear Box

Mode: RFC-A

| Parameter |                               | Range                            | Default     | Type |     |    |    |    |    |
|-----------|-------------------------------|----------------------------------|-------------|------|-----|----|----|----|----|
| 37.001    | AMC EGB Enable Rigid Lock     | Off (0) or On (1)                | Off (0)     | RW   | Bit |    |    |    | US |
| 37.002    | AMC EGB Ratio Numerator       | 1 to 2147483647                  | 1000        | RW   | Num |    |    |    | US |
| 37.003    | AMC EGB Ratio Denominator     | 1 to 2147483647                  | 1000        | RW   | Num |    |    |    | US |
| 37.004    | AMC EGB Locking Speed Band    | ±VM_AMC_SPEED_UNIPOLAR UU/ms     | 10.92 UU/ms | RW   | Num |    |    |    | US |
| 37.005    | AMC EGB Locking Position Band | 0 to VM_AMC_POSITION_UNIPOLAR UU | 256 UU      | RW   | Num |    |    |    | US |
| 37.006    | AMC EGB Locked                | Off (0) or On (1)                |             | RO   | Bit | ND | NC | PT |    |

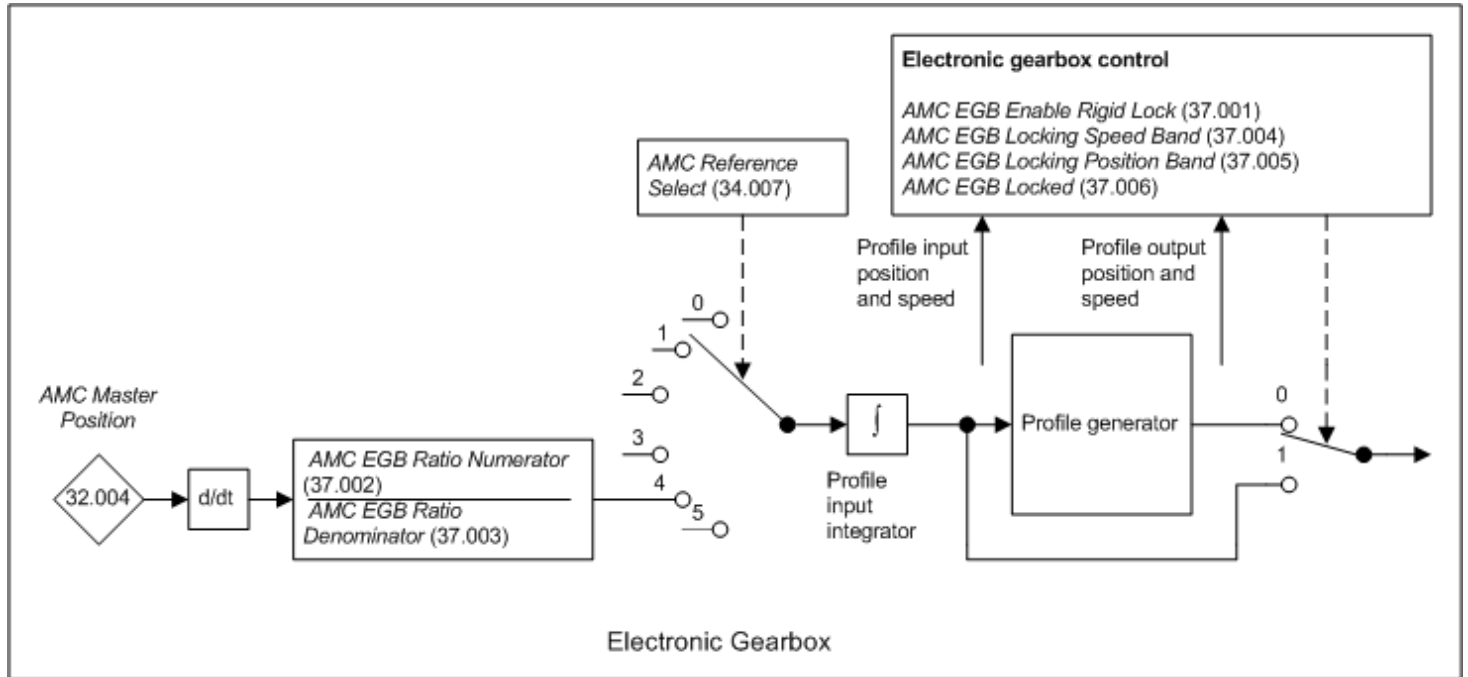
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |



# Menu 37 – AMC Electronic Gear Box

Mode: RFC-A

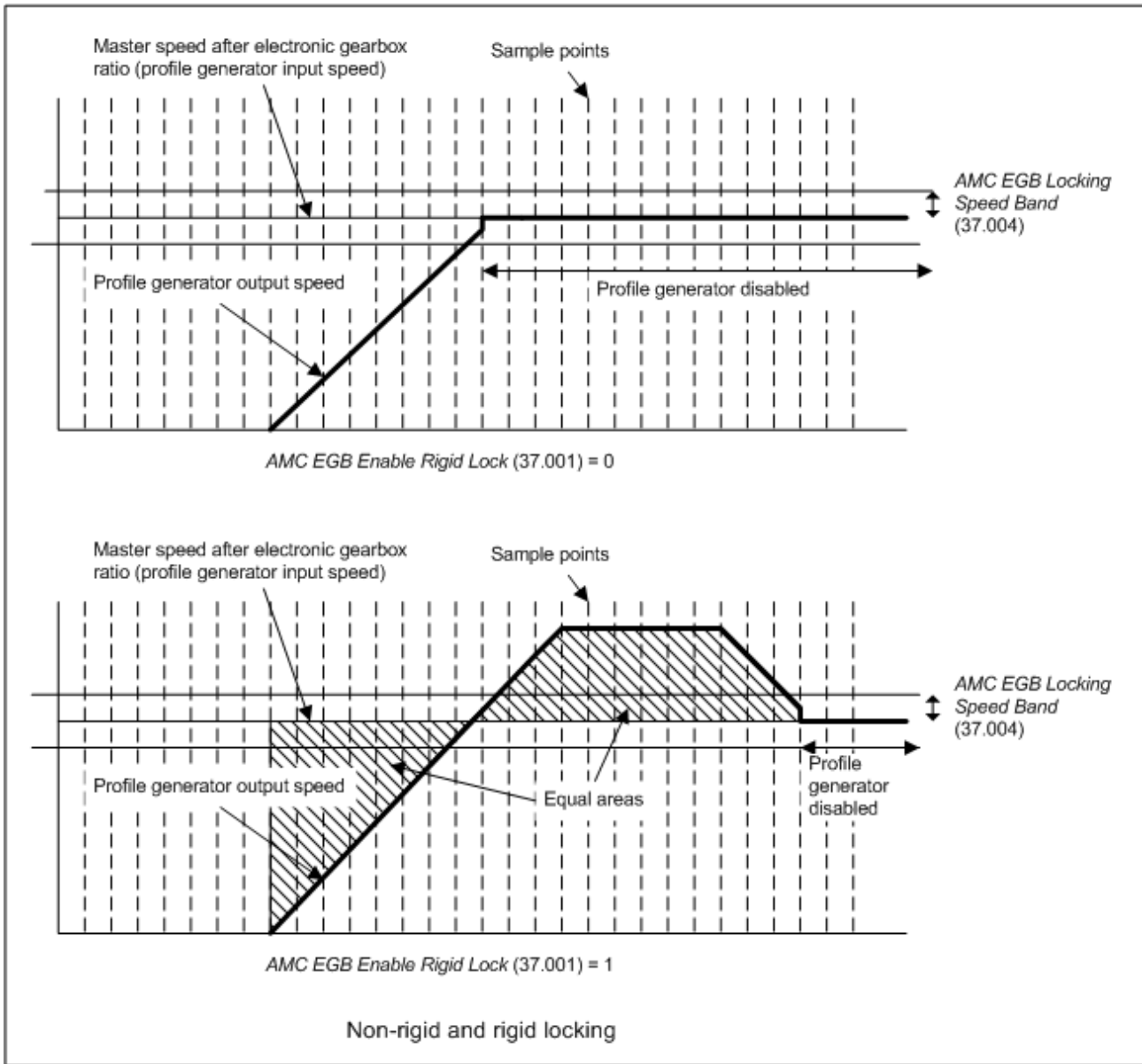
## Electronic gearbox



| Parameter         | 37.001 AMC EGB Enable Rigid Lock                           |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Set to 1 to enable rigid locking of the electronic gearbox |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 1 Bit User Save  | Update Rate    | Background read |
| Display Format    | Standard   | Decimal Places | 0               |
| Coding            | RW   |                |                 |

When the electronic gearbox is not selected or the Advanced Motion Controller is disabled *AMC EGB Locked (37.006)* = 0 and the electronic gearbox control is in the inactive state. The electronic gearbox is enabled when the motion controller is enabled and *AMC Reference Select (34.007)* is changed to a value of 4 (electronic gear box).

If *AMC EGB Enable Rigid Lock (37.001)* = 0 the system attempts to match the speed of the slave with the speed of the master. The speed at the output of the profile generator can only change within the acceleration/deceleration constraints set up for the profile generator (i.e. *AMC Profile Acceleration (38.001)*, *AMC Profile Deceleration (38.002)* and *AMC Profile Maximum Speed (38.003)*). Once the modulus of the difference between the speed at the input and output of the profile generator is less than or equal to *AMC EGB Locking Speed Band (37.004)* the profile generator is disabled so that the output of the profile generator follows the input with no delay and *AMC EGB Locked (37.006)* is set to 1. *AMC EGB Locked (37.006)* can be reset and the profile generator re-enabled by selecting another reference with *AMC Reference Select (34.007)* or by disabling the motion controller. The diagram below shows the speed of the master and slave systems with *AMC EGB Enable Rigid Lock (37.001)* = 0.



If *AMC EGB Enable Rigid Lock (37.001) = 1* the system attempts to match the speed and position of the slave before changing to the locked state as shown above. The profile generator output will exceed the profile generator input speed to make up the position lost during acceleration. The system only changes to the locked state when the modulus of the speed difference between the input and output of the profile generator is within *AMC EGB Locking Speed Band (37.004)* and the modulus of the difference between the input and output position is within *AMC EGB Locking Position Band (37.005)*.

Note that rigid lock will not be enabled when the output of the profile generator is jerk limited, i.e. *AMC Profile Jerk 1 (38.011) > 0*.

| Parameter         | 37.002 AMC EGB Ratio Numerator   |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines the numerator of the ratio used at the input to the electronic gearbox |                |            |
| Mode              | RFC-A  |                |            |
| Minimum           | 1  | Maximum        | 2147483647 |
| Default           | 1000   | Units          |            |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read   |
| Display Format    | Standard   | Decimal Places | 0          |
| Coding            | RW   |                |            |

The electronic gear box ratio (*AMC EGB Ratio Numerator (37.002) / AMC EGB Ratio Denominator (37.003)*) is applied to changes in the *AMC Master Position (32.004)* at the input to the electronic gearbox.

| Parameter         | 37.003 AMC EGB Ratio Denominator   |                |            |
|-------------------|--|----------------|------------|
| Short description | Defines the denominator of the ratio used at the input to the electronic gearbox |                |            |
| Mode              | RFC-A  |                |            |
| Minimum           | 1  | Maximum        | 2147483647 |
| Default           | 1000   | Units          |            |
| Type              | 32 Bit User Save   | Update Rate    | 4ms read   |
| Display Format    | Standard   | Decimal Places | 0          |
| Coding            | RW   |                |            |

See *AMC EGB Ratio Numerator* (37.002).

| Parameter         | 37.004 <i>AMC EGB Locking Speed Band</i>                   |                |                       |
|-------------------|--|----------------|-----------------------|
| Short description | Defines the speed band used to lock the electronic gearbox |                |                       |
| Mode              | RFC-A  |                |                       |
| Minimum           | 0.00   | Maximum        | VM_AMC_SPEED_UNIPOLAR |
| Default           | 10.92  | Units          | UU/ms                 |
| Type              | 32 Bit User Save   | Update Rate    | Background read       |
| Display Format    | Standard   | Decimal Places | 2                     |
| Coding            | RW, VM   |                |                       |

The default value of 10.92 UU/ms is the equivalent of 10rpm for a feedback device with 16 normalised position bits per revolution and a user unit ratio of unity.

See *AMC EGB Enable Rigid Lock* (37.001).

| Parameter         | 37.005 <i>AMC EGB Locking Position Band</i>                   |                |                          |
|-------------------|---|----------------|--------------------------|
| Short description | Defines the position band used to lock the electronic gearbox |                |                          |
| Mode              | RFC-A   |                |                          |
| Minimum           | 0   | Maximum        | VM_AMC_POSITION_UNIPOLAR |
| Default           | 256   | Units          | UU                       |
| Type              | 32 Bit User Save  | Update Rate    | Background read          |
| Display Format    | Standard  | Decimal Places | 0                        |
| Coding            | RW, VM  |                |                          |

See *AMC EGB Enable Rigid Lock* (37.001).

| Parameter         | 37.006 <i>AMC EGB Locked</i>                   |                |           |
|-------------------|--|----------------|-----------|
| Short description | Displays when the electronic gearbox is locked |                |           |
| Mode              | RFC-A  |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile                                 | Update Rate    | 4ms write |
| Display Format    | Standard                                       | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                                 |                |           |

See *AMC EGB Enable Rigid Lock* (37.001).

## Menu 38 Single Line Descriptions – AMC Profile Generator

Mode: RFC-A

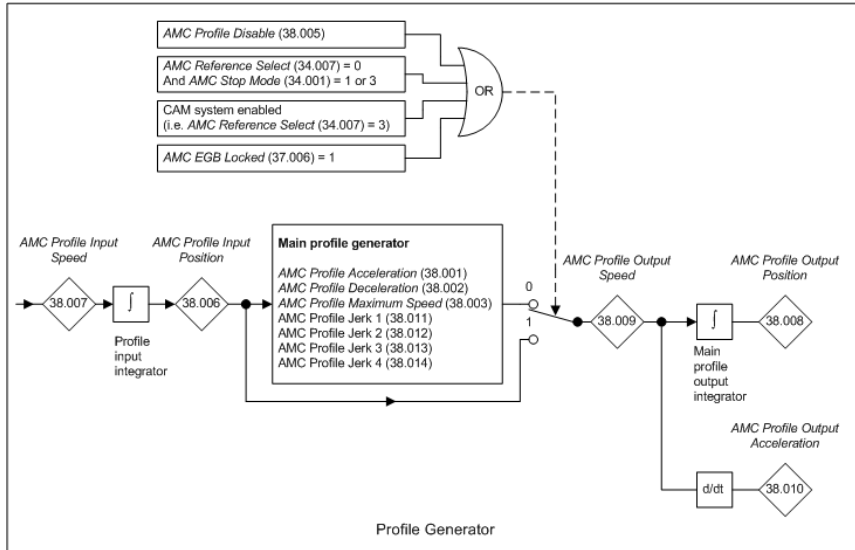
| Parameter |                                 | Range  | Default                   | Type |     |    |    |    |    |    |
|-----------|---------------------------------|--|---------------------------|------|-----|----|----|----|----|----|
| 38.001    | AMC Profile Acceleration        | $\pm VM\_AMC\_RATE\_UNIPOLAR$ UU/ms <sup>2</sup> | 1.092 UU/ms <sup>2</sup>  | RW   | Num |    |    |    |    | US |
| 38.002    | AMC Profile Deceleration        | $\pm VM\_AMC\_RATE\_UNIPOLAR$ UU/ms <sup>2</sup> | 1.092 UU/ms <sup>2</sup>  | RW   | Num |    |    |    |    | US |
| 38.003    | AMC Profile Maximum Speed       | $\pm VM\_AMC\_SPEED\_UNIPOLAR$ UU/ms             | 1092.00 UU/ms             | RW   | Num |    |    |    |    | US |
| 38.005    | AMC Profile Disable             | Off (0) or On (1)                                | Off (0)                   | RW   | Bit |    |    |    |    |    |
| 38.006    | AMC Profile Input Position      | $\pm VM\_AMC\_POSITION$ UU                       |                           | RO   | Num | ND | NC | PT |    |    |
| 38.007    | AMC Profile Input Speed         | $\pm VM\_AMC\_SPEED$ UU/ms                       |                           | RO   | Num | ND | NC | PT | FI |    |
| 38.008    | AMC Profile Output Position     | $\pm VM\_AMC\_POSITION$ UU                       |                           | RO   | Num | ND | NC | PT |    |    |
| 38.009    | AMC Profile Output Speed        | $\pm VM\_AMC\_SPEED$ UU/ms                       |                           | RO   | Num | ND | NC | PT | FI |    |
| 38.010    | AMC Profile Output Acceleration | $\pm VM\_AMC\_RATE$ UU/ms <sup>2</sup>           |                           | RO   | Num | ND | NC | PT |    |    |
| 38.011    | AMC Profile Jerk 1              | $\pm VM\_AMC\_JERK\_UNIPOLAR$ UU/ms <sup>3</sup> | 0.0000 UU/ms <sup>3</sup> | RW   | Num |    |    |    |    | US |
| 38.012    | AMC Profile Jerk 2              | $\pm VM\_AMC\_JERK\_UNIPOLAR$ UU/ms <sup>3</sup> | 0.0000 UU/ms <sup>3</sup> | RW   | Num |    |    |    |    | US |
| 38.013    | AMC Profile Jerk 3              | $\pm VM\_AMC\_JERK\_UNIPOLAR$ UU/ms <sup>3</sup> | 0.0000 UU/ms <sup>3</sup> | RW   | Num |    |    |    |    | US |
| 38.014    | AMC Profile Jerk 4              | $\pm VM\_AMC\_JERK\_UNIPOLAR$ UU/ms <sup>3</sup> | 0.0000 UU/ms <sup>3</sup> | RW   | Num |    |    |    |    | US |
| 38.015    | AMC Profile Update Mode         | 0 to 1   | 1                         | RW   | Num |    |    |    |    | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Menu 38 – AMC Profile Generator

Mode: RFC-A

### Profile generator



### Main profile

AMC Profile Input Speed (38.007) is the rate of change of position over each sample from any of the references. This provides the speed target for the profile generator and this is integrated to give AMC Profile Input Position (38.006) which is the position target. When the profile generator is enabled it produces AMC Profile Output Speed (38.009) which is the rate of change of output position and this is integrated to give AMC Profile Output Position (38.008). Depending on the profile mode the profile generator aims to make either the AMC Profile Output Speed (38.009) equal to the AMC Profile Input Speed (38.007), the AMC Profile Output Position (38.008) equal to the AMC Profile Input Position (38.006) at zero speed, or both. The profile target mode depends on the input to the profile generator as follows.

| Input  | Target   |
|--|--|
| AMC Stop Reference (34.002)  | Stop reference at zero speed   |
| AMC Position Reference (34.003) (AMC Reference Select (34.007) = 1 or 6) | Position reference at zero speed   |
| AMC Speed Reference (34.006)   | Speed reference  |
| Cam  | Profile disabled   |
| Electronic gearbox with non-rigid lock                                   | Input speed when not locked<br>Profile disabled when locked  |
| Electronic gearbox with rigid lock                                       | Input speed and position when not locked<br>Profile disabled when locked                                   |
| Homing system  | Input speed while finding home position<br>Input position at zero speed when moving to home reset position |
| Profile input position (AMC Reference Select (34.007) = 7)               | Constant target position at zero speed   |

The profile generator can operate with a linear ramp (AMC Profile Jerk 1 (38.011) = 0) or an s-ramp profile (AMC Profile Jerk 1 (38.011) > 0). When the profile is operating in linear mode the rate of change of AMC Profile Output Speed (38.009) is constrained by the profile generator. If an s-ramp profile is enabled the rate of change of acceleration is also constrained and up to four unique jerk values can be defined, see AMC Profile Jerk 1 (38.011).

If the profile generator is disabled AMC Profile Output Speed (38.009) = AMC Profile Input Speed (38.007) and AMC Profile Output Position (38.008) = AMC Profile Input Position (38.006). The profile generator can be disabled under any of the following conditions.

| Conditions for profile generator disable                              | Comments  |
|---|---|
| AMC Profile Disable (38.005) = 1                                      | Profile disabled by the user  |
| AMC Reference Select (34.007) = 0 and AMC Stop Mode (34.001) = 1 or 3 | Stop reference selected and no profile stop required  |
| Cam system enabled (i.e. AMC Reference Select (34.007) = 3)           | The Cam system provides its own profile, and so the profile generator is not required       |
| AMC EGB Locked (37.006) = 1   | Electronic gearbox output is locked and should follow the master position without any delay |

| Parameter         | 38.001 AMC Profile Acceleration |                |                      |
|-------------------|---------------------------------|----------------|----------------------|
| Short description |                                 |                |                      |
| Mode              | RFC-A                           |                |                      |
| Minimum           | -VM AMC RATE UNIPOLAR           | Maximum        | VM AMC RATE UNIPOLAR |
| Default           | 1.092                           | Units          | UU/ms <sup>2</sup>   |
| Type              | 32 Bit User Save                | Update Rate    | 4ms read             |
| Display Format    | Standard                        | Decimal Places | 3                    |
| Coding            | RW, VM                          |                |                      |

The default value of 1.092 UU/ms<sup>2</sup> is the equivalent of an acceleration of 1000rpm/s for a feedback device with 16 normalised position bits per revolution and a user unit ratio of unity.

The profile generator applies the constraints to the output speed defined by AMC Profile Acceleration (38.001) when the speed is moving away from 0, AMC Profile Deceleration (38.002) when the speed is moving towards 0, and AMC Profile Maximum Speed (38.003) in either direction.

| Parameter         | 38.002 AMC Profile Deceleration |                |                      |
|-------------------|---------------------------------|----------------|----------------------|
| Short description |                                 |                |                      |
| Mode              | RFC-A                           |                |                      |
| Minimum           | -VM AMC RATE UNIPOLAR           | Maximum        | VM AMC RATE UNIPOLAR |
| Default           | 1.092                           | Units          | UU/ms <sup>2</sup>   |
| Type              | 32 Bit User Save                | Update Rate    | 4ms read             |
| Display Format    | Standard                        | Decimal Places | 3                    |
| Coding            | RW, VM                          |                |                      |

The default value of 1.092 UU/ms<sup>2</sup> is the equivalent of a deceleration of 1000rpm/s for a feedback device with 16 normalised position bits per revolution and a user unit ratio of unity.

See AMC Profile Acceleration (38.001).

| Parameter         | 38.003 AMC Profile Maximum Speed |                |                       |
|-------------------|----------------------------------|----------------|-----------------------|
| Short description |                                  |                |                       |
| Mode              | RFC-A                            |                |                       |
| Minimum           | 0.00                             | Maximum        | VM AMC SPEED UNIPOLAR |
| Default           | 1092.00                          | Units          | UU/ms                 |
| Type              | 32 Bit User Save                 | Update Rate    | 4ms read              |
| Display Format    | Standard                         | Decimal Places | 2                     |
| Coding            | RW, VM                           |                |                       |

The default value of 1092 UU/ms is the equivalent of 1000rpm for a feedback device with 16 normalised position bits per revolution and a user unit ratio of unity.

See *AMC Profile Acceleration* (38.001).

| Parameter         | 38.005 AMC Profile Disable |                |                 |
|-------------------|----------------------------|----------------|-----------------|
| Short description |                            |                |                 |
| Mode              | RFC-A                      |                |                 |
| Minimum           | 0                          | Maximum        | 1               |
| Default           | 0                          | Units          |                 |
| Type              | 1 Bit Volatile             | Update Rate    | Background read |
| Display Format    | Standard                   | Decimal Places | 0               |
| Coding            | RW                         |                |                 |

See the introduction to menu 38.

| Parameter         | 38.006 AMC Profile Input Position |                |                 |
|-------------------|-----------------------------------|----------------|-----------------|
| Short description |                                   |                |                 |
| Mode              | RFC-A                             |                |                 |
| Minimum           | -VM_AMC_POSITION                  | Maximum        | VM_AMC_POSITION |
| Default           |                                   | Units          | UU              |
| Type              | 32 Bit Volatile                   | Update Rate    | 4ms write       |
| Display Format    | Standard                          | Decimal Places | 0               |
| Coding            | RO, VM, ND, NC, PT                |                |                 |

See the introduction to menu 38.

| Parameter         | 38.007 AMC Profile Input Speed |                |              |
|-------------------|--------------------------------|----------------|--------------|
| Short description |                                |                |              |
| Mode              | RFC-A                          |                |              |
| Minimum           | -VM_AMC_SPEED                  | Maximum        | VM_AMC_SPEED |
| Default           |                                | Units          | UU/ms        |
| Type              | 32 Bit Volatile                | Update Rate    | 4ms write    |
| Display Format    | Standard                       | Decimal Places | 2            |
| Coding            | RO, FI, VM, ND, NC, PT         |                |              |

See the introduction to menu 38.

| Parameter         | 38.008 AMC Profile Output Position |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description |                                    |                |                 |
| Mode              | RFC-A                              |                |                 |
| Minimum           | -VM_AMC_POSITION                   | Maximum        | VM_AMC_POSITION |
| Default           |                                    | Units          | UU              |
| Type              | 32 Bit Volatile                    | Update Rate    | 4ms write       |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RO, VM, ND, NC, PT                 |                |                 |

See the introduction to menu 38.

| Parameter         | 38.009 AMC Profile Output Speed |                |              |
|-------------------|---------------------------------|----------------|--------------|
| Short description |                                 |                |              |
| Mode              | RFC-A                           |                |              |
| Minimum           | -VM_AMC_SPEED                   | Maximum        | VM_AMC_SPEED |
| Default           |                                 | Units          | UU/ms        |
| Type              | 32 Bit Volatile                 | Update Rate    | 4ms write    |
| Display Format    | Standard                        | Decimal Places | 2            |
| Coding            | RO, FI, VM, ND, NC, PT          |                |              |

See the introduction to menu 38.

| Parameter         | 38.010 AMC Profile Output Acceleration |                |                    |
|-------------------|--|----------------|--------------------|
| Short description |  |                |                    |
| Mode              | RFC-A                                  |                |                    |
| Minimum           | -VM_AMC_RATE                           | Maximum        | VM_AMC_RATE        |
| Default           |  | Units          | UU/ms <sup>2</sup> |
| Type              | 32 Bit Volatile                        | Update Rate    | 4ms write          |
| Display Format    | Standard                               | Decimal Places | 3                  |
| Coding            | RO, VM, ND, NC, PT                     |                |                    |

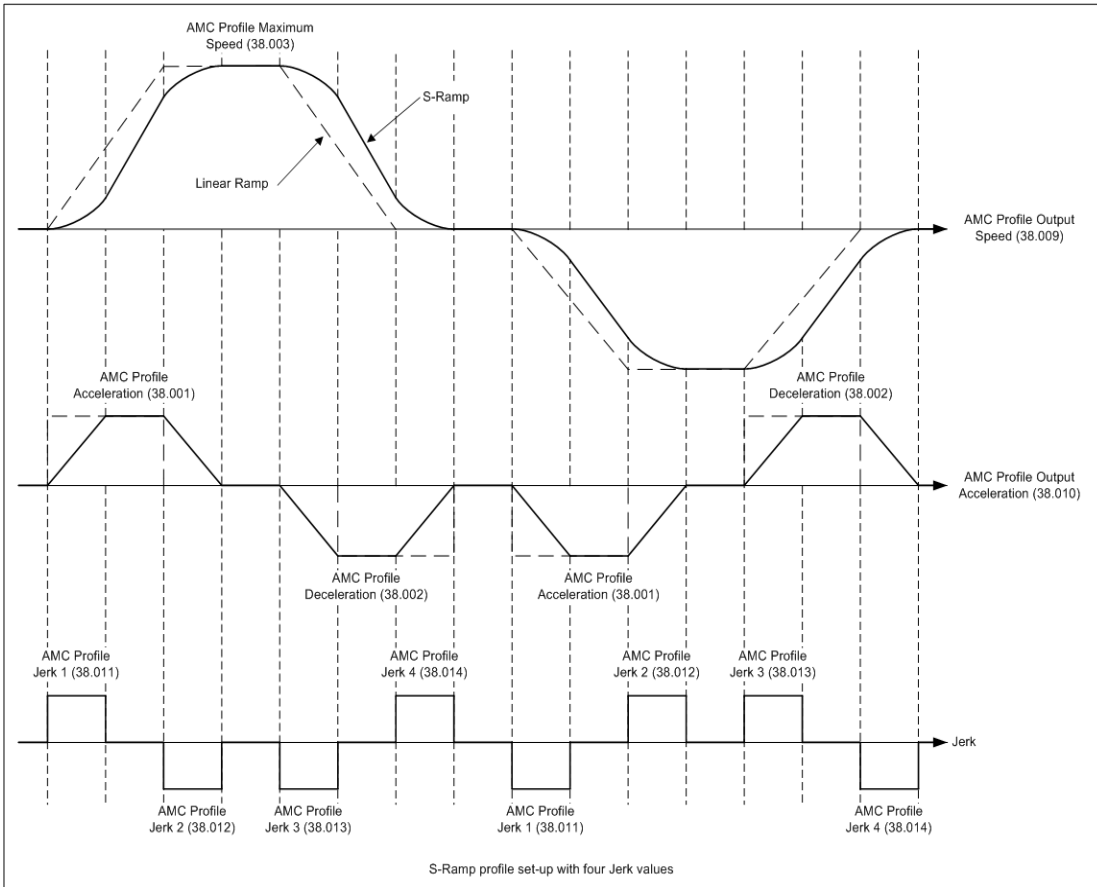
See the introduction to menu 38.

| Parameter         | 38.011 AMC Profile Jerk 1 |                |                      |
|-------------------|---------------------------|----------------|----------------------|
| Short description |                           |                |                      |
| Mode              | RFC-A                     |                |                      |
| Minimum           | -VM_AMC_JERK_UNIPOLAR     | Maximum        | VM_AMC_JERK_UNIPOLAR |
| Default           | 0.0000                    | Units          | UU/ms <sup>3</sup>   |
| Type              | 32 Bit User Save          | Update Rate    | Background read      |
| Display Format    | Standard                  | Decimal Places | 4                    |
| Coding            | RW, VM                    |                |                      |

If *AMC Profile Jerk 1* (38.011) > 0 and *AMC Rate Selected* (31.013) >= 1ms the maximum rate of change of *AMC Profile Output Acceleration* (38.010) is constrained by the jerk parameters in *AMC Profile Generator* (38). Note that it is only possible to change between the s-ramp profile and the linear profile when the drive or motion controller is disabled.

#### Jerk configuration

It is possible to configure up to four independent jerk values as shown in the diagram below.



To minimise the error between *AMC Profile Input Position* (38.006) and *AMC Profile Output Position* (38.008) after the initial profile has been completed the maximum values of *AMC Profile Jerk 3* (38.013) and *AMC Profile Jerk 4* (38.014) which are used during the profile are limited to the following ratios.

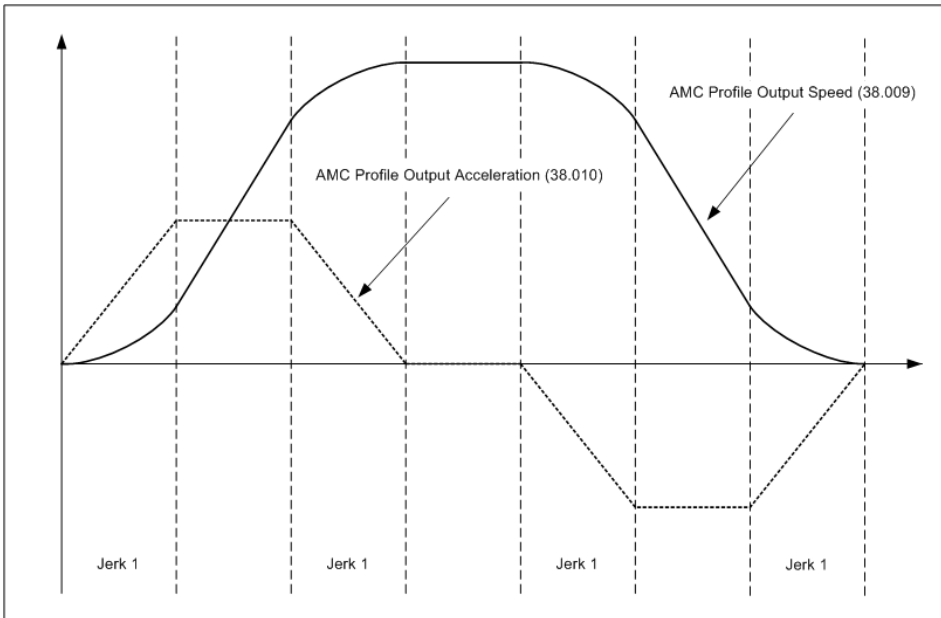
$$AMC Profile Jerk 3 (38.013) \leq 100 \times AMC Profile Jerk 4 (38.014)$$

$$AMC Profile Jerk 4 (38.014) \leq 100 \times AMC Profile Jerk 3 (38.013)$$

If any of the jerk parameters are set to zero the jerk used in that section is inherited from the previous section. This allows the s-ramp to be setup in one of the following configurations without changing all of the jerk parameters individually. If a linear change of speed is required in a section of the s-ramp the corresponding jerk parameter must be set to a value that ensures that the maximum rate (*AMC Profile Acceleration* (38.001) or *AMC Profile Deceleration* (38.002)) is achieved in a single sample.

Note that if *AMC Profile Update Mode* (38.015) is configured to allow a change of jerk during a profile and *AMC Profile Jerk 1* (38.011) is set to zero before the profile has been completed the minimum jerk ( $0.0001 \text{ uu/ms}^3$ ) will be used until *AMC Profile Output Speed* (38.009) reaches standstill.

Profile 1 - Single jerk



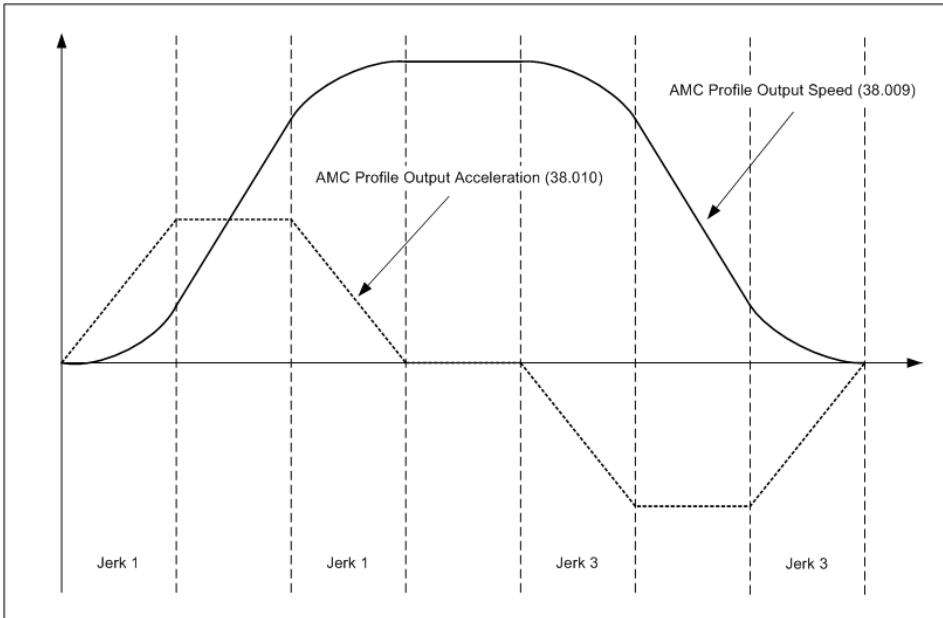
$$AMC Profile Jerk 1 (38.011) > 0$$

$$AMC Profile Jerk 2 (38.012) = 0$$

$$AMC Profile Jerk 3 (38.013) = 0$$

$$AMC Profile Jerk 4 (38.014) = 0$$

Profile 2 - Acceleration and deceleration jerk



AMC Profile Jerk 1 (38.011) > 0

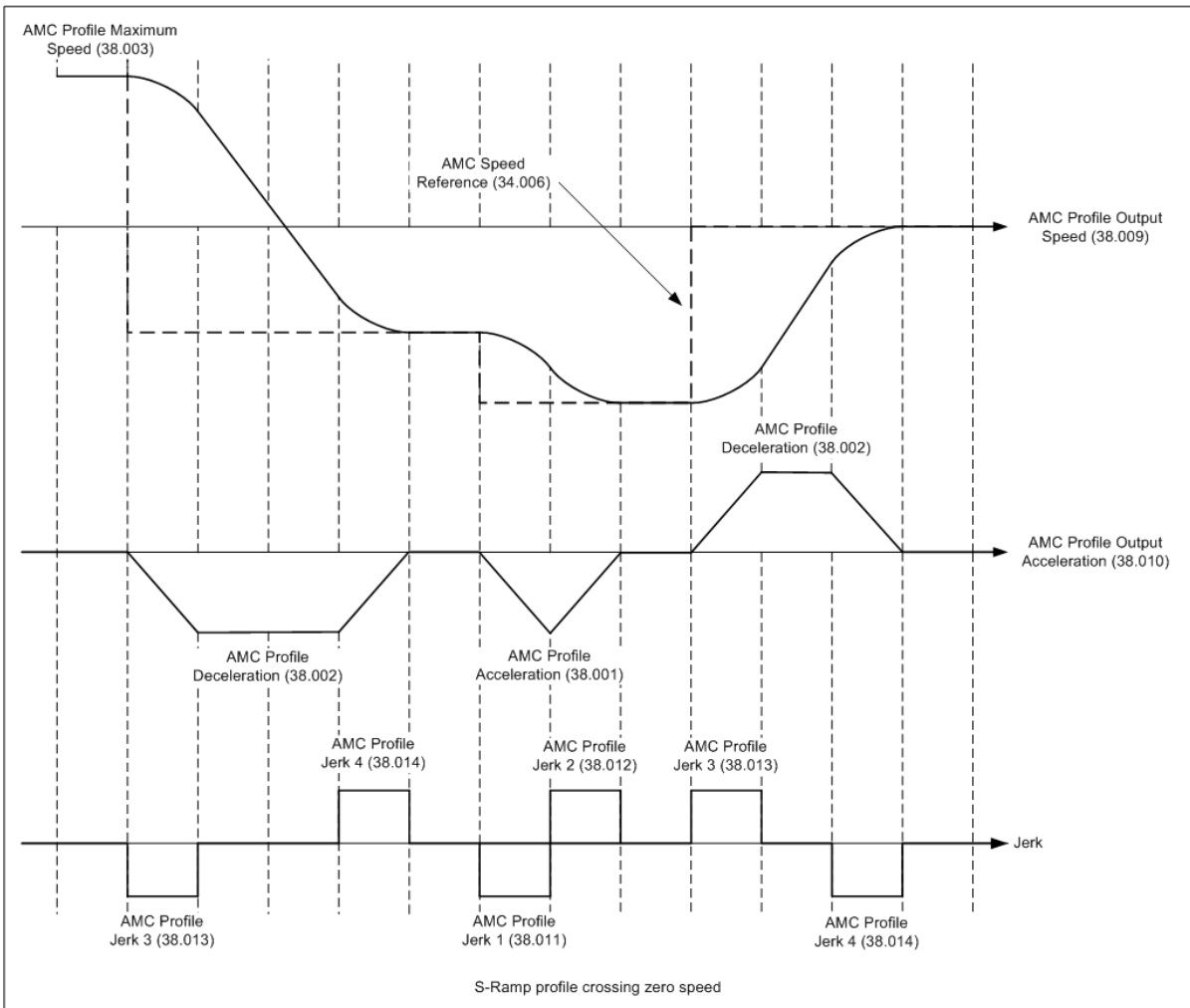
AMC Profile Jerk 2 (38.012) = 0

AMC Profile Jerk 3 (38.013) > 0

AMC Profile Jerk 4 (38.014) = 0

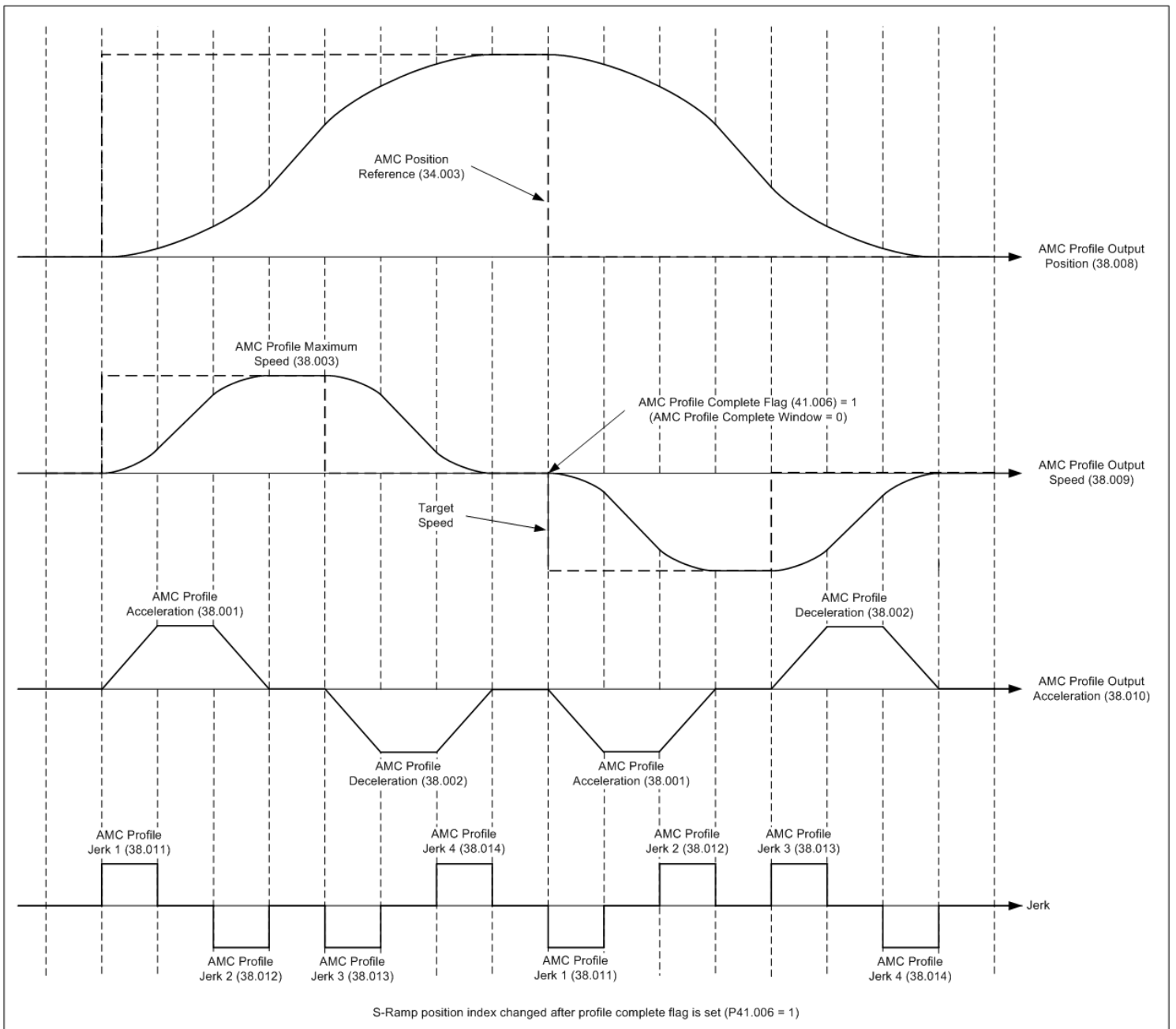
**Profile operation**

If AMC Profile Output Speed (38.009) crosses the zero boundary without stopping (i.e. AMC Speed Reference (34.006) is changed from a positive to negative value) AMC Profile Output Acceleration (38.010) is limited by the deceleration parameters (AMC Profile Deceleration (38.002), AMC Profile Jerk 3 (38.013) and AMC Profile Jerk 4 (38.014)) until the acceleration is reduced to zero (constant speed) as shown in the diagram below.

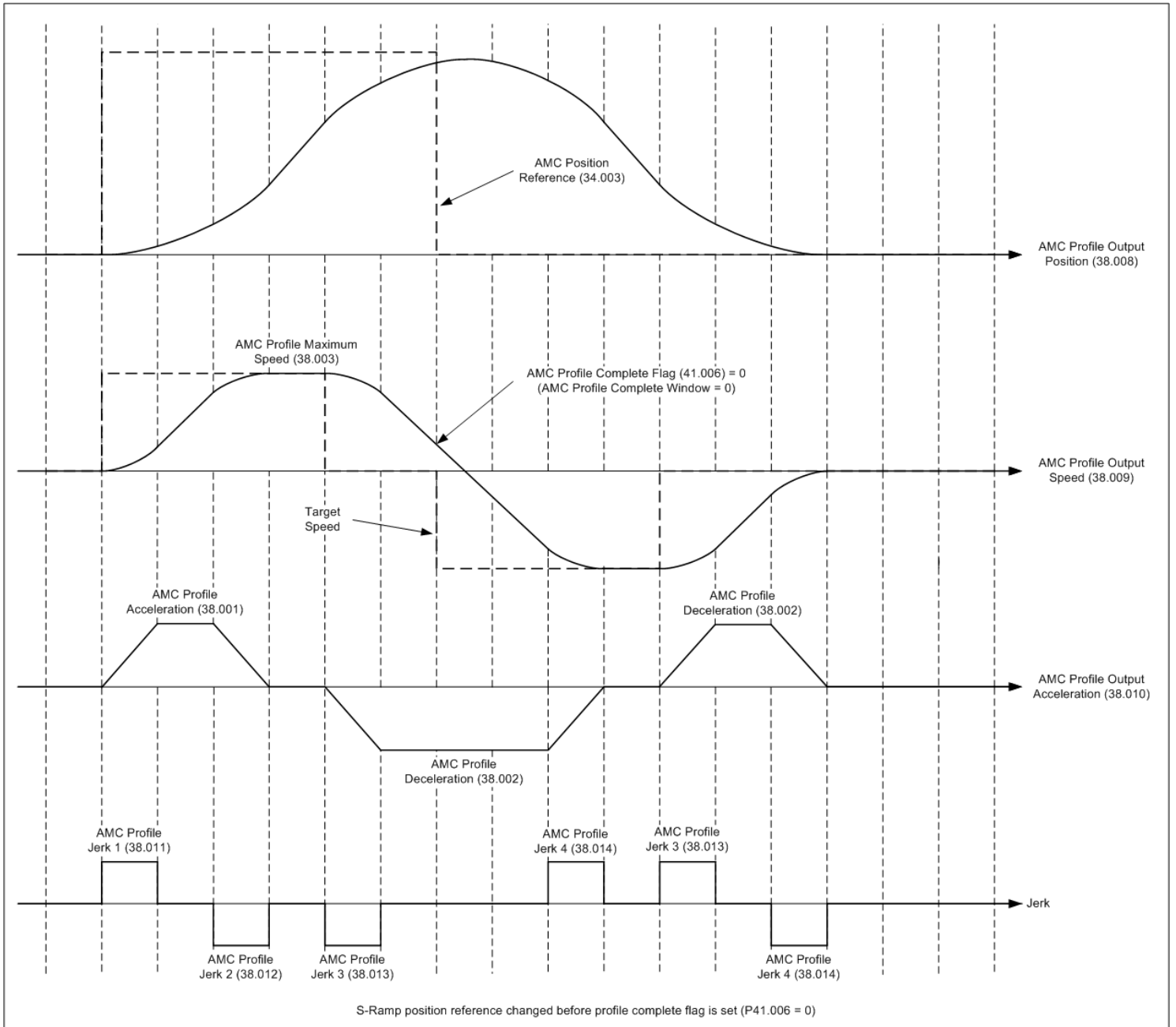


The above description also applies when the s-ramp is operating in position mode. If AMC Profile Input Position (38.006) is changed when the output of the profile is at standstill (AMC Profile Output Speed (38.009) and AMC Profile Output Acceleration (38.010) = 0) the profile will accelerate to the target speed under the constraints of AMC Profile Acceleration (38.001), AMC Profile Jerk 1 (38.011) and AMC Profile Jerk 2 (38.012) and decelerate to zero speed under the constraints of AMC Profile Deceleration (38.002), AMC Profile Jerk 3 (38.013) and AMC Profile Jerk 4 (38.014). This is shown in the diagram below. Note that when AMC Profile Complete Window (41.005) is set to zero AMC Profile Complete Flag (41.006) can be used to detect when the output of the profile has reached the target position and is at standstill.





If *AMC Profile Input Position (38.006)* is changed before the profile has been completed and *AMC Profile Output Speed (38.009)* must cross the zero boundary to reach the new target speed the profile will be constrained by the deceleration parameters for the entire movement as shown in the diagram below.



| Parameter         | 38.012 AMC Profile Jerk 2 |                |                      |
|-------------------|---------------------------|----------------|----------------------|
| Short description |                           |                |                      |
| Mode              | RFC-A                     |                |                      |
| Minimum           | -VM_AMC_JERK_UNIPOLAR     | Maximum        | VM_AMC_JERK_UNIPOLAR |
| Default           | 0.0000                    | Units          | UU/ms <sup>3</sup>   |
| Type              | 32 Bit User Save          | Update Rate    | Background read      |
| Display Format    | Standard                  | Decimal Places | 4                    |
| Coding            | RW, VM                    |                |                      |

See AMC Profile Jerk 1 (38.011).

| Parameter         | 38.013 AMC Profile Jerk 3 |                |                      |
|-------------------|---------------------------|----------------|----------------------|
| Short description |                           |                |                      |
| Mode              | RFC-A                     |                |                      |
| Minimum           | -VM_AMC_JERK_UNIPOLAR     | Maximum        | VM_AMC_JERK_UNIPOLAR |
| Default           | 0.0000                    | Units          | UU/ms <sup>3</sup>   |
| Type              | 32 Bit User Save          | Update Rate    | Background read      |
| Display Format    | Standard                  | Decimal Places | 4                    |
| Coding            | RW, VM                    |                |                      |

See AMC Profile Jerk 1 (38.011).

| Parameter         | 38.014 AMC Profile Jerk 4 |                |                      |
|-------------------|---------------------------|----------------|----------------------|
| Short description |                           |                |                      |
| Mode              | RFC-A                     |                |                      |
| Minimum           | -VM_AMC_JERK_UNIPOLAR     | Maximum        | VM_AMC_JERK_UNIPOLAR |
| Default           | 0.0000                    | Units          | UU/ms <sup>3</sup>   |
| Type              | 32 Bit User Save          | Update Rate    | Background read      |
| Display Format    | Standard                  | Decimal Places | 4                    |
| Coding            | RW, VM                    |                |                      |

See AMC Profile Jerk 1 (38.011).

|                   |                                       |                |                 |
|-------------------|---------------------------------------|----------------|-----------------|
| <b>Parameter</b>  | <b>38.015 AMC Profile Update Mode</b> |                |                 |
| Short description |                                       |                |                 |
| Mode              | RFC-A                                 |                |                 |
| Minimum           | 0                                     | Maximum        | 1               |
| Default           | 1                                     | Units          |                 |
| Type              | 8 Bit User Save                       | Update Rate    | Background read |
| Display Format    | Standard                              | Decimal Places | 0               |
| Coding            | RW                                    |                |                 |

AMC Profile Update Mode (38.015) can be used to select when a change to the profile acceleration, deceleration or jerk parameter is applied to the profile generator.

| AMC Profile Update Mode (38.015) | Profile update   | Ramp type              |
|----------------------------------|--|------------------------|
| 0                                | Profile acceleration, deceleration and jerk values are updated in the sample after the parameter has been read by the drive.   | Linear ramp and S-ramp |
| 1                                | When the s-ramp profile is enabled ( <i>AMC Profile Jerk 1</i> (38.011) > 0) the profile acceleration, deceleration and jerk values are only updated when the output of the profile generator is at standstill (speed and acceleration = 0). This prevents a change to the profile constraints causing an overshoot of the target speed or position. Note that an overshoot can still occur if the target speed or position is changed when the profile generator is not at standstill. If the profile generator is disabled (see the introduction to menu 38) or the linear ramp is enabled the profile parameters are updated as described in the previous mode. | S-ramp                 |

## Menu 39 Single Line Descriptions – AMC Position Control Loop

Mode: RFC-A

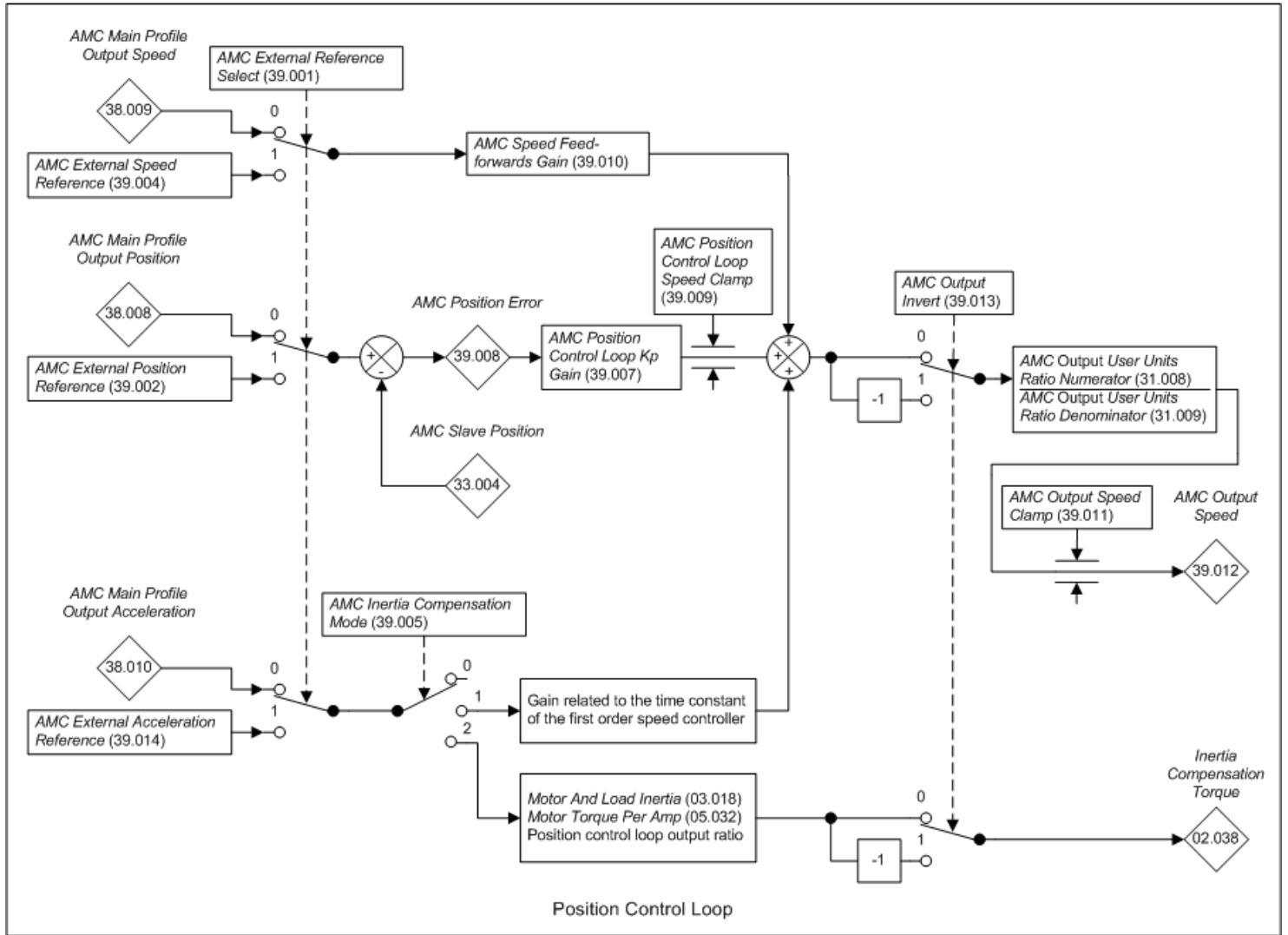
| Parameter |                                       | Range                                  | Default                  | Type |     |    |    |    |    |
|-----------|---------------------------------------|--|--------------------------|------|-----|----|----|----|----|
| 39.001    | AMC External Reference Select         | Off (0) or On (1)                      | Off (0)                  | RW   | Bit |    |    |    | US |
| 39.002    | AMC External Position Reference       | -2147483648 to 2147483647 UU           | 0 UU                     | RW   | Num |    |    |    |    |
| 39.004    | AMC External Speed Reference          | ±VM_AMC_SPEED UU/ms                    | 0.00 UU/ms               | RW   | Num |    |    |    |    |
| 39.005    | AMC Inertia Compensation Mode         | None (0), Acceleration (1), Torque (2) | None (0)                 | RW   | Txt |    |    |    | US |
| 39.007    | AMC Position Control Loop Kp Gain     | 0.000 to 500.000                       | 25.000                   | RW   | Num |    |    |    | US |
| 39.008    | AMC Position Error                    | ±VM_AMC_POSITION UU                    |                          | RO   | Num | ND | NC | PT | FI |
| 39.009    | AMC Position Control Loop Speed Clamp | ±VM_AMC_SPEED_UNIPOLAR UU/ms           | 109.20 UU/ms             | RW   | Num |    |    |    | US |
| 39.010    | AMC Speed Feed-forwards Gain          | 0.000 to 2.000                         | 1.000                    | RW   | Num |    |    |    | US |
| 39.011    | AMC Output Speed Clamp                | ±VM_SPEED_FREQ_REF                     | 1000.0                   | RW   | Num |    |    |    | US |
| 39.012    | AMC Output Speed                      | ±VM_SPEED_FREQ_REF                     |                          | RO   | Num | ND | NC | PT | FI |
| 39.013    | AMC Output Invert                     | Off (0) or On (1)                      | Off (0)                  | RW   | Bit |    |    |    | US |
| 39.014    | AMC External Acceleration Reference   | ±VM_AMC_RATE UU/ms <sup>2</sup>        | 0.000 UU/ms <sup>2</sup> | RW   | Num |    |    |    |    |
| 39.015    | AMC External Reference Mode           | 0 to 1                                 | 0                        | RW   | Num |    |    |    | US |
| 39.016    | AMC External Control State            | 0 to 17                                |                          | RO   | Num | ND | NC | PT |    |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 39 – AMC Position Control Loop

Mode: RFC-A

## Position control loop



| Parameter         | 39.001 AMC External Reference Select |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description |                                      |                |                 |
| Mode              | RFC-A                                |                |                 |
| Minimum           | 0                                    | Maximum        | 1               |
| Default           | 0                                    | Units          |                 |
| Type              | 1 Bit User Save                      | Update Rate    | Background read |
| Display Format    | Standard                             | Decimal Places | 0               |
| Coding            | RW                                   |                |                 |

If *AMC External Reference Select* (39.001) = 0 the position, speed and acceleration reference for the position control loop are taken from the output of the profile generator. However, it is possible to provide these references from an external application (i.e. an applications category module program). If *AMC External Reference Select* (39.001) = 1 the position reference is taken from *AMC External Position Reference* (39.002), the speed reference is taken from *AMC External Speed Reference* (39.004) and the acceleration reference is taken from *AMC External Acceleration Reference* (39.014).

| Parameter         | 39.002 AMC External Position Reference |                |                      |
|-------------------|--|----------------|----------------------|
| Short description |  |                |                      |
| Mode              | RFC-A                                  |                |                      |
| Minimum           | -2147483648                            | Maximum        | 2147483647           |
| Default           | 0                                      | Units          | UU                   |
| Type              | 32 Bit Volatile                        | Update Rate    | AMC sample rate read |
| Display Format    | Standard                               | Decimal Places | 0                    |
| Coding            | RW                                     |                |                      |

See *AMC External Reference Select* (39.001).

| Parameter         | 39.004 AMC External Speed Reference |                |                      |
|-------------------|-------------------------------------|----------------|----------------------|
| Short description |                                     |                |                      |
| Mode              | RFC-A                               |                |                      |
| Minimum           | -VM_AMC_SPEED                       | Maximum        | VM_AMC_SPEED         |
| Default           | 0.00                                | Units          | UU/ms                |
| Type              | 32 Bit Volatile                     | Update Rate    | AMC sample rate read |
| Display Format    | Standard                            | Decimal Places | 2                    |
| Coding            | RW, VM                              |                |                      |

See *AMC External Reference Select* (39.001).

| Parameter         | 39.005 AMC Inertia Compensation Mode |                |                 |
|-------------------|--------------------------------------|----------------|-----------------|
| Short description |                                      |                |                 |
| Mode              | RFC-A                                |                |                 |
| Minimum           | 0                                    | Maximum        | 2               |
| Default           | 0                                    | Units          |                 |
| Type              | 8 Bit User Save                      | Update Rate    | Background read |
| Display Format    | Standard                             | Decimal Places | 0               |
| Coding            | RW, TE                               |                |                 |

| Value | Text         |
|-------|--------------|
| 0     | None         |
| 1     | Acceleration |
| 2     | Torque       |

*AMC Inertia Compensation Mode* (39.005) selects the inertia compensation mode as shown below.

#### 0 (None)

No inertia compensation.

#### 1 (Acceleration feed-forwards)

When acceleration feed-forwards is selected a gain term is automatically calculated based on the currently active drive speed controller gains, *Motor And Load Inertia* (03.018) and *Torque Per Amp* (05.032). The acceleration feed-forwards term is intended to cancel the effect of the speed controller time constant and give a faster position control loop response. The acceleration feed-forwards term is only compatible with a first order speed controller, i.e. *Speed Controller Set-up Method* (03.017) = 7.

#### 2 (Torque feed-forwards)

When torque feed-forwards is selected the acceleration from the profile generator is used to define the torque feed-forwards. The *Motor And Load Inertia* (03.018), *Torque Per Amp* (05.032) and the output user units ratio are used to convert from acceleration to torque. It should be noted that the *Inertia Compensation Torque* (02.038) is added to the output of the speed controller when *Inertia Compensation Enable* (04.022) = 1.

| Parameter         | 39.007 AMC Position Control Loop Kp Gain |                |                 |
|-------------------|--|----------------|-----------------|
| Short description |  |                |                 |
| Mode              | RFC-A                                    |                |                 |
| Minimum           | 0.000                                    | Maximum        | 500.000         |
| Default           | 25.000                                   | Units          |                 |
| Type              | 32 Bit User Save                         | Update Rate    | Background read |
| Display Format    | Standard                                 | Decimal Places | 3               |
| Coding            | RW                                       |                |                 |

*AMC Position Control Loop Kp Gain* (39.007) is the proportional gain with units of (User units/s) / User units. A *AMC Position Control Loop Kp Gain* (39.007) of unity and a *AMC Position Error* (39.008) of one User unit will give a position control loop speed of 1 User unit/s.

| Parameter         | 39.008 AMC Position Error |                |                 |
|-------------------|---------------------------|----------------|-----------------|
| Short description |                           |                |                 |
| Mode              | RFC-A                     |                |                 |
| Minimum           | -VM_AMC_POSITION          | Maximum        | VM_AMC_POSITION |
| Default           |                           | Units          | UU              |
| Type              | 32 Bit Volatile           | Update Rate    | 4ms write       |
| Display Format    | Standard                  | Decimal Places | 0               |
| Coding            | RO, FI, VM, ND, NC, PT    |                |                 |

*AMC Position Error* (39.008) gives the difference between the final position reference and the *AMC Slave Position* (33.004) in User units.

| Parameter         | 39.009 AMC Position Control Loop Speed Clamp |                |                       |
|-------------------|--|----------------|-----------------------|
| Short description |  |                |                       |
| Mode              | RFC-A  |                |                       |
| Minimum           | 0.00   | Maximum        | VM_AMC_SPEED_UNIPOLAR |
| Default           | 109.20                                       | Units          | UU/ms                 |
| Type              | 32 Bit User Save                             | Update Rate    | Background read       |
| Display Format    | Standard                                     | Decimal Places | 2                     |
| Coding            | RW, VM                                       |                |                       |

The default value of 109.2 UU/ms is the equivalent of 100rpm for a feedback device with 16 normalised position bits per revolution and a user unit ratio of unity.

The *AMC Position Control Loop Speed Clamp* (39.009) defines the maximum positive or negative speed output from the position control loop in User units/ms.

| Parameter         | 39.010 AMC Speed Feed-forwards Gain |                |                 |
|-------------------|-------------------------------------|----------------|-----------------|
| Short description |                                     |                |                 |
| Mode              | RFC-A                               |                |                 |
| Minimum           | 0.000                               | Maximum        | 2.000           |
| Default           | 1.000                               | Units          |                 |
| Type              | 16 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                            | Decimal Places | 3               |
| Coding            | RW                                  |                |                 |

Normally the speed feed-forwards is used directly to provide the speed reference for the drive, with the position controller used as a trim to compensate for system and load effects to give the correct position. The default value of *AMC Speed Feed-forwards Gain* (39.010) is unity, but in some applications it may be necessary to reduce the speed feed-forward component to reduce overshoot.

| Parameter         | 39.011 AMC Output Speed Clamp |                |                   |
|-------------------|-------------------------------|----------------|-------------------|
| Short description |                               |                |                   |
| Mode              | RFC-A                         |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF            | Maximum        | VM_SPEED_FREQ_REF |
| Default           | 1000.0                        | Units          |                   |
| Type              | 32 Bit User Save              | Update Rate    | Background read   |
| Display Format    | Standard                      | Decimal Places | 1                 |
| Coding            | RW, VM                        |                |                   |

*AMC Output Speed Clamp* (39.011) provides a final clamp on the output speed in drive speed parameter units (i.e. rpm or mm/s).

| Parameter         | 39.012 AMC Output Speed |                |                   |
|-------------------|-------------------------|----------------|-------------------|
| Short description |                         |                |                   |
| Mode              | RFC-A                   |                |                   |
| Minimum           | -VM_SPEED_FREQ_REF      | Maximum        | VM_SPEED_FREQ_REF |
| Default           |                         | Units          |                   |
| Type              | 32 Bit Volatile         | Update Rate    | 4ms write         |
| Display Format    | Standard                | Decimal Places | 1                 |
| Coding            | RO, FI, VM, ND, NC, PT  |                |                   |

*AMC Output Speed* (39.012) is the final output from the Advanced Motion Controller in 0.1rpm or 0.1mm/s. Although the update rate for this parameter is 4ms the output speed is written to the *Hard Speed Reference* (03.022) at the sample rate selected in *AMC Rate Select* (31.012). The output speed is written in internal units ( $2^{32} \text{cpr}/250\mu\text{s}$ ) to increase the maximum speed resolution to  $5.59\text{e}^{-5} \text{rpm}$  or Pole Pitch  $\times 9.31\text{e}^{-7} \text{mm/s}$ .

| Parameter         | 39.013 AMC Output Invert                |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to invert the AMC output speed |                |                 |
| Mode              | RFC-A                                   |                |                 |
| Minimum           | 0                                       | Maximum        | 1               |
| Default           | 0                                       | Units          |                 |
| Type              | 1 Bit User Save                         | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW                                      |                |                 |

If *AMC Output Invert* (39.013) = 1 then *AMC Output Speed* (39.012) and the output torque (*AMC Inertia Compensation Mode* (39.005) = 2) is inverted.

| Parameter         | 39.014 AMC External Acceleration Reference |                |                      |
|-------------------|--|----------------|----------------------|
| Short description |  |                |                      |
| Mode              | RFC-A                                      |                |                      |
| Minimum           | -VM_AMC_RATE                               | Maximum        | VM_AMC_RATE          |
| Default           | 0.000                                      | Units          | UU/ms <sup>2</sup>   |
| Type              | 32 Bit Volatile                            | Update Rate    | AMC sample rate read |
| Display Format    | Standard                                   | Decimal Places | 3                    |
| Coding            | RW, VM                                     |                |                      |

See *AMC External Reference Select* (39.001).

| Parameter         | 39.015 AMC External Reference Mode |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description |                                    |                |                 |
| Mode              | RFC-A                              |                |                 |
| Minimum           | 0                                  | Maximum        | 1               |
| Default           | 0                                  | Units          |                 |
| Type              | 8 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW                                 |                |                 |

*AMC External Reference Mode* (39.015) can be used to modify the operation of the Advanced Motion Controller when an external profile generator is being used to provide the references for the position control loop. When an external profile is used it is important that the profile is always synchronised to *AMC Slave Position* (33.004) and the outputs of the profile are written to the external references before the drive is enabled. If this is not done the position error may cause the slave to move.

If *AMC External Reference Mode* (39.015) = 0 the external references are always used when selected (*AMC External Reference Select* (39.001) = 1) and no other changes are made to the operation of the Advanced Motion Controller.

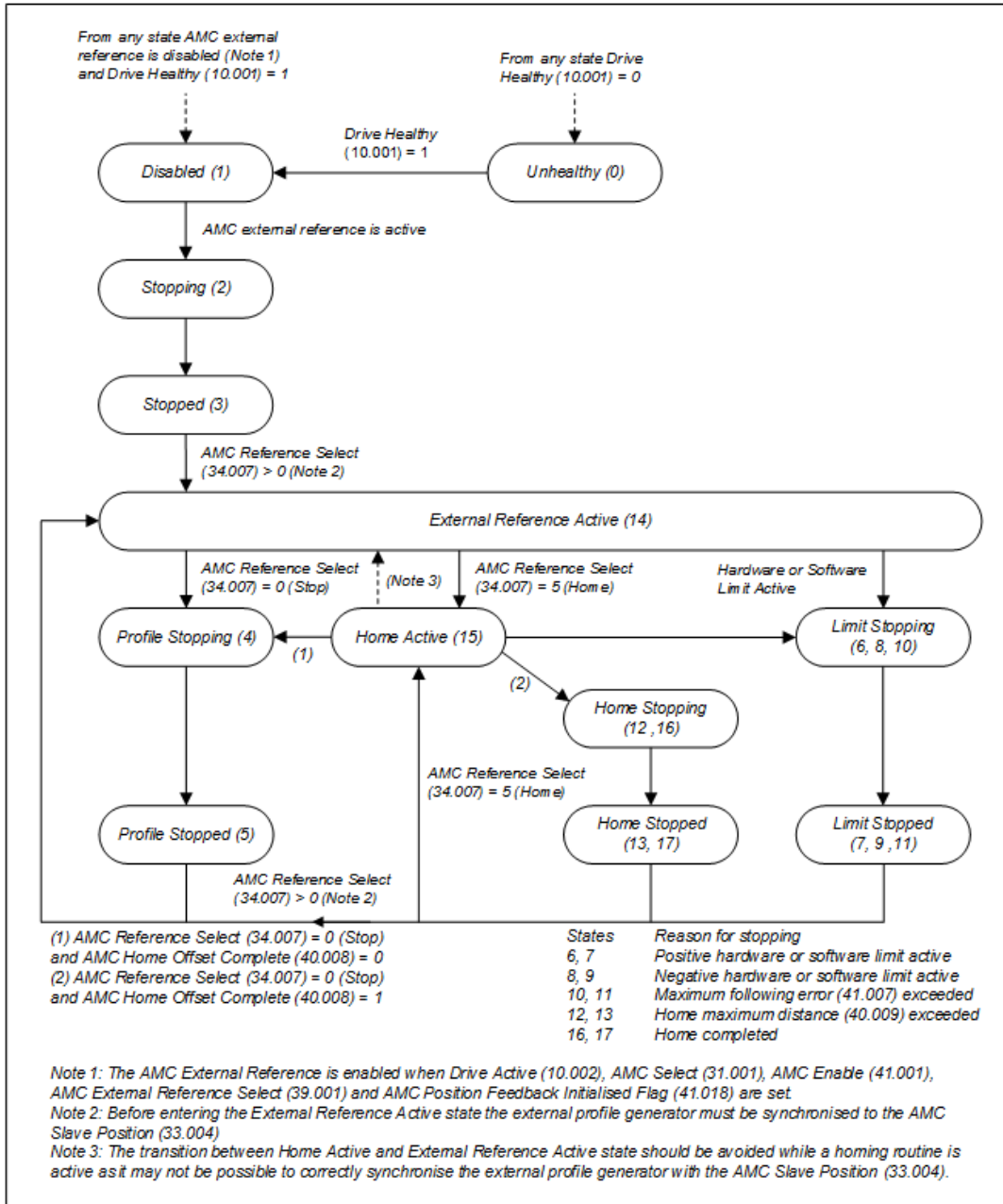
If *AMC External Reference Mode* (39.015) = 1 the following apply when the external references are selected. This mode of operation is intended to be used with an external motion controller, such as the MCi option module.

1. The state machine described in *AMC External Control State* (39.016) is enabled. *AMC External Control State* (39.016) provides the state of the drive (unhealthy or disabled), indicates the active reference, the status of a homing routine and if an error has occurred, i.e. the stop reference has been selected while the external reference or homing routine was active, a limits has become active, etc. To synchronise the external profile with the slave position *AMC External Control State* (39.016) should be in one of the stopped states. In a stopped state the reference selector is set to stop and *AMC Profile Input Position* (38.006) = *AMC Profile Output Position* (38.008) which ensures that the external profile can be updated without introducing a position error when the external reference is activated.
2. The external references are not used when *AMC Reference Select* (34.007) is set to stop or home. This allows the on-board profile generator to perform a stop or homing routine without having to change *AMC External Reference Select* (39.001).

- When the external references are being used the outputs of the on-board profile generator are set to the slave position, speed and acceleration. This allows the stop reference to be selected while the slave is moving and for a ramped stop to be performed.
- AMC Reference Select (34.007) is set to stop when the drive is disabled. This ensures that the slave will be held at the slave position until the external profile is synchronised and is ready to provide the external reference.
- AMC Profile Input Position (38.006) displays the rollover position when rollover mode is enabled (*AMC Profile Output Position* (38.008) > 0). This allows the external profile to be synchronised with the internal (*AMC Profile Output Position* (38.008)) and rollover (*AMC Slave Position* (33.004)) positions.
- If a hardware or software limit is active and the output speed due to the position error or velocity feedforwards is towards the active limit *AMC Output Speed* (39.012) is set to zero and *AMC Reference Select* (34.007) is set to stop.

| Parameter         | 39.016 AMC External Control State |                |           |
|-------------------|-----------------------------------|----------------|-----------|
| Short description |                                   |                |           |
| Mode              | RFC-A                             |                |           |
| Minimum           | 0                                 | Maximum        | 17        |
| Default           |                                   | Units          |           |
| Type              | 8 Bit Volatile                    | Update Rate    | 4ms write |
| Display Format    | Standard                          | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                    |                |           |

AMC External Control State (39.016) shows the current state of the state machine shown in the diagram below. This state machine is active when AMC External Reference Mode (39.015) is set. See AMC External Reference Mode (39.015) for a description of how the state machine is used.





# Menu 40 Single Line Descriptions – AMC Homing System

Mode: RFC-A

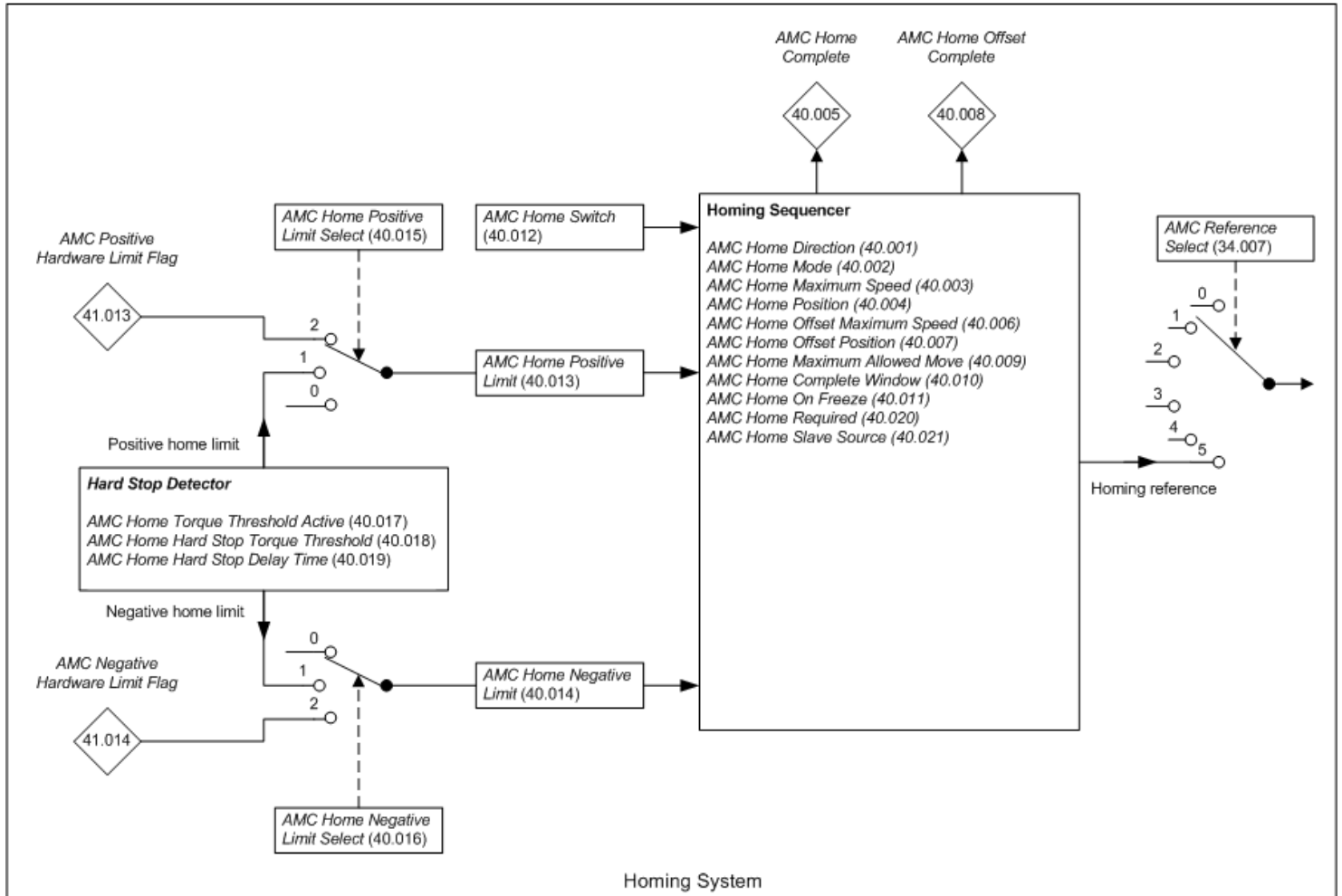
| Parameter |                                     | Range   | Default       | Type |     |    |    |    |    |
|-----------|-------------------------------------|---|---------------|------|-----|----|----|----|----|
| 40.001    | AMC Home Direction                  | Off (0) or On (1)   | Off (0)       | RW   | Bit |    |    |    | US |
| 40.002    | AMC Home Mode                       | 0 to 9  | 0             | RW   | Num |    |    |    | US |
| 40.003    | AMC Home Maximum Speed              | ±VM_AMC_SPEED_UNIPOLAR UU/ms  | 10.92 UU/ms   | RW   | Num |    |    |    | US |
| 40.004    | AMC Home Position                   | ±VM_AMC_POSITION UU   | 0 UU          | RW   | Num |    |    |    | US |
| 40.005    | AMC Home Complete                   | Off (0) or On (1)   |               | RO   | Bit | ND | NC | PT |    |
| 40.006    | AMC Home Offset Maximum Speed       | ±VM_AMC_SPEED_UNIPOLAR UU/ms  | 10.92 UU/ms   | RW   | Num |    |    |    | US |
| 40.007    | AMC Home Offset Position            | ±VM_AMC_POSITION UU   | 0 UU          | RW   | Num |    |    |    | US |
| 40.008    | AMC Home Offset Complete            | Off (0) or On (1)   |               | RO   | Bit | ND | NC | PT |    |
| 40.009    | AMC Home Maximum Allowed Move       | 0 to VM_AMC_POSITION_UNIPOLAR UU  | 0 UU          | RW   | Num |    |    |    | US |
| 40.010    | AMC Home Complete Window            | 0 to VM_AMC_POSITION_UNIPOLAR UU  | 0 UU          | RW   | Num |    |    |    | US |
| 40.011    | AMC Home On Freeze                  | Off (0) or On (1)   | Off (0)       | RW   | Bit |    |    |    | US |
| 40.012    | AMC Home Switch                     | Off (0) or On (1)   | Off (0)       | RW   | Bit |    | NC |    |    |
| 40.013    | AMC Home Positive Limit             | Off (0) or On (1)   | Off (0)       | RW   | Bit |    | NC |    |    |
| 40.014    | AMC Home Negative Limit             | Off (0) or On (1)   | Off (0)       | RW   | Bit |    | NC |    |    |
| 40.015    | AMC Home Positive Limit Selector    | 0 to 2  | 0             | RW   | Num |    |    |    | US |
| 40.016    | AMC Home Negative Limit Selector    | 0 to 2  | 0             | RW   | Num |    |    |    | US |
| 40.017    | AMC Home Torque Limit Active        | Off (0) or On (1)   |               | RO   | Bit | ND | NC | PT |    |
| 40.018    | AMC Home Hard Stop Torque Threshold | 0.0 to 1000.0 %   | 0.0 %         | RW   | Num |    |    |    | US |
| 40.019    | AMC Home Hard Stop Delay Time       | 0.000 to 60.000 s   | 0.000 s       | RW   | Num |    |    |    | US |
| 40.020    | AMC Home Required                   | Off (0) or On (1)   | Off (0)       | RW   | Bit |    |    |    | US |
| 40.021    | AMC Home Slave Source               | None (-1), User Position (0),<br>Sensorless (1), P1 Drive (2), P2 Drive (3),<br>P1 Slot1 (4), P2 Slot1 (5), P1 Slot2 (6),<br>P2 Slot2 (7), P1 Slot3 (8), P2 Slot3 (9) | None (-1)     | RW   | Txt |    |    |    | US |
| 40.022    | AMC Home Mode Setup                 | 0000000000000 to 1111111111111  | 0000000000000 | RW   | Bin |    | NC |    | US |
| 40.023    | AMC Home Restart                    | Off (0) or On (1)   | Off (0)       | RW   | Bit |    | NC |    |    |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| Fl  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 40 – AMC Homing System

Mode: RFC-A

## Homing system



| Parameter         | 40.001 AMC Home Direction |                |                 |
|-------------------|---------------------------|----------------|-----------------|
| Short description |                           |                |                 |
| Mode              | RFC-A                     |                |                 |
| Minimum           | 0                         | Maximum        | 1               |
| Default           | 0                         | Units          |                 |
| Type              | 1 Bit User Save           | Update Rate    | Background read |
| Display Format    | Standard                  | Decimal Places | 0               |
| Coding            | RW                        |                |                 |

The *AMC Home Direction* (40.001) is used to select the direction of movement to the freeze input associated with the slave position source, where 0 is forwards and 1 is backwards.

| Parameter         | 40.002 AMC Home Mode |                |                 |
|-------------------|----------------------|----------------|-----------------|
| Short description |                      |                |                 |
| Mode              | RFC-A                |                |                 |
| Minimum           | 0                    | Maximum        | 9               |
| Default           | 0                    | Units          |                 |
| Type              | 8 Bit User Save      | Update Rate    | Background read |
| Display Format    | Standard             | Decimal Places | 0               |
| Coding            | RW                   |                |                 |

The homing sequence always runs at a sample rate of 4ms and cannot be changed using *AMC Rate Select* (31.012). Homing begins when *AMC Reference Select* (34.007) is set to 5 and the motion controller is enabled. The following sequence then occurs.

### Homing Phase

1. *AMC Home Complete* (40.005) and *AMC Home Offset Complete* (40.008) are reset to 0
2. A speed reference with a magnitude defined by *AMC Home Maximum Speed* (40.003) is applied to the profile generator until the home position is detected. During the homing phase the direction of movement is controlled by *AMC Home Mode* (40.002) and *AMC Home Direction* (40.001).
3. If *AMC Home On Freeze* (40.011) = 1 the home position is set to the *AMC Slave Freeze Position* (33.006) or when *AMC Home On Freeze* (40.011) = 0 the home position is set to *AMC Slave Position* (33.004) in the sample after the home event, i.e. the correct transition has been detected.
4. The difference between *AMC Home Position* (40.004) and the home position above is added to *AMC Slave Offset* (33.003). This has the effect of making *AMC Slave Position* (33.004) equal to *AMC Home Position* (40.004) at the physical home position. The profile output position is automatically adjusted to prevent any position transients.
5. *AMC Home Complete* (40.005) is set to 1.

### Reset Phase

1. The homing reference becomes a position reference instead of a speed reference and the target position is set to *AMC Home Position* (40.004) + *AMC Home Offset Position* (40.007). The system will move towards the position reference, which is the position relative to the home position, with the maximum speed limited to *AMC Home Offset Maximum Speed* (40.006).
2. *AMC Home Offset Complete* (40.008) is set to 1 and *AMC Reference Select* (34.007) is set to 0 when  $[(AMC Home Position (40.004) + AMC Home Offset Position (40.007)) - AMC Slave Position (33.004)] \leq AMC Home Complete Window (40.010)$ .

The table below shows a summary of the actions performed by *AMC Home Switch* (40.012), *AMC Home Positive Limit* (40.013) and *AMC Home Negative Limit* (40.014) in each mode. If the positive or negative limits are not required to complete the homing sequence and a limit is reached (state = 1) before the home position has been detected or while moving to the reset position then *AMC Reference Select* (34.007) is set to 0 (stop) to force the system to stop.

| <b>AMC Home Mode (40.002)</b> | <b>Slave Freeze Flag</b>  | <b>AMC Home Switch (40.012)</b>   | <b>AMC Home Positive Limit (40.013)</b>   | <b>AMC Home Negative Limit (40.014)</b>   |
|-------------------------------|---|---|---|---|
| 0                             | Not used  | Home position = <i>AMC Slave Position</i> (33.004)                                    | Home backwards  | Home forwards   |
| 1                             | Home position = <i>AMC Slave Position</i> (33.004)                                    | Not used  | Force stop*   | Force stop*   |
| 2                             | Home position = <i>AMC Slave Position</i> (33.004) when <i>AMC Home On Freeze</i> = 1 | Not used  | Home position = <i>AMC Slave Position</i> (33.004) when <i>AMC Home On Freeze</i> = 0 | Force stop*   |
| 3                             | Home position = <i>AMC Slave Position</i> (33.004) when <i>AMC Home On Freeze</i> = 1 | Not used  | Force stop*   | Home position = <i>AMC Slave Position</i> (33.004) when <i>AMC Home On Freeze</i> = 0 |
| 4                             | Home position = <i>AMC Slave Position</i> (33.004) when <i>AMC Home On Freeze</i> = 1 | Home position = <i>AMC Slave Position</i> (33.004) when <i>AMC Home On Freeze</i> = 0 | Force stop*   | Force stop*   |
| 5                             | Home position = <i>AMC Slave Position</i> (33.004) when <i>AMC Home On Freeze</i> = 1 | Home position = <i>AMC Slave Position</i> (33.004) when <i>AMC Home On Freeze</i> = 0 | Home backwards  | Force stop*   |
| 6                             | Home position = <i>AMC Slave Position</i> (33.004) when <i>AMC Home On Freeze</i> = 1 | Home position = <i>AMC Slave Position</i> (33.004) when <i>AMC Home On Freeze</i> = 0 | Home backwards  | Force stop*   |
| 7                             | Home position = <i>AMC Slave Position</i> (33.004) when <i>AMC Home On Freeze</i> = 1 | Home position = <i>AMC Slave Position</i> (33.004) when <i>AMC Home On Freeze</i> = 0 | Force stop*   | Home forwards   |
| 8                             | Home position = <i>AMC Slave Position</i> (33.004) when <i>AMC Home On Freeze</i> = 1 | Home position = <i>AMC Slave Position</i> (33.004) when <i>AMC Home On Freeze</i> = 0 | Force stop*   | Home forwards   |
| 9                             | Refer to description for <i>AMC Home Mode Setup</i> (40.022)                          |   |   |   |

\* If the limit becomes active during the homing sequence *AMC Reference Select* (34.007) is set to 0 and the slave will stop under the constraints defined by *AMC Stop Mode* (34.001).

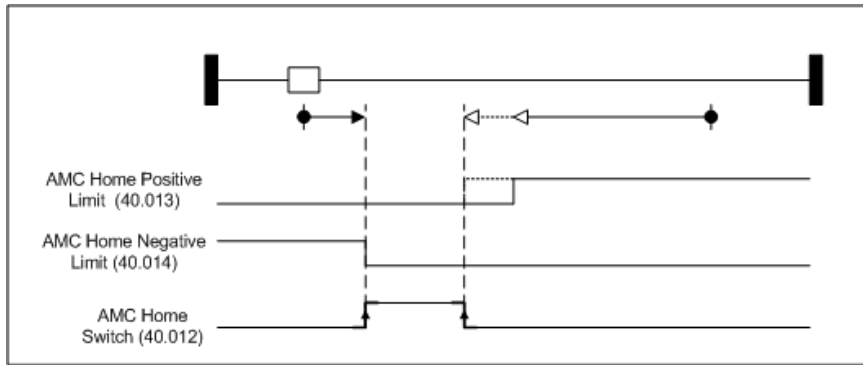
If the freeze flag for the slave source is used as the home event the home position is set to *AMC Slave Freeze Position* (33.006) and *AMC Home Maximum Speed* (40.003) will not have any influence on the accuracy of the home position. However, if *AMC Home Switch* (40.012) is used as the home event the home position is set to *AMC Slave Position* (33.004) in the sample after the home event occurs. The time between when the home event occurs and the home position is set to *AMC Slave Position* (33.004) will be no more than one complete sample (4ms) and the home position will be within  $4ms \times AMC Home Maximum Speed (40.003)$  of the physical home position.

## Homing Modes

The direction of movement during the homing sequence is controlled by *AMC Home Mode* (40.002) and *AMC Home Direction* (40.001). The homing sequence for each mode is described in more detail below. In each example it is assumed that the slave feedback device is connected to the drives P1 interface and uses *F1 Freeze Flag* (03.104) as the freeze source. The actual freeze flag used during the homing sequence is defined by *AMC Slave Source Select* (33.001) and *AMC Slave Freeze Select* (33.007).

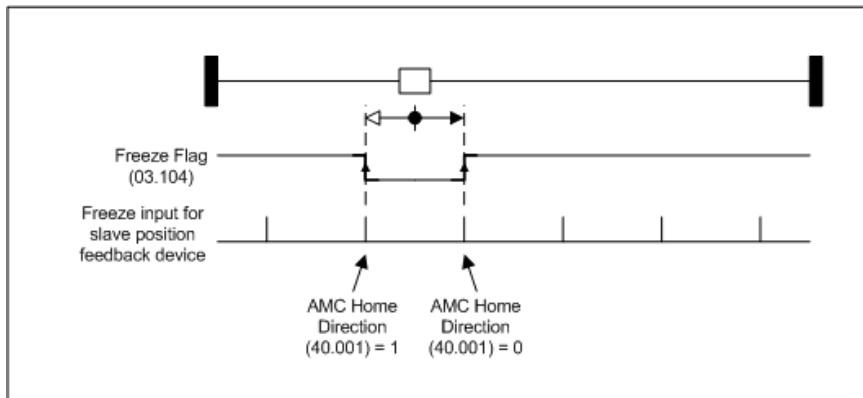
| Symbol | Description   |
|--------|---|
| ●      | Slave position at the beginning of the home sequence  |
| →      | Slave moving in a positive direction  |
| ←      | Slave moving in a negative direction  |
| ⬆      | Home to <i>AMC Home Switch</i> (40.012), <i>AMC Home Positive Limit</i> (40.013) or <i>AMC Home Negative Limit</i> (40.014) is complete when a positive transition is detected and the slave is moving in a positive direction or a negative transition is detected and the slave is moving in a negative direction |
| ⬆      | Home to <i>AMC Home Switch</i> (40.012), <i>AMC Home Positive Limit</i> (40.013) or <i>AMC Home Negative Limit</i> (40.014) is complete when a negative transition is detected and the slave is moving in a positive direction or a positive transition is detected and the slave is moving in a negative direction |
| ↑      | Positive freeze flag transition   |

### Mode 0 - Manual



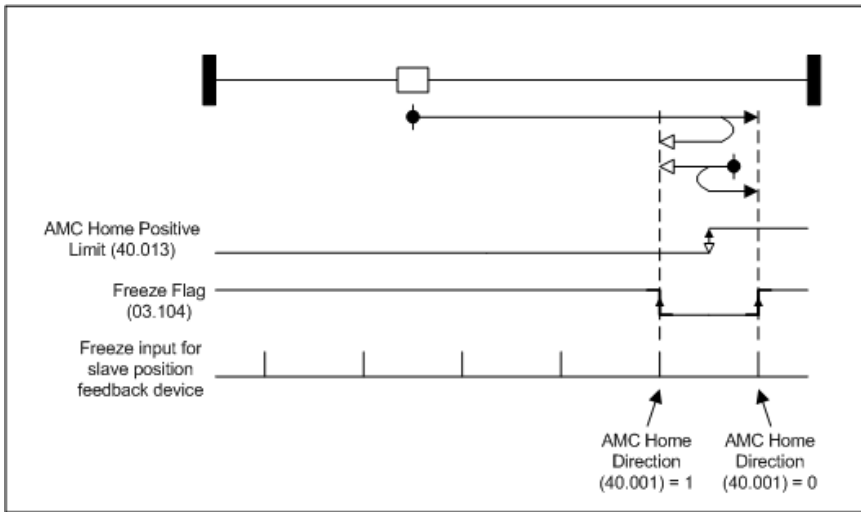
In manual mode the direction of movement is controlled by *AMC Home Positive Limit* (40.013) and *AMC Home Negative Limit* (40.014). When *AMC Home Negative Limit* (40.014) is set to 1 a positive homing reference is applied to the profile generator and when *AMC Home Positive Limit* (40.013) is set to 1 a negative reference is applied. If both limits are set at the same time the homing reference is set to 0 and the slave will profile to a stop. The home position is set to *AMC Slave Position* (33.004) when a positive transition of *AMC Home Switch* (40.012) is detected.

### Mode 1 - Home on freeze flag



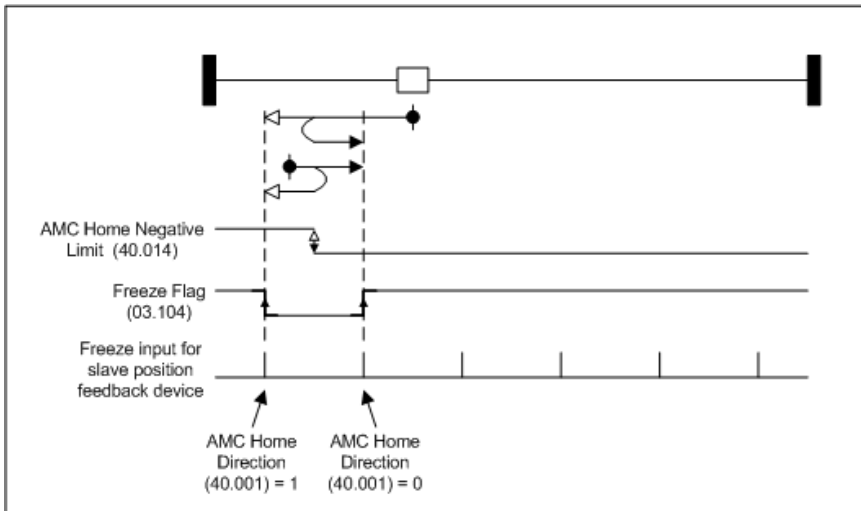
The slave will move in the direction defined by *AMC Home Direction* (40.001) until a positive transition of *F1 Freeze Flag* (03.104) is detected. The home position is then set to *AMC Slave Position* (33.004). Note that *F1 Freeze Flag* (03.104) is reset at the beginning of the homing sequence.

### Mode 2 - Home on positive limit



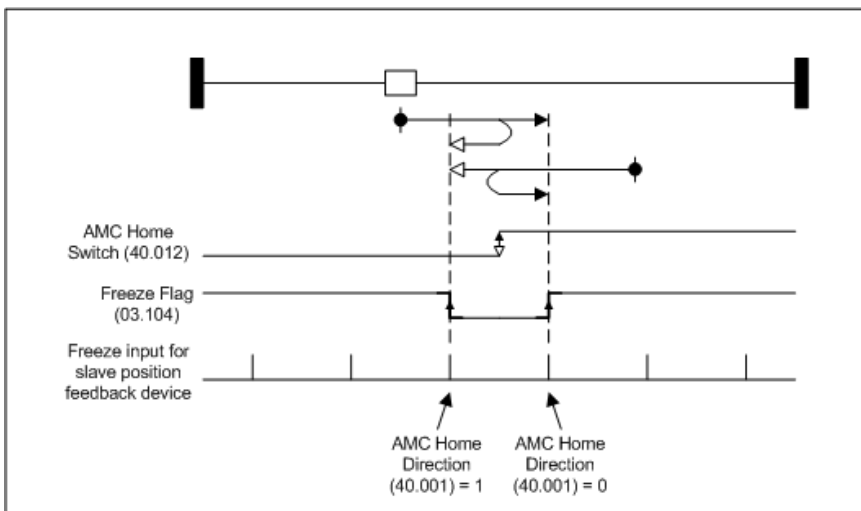
If *AMC Home Positive Limit* (40.013) = 0 when the homing sequence begins the slave will move forwards until a positive transition of *AMC Home Positive Limit* (40.013) is detected otherwise when *AMC Home Positive Limit* (40.013) = 1 the slave will move backwards until a negative transition of *AMC Home Positive Limit* (40.013) is detected. If *AMC Home On Freeze* (40.011) = 0 the home position is set to *AMC Slave Position* (33.004) at the transition of *AMC Home Positive Limit* (40.013) or when *AMC Home On Freeze* (40.011) = 1 the freeze flag is reset and the slave will move in the direction defined by *AMC Home Direction* (40.001) until a positive transition of *F1 Freeze Flag* (03.104) is detected. The home position is then set to *AMC Slave Freeze Position* (33.006).

#### Mode 3 - Home on negative limit



If *AMC Home Negative Limit* (40.014) = 0 when the homing sequence begins the slave will move backwards until a positive transition of *AMC Home Negative Limit* (40.014) is detected otherwise when *AMC Home Negative Limit* (40.014) = 1 the slave will move forwards until a negative transition of *AMC Home Negative Limit* (40.014) is detected. If *AMC Home On Freeze* (40.011) = 0 the home position is set to *AMC Slave Position* (33.004) at the transition of *AMC Home Negative Limit* (40.014) or when *AMC Home On Freeze* (40.011) = 1 the freeze flag is reset and the slave will move in the direction defined by *AMC Home Direction* (40.001) until a positive transition of *F1 Freeze Flag* (03.104) is detected. The home position is then set to *AMC Slave Freeze Position* (33.006).

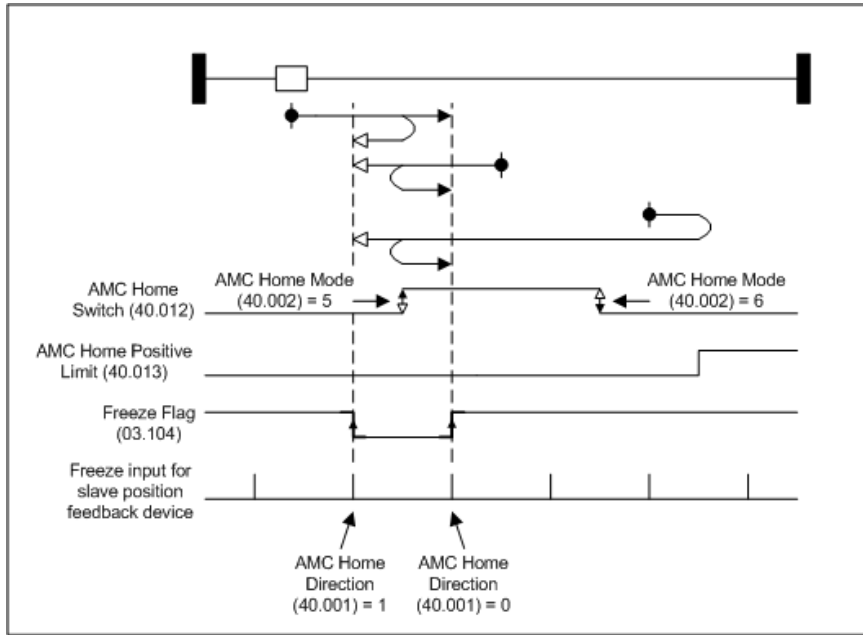
#### Mode 4 - Home on home switch



If *AMC Home Switch* (40.012) = 0 when the homing sequence begins the slave will move forwards until a positive transition of *AMC Home Switch* (40.012) is detected otherwise when *AMC Home Switch* (40.012) = 1 the slave will move backwards until a negative transition of *AMC Home Switch* (40.012) is detected. If *AMC Home On Freeze* (40.011) = 0 the home position is set to *AMC Slave Position* (33.004) at the transition of *AMC Home Switch* (40.012) or when *AMC Home On Freeze* (40.011) = 1 the freeze flag is reset and the slave will move in the direction defined by *AMC Home Direction* (40.001) until a positive transition of *F1 Freeze Flag* (03.104) is detected. The home position is then set to the *AMC Slave Freeze Position* (33.006).

#### Mode 5 and 6 - Home on home switch with positive limit

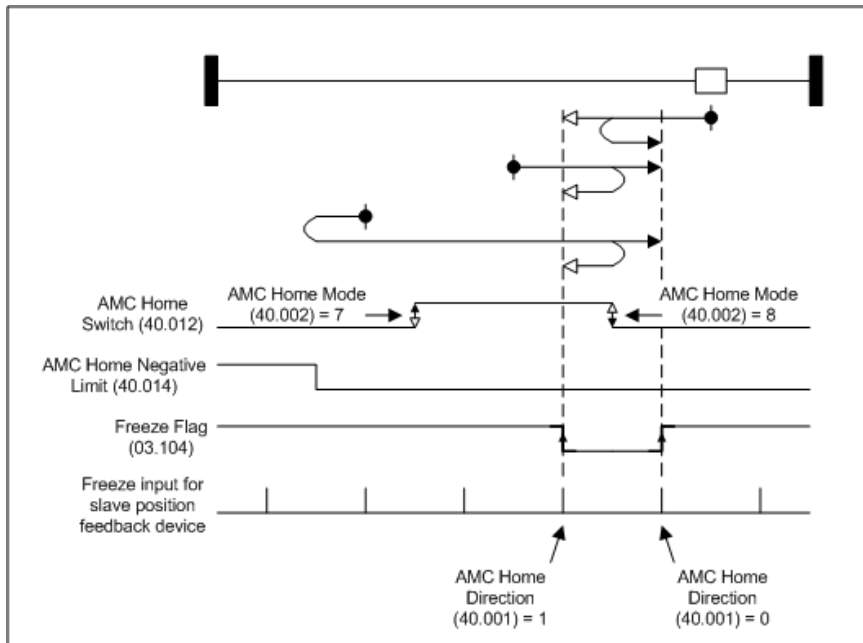
Homing modes 5 and 6 use the same general sequence but home to different sides of the active home region. When *AMC Home Mode* (40.002) = 5 the slave will home to the negative side of the home region and when *AMC Home Mode* (40.002) = 6 the slave will home to the positive side. The homing sequence for mode 5 is as follows.



If *AMC Home Switch* (40.012) = 0 when the homing sequence begins the slave will move forwards until a positive transition of *AMC Home Switch* (40.012) is detected otherwise when *AMC Home Switch* (40.012) = 1 the slave will move backwards until a negative transition of *AMC Home Switch* (40.012) is detected. If the slave is initially on the positive side of the active home region *AMC Home Positive Limit* (40.013) will be set to 1 before the home position is detected. If this happens the slave will move backwards until a negative transition of *AMC Home Switch* (40.012) is detected. If *AMC Home On Freeze* (40.011) = 0 the home position is set to *AMC Slave Position* (33.004) at the transition of *AMC Home Switch* (40.012) or when *AMC Home On Freeze* (40.011) = 1 the freeze flag is reset and the slave will move in the direction defined by *AMC Home Direction* (40.001) until a positive transition of *F1 Freeze Flag* (03.104) is detected. The home position is then set to *AMC Slave Freeze Position* (33.006).

#### Mode 7 and 8 - Home on home switch with negative limit

Homing modes 7 and 8 use the same general sequence but home to different sides of an active home region. When *AMC Home Mode* (40.002) = 7 the slave will home to the negative side of the home region and when *AMC Home Mode* (40.002) = 8 the slave will home to the positive side. The homing sequence for mode 8 is as follows.



If *AMC Home Switch* (40.012) = 0 when the homing sequence begins the slave will move backwards until a positive transition of *AMC Home Switch* (40.012) is detected otherwise when *AMC Home Switch* (40.012) = 1 the slave will move forwards until a negative transition of *AMC Home Switch* (40.012) is detected. If the slave is initially on the negative side of the active home region *AMC Home Negative Limit* (40.014) will be set to 1 before the home position is detected. If this happens the slave will move forwards until a negative transition of *AMC Home Switch* (40.012) is detected. If *AMC Home On Freeze* (40.011) = 0 the home position is set to *AMC Slave Position* (33.004) at the transition of *AMC Home Switch* (40.012) or when *AMC Home On Freeze* (40.011) = 1 the freeze flag is reset and the slave will move in the direction defined by *AMC Home Direction* (40.001) until a positive transition of *F1 Freeze Flag* (03.104) is detected. The home position is then set to the *AMC Slave Freeze Position* (33.006).

| Parameter         | 40.003 <i>AMC Home Maximum Speed</i> |                |                       |
|-------------------|--------------------------------------|----------------|-----------------------|
| Short description |                                      |                |                       |
| Mode              | RFC-A                                |                |                       |
| Minimum           | 0.00                                 | Maximum        | VM_AMC_SPEED_UNIPOLAR |
| Default           | 10.92                                | Units          | UU/ms                 |
| Type              | 32 Bit User Save                     | Update Rate    | Background read       |
| Display Format    | Standard                             | Decimal Places | 2                     |
| Coding            | RW, VM                               |                |                       |

The default value of 10.92 UU/ms is the equivalent of 10rpm for a feedback device with 16 normalised position bits per revolution and a user unit ratio of unity.

See *AMC Home Mode* (40.002).

| Parameter         | 40.004 AMC Home Position |                |                 |
|-------------------|--------------------------|----------------|-----------------|
| Short description |                          |                |                 |
| Mode              | RFC-A                    |                |                 |
| Minimum           | -VM_AMC_POSITION         | Maximum        | VM_AMC_POSITION |
| Default           | 0                        | Units          | UU              |
| Type              | 32 Bit User Save         | Update Rate    | Background read |
| Display Format    | Standard                 | Decimal Places | 0               |
| Coding            | RW, VM                   |                |                 |

The *AMC Home Position* (40.004) is the required *AMC Slave Position* (33.004) at the point where the homing sequence is complete (*AMC Home Complete* (40.005) = 1).

| Parameter         | 40.005 AMC Home Complete |                |           |
|-------------------|--------------------------|----------------|-----------|
| Short description |                          |                |           |
| Mode              | RFC-A                    |                |           |
| Minimum           | 0                        | Maximum        | 1         |
| Default           |                          | Units          |           |
| Type              | 1 Bit Volatile           | Update Rate    | 4ms write |
| Display Format    | Standard                 | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT           |                |           |

See *AMC Home Mode* (40.002).

| Parameter         | 40.006 AMC Home Offset Maximum Speed |                |                       |
|-------------------|--------------------------------------|----------------|-----------------------|
| Short description |                                      |                |                       |
| Mode              | RFC-A                                |                |                       |
| Minimum           | 0.00                                 | Maximum        | VM_AMC_SPEED_UNIPOLAR |
| Default           | 10.92                                | Units          | UU/ms                 |
| Type              | 32 Bit User Save                     | Update Rate    | Background read       |
| Display Format    | Standard                             | Decimal Places | 2                     |
| Coding            | RW, VM                               |                |                       |

The default value of 10.92 UU/ms is the equivalent of 10rpm for a feedback device with 16 normalised position bits per revolution and a user unit ratio of unity.

If *AMC Home Offset Maximum Speed* (40.006) = 0 then *AMC Profile Maximum Speed* (38.003) is used during the reset phase. See *AMC Home Mode* (40.002).

| Parameter         | 40.007 AMC Home Offset Position |                |                 |
|-------------------|---------------------------------|----------------|-----------------|
| Short description |                                 |                |                 |
| Mode              | RFC-A                           |                |                 |
| Minimum           | -VM_AMC_POSITION                | Maximum        | VM_AMC_POSITION |
| Default           | 0                               | Units          | UU              |
| Type              | 32 Bit User Save                | Update Rate    | Background read |
| Display Format    | Standard                        | Decimal Places | 0               |
| Coding            | RW, VM                          |                |                 |

*AMC Home Offset Position* (40.007) is the position that the system should move to at the end of the homing sequence (*AMC Home Complete* (40.005) = 1) relative to the new home position. If *AMC Home Offset Position* (40.007) = 0 the slave will stop at *AMC Home Position* (40.004).

| Parameter         | 40.008 AMC Home Offset Complete |                |           |
|-------------------|---------------------------------|----------------|-----------|
| Short description |                                 |                |           |
| Mode              | RFC-A                           |                |           |
| Minimum           | 0                               | Maximum        | 1         |
| Default           |                                 | Units          |           |
| Type              | 1 Bit Volatile                  | Update Rate    | 4ms write |
| Display Format    | Standard                        | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                  |                |           |

See *AMC Home Mode* (40.002).

| Parameter         | 40.009 AMC Home Maximum Allowed Move |                |                          |
|-------------------|--------------------------------------|----------------|--------------------------|
| Short description |                                      |                |                          |
| Mode              | RFC-A                                |                |                          |
| Minimum           | 0                                    | Maximum        | VM_AMC_POSITION_UNIPOLAR |
| Default           | 0                                    | Units          | UU                       |
| Type              | 32 Bit User Save                     | Update Rate    | Background read          |
| Display Format    | Standard                             | Decimal Places | 0                        |
| Coding            | RW, VM                               |                |                          |

If the modulus of the change in *AMC Slave Position* (33.004) exceeds *AMC Home Maximum Allowed Move* (40.009) before the event required to indicate the home position occurs and *AMC Home Maximum Allowed Move* (40.009) > 0, the system is forced to stop by setting *AMC Reference Select* (34.007) to 0.

| Parameter         | 40.010 AMC Home Complete Window |                |                          |
|-------------------|---------------------------------|----------------|--------------------------|
| Short description |                                 |                |                          |
| Mode              | RFC-A                           |                |                          |
| Minimum           | 0                               | Maximum        | VM_AMC_POSITION_UNIPOLAR |
| Default           | 0                               | Units          | UU                       |
| Type              | 32 Bit User Save                | Update Rate    | Background read          |
| Display Format    | Standard                        | Decimal Places | 0                        |
| Coding            | RW, VM                          |                |                          |

When the home position has been detected *AMC Profile Input Position* (38.006) is set to *AMC Home Offset Position* (40.007). The homing sequence is complete (*AMC Home Offset Complete* (40.008) = 1) when  $|AMC Profile Input Position (38.006) - AMC Slave Position (33.004)| \leq AMC Home Complete Window (40.010)$ .

| Parameter         | 40.011 AMC Home On Freeze |                |                             |
|-------------------|---------------------------|----------------|-----------------------------|
| Short description |                           |                |                             |
| Mode              | RFC-A                     |                |                             |
| Minimum           | 0                         | Maximum        | 1                           |
| Default           | 0                         | Units          |                             |
| Type              | 1 Bit User Save           | Update Rate    | Read when homing is enabled |
| Display Format    | Standard                  | Decimal Places | 0                           |
| Coding            | RW                        |                |                             |

See *AMC Home Mode* (40.002).

| Parameter         | 40.012 AMC Home Switch |                |          |
|-------------------|------------------------|----------------|----------|
| Short description |                        |                |          |
| Mode              | RFC-A                  |                |          |
| Minimum           | 0                      | Maximum        | 1        |
| Default           | 0                      | Units          |          |
| Type              | 1 Bit Volatile         | Update Rate    | 4ms read |
| Display Format    | Standard               | Decimal Places | 0        |
| Coding            | RW, NC                 |                |          |

See *AMC Home Mode* (40.002).

| Parameter         | 40.013 AMC Home Positive Limit |                |          |
|-------------------|--------------------------------|----------------|----------|
| Short description |                                |                |          |
| Mode              | RFC-A                          |                |          |
| Minimum           | 0                              | Maximum        | 1        |
| Default           | 0                              | Units          |          |
| Type              | 1 Bit Volatile                 | Update Rate    | 4ms read |
| Display Format    | Standard                       | Decimal Places | 0        |
| Coding            | RW, NC                         |                |          |

See *AMC Home Mode* (40.002).

| Parameter         | 40.014 AMC Home Negative Limit |                |          |
|-------------------|--------------------------------|----------------|----------|
| Short description |                                |                |          |
| Mode              | RFC-A                          |                |          |
| Minimum           | 0                              | Maximum        | 1        |
| Default           | 0                              | Units          |          |
| Type              | 1 Bit Volatile                 | Update Rate    | 4ms read |
| Display Format    | Standard                       | Decimal Places | 0        |
| Coding            | RW, NC                         |                |          |

See *AMC Home Mode* (40.002).

| Parameter         | 40.015 AMC Home Positive Limit Selector |                |                 |
|-------------------|---|----------------|-----------------|
| Short description |   |                |                 |
| Mode              | RFC-A                                   |                |                 |
| Minimum           | 0                                       | Maximum        | 2               |
| Default           | 0                                       | Units          |                 |
| Type              | 8 Bit User Save                         | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW                                      |                |                 |

*AMC Home Positive Limit* (40.013) is used to indicate that the positive limit has been reached. If *AMC Home Positive Limit Selector* (40.015) is set to 0 then *AMC Home Positive Limit* (40.013) can be set by writing directly to the parameter or using bit 4 in *AMC Control Word* (41.019).

If *AMC Home Positive Limit Selector* (40.015) is set to 1 then *AMC Home Positive Limit* (40.013) is set to the output of the hard stop detector which is configured using *AMC Home Hard Stop Torque Threshold* (40.018) and *AMC Home Hard Stop Delay Time* (40.019).

If *AMC Home Positive Limit Selector* (40.015) is set to 2 then *AMC Home Positive Limit* (40.013) is set to *AMC Positive Hardware Limit Flag* (41.013). Note that when *AMC Positive Hardware Limit Flag* (41.013) is used as the positive limit for the homing sequence the positive hardware and software limits configured in *AMC Control and Status* (41) are disabled.

| Parameter         | 40.016 AMC Home Negative Limit Selector |                |                 |
|-------------------|---|----------------|-----------------|
| Short description |   |                |                 |
| Mode              | RFC-A                                   |                |                 |
| Minimum           | 0                                       | Maximum        | 2               |
| Default           | 0                                       | Units          |                 |
| Type              | 8 Bit User Save                         | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW                                      |                |                 |

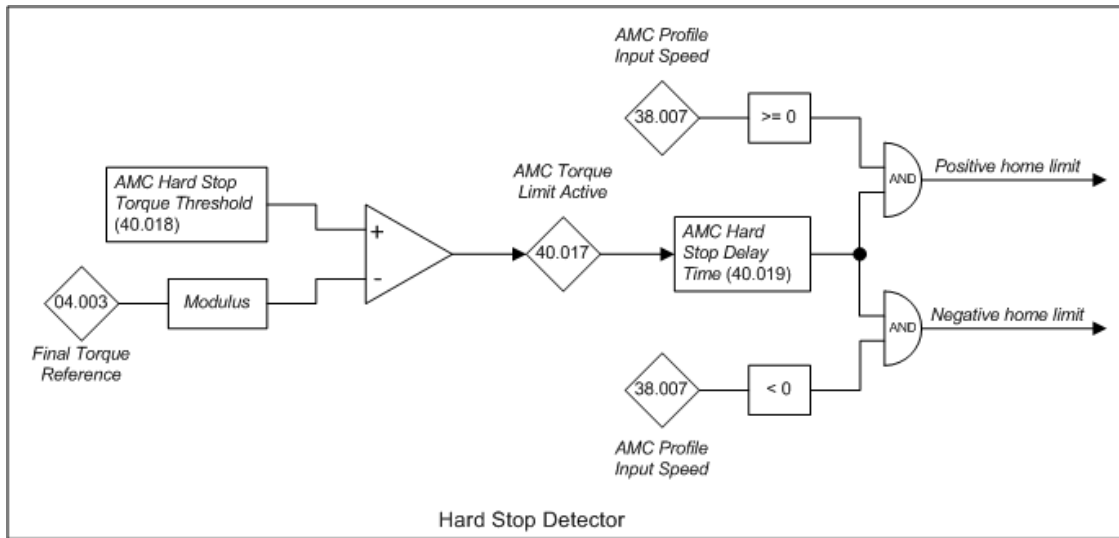
*AMC Home Negative Limit* (40.014) is used to indicate that the positive limit has been reached. If *AMC Home Negative Limit Selector* (40.016) is set to 0 then *AMC Home Negative Limit* (40.014) can be set by writing directly to the parameter or using bit 5 in *AMC Control Word* (41.019).

If *AMC Home Negative Limit Selector* (40.016) is set to 1 then *AMC Home Negative Limit* (40.014) is set to the output of the hard stop detector which is configured using *AMC Home Hard Stop Torque Threshold* (40.018) and *AMC Home Hard Stop Delay Time* (40.019).

If *AMC Home Negative Limit Selector* (40.016) is set to 2 then *AMC Home Negative Limit* (40.014) is set to *AMC Negative Hardware Limit Flag* (41.014). Note that when *AMC Negative Hardware Limit Flag* (41.014) is used as the negative limit for the homing sequence the negative hardware and software limits configured in *AMC Control and Status* (41) are disabled.



|                   |  |                |           |
|-------------------|--|----------------|-----------|
| <b>Parameter</b>  | <b>40.017 AMC Home Torque Limit Active</b> |                |           |
| Short description |  |                |           |
| Mode              | RFC-A                                      |                |           |
| Minimum           | 0  | Maximum        | 1         |
| Default           |  | Units          |           |
| Type              | 1 Bit Volatile                             | Update Rate    | 4ms write |
| Display Format    | Standard                                   | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                             |                |           |



AMC Home Torque Limit Active (40.017) is set to 1 when Final Torque Reference (04.003)  $\geq$  AMC Home Hard Stop Torque Threshold (40.018). A hard stop is detected when AMC Home Torque Limit Active (40.017) has been continuously active for the AMC Home Hard Stop Delay Time (40.019). To allow the hard stop detector to perform the correct action in each AMC Home Mode (40.002) the home reference is used to differentiate between a positive and negative limit.

|                   |   |                |                 |
|-------------------|---|----------------|-----------------|
| <b>Parameter</b>  | <b>40.018 AMC Home Hard Stop Torque Threshold</b> |                |                 |
| Short description |   |                |                 |
| Mode              | RFC-A   |                |                 |
| Minimum           | 0.0   | Maximum        | 1000.0          |
| Default           | 0.0   | Units          | %               |
| Type              | 16 Bit User Save                                  | Update Rate    | Background read |
| Display Format    | Standard  | Decimal Places | 1               |
| Coding            | RW  |                |                 |

See AMC Home Torque Limit Active (40.017).

|                   |   |                |                 |
|-------------------|---|----------------|-----------------|
| <b>Parameter</b>  | <b>40.019 AMC Home Hard Stop Delay Time</b> |                |                 |
| Short description |   |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | 0.000                                       | Maximum        | 60.000          |
| Default           | 0.000                                       | Units          | s               |
| Type              | 16 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 3               |
| Coding            | RW, BU                                      |                |                 |

See AMC Home Torque Limit Active (40.017).

|                   |                                 |                |                 |
|-------------------|---------------------------------|----------------|-----------------|
| <b>Parameter</b>  | <b>40.020 AMC Home Required</b> |                |                 |
| Short description |                                 |                |                 |
| Mode              | RFC-A                           |                |                 |
| Minimum           | 0                               | Maximum        | 1               |
| Default           | 0                               | Units          |                 |
| Type              | 1 Bit User Save                 | Update Rate    | Background read |
| Display Format    | Standard                        | Decimal Places | 0               |
| Coding            | RW                              |                |                 |

AMC Home Required (40.020) can be used to prevent AMC Profile Input Position (38.006) from being changed until a home sequence has been completed.

If AMC Home Required (40.020) is enabled and AMC Home Slave Source (40.021) is not the same as AMC Slave Source Select (33.001) then AMC Profile Input Speed (38.007) is held at zero unless AMC Reference Select (34.007) is set to Home, i.e. no motion other than a home is possible until a home has been completed using the slave feedback device selected in AMC Slave Source Select (33.001). Under this condition AMC Home Required Flag (41.017) and the corresponding bit in AMC Status (41.002) are set to indicate that a home is required before a reference can be applied to the input of the profile generator.

When a home has been completed AMC Home Slave Source (40.021) is set to AMC Slave Source Select (33.001) and the following parameters are saved automatically if the position feedback is configured to be absolute.

|                                |
|--------------------------------|
| <b>Parameters saved</b>        |
| AMC Home Slave Source (40.021) |
| AMC Slave Offset (33.003)      |

AMC Home Slave Source (40.021) is automatically reset (None) forcing another home to be completed in the following conditions.

|  |   |
|--|---|
| <b>Reset conditions</b>  | <b>AMC Home Slave Source (40.021) saved</b> |
| Home reference is selected   | No  |
| Absolute mode is disabled after the motion controller has been initialised   | Yes   |
| AMC Slave Source Select (33.001) is changed  | Yes   |
| AMC Slave Source Select (33.001) is set to the P1 or P2 feedback interface on the drive and an encoder trip is detected on the feedback device selected by AMC Slave Source Select (33.001). Note that AMC Home Slave Source (40.021) is not automatically reset if an encoder trip is detected when an option module is used to provide the slave feedback. | Yes   |

Note that if AMC Home Required (40.020) is disabled then AMC Home Required Flag (41.017) and the corresponding bit in AMC Status (41.002) are reset.

| Parameter         | 40.021 AMC Home Slave Source |                |                  |
|-------------------|------------------------------|----------------|------------------|
| Short description |                              |                |                  |
| Mode              | RFC-A                        |                |                  |
| Minimum           | -1                           | Maximum        | 9                |
| Default           | -1                           | Units          |                  |
| Type              | 8 Bit User Save              | Update Rate    | Background write |
| Display Format    | Standard                     | Decimal Places | 0                |
| Coding            | RW, TE                       |                |                  |

| Value | Text          |
|-------|---------------|
| -1    | None          |
| 0     | User Position |
| 1     | Sensorless    |
| 2     | P1 Drive      |
| 3     | P2 Drive      |
| 4     | P1 Slot1      |
| 5     | P2 Slot1      |
| 6     | P1 Slot2      |
| 7     | P2 Slot2      |
| 8     | P1 Slot3      |
| 9     | P2 Slot3      |

See AMC Home Required (40.020).

| Parameter         | 40.022 AMC Home Mode Setup     |                |                                   |
|-------------------|--------------------------------|----------------|-----------------------------------|
| Short description |                                |                |                                   |
| Mode              | RFC-A                          |                |                                   |
| Minimum           | 0<br>(Display: 00000000000000) | Maximum        | 8191<br>(Display: 11111111111111) |
| Default           | 0<br>(Display: 00000000000000) | Units          |                                   |
| Type              | 16 Bit User Save               | Update Rate    | Background read                   |
| Display Format    | Binary                         | Decimal Places | 0                                 |
| Coding            | RW, NC, BU                     |                |                                   |

When AMC Home Mode (40.002) is set to mode 9 the homing phase (step 2 of the homing sequence described in AMC Home Mode (40.002)) is configured using the bits in AMC Home Mode Setup (40.022). This allows all of the possible homing combinations to be configured without having a dedicated mode for each one and by setting bit 2 in AMC Home Mode Setup (40.022) it is possible to complete a homing sequence without modifying AMC Slave Position (33.004).

| Bit   | Function                       | Description   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
|-------|--------------------------------|---|-------|------------------|-------------|---------------|---|---------------------------------|---|---|---|---|---|---|---|---|---------------------------------------|
| 0     | Home direct                    | The slave position is set to <i>AMC Home Position</i> (40.004) and the home sequence is completed without any movement. Note that when this bit is set all configuration bits apart from bit 1 are ignored.   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 1     | Do not update home position    | The homing sequence configured is completed but the slave position is not modified.   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 2     | Direction off high home switch | Direction of the homing sequence if the home switch configured in bits 4 and 5 is high when the homing sequence is initiated.<br><table border="1"> <thead> <tr> <th>Bit 2</th> <th>Home Direction</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Forwards</td> </tr> <tr> <td>1</td> <td>Backwards</td> </tr> </tbody> </table>   | Bit 2 | Home Direction   | 0           | Forwards      | 1 | Backwards                       |   |   |   |   |   |   |   |   |                                       |
| Bit 2 | Home Direction                 |   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 0     | Forwards                       |   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 1     | Backwards                      |   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 3     | Direction off low home switch  | Direction of the homing sequence if the home switch configured in bits 4 and 5 is low when the homing sequence is initiated.<br><table border="1"> <thead> <tr> <th>Bit 3</th> <th>Home Direction</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Forwards</td> </tr> <tr> <td>1</td> <td>Backwards</td> </tr> </tbody> </table>  | Bit 3 | Home Direction   | 0           | Forwards      | 1 | Backwards                       |   |   |   |   |   |   |   |   |                                       |
| Bit 3 | Home Direction                 |   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 0     | Forwards                       |   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 1     | Backwards                      |   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 4     | Home switch selector bit 1     | The home switch selector (bit 1 and 2) is used to select the switch used by the homing sequence.<br><table border="1"> <thead> <tr> <th>Bit 5</th> <th>Bit 4</th> <th>Home switch</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td><i>AMC Home Switch</i> (40.012)</td> </tr> <tr> <td>0</td> <td>1</td> <td><i>AMC Home Positive Limit</i> (40.013)</td> </tr> <tr> <td>1</td> <td>0</td> <td><i>AMC Home Negative Limit</i> (40.014)</td> </tr> <tr> <td>1</td> <td>1</td> <td><i>AMC Slave Freeze Flag</i> (33.010)</td> </tr> </tbody> </table> | Bit 5 | Bit 4            | Home switch | 0             | 0 | <i>AMC Home Switch</i> (40.012) | 0 | 1 | <i>AMC Home Positive Limit</i> (40.013) | 1 | 0 | <i>AMC Home Negative Limit</i> (40.014) | 1 | 1 | <i>AMC Slave Freeze Flag</i> (33.010) |
| Bit 5 | Bit 4                          | Home switch   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 0     | 0                              | <i>AMC Home Switch</i> (40.012)   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 0     | 1                              | <i>AMC Home Positive Limit</i> (40.013)   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 1     | 0                              | <i>AMC Home Negative Limit</i> (40.014)   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 1     | 1                              | <i>AMC Slave Freeze Flag</i> (33.010)   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 5     | Home switch selector bit 2     | See bit 4   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 6     | Positive limit enabled         | If the positive limit becomes active when it is enabled and it is not being used as the home switch (bits 4 and 5) the homing direction is reversed. If the limit is not enabled but becomes active the homing sequence is stopped.   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 7     | Negative limit enabled         | If the negative limit becomes active when it is enabled and it is not being used as the home switch (bits 4 and 5) the homing direction is reversed. If the limit is not enabled but becomes active the homing sequence is stopped.   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 8     | Home transition selector bit 1 | The home transition selector (bit 8 and 9) is used to select the transition of the home switch (bits 4 and 5) which will complete the homing sequence.<br><table border="1"> <thead> <tr> <th>Bit 9</th> <th>Bit 8</th> <th>Home switch</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>High switch state</td> </tr> <tr> <td>0</td> <td>1</td> <td>Low switch state</td> </tr> <tr> <td>1</td> <td>0</td> <td>Rising edge</td> </tr> <tr> <td>1</td> <td>1</td> <td>Falling edge</td> </tr> </tbody> </table>                                     | Bit 9 | Bit 8            | Home switch | 0             | 0 | High switch state               | 0 | 1 | Low switch state                        | 1 | 0 | Rising edge                             | 1 | 1 | Falling edge                          |
| Bit 9 | Bit 8                          | Home switch   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 0     | 0                              | High switch state   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 0     | 1                              | Low switch state  |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 1     | 0                              | Rising edge   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 1     | 1                              | Falling edge  |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 9     | Home transition selector bit 2 | See bit 8   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 10    | Home switch side               | The home switch side selects the side of the home switch used to complete the homing sequence. Positive side refers to the switch edge closest to the positive limit switch.<br><table border="1"> <thead> <tr> <th>Bit 2</th> <th>Home switch side</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Positive side</td> </tr> <tr> <td>1</td> <td>Negative side</td> </tr> </tbody> </table>   | Bit 2 | Home switch side | 0           | Positive side | 1 | Negative side                   |   |   |   |   |   |   |   |   |                                       |
| Bit 2 | Home switch side               |   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 0     | Positive side                  |   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 1     | Negative side                  |   |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 11    | Home on edge                   | When home on edge is not selected the homing sequence will always complete in the same direction. If selected the transition used to complete the sequence will change depending on the direction of travel.  |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |
| 12    | Home to freeze                 | The home sequence will complete when on a freeze event after the home transition has been detected  |       |                  |             |               |   |                                 |   |   |   |   |   |   |   |   |                                       |

As well as configuring custom homing phases it is possible to use *AMC Home Mode Setup* (40.022) to replicate all of the homing routines described in *AMC Home Mode* (40.002). For example, to home to the positive limit switch (mode 2) the following configuration is required; home switch is set to positive limit, direction off a low home switch is set to forwards, direction of a high home switch is set to backwards, the home transition is set to rising, home switch side is set to negative side and home on edge is selected.

|                   |                                |                |          |
|-------------------|--------------------------------|----------------|----------|
| <b>Parameter</b>  | <b>40.023 AMC Home Restart</b> |                |          |
| Short description |                                |                |          |
| Mode              | RFC-A                          |                |          |
| Minimum           | 0                              | Maximum        | 1        |
| Default           | 0                              | Units          |          |
| Type              | 1 Bit Volatile                 | Update Rate    | 4ms read |
| Display Format    | Standard                       | Decimal Places | 0        |
| Coding            | RW, NC                         |                |          |

*AMC Home Restart* (40.023) can be used to restart the home sequence without changing the reference selector. Note that the home sequence will always restart from the beginning of the sequence and any information from the previous home will be ignored.

# Menu 41 Single Line Descriptions – AMC Control and Status

Mode: RFC-A

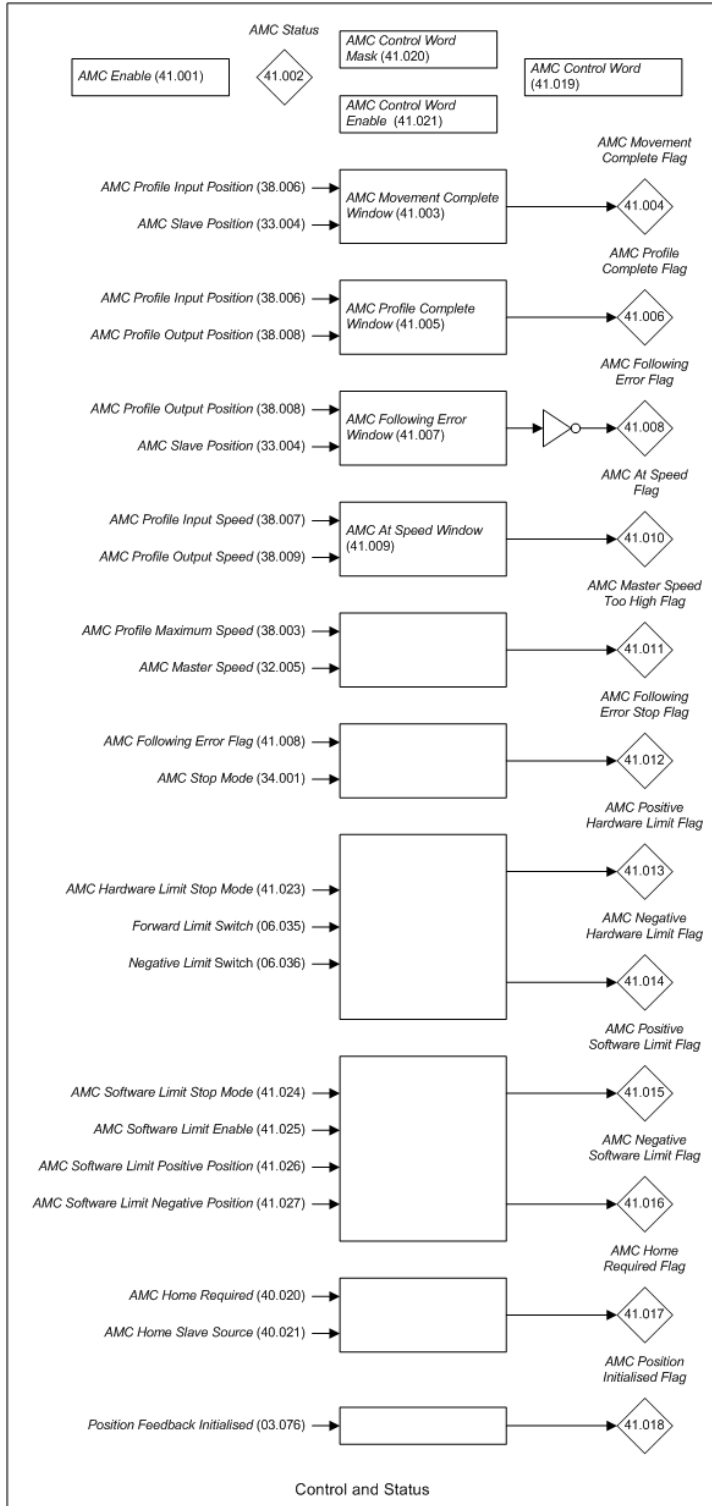
| Parameter |  | Range                                | Default          | Type |     |    |    |    |       |
|-----------|--|--------------------------------------|------------------|------|-----|----|----|----|-------|
| 41.001    | AMC Enable                             | Off (0) or On (1)                    | Off (0)          | RW   | Bit |    |    |    | US    |
| 41.002    | AMC Status                             | 0000000000000000 to 1111111111111111 | 0000000000000000 | RO   | Bin |    | NC |    |       |
| 41.003    | AMC Movement Complete Window           | 0 to VM_AMC_POSITION_UNIPOLAR UU     | 256 UU           | RW   | Num |    |    |    | US    |
| 41.004    | AMC Movement Complete Flag             | Off (0) or On (1)                    |                  | RO   | Bit | ND | NC | PT |       |
| 41.005    | AMC Profile Complete Window            | 0 to VM_AMC_POSITION_UNIPOLAR UU     | 256 UU           | RW   | Num |    |    |    | US    |
| 41.006    | AMC Profile Complete Flag              | Off (0) or On (1)                    |                  | RO   | Bit | ND | NC | PT |       |
| 41.007    | AMC Following Error Window             | 0 to VM_AMC_POSITION_UNIPOLAR UU     | 256 UU           | RW   | Num |    |    |    | US    |
| 41.008    | AMC Following Error Flag               | Off (0) or On (1)                    |                  | RO   | Bit | ND | NC | PT |       |
| 41.009    | AMC At Speed Window                    | ±VM_AMC_SPEED_UNIPOLAR UU/ms         | 10.92 UU/ms      | RW   | Num |    |    |    | US    |
| 41.010    | AMC At Speed Flag                      | Off (0) or On (1)                    |                  | RO   | Bit | ND | NC | PT |       |
| 41.011    | AMC Master Speed Too High Flag         | Off (0) or On (1)                    |                  | RO   | Bit | ND | NC | PT |       |
| 41.012    | AMC Following Error Stop Flag          | Off (0) or On (1)                    |                  | RO   | Bit | ND | NC | PT |       |
| 41.013    | AMC Positive Hardware Limit Flag       | Off (0) or On (1)                    |                  | RO   | Bit | ND | NC | PT |       |
| 41.014    | AMC Negative Hardware Limit Flag       | Off (0) or On (1)                    |                  | RO   | Bit | ND | NC | PT |       |
| 41.015    | AMC Positive Software Limit Flag       | Off (0) or On (1)                    |                  | RO   | Bit | ND | NC | PT |       |
| 41.016    | AMC Negative Software Limit Flag       | Off (0) or On (1)                    |                  | RO   | Bit | ND | NC | PT |       |
| 41.017    | AMC Home Required Flag                 | Off (0) or On (1)                    |                  | RO   | Bit | ND | NC | PT |       |
| 41.018    | AMC Position Feedback Initialised Flag | Off (0) or On (1)                    |                  | RO   | Bit | ND | NC | PT |       |
| 41.019    | AMC Control Word                       | 0000000000000000 to 1111111111111111 | 0000000000000000 | RW   | Bin |    | NC |    |       |
| 41.020    | AMC Control Word Mask                  | 0000000000000000 to 1111111111111111 | 1111111111111111 | RW   | Bin |    |    |    | US    |
| 41.021    | AMC Control Word Enable                | 0 to 2                               | 0                | RW   | Num |    |    |    | US    |
| 41.022    | AMC Active Control Word                | 0000000000000000 to 1111111111111111 | 0000000000000000 | RO   | Bin |    |    |    | PT PS |
| 41.023    | AMC Hardware Limit Stop Mode           | Profile (0), No Profile (1)          | No Profile (1)   | RW   | Txt |    |    |    | US    |
| 41.024    | AMC Software Limit Stop Mode           | Profile (0), No Profile (1)          | Profile (0)      | RW   | Txt |    |    |    | US    |
| 41.025    | AMC Enable Software Limits             | Off (0) or On (1)                    | Off (0)          | RW   | Bit |    |    |    | US    |
| 41.026    | AMC Positive Software Limit Position   | ±VM_AMC_POSITION UU                  | 0 UU             | RW   | Num |    |    |    | US    |
| 41.027    | AMC Negative Software Limit Position   | ±VM_AMC_POSITION UU                  | 0 UU             | RW   | Num |    |    |    | US    |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Menu 41 – AMC Control and Status

Mode: RFC-A

## Control and status



| Parameter         | 41.001 AMC Enable           |                |                      |
|-------------------|-----------------------------|----------------|----------------------|
| Short description | Enables or disables the AMC |                |                      |
| Mode              | RFC-A                       |                |                      |
| Minimum           | 0                           | Maximum        | 1                    |
| Default           | 0                           | Units          |                      |
| Type              | 1 Bit User Save             | Update Rate    | AMC sample rate read |
| Display Format    | Standard                    | Decimal Places | 0                    |
| Coding            | RW                          |                |                      |

If AMC Enable (41.001), Reference On (01.011) or AMC Position Feedback Initialised Flag (41.018) = 0 the Advanced Motion Controller is held in the disabled state. The parameters given in the table below are held at the values given while the motion controller is disabled.

| Parameter   | Value in disable state                                  |
|---|---|
| AMC Stop Reference (34.002)   | AMC Slave Position (33.004)                             |
| AMC Profile Input Position (38.006) if AMC Reference Select (34.007) is 4     | AMC Master Position (32.004) x Electronic gearbox ratio |
| AMC Profile Input Position (38.006) if AMC Reference Select (34.007) is not 4 | AMC Slave Position (33.004)                             |
| AMC Profile Output Position (38.008)  | AMC Slave Position (33.004)                             |

When the motion controller is disabled the electronic gearbox is held in the unlocked state and the cam system is held at its start position.

| Parameter         | 41.002 AMC Status                |                |                                      |
|-------------------|----------------------------------|----------------|--------------------------------------|
| Short description | Shows the status of the AMC      |                |                                      |
| Mode              | RFC-A                            |                |                                      |
| Minimum           | 0<br>(Display: 0000000000000000) | Maximum        | 65535<br>(Display: 1111111111111111) |
| Default           | 0<br>(Display: 0000000000000000) | Units          |                                      |
| Type              | 16 Bit Volatile                  | Update Rate    | 4ms write                            |
| Display Format    | Binary                           | Decimal Places | 0                                    |
| Coding            | RO, NC, BU                       |                |                                      |

AMC Status (41.002) gives the status of the motion controller with the bits shown in the table below.

| Bit | Status  |
|-----|---|
| 0   | AMC EGB Locked (37.006)                         |
| 1   | AMC Cam Complete (35.010)                       |
| 2   | AMC Movement Complete Flag (41.004)             |
| 3   | AMC Profile Complete Flag (41.006)              |
| 4   | AMC Following Error Flag (41.008)               |
| 5   | AMC At Speed Flag (41.010)                      |
| 6   | AMC Master Speed Too High Flag (41.011)         |
| 7   | AMC Following Error Stop Flag (41.012)          |
| 8   | AMC Home Complete (40.005)                      |
| 9   | AMC Home Offset Complete (40.008)               |
| 10  | AMC Positive Hardware Limit Flag (41.013)       |
| 11  | AMC Negative Hardware Limit Flag (41.014)       |
| 12  | AMC Positive Software Limit Flag (41.015)       |
| 13  | AMC Negative Software Limit Flag (41.016)       |
| 14  | AMC Home Required Flag (41.017)                 |
| 15  | AMC Position Feedback Initialised Flag (41.018) |

| Parameter         | 41.003 AMC Movement Complete Window |                |                          |
|-------------------|-------------------------------------|----------------|--------------------------|
| Short description |                                     |                |                          |
| Mode              | RFC-A                               |                |                          |
| Minimum           | 0                                   | Maximum        | VM AMC POSITION UNIPOLAR |
| Default           | 256                                 | Units          | UU                       |
| Type              | 32 Bit User Save                    | Update Rate    | Background read          |
| Display Format    | Standard                            | Decimal Places | 0                        |
| Coding            | RW, VM                              |                |                          |

AMC Movement Complete Flag (41.004) is set to 1 if  $|AMC Profile Input Position (38.006) - AMC Slave Position (33.004)| \leq AMC Movement Complete Window (41.003)$ .

| Parameter         | 41.004 AMC Movement Complete Flag |                |           |
|-------------------|-----------------------------------|----------------|-----------|
| Short description |                                   |                |           |
| Mode              | RFC-A                             |                |           |
| Minimum           | 0                                 | Maximum        | 1         |
| Default           |                                   | Units          |           |
| Type              | 1 Bit Volatile                    | Update Rate    | 4ms write |
| Display Format    | Standard                          | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                    |                |           |

See AMC Movement Complete Window (41.003).

| Parameter         | 41.005 AMC Profile Complete Window |                |                          |
|-------------------|------------------------------------|----------------|--------------------------|
| Short description |                                    |                |                          |
| Mode              | RFC-A                              |                |                          |
| Minimum           | 0                                  | Maximum        | VM AMC POSITION UNIPOLAR |
| Default           | 256                                | Units          | UU                       |
| Type              | 32 Bit User Save                   | Update Rate    | Background read          |
| Display Format    | Standard                           | Decimal Places | 0                        |
| Coding            | RW, VM                             |                |                          |

AMC Profile Complete Flag (41.006) is set to 1 if  $|AMC Profile Input Position (38.006) - AMC Profile Output Position (38.008)| \leq AMC Profile Complete Window (41.005)$ . If AMC Profile Complete Window (41.005) is set to zero when the s-ramp profile is enabled (AMC Profile Jerk 1 (38.011) > 0) then AMC Profile Complete Flag (41.006) is not set until AMC Profile Input Position (38.006) = AMC Profile Output Position (38.008) and the output of the profile is at standstill, i.e. AMC Profile Output Speed (38.009) = 0 and AMC Profile Output Acceleration (38.010) = 0.

| Parameter         | 41.006 AMC Profile Complete Flag |                |           |
|-------------------|----------------------------------|----------------|-----------|
| Short description |                                  |                |           |
| Mode              | RFC-A                            |                |           |
| Minimum           | 0                                | Maximum        | 1         |
| Default           |                                  | Units          |           |
| Type              | 1 Bit Volatile                   | Update Rate    | 4ms write |
| Display Format    | Standard                         | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                   |                |           |

See AMC Profile Complete Window (41.005).

| Parameter         | 41.007 AMC Following Error Window |                |                          |
|-------------------|-----------------------------------|----------------|--------------------------|
| Short description |                                   |                |                          |
| Mode              | RFC-A                             |                |                          |
| Minimum           | 0                                 | Maximum        | VM AMC POSITION UNIPOLAR |
| Default           | 256                               | Units          | UU                       |
| Type              | 32 Bit User Save                  | Update Rate    | Background read          |
| Display Format    | Standard                          | Decimal Places | 0                        |
| Coding            | RW, VM                            |                |                          |

AMC Following Error Flag (41.008) is set to 1 if  $AMC Profile Output Position (38.008) - AMC Slave Position (33.004) > AMC Following Error Window (41.007)$ .

| Parameter         | 41.008 AMC Following Error Flag |                |           |
|-------------------|---------------------------------|----------------|-----------|
| Short description |                                 |                |           |
| Mode              | RFC-A                           |                |           |
| Minimum           | 0                               | Maximum        | 1         |
| Default           |                                 | Units          |           |
| Type              | 1 Bit Volatile                  | Update Rate    | 4ms write |
| Display Format    | Standard                        | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                  |                |           |

See AMC Following Error Window (41.007).

| Parameter         | 41.009 AMC At Speed Window |                |                       |
|-------------------|----------------------------|----------------|-----------------------|
| Short description |                            |                |                       |
| Mode              | RFC-A                      |                |                       |
| Minimum           | 0.00                       | Maximum        | VM AMC SPEED UNIPOLAR |
| Default           | 10.92                      | Units          | UU/ms                 |
| Type              | 32 Bit User Save           | Update Rate    | Background read       |
| Display Format    | Standard                   | Decimal Places | 2                     |
| Coding            | RW, VM                     |                |                       |

\*10rpm for a 16 bits per revolution device (user units ratio = 1)

AMC At Speed Flag (41.010) is set to 1 if  $AMC Profile Output Speed (38.009) - AMC Profile Input Speed (38.007) \leq AMC At Speed Window (41.009)$ .

| Parameter         | 41.010 AMC At Speed Flag |                |           |
|-------------------|--------------------------|----------------|-----------|
| Short description |                          |                |           |
| Mode              | RFC-A                    |                |           |
| Minimum           | 0                        | Maximum        | 1         |
| Default           | Units                    |                |           |
| Type              | 1 Bit Volatile           | Update Rate    | 4ms write |
| Display Format    | Standard                 | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT           |                |           |

See AMC At Speed Window (41.009).

| Parameter         | 41.011 AMC Master Speed Too High Flag |                |           |
|-------------------|---------------------------------------|----------------|-----------|
| Short description |                                       |                |           |
| Mode              | RFC-A                                 |                |           |
| Minimum           | 0                                     | Maximum        | 1         |
| Default           | Units                                 |                |           |
| Type              | 1 Bit Volatile                        | Update Rate    | 4ms write |
| Display Format    | Standard                              | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                        |                |           |

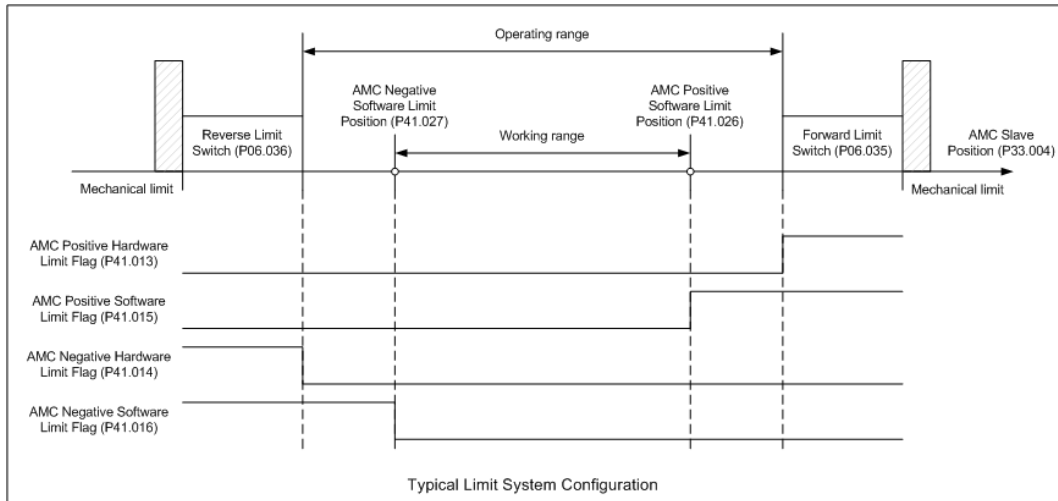
AMC Master Speed Too High Flag (41.011) is set to 1 if  $|AMC Master Speed (32.005)| > AMC Profile Maximum Speed (38.003)$ .

| Parameter         | 41.012 AMC Following Error Stop Flag |                |           |
|-------------------|--------------------------------------|----------------|-----------|
| Short description |                                      |                |           |
| Mode              | RFC-A                                |                |           |
| Minimum           | 0                                    | Maximum        | 1         |
| Default           | Units                                |                |           |
| Type              | 1 Bit Volatile                       | Update Rate    | 4ms write |
| Display Format    | Standard                             | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                       |                |           |

AMC Following Error Stop Flag (41.012) is set to 1 when AMC Reference Select (34.007) is automatically changed to 0 because a following error stop mode has been selected (AMC Stop Mode (34.001) = 2 or 3) and AMC Following Error Flag (41.008) is set, i.e. the following error has exceeded AMC Following Error Window (41.007) during a motion sequence. AMC Following Error Stop Flag (41.012) is cleared when AMC Reference Select (34.007) is changed.

| Parameter         | 41.013 AMC Positive Hardware Limit Flag |                |           |
|-------------------|---|----------------|-----------|
| Short description |   |                |           |
| Mode              | RFC-A                                   |                |           |
| Minimum           | 0                                       | Maximum        | 1         |
| Default           | Units                                   |                |           |
| Type              | 1 Bit Volatile                          | Update Rate    | 4ms write |
| Display Format    | Standard                                | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                          |                |           |

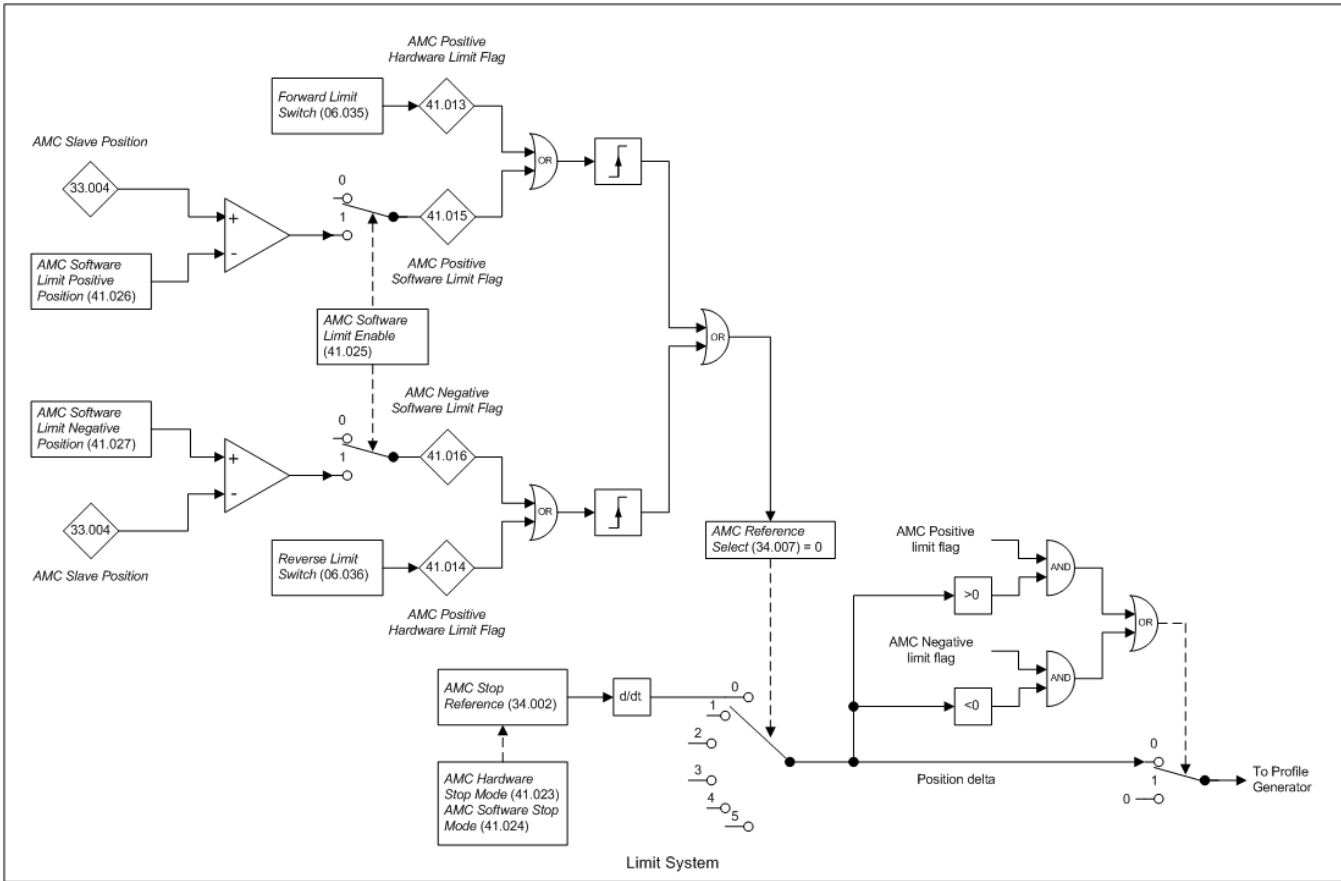
The following diagram shows a typical configuration for the hardware and software limits.



The operating range of the Advanced Motion Controller is defined by the physical position of the hardware limit switches which are routed to *Forward Limit Switch* (06.035) and *Reverse Limit Switch* (06.036). If digital input 4 or 5 are routed to *Forward Limit Switch* (06.035) or *Reverse Limit Switch* (06.036) the maximum delay between a limit switch being reached and the motion controller taking action is 4.35ms. The software limits are configured using *AMC Positive Software Limit Position* (41.026) and *AMC Negative Software Limit Position* (41.027) and these limits are active when *AMC Enable Software Limits* (41.025) = 1. The software position limits can be used to define a working range which will normally be within the operating range defined by the hardware limits. Unlike the operating range the working range is flexible and can be configured for an individual motion sequence. The maximum delay for a software limit is 4ms. Note that the software limits are disabled when performing a homing routine (*AMC Reference Select* (34.007) = 7).

The logic diagram for the limit switches is shown below.





The hardware and software limits are active in the following conditions.

| Limit switch                              | 0   | 1  |
|---|---|--|
| AMC Positive Hardware Limit Flag (41.013) | Forward Limit Switch (06.035) = 0   | Forward Limit Switch (06.035) = 1  |
| AMC Negative Hardware Limit Flag (41.014) | Reverse Limit Switch (06.036) = 0   | Reverse Limit Switch (06.036) = 1  |
| AMC Positive Software Limit Flag (41.015) | AMC Enable Software Limits (41.025) = 0 or AMC Slave Position (33.004) < (AMC Positive Software Limit Position (41.026) + Hysteresis) | AMC Slave Position (33.004) >= AMC Positive Software Limit Position (41.026) |
| AMC Negative Software Limit Flag (41.016) | AMC Enable Software Limits (41.025) = 0 or AMC Slave Position (33.004) > (AMC Negative Software Limit Position (41.027) + Hysteresis) | AMC Slave Position (33.004) <= AMC Negative Software Limit Position (41.027) |

Note: When a software limit is active a hysteresis is applied to prevent the limit being disabled until the slave has moved away from the limit. This is required to prevent a small change of slave position from reactivating the limit when the slave is close to the position limit. The hysteresis applied is  $4 \times \text{AMC Slave User Units Ratio Numerator (31.006)} / \text{AMC Slave User Units Ratio Denominator (31.007)}$ .

When a positive or negative limit is reached (positive transition of limit flag) **AMC Stop Reference (34.002)** is updated with the stop position and **AMC Reference Select (34.007)** is set to the stop reference. The stop mode used by the profile when a limit is reached is selected by **AMC Hardware Limit Stop Mode (41.023)** and **AMC Software Limit Stop Mode (41.024)**. If **AMC Hardware Limit Stop Mode (41.023)** or **AMC Software Limit Stop Mode (41.024) = 0** (profile) **AMC Stop Reference (34.002)** is set to **AMC Profile Output Position (38.008) + stop position delta** (position taken to reduce **AMC Profile Output Speed (38.009)** to zero under the constraints of the profile generator). Note that the target position for the slave will include **AMC Position Error (39.008)**. When **AMC Hardware Limit Stop Mode (41.023)** or **AMC Software Limit Stop Mode (41.024) = 1** (no profile) **AMC Stop Reference (34.002)** is set to **AMC Slave Position (33.004)** bringing the slave to a hard stop. If a limit is reached during a profiled stop and the stop mode for this limit is set to no profile the no profile stop will take priority and override the profile stop. When a limit is active the change of position applied to the input of the profile generator can only be in the direction that moves the slave away from the active limit. If a positive and negative limit are active no movement will be allowed.

| Parameter         | 41.014 AMC Negative Hardware Limit Flag |                       |
|-------------------|---|-----------------------|
| Short description |   |                       |
| Mode              | RFC-A                                   |                       |
| Minimum           | 0                                       | Maximum 1             |
| Default           | Units                                   |                       |
| Type              | 1 Bit Volatile                          | Update Rate 4ms write |
| Display Format    | Standard                                | Decimal Places 0      |
| Coding            | RO, ND, NC, PT                          |                       |

See **AMC Positive Hardware Limit Flag (41.013)**.

| Parameter         | 41.015 AMC Positive Software Limit Flag |                       |
|-------------------|---|-----------------------|
| Short description |   |                       |
| Mode              | RFC-A                                   |                       |
| Minimum           | 0                                       | Maximum 1             |
| Default           | Units                                   |                       |
| Type              | 1 Bit Volatile                          | Update Rate 4ms write |
| Display Format    | Standard                                | Decimal Places 0      |
| Coding            | RO, ND, NC, PT                          |                       |

See **AMC Positive Hardware Limit Flag (41.013)**.

| Parameter         | 41.016 AMC Negative Software Limit Flag |                       |
|-------------------|---|-----------------------|
| Short description |   |                       |
| Mode              | RFC-A                                   |                       |
| Minimum           | 0                                       | Maximum 1             |
| Default           | Units                                   |                       |
| Type              | 1 Bit Volatile                          | Update Rate 4ms write |
| Display Format    | Standard                                | Decimal Places 0      |
| Coding            | RO, ND, NC, PT                          |                       |

See **AMC Positive Hardware Limit Flag (41.013)**.

| Parameter         | 41.017 AMC Home Required Flag |                |           |
|-------------------|-------------------------------|----------------|-----------|
| Short description |                               |                |           |
| Mode              | RFC-A                         |                |           |
| Minimum           | 0                             | Maximum        | 1         |
| Default           |                               | Units          |           |
| Type              | 1 Bit Volatile                | Update Rate    | 4ms Write |
| Display Format    | Standard                      | Decimal Places | 0         |
| Coding            | RO, ND, NC, PT                |                |           |

AMC Home Required Flag (41.017) is set to 1 if AMC Home Required (40.020) is enabled and AMC Home Slave Source (40.021) is not the same as AMC Slave Source Select (33.001).

| Parameter         | 41.018 AMC Position Feedback Initialised Flag |                |                  |
|-------------------|---|----------------|------------------|
| Short description |   |                |                  |
| Mode              | RFC-A   |                |                  |
| Minimum           | 0   | Maximum        | 1                |
| Default           |   | Units          |                  |
| Type              | 1 Bit Volatile                                | Update Rate    | Background write |
| Display Format    | Standard                                      | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                                |                |                  |

AMC Position Feedback Initialised Flag (41.018) is set to 1 when the master and slave position accumulators have been initialised. The motion controller cannot enter the enabled state (see AMC Enable (41.001)) until this flag is set. Note that the initialisation of the master and slave feedback cannot be completed until all of the position feedback devices connected to the drive (see Position Feedback Initialized (03.076)) have been initialised and AMC Position Feedback Initialised Flag (41.018) is reset if any bit in Position Feedback Initialized (03.076) is cleared (e.g. Initialise Position Feedback (03.075) = 1).

| Parameter         | 41.019 AMC Control Word                         |                |                                      |
|-------------------|---|----------------|--------------------------------------|
| Short description | Controls the AMC if the control word is enabled |                |                                      |
| Mode              | RFC-A   |                |                                      |
| Minimum           | 0<br>(Display: 0000000000000000)                | Maximum        | 65535<br>(Display: 1111111111111111) |
| Default           | 0<br>(Display: 0000000000000000)                | Units          |                                      |
| Type              | 16 Bit Volatile                                 | Update Rate    | 4ms read                             |
| Display Format    | Binary  | Decimal Places | 0                                    |
| Coding            | RW, NC, BU                                      |                |                                      |

When AMC Control Word Enable (41.021) = 0 the control word is disabled and AMC Control Word (41.019), AMC Control Word Mask (41.020) and AMC Active Control Word (41.022) are not used by the motion controller. If AMC Control Word Enable (41.021) = 1 the bits in AMC Control Word (41.019) can be used instead of the parameters listed in the table below. Note that in this mode AMC Active Control Word (41.022) is always set to AMC Control Word (41.019) and bit 15 in the control word is ignored.

| Bits | Corresponding parameter or function          |
|------|--|
| 0    | AMC Enable (41.001)                          |
| 1    | AMC Absolute Mode Enable (31.002)            |
| 2    | AMC Incremental Position Reset Mode (31.003) |
| 3    | AMC Home Switch (40.012)                     |
| 4    | AMC Home Positive Limit (40.013)             |
| 5    | AMC Home Negative Limit (40.014)             |
| 6    | AMC Master Invert (32.002)                   |
| 7    | AMC Slave Invert (33.002)                    |
| 8    | AMC Output Invert (39.013)                   |
| 9    | AMC EGB Enable Rigid Lock (37.001)           |
| 10   | AMC Speed Mode Enable (31.014)               |
| 11   | AMC Enable Software Limits (41.025)          |
| 12   | AMC Auto Resolution Enable (31.015)          |
| 13   | AMC Home Required (40.020)                   |
| 14   | Not used                                     |
| 15   | Control word valid                           |

Note that bits 4 and 5 are only used when the corresponding selector (AMC Home Positive Limit Selector (40.015) or AMC Home Negative Limit Selector (40.016)) is set to zero.

Each bit in the control word can be enabled or disabled independently by selecting or deselecting the corresponding bits in AMC Control Word Mask (41.020). None of the parameters in the table above have any effect when the control word is enabled unless the corresponding bit in the control word is disabled by the mask.

When AMC Control Word Enable (41.021) = 2 and a valid control word is written to AMC Control Word (41.019) (bit 15 = 1) the control word is copied to AMC Active Control Word (41.022) and the motion controller uses the control word to control the motion. If the control word is invalid (bit 15 = 0) the motion controller will continue to use the control word in AMC Active Control Word (41.022) until another valid control word is written to AMC Control Word (41.019). If the control word is being used to enable absolute mode then AMC Control Word Enable (41.021) should always be set to mode 2 otherwise the home position with rollover enabled will not be correct when the drive is power cycled.

| Parameter         | 41.020 AMC Control Word Mask                     |                |                                      |
|-------------------|--|----------------|--------------------------------------|
| Short description | Controls the active bits in the AMC control word |                |                                      |
| Mode              | RFC-A  |                |                                      |
| Minimum           | 0<br>(Display: 0000000000000000)                 | Maximum        | 65535<br>(Display: 1111111111111111) |
| Default           | 65535<br>(Display: 1111111111111111)             | Units          |                                      |
| Type              | 16 Bit User Save                                 | Update Rate    | 4ms read                             |
| Display Format    | Binary   | Decimal Places | 0                                    |
| Coding            | RW, BU   |                |                                      |

See AMC Control Word (41.019).

| Parameter         | 41.021 AMC Control Word Enable          |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to 1 to enable the AMC control word |                |                 |
| Mode              | RFC-A                                   |                |                 |
| Minimum           | 0                                       | Maximum        | 2               |
| Default           | 0                                       | Units          |                 |
| Type              | 8 Bit User Save                         | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW                                      |                |                 |

See AMC Control Word (41.019).

| Parameter         | 41.022 AMC Active Control Word   |                |                                      |
|-------------------|----------------------------------|----------------|--------------------------------------|
| Short description | Control word used by the AMC     |                |                                      |
| Mode              | RFC-A                            |                |                                      |
| Minimum           | 0<br>(Display: 0000000000000000) | Maximum        | 65535<br>(Display: 1111111111111111) |
| Default           | 0<br>(Display: 0000000000000000) | Units          |                                      |
| Type              | 16 Bit Power Down Save           | Update Rate    | 4ms write                            |
| Display Format    | Binary                           | Decimal Places | 0                                    |
| Coding            | RO, PT, BU                       |                |                                      |

See AMC Control Word (41.019).

| Parameter         | 41.023 AMC Hardware Limit Stop Mode            |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Stop mode used when a hardware limit is active |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 1  | Units          |                 |
| Type              | 8 Bit User Save                                | Update Rate    | Background read |
| Display Format    | Standard                                       | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text       |
|-------|------------|
| 0     | Profile    |
| 1     | No Profile |

See *AMC Positive Hardware Limit Flag* (41.013).

| Parameter         | 41.024 AMC Software Limit Stop Mode            |                |                 |
|-------------------|--|----------------|-----------------|
| Short description | Stop mode used when a software limit is active |                |                 |
| Mode              | RFC-A  |                |                 |
| Minimum           | 0  | Maximum        | 1               |
| Default           | 0  | Units          |                 |
| Type              | 8 Bit User Save                                | Update Rate    | Background read |
| Display Format    | Standard                                       | Decimal Places | 0               |
| Coding            | RW, TE   |                |                 |

| Value | Text       |
|-------|------------|
| 0     | Profile    |
| 1     | No Profile |

See *AMC Positive Hardware Limit Flag* (41.013).

| Parameter         | 41.025 AMC Enable Software Limits |                |                 |
|-------------------|-----------------------------------|----------------|-----------------|
| Short description |                                   |                |                 |
| Mode              | RFC-A                             |                |                 |
| Minimum           | 0                                 | Maximum        | 1               |
| Default           | 0                                 | Units          |                 |
| Type              | 1 Bit User Save                   | Update Rate    | Background read |
| Display Format    | Standard                          | Decimal Places | 0               |
| Coding            | RW                                |                |                 |

See *AMC Positive Hardware Limit Flag* (41.013).

| Parameter         | 41.026 AMC Positive Software Limit Position |                |                 |
|-------------------|---|----------------|-----------------|
| Short description |   |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | -VM AMC POSITION                            | Maximum        | VM AMC POSITION |
| Default           | 0   | Units          | UU              |
| Type              | 32 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 0               |
| Coding            | RW, VM                                      |                |                 |

See *AMC Positive Hardware Limit Flag* (41.013).

| Parameter         | 41.027 AMC Negative Software Limit Position |                |                 |
|-------------------|---|----------------|-----------------|
| Short description |   |                |                 |
| Mode              | RFC-A                                       |                |                 |
| Minimum           | -VM AMC POSITION                            | Maximum        | VM AMC POSITION |
| Default           | 0   | Units          | UU              |
| Type              | 32 Bit User Save                            | Update Rate    | Background read |
| Display Format    | Standard                                    | Decimal Places | 0               |
| Coding            | RW, VM                                      |                |                 |

See *AMC Positive Hardware Limit Flag* (41.013).

## Slot 4 Menu 0 Single Line Descriptions – Ethernet Setup

Mode: RFC-A

| Parameter |                   | Range   | Default          | Type |     |    |    |    |  |
|-----------|-------------------|---|------------------|------|-----|----|----|----|--|
| 4.00.001  | Module ID         | 0 to 65535  |                  | RO   | Num | ND | NC | PT |  |
| 4.00.002  | Software Version  | 0 to 99999999   |                  | RO   | Num | ND | NC | PT |  |
| 4.00.003  | Hardware Version  | 0.00 to 99.99   |                  | RO   | Num | ND | NC | PT |  |
| 4.00.004  | Serial Number LS  | 00000000 to 99999999  |                  | RO   | Num | ND | NC | PT |  |
| 4.00.005  | Serial Number MS  | 0 to 99999999   |                  | RO   | Num | ND | NC | PT |  |
| 4.00.006  | Status            | Bootldr - Update (-2), Bootldr - Idle (-1), Initialising (0), OK (1), Config (2), Error (3) |                  | RO   | Txt | ND | NC | PT |  |
| 4.00.007  | Reset             | Off (0) or On (1)   | Off (0)          | RW   | Bit |    | NC |    |  |
| 4.00.008  | Default           | Off (0) or On (1)   | Off (0)          | RW   | Bit |    | NC |    |  |
| 4.00.009  | Active Alarm Bits | 0000000000000000 to 1111111111111111  | 0000000000000000 | RO   | Bin |    | NC |    |  |
| 4.00.010  | Active IP Address | 128.0.0.0 to 127.255.255.255  | 0.0.0.0          | RO   | IP  |    | NC | PT |  |
| 4.00.011  | Date Code         | 0 to 65535  |                  | RO   | Num | ND | NC | PT |  |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Slot 4 Menu 0 – Ethernet Setup

Mode: RFC-A

| Parameter         | 4.00.001 Module ID |                |       |
|-------------------|--------------------|----------------|-------|
| Short description | Module ID          |                |       |
| Minimum           | 0                  | Maximum        | 65535 |
| Default           |                    | Units          |       |
| Type              | 16 Bit Volatile    | Update Rate    |       |
| Display Format    | Standard           | Decimal Places | 0     |
| Coding            | RO, ND, NC, PT, BU |                |       |

The Module ID. Ethernet Factory Fit Module (FFM) = 430.

| Parameter         | 4.00.002 Software Version |                |          |
|-------------------|---------------------------|----------------|----------|
| Short description | Software Version          |                |          |
| Minimum           | 0                         | Maximum        | 99999999 |
| Default           |                           | Units          |          |
| Type              | 32 Bit Volatile           | Update Rate    |          |
| Display Format    | Version                   | Decimal Places | 0        |
| Coding            | RO, ND, NC, PT            |                |          |

Module firmware version in ww.xx.yy.zz format

| Parameter         | 4.00.003 Hardware Version |                |       |
|-------------------|---------------------------|----------------|-------|
| Short description | Hardware Version          |                |       |
| Minimum           | 0.00                      | Maximum        | 99.99 |
| Default           |                           | Units          |       |
| Type              | 16 Bit Volatile           | Update Rate    |       |
| Display Format    | Standard                  | Decimal Places | 2     |
| Coding            | RO, ND, NC, PT            |                |       |

Contains the module's hardware version information in the format xx.yy.

| Parameter         | 4.00.004 Serial Number LS |                |                                 |
|-------------------|---------------------------|----------------|---------------------------------|
| Short description | Serial Number LS          |                |                                 |
| Minimum           | 0<br>(Display: 00000000)  | Maximum        | 99999999<br>(Display: 99999999) |
| Default           |                           | Units          |                                 |
| Type              | 32 Bit Volatile           | Update Rate    | Power-up write                  |
| Display Format    | Lead Zero Pad             | Decimal Places | 0                               |
| Coding            | RO, ND, NC, PT            |                |                                 |

The module serial number is available as a pair of 32 bit values where *Serial Number LS* (MM.004) provides the least significant 8 decimal digits and *Serial Number MS* (MM.005) provides the most significant 8 decimal digits. The reconstructed serial number is ((MM.005 \* 100000000) + MM.004). For example serial number "0001234567898765" would be stored as MM.005 = 12345, MM.004 = 67898765.

| Parameter         | 4.00.005 Serial Number MS |                |                |
|-------------------|---------------------------|----------------|----------------|
| Short description | Serial Number MS          |                |                |
| Minimum           | 0                         | Maximum        | 99999999       |
| Default           |                           | Units          |                |
| Type              | 32 Bit Volatile           | Update Rate    | Power-up write |
| Display Format    | Standard                  | Decimal Places | 0              |
| Coding            | RO, ND, NC, PT            |                |                |

See *Serial Number LS* (MM.004).

| Parameter         | 4.00.006 Status    |                |            |
|-------------------|--------------------|----------------|------------|
| Short description | Status             |                |            |
| Minimum           | -2                 | Maximum        | 3          |
| Default           |                    | Units          |            |
| Type              | 8 Bit Volatile     | Update Rate    | Background |
| Display Format    | Standard           | Decimal Places | 0          |
| Coding            | RO, TE, ND, NC, PT |                |            |

| Value | Text             | Description  |
|-------|------------------|--|
| -2    | Bootldr - Update | The bootloader is performing a flash update                        |
| -1    | Bootldr - Idle   | The bootloader is idle   |
| 0     | Initialising     |  |
| 1     | OK               | Module is initialised with no errors present                       |
| 2     | Config           | A configuration error has been detected                            |
| 3     | Error            | An error has occurred preventing the module from running correctly |

| Parameter         | 4.00.007 Reset |                |   |
|-------------------|----------------|----------------|---|
| Short description | Reset          |                |   |
| Minimum           | 0              | Maximum        | 1   |
| Default           | 0              | Units          |   |
| Type              | 1 Bit Volatile | Update Rate    | Read every 200ms, Written to 0 on module initialisation |
| Display Format    | Standard       | Decimal Places | 0   |
| Coding            | RW, NC         |                |   |

When set the module performs a warm reset. When the reset has been performed and the module is performing its initialization routines the parameter will be cleared to zero. Note: The drive, and any other modules fitted to the drive will not be affected by the reset.

| Parameter         | 4.00.008 Default |                |   |
|-------------------|------------------|----------------|---|
| Short description | Default          |                |   |
| Minimum           | 0                | Maximum        | 1   |
| Default           | 0                | Units          |   |
| Type              | 1 Bit Volatile   | Update Rate    | Read every 200ms, Written to 0 on module initialisation |
| Display Format    | Standard         | Decimal Places | 0   |
| Coding            | RW, NC           |                |   |

If set to "ON" when the module is reset, this parameter will cause the option module to return to its "Out of Box configuration" any settings stored on the module will be returned to their default values. This will include any Web page customisations, e-mail settings etc. Following the default the module will set the parameter to "OFF" and the module will reset.

Take care using this parameter as any configuration information will be irretrievably lost!

Note: The password for the 'root' account is not reset back to default.

| Parameter         | 4.00.009 Active Alarm Bits       |                |                                      |
|-------------------|----------------------------------|----------------|--------------------------------------|
| Short description |                                  |                |                                      |
| Minimum           | 0<br>(Display: 0000000000000000) | Maximum        | 65535<br>(Display: 1111111111111111) |
| Default           | 0<br>(Display: 0000000000000000) | Units          |                                      |
| Type              | 16 Bit Volatile                  | Update Rate    | Background                           |
| Display Format    | Binary                           | Decimal Places | 0                                    |
| Coding            | RO, NC, BU                       |                |                                      |

| Bit | Alarm        |
|-----|--------------|
| 0   | User Program |
| 1   | eCMP         |
| 2   | Modbus       |
| 3   | Ethernet/IP  |
| 4   | Reserved     |
| 5   | Filesystem   |
| 6   | Too Hot      |

| Parameter         | 4.00.010 Active IP Address          |                |  |
|-------------------|-------------------------------------|----------------|--|
| Short description |                                     |                |  |
| Minimum           | -2147483648<br>(Display: 128.0.0.0) | Maximum        | 2147483647<br>(Display: 127.255.255.255) |
| Default           | 0<br>(Display: 0.0.0.0)             | Units          |  |
| Type              | 32 Bit Volatile                     | Update Rate    | Background                               |
| Display Format    | IP Address                          | Decimal Places | 0  |
| Coding            | RO, NC, PT                          |                |  |

Modules active IP address.

| Parameter         | 4.00.011 <i>Date Code</i> |                |            |
|-------------------|---------------------------|----------------|------------|
| Short description |                           |                |            |
| Minimum           | 0                         | Maximum        | 65535      |
| Default           |                           | Units          |            |
| Type              | 16 Bit Volatile           | Update Rate    | Background |
| Display Format    | Standard                  | Decimal Places | 0          |
| Coding            | RO, ND, NC, PT, BU        |                |            |

*Date Code* (4.00.011) is a two-digit number in the form yyww where yy is the year and ww the week number.

## Slot 4 Menu 2 Single Line Descriptions – Ethernet Configuration

Mode: RFC-A

| Parameter |                           | Range   | Default        | Type |     |    |    |    |    |
|-----------|---------------------------|---|----------------|------|-----|----|----|----|----|
| 4.02.003  | Network Status            | Initialising (0), Links Down (1), DHCP In Progress (2), No Address (3), Ready (4), Active (5) |                | RO   | Txt | ND | NC | PT |    |
| 4.02.004  | Network Message Count     | 0 to 65535 Messages/s   |                | RO   | Num | ND | NC | PT |    |
| 4.02.005  | DHCP Enable               | Off (0) or On (1)   | On (1)         | RW   | Bit |    |    |    | US |
| 4.02.006  | IP Address                | 0.0.0.0 to 255.255.255.255  | 192.168.1.100  | RW   | IP  |    |    |    | US |
| 4.02.007  | Subnet Mask               | 0.0.0.0 to 255.255.255.255  | 255.255.255.0  | RW   | IP  |    |    |    | US |
| 4.02.008  | Default Gateway           | 0.0.0.0 to 255.255.255.255  | 192.168.1.254  | RW   | IP  |    |    |    | US |
| 4.02.009  | Primary DNS               | 0.0.0.0 to 255.255.255.255  | 0.0.0.0        | RW   | IP  |    |    |    | US |
| 4.02.010  | Secondary DNS             | 0.0.0.0 to 255.255.255.255  | 0.0.0.0        | RW   | IP  |    |    |    | US |
| 4.02.011  | MAC Address               | 00:00:00:00:00:00 to FF:FF:FF:FF:FF:FF  |                | RO   | Mac | ND | NC | PT |    |
| 4.02.020  | Priority Protocol         | None (0), Modbus TCP (1), EtherNet/IP (2)   | None (0)       | RW   | Txt |    |    |    | US |
| 4.02.021  | Web Server Enable         | Off (0) or On (1)   | On (1)         | RW   | Bit |    |    |    | US |
| 4.02.022  | Web Server Port           | 0 to 65535  | 80             | RW   | Num |    |    |    | US |
| 4.02.024  | Ethernet MTU              | 158 to 1500 Bytes   | 1500 Bytes     | RW   | Num |    |    |    | US |
| 4.02.025  | Gateway Mode              | Switch (0), Gateway (1), Strict Gateway (2)   | Switch (0)     | RW   | Txt |    |    |    | US |
| 4.02.030  | VLAN Enable               | Off (0) or On (1)   | Off (0)        | RW   | Bit |    |    |    | US |
| 4.02.031  | Drive VLAN ID             | 0 to 255  | 0              | RW   | Num |    |    |    | US |
| 4.02.034  | Drive compatibility mode  | Unidrive M (0), Unidrive SP (1)   | Unidrive M (0) | RW   | Txt |    |    |    | US |
| 4.02.035  | Non cyclic enable         | Off (0) or On (1)   | Off (0)        | RW   | Bit |    |    |    | US |
| 4.02.036  | Non cyclic base parameter | 0 to 59999  | 0              | RW   | Num |    |    |    | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |



## Slot 4 Menu 2 – Ethernet Configuration

Mode: RFC-A

Note: The maximum Ethernet packet size is 400 bytes.

| Parameter         | 4.02.003 Network Status |                |                      |
|-------------------|-------------------------|----------------|----------------------|
| Short description | Shows the module status |                |                      |
| Minimum           | 0                       | Maximum        | 5                    |
| Default           |                         | Units          |                      |
| Type              | 8 Bit Volatile          | Update Rate    | Written every second |
| Display Format    | Standard                | Decimal Places | 0                    |
| Coding            | RO, TE, ND, NC, PT, BU  |                |                      |

| Value | Text             | Description   |
|-------|------------------|---|
| 0     | Initialising     | The network interface is being initialised  |
| 1     | Links Down       | No link connection has been detected on either of the Ethernet ports  |
| 2     | DHCP In Progress | The module is attempting to obtain an IP address, subnet mask, default gateway and DNS server addresses from a DHCP server    |
| 3     | No Address       | The module does not have an IP address - either the user has not provided one manually or one could not be allocated via DHCP |
| 4     | Ready            | The network interface has been successfully configured but no data is being received or transmitted                           |
| 5     | Active           | The network interface is receiving or transmitting data   |

This parameter indicates the status of the network that the module is connected to.

| Parameter         | 4.02.004 Network Message Count          |                |                      |
|-------------------|---|----------------|----------------------|
| Short description | Shows the number of messages per second |                |                      |
| Minimum           | 0                                       | Maximum        | 65535                |
| Default           |   | Units          | Messages/s           |
| Type              | 16 Bit Volatile                         | Update Rate    | Written every second |
| Display Format    | Standard                                | Decimal Places | 0                    |
| Coding            | RO, ND, NC, PT, BU                      |                |                      |

The number of frames that the module is transmitting / receiving every second.

| Parameter         | 4.02.005 DHCP Enable |                |                 |
|-------------------|----------------------|----------------|-----------------|
| Short description | Set to enable DHCP   |                |                 |
| Minimum           | 0                    | Maximum        | 1               |
| Default           | 1                    | Units          |                 |
| Type              | 1 Bit User Save      | Update Rate    | Background read |
| Display Format    | Standard             | Decimal Places | 0               |
| Coding            | RW, BU               |                |                 |

Controls whether or not the module will attempt to use a Dynamic Host Configuration Protocol (DHCP) server to obtain an IP address, subnet mask, default gateway and DNS servers.

When DHCP is enabled, the following parameters will become read-only immediately (no reset required):

*IP Address* (4.02.006)

*Subnet Mask* (4.02.007)

*Default Gateway* (4.02.008)

*Primary DNS* (4.02.009)

*Secondary DNS* (4.02.010)

| Parameter         | 4.02.006 IP Address                            |                |  |
|-------------------|--|----------------|--|
| Short description | Sets and/or shows the IP address of the module |                |  |
| Minimum           | 0<br>(Display: 0.0.0.0)                        | Maximum        | 4294967295<br>(Display: 255.255.255.255)                     |
| Default           | 3232235876<br>(Display: 192.168.1.100)         | Units          |  |
| Type              | 32 Bit User Save                               | Update Rate    | DHCP enabled : write on event; DHCP disabled : read on reset |
| Display Format    | IP Address                                     | Decimal Places | 0  |
| Coding            | RW, BU   |                |  |

Controls and displays the IP address of the module.

If DHCP is enabled ( *DHCP Enable* (4.02.005) ) this parameter becomes read-only and, until an IP address is allocated to the module, will display 0.0.0.0.

If DHCP is disabled the module will initialise, on reset or power cycle, with the IP address stored for the parameter.

| Parameter         | 4.02.007 Subnet Mask                            |                |  |
|-------------------|---|----------------|--|
| Short description | Sets and/or shows the subnet mask of the module |                |  |
| Minimum           | 0<br>(Display: 0.0.0.0)                         | Maximum        | 4294967295<br>(Display: 255.255.255.255)                     |
| Default           | 4294967040<br>(Display: 255.255.255.0)          | Units          |  |
| Type              | 32 Bit User Save                                | Update Rate    | DHCP enabled : write on event; DHCP disabled : read on reset |
| Display Format    | IP Address                                      | Decimal Places | 0  |
| Coding            | RW, BU  |                |  |

Controls and displays the subnet mask of the module.

If DHCP is enabled ( *DHCP Enable* (4.02.005) ) this parameter becomes read-only and, until a subnet mask is allocated to the module, will display 0.0.0.0.

If DHCP is disabled the module will initialise, on reset or power cycle, with the subnet mask stored for the parameter.

| Parameter         | 4.02.008 Default Gateway                            |                |  |
|-------------------|---|----------------|--|
| Short description | Sets and/or shows the default gateway of the module |                |  |
| Minimum           | 0<br>(Display: 0.0.0.0)                             | Maximum        | 4294967295<br>(Display: 255.255.255.255)                     |
| Default           | 3232236030<br>(Display: 192.168.1.254)              | Units          |  |
| Type              | 32 Bit User Save                                    | Update Rate    | DHCP enabled : write on event; DHCP disabled : read on reset |
| Display Format    | IP Address  | Decimal Places | 0  |
| Coding            | RW, BU  |                |  |

Controls and displays the default gateway of the module.

If DHCP is enabled ( *DHCP Enable* (4.02.005) ) this parameter becomes read-only and, until a default gateway is allocated to the module, will display 0.0.0.0.

If DHCP is disabled the module will initialise, on reset or power cycle, with the default gateway stored for the parameter.

| Parameter         | 4.02.009 Primary DNS                                    |                |  |
|-------------------|---|----------------|--|
| Short description | Sets and/or shows the primary DNS address of the module |                |  |
| Minimum           | 0<br>(Display: 0.0.0.0)                                 | Maximum        | 4294967295<br>(Display: 255.255.255.255)                     |
| Default           | 0<br>(Display: 0.0.0.0)                                 | Units          |  |
| Type              | 32 Bit User Save  | Update Rate    | DHCP enabled : write on event; DHCP disabled : read on reset |
| Display Format    | IP Address  | Decimal Places | 0  |
| Coding            | RW, BU  |                |  |

The module can use this IP address when it wishes to resolve the IP address for a domain name. This parameter performs the same function as the Secondary DNS parameter *Secondary DNS* (4.02.010) , however the address specified in this parameter will be tried first. Only when this address is unsuccessful will the Secondary DNS address be tried.

If DHCP is enabled ( *DHCP Enable* (4.02.005) ) this parameter becomes read-only and, until a primary DNS address is allocated to the module, will display 0.0.0.0.

If DHCP is disabled the module will initialise, on reset or power cycle, with the primary DNS address stored for the parameter.

| Parameter         | 4.02.010 Secondary DNS                                    |                |  |
|-------------------|---|----------------|--|
| Short description | Sets and/or shows the secondary DNS address of the module |                |  |
| Minimum           | 0<br>(Display: 0.0.0.0)                                   | Maximum        | 4294967295<br>(Display: 255.255.255.255)                     |
| Default           | 0<br>(Display: 0.0.0.0)                                   | Units          |  |
| Type              | 32 Bit User Save  | Update Rate    | DHCP enabled : write on event; DHCP disabled : read on reset |
| Display Format    | IP Address  | Decimal Places | 0  |
| Coding            | RW, BU  |                |  |

The module can use this IP address when it wishes to resolve the IP address for a domain name. This parameter performs the same function as the Primary DNS parameter *Primary DNS* (4.02.009) , however the address specified in this parameter will be tried only when the Primary DNS address is unsuccessful.

If DHCP is enabled ( *DHCP Enable* (4.02.005) ) this parameter becomes read-only and, until a secondary DNS address is allocated to the module, will display 0.0.0.0.

If DHCP is disabled the module will initialise, on reset or power cycle, with the secondary DNS address stored for the parameter.

| Parameter         | 4.02.011 MAC Address                |                |   |
|-------------------|-------------------------------------|----------------|---|
| Short description | Shows the MAC address of the module |                |   |
| Minimum           | 0<br>(Display: 00:00:00:00:00:00)   | Maximum        | 281474976710655<br>(Display: FF:FF:FF:FF:FF:FF) |
| Default           |                                     | Units          |   |
| Type              | 64 Bit Volatile                     | Update Rate    | Power-up write                                  |
| Display Format    | MAC Address                         | Decimal Places | 0   |
| Coding            | RO, ND, NC, PT, BU                  |                |   |

The 48-bit MAC address of the module.

| Parameter         | 4.02.020 Priority Protocol |                |                 |
|-------------------|----------------------------|----------------|-----------------|
| Short description | Sets the Priority Protocol |                |                 |
| Minimum           | 0                          | Maximum        | 2               |
| Default           | 0                          | Units          |                 |
| Type              | 8 Bit User Save            | Update Rate    | Background read |
| Display Format    | Standard                   | Decimal Places | 0               |
| Coding            | RW, TE, BU                 |                |                 |

Selection of the fieldbus protocol to have priority over all other protocols.

| Value | Text        | Description                       |
|-------|-------------|-----------------------------------|
| 0     | None        | All protocols have equal priority |
| 1     | Modbus TCP  | Modbus TCP has highest priority   |
| 2     | EtherNet/IP | EtherNet/IP has highest priority  |

Enables selection of one fieldbus protocol to have priority over others. A tick period of 1 ms will be given to the highest priority fieldbus protocol, 5 ms to all other fieldbus protocols (equal priority).

If no fieldbus protocol has been selected to have priority over others all protocols will have equal priority and a tick rate of 5 ms.

| Parameter         | 4.02.021 Web Server Enable |                |                 |
|-------------------|----------------------------|----------------|-----------------|
| Short description | Enables the Web Server     |                |                 |
| Minimum           | 0                          | Maximum        | 1               |
| Default           | 1                          | Units          |                 |
| Type              | 1 Bit User Save            | Update Rate    | Background read |
| Display Format    | Standard                   | Decimal Places | 0               |
| Coding            | RW, BU                     |                |                 |

Controls the running of the webserver on the module.

| Parameter         | 4.02.022 Web Server Port      |                |                                      |
|-------------------|-------------------------------|----------------|--------------------------------------|
| Short description | Specifies the web server port |                |                                      |
| Minimum           | 0                             | Maximum        | 65535                                |
| Default           | 80                            | Units          |                                      |
| Type              | 16 Bit User Save              | Update Rate    | Read on module reset and HTTP_ENABLE |
| Display Format    | Standard                      | Decimal Places | 0                                    |
| Coding            | RW, BU                        |                |                                      |

The web server port. This may be changed for added security.

| Parameter         | 4.02.024 Ethernet MTU                        |                |                      |
|-------------------|--|----------------|----------------------|
| Short description | Specifies the MTU for the Ethernet interface |                |                      |
| Minimum           | 158  | Maximum        | 1500                 |
| Default           | 1500   | Units          | Bytes                |
| Type              | 16 Bit User Save                             | Update Rate    | Read on module reset |
| Display Format    | Standard                                     | Decimal Places | 0                    |
| Coding            | RW, BU                                       |                |                      |

This parameter is now deprecated. The maximum Ethernet packet size is now 400 bytes.

| Parameter         | 4.02.025 Gateway Mode                       |                |                      |
|-------------------|---|----------------|----------------------|
| Short description | Specifies the operation mode of the gateway |                |                      |
| Minimum           | 0   | Maximum        | 2                    |
| Default           | 0   | Units          |                      |
| Type              | 8 Bit User Save                             | Update Rate    | Read on module reset |
| Display Format    | Standard                                    | Decimal Places | 0                    |
| Coding            | RW, TE, BU                                  |                |                      |

| Value | Text           |
|-------|----------------|
| 0     | Switch         |
| 1     | Gateway        |
| 2     | Strict Gateway |

Specifies the operation mode of the gateway. By default the gateway is disabled and the switch operates in normal switch mode, by enabling the gateway mode all packets are filtered by the module and prioritised before being forwarded on. In strict mode the gateway will drop packets from unsupported protocols.

VLAN must be enabled *VLAN Enable* (4.02.030) when the gateway is enabled.

| Parameter         | 4.02.030 VLAN Enable |                |                      |
|-------------------|----------------------|----------------|----------------------|
| Short description | Enables VLAN tagging |                |                      |
| Minimum           | 0                    | Maximum        | 1                    |
| Default           | 0                    | Units          |                      |
| Type              | 1 Bit User Save      | Update Rate    | Read on module reset |
| Display Format    | Standard             | Decimal Places | 0                    |
| Coding            | RW                   |                |                      |

Controls whether the module will use VLAN tagging.

When used in conjunction with *Drive VLAN ID* (4.02.031) network traffic from the interface will be tagged with the chosen VLAN identifier.

When default values for *Drive VLAN ID* (4.02.031) is set, enabling this parameter will add VLAN prioritisation to all packets helping to ensure real-time packets are not delayed by those of lower priority. If disabled, prioritisation will use the Diffserv field in IP traffic only, meaning non-IP traffic can still affect real-time IP traffic.

| Parameter         | 4.02.031 Drive VLAN ID  |                |                                      |
|-------------------|---|----------------|--------------------------------------|
| Short description | Specifies a VLAN ID that the drive (Port 0) will be a member of |                |                                      |
| Minimum           | 0   | Maximum        | 255                                  |
| Default           | 0   | Units          |                                      |
| Type              | 8 Bit User Save   | Update Rate    | Read on module reset and VLAN_ENABLE |
| Display Format    | Standard  | Decimal Places | 0                                    |
| Coding            | RW, BU  |                |                                      |

Specifies the VLAN ID that the interface will be a member of. Any packets entering the switch without this VLAN ID will not be handled.

| Parameter         | 4.02.034 Drive compatibility mode                                   |                |                      |
|-------------------|---|----------------|----------------------|
| Short description | Specifies the mimic of the GT8 from a PLC for EthernetIP and Modbus |                |                      |
| Minimum           | 0   | Maximum        | 1                    |
| Default           | 0   | Units          |                      |
| Type              | 8 Bit User Save   | Update Rate    | Read on module reset |
| Display Format    | Standard  | Decimal Places | 0                    |
| Coding            | RW, TE, BU  |                |                      |

Defines the parameter conversion for EthernetIP and Modbus.

| Value | Text        |
|-------|-------------|
| 0     | Unidrive M  |
| 1     | Unidrive SP |

| Parameter         | 4.02.035 Non cyclic enable |                |            |
|-------------------|----------------------------|----------------|------------|
| Short description | Specify non cyclic enable  |                |            |
| Minimum           | 0                          | Maximum        | 1          |
| Default           | 0                          | Units          |            |
| Type              | 1 Bit User Save            | Update Rate    | Background |
| Display Format    | Standard                   | Decimal Places | 0          |
| Coding            | RW                         |                |            |

Enable the Non cyclic data transfer.

| Parameter         | 4.02.036 Non cyclic base parameter                                 |                |            |
|-------------------|--|----------------|------------|
| Short description | Specify the base parameter of the user program non cyclic handling |                |            |
| Minimum           | 0  | Maximum        | 59999      |
| Default           | 0  | Units          |            |
| Type              | 16 Bit User Save   | Update Rate    | Background |
| Display Format    | Slot Menu Parameter  | Decimal Places | 0          |
| Coding            | RW, BU   |                |            |

The value in this parameter points to the base address of a group of parameters which used for handling non cyclic data by user programs.

Suppose the base address is S.MM.PPP, the following are the functions of the group of the parameters. Please note that these parameters should be at least 16 bits in size.

|             |                    |             |        |
|-------------|--------------------|-------------|--------|
| Parameter   | S.MM.PPP           |             |        |
| Description | Command and Status |             |        |
| Identifier  |                    |             |        |
| Mode(s)     |                    |             |        |
| Minimum     | 0                  | Maximum     | 0x0403 |
| Default     | 0                  | Units       |        |
| Type        | 16 bit user save   | Update rate |        |

|      |    |                          |                |    |                  |   |
|------|----|--------------------------|----------------|----|------------------|---|
|      | FL | Floating point parameter | 0              | ND | No default       | 0   |
|      | DF | Display format           | 0              | RA | Rating dependent | 0   |
|      | PR | Pseudo read-only         | 0              | NC | Not clonable     | 1   |
|      | FI | Filtered                 | 0              | NV | Not visible      | 0   |
|      | DE | Destination parameter    | 0              | PT | Protected        | 0   |
|      | TE | Text parameter           | 0              | NR | Not readable     | 0   |
|      | VM | Variable minimum/maximum | 0              | W  | Writable         | 1   |
| UNIT | 0  | DP                       | Decimal places | 0  | BU               | Default (1 bit types) / Unipolar (all other types): 1 |

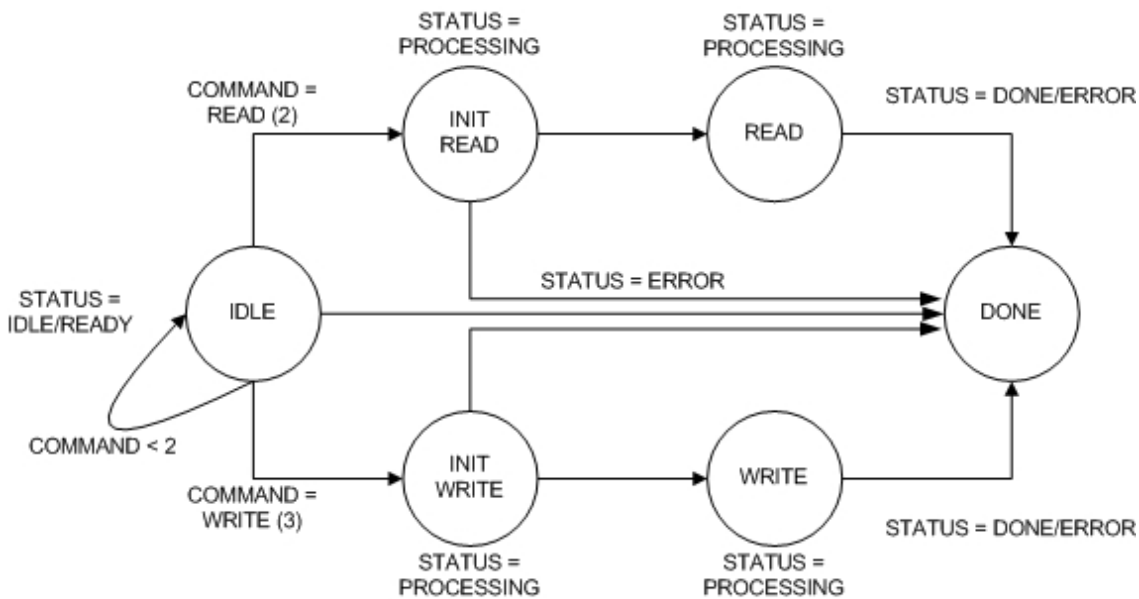
The MSB is used for Status and the LSB is used for Command.

Possible values for the Command are:

| Value | Meaning       | Description   |
|-------|---------------|---|
| 0     | No Command    | No command or Abort during a command process                  |
| 1     | Check / Abort | Check if the status idle or abort from read or write command. |
| 2     | Read          | Read one parameter  |
| 3     | Write         | Write one parameter   |

Possible values for the Status are:

| Value | Meaning    | Description   |
|-------|------------|---|
| 0     | IDLE       | Idle  |
| 1     | READY      | The parameter channel is ready to take commands                 |
| 2     | PROCESSING | Processing the command  |
| 3     | OK         | The command processed successfully                              |
| 4     | ERROR      | Error is detected, detail will be found in the first parameter. |



Note:  
COMMAND = ABORT (0) in ANY state causes immediate transition to IDLE state

|             |                                |         |             |
|-------------|--------------------------------|---------|-------------|
| Parameter   | S.MM.PPP + 1                   |         |             |
| Description | Destination IP Address www.xxx |         |             |
| Identifier  |                                |         |             |
| Mode(s)     |                                |         |             |
| Minimum     | 0                              | Maximum | 0xFFFF      |
| Default     | 0                              | Units   |             |
| Type        | 16 Bit User Save               |         | Update rate |

|      |    |                          |                |    |                  |   |
|------|----|--------------------------|----------------|----|------------------|---|
|      | FL | Floating point parameter | 0              | ND | No default       | 0   |
|      | DF | Display format           | 0              | RA | Rating dependent | 0   |
|      | PR | Pseudo read-only         | 0              | NC | Not clonable     | 0   |
|      | FI | Filtered                 | 0              | NV | Not visible      | 0   |
|      | DE | Destination parameter    | 1              | PT | Protected        | 0   |
|      | TE | Text parameter           | 0              | NR | Not readable     | 0   |
|      | VM | Variable minimum/maximum | 0              | W  | Writable         | 1   |
| UNIT | 0  | DP                       | Decimal places | 0  | BU               | Default (1 bit types) / Unipolar (all other types): 1 |

The higher two sections for the destination IP address. 0xFF000000 (127.0.0.1) represents the current drive.

|             |                                |         |             |
|-------------|--------------------------------|---------|-------------|
| Parameter   | S.MM.PPP + 2                   |         |             |
| Description | Destination IP Address yyy.zzz |         |             |
| Identifier  |                                |         |             |
| Mode(s)     |                                |         |             |
| Minimum     | 0                              | Maximum | 0xFFFF      |
| Default     | 0                              | Units   |             |
| Type        | 16 Bit User Save               |         | Update rate |

|      |    |                          |   |    |   |   |
|------|----|--------------------------|---|----|---|---|
|      | FL | Floating point parameter | 0 | ND | No default  | 0 |
|      | DF | Display format           | 0 | RA | Rating dependent                                    | 0 |
|      | PR | Pseudo read-only         | 0 | NC | Not clonable  | 0 |
|      | FI | Filtered                 | 0 | NV | Not visible   | 0 |
|      | DE | Destination parameter    | 1 | PT | Protected   | 0 |
|      | TE | Text parameter           | 0 | NR | Not readable  | 0 |
|      | VM | Variable minimum/maximum | 0 | W  | Writable  | 1 |
| UNIT | 0  | DP                       | 0 | BU | Default (1 bit types) / Unipolar (all other types): | 1 |

The lower two sections for the destination IP address

|             |                       |             |     |
|-------------|-----------------------|-------------|-----|
| Parameter   | S.MM.PPP + 3          |             |     |
| Description | Parameter Address SMM |             |     |
| Identifier  |                       |             |     |
| Mode(s)     |                       |             |     |
| Minimum     | 0                     | Maximum     | 499 |
| Default     | 0                     | Units       |     |
| Type        | 16 Bit User Save      | Update rate |     |

|      |    |                          |   |    |   |   |
|------|----|--------------------------|---|----|---|---|
|      | FL | Floating point parameter | 0 | ND | No default  | 0 |
|      | DF | Display format           | 0 | RA | Rating dependent                                    | 0 |
|      | PR | Pseudo read-only         | 0 | NC | Not clonable  | 0 |
|      | FI | Filtered                 | 0 | NV | Not visible   | 0 |
|      | DE | Destination parameter    | 0 | PT | Protected   | 0 |
|      | TE | Text parameter           | 0 | NR | Not readable  | 0 |
|      | VM | Variable minimum/maximum | 0 | W  | Writable  | 1 |
| UNIT | 0  | DP                       | 0 | BU | Default (1 bit types) / Unipolar (all other types): | 1 |

Destination parameter address – Slot and Menu sections.



|             |                       |             |     |
|-------------|-----------------------|-------------|-----|
| Parameter   | S.MM.PPP + 4          |             |     |
| Description | Parameter Address PPP |             |     |
| Identifier  |                       |             |     |
| Mode(s)     |                       |             |     |
| Minimum     | 0                     | Maximum     | 999 |
| Default     | 0                     | Units       |     |
| Type        | 16 Bit User Save      | Update rate |     |

|      |    |                          |                |    |                  |   |
|------|----|--------------------------|----------------|----|------------------|---|
|      | FL | Floating point parameter | 0              | ND | No default       | 0   |
|      | DF | Display format           | 0              | RA | Rating dependent | 0   |
|      | PR | Pseudo read-only         | 0              | NC | Not clonable     | 0   |
|      | FI | Filtered                 | 0              | NV | Not visible      | 0   |
|      | DE | Destination parameter    | 0              | PT | Protected        | 0   |
|      | TE | Text parameter           | 0              | NR | Not readable     | 0   |
|      | VM | Variable minimum/maximum | 0              | W  | Writable         | 1   |
| UNIT | 0  | DP                       | Decimal places | 0  | BU               | Default (1 bit types) / Unipolar (all other types): 1 |

Destination parameter address - parameter section

|             |                                  |             |                    |
|-------------|----------------------------------|-------------|--------------------|
| Parameter   | S.MM.PPP + 5                     |             |                    |
| Description | Parameter Value LSW / Error Code |             |                    |
| Identifier  |                                  |             |                    |
| Mode(s)     |                                  |             |                    |
| Minimum     | -2 <sup>15</sup>                 | Maximum     | 2 <sup>15</sup> -1 |
| Default     | 0                                | Units       |                    |
| Type        | 16 Bit User Save                 | Update rate |                    |

|      |    |                          |   |    |   |   |
|------|----|--------------------------|---|----|---|---|
|      | FL | Floating point parameter | 0 | ND | No default  | 0 |
|      | DF | Display format           | 4 | RA | Rating dependent                                    | 0 |
|      | PR | Pseudo read-only         | 0 | NC | Not clonable  | 0 |
|      | FI | Filtered                 | 0 | NV | Not visible   | 0 |
|      | DE | Destination parameter    | 0 | PT | Protected   | 0 |
|      | TE | Text parameter           | 0 | NR | Not readable  | 0 |
|      | VM | Variable minimum/maximum | 0 | W  | Writable  | 1 |
| UNIT | 0  | DP                       | 0 | BU | Default (1 bit types) / Unipolar (all other types): | 0 |

It stores the least significant word of the value to be write in to the destination parameter if the command is Write (2)

It stores the least significant word of the value read from the destination parameter if the command is read and the status is Done.

It is the error code for the process if the status is Error.

The following table list the possible error codes:

| Value       | Meaning          | Description   |
|-------------|------------------|---|
| -1          | Address Type     | The addressing type is not supported  |
| -2          | Timeout          | A timeout occurred trying to access the specified item                                      |
| -3          | Access Denied    | The requesting device does not have sufficient access rights                                |
| -4          | Does not exist   | The specified item does not exist   |
| -5          | Data Type        | The data could not be converted from the specified type                                     |
| -6          | Failed Read      | The value could not be read, reason unknown   |
| -7          | Failed Write     | The value could not be written, reason unknown  |
| -8          | Not Readable     | The data could not be read as the source does not allow read access.                        |
| -9          | Not Writeable    | The data could not be written as the destination does not allow write access.               |
| -10         | Over Range       | The specified value is outside the suitable range for the item.                             |
| -11         | Request Invalid  | The request contained invalid information.  |
| -12         | Response Too Big | The response will not fit in the maximum response size.                                     |
| -13         | Decimal Place    | The decimal place information is invalid (i.e. out of range of allowed values for a write). |
| -14         | Invalid Param    | Invalid parameter in the parameter channel.   |
| -15         | Invalid CMD      | Invalid command   |
| -16         | Invalid IP       | Invalid IP address  |
| -17         | Unknown Error    | An unknown error happens  |
| -18 to -128 | <i>Reserved</i>  |   |

|             |                     |             |                    |
|-------------|---------------------|-------------|--------------------|
| Parameter   | S.MM.PPP + 6        |             |                    |
| Description | Parameter Value MSW |             |                    |
| Identifier  |                     |             |                    |
| Mode(s)     |                     |             |                    |
| Minimum     | -2 <sup>15</sup>    | Maximum     | 2 <sup>15</sup> -1 |
| Default     | 0                   | Units       |                    |
| Type        | 16 Bit User Save    | Update rate |                    |

|      |    |                          |   |    |   |   |
|------|----|--------------------------|---|----|---|---|
|      | FL | Floating point parameter | 0 | ND | No default  | 0 |
|      | DF | Display format           | 4 | RA | Rating dependent                                    | 0 |
|      | PR | Pseudo read-only         | 0 | NC | Not clonable  | 0 |
|      | FI | Filtered                 | 0 | NV | Not visible   | 0 |
|      | DE | Destination parameter    | 0 | PT | Protected   | 0 |
|      | TE | Text parameter           | 0 | NR | Not readable  | 0 |
|      | VM | Variable minimum/maximum | 0 | W  | Writable  | 1 |
| UNIT | 0  | DP                       | 0 | BU | Default (1 bit types) / Unipolar (all other types): | 0 |

It stores the most significant word of the value to be write in to the destination parameter if the command is Write (2)

It stores the most significant word of the value read from the destination parameter if the command is read and the status is Done.

## Slot 4 Menu 9 Single Line Descriptions – Resources

Mode: RFC-A

| Parameter |                               | Range          | Default | Type |     |    |    |    |  |
|-----------|-------------------------------|----------------|---------|------|-----|----|----|----|--|
| 4.09.001  | Cyclic Tx Links Free          | 0 to 255       |         | RO   | Num | ND | NC | PT |  |
| 4.09.002  | Cyclic Rx Links Free          | 0 to 255       |         | RO   | Num | ND | NC | PT |  |
| 4.09.003  | Fieldbus Links Free           | 0 to 255       |         | RO   | Num | ND | NC | PT |  |
| 4.09.004  | Cyclic Mappings Free          | 0 to 255       |         | RO   | Num | ND | NC | PT |  |
| 4.09.008  | Background cycles per second  | 0 to 65535     |         | RO   | Num | ND | NC | PT |  |
| 4.09.010  | Synchronous Task % Free       | 0 to 255 %     |         | RO   | Num | ND | NC | PT |  |
| 4.09.020  | Synchronous Task Worst % Free | 0 to 255 %     |         | RO   | Num | ND | NC | PT |  |
| 4.09.030  | PCB Temperature               | -128 to 127 °C |         | RO   | Num | ND | NC | PT |  |

|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Slot 4 Menu 9 – Resources

Mode: RFC-A

### Message Load

The Ethernet interface can accommodate multiple protocols running concurrently, each protocol demanding system resources. To ensure that the interface is not overloaded the following limitations should be followed.

1. maximum number of parameter accesses per second is 6000 (Unidrive M Ethernet interface) / 200 (SI-Ethernet on Unidrive M200 - M600)
2. maximum number of messages per second (02.004) is 8000

When checking that the message loading on a device is going to be acceptable, consider all protocols, e.g.:

| Protocol                           | Number of Parameters | Rate   | Parameters Accesses / Second | Message Rate / Second |
|------------------------------------|----------------------|--------|------------------------------|-----------------------|
| Modbus TCP/IP                      | 10 read              | 100 ms | 100                          | 10                    |
| EtherNet/IP                        | 5 read               | 10 ms  | 500                          | 100                   |
|                                    | 5 write              | 10 ms  | 500                          | 100                   |
| RTMoE                              | 2 write              | 500 µs | 4000                         | 2000                  |
| <b>Total</b>                       |                      |        | 5100                         | 2210                  |
| <b>Max. supported on M700/M800</b> |                      |        | 6000                         | 8000                  |
| <b>Within Capability?</b>          |                      |        | Yes                          | Yes                   |

Cyclic data, with the exception of synchronous cyclic data, is exchanged with the drive and other options in the interface's background task. *Background cycles per second* (4.09.008) can be used to view the cycle rate of the background task. If the value drops to zero then a *BG Overrun* drive trip will occur.

### RTMoE

RTMoE is an industrial Ethernet protocol for both cyclic and acyclic communication. The Ethernet interface RTMoE capabilities can be found in the table below.

| Capability                                      | Support Level                      |
|---|------------------------------------|
| Non-cyclic communication                        | Supported                          |
| Total transmit cyclic links                     | 5                                  |
| Total receive cyclic links                      | 5                                  |
| Max number of transmit synchronous cyclic links | 1 (Unidrive M interface only)      |
| Max number of receive synchronous cyclic links  | 1 (Unidrive M interface only)      |
| Max length of non-synchronous cyclic link       | 10 x 32 bit                        |
| Max length of synchronous cyclic link           | 2 x 32 bit                         |
| Min transmission period                         | 500 $\mu$ s                        |
| Synchronized with AMC                           | Yes (when cycle time $\geq$ 500us) |
| Synchronized with onboard program               | Yes (when cycle time = 4ms)        |

| Parameter         | 4.09.001 <i>Cyclic Tx Links Free</i> |                |                  |
|-------------------|--------------------------------------|----------------|------------------|
| Short description |                                      |                |                  |
| Minimum           | 0                                    | Maximum        | 255              |
| Default           |                                      | Units          |                  |
| Type              | 8 Bit Volatile                       | Update Rate    | Background write |
| Display Format    | Standard                             | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT, BU                   |                |                  |

The number of available transmit cyclic links.

| Parameter         | 4.09.002 <i>Cyclic Rx Links Free</i> |                |                  |
|-------------------|--------------------------------------|----------------|------------------|
| Short description |                                      |                |                  |
| Minimum           | 0                                    | Maximum        | 255              |
| Default           |                                      | Units          |                  |
| Type              | 8 Bit Volatile                       | Update Rate    | Background write |
| Display Format    | Standard                             | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT, BU                   |                |                  |

The number of available receive cyclic links.

| Parameter         | 4.09.003 <i>Fieldbus Links Free</i> |                |                  |
|-------------------|-------------------------------------|----------------|------------------|
| Short description |                                     |                |                  |
| Minimum           | 0                                   | Maximum        | 255              |
| Default           |                                     | Units          |                  |
| Type              | 8 Bit Volatile                      | Update Rate    | Background write |
| Display Format    | Standard                            | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT, BU                  |                |                  |

The number of available transmit / receive process images for fieldbus protocols such as Ethernet/IP.

| Parameter         | 4.09.004 <i>Cyclic Mappings Free</i> |                |                  |
|-------------------|--------------------------------------|----------------|------------------|
| Short description |                                      |                |                  |
| Minimum           | 0                                    | Maximum        | 255              |
| Default           |                                      | Units          |                  |
| Type              | 8 Bit Volatile                       | Update Rate    | Background write |
| Display Format    | Standard                             | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT, BU                   |                |                  |

The number of available mappings in the system for use in cyclic links.

| Parameter         | 4.09.008 <i>Background cycles per second</i> |                |                  |
|-------------------|--|----------------|------------------|
| Short description |  |                |                  |
| Minimum           | 0  | Maximum        | 65535            |
| Default           |  | Units          |                  |
| Type              | 16 Bit Volatile                              | Update Rate    | Background write |
| Display Format    | Standard                                     | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT, BU                           |                |                  |

The background task cycles per second represents the number of times per second the background task is currently executing. The background task is responsible for cyclic data exchange with the drive. With more cyclic data mapped the cycle rate of the task will decrease.

| Parameter         | 4.09.010 <i>Synchronous Task % Free</i> |                |                  |
|-------------------|---|----------------|------------------|
| Short description |   |                |                  |
| Minimum           | 0                                       | Maximum        | 255              |
| Default           |   | Units          | %                |
| Type              | 8 Bit Volatile                          | Update Rate    | Background write |
| Display Format    | Standard                                | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT, BU                      |                |                  |

Note: Synchronous Cyclic Links are supported on (Unidrive M Ethernet interface) but not on (SI-Ethernet on Unidrive M200 - M600).

| Parameter         | 4.09.020 <i>Synchronous Task Worst % Free</i> |                |                  |
|-------------------|---|----------------|------------------|
| Short description |   |                |                  |
| Minimum           | 0   | Maximum        | 255              |
| Default           |   | Units          | %                |
| Type              | 8 Bit Volatile                                | Update Rate    | Background write |
| Display Format    | Standard                                      | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT, BU                            |                |                  |

Worst case free resource of the synchronous task.

Note: Synchronous Cyclic Links are supported on (Unidrive M Ethernet interface) but not on (SI-Ethernet on Unidrive M200 - M600).

| Parameter         | 4.09.030 <i>PCB Temperature</i> |                |                  |
|-------------------|---------------------------------|----------------|------------------|
| Short description |                                 |                |                  |
| Minimum           | -128                            | Maximum        | 127              |
| Default           |                                 | Units          | °C               |
| Type              | 8 Bit Volatile                  | Update Rate    | Background write |
| Display Format    | Standard                        | Decimal Places | 0                |
| Coding            | RO, ND, NC, PT                  |                |                  |



## Slot 4 Menu 10 Single Line Descriptions – *Easy Mode Cyclic Data*

Mode: RFC-A

| Parameter |                            | Range   | Default     | Type |     |    |    |    |    |
|-----------|----------------------------|---|-------------|------|-----|----|----|----|----|
| 4.10.001  | Enable                     | Off (0) or On (1)   | On (1)      | RW   | Bit |    |    |    | US |
| 4.10.002  | Reset                      | Off (0) or On (1)   | Off (0)     | RW   | Bit |    | NC |    |    |
| 4.10.003  | Default                    | Off (0) or On (1)   | Off (0)     | RW   | Bit |    | NC |    |    |
| 4.10.004  | Cyclic Messages Per Second | 0 to 65535 Messages/s   |             | RO   | Num | ND | NC | PT |    |
| 4.10.005  | Configuration Valid        | Off (0) or On (1)   |             | RO   | Bit | ND | NC | PT |    |
| 4.10.006  | Operational                | Off (0) or On (1)   |             | RO   | Bit | ND | NC | PT |    |
| 4.10.007  | Active Configuration       | None (0), Easy Mode (1), Offline (2)  |             | RO   | Txt | ND | NC | PT |    |
| 4.10.008  | Timeout Count              | 0 to 65535  |             | RO   | Num | ND | NC | PT |    |
| 4.10.009  | Data Late Count            | 0 to 65535  |             | RO   | Num | ND | NC | PT |    |
| 4.10.010  | Tx1 Link Profile           | Std (0), Sync (1)   | Std (0)     | RW   | Txt |    |    |    | US |
| 4.10.011  | Tx1 Link Number            | 0 to 255  | 0           | RW   | Num |    |    |    | US |
| 4.10.012  | Tx1 Source Parameter       | 0 to 499999   | 0           | RW   | Num |    |    | PT | US |
| 4.10.013  | Tx1 Parameter Count        | 0 to 10   | 0           | RW   | Num |    |    |    | US |
| 4.10.014  | Tx1 Link Transmission Type | Unicast (0), Broadcast (1), Multicast1 (2), Multicast2 (3), Multicast3 (4), Multicast4 (5), Multicast5 (6), Multicast6 (7), Multicast7 (8), Multicast8 (9), Multicast9 (10), Multicast10 (11)   | Unicast (0) | RW   | Txt |    |    |    | US |
| 4.10.015  | Tx1 Destination Address    | 0.0.0.0 to 255.255.255.255  | 0.0.0.0     | RW   | IP  |    |    |    | US |
| 4.10.016  | Tx1 Message Rate           | 0 to 100 ms   | 0 ms        | RW   | Num |    |    |    | US |
| 4.10.019  | Tx1 Link Status            | Disabled (-31), VLAN disabled (-30), Reserved 29 (-29), Reserved 28 (-28), Reserved 27 (-27), Reserved 26 (-26), Reserved 25 (-25), Reserved 24 (-24), Reserved 23 (-23), Invalid DST IP (-22), SYNC unsupported (-21), MEC offset (-20), Invalid tx rate (-19), Too many mapping (-18), Link busy (-17), Invalid profile (-16), Invalid mapping (-15), Read only param (-14), Msg mismatch (-13), Msg too long (-12), Attrib NA (-11), Attrib RO (-10), Attrib missing (-9), Timeout (-8), In error (-7), Link num in use (-6), Not editable (-5), Invalid link num (-4), Invalid args (-3), Too many links (-2), Out of memory (-1), OK (0), Not running (1), OK sync (2) |             | RO   | Txt | ND | NC | PT |    |
| 4.10.020  | Tx2 Link Profile           | Std (0), Sync (1)   | Std (0)     | RW   | Txt |    |    |    | US |
| 4.10.021  | Tx2 Link Number            | 0 to 255  | 0           | RW   | Num |    |    |    | US |
| 4.10.022  | Tx2 Source Parameter       | 0 to 499999   | 0           | RW   | Num |    |    | PT | US |
| 4.10.023  | Tx2 Parameter Count        | 0 to 10   | 0           | RW   | Num |    |    |    | US |
| 4.10.024  | Tx2 Link Transmission Type | Unicast (0), Broadcast (1), Multicast1 (2), Multicast2 (3), Multicast3 (4), Multicast4 (5), Multicast5 (6), Multicast6 (7), Multicast7 (8), Multicast8 (9), Multicast9 (10), Multicast10 (11)   | Unicast (0) | RW   | Txt |    |    |    | US |
| 4.10.025  | Tx2 Destination Address    | 0.0.0.0 to 255.255.255.255  | 0.0.0.0     | RW   | IP  |    |    |    | US |
| 4.10.026  | Tx2 Message Rate           | 0 to 100 ms   | 0 ms        | RW   | Num |    |    |    | US |
| 4.10.029  | Tx2 Link Status            | Disabled (-31), VLAN disabled (-30), Reserved 29 (-29), Reserved 28 (-28), Reserved 27 (-27), Reserved 26 (-26), Reserved 25 (-25), Reserved 24 (-24), Reserved 23 (-23), Invalid DST IP (-22), SYNC unsupported (-21), MEC offset (-20), Invalid tx rate (-19), Too many mapping (-18), Link busy (-17), Invalid profile (-16), Invalid mapping (-15), Read only param (-14), Msg mismatch (-13), Msg too long (-12), Attrib NA (-11), Attrib RO (-10), Attrib missing (-9), Timeout (-8), In error (-7), Link num in use (-6), Not editable (-5), Invalid link num (-4), Invalid args (-3), Too many links (-2), Out of memory (-1), OK (0), Not running (1), OK sync (2) |             | RO   | Txt | ND | NC | PT |    |
| 4.10.030  | Tx3 Link Profile           | Std (0), Sync (1)   | Std (0)     | RW   | Txt |    |    |    | US |

|          |                               |   |               |    |     |    |    |    |    |    |
|----------|-------------------------------|---|---------------|----|-----|----|----|----|----|----|
| 4.10.031 | Tx3 Link Number               | 0 to 255  | 0             | RW | Num |    |    |    |    | US |
| 4.10.032 | Tx3 Source Parameter          | 0 to 499999   | 0             | RW | Num |    |    |    | PT | US |
| 4.10.033 | Tx3 Parameter Count           | 0 to 10   | 0             | RW | Num |    |    |    |    | US |
| 4.10.034 | Tx3 Link Transmission Type    | Unicast (0), Broadcast (1), Multicast1 (2), Multicast2 (3), Multicast3 (4), Multicast4 (5), Multicast5 (6), Multicast6 (7), Multicast7 (8), Multicast8 (9), Multicast9 (10), Multicast10 (11)   | Unicast (0)   | RW | Txt |    |    |    |    | US |
| 4.10.035 | Tx3 Destination Address       | 0.0.0.0 to 255.255.255.255  | 0.0.0.0       | RW | IP  |    |    |    |    | US |
| 4.10.036 | Tx3 Message Rate              | 0 to 100 ms   | 0 ms          | RW | Num |    |    |    |    | US |
| 4.10.039 | Tx3 Link Status               | Disabled (-31), VLAN disabled (-30), Reserved 29 (-29), Reserved 28 (-28), Reserved 27 (-27), Reserved 26 (-26), Reserved 25 (-25), Reserved 24 (-24), Reserved 23 (-23), Invalid DST IP (-22), SYNC unsupported (-21), MEC offset (-20), Invalid tx rate (-19), Too many mapping (-18), Link busy (-17), Invalid profile (-16), Invalid mapping (-15), Read only param (-14), Msg mismatch (-13), Msg too long (-12), Attrib NA (-11), Attrib RO (-10), Attrib missing (-9), Timeout (-8), In error (-7), Link num in use (-6), Not editable (-5), Invalid link num (-4), Invalid args (-3), Too many links (-2), Out of memory (-1), OK (0), Not running (1), OK sync (2) |               | RO | Txt | ND | NC | PT |    |    |
| 4.10.040 | Rx1 Link Profile              | Std (0), Sync (1)   | Std (0)       | RW | Txt |    |    |    |    | US |
| 4.10.041 | Rx1 Link Number               | 0 to 255  | 0             | RW | Num |    |    |    |    | US |
| 4.10.042 | Rx1 Destination Parameter     | 0 to 499999   | 0             | RW | Num |    |    |    |    | US |
| 4.10.043 | Rx1 Parameter Count           | 0 to 10   | 0             | RW | Num |    |    |    |    | US |
| 4.10.044 | Rx1 Source Type               | Direct (0), Multicast1 (1), Multicast2 (2), Multicast3 (3), Multicast4 (4), Local (5), Multicast5 (6), Multicast6 (7), Multicast7 (8), Multicast8 (9), Multicast9 (10), Multicast10 (11)  | Direct (0)    | RW | Txt |    |    |    |    | US |
| 4.10.045 | Rx1 Timeout                   | 0 to 65535 ms   | 100 ms        | RW | Num |    |    |    |    | US |
| 4.10.046 | Rx1 Timeout Action            | Trip (0), Clear output (1), Hold last (2)   | Trip (0)      | RW | Txt |    |    |    |    | US |
| 4.10.047 | Rx1 Timeout Event Destination | This slot (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4)   | This slot (0) | RW | Txt |    |    |    |    | US |
| 4.10.048 | Rx1 Timeout Event Type        | No Event (0), Event (1), Event1 (2), Event2 (3), Event3 (4)   | No Event (0)  | RW | Txt |    |    |    |    | US |
| 4.10.049 | Rx1 Link Status               | Disabled (-31), VLAN disabled (-30), Reserved 29 (-29), Reserved 28 (-28), Reserved 27 (-27), Reserved 26 (-26), Reserved 25 (-25), Reserved 24 (-24), Reserved 23 (-23), Invalid DST IP (-22), SYNC unsupported (-21), MEC offset (-20), Invalid tx rate (-19), Too many mapping (-18), Link busy (-17), Invalid profile (-16), Invalid mapping (-15), Read only param (-14), Msg mismatch (-13), Msg too long (-12), Attrib NA (-11), Attrib RO (-10), Attrib missing (-9), Timeout (-8), In error (-7), Link num in use (-6), Not editable (-5), Invalid link num (-4), Invalid args (-3), Too many links (-2), Out of memory (-1), OK (0), Not running (1), OK sync (2) |               | RO | Txt | ND | NC | PT |    |    |
| 4.10.050 | Rx2 Link Profile              | Std (0), Sync (1)   | Std (0)       | RW | Txt |    |    |    |    | US |
| 4.10.051 | Rx2 Link Number               | 0 to 255  | 0             | RW | Num |    |    |    |    | US |
| 4.10.052 | Rx2 Destination Parameter     | 0 to 499999   | 0             | RW | Num |    |    |    |    | US |
| 4.10.053 | Rx2 Parameter Count           | 0 to 10   | 0             | RW | Num |    |    |    |    | US |
| 4.10.054 | Rx2 Source Type               | Direct (0), Multicast1 (1), Multicast2 (2), Multicast3 (3), Multicast4 (4), Local (5), Multicast5 (6), Multicast6 (7), Multicast7 (8), Multicast8 (9)   | Direct (0)    | RW | Txt |    |    |    |    | US |

|          |                               |   |               |    |     |    |    |    |  |  |    |
|----------|-------------------------------|---|---------------|----|-----|----|----|----|--|--|----|
|          |                               | Multicast9 (10), Multicast10 (11)   |               |    |     |    |    |    |  |  |    |
| 4.10.055 | Rx2 Timeout                   | 0 to 65535 ms   | 100 ms        | RW | Num |    |    |    |  |  | US |
| 4.10.056 | Rx2 Timeout Action            | Trip (0), Clear output (1), Hold last (2)   | Trip (0)      | RW | Txt |    |    |    |  |  | US |
| 4.10.057 | Rx2 Timeout Event Destination | This slot (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4)   | This slot (0) | RW | Txt |    |    |    |  |  | US |
| 4.10.058 | Rx2 Timeout Event Type        | No Event (0), Event (1), Event1 (2), Event2 (3), Event3 (4)   | No Event (0)  | RW | Txt |    |    |    |  |  | US |
| 4.10.059 | Rx2 Link Status               | Disabled (-31), VLAN disabled (-30), Reserved 29 (-29), Reserved 28 (-28), Reserved 27 (-27), Reserved 26 (-26), Reserved 25 (-25), Reserved 24 (-24), Reserved 23 (-23), Invalid DST IP (-22), SYNC unsupported (-21), MEC offset (-20), Invalid tx rate (-19), Too many mapping (-18), Link busy (-17), Invalid profile (-16), Invalid mapping (-15), Read only param (-14), Msg mismatch (-13), Msg too long (-12), Attrib NA (-11), Attrib RO (-10), Attrib missing (-9), Timeout (-8), In error (-7), Link num in use (-6), Not editable (-5), Invalid link num (-4), Invalid args (-3), Too many links (-2), Out of memory (-1), OK (0), Not running (1), OK sync (2) |               | RO | Txt | ND | NC | PT |  |  |    |
| 4.10.060 | Rx3 Link Profile              | Std (0), Sync (1)   | Std (0)       | RW | Txt |    |    |    |  |  | US |
| 4.10.061 | Rx3 Link Number               | 0 to 255  | 0             | RW | Num |    |    |    |  |  | US |
| 4.10.062 | Rx3 Destination Parameter     | 0 to 499999   | 0             | RW | Num |    |    |    |  |  | US |
| 4.10.063 | Rx3 Parameter Count           | 0 to 10   | 0             | RW | Num |    |    |    |  |  | US |
| 4.10.064 | Rx3 Source Type               | Direct (0), Multicast1 (1), Multicast2 (2), Multicast3 (3), Multicast4 (4), Local (5), Multicast5 (6), Multicast6 (7), Multicast7 (8), Multicast8 (9), Multicast9 (10), Multicast10 (11)  | Direct (0)    | RW | Txt |    |    |    |  |  | US |
| 4.10.065 | Rx3 Timeout                   | 0 to 65535 ms   | 100 ms        | RW | Num |    |    |    |  |  | US |
| 4.10.066 | Rx3 Timeout Action            | Trip (0), Clear output (1), Hold last (2)   | Trip (0)      | RW | Txt |    |    |    |  |  | US |
| 4.10.067 | Rx3 Timeout Event Destination | This slot (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4)   | This slot (0) | RW | Txt |    |    |    |  |  | US |
| 4.10.068 | Rx3 Timeout Event Type        | No Event (0), Event (1), Event1 (2), Event2 (3), Event3 (4)   | No Event (0)  | RW | Txt |    |    |    |  |  | US |
| 4.10.069 | Rx3 Link Status               | Disabled (-31), VLAN disabled (-30), Reserved 29 (-29), Reserved 28 (-28), Reserved 27 (-27), Reserved 26 (-26), Reserved 25 (-25), Reserved 24 (-24), Reserved 23 (-23), Invalid DST IP (-22), SYNC unsupported (-21), MEC offset (-20), Invalid tx rate (-19), Too many mapping (-18), Link busy (-17), Invalid profile (-16), Invalid mapping (-15), Read only param (-14), Msg mismatch (-13), Msg too long (-12), Attrib NA (-11), Attrib RO (-10), Attrib missing (-9), Timeout (-8), In error (-7), Link num in use (-6), Not editable (-5), Invalid link num (-4), Invalid args (-3), Too many links (-2), Out of memory (-1), OK (0), Not running (1), OK sync (2) |               | RO | Txt | ND | NC | PT |  |  |    |

|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Slot 4 Menu 10 – Easy Mode Cyclic Data

Mode: RFC-A

## Overview

The minimum parameters required to configure a 3 transmit links and 3 receive links are specified below. In addition to these each receive link can have its own timeout configured with an additional custom action.

Base link parameters

| Link | Sync Enable | Link No. | Src/Dst Par | Par Count | Type      | IP Address | Message Period |
|------|-------------|----------|-------------|-----------|-----------|------------|----------------|
| Tx 1 | S.10.010    | S.10.011 | S.10.012†   | S.10.013  | S.10.014† | S.10.015†  | S.10.016       |
| Tx 2 | S.10.020    | S.10.021 | S.10.022†   | S.10.023  | S.10.024† | S.10.025†  | S.10.026       |
| Tx 3 | S.10.030    | S.10.031 | S.10.032†   | S.10.033  | S.10.034† | S.10.035†  | S.10.036       |
|      |             |          |             |           |           |            |                |
| Rx 1 | S.10.040    | S.10.041 | S.10.042    | S.10.043  | S.10.044  | n/a        | n/a            |
| Rx 2 | S.10.050    | S.10.051 | S.10.052    | S.10.053  | S.10.054  | n/a        | n/a            |
| Rx 3 | S.10.060    | S.10.061 | S.10.062    | S.10.063  | S.10.064  | n/a        | n/a            |

† Required if Type == 'direct'

## Parameter Mapping Configuration

For each cyclic link a start parameter and number of consecutive parameters must be defined. A typical requirement is to transmit and receive parameter values from non-consecutive parameters. This can be performed by configuring a suitable Menu 0 parameter as the start parameter and the required number of parameters as the count. Menu 22 of the drive can be used to configure what parameters the selected Menu 0 parameters point to.

For example to configure a 1ms transmit cyclic link with control word and speed reference the following parameter changes would be required:

|             |               |
|-------------|---------------|
| Pr S.10.011 | 1             |
| Pr S.10.012 | 0.00.020      |
| Pr S.10.013 | 2             |
| Pr S.10.014 | Broadcast (1) |
| Pr S.10.016 | 1             |
| Pr 0.22.020 | 6.042         |
| Pr 0.22.021 | 1.021         |

## Synchronous Cyclic Data

Note: Synchronous Cyclic Links are supported on Unidrive M onboard Ethernet interface but not on SI-Ethernet on Unidrive M200 - M600.

Cyclic data links can be made synchronous, utilising the IEEE1588 clock time distributed across the network. The IEEE1588 clock can synchronise the drive's control loops, Pr 11.002 displays the active option slot providing synchronisation. With synchronised control loops the Ethernet interface can be used to transfer drive parameters containing motion information, including those from the AMC.

Synchronous links work by including the time of when the data should be used along with the data values. This time allows enough time for the cyclic link to reach all destination devices, the time allowed for can be set in *Easy Mode Maximum Network Delay* (11.030). The receiving interface will wait for its current time to match the timestamp in the cyclic link before processing the message.

### Transmit

1 link can be synchronous with a maximum of 2 x 32bit parameters.

### Receive

1 link can be synchronous with a maximum of 2 x 32bit parameters.

### VLAN

To guarantee the timing of synchronous links VLANs must be enabled using *Drive VLAN ID* (4.02.031). VLANs include a priority field that is applied to all messages. This field is used to apply a higher priority to synchronous cyclic data than other non-deterministic traffic.

## AMC & Onboard User Program Timing

Synchronous cyclic data can be used with both the AMC and the drives user program. When using synchronous cyclic data with the AMC ensure that the AMC Rate Select (Pr 31.012) is the same as the transmission rate; 250us, 500us, 1ms, 2ms or 4ms. the clock task of the onboard user program can be scheduled for periods 4ms and greater. For the clock task on multiple drives synchronised with IEEE1588 to be synchronised and in phase all clock tasks must be set to 4ms only. If synchronous cyclic data is used both for the AMC and the user program interacting with the AMC then Pr 31.012 and the clock task must be 4ms.

## Virtual Master

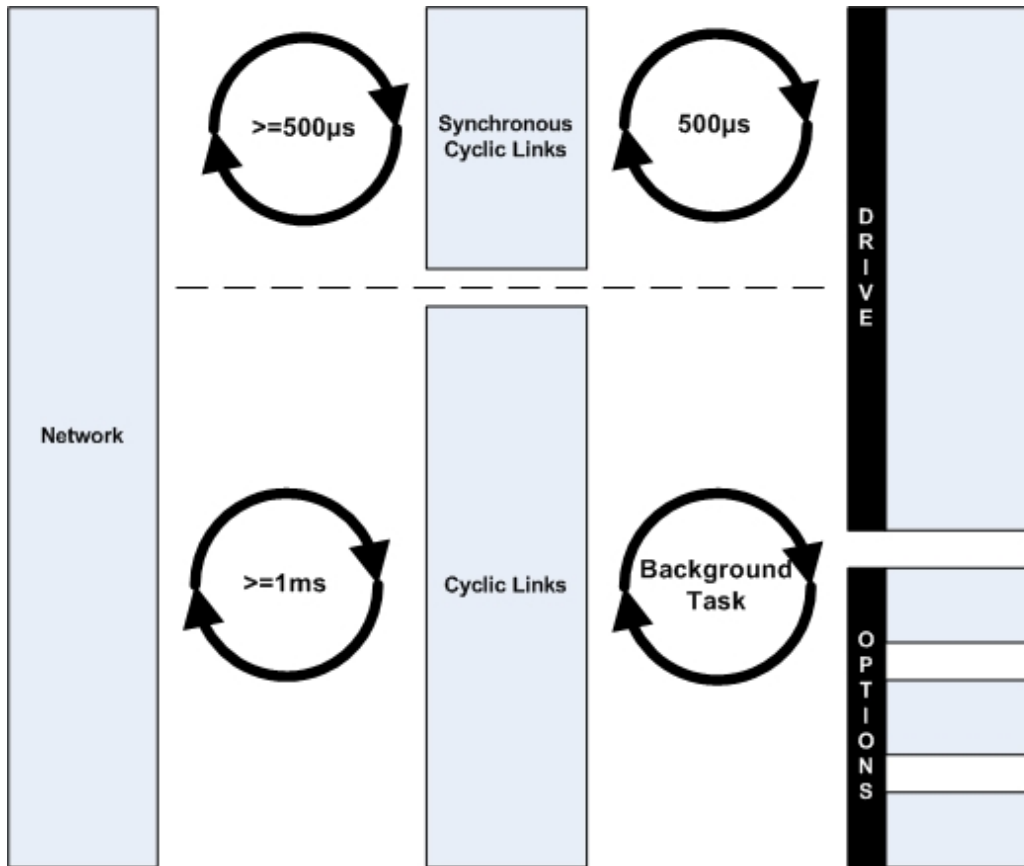
It is possible to send cyclic data to devices on the network and use the same data on the transmitting device. The cyclic links must be synchronous to include timing information. On the transmitting device a receive link must also be configured with a matching link number to the transmit. for this link you must set the source type *Rx1 Source Type* (4.10.044) to *Local*. The Ethernet interface will delay the usage of the data transmitted until the same point in time that all receiving slaves will use the data.

## Parameter Update Rate

Parameters are exchange over the network. The value exchanged with the network must be exchanged with the drive or option parameter. The rate of

data exchange differs for synchronous / non-synchronous cyclic links as well as for drive/option destinations.

The diagram below depicts the update cycles used within the Ethernet interface. Cyclic link mappings being exchanged with the drive will be updated at the background task rate. This rate *Background cycles per second* (4.09.008) varies with the load on the Ethernet interface; Ethernet/IP data exchange also takes place in the background task.



| Parameter         | 4.10.001 <i>Enable</i> |                |                 |
|-------------------|------------------------|----------------|-----------------|
| Short description | Easy mode enable       |                |                 |
| Minimum           | 0                      | Maximum        | 1               |
| Default           | 1                      | Units          |                 |
| Type              | 1 Bit User Save        | Update Rate    | Background read |
| Display Format    | Standard               | Decimal Places | 0               |
| Coding            | RW, BU                 |                |                 |

| Parameter         | 4.10.002 <i>Reset</i>      |                |                 |
|-------------------|----------------------------|----------------|-----------------|
| Short description | Set to reset the interface |                |                 |
| Minimum           | 0                          | Maximum        | 1               |
| Default           | 0                          | Units          |                 |
| Type              | 1 Bit Volatile             | Update Rate    | Background read |
| Display Format    | Standard                   | Decimal Places | 0               |
| Coding            | RW, NC                     |                |                 |

This parameter is used to perform a warm reset of the protocol interface. When set and the protocol has reset, the parameter will be reset to zero (Off).

| Parameter         | 4.10.003 <i>Default</i>               |                |               |
|-------------------|---------------------------------------|----------------|---------------|
| Short description | Set to default the protocol interface |                |               |
| Minimum           | 0                                     | Maximum        | 1             |
| Default           | 0                                     | Units          |               |
| Type              | 1 Bit Volatile                        | Update Rate    | Read on reset |
| Display Format    | Standard                              | Decimal Places | 0             |
| Coding            | RW, NC                                |                |               |

This parameter allows the protocol to be defaulted to factory settings. This includes all of the protocol features, configuration, mappings and stored objects.

| Parameter         | 4.10.004 <i>Cyclic Messages Per Second</i>                       |                |            |
|-------------------|--|----------------|------------|
| Short description | Displays the total number of received and transmitted per second |                |            |
| Minimum           | 0  | Maximum        | 65535      |
| Default           |  | Units          | Messages/s |
| Type              | 16 Bit Volatile  | Update Rate    | Background |
| Display Format    | Standard   | Decimal Places | 0          |
| Coding            | RO, ND, NC, PT, BU   |                |            |

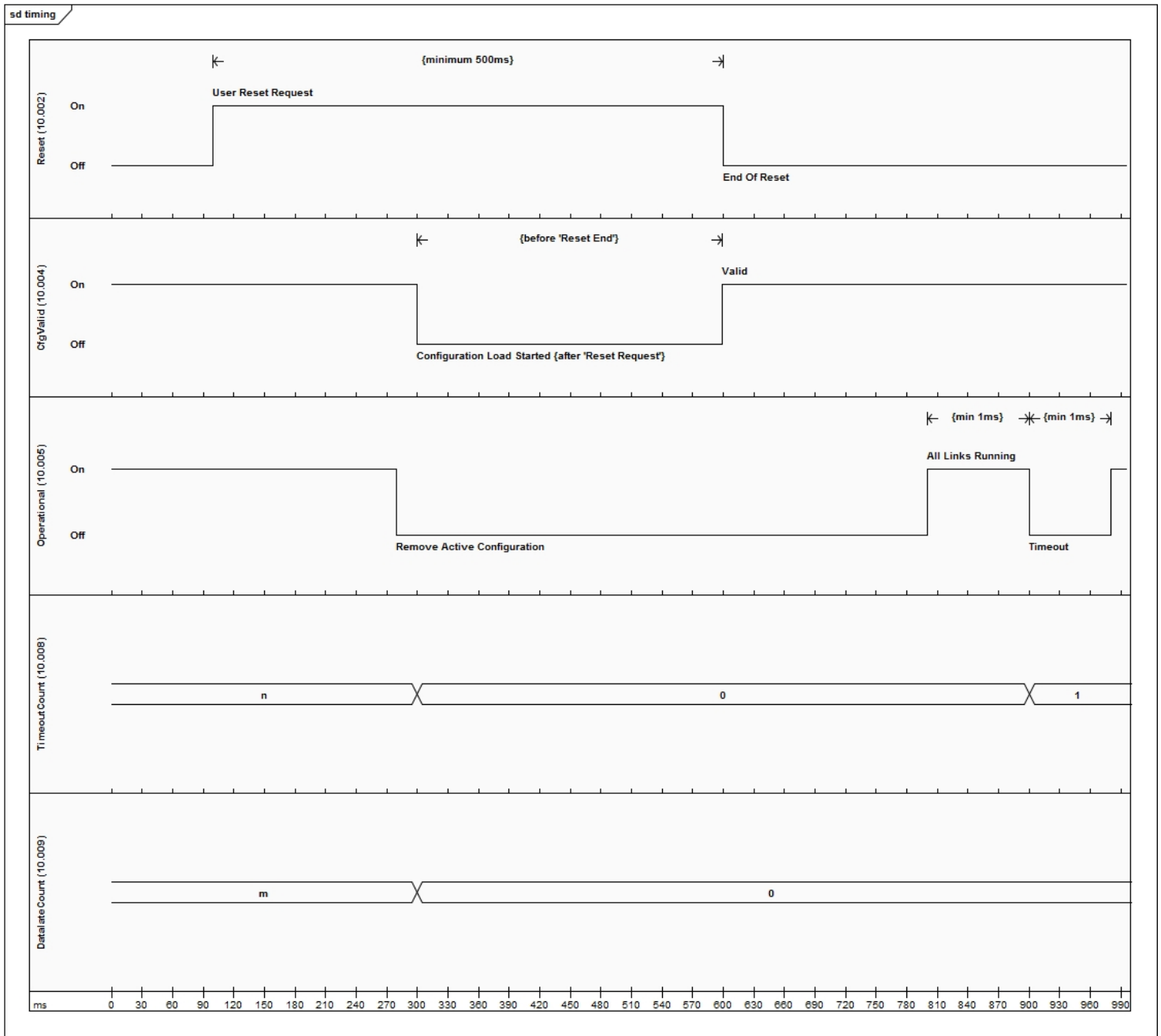
Displays the total number of cyclic (Rx and Tx) messages per second. This includes Easy Mode and Offline configurations.

| Parameter         | 4.10.005 <i>Configuration Valid</i>              |                |                   |
|-------------------|--|----------------|-------------------|
| Short description | Indicates that the active configuration is valid |                |                   |
| Minimum           | 0  | Maximum        | 1                 |
| Default           |  | Units          |                   |
| Type              | 1 Bit Volatile                                   | Update Rate    | Reset, Background |
| Display Format    | Standard   | Decimal Places | 0                 |
| Coding            | RO, ND, NC, PT                                   |                |                   |

If the active configuration identified by *Active Configuration* (4.10.007) has no configuration errors then the configuration is valid and this parameter will be On (1).

If the active configuration is *Easy Mode* made effective through a *Reset* (4.10.002) to On; *Configuration Valid* (4.10.005) value can be read once *Reset* (4.10.002) returns to Off as shown in the associated timing diagram.

If the active configuration is *Offline* (representing a configuration provided by a PC tool) the configuration was created in conjunction with the user application.



| Parameter         | 4.10.006 Operational   |                |     |
|-------------------|--|----------------|-----|
| Short description | Indicates that the all links in the active configuration are receiving/transmitting successfully |                |     |
| Minimum           | 0  | Maximum        | 1   |
| Default           |  | Units          |     |
| Type              | 1 Bit Volatile   | Update Rate    | 1ms |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RO, ND, NC, PT   |                |     |

This parameter provides an indication that all links in the active configuration are:

1. Receiving new messages successfully AND
2. Transmitting links; this however does not mean the destination devices are receiving the messages; this will be dependent on their own state.

A receive link timeout will cause this parameter to become cleared until a new message is received. A single data late event will cause this parameter to be Off until the next cyclic message is received on time. This parameter is updated every 1ms; if low latency reactions to timeout and data late events are required then appropriate actions should be configured for the links, see *Rx1 Timeout Action* (4.10.046) and *Rx1 Late Synchronisation Frame Action* (4.11.040) for further details.

See timing diagram in *Configuration Valid* (4.10.005).

A user program utilising cyclic data may use this parameter along with *Configuration Valid* (4.10.005) to detect when cyclic communication is operational; once detected if the user program wishes to monitor for timeout or data late events the provided counters (*Timeout Count* (4.10.008) and *Data Late Count* (4.10.009)) can be used.



| Parameter         | 4.10.007 Active Configuration                           |                |       |
|-------------------|---|----------------|-------|
| Short description | Displays the active configuration source of cyclic data |                |       |
| Minimum           | 0   | Maximum        | 2     |
| Default           |   | Units          |       |
| Type              | 8 Bit Volatile  | Update Rate    | Reset |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RO, TE, ND, NC, PT, BU                                  |                |       |

| Value | Text      | Description                                |
|-------|-----------|--|
| 0     | None      | No configuration active                    |
| 1     | Easy Mode | Easy Mode configuration active             |
| 2     | Offline   | Offline configuration from PC tools active |

Displays the active configuration source of cyclic data.

| Parameter         | 4.10.008 Timeout Count                        |                |       |
|-------------------|---|----------------|-------|
| Short description | Displays the number of receive timeout events |                |       |
| Minimum           | 0   | Maximum        | 65535 |
| Default           |   | Units          |       |
| Type              | 16 Bit Volatile                               | Update Rate    | 1ms   |
| Display Format    | Standard                                      | Decimal Places | 0     |
| Coding            | RO, ND, NC, PT, BU                            |                |       |

This parameter displays the total number of receive timeout events; the parameter value will wrap over to zero.

A reset of the configuration will clear this count; see the timing diagram of *Configuration Valid* (4.10.005). Each timeout event will increment the count. The count can be sampled by a user application in order to detect change since the last sample; this enables custom reaction to a timeout event occurring on any cyclic receive link which has a timeout value configured, irrespective of the timeout action for the link.

If a custom timeout reaction is required on a per-link basis then the link action must be chosen appropriately in *Rx1 Timeout Action* (4.10.046); this could be *Clear output* to write zero to all of the cyclic parameters and implement monitoring code for this condition in the user application.

| Parameter         | 4.10.009 Data Late Count                        |                |       |
|-------------------|---|----------------|-------|
| Short description | Displays the number of receive data late events |                |       |
| Minimum           | 0   | Maximum        | 65535 |
| Default           |   | Units          |       |
| Type              | 16 Bit Volatile                                 | Update Rate    | 1ms   |
| Display Format    | Standard  | Decimal Places | 0     |
| Coding            | RO, ND, NC, PT, BU                              |                |       |

This parameter displays the total number of receive data late events; the parameter value will wrap over to zero.

A reset of the configuration will clear this count; see the timing diagram of *Configuration Valid* (4.10.005). Each data late event will increment the count. The count can be sampled by a user application in order to detect change since the last sample; this enables custom reaction to a data late event occurring on a synchronous cyclic receive link which has a received a message containing a time that is now in the past irrespective the defined action for the link.

| Parameter         | 4.10.010 Tx1 Link Profile                                     |                |               |
|-------------------|---|----------------|---------------|
| Short description | Selects the Tx1 link as a standard or synchronous cyclic link |                |               |
| Minimum           | 0   | Maximum        | 1             |
| Default           | 0   | Units          |               |
| Type              | 8 Bit User Save   | Update Rate    | Read on reset |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, TE  |                |               |

| Value | Text | Description       |
|-------|------|-------------------|
| 0     | Std  | Standard link     |
| 1     | Sync | Synchronized link |

Used to select Tx1 as a standard or synchronous cyclic link.

| Parameter         | 4.10.011 Tx1 Link Number              |                |               |
|-------------------|---------------------------------------|----------------|---------------|
| Short description | Sets the link number for the Tx1 link |                |               |
| Minimum           | 0                                     | Maximum        | 255           |
| Default           | 0                                     | Units          |               |
| Type              | 8 Bit User Save                       | Update Rate    | Read on reset |
| Display Format    | Standard                              | Decimal Places | 0             |
| Coding            | RW, BU                                |                |               |

This is used to set the link number for the Tx1 link.

| Parameter         | 4.10.012 Tx1 Source Parameter              |                |               |
|-------------------|--|----------------|---------------|
| Short description | Sets the source parameter for the Tx1 link |                |               |
| Minimum           | 0  | Maximum        | 499999        |
| Default           | 0  | Units          |               |
| Type              | 32 Bit User Save                           | Update Rate    | Read on reset |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0             |
| Coding            | RW, PT, BU                                 |                |               |

This sets the source parameter for the Tx1 link.

| Parameter         | 4.10.013 Tx1 Parameter Count                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Sets the number of parameters for the Tx1 link |                |               |
| Minimum           | 0  | Maximum        | 10            |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save                                | Update Rate    | Read on reset |
| Display Format    | Standard                                       | Decimal Places | 0             |
| Coding            | RW, BU   |                |               |

This is used to set the number of contiguous parameters for the Tx1 link.

| Parameter         | 4.10.014 Tx1 Link Transmission Type        |                |               |
|-------------------|--|----------------|---------------|
| Short description | Sets the transmission type of the Tx1 link |                |               |
| Minimum           | 0  | Maximum        | 11            |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save                            | Update Rate    | Read on reset |
| Display Format    | Standard                                   | Decimal Places | 0             |
| Coding            | RW, TE, BU                                 |                |               |

| Value | Text        | Description                                 |
|-------|-------------|---|
| 0     | Unicast     | Link is unicast to the IP address specified |
| 1     | Broadcast   | Link is broadcast (255.255.255.255)         |
| 2     | Multicast1  | Link is multicast to the IP address         |
| 3     | Multicast2  | Link is multicast to the IP address         |
| 4     | Multicast3  | Link is multicast to the IP address         |
| 5     | Multicast4  | Link is multicast to the IP address         |
| 6     | Multicast5  | Link is multicast to the IP address         |
| 7     | Multicast6  | Link is multicast to the IP address         |
| 8     | Multicast7  | Link is multicast to the IP address         |
| 9     | Multicast8  | Link is multicast to the IP address         |
| 10    | Multicast9  | Link is multicast to the IP address         |
| 11    | Multicast10 | Link is multicast to the IP address         |

This specifies the type of transmission for the Tx1 link.

| Parameter         | 4.10.015 Tx1 Destination Address             |                |  |
|-------------------|--|----------------|--|
| Short description | Sets the destination address of the Tx1 link |                |  |
| Minimum           | 0<br>(Display: 0.0.0.0)                      | Maximum        | 4294967295<br>(Display: 255.255.255.255) |
| Default           | 0<br>(Display: 0.0.0.0)                      | Units          |  |
| Type              | 32 Bit User Save                             | Update Rate    | Read on reset                            |
| Display Format    | IP Address                                   | Decimal Places | 0  |
| Coding            | RW, BU                                       |                |  |

This specifies the IP address of the destination device for the Tx1 link. If *Tx1 Link Transmission Type* (4.10.014) is set to either broadcast or multicast this parameter will display the appropriate address.

| Parameter         | 4.10.016 Tx1 Message Rate   |                |               |
|-------------------|---|----------------|---------------|
| Short description | Defines the period at which Tx1 Link will be transmitted. Zero disables the transmission. |                |               |
| Minimum           | 0   | Maximum        | 100           |
| Default           | 0   | Units          | ms            |
| Type              | 8 Bit User Save   | Update Rate    | Read on reset |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, BU  |                |               |

Defines, in milliseconds, the period at which Tx1 Link will be transmitted. A value of zero disables the transmission of data.

| Parameter         | 4.10.019 Tx1 Link Status |                |                |
|-------------------|--------------------------|----------------|----------------|
| Short description | Link status when loaded  |                |                |
| Minimum           | -31                      | Maximum        | 2              |
| Default           |                          | Units          |                |
| Type              | 8 Bit Volatile           | Update Rate    | Write on reset |
| Display Format    | Standard                 | Decimal Places | 0              |
| Coding            | RO, TE, ND, NC, PT       |                |                |

| Value | Text             | Description   |
|-------|------------------|---|
| -31   | Disabled         | Easy Mode protocol is disabled or link number is set to 0                             |
| -30   | VLAN disabled    | VLAN is required in order to guarantee timing in synchronous mode but it is disabled. |
| -29   | Reserved 29      |   |
| -28   | Reserved 28      |   |
| -27   | Reserved 27      |   |
| -26   | Reserved 26      |   |
| -25   | Reserved 25      |   |
| -24   | Reserved 24      |   |
| -23   | Reserved 23      |   |
| -22   | Invalid DST IP   | The destination IP address is invalid   |
| -21   | SYNC unsupported | Sync link does not support mappings to other option parameters                        |
| -20   | MEC offset       | Incorrect MEC offset  |
| -19   | Invalid tx rate  | Tx rate must be a factor of 1 second  |
| -18   | Too many mapping | The number of mapping items exceeds the range supported                               |
| -17   | Link busy        | The link specified is busy  |
| -16   | Invalid profile  | The profile is invalid  |
| -15   | Invalid mapping  | The mapped parameter does not exist   |
| -14   | Read only param  | The mapped parameter is read only   |
| -13   | Msg mismatch     | Link number and direction do not match  |
| -12   | Msg too long     | Resulting message is too long   |
| -11   | Attrib NA        | Attribute not available   |
| -10   | Attrib RO        | Attribute is read only  |
| -9    | Attrib missing   | Attribute is missing  |
| -8    | Timeout          | Timeout   |
| -7    | In error         | The link specified is in Error state  |
| -6    | Link num in use  | The link number specified is already in use   |
| -5    | Not editable     | The link specified is not editable  |
| -4    | Invalid link num | An invalid link number was specified  |
| -3    | Invalid args     | Link Number or another argument specified was zero or some other invalid number       |
| -2    | Too many links   | Operation failed as the maximum number of links in use has been reached               |
| -1    | Out of memory    | Failed to allocate memory.  |
| 0     | OK               | Configuration of link successful  |
| 1     | Not running      | OK. Not running.  |
| 2     | OK sync          | Configuration of synchronous link successful  |

This reports the links status if it has been loaded. A *Reset* (4.10.002) is required to load any changes.

| Parameter         | 4.10.020 Tx2 Link Profile                                     |                |               |
|-------------------|---|----------------|---------------|
| Short description | Selects the Tx2 link as a standard or synchronous cyclic link |                |               |
| Minimum           | 0   | Maximum        | 1             |
| Default           | 0   | Units          |               |
| Type              | 8 Bit User Save   | Update Rate    | Read on reset |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, TE  |                |               |

| Value | Text | Description       |
|-------|------|-------------------|
| 0     | Std  | Standard link     |
| 1     | Sync | Synchronized link |

Used to select Tx2 as a standard or synchronous cyclic link.

| Parameter         | 4.10.021 Tx2 Link Number              |                |               |
|-------------------|---------------------------------------|----------------|---------------|
| Short description | Sets the link number for the Tx2 link |                |               |
| Minimum           | 0                                     | Maximum        | 255           |
| Default           | 0                                     | Units          |               |
| Type              | 8 Bit User Save                       | Update Rate    | Read on reset |
| Display Format    | Standard                              | Decimal Places | 0             |
| Coding            | RW, BU                                |                |               |

This is used to set the link number for the Tx2 link.

| Parameter         | 4.10.022 Tx2 Source Parameter              |                |               |
|-------------------|--|----------------|---------------|
| Short description | Sets the source parameter for the Tx2 link |                |               |
| Minimum           | 0  | Maximum        | 499999        |
| Default           | 0  | Units          |               |
| Type              | 32 Bit User Save                           | Update Rate    | Read on reset |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0             |
| Coding            | RW, PT, BU                                 |                |               |

This sets the source parameter for the Tx2 link.

| Parameter         | 4.10.023 Tx2 Parameter Count                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Sets the number of parameters for the Tx2 link |                |               |
| Minimum           | 0  | Maximum        | 10            |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save                                | Update Rate    | Read on reset |
| Display Format    | Standard                                       | Decimal Places | 0             |
| Coding            | RW, BU   |                |               |

This is used to set the number of contiguous parameters for the Tx2 link.

| Parameter         | 4.10.024 Tx2 Link Transmission Type        |                |               |
|-------------------|--|----------------|---------------|
| Short description | Sets the transmission type of the Tx2 link |                |               |
| Minimum           | 0  | Maximum        | 11            |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save                            | Update Rate    | Read on reset |
| Display Format    | Standard                                   | Decimal Places | 0             |
| Coding            | RW, TE, BU                                 |                |               |

| Value | Text        | Description                                 |
|-------|-------------|---|
| 0     | Unicast     | Link is unicast to the IP address specified |
| 1     | Broadcast   | Link is broadcast (255.255.255.255)         |
| 2     | Multicast1  | Link is multicast to the IP address         |
| 3     | Multicast2  | Link is multicast to the IP address         |
| 4     | Multicast3  | Link is multicast to the IP address         |
| 5     | Multicast4  | Link is multicast to the IP address         |
| 6     | Multicast5  | Link is multicast to the IP address         |
| 7     | Multicast6  | Link is multicast to the IP address         |
| 8     | Multicast7  | Link is multicast to the IP address         |
| 9     | Multicast8  | Link is multicast to the IP address         |
| 10    | Multicast9  | Link is multicast to the IP address         |
| 11    | Multicast10 | Link is multicast to the IP address         |

This specifies the type of transmission for the Tx2 link.

| Parameter         | 4.10.025 Tx2 Destination Address             |                |  |
|-------------------|--|----------------|--|
| Short description | Sets the destination address of the Tx2 link |                |  |
| Minimum           | 0<br>(Display: 0.0.0.0)                      | Maximum        | 4294967295<br>(Display: 255.255.255.255) |
| Default           | 0<br>(Display: 0.0.0.0)                      | Units          |  |
| Type              | 32 Bit User Save                             | Update Rate    | Read on reset                            |
| Display Format    | IP Address                                   | Decimal Places | 0  |
| Coding            | RW, BU                                       |                |  |

This specifies the IP address of the destination device for the Tx1 link. If *Tx2 Link Transmission Type* (4.10.024) is set to either broadcast or multicast this parameter will display the appropriate address.

| Parameter         | 4.10.026 Tx2 Message Rate           |                |               |
|-------------------|-------------------------------------|----------------|---------------|
| Short description | Sets and shows the Tx2 message rate |                |               |
| Minimum           | 0                                   | Maximum        | 100           |
| Default           | 0                                   | Units          | ms            |
| Type              | 8 Bit User Save                     | Update Rate    | Read on reset |
| Display Format    | Standard                            | Decimal Places | 0             |
| Coding            | RW, BU                              |                |               |

Defines, in milliseconds, the period at which Tx2 Link will be transmitted. A value of zero disables the transmission of data.

| Parameter         | 4.10.029 Tx2 Link Status |                |                |
|-------------------|--------------------------|----------------|----------------|
| Short description | Link status when loaded  |                |                |
| Minimum           | -31                      | Maximum        | 2              |
| Default           |                          | Units          |                |
| Type              | 8 Bit Volatile           | Update Rate    | Write on reset |
| Display Format    | Standard                 | Decimal Places | 0              |
| Coding            | RO, TE, ND, NC, PT       |                |                |

| Value | Text             | Description   |
|-------|------------------|---|
| -31   | Disabled         | Easy Mode protocol is disabled or link number is set to 0                             |
| -30   | VLAN disabled    | VLAN is required in order to guarantee timing in synchronous mode but it is disabled. |
| -29   | Reserved 29      |   |
| -28   | Reserved 28      |   |
| -27   | Reserved 27      |   |
| -26   | Reserved 26      |   |
| -25   | Reserved 25      |   |
| -24   | Reserved 24      |   |
| -23   | Reserved 23      |   |
| -22   | Invalid DST IP   | The destination IP address is invalid   |
| -21   | SYNC unsupported | Sync link does not support mappings to other option parameters                        |
| -20   | MEC offset       | Incorrect MEC offset  |
| -19   | Invalid tx rate  | Tx rate must be a factor of 1 second  |
| -18   | Too many mapping | The number of mapping items exceeds the range supported                               |
| -17   | Link busy        | The link specified is busy  |
| -16   | Invalid profile  | The profile is invalid  |
| -15   | Invalid mapping  | The mapped parameter does not exist   |
| -14   | Read only param  | The mapped parameter is read only   |
| -13   | Msg mismatch     | Link number and direction do not match  |
| -12   | Msg too long     | Resulting message is too long   |
| -11   | Attrib NA        | Attribute not available   |
| -10   | Attrib RO        | Attribute is read only  |
| -9    | Attrib missing   | Attribute is missing  |
| -8    | Timeout          | Timeout   |
| -7    | In error         | The link specified is in Error state  |
| -6    | Link num in use  | The link number specified is already in use   |
| -5    | Not editable     | The link specified is not editable  |
| -4    | Invalid link num | An invalid link number was specified  |
| -3    | Invalid args     | Link Number or another argument specified was zero or some other invalid number       |
| -2    | Too many links   | Operation failed as the maximum number of links in use has been reached               |
| -1    | Out of memory    | Failed to allocate memory.  |
| 0     | OK               | Configuration of link successful  |
| 1     | Not running      | OK. Not running.  |
| 2     | OK sync          | Configuration of synchronous link successful  |

This reports the links status if it has been loaded. A *Reset* (4.10.002) is required to load any changes.

| Parameter         | 4.10.030 Tx3 Link Profile                                     |                |               |
|-------------------|---|----------------|---------------|
| Short description | Selects the Tx3 link as a standard or synchronous cyclic link |                |               |
| Minimum           | 0   | Maximum        | 1             |
| Default           | 0   | Units          |               |
| Type              | 8 Bit User Save   | Update Rate    | Read on reset |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, TE  |                |               |

| Value | Text | Description       |
|-------|------|-------------------|
| 0     | Std  | Standard link     |
| 1     | Sync | Synchronized link |

Used to select Tx3 as a standard or synchronous cyclic link.

| Parameter         | 4.10.031 Tx3 Link Number              |                |               |
|-------------------|---------------------------------------|----------------|---------------|
| Short description | Sets the link number for the Tx3 link |                |               |
| Minimum           | 0                                     | Maximum        | 255           |
| Default           | 0                                     | Units          |               |
| Type              | 8 Bit User Save                       | Update Rate    | Read on reset |
| Display Format    | Standard                              | Decimal Places | 0             |
| Coding            | RW, BU                                |                |               |

This is used to set the link number for the Tx3 link.

| Parameter         | 4.10.032 Tx3 Source Parameter              |                |               |
|-------------------|--|----------------|---------------|
| Short description | Sets the source parameter for the Tx3 link |                |               |
| Minimum           | 0  | Maximum        | 499999        |
| Default           | 0  | Units          |               |
| Type              | 32 Bit User Save                           | Update Rate    | Read on reset |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0             |
| Coding            | RW, PT, BU                                 |                |               |

This sets the source parameter for the Tx3 link.

| Parameter         | 4.10.033 Tx3 Parameter Count                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Sets the number of parameters for the Tx3 link |                |               |
| Minimum           | 0  | Maximum        | 10            |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save                                | Update Rate    | Read on reset |
| Display Format    | Standard                                       | Decimal Places | 0             |
| Coding            | RW, BU   |                |               |

This is used to set the number of contiguous parameters for the Tx3 link.

| Parameter         | 4.10.034 Tx3 Link Transmission Type        |                |               |
|-------------------|--|----------------|---------------|
| Short description | Sets the transmission type of the Tx3 link |                |               |
| Minimum           | 0  | Maximum        | 11            |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save                            | Update Rate    | Read on reset |
| Display Format    | Standard                                   | Decimal Places | 0             |
| Coding            | RW, TE, BU                                 |                |               |

| Value | Text        | Description                                 |
|-------|-------------|---|
| 0     | Unicast     | Link is unicast to the IP address specified |
| 1     | Broadcast   | Link is broadcast (255.255.255.255)         |
| 2     | Multicast1  | Link is multicast to the IP address         |
| 3     | Multicast2  | Link is multicast to the IP address         |
| 4     | Multicast3  | Link is multicast to the IP address         |
| 5     | Multicast4  | Link is multicast to the IP address         |
| 6     | Multicast5  | Link is multicast to the IP address         |
| 7     | Multicast6  | Link is multicast to the IP address         |
| 8     | Multicast7  | Link is multicast to the IP address         |
| 9     | Multicast8  | Link is multicast to the IP address         |
| 10    | Multicast9  | Link is multicast to the IP address         |
| 11    | Multicast10 | Link is multicast to the IP address         |

This specifies the type of transmission for the Tx3 link.

| Parameter         | 4.10.035 Tx3 Destination Address             |                |  |
|-------------------|--|----------------|--|
| Short description | Sets the destination address of the Tx3 link |                |  |
| Minimum           | 0<br>(Display: 0.0.0.0)                      | Maximum        | 4294967295<br>(Display: 255.255.255.255) |
| Default           | 0<br>(Display: 0.0.0.0)                      | Units          |  |
| Type              | 32 Bit User Save                             | Update Rate    | Read on reset                            |
| Display Format    | IP Address                                   | Decimal Places | 0  |
| Coding            | RW, BU                                       |                |  |

This specifies the IP address of the destination device for the Tx1 link. If *Tx3 Link Transmission Type* (4.10.034) is set to either broadcast or multicast this parameter will display the appropriate address.

| Parameter         | 4.10.036 Tx3 Message Rate           |                |               |
|-------------------|-------------------------------------|----------------|---------------|
| Short description | Sets and shows the Tx3 message rate |                |               |
| Minimum           | 0                                   | Maximum        | 100           |
| Default           | 0                                   | Units          | ms            |
| Type              | 8 Bit User Save                     | Update Rate    | Read on reset |
| Display Format    | Standard                            | Decimal Places | 0             |
| Coding            | RW, BU                              |                |               |

Defines, in milliseconds, the period at which Tx3 Link will be transmitted. A value of zero disables the transmission of data.

| Parameter         | 4.10.039 Tx3 Link Status |                |                |
|-------------------|--------------------------|----------------|----------------|
| Short description | Link status when loaded  |                |                |
| Minimum           | -31                      | Maximum        | 2              |
| Default           |                          | Units          |                |
| Type              | 8 Bit Volatile           | Update Rate    | Write on reset |
| Display Format    | Standard                 | Decimal Places | 0              |
| Coding            | RO, TE, ND, NC, PT       |                |                |

| Value | Text             | Description   |
|-------|------------------|---|
| -31   | Disabled         | Easy Mode protocol is disabled or link number is set to 0                             |
| -30   | VLAN disabled    | VLAN is required in order to guarantee timing in synchronous mode but it is disabled. |
| -29   | Reserved 29      |   |
| -28   | Reserved 28      |   |
| -27   | Reserved 27      |   |
| -26   | Reserved 26      |   |
| -25   | Reserved 25      |   |
| -24   | Reserved 24      |   |
| -23   | Reserved 23      |   |
| -22   | Invalid DST IP   | The destination IP address is invalid   |
| -21   | SYNC unsupported | Sync link does not support mappings to other option parameters                        |
| -20   | MEC offset       | Incorrect MEC offset  |
| -19   | Invalid tx rate  | Tx rate must be a factor of 1 second  |
| -18   | Too many mapping | The number of mapping items exceeds the range supported                               |
| -17   | Link busy        | The link specified is busy  |
| -16   | Invalid profile  | The profile is invalid  |
| -15   | Invalid mapping  | The mapped parameter does not exist   |
| -14   | Read only param  | The mapped parameter is read only   |
| -13   | Msg mismatch     | Link number and direction do not match  |
| -12   | Msg too long     | Resulting message is too long   |
| -11   | Attrib NA        | Attribute not available   |
| -10   | Attrib RO        | Attribute is read only  |
| -9    | Attrib missing   | Attribute is missing  |
| -8    | Timeout          | Timeout   |
| -7    | In error         | The link specified is in Error state  |
| -6    | Link num in use  | The link number specified is already in use   |
| -5    | Not editable     | The link specified is not editable  |
| -4    | Invalid link num | An invalid link number was specified  |
| -3    | Invalid args     | Link Number or another argument specified was zero or some other invalid number       |
| -2    | Too many links   | Operation failed as the maximum number of links in use has been reached               |
| -1    | Out of memory    | Failed to allocate memory.  |
| 0     | OK               | Configuration of link successful  |
| 1     | Not running      | OK. Not running.  |
| 2     | OK sync          | Configuration of synchronous link successful  |

This reports the links status if it has been loaded. A *Reset* (4.10.002) is required to load any changes.

| Parameter         | 4.10.040 Rx1 Link Profile                                     |                |               |
|-------------------|---|----------------|---------------|
| Short description | Selects the Rx1 link as a standard or synchronous cyclic link |                |               |
| Minimum           | 0   | Maximum        | 1             |
| Default           | 0   | Units          |               |
| Type              | 8 Bit User Save   | Update Rate    | Read on reset |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, TE  |                |               |

| Value | Text | Description       |
|-------|------|-------------------|
| 0     | Std  | Standard link     |
| 1     | Sync | Synchronized link |

Used to select Rx1 as a standard or synchronous cyclic link.

| Parameter         | 4.10.041 Rx1 Link Number              |                |               |
|-------------------|---------------------------------------|----------------|---------------|
| Short description | Sets the link number for the Rx1 link |                |               |
| Minimum           | 0                                     | Maximum        | 255           |
| Default           | 0                                     | Units          |               |
| Type              | 8 Bit User Save                       | Update Rate    | Read on reset |
| Display Format    | Standard                              | Decimal Places | 0             |
| Coding            | RW, BU                                |                |               |

This parameter is used to set the link number for the Rx1 link.

| Parameter         | 4.10.042 Rx1 Destination Parameter              |                |               |
|-------------------|---|----------------|---------------|
| Short description | Sets the destination parameter for the Rx1 link |                |               |
| Minimum           | 0   | Maximum        | 499999        |
| Default           | 0   | Units          |               |
| Type              | 32 Bit User Save                                | Update Rate    | Read on reset |
| Display Format    | Slot Menu Parameter                             | Decimal Places | 0             |
| Coding            | RW, BU  |                |               |

This parameter sets the destination parameter for the Rx1 link.

| Parameter         | 4.10.043 Rx1 Parameter Count                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Sets the number of parameters for the Rx1 link |                |               |
| Minimum           | 0  | Maximum        | 10            |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save                                | Update Rate    | Read on reset |
| Display Format    | Standard                                       | Decimal Places | 0             |
| Coding            | RW, BU   |                |               |

This parameter is used to set the number of contiguous parameters for the Rx1 link.

| Parameter         | 4.10.044 Rx1 Source Type                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Sets the transmission type of the Rx1 link |                |               |
| Minimum           | 0  | Maximum        | 11            |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save                            | Update Rate    | Read on reset |
| Display Format    | Standard                                   | Decimal Places | 0             |
| Coding            | RW, TE, BU                                 |                |               |

| Value | Text        | Description                                |
|-------|-------------|--|
| 0     | Direct      | Link is unicast or broadcast               |
| 1     | Multicast1  | Link is multicast to the IP address        |
| 2     | Multicast2  | Link is multicast to the IP address        |
| 3     | Multicast3  | Link is multicast to the IP address        |
| 4     | Multicast4  | Link is multicast to the IP address        |
| 5     | Local       | Link will receive from local transmit link |
| 6     | Multicast5  | Link is multicast to the IP address        |
| 7     | Multicast6  | Link is multicast to the IP address        |
| 8     | Multicast7  | Link is multicast to the IP address        |
| 9     | Multicast8  | Link is multicast to the IP address        |
| 10    | Multicast9  | Link is multicast to the IP address        |
| 11    | Multicast10 | Link is multicast to the IP address        |

This parameter specifies the type of transmission for the Rx1 link.



| Parameter         | 4.10.045 Rx1 Timeout                    |                |               |
|-------------------|---|----------------|---------------|
| Short description | Sets the timeout value for the Rx1 link |                |               |
| Minimum           | 0                                       | Maximum        | 65535         |
| Default           | 100                                     | Units          | ms            |
| Type              | 16 Bit User Save                        | Update Rate    | Read on reset |
| Display Format    | Standard                                | Decimal Places | 0             |
| Coding            | RW, BU                                  |                |               |

This parameter specifies the watchdog timer for the Rx1 link. If no cyclic data is received on the Rx1 link the action taken will be determined by the setting in *Rx1 Timeout Action* (4.10.046).

Note:

It is good system design to allow for some message loss by setting the timeout duration to be greater than the transmit period by a factor of 2 or more.

| Parameter         | 4.10.046 Rx1 Timeout Action                 |                |               |
|-------------------|---|----------------|---------------|
| Short description | Defines the timeout action for the Rx1 link |                |               |
| Minimum           | 0   | Maximum        | 2             |
| Default           | 0   | Units          |               |
| Type              | 8 Bit User Save                             | Update Rate    | Read on reset |
| Display Format    | Standard                                    | Decimal Places | 0             |
| Coding            | RW, TE, BU                                  |                |               |

| Value | Text         | Description  |
|-------|--------------|--|
| 0     | Trip         | Trip drive with Slx.Er and sub-trip code                 |
| 1     | Clear output | PLC output parameters will have their values set to zero |
| 2     | Hold last    | Hold the last value in output parameters                 |

Defines the action to be taken for a timeout on the Rx1 link.

| Parameter         | 4.10.047 Rx1 Timeout Event Destination                      |                |               |
|-------------------|---|----------------|---------------|
| Short description | Defines the timeout event destination slot for the Rx1 link |                |               |
| Minimum           | 0   | Maximum        | 4             |
| Default           | 0   | Units          |               |
| Type              | 8 Bit User Save   | Update Rate    | Read on reset |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, TE, BU  |                |               |

| Value | Text      | Description                       |
|-------|-----------|-----------------------------------|
| 0     | This slot | Trigger module event in this slot |
| 1     | Slot 1    | Trigger module event in slot 1    |
| 2     | Slot 2    | Trigger module event in slot 2    |
| 3     | Slot 3    | Trigger module event in slot 3    |
| 4     | Slot 4    | Trigger module event in slot 4    |

This parameter defines the slot in which an event will occur if a cyclic data timeout occurs on the Rx1 link.

<< This feature is not currently supported >>

| Parameter         | 4.10.048 Rx1 Timeout Event Type                            |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the event to trigger for a timeout on the Rx1 link |                |               |
| Minimum           | 0  | Maximum        | 4             |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save  | Update Rate    | Read on reset |
| Display Format    | Standard   | Decimal Places | 0             |
| Coding            | RW, TE, BU   |                |               |

| Value | Text     | Description            |
|-------|----------|------------------------|
| 0     | No Event | No event               |
| 1     | Event    | Trigger module event   |
| 2     | Event1   | Trigger module event 1 |
| 3     | Event2   | Trigger module event 2 |
| 4     | Event3   | Trigger module event 3 |

Defines the event to trigger in the given destination, as specified in *Rx1 Timeout Event Destination* (4.10.047), if a cyclic data timeout occurs on the Rx1 link.

| Parameter         | 4.10.049 Rx1 Link Status |                |                |
|-------------------|--------------------------|----------------|----------------|
| Short description | Link status when loaded  |                |                |
| Minimum           | -31                      | Maximum        | 2              |
| Default           |                          | Units          |                |
| Type              | 8 Bit Volatile           | Update Rate    | Write on reset |
| Display Format    | Standard                 | Decimal Places | 0              |
| Coding            | RO, TE, ND, NC, PT       |                |                |

| Value | Text             | Description   |
|-------|------------------|---|
| -31   | Disabled         | Easy Mode protocol is disabled or link number is set to 0                             |
| -30   | VLAN disabled    | VLAN is required in order to guarantee timing in synchronous mode but it is disabled. |
| -29   | Reserved 29      |   |
| -28   | Reserved 28      |   |
| -27   | Reserved 27      |   |
| -26   | Reserved 26      |   |
| -25   | Reserved 25      |   |
| -24   | Reserved 24      |   |
| -23   | Reserved 23      |   |
| -22   | Invalid DST IP   | The destination IP address is invalid   |
| -21   | SYNC unsupported | Sync link does not support mappings to other option parameters                        |
| -20   | MEC offset       | Incorrect MEC offset  |
| -19   | Invalid tx rate  | Tx rate must be a factor of 1 second  |
| -18   | Too many mapping | The number of mapping items exceeds the range supported                               |
| -17   | Link busy        | The link specified is busy  |
| -16   | Invalid profile  | The profile is invalid  |
| -15   | Invalid mapping  | The mapped parameter does not exist   |
| -14   | Read only param  | The mapped parameter is read only   |
| -13   | Msg mismatch     | Link number and direction do not match  |
| -12   | Msg too long     | Resulting message is too long   |
| -11   | Attrib NA        | Attribute not available   |
| -10   | Attrib RO        | Attribute is read only  |
| -9    | Attrib missing   | Attribute is missing  |
| -8    | Timeout          | Timeout   |
| -7    | In error         | The link specified is in Error state  |
| -6    | Link num in use  | The link number specified is already in use   |
| -5    | Not editable     | The link specified is not editable  |
| -4    | Invalid link num | An invalid link number was specified  |
| -3    | Invalid args     | Link Number or another argument specified was zero or some other invalid number       |
| -2    | Too many links   | Operation failed as the maximum number of links in use has been reached               |
| -1    | Out of memory    | Failed to allocate memory.  |
| 0     | OK               | Configuration of link successful  |
| 1     | Not running      | OK. Not running.  |
| 2     | OK sync          | Configuration of synchronous link successful  |

This reports the links status if it has been loaded. A *Reset* (4.10.002) is required to load any changes.

| Parameter         | 4.10.050 Rx2 Link Profile                                     |                |               |
|-------------------|---|----------------|---------------|
| Short description | Selects the Rx2 link as a standard or synchronous cyclic link |                |               |
| Minimum           | 0   | Maximum        | 1             |
| Default           | 0   | Units          |               |
| Type              | 8 Bit User Save   | Update Rate    | Read on reset |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, TE  |                |               |

| Value | Text | Description       |
|-------|------|-------------------|
| 0     | Std  | Standard link     |
| 1     | Sync | Synchronized link |

Used to select Rx2 as a standard or synchronous cyclic link.

| Parameter         | 4.10.051 Rx2 Link Number              |                |               |
|-------------------|---------------------------------------|----------------|---------------|
| Short description | Sets the link number for the Rx2 link |                |               |
| Minimum           | 0                                     | Maximum        | 255           |
| Default           | 0                                     | Units          |               |
| Type              | 8 Bit User Save                       | Update Rate    | Read on reset |
| Display Format    | Standard                              | Decimal Places | 0             |
| Coding            | RW, BU                                |                |               |

This parameter is used to set the link number for the Rx2 link.

| Parameter         | 4.10.052 Rx2 Destination Parameter              |                |               |
|-------------------|---|----------------|---------------|
| Short description | Sets the destination parameter for the Rx2 link |                |               |
| Minimum           | 0   | Maximum        | 499999        |
| Default           | 0   | Units          |               |
| Type              | 32 Bit User Save                                | Update Rate    | Read on reset |
| Display Format    | Slot Menu Parameter                             | Decimal Places | 0             |
| Coding            | RW, BU  |                |               |

This parameter sets the destination parameter for the Rx2 link.

| Parameter         | 4.10.053 Rx2 Parameter Count                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Sets the number of parameters for the Rx2 link |                |               |
| Minimum           | 0  | Maximum        | 10            |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save                                | Update Rate    | Read on reset |
| Display Format    | Standard                                       | Decimal Places | 0             |
| Coding            | RW, BU   |                |               |

This parameter is used to set the number of contiguous parameters for the Rx2 link.

| Parameter         | 4.10.054 Rx2 Source Type                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Sets the transmission type of the Rx2 link |                |               |
| Minimum           | 0  | Maximum        | 11            |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save                            | Update Rate    | Read on reset |
| Display Format    | Standard                                   | Decimal Places | 0             |
| Coding            | RW, TE, BU                                 |                |               |

| Value | Text        | Description                                |
|-------|-------------|--|
| 0     | Direct      | Link is unicast or broadcast               |
| 1     | Multicast1  | Link is multicast to the IP address        |
| 2     | Multicast2  | Link is multicast to the IP address        |
| 3     | Multicast3  | Link is multicast to the IP address        |
| 4     | Multicast4  | Link is multicast to the IP address        |
| 5     | Local       | Link will receive from local transmit link |
| 6     | Multicast5  | Link is multicast to the IP address        |
| 7     | Multicast6  | Link is multicast to the IP address        |
| 8     | Multicast7  | Link is multicast to the IP address        |
| 9     | Multicast8  | Link is multicast to the IP address        |
| 10    | Multicast9  | Link is multicast to the IP address        |
| 11    | Multicast10 | Link is multicast to the IP address        |

This parameter specifies the type of transmission for the Rx2 link.

| Parameter         | 4.10.055 Rx2 Timeout                    |                |               |
|-------------------|---|----------------|---------------|
| Short description | Sets the timeout value for the Rx2 link |                |               |
| Minimum           | 0                                       | Maximum        | 65535         |
| Default           | 100                                     | Units          | ms            |
| Type              | 16 Bit User Save                        | Update Rate    | Read on reset |
| Display Format    | Standard                                | Decimal Places | 0             |
| Coding            | RW, BU                                  |                |               |

This parameter specifies the watchdog timer for the Rx1 link. If no cyclic data is received on the Rx1 link the action taken will be determined by the setting in *Rx2 Timeout Action* (4.10.056).

Note:

It is good system design to allow for some message loss by setting the timeout duration to be greater than the transmit period by a factor of 2 or more.

| Parameter         | 4.10.056 Rx2 Timeout Action                 |                |               |
|-------------------|---|----------------|---------------|
| Short description | Defines the timeout action for the Rx2 link |                |               |
| Minimum           | 0   | Maximum        | 2             |
| Default           | 0   | Units          |               |
| Type              | 8 Bit User Save                             | Update Rate    | Read on reset |
| Display Format    | Standard                                    | Decimal Places | 0             |
| Coding            | RW, TE, BU                                  |                |               |

| Value | Text         | Description  |
|-------|--------------|--|
| 0     | Trip         | Trip drive with Slx.Er and sub-trip code                 |
| 1     | Clear output | PLC output parameters will have their values set to zero |
| 2     | Hold last    | Hold the last value in output parameters                 |

Defines the action to be taken for a timeout on the Rx2 link.

| Parameter         | 4.10.057 Rx2 Timeout Event Destination                      |                |               |
|-------------------|---|----------------|---------------|
| Short description | Defines the timeout event destination slot for the Rx2 link |                |               |
| Minimum           | 0   | Maximum        | 4             |
| Default           | 0   | Units          |               |
| Type              | 8 Bit User Save   | Update Rate    | Read on reset |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, TE, BU  |                |               |

| Value | Text      | Description                       |
|-------|-----------|-----------------------------------|
| 0     | This slot | Trigger module event in this slot |
| 1     | Slot 1    | Trigger module event in slot 1    |
| 2     | Slot 2    | Trigger module event in slot 2    |
| 3     | Slot 3    | Trigger module event in slot 3    |
| 4     | Slot 4    | Trigger module event in slot 4    |

This parameter defines the slot in which an event will occur if a cyclic data timeout occurs on the Rx2 link.

<< This feature is not currently supported >>

| Parameter         | 4.10.058 Rx2 Timeout Event Type                            |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the event to trigger for a timeout on the Rx2 link |                |               |
| Minimum           | 0  | Maximum        | 4             |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save  | Update Rate    | Read on reset |
| Display Format    | Standard   | Decimal Places | 0             |
| Coding            | RW, TE, BU   |                |               |

| Value | Text     | Description            |
|-------|----------|------------------------|
| 0     | No Event | No event               |
| 1     | Event    | Trigger module event   |
| 2     | Event1   | Trigger module event 1 |
| 3     | Event2   | Trigger module event 2 |
| 4     | Event3   | Trigger module event 3 |

Defines the event to trigger in the given destination, as specified in *Rx2 Timeout Event Destination* (4.10.057), if a cyclic data timeout occurs on the Rx2 link.

| Parameter         | 4.10.059 Rx2 Link Status |                |                |
|-------------------|--------------------------|----------------|----------------|
| Short description | Link status when loaded  |                |                |
| Minimum           | -31                      | Maximum        | 2              |
| Default           |                          | Units          |                |
| Type              | 8 Bit Volatile           | Update Rate    | Write on reset |
| Display Format    | Standard                 | Decimal Places | 0              |
| Coding            | RO, TE, ND, NC, PT       |                |                |

| <b>Value</b> | <b>Text</b>      | <b>Description</b>  |
|--------------|------------------|---|
| -31          | Disabled         | Easy Mode protocol is disabled or link number is set to 0                             |
| -30          | VLAN disabled    | VLAN is required in order to guarantee timing in synchronous mode but it is disabled. |
| -29          | Reserved 29      |   |
| -28          | Reserved 28      |   |
| -27          | Reserved 27      |   |
| -26          | Reserved 26      |   |
| -25          | Reserved 25      |   |
| -24          | Reserved 24      |   |
| -23          | Reserved 23      |   |
| -22          | Invalid DST IP   | The destination IP address is invalid   |
| -21          | SYNC unsupported | Sync link does not support mappings to other option parameters                        |
| -20          | MEC offset       | Incorrect MEC offset  |
| -19          | Invalid tx rate  | Tx rate must be a factor of 1 second  |
| -18          | Too many mapping | The number of mapping items exceeds the range supported                               |
| -17          | Link busy        | The link specified is busy  |
| -16          | Invalid profile  | The profile is invalid  |
| -15          | Invalid mapping  | The mapped parameter does not exist   |
| -14          | Read only param  | The mapped parameter is read only   |
| -13          | Msg mismatch     | Link number and direction do not match  |
| -12          | Msg too long     | Resulting message is too long   |
| -11          | Attrib NA        | Attribute not available   |
| -10          | Attrib RO        | Attribute is read only  |
| -9           | Attrib missing   | Attribute is missing  |
| -8           | Timeout          | Timeout   |
| -7           | In error         | The link specified is in Error state  |
| -6           | Link num in use  | The link number specified is already in use   |
| -5           | Not editable     | The link specified is not editable  |
| -4           | Invalid link num | An invalid link number was specified  |
| -3           | Invalid args     | Link Number or another argument specified was zero or some other invalid number       |
| -2           | Too many links   | Operation failed as the maximum number of links in use has been reached               |
| -1           | Out of memory    | Failed to allocate memory.  |
| 0            | OK               | Configuration of link successful  |
| 1            | Not running      | OK. Not running.  |
| 2            | OK sync          | Configuration of synchronous link successful  |

This reports the links status if it has been loaded. A Reset (4.10.002) is required to load any changes.

| <b>Parameter</b>  | <b>4.10.060 Rx3 Link Profile</b>                              |                |               |
|-------------------|---|----------------|---------------|
| Short description | Selects the Rx3 link as a standard or synchronous cyclic link |                |               |
| Minimum           | 0   | Maximum        | 1             |
| Default           | 0   | Units          |               |
| Type              | 8 Bit User Save   | Update Rate    | Read on reset |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, TE  |                |               |

| <b>Value</b> | <b>Text</b> | <b>Description</b> |
|--------------|-------------|--------------------|
| 0            | Std         | Standard link      |
| 1            | Sync        | Synchronized link  |

Used to select Rx3 as a standard or synchronous cyclic link.

| <b>Parameter</b>  | <b>4.10.061 Rx3 Link Number</b>       |                |               |
|-------------------|---------------------------------------|----------------|---------------|
| Short description | Sets the link number for the Rx3 link |                |               |
| Minimum           | 0                                     | Maximum        | 255           |
| Default           | 0                                     | Units          |               |
| Type              | 8 Bit User Save                       | Update Rate    | Read on reset |
| Display Format    | Standard                              | Decimal Places | 0             |
| Coding            | RW, BU                                |                |               |

This parameter is used to set the link number for the Rx3 link.

| Parameter         | 4.10.062 Rx3 Destination Parameter              |                |               |
|-------------------|---|----------------|---------------|
| Short description | Sets the destination parameter for the Rx3 link |                |               |
| Minimum           | 0   | Maximum        | 499999        |
| Default           | 0   | Units          |               |
| Type              | 32 Bit User Save                                | Update Rate    | Read on reset |
| Display Format    | Slot Menu Parameter                             | Decimal Places | 0             |
| Coding            | RW, BU  |                |               |

This parameter sets the destination parameter for the Rx3 link.

| Parameter         | 4.10.063 Rx3 Parameter Count                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Sets the number of parameters for the Rx3 link |                |               |
| Minimum           | 0  | Maximum        | 10            |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save                                | Update Rate    | Read on reset |
| Display Format    | Standard                                       | Decimal Places | 0             |
| Coding            | RW, BU   |                |               |

This parameter is used to set the number of contiguous parameters for the Rx3 link.

| Parameter         | 4.10.064 Rx3 Source Type                   |                |               |
|-------------------|--|----------------|---------------|
| Short description | Sets the transmission type of the Rx3 link |                |               |
| Minimum           | 0  | Maximum        | 11            |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save                            | Update Rate    | Read on reset |
| Display Format    | Standard                                   | Decimal Places | 0             |
| Coding            | RW, TE, BU                                 |                |               |

| Value | Text        | Description                                |
|-------|-------------|--|
| 0     | Direct      | Link is unicast or broadcast               |
| 1     | Multicast1  | Link is multicast to the IP address        |
| 2     | Multicast2  | Link is multicast to the IP address        |
| 3     | Multicast3  | Link is multicast to the IP address        |
| 4     | Multicast4  | Link is multicast to the IP address        |
| 5     | Local       | Link will receive from local transmit link |
| 6     | Multicast5  | Link is multicast to the IP address        |
| 7     | Multicast6  | Link is multicast to the IP address        |
| 8     | Multicast7  | Link is multicast to the IP address        |
| 9     | Multicast8  | Link is multicast to the IP address        |
| 10    | Multicast9  | Link is multicast to the IP address        |
| 11    | Multicast10 | Link is multicast to the IP address        |

This parameter specifies the type of transmission for the Rx3 link.

| Parameter         | 4.10.065 Rx3 Timeout                    |                |               |
|-------------------|---|----------------|---------------|
| Short description | Sets the timeout value for the Rx3 link |                |               |
| Minimum           | 0                                       | Maximum        | 65535         |
| Default           | 100                                     | Units          | ms            |
| Type              | 16 Bit User Save                        | Update Rate    | Read on reset |
| Display Format    | Standard                                | Decimal Places | 0             |
| Coding            | RW, BU                                  |                |               |

This parameter specifies the watchdog timer for the Rx1 link. If no cyclic data is received on the Rx1 link the action taken will be determined by the setting in *Rx3 Timeout Action* (4.10.066).

Note:

It is good system design to allow for some message loss by setting the timeout duration to be greater than the transmit period by a factor of 2 or more.

| Parameter         | 4.10.066 Rx3 Timeout Action                 |                |               |
|-------------------|---|----------------|---------------|
| Short description | Defines the timeout action for the Rx3 link |                |               |
| Minimum           | 0   | Maximum        | 2             |
| Default           | 0   | Units          |               |
| Type              | 8 Bit User Save                             | Update Rate    | Read on reset |
| Display Format    | Standard                                    | Decimal Places | 0             |
| Coding            | RW, TE, BU                                  |                |               |

| Value | Text         | Description  |
|-------|--------------|--|
| 0     | Trip         | Trip drive with Slx.Er and sub-trip code                 |
| 1     | Clear output | PLC output parameters will have their values set to zero |
| 2     | Hold last    | Hold the last value in output parameters                 |

Defines the action to be taken for a timeout on the Rx3 link.

| Parameter         | 4.10.067 Rx3 Timeout Event Destination                      |                |               |
|-------------------|---|----------------|---------------|
| Short description | Defines the timeout event destination slot for the Rx3 link |                |               |
| Minimum           | 0   | Maximum        | 4             |
| Default           | 0   | Units          |               |
| Type              | 8 Bit User Save   | Update Rate    | Read on reset |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, TE, BU  |                |               |

| Value | Text      | Description                       |
|-------|-----------|-----------------------------------|
| 0     | This slot | Trigger module event in this slot |
| 1     | Slot 1    | Trigger module event in slot 1    |
| 2     | Slot 2    | Trigger module event in slot 2    |
| 3     | Slot 3    | Trigger module event in slot 3    |
| 4     | Slot 4    | Trigger module event in slot 4    |

This parameter defines the slot in which an event will occur if a cyclic data timeout occurs on the Rx3 link.

<< This feature is not currently supported >>

| Parameter         | 4.10.068 Rx3 Timeout Event Type                            |                |               |
|-------------------|--|----------------|---------------|
| Short description | Defines the event to trigger for a timeout on the Rx3 link |                |               |
| Minimum           | 0  | Maximum        | 4             |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save  | Update Rate    | Read on reset |
| Display Format    | Standard   | Decimal Places | 0             |
| Coding            | RW, TE, BU   |                |               |

| Value | Text     | Description            |
|-------|----------|------------------------|
| 0     | No Event | No event               |
| 1     | Event    | Trigger module event   |
| 2     | Event1   | Trigger module event 1 |
| 3     | Event2   | Trigger module event 2 |
| 4     | Event3   | Trigger module event 3 |

Defines the event to trigger in the given destination, as specified in *Rx3 Timeout Event Destination* (4.10.067), if a cyclic data timeout occurs on the Rx3 link.

| Parameter         | 4.10.069 Rx3 Link Status |                |                |
|-------------------|--------------------------|----------------|----------------|
| Short description | Link status when loaded  |                |                |
| Minimum           | -31                      | Maximum        | 2              |
| Default           |                          | Units          |                |
| Type              | 8 Bit Volatile           | Update Rate    | Write on reset |
| Display Format    | Standard                 | Decimal Places | 0              |
| Coding            | RO, TE, ND, NC, PT       |                |                |

| <b>Value</b> | <b>Text</b>      | <b>Description</b>  |
|--------------|------------------|---|
| -31          | Disabled         | Easy Mode protocol is disabled or link number is set to 0                             |
| -30          | VLAN disabled    | VLAN is required in order to guarantee timing in synchronous mode but it is disabled. |
| -29          | Reserved 29      |   |
| -28          | Reserved 28      |   |
| -27          | Reserved 27      |   |
| -26          | Reserved 26      |   |
| -25          | Reserved 25      |   |
| -24          | Reserved 24      |   |
| -23          | Reserved 23      |   |
| -22          | Invalid DST IP   | The destination IP address is invalid   |
| -21          | SYNC unsupported | Sync link does not support mappings to other option parameters                        |
| -20          | MEC offset       | Incorrect MEC offset  |
| -19          | Invalid tx rate  | Tx rate must be a factor of 1 second  |
| -18          | Too many mapping | The number of mapping items exceeds the range supported                               |
| -17          | Link busy        | The link specified is busy  |
| -16          | Invalid profile  | The profile is invalid  |
| -15          | Invalid mapping  | The mapped parameter does not exist   |
| -14          | Read only param  | The mapped parameter is read only   |
| -13          | Msg mismatch     | Link number and direction do not match  |
| -12          | Msg too long     | Resulting message is too long   |
| -11          | Attrib NA        | Attribute not available   |
| -10          | Attrib RO        | Attribute is read only  |
| -9           | Attrib missing   | Attribute is missing  |
| -8           | Timeout          | Timeout   |
| -7           | In error         | The link specified is in Error state  |
| -6           | Link num in use  | The link number specified is already in use   |
| -5           | Not editable     | The link specified is not editable  |
| -4           | Invalid link num | An invalid link number was specified  |
| -3           | Invalid args     | Link Number or another argument specified was zero or some other invalid number       |
| -2           | Too many links   | Operation failed as the maximum number of links in use has been reached               |
| -1           | Out of memory    | Failed to allocate memory.  |
| 0            | OK               | Configuration of link successful  |
| 1            | Not running      | OK. Not running.  |
| 2            | OK sync          | Configuration of synchronous link successful  |

This reports the links status if it has been loaded. A *Reset* (4.10.002) is required to load any changes.



## Slot 4 Menu 11 Single Line Descriptions – Synchronisation

Mode: RFC-A

| Parameter |  | Range   | Default       | Type |      |    |    |    |    |
|-----------|--|---|---------------|------|------|----|----|----|----|
| 4.11.001  | Preferred Sync Master                      | 0 to 4  | 1             | RW   | Num  |    |    |    | US |
| 4.11.002  | Master Clock Domain                        | 0 to 3  | 0             | RW   | Num  |    |    |    | US |
| 4.11.005  | Grandmaster MAC Address                    | 00:00:00:00:00:00 to FF:FF:FF:FF:FF:FF                        |               | RO   | Mac  | ND | NC | PT |    |
| 4.11.006  | Synchronisation Jitter From Grandmaster    | -2147483648 to 2147483647 ns                                  |               | RO   | Num  | ND | NC | PT |    |
| 4.11.007  | Synchronisation Jitter Threshold           | 500 to 1000000 ns   | 1000 ns       | RW   | Num  |    |    |    | US |
| 4.11.008  | Module Synchronised Flag                   | Off (0) or On (1)   | Off (0)       | RO   | Bit  |    |    |    |    |
| 4.11.009  | Inhibit Drive Synchronisation              | Off (0) or On (1)   | Off (0)       | RW   | Bit  |    |    |    | US |
| 4.11.010  | PTP Date                                   | 00-00-00 to 31-12-99  |               | RO   | Date | ND | NC | PT |    |
| 4.11.011  | PTP Time                                   | 00:00:00 to 23:59:59  |               | RO   | Time | ND | NC | PT |    |
| 4.11.015  | PTP Delay Measurement Select               | P2P DELAY (1), OFF (2)  | P2P DELAY (1) | RW   | Txt  |    |    |    | US |
| 4.11.016  | PTP Sync Rate                              | -4 to 0   | -4            | RW   | Num  |    |    |    | US |
| 4.11.017  | In sync window length                      | 3 to 255 s  | 20 s          | RW   | Num  |    |    |    | US |
| 4.11.020  | Network Error Count                        | 0 to 4294967295   |               | RO   | Num  | ND | NC | PT |    |
| 4.11.022  | Interoption Sync Status                    | MASTER (0), PRODUCER (1), INDEPENDENT (2)                     |               | RO   | Txt  | ND | NC | PT |    |
| 4.11.030  | Easy Mode Maximum Network Delay            | 1 to 100 ms   | 3 ms          | RW   | Num  |    |    |    | US |
| 4.11.040  | Rx1 Late Synchronisation Frame Action      | Trip (1), Do not use (2), Use (3)                             | Trip (1)      | RW   | Txt  |    |    |    | US |
| 4.11.041  | Rx1 Late Synchronisation Frame Destination | This slot (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4) | This slot (0) | RW   | Txt  |    |    |    | US |
| 4.11.042  | Rx1 Late Synchronisation Frame Event       | No Event (0), Event (1), Event1 (2), Event2 (3), Event3 (4)   | No Event (0)  | RW   | Txt  |    |    |    | US |
| 4.11.050  | Rx2 Late Synchronisation Frame Action      | Trip (1), Do not use (2), Use (3)                             | Trip (1)      | RW   | Txt  |    |    |    | US |
| 4.11.051  | Rx2 Late Synchronisation Frame Destination | This slot (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4) | This slot (0) | RW   | Txt  |    |    |    | US |
| 4.11.052  | Rx2 Late Synchronisation Frame Event       | No Event (0), Event (1), Event1 (2), Event2 (3), Event3 (4)   | No Event (0)  | RW   | Txt  |    |    |    | US |
| 4.11.060  | Rx3 Late Synchronisation Frame Action      | Trip (1), Do not use (2), Use (3)                             | Trip (1)      | RW   | Txt  |    |    |    | US |
| 4.11.061  | Rx3 Late Synchronisation Frame Destination | This slot (0), Slot 1 (1), Slot 2 (2), Slot 3 (3), Slot 4 (4) | This slot (0) | RW   | Txt  |    |    |    | US |
| 4.11.062  | Rx3 Late Synchronisation Frame Event       | No Event (0), Event (1), Event1 (2), Event2 (3), Event3 (4)   | No Event (0)  | RW   | Txt  |    |    |    | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Slot 4 Menu 11 – Synchronisation

Mode: RFC-A

Note: Synchronous Cyclic Links are supported on the Unidrive M onboard Ethernet interface but not on SI-Ethernet on Unidrive M200 - M600.

| Parameter         | 4.11.001 Preferred Sync Master                          |                |               |
|-------------------|---|----------------|---------------|
| Short description | Defines the module's synchronisation master preferences |                |               |
| Minimum           | 0   | Maximum        | 4             |
| Default           | 1   | Units          |               |
| Type              | 8 Bit User Save   | Update Rate    | Read on reset |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, BU  |                |               |

| Parameter         | 4.11.002 Master Clock Domain                         |                |               |
|-------------------|--|----------------|---------------|
| Short description | Specifies the clock domain for the grandmaster clock |                |               |
| Minimum           | 0  | Maximum        | 3             |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save                                      | Update Rate    | Read on reset |
| Display Format    | Standard   | Decimal Places | 0             |
| Coding            | RW, BU   |                |               |

Specifies the clock domain for the module to act as a grandmaster clock.

| Parameter         | 4.11.005 Grandmaster MAC Address                            |                |  |
|-------------------|---|----------------|--|
| Short description | Displays the MAC address of the synchronisation grandmaster |                |  |
| Minimum           | 0<br>(Display: 00:00:00:00:00:00)                           | Maximum        | 18446744073709551615<br>(Display: FF:FF:FF:FF:FF:FF) |
| Default           |   | Units          |  |
| Type              | 64 Bit Volatile   | Update Rate    | Background write                                     |
| Display Format    | MAC Address   | Decimal Places | 0  |
| Coding            | RO, ND, NC, PT, BU  |                |  |

This parameter displays the MAC address, as a 64-bit hexadecimal value, of the synchronisation grandmaster (if there is a grandmaster).

| Parameter         | 4.11.006 Synchronisation Jitter From Grandmaster |                |                     |
|-------------------|--|----------------|---------------------|
| Short description | Displays the jitter from the grandmaster         |                |                     |
| Minimum           | -2147483648                                      | Maximum        | 2147483647          |
| Default           |  | Units          | ns                  |
| Type              | 32 Bit Volatile                                  | Update Rate    | Written every 500ms |
| Display Format    | Standard   | Decimal Places | 0                   |
| Coding            | RO, ND, NC, PT                                   |                |                     |

This parameter displays the synchronisation jitter in nanoseconds. The value is filtered to be human readable.

| Parameter         | 4.11.007 Synchronisation Jitter Threshold |                |               |
|-------------------|---|----------------|---------------|
| Short description | Synchronisation Jitter Threshold          |                |               |
| Minimum           | 500                                       | Maximum        | 1000000       |
| Default           | 1000                                      | Units          | ns            |
| Type              | 32 Bit User Save                          | Update Rate    | Read on reset |
| Display Format    | Standard                                  | Decimal Places | 0             |
| Coding            | RW, BU                                    |                |               |

Sets the application tolerable clock jitter in ns from the grandmaster. If *Synchronisation Jitter From Grandmaster* (4.11.006) is within the tolerance the local clock is synchronised to the grandmaster and synchronised cyclic data links will be processed.

| Parameter         | 4.11.008 Module Synchronised Flag |                |                    |
|-------------------|-----------------------------------|----------------|--------------------|
| Short description | Module synchronised flag          |                |                    |
| Minimum           | 0                                 | Maximum        | 1                  |
| Default           | 0                                 | Units          |                    |
| Type              | 1 Bit Volatile                    | Update Rate    | Written every 10ms |
| Display Format    | Standard                          | Decimal Places | 0                  |
| Coding            | RO                                |                |                    |

The parameter displays the module's synchronisation status. 1 = Synchronised, 0 = Not synchronised.

| <b>Parameter</b>                              |  |                |           |
|---|--|----------------|-----------|
| <b>4.11.009 Inhibit Drive Synchronisation</b> |  |                |           |
| Short description                             | Specifies whether the module should synchronise with the grandmaster |                |           |
| Minimum                                       | 0  | Maximum        | 1         |
| Default                                       | 0  | Units          |           |
| Type  | 1 Bit User Save  | Update Rate    | Immediate |
| Display Format                                | Standard   | Decimal Places | 0         |
| Coding  | RW   |                |           |

This parameter controls whether the module synchronises the OPT\_SYNC with the network grandmaster. A value of ON inhibits this.

| <b>Parameter</b>         |                          |                |                               |
|--------------------------|--------------------------|----------------|-------------------------------|
| <b>4.11.010 PTP Date</b> |                          |                |                               |
| Short description        | PTP Date                 |                |                               |
| Minimum                  | 0<br>(Display: 00-00-00) | Maximum        | 311299<br>(Display: 31-12-99) |
| Default                  |                          | Units          |                               |
| Type                     | 32 Bit Volatile          | Update Rate    | Written every 500ms           |
| Display Format           | Date                     | Decimal Places | 0                             |
| Coding                   | RO, ND, NC, PT, BU       |                |                               |

This parameter displays the current date. If the module has no time source it will display the date based on its power-up date of 1st January 1970.

| <b>Parameter</b>         |                          |                |                               |
|--------------------------|--------------------------|----------------|-------------------------------|
| <b>4.11.011 PTP Time</b> |                          |                |                               |
| Short description        | PTP Time                 |                |                               |
| Minimum                  | 0<br>(Display: 00:00:00) | Maximum        | 235959<br>(Display: 23:59:59) |
| Default                  |                          | Units          |                               |
| Type                     | 32 Bit Volatile          | Update Rate    | Written every 500ms           |
| Display Format           | Time                     | Decimal Places | 0                             |
| Coding                   | RO, ND, NC, PT, BU       |                |                               |

This parameter displays the current time. If the module has no time source it will display the date based on its power-up date of 00:00:00.

| <b>Parameter</b>                             |                              |                |               |
|--|------------------------------|----------------|---------------|
| <b>4.11.015 PTP Delay Measurement Select</b> |                              |                |               |
| Short description                            | PTP delay measurement select |                |               |
| Minimum                                      | 1                            | Maximum        | 2             |
| Default                                      | 1                            | Units          |               |
| Type   | 8 Bit User Save              | Update Rate    | Read on reset |
| Display Format                               | Standard                     | Decimal Places | 0             |
| Coding                                       | RW, TE, BU                   |                |               |

| <b>Value</b> | <b>Text</b> | <b>Description</b> |
|--------------|-------------|--------------------|
| 1            | P2P DELAY   | Peer-to-peer delay |
| 2            | OFF         | Delay off          |

In Factory Fit Ethernet / SI-Ethernet firmware V01.03.00.00 onwards, this parameter is no longer supported. PTP Delay Measurement is always Peer-to-Peer.

*This parameter selects the delay measurement. 0 = End-to-end; 1 = Peer-to-peer, 2 = OFF*

*End-to-end is the delay mechanism between slave clocks and the master clock.*

*Peer-to-peer delay mechanism provides not only the PTP event transit time information, but also provides the corrections for the propagation delay of the link connected to the port receiving the PTP event message.*

*OFF disables the PTP messages so that the module will not respond to a PTP delay request message or initiate a PTP delay request message and will therefore not synchronise with the master.*

| <b>Parameter</b>              |                 |                |               |
|-------------------------------|-----------------|----------------|---------------|
| <b>4.11.016 PTP Sync Rate</b> |                 |                |               |
| Short description             | PTP Sync rate   |                |               |
| Minimum                       | -4              | Maximum        | 0             |
| Default                       | -4              | Units          |               |
| Type                          | 8 Bit User Save | Update Rate    | Read on reset |
| Display Format                | Standard        | Decimal Places | 0             |
| Coding                        | RW              |                |               |

This parameter controls the rate at which PTP Sync frames are sent. the message rate is determined by raising 2 to the power of this parameter. E.g the default value here of -2 results in four sync messages per second.

| Parameter         | 4.11.017 <i>In sync window length</i> |                |               |
|-------------------|---------------------------------------|----------------|---------------|
| Short description |                                       |                |               |
| Minimum           | 3                                     | Maximum        | 255           |
| Default           | 20                                    | Units          | s             |
| Type              | 8 Bit User Save                       | Update Rate    | Read on reset |
| Display Format    | Standard                              | Decimal Places | 0             |
| Coding            | RW, BU                                |                |               |

Duration that the jitter *Synchronisation Jitter From Grandmaster* (4.11.006) must be below the jitter threshold for before the in sync flag *Module Synchronised Flag* (4.11.008) is set.

For a system the duration depends upon the number of IEEE1588 capable master on the network. To use lower values here the number of devices who are capable of acting as a synchronisation master must be kept as low as possible by setting *Preferred Sync Master* (4.11.001) to 0 on all interfaces except those who may be master.

| Parameter         | 4.11.020 <i>Network Error Count</i>                   |                |                     |
|-------------------|---|----------------|---------------------|
| Short description | Displays the number of errors detected on the network |                |                     |
| Minimum           | 0   | Maximum        | 4294967295          |
| Default           |   | Units          |                     |
| Type              | 32 Bit Volatile                                       | Update Rate    | Written every 500ms |
| Display Format    | Standard  | Decimal Places | 0                   |
| Coding            | RO, ND, NC, PT, BU                                    |                |                     |

The parameter displays a count of network errors since startup. It can be used as an indication of a problem.

| Parameter         | 4.11.022 <i>Interoption Sync Status</i> |                |            |
|-------------------|---|----------------|------------|
| Short description | Interoption Sync Status                 |                |            |
| Minimum           | 0                                       | Maximum        | 2          |
| Default           |   | Units          |            |
| Type              | 8 Bit Volatile                          | Update Rate    | Background |
| Display Format    | Standard                                | Decimal Places | 0          |
| Coding            | RO, TE, ND, NC, PT, BU                  |                |            |

This module does not support Slave mode

| Value | Text        | Description                            |
|-------|-------------|--|
| 0     | MASTER      | The module is master but not producing |
| 1     | PRODUCER    | The module is master and producing     |
| 2     | INDEPENDENT | The module is not master               |

| Parameter         | 4.11.030 <i>Easy Mode Maximum Network Delay</i>                         |                |               |
|-------------------|---|----------------|---------------|
| Short description | Defines the maximum allowable delay for Easy Mode cyclic transmit links |                |               |
| Minimum           | 1   | Maximum        | 100           |
| Default           | 3   | Units          | ms            |
| Type              | 8 Bit User Save   | Update Rate    | Read on reset |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, BU  |                |               |

This defines the allowable network delay (in milliseconds) for the Easy Mode synchronous transmit cyclic links to arrive at their destination.

In Factory Fit Ethernet / SI-Ethernet firmware V01.03.00.00 onwards, the default delay has been changed to 3ms (previous value 0ms). If the old default of 0ms is encountered, this is automatically changed to 3ms as the new minimum is 1ms).

| Parameter         | 4.11.040 <i>Rx1 Late Synchronisation Frame Action</i>               |                |               |
|-------------------|---|----------------|---------------|
| Short description | Defines the action to take when synchronised frame is received late |                |               |
| Minimum           | 1   | Maximum        | 3             |
| Default           | 1   | Units          |               |
| Type              | 8 Bit User Save   | Update Rate    | Read on reset |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, TE, BU  |                |               |

| Value | Text       | Description                              |
|-------|------------|--|
| 1     | Trip       | Trip drive with Slx.Er and sub-trip code |
| 2     | Do not use | The data is ignored                      |
| 3     | Use        | The data is used immediately             |

This parameter defines the action to be taken when a late synchronised frame is received.

In Factory Fit Ethernet / SI-Ethernet firmware V01.03.00.00 onwards there are a reduced range of actions. Since the option zero has been deprecated, the new default action is Trip (1st option).

|                   |  |                |               |
|-------------------|--|----------------|---------------|
| <b>Parameter</b>  | <b>4.11.041 Rx1 Late Synchronisation Frame Destination</b> |                |               |
| Short description | Sets the slot to trigger an event                          |                |               |
| Minimum           | 0  | Maximum        | 4             |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save  | Update Rate    | Read on reset |
| Display Format    | Standard   | Decimal Places | 0             |
| Coding            | RW, TE, BU   |                |               |

| Value | Text      | Description                       |
|-------|-----------|-----------------------------------|
| 0     | This slot | Trigger module event in this slot |
| 1     | Slot 1    | Trigger module event in slot 1    |
| 2     | Slot 2    | Trigger module event in slot 2    |
| 3     | Slot 3    | Trigger module event in slot 3    |
| 4     | Slot 4    | Trigger module event in slot 4    |

Defines the destination (slot) to trigger the event when a late synchronised frame is received.

|                   |  |                |               |
|-------------------|--|----------------|---------------|
| <b>Parameter</b>  | <b>4.11.042 Rx1 Late Synchronisation Frame Event</b> |                |               |
| Short description | Sets the event number to trigger                     |                |               |
| Minimum           | 0  | Maximum        | 4             |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save                                      | Update Rate    | Read on reset |
| Display Format    | Standard   | Decimal Places | 0             |
| Coding            | RW, TE, BU   |                |               |

| Value | Text     | Description            |
|-------|----------|------------------------|
| 0     | No Event | No event               |
| 1     | Event    | Trigger module event   |
| 2     | Event1   | Trigger module event 1 |
| 3     | Event2   | Trigger module event 2 |
| 4     | Event3   | Trigger module event 3 |

Defines the event number to trigger in the given destination (slot) when a late synchronised frame is received.

|                   |   |                |               |
|-------------------|---|----------------|---------------|
| <b>Parameter</b>  | <b>4.11.050 Rx2 Late Synchronisation Frame Action</b>               |                |               |
| Short description | Defines the action to take when synchronised frame is received late |                |               |
| Minimum           | 1   | Maximum        | 3             |
| Default           | 1   | Units          |               |
| Type              | 8 Bit User Save   | Update Rate    | Read on reset |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, TE, BU  |                |               |

| Value | Text       | Description                              |
|-------|------------|--|
| 1     | Trip       | Trip drive with Slx.Er and sub-trip code |
| 2     | Do not use | The data is ignored                      |
| 3     | Use        | The data is used immediately             |

This parameter defines the action to be taken when a late synchronised frame is received.

In Factory Fit Ethernet / SI-Ethernet firmware V01.03.00.00 onwards there are a reduced range of actions. Since the option zero has been deprecated, the new default action is Trip (1st option).

|                   |  |                |               |
|-------------------|--|----------------|---------------|
| <b>Parameter</b>  | <b>4.11.051 Rx2 Late Synchronisation Frame Destination</b> |                |               |
| Short description | Sets the slot to trigger an event                          |                |               |
| Minimum           | 0  | Maximum        | 4             |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save  | Update Rate    | Read on reset |
| Display Format    | Standard   | Decimal Places | 0             |
| Coding            | RW, TE, BU   |                |               |

| Value | Text      | Description                       |
|-------|-----------|-----------------------------------|
| 0     | This slot | Trigger module event in this slot |
| 1     | Slot 1    | Trigger module event in slot 1    |
| 2     | Slot 2    | Trigger module event in slot 2    |
| 3     | Slot 3    | Trigger module event in slot 3    |
| 4     | Slot 4    | Trigger module event in slot 4    |

Defines the destination (slot) to trigger the event when a late synchronised frame is received.

|                   |  |                |               |
|-------------------|--|----------------|---------------|
| <b>Parameter</b>  | <b>4.11.052 Rx2 Late Synchronisation Frame Event</b> |                |               |
| Short description | Sets the event number to trigger                     |                |               |
| Minimum           | 0  | Maximum        | 4             |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save                                      | Update Rate    | Read on reset |
| Display Format    | Standard   | Decimal Places | 0             |
| Coding            | RW, TE, BU   |                |               |

| <b>Value</b> | <b>Text</b> | <b>Description</b>     |
|--------------|-------------|------------------------|
| 0            | No Event    | No event               |
| 1            | Event       | Trigger module event   |
| 2            | Event1      | Trigger module event 1 |
| 3            | Event2      | Trigger module event 2 |
| 4            | Event3      | Trigger module event 3 |

Defines the event number to trigger in the given destination (slot) when a late synchronised frame is received.

|                   |   |                |               |
|-------------------|---|----------------|---------------|
| <b>Parameter</b>  | <b>4.11.060 Rx3 Late Synchronisation Frame Action</b>               |                |               |
| Short description | Defines the action to take when synchronised frame is received late |                |               |
| Minimum           | 1   | Maximum        | 3             |
| Default           | 1   | Units          |               |
| Type              | 8 Bit User Save   | Update Rate    | Read on reset |
| Display Format    | Standard  | Decimal Places | 0             |
| Coding            | RW, TE, BU  |                |               |

| <b>Value</b> | <b>Text</b> | <b>Description</b>                       |
|--------------|-------------|--|
| 1            | Trip        | Trip drive with Slx.Er and sub-trip code |
| 2            | Do not use  | The data is ignored                      |
| 3            | Use         | The data is used immediately             |

This parameter defines the action to be taken when a late synchronised frame is received.

In Factory Fit Ethernet / SI-Ethernet firmware V01.03.00.00 onwards there are a reduced range of actions. Since the option zero has been deprecated, the new default action is Trip (1st option).

|                   |  |                |               |
|-------------------|--|----------------|---------------|
| <b>Parameter</b>  | <b>4.11.061 Rx3 Late Synchronisation Frame Destination</b> |                |               |
| Short description | Sets the slot to trigger an event                          |                |               |
| Minimum           | 0  | Maximum        | 4             |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save  | Update Rate    | Read on reset |
| Display Format    | Standard   | Decimal Places | 0             |
| Coding            | RW, TE, BU   |                |               |

| <b>Value</b> | <b>Text</b> | <b>Description</b>                |
|--------------|-------------|-----------------------------------|
| 0            | This slot   | Trigger module event in this slot |
| 1            | Slot 1      | Trigger module event in slot 1    |
| 2            | Slot 2      | Trigger module event in slot 2    |
| 3            | Slot 3      | Trigger module event in slot 3    |
| 4            | Slot 4      | Trigger module event in slot 4    |

Defines the destination (slot) to trigger the event when a late synchronised frame is received.

|                   |  |                |               |
|-------------------|--|----------------|---------------|
| <b>Parameter</b>  | <b>4.11.062 Rx3 Late Synchronisation Frame Event</b> |                |               |
| Short description | Sets the event number to trigger                     |                |               |
| Minimum           | 0  | Maximum        | 4             |
| Default           | 0  | Units          |               |
| Type              | 8 Bit User Save                                      | Update Rate    | Read on reset |
| Display Format    | Standard   | Decimal Places | 0             |
| Coding            | RW, TE, BU   |                |               |

| <b>Value</b> | <b>Text</b> | <b>Description</b>     |
|--------------|-------------|------------------------|
| 0            | No Event    | No event               |
| 1            | Event       | Trigger module event   |
| 2            | Event1      | Trigger module event 1 |
| 3            | Event2      | Trigger module event 2 |
| 4            | Event3      | Trigger module event 3 |

Defines the event number to trigger in the given destination (slot) when a late synchronised frame is received.

## Slot 4 Menu 15 Single Line Descriptions – Modbus TCP/IP Setup

Mode: RFC-A

| Parameter |                                  | Range   | Default       | Type |     |    |    |    |    |
|-----------|----------------------------------|---|---------------|------|-----|----|----|----|----|
| 4.15.001  | Enable                           | Off (0) or On (1)   | On (1)        | RW   | Bit |    |    |    | US |
| 4.15.002  | Reset                            | Off (0) or On (1)   | Off (0)       | RW   | Bit |    | NC |    |    |
| 4.15.003  | Default                          | Off (0) or On (1)   | Off (0)       | RW   | Bit |    | NC |    |    |
| 4.15.004  | Modbus Configuration Error       | No error (0), Port in use (1),<br>Timeout event (2),<br>Num Connections (3)   |               | RO   | Txt | ND | NC | PT |    |
| 4.15.005  | Modbus Listening Port            | 0 to 65535  | 502           | RW   | Num |    |    |    | US |
| 4.15.006  | Maximum Connections              | 0 to 4  | 2             | RW   | Num |    |    |    | US |
| 4.15.007  | Maximum Priority Connections     | 0 to 5  | 0             | RW   | Num |    |    |    | US |
| 4.15.008  | Maximum Connections Per Client   | 1 to 4  | 2             | RW   | Num |    |    |    | US |
| 4.15.009  | Modbus Timeout                   | 1 to 10000 ms   | 100 ms        | RW   | Num |    |    |    | US |
| 4.15.010  | Modbus Timeout Action            | Trip (0), No action (1)   | No action (1) | RW   | Txt |    |    |    | US |
| 4.15.011  | Modbus Timeout Event Destination | This slot (0), Slot 1 (1), Slot 2 (2),<br>Slot 3 (3), Slot 4 (4)  | This slot (0) | RW   | Txt |    |    |    | US |
| 4.15.012  | Modbus Timeout Event Type        | No event (0), Trigger Event (1),<br>Trigger Event 1 (2),<br>Trigger Event 2 (3),<br>Trigger Event 3 (4),<br>Trigger Event 4 (5) | No event (0)  | RW   | Txt |    |    |    | US |
| 4.15.013  | Modbus Register Addressing Mode  | Standard (0), Modified (1)  | Standard (0)  | RW   | Txt |    |    |    | US |
| 4.15.020  | Priority Connection 1            | 0.0.0.0 to 255.255.255.255  | 0.0.0.0       | RW   | IP  |    |    |    | US |
| 4.15.021  | Priority Connection 2            | 0.0.0.0 to 255.255.255.255  | 0.0.0.0       | RW   | IP  |    |    |    | US |
| 4.15.022  | Priority Connection 3            | 0.0.0.0 to 255.255.255.255  | 0.0.0.0       | RW   | IP  |    |    |    | US |
| 4.15.023  | Priority Connection 4            | 0.0.0.0 to 255.255.255.255  | 0.0.0.0       | RW   | IP  |    |    |    | US |

| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| Fl  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Slot 4 Menu 15 – Modbus TCP/IP Setup

Mode: RFC-A

Modbus TCP/IP is one of the most widely supported industrial Ethernet based protocols offering the functionality and simplicity of the Modbus protocol, with the flexibility of Ethernet. The table below shows the supported Modbus function codes.

The implementation of Modbus TCP/IP follows the specification provided by the Modbus organisation. Modbus TCP/IP uses the standard Protocol Data Unit (PDU) but without the CRC bytes and encapsulates it within a Modbus TCP/IP Application Data Unit (ADU) for transmission. This means that the Modbus PDU is the same for both standard and Ethernet based transmission.

| Code | Description                              |
|------|--|
| 3    | Read multiple 16 bit registers           |
| 6    | Write single 16 bit register             |
| 16   | Write multiple 16 bit registers          |
| 23   | Read and write multiple 16 bit registers |

| Parameter         | 4.15.001 <i>Enable</i>             |                |                 |
|-------------------|------------------------------------|----------------|-----------------|
| Short description | Set to enable Modbus functionality |                |                 |
| Minimum           | 0                                  | Maximum        | 1               |
| Default           | 1                                  | Units          |                 |
| Type              | 1 Bit User Save                    | Update Rate    | Background read |
| Display Format    | Standard                           | Decimal Places | 0               |
| Coding            | RW, BU                             |                |                 |

This parameter is used to enable or disable Modbus master and slave functionality.

| Parameter         | 4.15.002 <i>Reset</i>      |                |   |
|-------------------|----------------------------|----------------|---|
| Short description | Set to reset the interface |                |   |
| Minimum           | 0                          | Maximum        | 1   |
| Default           | 0                          | Units          |   |
| Type              | 1 Bit Volatile             | Update Rate    | Background read; written to 0 on initialisation |
| Display Format    | Standard                   | Decimal Places | 0   |
| Coding            | RW, NC                     |                |   |

This parameter is used to perform a warm reset of the protocol interface. When set and the protocol has reset, the parameter will be reset to zero (Off).

| Parameter         | 4.15.003 <i>Default</i>               |                |  |
|-------------------|---------------------------------------|----------------|--|
| Short description | Set to default the protocol interface |                |  |
| Minimum           | 0                                     | Maximum        | 1  |
| Default           | 0                                     | Units          |  |
| Type              | 1 Bit Volatile                        | Update Rate    | On module reset, protocol interface reset or protocol enable |
| Display Format    | Standard                              | Decimal Places | 0  |
| Coding            | RW, NC                                |                |  |

This parameter allows the protocol to be defaulted to factory settings. This includes all of the protocol features, configuration, mappings and stored objects.

| Parameter         | 4.15.004 <i>Modbus Configuration Error</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Displays the Modbus configuration error    |                |   |
| Minimum           | 0  | Maximum        | 3   |
| Default           |  | Units          |   |
| Type              | 8 Bit Volatile                             | Update Rate    | Module reset, Modbus interface reset or Modbus interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RO, TE, ND, NC, PT, BU                     |                |   |

| Value | Text            | Description   |
|-------|-----------------|---|
| 0     | No error        | No error  |
| 1     | Port in use     | Specified port is currently in use by another protocol          |
| 2     | Timeout event   | Timeout trigger event location is not valid                     |
| 3     | Num Connections | The Max priority connection is greater than the max connections |

This parameter will indicate any Modbus configuration errors.



| Parameter         | 4.15.005 <i>Modbus Listening Port</i> |                |                         |
|-------------------|---------------------------------------|----------------|-------------------------|
| Short description | Defines the Modbus TCP/IP port        |                |                         |
| Minimum           | 0                                     | Maximum        | 65535                   |
| Default           | 502                                   | Units          |                         |
| Type              | 16 Bit User Save                      | Update Rate    | MODBUS_THREAD_TICK_TIME |
| Display Format    | Standard                              | Decimal Places | 0                       |
| Coding            | RW, BU                                |                |                         |

This parameter can be changed from its default port of 502, however it is the user's responsibility to ensure that a valid port is set.

| Parameter         | 4.15.006 <i>Maximum Connections</i>                     |                |   |
|-------------------|---|----------------|---|
| Short description | Defines the maximum number of connections to the module |                |   |
| Minimum           | 0   | Maximum        | 4   |
| Default           | 2   | Units          |   |
| Type              | 8 Bit User Save   | Update Rate    | Module reset, Modbus interface reset or Modbus interface enable |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW, BU  |                |   |

This parameter permits the user to specify the total number of connections that one or more clients can open with the module at any one time.

| Parameter         | 4.15.007 <i>Maximum Priority Connections</i>       |                |   |
|-------------------|--|----------------|---|
| Short description | Defines the maximum number of priority connections |                |   |
| Minimum           | 0  | Maximum        | 5   |
| Default           | 0  | Units          |   |
| Type              | 8 Bit User Save                                    | Update Rate    | Module reset, Modbus interface reset or Modbus interface enable |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RW, BU   |                |   |

This parameter defines the how many of the maximum connections specified in *Maximum Connections* (4.15.006) can be configured as a priority connection. A connection is accepted into the priority connections pool if the client's IP address matches one of the values stored in parameters *Priority Connection 1* (4.15.020), *Priority Connection 2* (4.15.021), *Priority Connection 3* (4.15.022) or *Priority Connection 4* (4.15.023).

The priority connections are permanent and, once made will only be deleted at the request of the client or due to a communications error.

Any connections not in the priority connections pool are kept in the non-priority connections pool. If a client attempts to establish a priority connection and all available non-priority connections are in use, the non-priority connection that has not been used for the longest will be closed to make way for the new priority connection.

| Parameter         | 4.15.008 <i>Maximum Connections Per Client</i>       |                |   |
|-------------------|--|----------------|---|
| Short description | Defines the maximum number of connections per client |                |   |
| Minimum           | 1  | Maximum        | 4   |
| Default           | 2  | Units          |   |
| Type              | 8 Bit User Save                                      | Update Rate    | Module reset, Modbus interface reset or Modbus interface enable |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RW, BU   |                |   |

This parameter defines the maximum number of connections that any one client can establish. This check is only performed on the connections in the priority connections pool.

| Parameter         | 4.15.009 <i>Modbus Timeout</i>   |                |   |
|-------------------|----------------------------------|----------------|---|
| Short description | Defines the Modbus timeout value |                |   |
| Minimum           | 1                                | Maximum        | 10000   |
| Default           | 100                              | Units          | ms  |
| Type              | 16 Bit User Save                 | Update Rate    | Module reset, Modbus interface reset or Modbus interface enable |
| Display Format    | Standard                         | Decimal Places | 0   |
| Coding            | RW, BU                           |                |   |

This parameter defines the time period in which the Modbus server must receive a message before any specified action (as defined in ) is performed. When the timeout occurs, bit 1 in the module's alarm parameter ( ) will be set and the specified action will be performed.

The timeout is enabled when the server receives its first message.

Note:

It is good system design to allow for some message loss by setting the timeout duration to be greater than the transmit period by a factor of 2 or more.

| Parameter         | 4.15.010 Modbus Timeout Action                    |                |   |
|-------------------|---|----------------|---|
| Short description | Defines the action to perform on a Modbus timeout |                |   |
| Minimum           | 0   | Maximum        | 1   |
| Default           | 1   | Units          |   |
| Type              | 8 Bit User Save                                   | Update Rate    | Module reset, Modbus interface reset or Modbus interface enable |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW, TE, BU  |                |   |

| Value | Text      | Description                |
|-------|-----------|----------------------------|
| 0     | Trip      | Trip drive and raise error |
| 1     | No action | No action                  |

Defines the action when no message is received within the time period specified in *Modbus Timeout* (4.15.009). Note: if a Trip is enabled, this will be triggered by Unidrive M Connect scanning the network since Unidrive M Connect sends a Modbus function code 64. Similar Acyclic Read/Write PC Tools can cause a Timeout Trip for the same reason.

| Parameter         | 4.15.011 Modbus Timeout Event Destination            |                |   |
|-------------------|--|----------------|---|
| Short description | Defines the destination for the Modbus timeout event |                |   |
| Minimum           | 0  | Maximum        | 4   |
| Default           | 0  | Units          |   |
| Type              | 8 Bit User Save                                      | Update Rate    | Module reset, Modbus interface reset or Modbus interface enable |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RW, TE, BU   |                |   |

| Value | Text      | Description                |
|-------|-----------|----------------------------|
| 0     | This slot | Trigger event in this slot |
| 1     | Slot 1    | Trigger event in slot 1    |
| 2     | Slot 2    | Trigger event in slot 2    |
| 3     | Slot 3    | Trigger event in slot 3    |
| 4     | Slot 4    | Trigger event in slot 4    |

Defines the destination slot to trigger the event (defined by *Modbus Timeout Event Type* (4.15.012)) when a timeout occurs.

<< This feature is not currently supported >>

| Parameter         | 4.15.012 Modbus Timeout Event Type |                |   |
|-------------------|------------------------------------|----------------|---|
| Short description | Defines the event type to trigger  |                |   |
| Minimum           | 0                                  | Maximum        | 5   |
| Default           | 0                                  | Units          |   |
| Type              | 8 Bit User Save                    | Update Rate    | Module reset, Modbus interface reset or Modbus interface enable |
| Display Format    | Standard                           | Decimal Places | 0   |
| Coding            | RW, TE, BU                         |                |   |

| Value | Text            | Description            |
|-------|-----------------|------------------------|
| 0     | No event        | No event               |
| 1     | Trigger Event   | Trigger module Event   |
| 2     | Trigger Event 1 | Trigger module Event 1 |
| 3     | Trigger Event 2 | Trigger module Event 2 |
| 4     | Trigger Event 3 | Trigger module Event 3 |
| 5     | Trigger Event 4 | Trigger module Event 4 |

Defines the event to trigger when a timeout occurs. *Modbus Timeout Event Destination* (4.15.011) must specify an appropriate consumer (slot option) of the event.

| Parameter         | 4.15.013 Modbus Register Addressing Mode    |                |   |
|-------------------|---|----------------|---|
| Short description | Defines the Modbus register addressing mode |                |   |
| Minimum           | 0   | Maximum        | 1   |
| Default           | 0   | Units          |   |
| Type              | 8 Bit User Save                             | Update Rate    | Module reset, Modbus interface reset or Modbus interface enable |
| Display Format    | Standard                                    | Decimal Places | 0   |
| Coding            | RW, TE, BU                                  |                |   |

| Value | Text     | Description                            |
|-------|----------|--|
| 0     | Standard | (mm x 100) + ppp - mm<=162 and ppp<=99 |
| 1     | Modified | (mm x 256) + ppp - mm<=63 and ppp<=255 |

Specifies the Modbus register addressing mode.

| Parameter         | 4.15.020 Priority Connection 1              |                |   |
|-------------------|---|----------------|---|
| Short description | Specifies the IP address for the connection |                |   |
| Minimum           | 0<br>(Display: 0.0.0.0)                     | Maximum        | 4294967295<br>(Display: 255.255.255.255)                        |
| Default           | 0<br>(Display: 0.0.0.0)                     | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, Modbus interface reset or Modbus interface enable |
| Display Format    | IP Address                                  | Decimal Places | 0   |
| Coding            | RW, BU                                      |                |   |

This parameter specifies an IP address for a priority connection.

**Note:** parameters 20 through 23 must be filled in the order starting from the Priority\_Connection\_1 through Priority\_Connection\_4. If a higher numbered Priority Connection is specified without the lower ones being filled, then it will be ignored.

| Parameter         | 4.15.021 Priority Connection 2              |                |   |
|-------------------|---|----------------|---|
| Short description | Specifies the IP address for the connection |                |   |
| Minimum           | 0<br>(Display: 0.0.0.0)                     | Maximum        | 4294967295<br>(Display: 255.255.255.255)                        |
| Default           | 0<br>(Display: 0.0.0.0)                     | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, Modbus interface reset or Modbus interface enable |
| Display Format    | IP Address                                  | Decimal Places | 0   |
| Coding            | RW, BU                                      |                |   |

This parameter specifies an IP address for a priority connection.

**Note:** parameters 20 through 23 must be filled in the order starting from the Priority\_Connection\_1 through Priority\_Connection\_4. If a higher numbered Priority Connection is specified without the lower ones being filled, then it will be ignored.

| Parameter         | 4.15.022 Priority Connection 3              |                |   |
|-------------------|---|----------------|---|
| Short description | Specifies the IP address for the connection |                |   |
| Minimum           | 0<br>(Display: 0.0.0.0)                     | Maximum        | 4294967295<br>(Display: 255.255.255.255)                        |
| Default           | 0<br>(Display: 0.0.0.0)                     | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, Modbus interface reset or Modbus interface enable |
| Display Format    | IP Address                                  | Decimal Places | 0   |
| Coding            | RW, BU                                      |                |   |

This parameter specifies an IP address for a priority connection.

**Note:** parameters 20 through 23 must be filled in the order starting from the Priority\_Connection\_1 through Priority\_Connection\_4. If a higher numbered Priority Connection is specified without the lower ones being filled, then it will be ignored.

| Parameter         | 4.15.023 Priority Connection 4              |                |   |
|-------------------|---|----------------|---|
| Short description | Specifies the IP address for the connection |                |   |
| Minimum           | 0<br>(Display: 0.0.0.0)                     | Maximum        | 4294967295<br>(Display: 255.255.255.255)                        |
| Default           | 0<br>(Display: 0.0.0.0)                     | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, Modbus interface reset or Modbus interface enable |
| Display Format    | IP Address                                  | Decimal Places | 0   |
| Coding            | RW, BU                                      |                |   |

This parameter specifies an IP address for a priority connection.

**Note:** fill parameters 20 through 23 from the Priority\_Connection\_1. If a higher numbered Priority Connection is specified without the lower ones being filled, then it will be ignored.

## Slot 4 Menu 20 Single Line Descriptions – *EtherNet/IP Setup*

Mode: RFC-A

| Parameter |  | Range  | Default       | Type |     |    |    |    |    |    |
|-----------|--|--|---------------|------|-----|----|----|----|----|----|
| 4.20.001  | Enable EtherNet/IP                                   | Off (0) or On (1)  | On (1)        | RW   | Bit |    |    |    |    | US |
| 4.20.002  | Reset  | Off (0) or On (1)  | Off (0)       | RW   | Bit |    | NC |    |    |    |
| 4.20.003  | Default  | Off (0) or On (1)  | Off (0)       | RW   | Bit |    | NC |    |    |    |
| 4.20.004  | Configuration error                                  | No error (0),<br>RPI event dst (1),<br>RPI event type (2),<br>IDLE event dst (3),<br>IDLE event type (4),<br>Input mapping (5),<br>Output mapping (6),<br>In cons trig pr (7),<br>Out cons trig pr (8) |               | RO   | Txt | ND | NC | PT |    |    |
| 4.20.007  | Cyclic data transfers per second                     | 0 to 65535 Messages/s  |               | RO   | Num | ND | NC | PT |    |    |
| 4.20.011  | RPI timeout action                                   | Trip (0), Send fit values (1),<br>Clear output (2),<br>Hold last (3), No Action (4)  | Hold last (3) | RW   | Txt |    |    |    |    | US |
| 4.20.012  | RPI timeout event destination                        | This slot (0), Slot 1 (1),<br>Slot 2 (2), Slot 3 (3),<br>Slot 4 (4)  | This slot (0) | RW   | Txt |    |    |    |    | US |
| 4.20.013  | RPI timeout event type                               | No event (0),<br>Trigger Event (1),<br>Trigger Event 1 (2),<br>Trigger Event 2 (3),<br>Trigger Event 3 (4),<br>Trigger Event 4 (5)   | No event (0)  | RW   | Txt |    |    |    |    | US |
| 4.20.015  | PLC idle action                                      | Trip (0), Send fit values (1),<br>Clear output (2),<br>Hold last (3), No Action (4)  | No Action (4) | RW   | Txt |    |    |    |    | US |
| 4.20.016  | PLC idle event destination                           | This slot (0), Slot 1 (1),<br>Slot 2 (2), Slot 3 (3),<br>Slot 4 (4)  | This slot (0) | RW   | Txt |    |    |    |    | US |
| 4.20.017  | PLC idle event type                                  | No event (0),<br>Trigger Event (1),<br>Trigger Event 1 (2),<br>Trigger Event 2 (3),<br>Trigger Event 3 (4),<br>Trigger Event 4 (5)   | No event (0)  | RW   | Txt |    |    |    |    | US |
| 4.20.018  | Active input assembly object                         | 100-PrimaryI (0),<br>70-BscSpdCtrlI (1),<br>71-ExtSpdCtrlI (2),<br>72-SpdTqCtrlI (3),<br>73-ExtSpdTqCtrlI (4)  |               | RO   | Txt | ND | NC | PT |    |    |
| 4.20.019  | Active output assembly object                        | 101-PrimaryO (0),<br>20-BscSpdCtrlO (1),<br>21-ExtSpdCtrlO (2),<br>22-SpdTqCtrlO (3),<br>23-ExtSpdTqCtrlO (4)  |               | RO   | Txt | ND | NC | PT |    |    |
| 4.20.020  | Input assembly object size                           | 4 to 128 Bytes   | 8 Bytes       | RW   | Num |    |    |    |    | US |
| 4.20.021  | Output assembly object size                          | 4 to 128 Bytes   | 8 Bytes       | RW   | Num |    |    |    |    | US |
| 4.20.024  | Input assembly object process time                   | 0 to 65535 ms  |               | RO   | Num | ND | NC | PT |    |    |
| 4.20.025  | Output assembly object process time                  | 0 to 65535 ms  |               | RO   | Num | ND | NC | PT |    |    |
| 4.20.026  | Input assembly object consistency enable             | Off (0) or On (1)  | Off (0)       | RW   | Bit |    |    |    |    | US |
| 4.20.027  | Input assembly object consistency trigger parameter  | 0 to 499999  | 0             | RW   | Num |    |    |    |    | US |
| 4.20.028  | Output assembly object consistency enable            | Off (0) or On (1)  | Off (0)       | RW   | Bit |    |    |    |    | US |
| 4.20.029  | Output assembly object consistency trigger parameter | 0 to 499999  | 0             | RW   | Num |    |    |    |    | US |
| 4.20.030  | Custom Vendor ID                                     | 257 - CT (0),<br>553 - CT AMERICA (1)  | 257 - CT (0)  | RW   | Txt |    |    |    |    | US |
| 4.20.031  | Custom product code                                  | 0 to 65535   | 0             | RW   | Num |    |    |    |    | US |
| 4.20.032  | Custom product revision code                         | 0 to 65535   | 0             | RW   | Num |    |    |    |    | US |
| 4.20.033  | Actual Product Code                                  | 0 to 65535   |               | RO   | Num | ND | NC | PT |    |    |
| 4.20.034  | Actual Product Revision                              | 0 to 65535   |               | RO   | Num | ND | NC | PT |    |    |
| 4.20.040  | Type of Motor 1                                      | 2-FC DC (0), 6-WRI (1),<br>7-SCI (2), 9-Sin PM BL (3),<br>10-Trap PM BL (4)  | 7-SCI (2)     | RO   | Txt |    |    |    | PT | US |
| 4.20.041  | Type of Motor 2                                      | 2-FC DC (0), 6-WRI (1),<br>7-SCI (2), 9-Sin PM BL (3),<br>10-Trap PM BL (4)  | 7-SCI (2)     | RO   | Txt |    |    |    | PT | US |

|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| Fl  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

# Slot 4 Menu 20 – EtherNet/IP Setup

Mode: RFC-A

The Ethernet interface supports the EtherNet/IP protocol and conforms to the EtherNet/IP adaptation of the Common Industrial Protocol (CIP) Specification. This is the same upper-layer protocol and object model as used in DeviceNet.

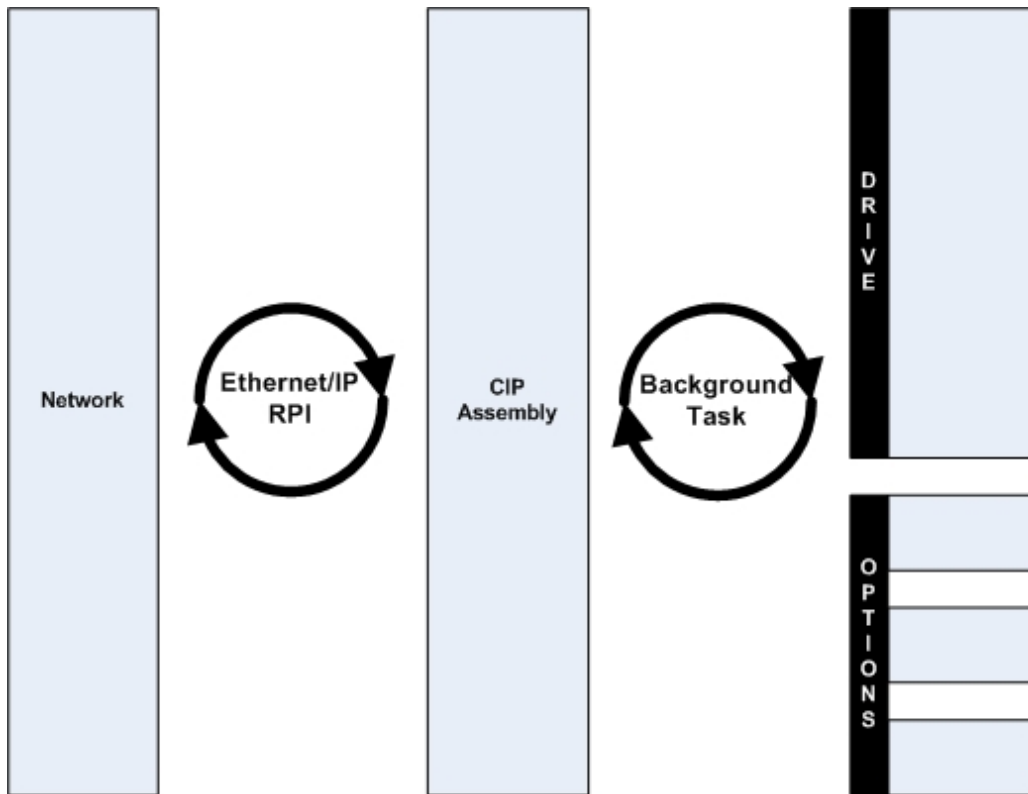
The Ethernet interface will operate as a slave device and the following functionality is supported.

- Variable length input assembly object (instance 100)
- Variable length output assembly object (instance 101)
- Maximum assembly object size of 128 bytes (32 parameters)
- Explicit (non-cyclic) access to parameters
- A.C. drive profiles
- Management of consistent data transfer between the Ethernet interface and user programs.
- Configuration via parameters

## Parameter Update Rate

Parameters are exchange over the network. The value exchanged with the network must be exchanged with the drive or option parameter. The rate of data exchange differs for drive/option destinations.

The diagram below depicts the update cycles used within the Ethernet interface. CIP assembly mappings being exchanged with the drive will be updated at the background task rate. This rate (*Background cycles per second* (09.008)) varies with the load on the Ethernet interface; Easy Mode data exchange also takes place in the background task.



| Parameter         | 4.20.001 Enable EtherNet/IP             |                |                 |
|-------------------|---|----------------|-----------------|
| Short description | Set to enable the EtherNet/IP interface |                |                 |
| Minimum           | 0                                       | Maximum        | 1               |
| Default           | 1                                       | Units          |                 |
| Type              | 1 Bit User Save                         | Update Rate    | Background read |
| Display Format    | Standard                                | Decimal Places | 0               |
| Coding            | RW, BU                                  |                |                 |

This parameter is used to enable or disable Ethernet/IP slave functionality.

| Parameter         | 4.20.002 Reset             |                |   |
|-------------------|----------------------------|----------------|---|
| Short description | Set to reset the interface |                |   |
| Minimum           | 0                          | Maximum        | 1   |
| Default           | 0                          | Units          |   |
| Type              | 1 Bit Volatile             | Update Rate    | Background read; written to 0 on initialisation |
| Display Format    | Standard                   | Decimal Places | 0   |
| Coding            | RW, NC                     |                |   |

This parameter is used to perform a warm reset of the protocol interface. When set and the protocol has reset, the parameter will be reset to zero (Off).

| Parameter         | 4.20.003 <i>Default</i>               |                |  |
|-------------------|---------------------------------------|----------------|--|
| Short description | Set to default the protocol interface |                |  |
| Minimum           | 0                                     | Maximum        | 1  |
| Default           | 0                                     | Units          |  |
| Type              | 1 Bit Volatile                        | Update Rate    | On module reset, protocol interface reset or protocol enable |
| Display Format    | Standard                              | Decimal Places | 0  |
| Coding            | RW, NC                                |                |  |

This parameter allows the protocol to be defaulted to factory settings. This includes all of the protocol features, configuration, mappings and stored objects.

| Parameter         | 4.20.004 <i>Configuration error</i>          |                |            |
|-------------------|--|----------------|------------|
| Short description | Displays the EtherNet/IP configuration error |                |            |
| Minimum           | 0  | Maximum        | 8          |
| Default           |  | Units          |            |
| Type              | 8 Bit Volatile                               | Update Rate    | Background |
| Display Format    | Standard                                     | Decimal Places | 0          |
| Coding            | RO, TE, ND, NC, PT, BU                       |                |            |

| Value | Text             | Description                                    |
|-------|------------------|--|
| 0     | No error         | No error                                       |
| 1     | RPI event dst    | RPI timeout event desination not valid         |
| 2     | RPI event type   | RPI timeout event type not valid               |
| 3     | IDLE event dst   | PLC IDLE event desination not valid            |
| 4     | IDLE event type  | PLC IDLE event type not valid                  |
| 5     | Input mapping    | Output mapping parameter not valid             |
| 6     | Output mapping   | Output mapping parameter not valid             |
| 7     | In cons trig pr  | Input consistency trigger parameter not valid  |
| 8     | Out cons trig pr | Output consistency trigger parameter not valid |

This parameter is used to display the error code if an Ethernet/IP configuration error occurs.

| Parameter         | 4.20.007 <i>Cyclic data transfers per second</i> |                |            |
|-------------------|--|----------------|------------|
| Short description | Showing the EIP cyclic data transfer rate        |                |            |
| Minimum           | 0  | Maximum        | 65535      |
| Default           |  | Units          | Messages/s |
| Type              | 16 Bit Volatile                                  | Update Rate    | Background |
| Display Format    | Standard   | Decimal Places | 0          |
| Coding            | RO, ND, NC, PT, BU                               |                |            |

This parameter shows the EtherNet/IP cyclic data transfer rate.

| Parameter         | 4.20.011 <i>RPI timeout action</i>            |                |   |
|-------------------|---|----------------|---|
| Short description | Defines the action when an RPI timeout occurs |                |   |
| Minimum           | 0   | Maximum        | 4   |
| Default           | 3   | Units          |   |
| Type              | 8 Bit User Save                               | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                      | Decimal Places | 0   |
| Coding            | RW, TE, BU                                    |                |   |

| Value | Text            | Description  |
|-------|-----------------|--|
| 0     | Trip            | Trip drive with Slx.Er and sub-trip code                 |
| 1     | Send flt values | Send configured fault values to the output parameters    |
| 2     | Clear output    | PLC output parameters will have their values set to zero |
| 3     | Hold last       | Hold the last value in output parameters                 |
| 4     | No Action       | No action with output parameters                         |

This timeout is defined by the EtherNet/IP protocol and is configured in the PLC master. The interface will monitor the data traffic and if data is not received within the specified time, it will perform the requested action. This indicates that the interface has detected that the cyclic data communication has been interrupted.

**Trip**  
On an RPI timeout the interface will cause a slot trip with sub trip value 101 (EtherNet/IP RPI Timeout).

**Send Fault Values**  
On an RPI timeout the interface will not trip the drive. It will write the values specified in Fault Values menu (23) to the PLC output mappings for the assembly object 101 if active.



### Clear Output

On an RPI timeout the interface will not trip the drive. It will write all PLC output mappings for the assembly object 101 if active to zero.

### Hold Last

On an RPI timeout the interface will not trip the drive. The last value received will be maintained.

### No Action

On an RPI timeout the interface will not trip the drive. The last value received will be maintained.

| Parameter         | 4.20.012 RPI timeout event destination            |                |   |
|-------------------|---|----------------|---|
| Short description | Defines the destination for the RPI timeout event |                |   |
| Minimum           | 0   | Maximum        | 4   |
| Default           | 0   | Units          |   |
| Type              | 8 Bit User Save                                   | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW, TE, BU  |                |   |

| Value | Text      | Description                |
|-------|-----------|----------------------------|
| 0     | This slot | Trigger event in this slot |
| 1     | Slot 1    | Trigger event in slot 1    |
| 2     | Slot 2    | Trigger event in slot 2    |
| 3     | Slot 3    | Trigger event in slot 3    |
| 4     | Slot 4    | Trigger event in slot 4    |

This parameter defines the destination slot to trigger the event upon an RPI timeout.

<< This feature is not currently supported >>

| Parameter         | 4.20.013 RPI timeout event type          |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the event to trigger on RPI timeout |                |   |
| Minimum           | 0  | Maximum        | 5   |
| Default           | 0  | Units          |   |
| Type              | 8 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                 | Decimal Places | 0   |
| Coding            | RW, TE, BU                               |                |   |

| Value | Text            | Description            |
|-------|-----------------|------------------------|
| 0     | No event        | No event               |
| 1     | Trigger Event   | Trigger module Event   |
| 2     | Trigger Event 1 | Trigger module Event 1 |
| 3     | Trigger Event 2 | Trigger module Event 2 |
| 4     | Trigger Event 3 | Trigger module Event 3 |
| 5     | Trigger Event 4 | Trigger module Event 4 |

Defines the event to trigger in the specified destination (*RPI timeout event destination* (4.20.012)) upon an RPI timeout

| Parameter         | 4.20.015 PLC idle action                |                |   |
|-------------------|---|----------------|---|
| Short description | Defines the action for a PLC idle event |                |   |
| Minimum           | 0                                       | Maximum        | 4   |
| Default           | 4                                       | Units          |   |
| Type              | 8 Bit User Save                         | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                | Decimal Places | 0   |
| Coding            | RW, TE, BU                              |                |   |

| Value | Text            | Description  |
|-------|-----------------|--|
| 0     | Trip            | Trip drive with Slx.Er and sub-trip code                 |
| 1     | Send flt values | Send configured fault values to the output parameters    |
| 2     | Clear output    | PLC output parameters will have their values set to zero |
| 3     | Hold last       | Hold the last value in output parameters                 |
| 4     | No Action       | No action with output parameters                         |

This parameter defines the action to be taken upon a PLC idle event.

| Parameter         | 4.20.016 PLC idle event destination          |                |   |
|-------------------|--|----------------|---|
| Short description | Defines the destination for a PLC idle event |                |   |
| Minimum           | 0  | Maximum        | 4   |
| Default           | 0  | Units          |   |
| Type              | 8 Bit User Save                              | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                     | Decimal Places | 0   |
| Coding            | RW, TE, BU                                   |                |   |

| Value | Text      | Description                |
|-------|-----------|----------------------------|
| 0     | This slot | Trigger event in this slot |
| 1     | Slot 1    | Trigger event in slot 1    |
| 2     | Slot 2    | Trigger event in slot 2    |
| 3     | Slot 3    | Trigger event in slot 3    |
| 4     | Slot 4    | Trigger event in slot 4    |

This parameter defines the destination slot to trigger the event upon a PLC idle event.

<< This feature is not currently supported >>

| Parameter         | 4.20.017 PLC idle event type          |                |   |
|-------------------|---------------------------------------|----------------|---|
| Short description | Sets the event to trigger on PLC idle |                |   |
| Minimum           | 0                                     | Maximum        | 5   |
| Default           | 0                                     | Units          |   |
| Type              | 8 Bit User Save                       | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                              | Decimal Places | 0   |
| Coding            | RW, TE, BU                            |                |   |

| Value | Text            | Description            |
|-------|-----------------|------------------------|
| 0     | No event        | No event               |
| 1     | Trigger Event   | Trigger module Event   |
| 2     | Trigger Event 1 | Trigger module Event 1 |
| 3     | Trigger Event 2 | Trigger module Event 2 |
| 4     | Trigger Event 3 | Trigger module Event 3 |
| 5     | Trigger Event 4 | Trigger module Event 4 |

Defines the event to trigger in the specified destination (*PLC idle event destination* (4.20.016)) upon a PLC idle event.

| Parameter         | 4.20.018 Active input assembly object              |                |   |
|-------------------|--|----------------|---|
| Short description | Sets and displays the active input assembly object |                |   |
| Minimum           | 0  | Maximum        | 4   |
| Default           |  | Units          |   |
| Type              | 8 Bit Volatile                                     | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RO, TE, ND, NC, PT, BU                             |                |   |

| Value | Text             | Description                                  |
|-------|------------------|--|
| 0     | 100-PrimaryI     | Primary input (100)                          |
| 1     | 70-BscSpdCtrlI   | Basic speed control input (70)               |
| 2     | 71-ExtSpdCtrlI   | Extended speed control input (71)            |
| 3     | 72-SpdTqCtrlI    | Speed and torque control input (72)          |
| 4     | 73-ExtSpdTqCtrlI | Extended speed and torque control input (73) |

This parameter defines and shows the required input assembly object.

| Parameter         | 4.20.019 Active output assembly object              |                |   |
|-------------------|---|----------------|---|
| Short description | Sets and displays the active output assembly object |                |   |
| Minimum           | 0   | Maximum        | 4   |
| Default           |   | Units          |   |
| Type              | 8 Bit Volatile                                      | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RO, TE, ND, NC, PT, BU                              |                |   |

| Value | Text             | Description                                   |
|-------|------------------|---|
| 0     | 101-PrimaryO     | Primary output (101)                          |
| 1     | 20-BscSpdCtrlO   | Basic speed control output (20)               |
| 2     | 21-ExtSpdCtrlO   | Extended speed control output (21)            |
| 3     | 22-SpdTqCtrlO    | Speed and torque control output (22)          |
| 4     | 23-ExtSpdTqCtrlO | Extended speed and torque control output (23) |

This parameter defines and shows the required output assembly object.

| Parameter         | 4.20.020 Input assembly object size           |                |   |
|-------------------|---|----------------|---|
| Short description | Defines the size of the input assembly object |                |   |
| Minimum           | 4   | Maximum        | 128   |
| Default           | 8   | Units          | Bytes   |
| Type              | 8 Bit User Save                               | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                      | Decimal Places | 0   |
| Coding            | RW, BU  |                |   |

This parameter defines the size of the input assembly object (100).

| Parameter         | 4.20.021 Output assembly object size           |                |   |
|-------------------|--|----------------|---|
| Short description | Defines the size of the output assembly object |                |   |
| Minimum           | 4  | Maximum        | 128   |
| Default           | 8  | Units          | Bytes   |
| Type              | 8 Bit User Save                                | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                       | Decimal Places | 0   |
| Coding            | RW, BU   |                |   |

This parameter defines the size of the output assembly object (101).

| Parameter         | 4.20.024 Input assembly object process time     |                |            |
|-------------------|---|----------------|------------|
| Short description | Displays the input assembly object process time |                |            |
| Minimum           | 0   | Maximum        | 65535      |
| Default           |   | Units          | ms         |
| Type              | 16 Bit Volatile                                 | Update Rate    | Background |
| Display Format    | Standard  | Decimal Places | 0          |
| Coding            | RO, ND, NC, PT, BU                              |                |            |

This is the time between getting the input value from the master and it being sent successfully to the drive.

| Parameter         | 4.20.025 Output assembly object process time     |                |            |
|-------------------|--|----------------|------------|
| Short description | Displays the output assembly object process time |                |            |
| Minimum           | 0  | Maximum        | 65535      |
| Default           |  | Units          | ms         |
| Type              | 16 Bit Volatile                                  | Update Rate    | Background |
| Display Format    | Standard   | Decimal Places | 0          |
| Coding            | RO, ND, NC, PT, BU                               |                |            |

This is the time between getting the output value from the drive and it being sent successfully to the master.

| Parameter         | 4.20.026 Input assembly object consistency enable            |                |   |
|-------------------|--|----------------|---|
| Short description | Enables or disables consistency on the input assembly object |                |   |
| Minimum           | 0  | Maximum        | 1   |
| Default           | 0  | Units          |   |
| Type              | 1 Bit User Save  | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RW   |                |   |

This parameter allows for enabling and disabling input assembly object consistency.

Under normal conditions, cyclic data is sampled and transmitted at the Requested Packet Interval (RPI). However, if an option module was in the process of modifying the mapped parameters while these parameters were being sampled, then the data transmitted across the network may not be consistent across the entire assembly object. If read consistency is enabled (and a trigger parameter specified in *Input assembly object consistency trigger parameter* (4.20.027)) then data will only be sampled when the trigger parameter *Input assembly object consistency trigger parameter* (4.20.027) contains a non-zero value. This trigger parameter will then be set to zero after the data has been sampled.

It is therefore possible, by controlling the trigger parameters, that a user program in the drive or option module can ensure that the values in the cyclic data parameters are not sampled until all values are updated. Whether consistency is enabled or not, data will always be consistent for an individual parameter, i.e. all 4 bytes of a 32 bit value will be consistent.

| Parameter         | 4.20.027 <i>Input assembly object consistency trigger parameter</i> |                |   |
|-------------------|---|----------------|---|
| Short description | Sets the trigger parameter for input assembly object consistency    |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save  | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter   | Decimal Places | 0   |
| Coding            | RW, BU  |                |   |

This parameter specifies the parameter to use for triggering input assembly object consistency. See *Input assembly object consistency enable* (4.20.026) for more information on consistency.

| Parameter         | 4.20.028 <i>Output assembly object consistency enable</i>     |                |   |
|-------------------|---|----------------|---|
| Short description | Enables or disables consistency on the output assembly object |                |   |
| Minimum           | 0   | Maximum        | 1   |
| Default           | 0   | Units          |   |
| Type              | 1 Bit User Save   | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard  | Decimal Places | 0   |
| Coding            | RW  |                |   |

This parameter allows for enabling and disabling output assembly object consistency.

Sampling of data can be controlled using consistency by enabling this parameter and setting a trigger parameter (*Output assembly object consistency trigger parameter* (4.20.029)).

#### **Consistency enabled**

When output assembly object consistency is enabled, the value in the output assembly object consistency trigger parameter (*Output assembly object consistency trigger parameter* (4.20.029)) is checked at the beginning of the writing routine. If it is zero then data is written to the cyclic data destination parameters and the trigger parameter is set to 1. If the value is non-zero then new data is discarded.

#### **Consistency disabled**

When output assembly object consistency is disabled, new data is written to the cyclic data destination parameters just after it has been received.

**Note :** If write consistency is enabled, then at reset or at power-up, the value in the trigger parameter is set to zero.

| Parameter         | 4.20.029 <i>Output assembly object consistency trigger parameter</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the trigger parameter for input assembly object consistency     |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save   | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter  | Decimal Places | 0   |
| Coding            | RW, BU   |                |   |

This parameter specifies the parameter to use for triggering output assembly object consistency. See *Output assembly object consistency enable* (4.20.028) for more information on consistency.

| Parameter         | 4.20.030 <i>Custom Vendor ID</i> |                |   |
|-------------------|----------------------------------|----------------|---|
| Short description | Custom Defined Vendor ID         |                |   |
| Minimum           | 0                                | Maximum        | 1   |
| Default           | 0                                | Units          |   |
| Type              | 8 Bit User Save                  | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                         | Decimal Places | 0   |
| Coding            | RW, TE, BU                       |                |   |

| Value | Text             | Description                   |
|-------|------------------|-------------------------------|
| 0     | 257 - CT         | EtherNet/IP interface         |
| 1     | 553 - CT AMERICA | EtherNet/IP America interface |

This parameter defines the customised vendor ID.

| Parameter         | 4.20.031 <i>Custom product code</i>       |                |   |
|-------------------|---|----------------|---|
| Short description | Sets and displays the custom product code |                |   |
| Minimum           | 0   | Maximum        | 65535   |
| Default           | 0   | Units          |   |
| Type              | 16 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                  | Decimal Places | 0   |
| Coding            | RW, BU                                    |                |   |

This parameter defines a custom product type value which is used to identify the product on the network.

| Parameter         | 4.20.032 Custom product revision code              |                |   |
|-------------------|--|----------------|---|
| Short description | Sets and displays the custom product revision code |                |   |
| Minimum           | 0  | Maximum        | 65535   |
| Default           | 0  | Units          |   |
| Type              | 16 Bit User Save                                   | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard   | Decimal Places | 0   |
| Coding            | RW, BU   |                |   |

This parameter defines a custom product revision value which is used to identify the product on the network.

| Parameter         | 4.20.033 Actual Product Code     |                |   |
|-------------------|----------------------------------|----------------|---|
| Short description | Displays the actual product code |                |   |
| Minimum           | 0                                | Maximum        | 65535   |
| Default           |                                  | Units          |   |
| Type              | 16 Bit Volatile                  | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                         | Decimal Places | 0   |
| Coding            | RO, ND, NC, PT, BU               |                |   |

This parameter defines the actual product code.

| Parameter         | 4.20.034 Actual Product Revision    |                |   |
|-------------------|-------------------------------------|----------------|---|
| Short description | Display the actual product revision |                |   |
| Minimum           | 0                                   | Maximum        | 65535   |
| Default           |                                     | Units          |   |
| Type              | 16 Bit Volatile                     | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                            | Decimal Places | 0   |
| Coding            | RO, ND, NC, PT, BU                  |                |   |

This parameter defines the actual revision number.

| Parameter         | 4.20.040 Type of Motor 1 |                |       |
|-------------------|--------------------------|----------------|-------|
| Short description | The type of motor 1      |                |       |
| Minimum           | 0                        | Maximum        | 4     |
| Default           | 2                        | Units          |       |
| Type              | 8 Bit User Save          | Update Rate    | Reset |
| Display Format    | Standard                 | Decimal Places | 0     |
| Coding            | RO, TE, PT, BU           |                |       |

| Value | Text          | Description                   |
|-------|---------------|-------------------------------|
| 0     | 2-FC DC       | FC DC Motor                   |
| 1     | 6-WRI         | Wound Rotor Induction Motor   |
| 2     | 7-SCI         | Squirrel Cage Induction Motor |
| 3     | 9-Sin PM BL   | Sinusoidal PM BL Motor        |
| 4     | 10-Trip PM BL | Trapezoidal PM BL Motor       |

This parameter defines the type of motor 1

| Parameter         | 4.20.041 Type of Motor 2 |                |       |
|-------------------|--------------------------|----------------|-------|
| Short description | The type of motor 2      |                |       |
| Minimum           | 0                        | Maximum        | 4     |
| Default           | 2                        | Units          |       |
| Type              | 8 Bit User Save          | Update Rate    | Reset |
| Display Format    | Standard                 | Decimal Places | 0     |
| Coding            | RO, TE, PT, BU           |                |       |

| Value | Text          | Description                   |
|-------|---------------|-------------------------------|
| 0     | 2-FC DC       | FC DC Motor                   |
| 1     | 6-WRI         | Wound Rotor Induction Motor   |
| 2     | 7-SCI         | Squirrel Cage Induction Motor |
| 3     | 9-Sin PM BL   | Sinusoidal PM BL Motor        |
| 4     | 10-Trip PM BL | Trapezoidal PM BL Motor       |

This parameter defines the type of motor 2

## Slot 4 Menu 21 Single Line Descriptions – EtherNet/IP In Mappings

Mode: RFC-A

| Parameter |                            | Range       | Default | Type |     |  |  |    |    |
|-----------|----------------------------|-------------|---------|------|-----|--|--|----|----|
| 4.21.001  | Input mapping parameter 1  | 0 to 499999 | 10040   | RW   | Num |  |  | PT | US |
| 4.21.002  | Input mapping parameter 2  | 0 to 499999 | 2001    | RW   | Num |  |  | PT | US |
| 4.21.003  | Input mapping parameter 3  | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.004  | Input mapping parameter 4  | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.005  | Input mapping parameter 5  | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.006  | Input mapping parameter 6  | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.007  | Input mapping parameter 7  | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.008  | Input mapping parameter 8  | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.009  | Input mapping parameter 9  | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.010  | Input mapping parameter 10 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.011  | Input mapping parameter 11 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.012  | Input mapping parameter 12 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.013  | Input mapping parameter 13 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.014  | Input mapping parameter 14 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.015  | Input mapping parameter 15 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.016  | Input mapping parameter 16 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.017  | Input mapping parameter 17 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.018  | Input mapping parameter 18 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.019  | Input mapping parameter 19 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.020  | Input mapping parameter 20 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.021  | Input mapping parameter 21 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.022  | Input mapping parameter 22 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.023  | Input mapping parameter 23 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.024  | Input mapping parameter 24 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.025  | Input mapping parameter 25 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.026  | Input mapping parameter 26 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.027  | Input mapping parameter 27 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.028  | Input mapping parameter 28 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.029  | Input mapping parameter 29 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.030  | Input mapping parameter 30 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.031  | Input mapping parameter 31 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.21.032  | Input mapping parameter 32 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |

|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| FI  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Slot 4 Menu 21 – EtherNet/IP In Mappings

Mode: RFC-A

| Parameter         | 4.21.001 <i>Input mapping parameter 1</i> |                |   |
|-------------------|---|----------------|---|
| Short description | Sets input mapping parameter 1            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 10040                                     | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                       | Decimal Places | 0   |
| Coding            | RW, PT, BU                                |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.002 <i>Input mapping parameter 2</i> |                |   |
|-------------------|---|----------------|---|
| Short description | Sets input mapping parameter 2            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 2001                                      | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                       | Decimal Places | 0   |
| Coding            | RW, PT, BU                                |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.003 <i>Input mapping parameter 3</i> |                |   |
|-------------------|---|----------------|---|
| Short description | Sets input mapping parameter 3            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                       | Decimal Places | 0   |
| Coding            | RW, PT, BU                                |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.004 <i>Input mapping parameter 4</i> |                |   |
|-------------------|---|----------------|---|
| Short description | Sets input mapping parameter 4            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                       | Decimal Places | 0   |
| Coding            | RW, PT, BU                                |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.005 <i>Input mapping parameter 5</i> |                |   |
|-------------------|---|----------------|---|
| Short description | Sets input mapping parameter 5            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                       | Decimal Places | 0   |
| Coding            | RW, PT, BU                                |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.006 <i>Input mapping parameter 6</i> |                |   |
|-------------------|---|----------------|---|
| Short description | Sets input mapping parameter 6            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                       | Decimal Places | 0   |
| Coding            | RW, PT, BU                                |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.007 <i>Input mapping parameter 7</i> |                |   |
|-------------------|---|----------------|---|
| Short description | Sets input mapping parameter 7            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                       | Decimal Places | 0   |
| Coding            | RW, PT, BU                                |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.008 <i>Input mapping parameter 8</i> |                |   |
|-------------------|---|----------------|---|
| Short description | Sets input mapping parameter 8            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                       | Decimal Places | 0   |
| Coding            | RW, PT, BU                                |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.009 <i>Input mapping parameter 9</i> |                |   |
|-------------------|---|----------------|---|
| Short description | Sets input mapping parameter 9            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                       | Decimal Places | 0   |
| Coding            | RW, PT, BU                                |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.010 <i>Input mapping parameter 10</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 10            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.011 <i>Input mapping parameter 11</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 11            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.012 <i>Input mapping parameter 12</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 12            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.



| Parameter         | 4.21.013 <i>Input mapping parameter 13</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 13            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.014 <i>Input mapping parameter 14</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 14            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.015 <i>Input mapping parameter 15</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 15            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.016 <i>Input mapping parameter 16</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 16            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.017 <i>Input mapping parameter 17</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 17            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.018 <i>Input mapping parameter 18</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 18            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.019 <i>Input mapping parameter 19</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 19            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.020 <i>Input mapping parameter 20</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 20            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.021 <i>Input mapping parameter 21</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 21            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.022 <i>Input mapping parameter 22</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 22            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.023 <i>Input mapping parameter 23</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 23            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.024 <i>Input mapping parameter 24</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 24            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.025 <i>Input mapping parameter 25</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 25            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.026 <i>Input mapping parameter 26</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 26            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.027 <i>Input mapping parameter 27</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 27            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.028 <i>Input mapping parameter 28</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 28            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.029 <i>Input mapping parameter 29</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 29            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.030 <i>Input mapping parameter 30</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 30            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.031 <i>Input mapping parameter 31</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 31            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

| Parameter         | 4.21.032 <i>Input mapping parameter 32</i> |                |   |
|-------------------|--|----------------|---|
| Short description | Sets input mapping parameter 32            |                |   |
| Minimum           | 0  | Maximum        | 499999  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                        | Decimal Places | 0   |
| Coding            | RW, PT, BU                                 |                |   |

This parameters defines a source parameter for the data that will be transmitted to the PLC. The default value for the parameter is zero.

# Slot 4 Menu 22 Single Line Descriptions – EtherNet/IP Out Mappings

Mode: RFC-A

| Parameter |                             | Range       | Default | Type |     |  |  |    |    |
|-----------|-----------------------------|-------------|---------|------|-----|--|--|----|----|
| 4.22.001  | Output mapping parameter 1  | 0 to 499999 | 6042    | RW   | Num |  |  | PT | US |
| 4.22.002  | Output mapping parameter 2  | 0 to 499999 | 1021    | RW   | Num |  |  | PT | US |
| 4.22.003  | Output mapping parameter 3  | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.004  | Output mapping parameter 4  | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.005  | Output mapping parameter 5  | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.006  | Output mapping parameter 6  | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.007  | Output mapping parameter 7  | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.008  | Output mapping parameter 8  | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.009  | Output mapping parameter 9  | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.010  | Output mapping parameter 10 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.011  | Output mapping parameter 11 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.012  | Output mapping parameter 12 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.013  | Output mapping parameter 13 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.014  | Output mapping parameter 14 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.015  | Output mapping parameter 15 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.016  | Output mapping parameter 16 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.017  | Output mapping parameter 17 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.018  | Output mapping parameter 18 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.019  | Output mapping parameter 19 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.020  | Output mapping parameter 20 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.021  | Output mapping parameter 21 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.022  | Output mapping parameter 22 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.023  | Output mapping parameter 23 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.024  | Output mapping parameter 24 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.025  | Output mapping parameter 25 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.026  | Output mapping parameter 26 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.027  | Output mapping parameter 27 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.028  | Output mapping parameter 28 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.029  | Output mapping parameter 29 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.030  | Output mapping parameter 30 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.031  | Output mapping parameter 31 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |
| 4.22.032  | Output mapping parameter 32 | 0 to 499999 | 0       | RW   | Num |  |  | PT | US |

|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| Fl  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Slot 4 Menu 22 – EtherNet/IP Out Mappings

Mode: RFC-A

| Parameter         | 4.22.001 Output mapping parameter 1 |                |   |
|-------------------|-------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 1     |                |   |
| Minimum           | 0                                   | Maximum        | 499999  |
| Default           | 6042                                | Units          |   |
| Type              | 32 Bit User Save                    | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                 | Decimal Places | 0   |
| Coding            | RW, PT, BU                          |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.002 Output mapping parameter 2 |                |   |
|-------------------|-------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 2     |                |   |
| Minimum           | 0                                   | Maximum        | 499999  |
| Default           | 1021                                | Units          |   |
| Type              | 32 Bit User Save                    | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                 | Decimal Places | 0   |
| Coding            | RW, PT, BU                          |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.003 Output mapping parameter 3 |                |   |
|-------------------|-------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 3     |                |   |
| Minimum           | 0                                   | Maximum        | 499999  |
| Default           | 0                                   | Units          |   |
| Type              | 32 Bit User Save                    | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                 | Decimal Places | 0   |
| Coding            | RW, PT, BU                          |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.004 Output mapping parameter 4 |                |   |
|-------------------|-------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 4     |                |   |
| Minimum           | 0                                   | Maximum        | 499999  |
| Default           | 0                                   | Units          |   |
| Type              | 32 Bit User Save                    | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                 | Decimal Places | 0   |
| Coding            | RW, PT, BU                          |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.005 Output mapping parameter 5 |                |   |
|-------------------|-------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 5     |                |   |
| Minimum           | 0                                   | Maximum        | 499999  |
| Default           | 0                                   | Units          |   |
| Type              | 32 Bit User Save                    | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                 | Decimal Places | 0   |
| Coding            | RW, PT, BU                          |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.006 Output mapping parameter 6 |                |   |
|-------------------|-------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 6     |                |   |
| Minimum           | 0                                   | Maximum        | 499999  |
| Default           | 0                                   | Units          |   |
| Type              | 32 Bit User Save                    | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                 | Decimal Places | 0   |
| Coding            | RW, PT, BU                          |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.007 Output mapping parameter 7 |                |   |
|-------------------|-------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 7     |                |   |
| Minimum           | 0                                   | Maximum        | 499999  |
| Default           | 0                                   | Units          |   |
| Type              | 32 Bit User Save                    | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                 | Decimal Places | 0   |
| Coding            | RW, PT, BU                          |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.008 Output mapping parameter 8 |                |   |
|-------------------|-------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 8     |                |   |
| Minimum           | 0                                   | Maximum        | 499999  |
| Default           | 0                                   | Units          |   |
| Type              | 32 Bit User Save                    | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                 | Decimal Places | 0   |
| Coding            | RW, PT, BU                          |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.009 Output mapping parameter 9 |                |   |
|-------------------|-------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 9     |                |   |
| Minimum           | 0                                   | Maximum        | 499999  |
| Default           | 0                                   | Units          |   |
| Type              | 32 Bit User Save                    | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                 | Decimal Places | 0   |
| Coding            | RW, PT, BU                          |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.010 Output mapping parameter 10 |                |   |
|-------------------|--------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 10     |                |   |
| Minimum           | 0                                    | Maximum        | 499999  |
| Default           | 0                                    | Units          |   |
| Type              | 32 Bit User Save                     | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                  | Decimal Places | 0   |
| Coding            | RW, PT, BU                           |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.011 Output mapping parameter 11 |                |   |
|-------------------|--------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 11     |                |   |
| Minimum           | 0                                    | Maximum        | 499999  |
| Default           | 0                                    | Units          |   |
| Type              | 32 Bit User Save                     | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                  | Decimal Places | 0   |
| Coding            | RW, PT, BU                           |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.012 Output mapping parameter 12 |                |   |
|-------------------|--------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 12     |                |   |
| Minimum           | 0                                    | Maximum        | 499999  |
| Default           | 0                                    | Units          |   |
| Type              | 32 Bit User Save                     | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                  | Decimal Places | 0   |
| Coding            | RW, PT, BU                           |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

|                   |   |                |   |
|-------------------|---|----------------|---|
| <b>Parameter</b>  | <b>4.22.013 Output mapping parameter 13</b> |                |   |
| Short description | Sets output mapping parameter 13            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                         | Decimal Places | 0   |
| Coding            | RW, PT, BU                                  |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

|                   |   |                |   |
|-------------------|---|----------------|---|
| <b>Parameter</b>  | <b>4.22.014 Output mapping parameter 14</b> |                |   |
| Short description | Sets output mapping parameter 14            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                         | Decimal Places | 0   |
| Coding            | RW, PT, BU                                  |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

|                   |   |                |   |
|-------------------|---|----------------|---|
| <b>Parameter</b>  | <b>4.22.015 Output mapping parameter 15</b> |                |   |
| Short description | Sets output mapping parameter 15            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                         | Decimal Places | 0   |
| Coding            | RW, PT, BU                                  |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

|                   |   |                |   |
|-------------------|---|----------------|---|
| <b>Parameter</b>  | <b>4.22.016 Output mapping parameter 16</b> |                |   |
| Short description | Sets output mapping parameter 16            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                         | Decimal Places | 0   |
| Coding            | RW, PT, BU                                  |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

|                   |   |                |   |
|-------------------|---|----------------|---|
| <b>Parameter</b>  | <b>4.22.017 Output mapping parameter 17</b> |                |   |
| Short description | Sets output mapping parameter 17            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                         | Decimal Places | 0   |
| Coding            | RW, PT, BU                                  |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

|                   |   |                |   |
|-------------------|---|----------------|---|
| <b>Parameter</b>  | <b>4.22.018 Output mapping parameter 18</b> |                |   |
| Short description | Sets output mapping parameter 18            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                         | Decimal Places | 0   |
| Coding            | RW, PT, BU                                  |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.



|                   |   |                |   |
|-------------------|---|----------------|---|
| <b>Parameter</b>  | <b>4.22.019 Output mapping parameter 19</b> |                |   |
| Short description | Sets output mapping parameter 19            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                         | Decimal Places | 0   |
| Coding            | RW, PT, BU                                  |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

|                   |   |                |   |
|-------------------|---|----------------|---|
| <b>Parameter</b>  | <b>4.22.020 Output mapping parameter 20</b> |                |   |
| Short description | Sets output mapping parameter 20            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                         | Decimal Places | 0   |
| Coding            | RW, PT, BU                                  |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

|                   |   |                |   |
|-------------------|---|----------------|---|
| <b>Parameter</b>  | <b>4.22.021 Output mapping parameter 21</b> |                |   |
| Short description | Sets output mapping parameter 21            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                         | Decimal Places | 0   |
| Coding            | RW, PT, BU                                  |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

|                   |   |                |   |
|-------------------|---|----------------|---|
| <b>Parameter</b>  | <b>4.22.022 Output mapping parameter 22</b> |                |   |
| Short description | Sets output mapping parameter 22            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                         | Decimal Places | 0   |
| Coding            | RW, PT, BU                                  |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

|                   |   |                |   |
|-------------------|---|----------------|---|
| <b>Parameter</b>  | <b>4.22.023 Output mapping parameter 23</b> |                |   |
| Short description | Sets output mapping parameter 23            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                         | Decimal Places | 0   |
| Coding            | RW, PT, BU                                  |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

|                   |   |                |   |
|-------------------|---|----------------|---|
| <b>Parameter</b>  | <b>4.22.024 Output mapping parameter 24</b> |                |   |
| Short description | Sets output mapping parameter 24            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                         | Decimal Places | 0   |
| Coding            | RW, PT, BU                                  |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.025 Output mapping parameter 25 |                |   |
|-------------------|--------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 25     |                |   |
| Minimum           | 0                                    | Maximum        | 499999  |
| Default           | 0                                    | Units          |   |
| Type              | 32 Bit User Save                     | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                  | Decimal Places | 0   |
| Coding            | RW, PT, BU                           |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.026 Output mapping parameter 26 |                |   |
|-------------------|--------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 26     |                |   |
| Minimum           | 0                                    | Maximum        | 499999  |
| Default           | 0                                    | Units          |   |
| Type              | 32 Bit User Save                     | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                  | Decimal Places | 0   |
| Coding            | RW, PT, BU                           |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.027 Output mapping parameter 27 |                |   |
|-------------------|--------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 27     |                |   |
| Minimum           | 0                                    | Maximum        | 499999  |
| Default           | 0                                    | Units          |   |
| Type              | 32 Bit User Save                     | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                  | Decimal Places | 0   |
| Coding            | RW, PT, BU                           |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.028 Output mapping parameter 28 |                |   |
|-------------------|--------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 28     |                |   |
| Minimum           | 0                                    | Maximum        | 499999  |
| Default           | 0                                    | Units          |   |
| Type              | 32 Bit User Save                     | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                  | Decimal Places | 0   |
| Coding            | RW, PT, BU                           |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.029 Output mapping parameter 29 |                |   |
|-------------------|--------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 29     |                |   |
| Minimum           | 0                                    | Maximum        | 499999  |
| Default           | 0                                    | Units          |   |
| Type              | 32 Bit User Save                     | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                  | Decimal Places | 0   |
| Coding            | RW, PT, BU                           |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.030 Output mapping parameter 30 |                |   |
|-------------------|--------------------------------------|----------------|---|
| Short description | Sets output mapping parameter 30     |                |   |
| Minimum           | 0                                    | Maximum        | 499999  |
| Default           | 0                                    | Units          |   |
| Type              | 32 Bit User Save                     | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                  | Decimal Places | 0   |
| Coding            | RW, PT, BU                           |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.031 <i>Output mapping parameter 31</i> |                |   |
|-------------------|---|----------------|---|
| Short description | Sets output mapping parameter 31            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                         | Decimal Places | 0   |
| Coding            | RW, PT, BU                                  |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

| Parameter         | 4.22.032 <i>Output mapping parameter 32</i> |                |   |
|-------------------|---|----------------|---|
| Short description | Sets output mapping parameter 32            |                |   |
| Minimum           | 0   | Maximum        | 499999  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                            | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Slot Menu Parameter                         | Decimal Places | 0   |
| Coding            | RW, PT, BU                                  |                |   |

This parameters defines a destination parameter for the data that will be transmitted from the PLC. The default value for the parameter is zero.

## Slot 4 Menu 23 Single Line Descriptions – EtherNet/IP Fault Values

Mode: RFC-A

| Parameter |                       | Range                     | Default | Type |     |  |  |    |    |
|-----------|-----------------------|---------------------------|---------|------|-----|--|--|----|----|
| 4.23.001  | Output fault value 1  | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.002  | Output fault value 2  | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.003  | Output fault value 3  | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.004  | Output fault value 4  | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.005  | Output fault value 5  | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.006  | Output fault value 6  | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.007  | Output fault value 7  | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.008  | Output fault value 8  | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.009  | Output fault value 9  | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.010  | Output fault value 10 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.011  | Output fault value 11 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.012  | Output fault value 12 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.013  | Output fault value 13 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.014  | Output fault value 14 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.015  | Output fault value 15 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.016  | Output fault value 16 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.017  | Output fault value 17 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.018  | Output fault value 18 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.019  | Output fault value 19 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.020  | Output fault value 20 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.021  | Output fault value 21 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.022  | Output fault value 22 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.023  | Output fault value 23 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.024  | Output fault value 24 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.025  | Output fault value 25 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.026  | Output fault value 26 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.027  | Output fault value 27 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.028  | Output fault value 28 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.029  | Output fault value 29 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.030  | Output fault value 30 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.031  | Output fault value 31 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |
| 4.23.032  | Output fault value 32 | -2147483648 to 2147483647 | 0       | RW   | Num |  |  | PT | US |

|     |                     |     |                  |     |                  |     |                  |      |                |      |                       |
|-----|---------------------|-----|------------------|-----|------------------|-----|------------------|------|----------------|------|-----------------------|
| RW  | Read / Write        | RO  | Read-only        | Bit | Bit parameter    | Txt | Text string      | Date | Date parameter | Time | Time parameter        |
| Chr | Character parameter | Bin | Binary parameter | IP  | IP address       | Mac | MAC address      | Ver  | Version number | SMP  | Slot, menu, parameter |
| Num | Number parameter    | DE  | Destination      | ND  | No default value | RA  | Rating dependent | NC   | Non-copyable   | PT   | Protected             |
| Fl  | Filtered            | US  | User save        | PS  | Power-down save  |     |                  |      |                |      |                       |

## Slot 4 Menu 23 – EtherNet/IP Fault Values

Mode: RFC-A

| Parameter         | 4.23.001 Output fault value 1             |                |   |
|-------------------|---|----------------|---|
| Short description | Sets the output fault value for mapping 1 |                |   |
| Minimum           | -2147483648                               | Maximum        | 2147483647  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                  | Decimal Places | 0   |
| Coding            | RW, PT                                    |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.002 Output fault value 2             |                |   |
|-------------------|---|----------------|---|
| Short description | Sets the output fault value for mapping 2 |                |   |
| Minimum           | -2147483648                               | Maximum        | 2147483647  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                  | Decimal Places | 0   |
| Coding            | RW, PT                                    |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.003 Output fault value 3             |                |   |
|-------------------|---|----------------|---|
| Short description | Sets the output fault value for mapping 3 |                |   |
| Minimum           | -2147483648                               | Maximum        | 2147483647  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                  | Decimal Places | 0   |
| Coding            | RW, PT                                    |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.004 Output fault value 4             |                |   |
|-------------------|---|----------------|---|
| Short description | Sets the output fault value for mapping 4 |                |   |
| Minimum           | -2147483648                               | Maximum        | 2147483647  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                  | Decimal Places | 0   |
| Coding            | RW, PT                                    |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.005 Output fault value 5             |                |   |
|-------------------|---|----------------|---|
| Short description | Sets the output fault value for mapping 5 |                |   |
| Minimum           | -2147483648                               | Maximum        | 2147483647  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                  | Decimal Places | 0   |
| Coding            | RW, PT                                    |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.006 Output fault value 6             |                |   |
|-------------------|---|----------------|---|
| Short description | Sets the output fault value for mapping 6 |                |   |
| Minimum           | -2147483648                               | Maximum        | 2147483647  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                  | Decimal Places | 0   |
| Coding            | RW, PT                                    |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.007 Output fault value 7             |                |   |
|-------------------|---|----------------|---|
| Short description | Sets the output fault value for mapping 7 |                |   |
| Minimum           | -2147483648                               | Maximum        | 2147483647  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                  | Decimal Places | 0   |
| Coding            | RW, PT                                    |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.008 Output fault value 8             |                |   |
|-------------------|---|----------------|---|
| Short description | Sets the output fault value for mapping 8 |                |   |
| Minimum           | -2147483648                               | Maximum        | 2147483647  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                  | Decimal Places | 0   |
| Coding            | RW, PT                                    |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.009 Output fault value 9             |                |   |
|-------------------|---|----------------|---|
| Short description | Sets the output fault value for mapping 9 |                |   |
| Minimum           | -2147483648                               | Maximum        | 2147483647  |
| Default           | 0   | Units          |   |
| Type              | 32 Bit User Save                          | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                  | Decimal Places | 0   |
| Coding            | RW, PT                                    |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.010 Output fault value 10             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 10 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.011 Output fault value 11             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 11 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.012 Output fault value 12             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 12 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.013 Output fault value 13             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 13 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.014 Output fault value 14             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 14 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.015 Output fault value 15             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 15 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.016 Output fault value 16             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 16 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.017 Output fault value 17             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 17 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.018 Output fault value 18             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 18 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.019 Output fault value 19             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 19 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.020 Output fault value 20             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 20 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.021 Output fault value 21             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 21 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.022 Output fault value 22             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 22 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.023 Output fault value 23             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 23 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).



| Parameter         | 4.23.024 Output fault value 24             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 24 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.025 Output fault value 25             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 25 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.026 Output fault value 26             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 26 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.027 Output fault value 27             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 27 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.028 Output fault value 28             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 28 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.029 Output fault value 29             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 29 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.030 Output fault value 30             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 30 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.031 Output fault value 31             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 31 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

| Parameter         | 4.23.032 Output fault value 32             |                |   |
|-------------------|--|----------------|---|
| Short description | Sets the output fault value for mapping 32 |                |   |
| Minimum           | -2147483648                                | Maximum        | 2147483647  |
| Default           | 0  | Units          |   |
| Type              | 32 Bit User Save                           | Update Rate    | Module reset, EtherNet/IP interface reset or EtherNet/IP interface enable |
| Display Format    | Standard                                   | Decimal Places | 0   |
| Coding            | RW, PT                                     |                |   |

This parameter defines the value to be sent to the mapped output destination when fault values have been configured to be sent (with *RPI timeout action* (4.20.011) and *PLC idle action* (4.20.015)).

# Trips

Mode: RFC-A

*Trip 0* (10.020) to *Trip 9* (10.029) store the most recent 10 trips that have occurred where *Trip 0* (10.020) is the most recent and *Trip 9* (10.029) is the oldest. When a new trip occurs it is written to *Trip 0* (10.020) and all the other trips move down the log, with oldest being lost. The date and time when each trip occurs are also stored in the date and time log, i.e. *Trip 0 Date* (10.041) to *Trip 9 Time* (10.060). The date and time are taken from *Date* (06.016) and *Time* (06.017). Some trips have sub-trip numbers which give more detail about the reason for the trip. If a trip has a sub-trip number its value is stored in the sub-trip log, i.e. *Trip 0 Sub-trip Number* (10.070) to *Trip 9 Sub-trip Number* (10.079). If the trip does not have a sub-trip number then zero is stored in the sub-trip log.

## Trip categories and priorities

Trips are grouped into the categories given in the table below. A trip can only occur when the drive is not tripped, or if it is already tripped and the new trip has a higher priority than the active trip (i.e. lower priority number). Unless otherwise stated a trip cannot be reset until 1.0s after it has been initiated.

| Priority | Category  | Trips   | Comments  |
|----------|---|---|---|
| 1        | Internal faults                                   | <i>HF01</i> – <i>HF20</i>   | These are fatal problems that cannot be reset. All drive features are inactive after any of these trips occur. If a basic keypad is fitted it will show the trip, but the keypad will not function. These trips are not stored in the trip log.                                       |
| 1        | Stored HF trip                                    | <i>Stored HF</i>  | This trip cannot be cleared unless 1299 is entered into <i>Parameter mm.000</i> (mm.000) and a reset is initiated.  |
| 2        | Non-resettable trips                              | Trip numbers 218 to 247, <i>Slot1 HF</i> , <i>Slot2 HF</i> , <i>Slot3 HF</i> or <i>Slot4 HF</i> | These trips cannot be reset.  |
| 3        | Volatile memory failure                           | <i>EEPROM Fail</i>  | This can only be reset if <i>Parameter mm.000</i> (mm.000) is set to 1233 or 1244, or if <i>Load Defaults</i> (11.043) is set to a non-zero value.  |
| 4        | Internal 24V power supply                         | <i>PSU 24V</i>  |   |
| 5        | Non-volatile media trips                          | Trip numbers 174, 175 and 177 to 188  | These trips are priority 6 during power-up.   |
| 5        | Position feedback interface power supply          | <i>Encoder 1</i>  | This trip can override <i>Encoder 2</i> to <i>Encoder 6</i> trips.  |
| 6        | Trips with extended reset times                   | <i>OI ac</i> , <i>OI Brake</i> , and <i>OI dc</i>   | These trips cannot be reset until 10s after the trip was initiated.   |
| 6        | Phase loss and d.c. link power circuit protection | <i>Phase Loss</i> and <i>OHI dc bus</i>   | The drive will attempt to stop the motor before tripping if a <i>Phase Loss.000</i> trip occurs unless this feature has been disabled (see <i>Action On Trip Detection</i> (10.037)). The drive will always attempt to stop the motor before tripping if an <i>OHI dc bus</i> occurs. |
| 6        | Standard trips                                    | All other trips   |   |

## Internal faults

Trips {*HF01*} to {*HF20*} are internal faults that do not have trip numbers. If one of these trips occurs, the main drive processor has detected an irrecoverable error. All drive functions are stopped and the trip message will be displayed on the drive keypad. The error can only be reset by powering the drive down and up again. The table below gives the reasons for internal faults and their corresponding trip.

| Trip   | Reason   |
|--------|--|
| {HF01} | CPU has detected an address error  |
| {HF02} | CPU DMAC has detected an address error   |
| {HF03} | CPU has detected an Illegal opcode   |
| {HF04} | CPU has detected an Illegal slot instruction   |
| {HF05} | An interrupt has occurred that does not have a defined function (Undefined exception)  |
| {HF06} | An interrupt has occurred which is reserved (Reserved exception)   |
| {HF07} | Watchdog failure   |
| {HF08} | CPU Interrupt crash  |
| {HF09} | Free store overflow  |
| {HF10} | Parameter routing system error   |
| {HF11} | Non-volatile memory comms error  |
| {HF12} | Stack overflow. Sub-trip is shown to indicate which stack:<br>1 – background tasks<br>2 – timed tasks<br>3 – main system interrupts  |
| {HF13} | The control hardware is not compatible with the firmware. The sub-trip number gives the actual ID code of the control board hardware.  |
| {HF14} | CPU register bank error  |
| {HF15} | CPU divide error   |
| {HF16} | RTOS error (the background task has returned)  |
| {HF17} | The clock supplied to the control board logic is out of specification  |
| {HF18} | The internal flash memory has failed when writing option module parameter data.<br>Sub-trip is shown to indicate which failure:<br>1 - Programming error while writing menu in flash<br>2 - Erase flash block containing setup menus failed<br>3 - Erase flash block containing application menus failed |
| {HF19} | Invalid main application firmware CRC. Reprogramming required.   |
| {HF20} | The ASIC is not compatible with the firmware. The sub-trip number displayed is the ASIC version.   |
| {HF23} | If this trip occurs please consult the drive supplier.   |
| {HF24} | If this trip occurs please consult the drive supplier.   |
| {HF25} | If this trip occurs please consult the drive supplier.   |

When the drive is subsequently powered up a *Stored HF* trip is initiated where the sub-trip number is the number of the HF trip that last occurred. This trip will occur at every power-up until it is reset. The trip can only be reset by first entering 1299 into *Parameter mm.000* (mm.000). If the drive is powered up and a *Stored HF* trip occurs, *Onboard User Program: Enable* (11.047) is reset to zero to prevent the on-board user program from running. This ensures that the user program can be changed or erased in case it causes an HF trip at every power-up. Once the *Stored HF* is cleared, it is necessary to power cycle the drive or to re-download the user program to allow the program to restart.

#### Similar trips that can be initiated by the control system or the power system

Trips shown in the table below can be generated either from the drive control system or from the power system. The sub-trip number which is in the form *xyzz* is used to identify the source of the trip. The digits *xx* are 00 for a trip generated by the control system or the number of a power module if generated by the power system. If the drive is not a multi-power module drive then *xx* will always have a value of 1 the trip is related to the power system. The *y* digit is used to identify the location of a trip which is generated by a rectifier module connected to a power module. Where the *y* digit is relevant it will have a value of 1 or more, otherwise it will be 0. The *zz* digits give the reason for the trip and are defined in each trip description.

|                     |                      |
|---------------------|----------------------|
| <i>Over Volts</i>   | <i>Oht dc bus</i>    |
| <i>OI ac</i>        | <i>Phase Loss</i>    |
| <i>OI Brake</i>     | <i>Power Comms</i>   |
| <i>PSU</i>          | <i>OI Snubber</i>    |
| <i>Oht Inverter</i> | <i>Cloning</i>       |
| <i>Oht Power</i>    | <i>Temp Feedback</i> |
| <i>Oht Control</i>  | <i>Power Data</i>    |

#### Braking IGBT

The list below gives conditions that will disable the braking IGBT:

1. *Braking IGBT Upper Threshold* (06.074) = 0, or *Low Voltage Braking IGBT Threshold Select* (06.076) = 1 and *Low Voltage Braking IGBT Threshold* (06.075) = 0.
2. The drive is in the under-voltage state.
3. A priority 1, 2 or 3 trip is active (see *Trip 0* (10.020)).
4. One of the following trips is active or would be active if another trip is not already active: *OI Brake*, *PSU*, *Th Brake Res* or *Oht Inverter*.
5. *Percentage Of Drive Thermal Trip Level* (07.036) = 100%. This is an indication that some part of the drive is too hot and is used to indicate if an internally fitted braking resistor is too hot.
6. *Brake R Too Hot* is active or the system has been set up to disable the braking IGBT based on the braking resistor temperature and the resistor is too hot (i.e. bit 2 of *Action On Trip Detection* (10.037) is set).

Note that the braking IGBT over-current trip cannot be reset until 10s after it is initiated. This period consists of a 9s period after the trip where the braking IGBT cannot be switched on again and the *OI Brake* trip is held active and cannot be reset. This 9s period is followed by the normal 1s delay, that is present for other trips, before the trip can be reset. During this 1s period it is possible for the braking IGBT to switch on again. If the conditions are still present that caused the trip then the trip will be initiated again with a further 9s hold-off period etc.

#### Trips Summary (numerical order)

| Value | Trip             |
|-------|------------------|
| 0     | None             |
| 1     | Reserved 001     |
| 2     | Over Volts       |
| 3     | OI ac            |
| 4     | OI Brake         |
| 5     | PSU              |
| 6     | External Trip    |
| 7     | Over Speed       |
| 8     | Inductance       |
| 9     | PSU 24V          |
| 10    | Th Brake Res     |
| 11    | Autotune 1       |
| 12    | Autotune 2       |
| 13    | Autotune 3       |
| 14    | Autotune 4       |
| 15    | Autotune 5       |
| 16    | Autotune 6       |
| 17    | Autotune 7       |
| 18    | Autotune Stopped |
| 19    | Brake R Too Hot  |
| 20    | Motor Too Hot    |
| 21    | OHT Inverter     |
| 22    | OHT Power        |
| 23    | OHT Control      |
| 24    | Thermistor       |
| 25    | Th Short Circuit |
| 26    | I/O Overload     |
| 27    | OHT dc bus       |
| 28    | An Input 1 Loss  |
| 29    | An Input 2 Loss  |
| 30    | Watchdog         |
| 31    | EEPROM Fail      |
| 32    | Phase Loss       |
| 33    | Resistance       |
| 34    | Keypad Mode      |
| 35    | Control Word     |
| 36    | User Save        |
| 37    | Power Down Save  |
| 38    | Low Load         |
| 39    | Line Sync        |
| 40    | User Trip 40     |
| 41    | User Trip 41     |
| 42    | User Trip 42     |
| 43    | User Trip 43     |
| 44    | User Trip 44     |
| 45    | User Trip 45     |
| 46    | User Trip 46     |
| 47    | User Trip 47     |
| 48    | User Trip 48     |
| 49    | User Trip 49     |
| 50    | User Trip 50     |
| 51    | User Trip 51     |
| 52    | User Trip 52     |
| 53    | User Trip 53     |
| 54    | User Trip 54     |
| 55    | User Trip 55     |
| 56    | User Trip 56     |
| 57    | User Trip 57     |
| 58    | User Trip 58     |
| 59    | User Trip 59     |
| 60    | User Trip 60     |
| 61    | User Trip 61     |
| 62    | User Trip 62     |
| 63    | User Trip 63     |
| 64    | User Trip 64     |
| 65    | User Trip 65     |
| 66    | User Trip 66     |
| 67    | User Trip 67     |
| 68    | User Trip 68     |

|     |                  |
|-----|------------------|
| 69  | User Trip 69     |
| 70  | User Trip 70     |
| 71  | User Trip 71     |
| 72  | User Trip 72     |
| 73  | User Trip 73     |
| 74  | User Trip 74     |
| 75  | User Trip 75     |
| 76  | User Trip 76     |
| 77  | User Trip 77     |
| 78  | User Trip 78     |
| 79  | User Trip 79     |
| 80  | User Trip 80     |
| 81  | User Trip 81     |
| 82  | User Trip 82     |
| 83  | User Trip 83     |
| 84  | User Trip 84     |
| 85  | User Trip 85     |
| 86  | User Trip 86     |
| 87  | User Trip 87     |
| 88  | User Trip 88     |
| 89  | User Trip 89     |
| 90  | Power Comms      |
| 91  | User 24V         |
| 92  | OI Snubber       |
| 93  | Inductor Too Hot |
| 94  | Rectifier Set-up |
| 95  | Reserved 095     |
| 96  | User Prog Trip   |
| 97  | Data Changing    |
| 98  | Out Phase Loss   |
| 99  | CAM              |
| 100 | Reset            |
| 101 | OHT Brake        |
| 102 | Cloning          |
| 103 | Inter-connect    |
| 104 | Reserved 104     |
| 105 | Reserved 105     |
| 106 | Reserved 106     |
| 107 | Reserved 107     |
| 108 | Reserved 108     |
| 109 | OI dc            |
| 110 | Undefined        |
| 111 | Configuration    |
| 112 | User Trip 112    |
| 113 | User Trip 113    |
| 114 | User Trip 114    |
| 115 | User Trip 115    |
| 116 | User Trip 116    |
| 117 | User Trip 117    |
| 118 | User Trip 118    |
| 119 | User Trip 119    |
| 120 | User Trip 120    |
| 121 | User Trip 121    |
| 122 | User Trip 122    |
| 123 | User Trip 123    |
| 124 | User Trip 124    |
| 125 | User Trip 125    |
| 126 | User Trip 126    |
| 127 | User Trip 127    |
| 128 | User Trip 128    |
| 129 | User Trip 129    |
| 130 | User Trip 130    |
| 131 | User Trip 131    |
| 132 | User Trip 132    |
| 133 | User Trip 133    |
| 134 | User Trip 134    |
| 135 | User Trip 135    |
| 136 | User Trip 136    |
| 137 | User Trip 137    |
| 138 | User Trip 138    |

|     |                  |
|-----|------------------|
| 139 | User Trip 139    |
| 140 | User Trip 140    |
| 141 | User Trip 141    |
| 142 | User Trip 142    |
| 143 | User Trip 143    |
| 144 | User Trip 144    |
| 145 | User Trip 145    |
| 146 | User Trip 146    |
| 147 | User Trip 147    |
| 148 | User Trip 148    |
| 149 | User Trip 149    |
| 150 | User Trip 150    |
| 151 | User Trip 151    |
| 152 | User Trip 152    |
| 153 | User Trip 153    |
| 154 | User Trip 154    |
| 155 | User Trip 155    |
| 156 | User Trip 156    |
| 157 | User Trip 157    |
| 158 | User Trip 158    |
| 159 | User Trip 159    |
| 160 | Island           |
| 161 | Reserved 161     |
| 162 | Encoder 12       |
| 163 | Encoder 13       |
| 164 | Encoder 14       |
| 165 | Reserved 165     |
| 166 | Reserved 166     |
| 167 | Reserved 167     |
| 168 | Reserved 168     |
| 169 | Voltage Range    |
| 171 | Reserved 171     |
| 172 | Reserved 172     |
| 173 | Reserved 173     |
| 174 | Card Slot        |
| 175 | Card Product     |
| 176 | Name Plate       |
| 177 | Card Boot        |
| 178 | Card Busy        |
| 179 | Card Data Exists |
| 180 | Card Option      |
| 181 | Card Read Only   |
| 182 | Card Error       |
| 183 | Card No Data     |
| 184 | Card Full        |
| 185 | Card Access      |
| 186 | Card Rating      |
| 187 | Card Drive Mode  |
| 188 | Card Compare     |
| 189 | Encoder 1        |
| 190 | Encoder 2        |
| 191 | Encoder 3        |
| 192 | Encoder 4        |
| 193 | Encoder 5        |
| 194 | Encoder 6        |
| 195 | Encoder 7        |
| 196 | Encoder 8        |
| 197 | Encoder 9        |
| 199 | Destination      |
| 200 | Slot1 HF         |
| 201 | Slot1 Watchdog   |
| 202 | Slot1 Error      |
| 203 | Slot1 Not Fitted |
| 204 | Slot1 Different  |
| 205 | Slot2 HF         |
| 206 | Slot2 Watchdog   |
| 207 | Slot2 Error      |
| 208 | Slot2 Not Fitted |
| 209 | Slot2 Different  |
| 210 | Slot3 HF         |

|     |                  |
|-----|------------------|
| 211 | Slot3 Watchdog   |
| 212 | Slot3 Error      |
| 213 | Slot3 Not Fitted |
| 214 | Slot3 Different  |
| 215 | Option Disable   |
| 216 | Slot App Menu    |
| 217 | App Menu Changed |
| 218 | Temp Feedback    |
| 219 | An Output Calib  |
| 220 | Power Data       |
| 221 | Stored HF        |
| 222 | Reserved 222     |
| 223 | Rating Mismatch  |
| 224 | Drive Size       |
| 225 | Current Offset   |
| 226 | Soft Start       |
| 227 | Sub-array RAM    |
| 228 | Reserved 228     |
| 229 | Reserved 229     |
| 230 | Reserved 230     |
| 231 | Reserved 231     |
| 232 | Reserved 232     |
| 233 | Reserved 233     |
| 234 | Reserved 234     |
| 235 | Reserved 235     |
| 236 | Reserved 236     |
| 237 | Reserved 237     |
| 238 | Reserved 238     |
| 239 | Reserved 239     |
| 240 | Reserved 240     |
| 241 | Reserved 241     |
| 242 | Reserved 242     |
| 243 | Reserved 243     |
| 244 | Reserved 244     |
| 245 | Reserved 245     |
| 246 | Reserved 246     |
| 247 | Derivative ID    |
| 248 | Derivative Image |
| 249 | User Program     |
| 250 | Slot4 HF         |
| 251 | Slot4 Watchdog   |
| 252 | Slot4 Error      |
| 253 | Slot4 Not Fitted |
| 254 | Slot4 Different  |
| 255 | Reset Logs       |

**Trips** (alphabetical order)

| Trip              | <b>An Input 1 Loss</b> |
|-------------------|------------------------|
| Value             | 28                     |
| Short description |                        |

Indicates that a current loss was detected in current mode on Analog Input 1 (Terminal 5, 6). In 4-20mA and 20-4mA modes. loss of input is detected if the current falls below 3mA. See *Analog Input 1 Mode* (07.007) for further details.

**Recommended actions:**

- Check control wiring is correct.
- Check control wiring is undamaged.
- Check *Analog Input 1 Mode* (07.007).
- Check that the current signal is present and greater than 3mA.

| Trip              | <b>An Input 2 Loss</b> |
|-------------------|------------------------|
| Value             | 29                     |
| Short description |                        |

Indicates that a current loss was detected in current mode on Analog Input 2 (Terminal 7). In 4-20mA and 20-4mA modes. loss of input is detected if the current falls below 3mA. See *Analog Input 2 Mode* (07.011) for further details.

**Recommended actions:**

- Check control wiring is correct.
- Check control wiring is undamaged.
- Check *Analog Input 2 Mode* (07.011).



- Check that the current signal is present and greater than 3mA.

|                   |                        |
|-------------------|------------------------|
| <b>Trip</b>       | <b>An Output Calib</b> |
| Value             | 219                    |
| Short description |                        |

The zero offset calibration of one or both of the analogue outputs has failed. This indicates that the drive hardware has failed, or a voltage has been applied to the output via a low impedance possibly due to a wiring error.

| Sub-trip | Reason          |
|----------|-----------------|
| 1        | Output 1 failed |
| 2        | Output 2 failed |

**Recommended actions:**

- Check the wiring associated with analog outputs.
- Remove all the wiring that is connected to analog outputs and perform a recalibration by power cycling the drive.
- If trip persists, replace the drive.

|                   |                         |
|-------------------|-------------------------|
| <b>Trip</b>       | <b>App Menu Changed</b> |
| Value             | 217                     |
| Short description |                         |

The customisation table for an application menu has been changed. The sub-trip indicates which menu has changed:

| Sub-trip | Reason  |
|----------|---------|
| 1        | Menu 18 |
| 2        | Menu 19 |
| 3        | Menu 20 |

If more than one menu has changed the lowest menu has priority. Drive user parameters must be saved to prevent this trip on the next power-up.

**Recommended actions:**

- Reset the trip and perform a parameter save to accept the new settings.

|                   |                   |
|-------------------|-------------------|
| <b>Trip</b>       | <b>Autotune 1</b> |
| Value             | 11                |
| Short description |                   |

The drive has tripped during an auto-tune. The cause of the trip can be identified from the sub-trip number.

| Sub-trip | Reason   | Recommended actions  |
|----------|--|--|
| 1        | The position feedback did not change when position feedback is being used during rotating auto-tune.   | Ensure that the motor is free to turn (i.e. mechanical brake is released).<br>Check that the position feedback is selected correctly and operates correctly.                                   |
| 2        | The motor did not reach the required speed during mechanical load measurement.   | Ensure that the motor is free to turn and that the static load plus inertia is not too large for the drive to accelerate within the test time.   |
| 3        | The required commutation signal edge could not be found during a rotating auto-tune with a Commutation Only position feedback device.                            | Check that the position feedback signals are connected correctly.  |
| 4        | The required movement angle cannot be produced during a minimal movement test.   | Reduce the angular movement required.  |
| 5        | The second part of the minimal movement test during auto-tuning cannot locate the motor flux position accurately.  | Reduce the angular movement required.  |
| 6        | The phasing offset angle is measured twice during a stationary auto-tune and the results are not within 30° of each other.                                       | If a minimal movement test is being used and excessive motor movement is occurring during the test reduce the required angle movement. Otherwise try and increase the required angle movement. |
| 7        | The motor is moving when a phasing test on enable is selected and the drive is enabled, but the motor is still moving at a speed above the zero speed threshold. | Ensure that the motor is stationary before the drive is enabled.   |

|                   |                   |
|-------------------|-------------------|
| <b>Trip</b>       | <b>Autotune 2</b> |
| Value             | 12                |
| Short description |                   |

The drive has tripped during a rotating auto-tune. The cause of the trip can be identified from the associated sub-trip number.

| Sub-trip | Reason  |
|----------|---|
| 1        | The position feedback direction is incorrect when position feedback is being used during a rotating auto-tune.  |
| 2        | A SINCOS encoder with comms is being used for position feedback and the comms position is rotating in the opposite direction to the sine wave based position. |

**Recommended actions:**

- Check motor cable wiring is correct.
- Check feedback device wiring is correct.
- Swap any two motor phases.

|                   |                   |
|-------------------|-------------------|
| <b>Trip</b>       | <b>Autotune 3</b> |
| Value             | 13                |
| Short description |                   |

The drive has tripped during a rotating auto-tune or mechanical load measurement. The cause of the trip can be identified from the associated sub-trip number.

| Sub-trip | Reason  |
|----------|---|
| 1        | Measured inertia has exceeded the parameter range during a mechanical load measurement. |
| 2        | The commutation signals changed in the wrong direction during a rotating auto-tune.     |
| 3        | The mechanical load test has been unable to identify the motor inertia.                 |

**Recommended actions for sub-trip 2:**

- Check motor cable wiring is correct.
- Check feedback device U, V and W commutation signal wiring is correct.

**Recommended actions for sub-trip 3:**

- Increase the test level.
- If the test was carried out at standstill repeat the test with the motor rotating within the recommended speed range.

|                   |                   |
|-------------------|-------------------|
| <b>Trip</b>       | <b>Autotune 4</b> |
| Value             | 14                |
| Short description |                   |

A position feedback device with commutation signals is being used (i.e AB Servo, FD Servo, FR Servo, SC Servo or Commutation Only encoder) and the U commutation signal did not change during a rotating auto-tune.

**Recommended actions:**

- Check feedback device U commutation signal wiring is correct (Encoder terminals 7 and 8).

|                   |                   |
|-------------------|-------------------|
| <b>Trip</b>       | <b>Autotune 5</b> |
| Value             | 15                |
| Short description |                   |

A position feedback device with commutation signals is being used (i.e AB Servo, FD Servo, FR Servo, SC Servo or Commutation Only encoder) and the V commutation signal did not change during a rotating auto-tune.

**Recommended actions:**

- Check feedback device V commutation signal wiring is correct (Encoder terminals 9 and 10).

|                   |                   |
|-------------------|-------------------|
| <b>Trip</b>       | <b>Autotune 6</b> |
| Value             | 16                |
| Short description |                   |

A position feedback device with commutation signals is being used (i.e AB Servo, FD Servo, FR Servo, SC Servo or Commutation Only encoder) and the W commutation signal did not change during a rotating auto-tune.

**Recommended actions:**

- Check feedback device W commutation signal wiring is correct (Encoder terminals 11 and 12).

|                   |                   |
|-------------------|-------------------|
| <b>Trip</b>       | <b>Autotune 7</b> |
| Value             | 17                |
| Short description |                   |

An *Autotune 7* trip is initiated during a rotating auto-tune, if the number of motor poles or the position feedback resolution have been set up incorrectly where position feedback is being used.

**Recommended actions:**

- Check the lines per revolution for the feedback device.
- Check the number of poles in *Number Of Motor Poles* (05.011).

|                   |                         |
|-------------------|-------------------------|
| <b>Trip</b>       | <b>Autotune Stopped</b> |
| Value             | 18                      |
| Short description |                         |

The drive was prevented from completing an auto-tune, because either the Final drive enable or the Final drive run were removed.

**Recommended actions:**

- Check the drive enable signal (Terminal 31) was active during the auto-tune.
- Check the run command was active in *Digital Input 05 State* (08.005) during the auto-tune.

|                   |                        |
|-------------------|------------------------|
| <b>Trip</b>       | <b>Brake R Too Hot</b> |
| Value             | 19                     |
| Short description |                        |

This trip indicates that braking resistor overload has timed out. The value in *Braking Resistor Thermal Accumulator* (10.039) is calculated using *Braking Resistor Rated Power* (10.030), *Braking Resistor Thermal Time Constant* (10.031) and *Braking Resistor Resistance* (10.061). This trip is initiated when *Braking Resistor Thermal Accumulator* (10.039) reaches 100%.

**Recommended actions:**

- Ensure the values entered in *Braking Resistor Rated Power* (10.030), *Braking Resistor Thermal Time Constant* (10.031) and *Braking Resistor Resistance* (10.061) are correct.
- If an external thermal protection device is being used and the braking resistor software overload protection is not required, set *Braking Resistor Rated Power* (10.030), *Braking Resistor Thermal Time Constant* (10.031) and *Braking Resistor Resistance* (10.061) to 0 to disable the trip.

|                   |            |
|-------------------|------------|
| <b>Trip</b>       | <b>CAM</b> |
| Value             | 99         |
| Short description |            |

Advanced motion controller cam failure.

| Sub-trip | Reason  |
|----------|---|
| 1        | AMC Cam Start Index (35.001) > AMC Cam Size (35.003) or AMC Cam Start Position In Segment (35.002) > Cam Table In for the start index |
| 2        | AMC Cam Index (35.007) has change by more than 2 in one sample  |
| 3        | The rate of change at a segment boundary has exceeded the maximum value   |
| 4        | The sum of the AMC Cam Position In Segment (35.008) and the change of master position has exceeded the maximum value                  |

|                   |                    |
|-------------------|--------------------|
| <b>Trip</b>       | <b>Card Access</b> |
| Value             | 185                |
| Short description |                    |

A communications failure has occurred with a NV media card. If this occurs during a data transfer to the card then the file being written may be corrupted. If this occurs when data is being transferred from the card then the data transfer may be incomplete. If a parameter file is transferred to the drive and this trip occurs during the transfer the parameters are not saved to non-volatile memory, and so the original parameters can be restored by powering the drive down and up again.

**Recommended actions:**

- Check the NV media card is installed / located correctly.
- Replace the NV media card.

|                   |                  |
|-------------------|------------------|
| <b>Trip</b>       | <b>Card Boot</b> |
| Value             | 177              |
| Short description |                  |

A write to a Menu 0 parameter has been initiated via the keypad by exiting edit mode and *Parameter Cloning* (11.042) is set up for auto or boot mode, but the necessary boot file has not been created on the NV media card fitted to the drive to take the new parameter value. This occurs when *Parameter Cloning* (11.042) is changed to auto or boot mode, but the drive is not subsequently reset. The action of resetting the trip will create the necessary file and prevent further trips.

If this trip occurs after the drive has attempted to transfer parameters from the NV media card to the drive at boot, then the following sub-trips will give the reason for the trip.

| Sub-trip | Reason  |
|----------|---|
| 1        | Failed to open / read / close card file 001 when retrieving drive parameter data                |
| 2        | Failed to open / write / close drive parameter file   |
| 11       | Failed to open / read / close card file 001 when retrieving option module slot 1 parameter data |
| 12       | Failed to open / write / close option module slot 1 parameter file                              |
| 21       | Failed to open / read / close card file 001 when retrieving option module slot 2 parameter data |
| 22       | Failed to open / write / close option module slot 2 parameter file                              |
| 31       | Failed to open / read / close card file 001 when retrieving option module slot 3 parameter data |
| 32       | Failed to open / write / close option module slot 3 parameter file                              |
| 41       | Failed to open / read / close card file 001 when retrieving option module slot 4 parameter data |
| 42       | Failed to open / write / close option module slot 4 parameter file                              |
| 3        | Failed to open / read / close card file 002 when retrieving onboard user program                |
| 4        | Failed to open / write / close onboard user program in the drive                                |
| 5        | Drive failed to restart following onboard user program update                                   |

**Recommended actions:**

- Ensure that *Parameter Cloning* (11.042) is correctly set, and then reset the drive to create the necessary file on the NV media card.
- Re-attempt the parameter write to the Menu 0 parameter.
- Ensure any option modules are correctly fitted
- Erase the file on the NV media card and recreate the bootable parameter file

|                   |                  |
|-------------------|------------------|
| <b>Trip</b>       | <b>Card Busy</b> |
| Value             | 178              |
| Short description |                  |

An attempt has been made to access a file on a NV media card, but the file is already being accessed by an Option Module, such as one of the Applications modules. No data is transferred.

**Recommended actions:**

- Wait for the Option Module to finish accessing the NV media card and re-attempt the required function.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Card Compare</b> |
| Value             | 188                 |
| Short description |                     |

A compare has been carried out between a file on a NV media card and the drive and these are different and no other NV media card related trips have occurred.

**Recommended actions:**

- Set Pr *mm.000* to 0 to reset the trip.
- Check to ensure the correct data block on the NV media card has been used for the compare.

|                   |                         |
|-------------------|-------------------------|
| <b>Trip</b>       | <b>Card Data Exists</b> |
| Value             | 179                     |
| Short description |                         |

An attempt has been made to store data on a NV media card, but the file already exists. No data is transferred. The file should be erased first to prevent this trip.

**Recommended actions:**

- Erase the data in data location.
- Write data to an alternative data location.

|                   |                        |
|-------------------|------------------------|
| <b>Trip</b>       | <b>Card Drive Mode</b> |
| Value             | 187                    |
| Short description |                        |

This trip is produced during a compare if the drive mode in the file on the NV media card is different from the current drive mode and the file is a parameter file. This trip is also produced if an attempt is made to transfer a parameter file where the source and target drive modes are different and the drive mode is outside the range allowed for the target drive.

**Recommended actions:**

- Ensure the destination drive supports the drive operating mode in the parameter file.
- Clear the value in Pr *mm.000* and reset the drive.
- Ensure destination drive operating mode is the same as the source parameter file.

|                   |                   |
|-------------------|-------------------|
| <b>Trip</b>       | <b>Card Error</b> |
| Value             | 182               |
| Short description |                   |

An attempt has been made to access a NV media card, but an error has been detected in the data structure on the card. Resetting this trip will cause the drive to erase the <MCDF> folder from the NV media card (if it exists) and create the correct folder structure. On an SD card, whilst this trip is still present, missing directories will be created, and if the header file is missing it will be created. The following sub-trip numbers are used with this trip.

| Sub-trip | Reason  |
|----------|---|
| 1        | The required folder and file structure is not present.                            |
| 2        | The <000> file is corrupted.  |
| 3        | Two or more files in the <MCDF\> folder have the same file identification number. |

**Recommended actions:**

- Erase all the data blocks and re-attempt the process.
- Ensure the card is located correctly.
- Replace the NV media card.

|                   |                  |
|-------------------|------------------|
| <b>Trip</b>       | <b>Card Full</b> |
| Value             | 184              |
| Short description |                  |

An attempt has been made to write to a NV media card, but there is insufficient space available. No data is transferred.

**Recommended actions:**

- Delete a data block or the entire NV media card to create space.
- Replace the NV media card.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Card No Data</b> |
| Value             | 183                 |
| Short description |                     |

An attempt has been made to access a non-existent file on a NV media card. No data is transferred.

**Recommended actions:**

- Ensure data block number is correct.

|                   |                    |
|-------------------|--------------------|
| <b>Trip</b>       | <b>Card Option</b> |
| Value             | 180                |
| Short description |                    |

A parameter file has been transferred from a NV media card to the drive, but at least one of the option modules are difference between source and target drives. This trip does not stop the data transfer, but is a warning that the data for the option modules that are different will be set to the default values and not the values from the card. This trip also applies if a compare is performed between a parameter file on a card and the drive and the option modules fitted are different between the source and target.

If this trip occurs after the drive has attempted to transfer parameters from the NV media card to the drive at boot, then the following sub-trips will give the reason for the trip.

| Sub-trip | Reason  |
|----------|---|
| 0        | One or more option module in the drive differs to the booted image. |
| 1        | Option module missing from slot 1                                   |
| 2        | Option module missing from slot 2                                   |
| 3        | Option module missing from slot 3                                   |
| 4        | Option module missing from slot 4                                   |

**Recommended actions:**

- Ensure the correct option modules are installed.
- Ensure the option modules are in the same option module slot as the parameter set stored.
- Press the red reset button to acknowledge that the parameters for one or more of the option modules installed will be at their default vaules.
- This trip can be suppressed by setting Pr *mm.000* to 9666 and resetting the drive.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Card Product</b> |
| Value             | 175                 |
| Short description |                     |

If *Drive Derivative* (11.028) or *Product Type* (11.063) are different between the source and target drives then this trip is initiated either at power-up or when the card is accessed. It will have one of the following sub-trip numbers:

| Sub-trip | Reason  |
|----------|---|
| 1        | If <i>Drive Derivative</i> (11.028) is different between the source and target drives, this trip is initiated either at power-up or when the SD Card is accessed. Data is still transferred, since this is a warning trip; the trip can be suppressed by entering code 9666 in parameter <i>xx.000</i> , and resetting the drive (this applies the warning suppression flag to the card). |
| 2        | If <i>Product Type</i> (11.063) is different between the source and target drives or if corruption is detected in the parameter file, this trip is initiated either at power-up or when the SD Card is accessed. This trip can be reset but no data are transferred in either direction between the drive and the card.   |
| 3        | A Unidrive SP parameter value was found that has no equivalent parameter on the destination drive. Data is still transferred, since this is a warning trip; the trip can be suppressed by entering code 9666 in parameter <i>xx.000</i> , and resetting the drive (this applies the warning suppression flag to the card).  |

**Recommended actions:**

- Use a different NV media card.
- This trip can be suppressed by setting Pr *mm.000* to 9666 and resetting the drive.

|                   |                    |
|-------------------|--------------------|
| <b>Trip</b>       | <b>Card Rating</b> |
| Value             | 186                |
| Short description |                    |

A parameter file has been transferred from a NV media card to the drive, but the current and/or voltage rating are different between source and target drive. This trip does not stop the data transfer, but is a warning that the data for rating dependent parameters may not be the same on the target as the source drive. This trip also applies if a compare (using Pr *mm.000* set to 8yyy) is performed between a parameter file on the card on the drive.

**Recommended actions:**

- Reset the drive to clear the trip.
- This trip can be suppressed by setting Pr *mm.000* to 9666 and resetting the drive.

|                   |                       |
|-------------------|-----------------------|
| <b>Trip</b>       | <b>Card Read Only</b> |
| Value             | 181                   |
| Short description |                       |

An attempt has been made to modify data on a read-only NV media card or to modify a read-only file (i.e. erase the card, erase a file or create a file). No data is transferred.

**Recommended actions:**

- Clear the read only flag by setting Pr *mm.000* to 9777 and reset the drive. This will clear the read only flag for all data blocks in the NV media card.

| Trip              | Card Slot |
|-------------------|-----------|
| Value             | 174       |
| Short description |           |

The transfer of an option module application program to or from an application module can fail because the option module does not respond correctly. If this happens this trip is produced with the sub-trip indicating the option module slot number.

| Sub-trip number | Reason                 |
|-----------------|------------------------|
| 1               | Error in option slot 1 |
| 2               | Error in option slot 2 |
| 3               | Error in option slot 3 |
| 4               | Error in option slot 4 |

**Recommended actions:**

- Ensure the source / destination option module is installed on the correct slot.

| Trip              | Cloning |
|-------------------|---------|
| Value             | 102     |
| Short description |         |

If an attempt is made to use the cloning system to back-up the drive and option modules (parameter *mm.000* values from 40001 to 40999) or restore the drive and option modules (parameter *mm.000* values from 60001 to 60999) and the action fails then a "Cloning" trip is initiated. The sub-trip value indicates the reason for the trip.

| Sub-trip | Reason  |
|----------|---|
| 1        | The option module in Slot 1 has indicated that it will either back-up or restore its data to/from an SD card, but has failed to respond correctly and the system has timed out. |
| 2        | As 1, but for Option Slot 2.  |
| 3        | As 1, but for Option Slot 3.  |
| 4        | As 1, but for Option Slot 4.  |
| 5        | Back-up folders exist or cannot be created when a back-up is initiated.   |
| 6        | The required back-up folders do not exist when a restore is initiated.  |

| Trip              | Configuration |
|-------------------|---------------|
| Value             | 111           |
| Short description |               |

The *Number Of Power Modules Detected* (11.071) is different from the number expected. The sub-trip value indicates the number of power modules expected.

**Recommended actions:**

- Ensure that all the power modules are correctly connected and powered up.
- Ensure that the value in *Number Of Power Modules Detected* (11.071) is set to the number of power modules connected.
- Set *Number Of Power Modules Test* (11.035) to 0 to disable the trip if not required.

This trip is also initiated if the number of external rectifiers connected to each power module is less than the number defined by *Number Of Rectifiers Expected* (11.096). If this is the reason for the trip the sub-trip is 10x where x is the number of external rectifiers that should be connected.

**Recommended actions:**

- Ensure that all the external rectifiers are connected correctly.
- Ensure that the value in *Number Of Rectifiers Expected* (11.096) is correct.

| Trip              | Control Word |
|-------------------|--------------|
| Value             | 35           |
| Short description |              |

This trip is initiated by setting bit 12 on the control word in *Control Word* (06.042) when the control word is enabled (*Control Word Enable* (06.043) = On).

**Recommended actions:**

- Check the value of *Control Word* (06.042).
- Disable the control word in *Control Word Enable* (06.043).

| Trip              | Current Offset |
|-------------------|----------------|
| Value             | 225            |
| Short description |                |

The current feedback offset is too large to be trimmed correctly. The sub-trip relates to the output phase for which the offset error has been detected.

| Sub-trip | Phase |
|----------|-------|
| 1        | U     |
| 2        | V     |
| 3        | W     |

**Recommended actions:**

- Ensure that there is no possibility of current flowing in the output phase of the drive when the drive is not enabled.
- Hardware fault - contact the supplier of the drive.

| Trip              | Data Changing |
|-------------------|---------------|
| Value             | 97            |
| Short description |               |

A user action or a file system write is active that is changing the drive parameters and the drive has become active, i.e. *Drive Active* (10.002) = 1. The user actions that change drive parameters are loading defaults, changing drive mode, or transferring data from an NV memory card or a position feedback device to the drive. The file system actions that will cause this trip to be initiated if the drive is enabled during the transfer are writing a parameter or macro file to the drive, or transferring a derivative or user program to the drive. It should be noted that none of these actions can be started if the drive is active, and so the trip only occurs if the action is started and then the drive is enabled.

**Recommended actions:**

- Ensure the drive is not enabled when one of the following is being carried out:
  - Loading defaults
  - Changing drive mode
  - Transferring data from a NV media card or position feedback device
  - Transferring user programs

| Trip              | Derivative ID |
|-------------------|---------------|
| Value             | 247           |
| Short description |               |

There is a problem with the identifier associated with derivative image which customises the drive. The reason for the trip is given by the sub-trip as follows.

| Sub-trip | Reason for trip   |
|----------|---|
| 1        | There should be a derivative image in the product but this has been erased. |
| 2        | The identifier is out of range.   |
| 3        | The derivative image has been changed.                                      |

| Trip              | Derivative Image |
|-------------------|------------------|
| Value             | 248              |
| Short description |                  |

An error has been detected in the derivative product image. The sub-trip indicated the reason for the trip.

| Sub-trip | Reason  | Comments   |
|----------|---|--|
| 1        | Divide by zero  |  |
| 2        | Undefined trip  |  |
| 3        | Attempted fast parameter access set-up with non-existent parameter  |  |
| 4        | Attempted access to non-existent parameter  |  |
| 5        | Attempted write to read-only parameter  |  |
| 6        | Attempted and over-range write  |  |
| 7        | Attempted read from write-only parameter  |  |
|          |   |  |
| 30       | The image has failed because either its CRC is incorrect, or there are less than 6 bytes in the image or the image header version is less than 5. | Occurs when the drive powers-up or the image is programmed. The image tasks will not run.  |
| 31       | The image requires more RAM for heap and stack than can be provided by the drive.   | As 30.   |
| 32       | The image requires an OS function call that is higher than the maximum allowed.   | As 30.   |
|          |   |  |
| 40       | The timed task has not completed in time and has been suspended.  |  |
| 41       | Undefined function called, i.e. a function in the host system vector table that has not been assigned.  | As 40.   |
|          |   |  |
| 51       | Core menu customisation table CRC check failed  | As 30.   |
| 52       | Customisable menu table CRC check failed  | As 30.   |
| 53       | Customisable menu table changed   | Occurs when the drive powers-up or the image is programmed and the table has changed. Defaults are loaded for the derivative menu and the trip will keep occurring until drive parameters are saved. |
|          |   |  |
| 61       | The option module fitted in slot 1 is not allowed with the derivative image.  | As 30.   |
| 62       | The option module fitted in slot 2 is not allowed with the derivative image.  | As 30.   |
| 63       | The option module fitted in slot 3 is not allowed with the derivative image.  | As 30.   |
| 64       | The option module fitted in slot 4 is not allowed with the derivative image.  | As 30.   |
|          |   |  |
| 70       | An option module that is required by the derivative image is not fitted in any slot.  | As 30.   |
| 71       | An option module specifically required to be fitted in slot 1 not present.  | As 30.   |
| 72       | An option module specifically required to be fitted in slot 2 not present.  | As 30.   |
| 73       | An option module specifically required to be fitted in slot 3 not present.  | As 30.   |
| 74       | An option module specifically required to be fitted in slot 4 not present.  | As 30.   |
|          |   |  |
| 80       | *Image is not compatible with the control board   | Initiated from within the image code.  |
| 81       | *Image is not compatible with the control board serial number   | As 80.   |

**Recommended actions:**

- Contact the supplier of the drive.

| Trip              | Destination |
|-------------------|-------------|
| Value             | 199         |
| Short description |             |

This trip indicated that destination output parameters of two or more logic functions (Menus 05, 07, 08, 09, 12 or 14) within the drive are writing to the same parameter.

**Recommended actions:**

- Set Pr *mm.000* to "Destinations" or 12001 and check all visible parameters in all menus for parameter write conflicts.

| Trip              | Drive Size |
|-------------------|------------|
| Value             | 224        |
| Short description |            |

This trip indicates that the control PCB has not recognized the drive size of the power circuit to which it is connected.



**Recommended actions:**

- Ensure the drive is programmed to the latest software version.
- Hardware fault - return drive to supplier.

|                   |                    |
|-------------------|--------------------|
| <b>Trip</b>       | <b>EEPROM Fail</b> |
| Value             | 31                 |
| Short description |                    |

EEPROM Fail trip indicates that default parameters have been loaded because of the reasons given below.

| Sub-trip | Reason   |
|----------|--|
| 1        | The most significant digit of the internal parameter database version number has changed.  |
| 2        | The CRC's applied to the parameter data stored in internal non-volatile memory indicate that a valid set of parameters cannot be loaded.                               |
| 3        | The drive mode restored from internal non-volatile memory is outside the allowed range for the product or the derivative image does not allow the previous drive mode. |
| 4        | The drive derivative image has been changed and it has changed the customisation of the drive core menus.  |
| 5        | The power stage hardware has been change and changed the customisation of the drive core menus.  |
| 6        | The internal I/O hardware has been change and changed the customisation of the drive core menus.   |
| 7        | The position feedback interface hardware has been change and changed the customisation of the drive core menus.  |
| 8        | The control board hardware has been change and changed the customisation of the drive core menus.  |
| 9        | The checksum on the non-parameter area of the EEPROM has failed.   |

The drive holds two banks of user save parameters and two banks of power down save parameters in non-volatile memory. If the last bank of either set of parameters that was saved is corrupted a *User Save* or *Power Down Save* trip is produced. If one of these trips occurs the parameters values that were last saved successfully are used. It can take some time to save parameters when requested by the user and if the power is removed from the drive during this process it is possible to corrupt the data in the non-volatile memory.

If both banks of user save parameters or both banks of power down save parameters are corrupted or one of the other conditions given in the table above occurs *EEPROM Fail.xxx* trip is produced. If this trip occurs it is not possible to use the data that has been saved previously, and so the drive will be in lowest allowed drive mode with default parameters. The trip can only be reset if *Parameter mm.000* (mm.000) is set to 10, 11, 1233 or 1244 or if *Load Defaults* (11.043) is set to a non-zero value.

**Recommended actions:**

- Default the drive and perform a drive reset.
- Allow sufficient time to perform a save before the supply to the drive is removed.
- If the trip persists, return drive to the supplier.

|                   |                  |
|-------------------|------------------|
| <b>Trip</b>       | <b>Encoder 1</b> |
| Value             | 189              |
| Short description |                  |

Drive position feedback interface power supply overloaded. Terminals 13 & 14 of the 15 way D-type connector can supply a maximum current of 200mA at 15V or 300mA at 5V.

**Recommended actions:**

- Check encoder power supply wiring.
- Disable the termination resistors (*P1 Termination Select* (03.039) set to 0) to reduce current consumption.
- For 5V encoders with long cables, select 8V (*P1 Supply Voltage* (03.036)) and fit a 5V voltage regulator close to the encoder.
- Check the encoder specification to confirm it is compatible with the encoder port power supply current capability.
- Replace the encoder.
- Use an external power supply with higher current capability.

|                   |                  |
|-------------------|------------------|
| <b>Trip</b>       | <b>Encoder 2</b> |
| Value             | 190              |
| Short description |                  |

There is a wire break between the drive and the position feedback device. These trips are provided for the P1 position feedback interface only and the exact cause of the trip can be identified from the sub-trip number as given below.

| Sub-trip | Signals   |
|----------|---|
| 1        | Resolver or SIN COS sine wave signals                   |
| 11       | Digital incremental A signal                            |
| 12       | Digital incremental B signal                            |
| 13       | Digital incremental Z signal                            |
| 14       | SC SC device single turn sine wave commutation signals. |
| 15       | SC SC device marker                                     |

This trip can occur if the position feedback device type selected in *P1 Device Type* (03.038) is not correct for the position feedback device connected to the drive.

**Recommended actions:**

- Ensure that the position feedback device type selected in *P1 Device Type* (03.038) is correct for the position feedback device connected to the P1 interface on the drive.

- If wire break detection on the drive encoder input is not required, set bit 0 of *P1 Error Detection Level* (03.040) to 0 to disable the Encoder 2 trip.
- If the trip is due to the digital incremental Z (marker signal) this is often not connected. Check that this trip is disabled by setting *P1 Termination Select* (03.039) to a value that disables the termination on this input, which will disable hardware wire break detection.
- Check cable continuity.
- Check wiring of feedback signals is correct.
- Check encoder power supply is set correctly (*P1 Supply Voltage* (03.036)).
- Replace the encoder.

| Trip              | Encoder 3 |
|-------------------|-----------|
| Value             | 191       |
| Short description |           |

The drive has detected an incorrect UVW phase angle while running (RFC-S mode only) or SINCOS phase error. The feedback device which has caused the trip can be identified by the sub-trip number.

| Sub-trip | Reason                              |
|----------|-------------------------------------|
| 1        | Drive position feedback interface 1 |
| 2        | Drive position feedback interface 2 |

**Recommended actions:**

- Check encoder shield connections.
- Ensure the encoder cable is one uninterrupted cable.
- Check the encoder signal for noise with an oscilloscope.
- Check the integrity of the encoder mechanical mounting.
- For a UVW servo encoder, ensure that the phase rotation of the UVW commutation signals is the same as the phase rotation of the motor.
- For a SINCOS encoder, ensure that motor and incremental SINCOS connections are correct and that for forward rotation of the motor, the encoder rotates clockwise (when looking at the shaft of the encoder).
- Repeat the offset measurement test.

| Trip              | Encoder 4 |
|-------------------|-----------|
| Value             | 192       |
| Short description |           |

This trip indicates that the encoder communications has timed out or the communications position message transfer time is too long. This trip can also be caused due to a wire break in the communication channel between the drive and the encoder. The feedback device which has caused the trip can be identified by the sub-trip number.

| Sub-trip | Reason                              |
|----------|-------------------------------------|
| 1        | Drive position feedback interface 1 |
| 2        | Drive position feedback interface 2 |

**Recommended actions:**

- Ensure the encoder power supply setting (*P1 Supply Voltage* (03.036)) is correct.
- Complete encoder auto-configuration (*P1 Auto-configuration Select* (03.041) = Enabled).
- Check the encoder wiring.
- Replace the feedback device.

| Trip              | Encoder 5 |
|-------------------|-----------|
| Value             | 193       |
| Short description |           |

This trip indicates that there is a checksum or CRC error, or the SSI encoder is not ready. The Encoder 5 trip can also indicate a wire break to a communications based encoder.

| Sub-trip | Reason                              |
|----------|-------------------------------------|
| 1        | Drive position feedback interface 1 |
| 2        | Drive position feedback interface 2 |

**Recommended actions:**

- Check the encoder cable shield connections.
- Ensure the cable is one uninterrupted cable - remove any connector blocks or if unavoidable minimise the length of any shield pigtailed to the connector block.
- Check the encoder signal for noise with an oscilloscope.
- Check *P1 Comms Bits* (03.035).
- If using a HiPerface, EnDat or BiSS encoder, carry out an encoder auto-configuration (*P1 Auto-configuration Select* (03.041) = Enabled).
- Replace the encoder.

| Trip              | Encoder 6 |
|-------------------|-----------|
| Value             | 194       |
| Short description |           |

This trip indicates that the encoder has indicated an error or that the power supply has failed to an SSI encoder. This trip can also indicate a wire break to an SSI encoder.

| Sub-trip | Reason                              |
|----------|-------------------------------------|
| 1        | Drive position feedback interface 1 |
| 2        | Drive position feedback interface 2 |

**Recommended actions:**

- For SSI encoders, check the wiring and encoder power supply setting (*P1 Supply Voltage* (03.036)).
- For BiSS encoders this trip will often occur if *P1 Comms Bits* (03.035) is not set correctly because a position or CRC bit may be read instead of the /Error bit.
- For SC Hiperface encoders this trip indicates that the encoder is detecting an error.
- Replace the encoder / contact the supplier of the encoder.

| Trip              | Encoder 7 |
|-------------------|-----------|
| Value             | 195       |
| Short description |           |

A set-up parameter for the position feedback device has been changed. See *P1 Error Detection Level* (03.040).

| Sub-trip | Reason                              |
|----------|-------------------------------------|
| 1        | Drive position feedback interface 1 |
| 2        | Drive position feedback interface 2 |

| Trip              | Encoder 8 |
|-------------------|-----------|
| Value             | 196       |
| Short description |           |

This trip indicates that the position feedback interface communications time exceeds 250µs. The feedback device which has caused the trip can be identified by the sub-trip number.

| Sub-trip | Reason                              |
|----------|-------------------------------------|
| 1        | Drive position feedback interface 1 |
| 2        | Drive position feedback interface 2 |

**Recommended actions:**

- Ensure the encoder is connected correctly.
- Ensure that the encoder is compatible.
- Increase baud rate.

| Trip              | Encoder 9 |
|-------------------|-----------|
| Value             | 197       |
| Short description |           |

- This indicates that the position feedback selected from an option slot that does not contain a position feedback category option module.

**Recommended action:**

- Check the setting of *Motor Control Feedback Select* (03.026) (or *M2 Motor Control Feedback Select* (21.021) if the second motor parameters have been enabled).
- Ensure that the option slot selected in *Motor Control Feedback Select* (03.026) has a feedback option module installed.

| Trip              | Encoder 12 |
|-------------------|------------|
| Value             | 162        |
| Short description |            |

This trip indicates that the drive is communicating with the encoder but the encoder type is not recognised.

| Sub-trip | Reason                              |
|----------|-------------------------------------|
| 1        | Drive position feedback interface 1 |
| 2        | Drive position feedback interface 2 |

**Recommended actions:**

- Enter the encoder setup parameters manually.
- Check to see if the encoder supports auto-configuration.

| Trip              | Encoder 13 |
|-------------------|------------|
| Value             | 163        |
| Short description |            |

This trip indicates that the data read from the encoder was out of range during auto-configuration. No parameters will be modified with data read from the encoder as a result of auto-configuration. The tens in the sub-trip number indicate the interface number (i.e. 1 for P1 interface and 2 for P2 interface).

| Sub-trip | Reason                                 |
|----------|--|
| x1       | Rotary lines per revolution error      |
| x2       | Linear comms pitch error               |
| x3       | Linear line pitch error                |
| x4       | Rotary turns bits error                |
| x5       | Communications bits error              |
| x6       | Calculation time is too long           |
| x7       | Line delay measured is longer than 5µs |

**Recommended actions:**

- Enter the encoder setup parameters manually.
- Check to see if the encoder supports auto-configuration.

| Trip              | Encoder 14 |
|-------------------|------------|
| Value             | 164        |
| Short description |            |

The data given in the additional configuration parameter for a position feedback interface is out of range. If the sub-trip number is one then the data is out of range in *P1 Additional Configuration* (03.074), or if the sub-trip number is 2 the data is out of range in *P2 Additional Configuration* (03.174). Not all position feedback devices use the additional configuration, but those that do are listed below.

#### BiSS

Range checking is applied to the turns padding (decimal digits 5-3) and position padding (decimal digits 2-0). If these give a padding value outside +/-16 then the trip is initiated. Note that in each case the most significant digit indicates left (0) or right (1) padding, and the least significant 2 digits indicate the number of bits.

| Trip              | External Trip |
|-------------------|---------------|
| Value             | 6             |
| Short description |               |

External trip is initiated as shown in the table below.

| Sub-trip | Reason   |
|----------|--|
| 1        | <i>External Trip Mode</i> (08.010) = 1 or 3 and SAFE TORQUE OFF Input 1 is low |
| 2        | <i>External Trip Mode</i> (08.010) = 2 or 3 and SAFE TORQUE OFF Input 2 is low |
| 3        | <i>External Trip</i> (10.032) = 1  |

#### Recommended actions:

- Check the SAFE TORQUE OFF signal voltage on terminal 31 is 24V.
- Check the value of *STO Input 01 State* (08.009) which indicates the digital state of terminal 31.
- If external trip detection of the SAFE TORQUE OFF input is not required, set *External Trip Mode* (08.010) to Off (0).
- Check the value of *External Trip* (10.032).
- Select "Destinations" (or enter 12001) in *Pr mm.000* and check for a parameter controlling *External Trip* (10.032).
- Ensure *External Trip* (10.032) or *User Trip* (10.038) (=6) is not being used by serial comms.

| Trip              | I/O Overload |
|-------------------|--------------|
| Value             | 26           |
| Short description |              |

This trip indicates that the total current drawn from the 24V user supply or from the digital output has exceeded the limit. A trip is initiated if one or more of the following conditions:

- Maximum output current from one digital output is 100mA.
- The combined maximum output current from outputs 1 and 2 is 100mA.
- The combined maximum output current from output 3 and +24V output is 100mA.

#### Recommended actions:

- Check total loads on digital outputs.
- Check control wiring is correct.
- Check output wiring is undamaged.

| Trip              | Inductance |
|-------------------|------------|
| Value             | 8          |
| Short description |            |

This trip occurs in RFC-S mode when the drive has detected that the motor inductances are not suitable for the operation being attempted. The trip is either caused because the ratio or difference between  $L_d$  and  $L_q$  is too small or because the saturation characteristic of the motor cannot be measured.

If the inductance ratio or difference is too small this is because one of the following conditions is true:

$$(No-load L_q (05.072) - L_d (05.024)) / L_d (05.024) < 0.1$$

$$(No-load L_q (05.072) - L_d (05.024)) < (K / Full Scale Current K_c (11.061))H$$

where:

| Drive Rated Voltage (11.033) | K      |
|------------------------------|--------|
| 200V                         | 0.0073 |
| 400V                         | 0.0146 |
| 575V                         | 0.0174 |
| 690V                         | 0.0209 |

If the saturation characteristic of the motor cannot be measured this is because when the flux in the motor is changed the measured value of  $L_d$  does not change sufficiently due to saturation to be measured. When half of *Rated Current* (05.007) is applied in the d axis of the motor in each direction the inductance must change by at least  $(K / (2 \times Full Scale Current K_c (11.061))) H$ .

The specific reasons for each of the sub-trips are given in the table below.

| Sub-trip | Reason  |
|----------|---|
| 1        | The inductance ratio or difference is too small when the drive has been started in sensorless mode.   |
| 2        | The saturation characteristic of the motor cannot be measured when the drive has been started in sensorless mode.   |
| 3        | The inductance ratio or difference is too small when an attempt is made to determine the location of the motor flux during a stationary auto-tune in RFC-S mode. This trip is also produced when the inductance ratio or inductance difference is too small when carrying out a phasing test on starting in RFC-S mode. If position feedback is being used the measured value for <i>Position Feedback Phase Angle</i> (03.025) may not be reliable. Also the measured values of <i>Ld</i> (05.024) and <i>No-load Lq</i> (05.072) may not correspond to the d and q axis respectively. |
| 4        | The direction of the flux in the motor is detected by the change of inductance with different currents. This trip is initiated if the change cannot be detected when an attempt is made to perform a stationary auto-tune when position feedback is being used, or to perform a phasing test on starting in RFC-S mode.   |

| Trip              | <i>Inductor Too Hot</i> |
|-------------------|-------------------------|
| Value             | 93                      |
| Short description |                         |

Regen inductor overload. See *Inductor Thermal Time Constant* (04.015).

| Trip              | <i>Inter-connect</i> |
|-------------------|----------------------|
| Value             | 103                  |
| Short description |                      |

Multi-power module drive interconnection cable error. The sub-trip "xx.0.00" indicates which power module has detected the fault where xx is the power module number. This trip is also initiated if the number of modules present changes from the number of modules detected at power-up. In this case the sub-trip is the number of modules that are still communicating correctly.

| Trip              | <i>Island</i> |
|-------------------|---------------|
| Value             | 160           |
| Short description |               |

This trip indicates that a regen system is connected to an islanded supply. The sub-trips indicate the reason for the trip.

| Sub-trip | Reason  |
|----------|---|
| 1        | Island detection system has been enabled and detected an island condition   |
| 2        | The minimum synchronisation voltage is non-zero and the supply voltage has been below this threshold and been simulating its own supply synchronisation for more than 2.0s. |

**Recommended actions:**

- Check the supply / supply connections to the regen drive.

| Trip              | <i>Keypad Mode</i> |
|-------------------|--------------------|
| Value             | 34                 |
| Short description |                    |

If keypad reference mode is enabled (*Reference Selected Indicator* (01.049) = 4 or 6) (i.e. *Reference Selector* (01.014) is set to 4 or 6 if motor map 1 is selected, or *M2 Reference Selector* (21.003) is set to 4 or 6 if motor map 2 is selected) and the keypad removed, then this trip is initiated.

**Recommended actions:**

- Re-install keypad and reset.
- Change *Reference Selector* (01.014) to select the reference from another source.

| Trip              | <i>Line Sync</i> |
|-------------------|------------------|
| Value             | 39               |
| Short description |                  |

This trip indicates that the inverter has lost the synchronization with the ac supply in Regen mode.

**Recommended actions:**

- Check the supply / supply connections to the regen drive.

| Trip              | <i>Low Load</i> |
|-------------------|-----------------|
| Value             | 38              |
| Short description |                 |

This trip is initiated if the low load detector is set up to produce a trip on low load detection and this condition occurs. See *Enable Trip On Low Load* (04.029).

| Trip              | <i>Motor Too Hot</i> |
|-------------------|----------------------|
| Value             | 20                   |
| Short description |                      |

This trip indicates a motor thermal overload based on the *Rated Current* (05.007) and *Motor Thermal Time Constant 1* (04.015). *Motor Protection Accumulator* (04.019) displays the motor temperature as a percentage of the maximum value. The drive will trip on *Motor Too Hot* when *Motor Protection Accumulator* (04.019) gets to 100%.

**Recommended actions:**

- Ensure the load is not jammed / sticking.
- Check the load on the motor has not changed.
- If seen during an auto-tune test in RFC-S mode, ensure the *Rated Current* (05.007) is = Heavy duty current rating of the drive.
- Tune the *Rated Speed* (05.008) (RFC-A mode only).
- Check feedback signal for noise.
- Ensure the motor rated current is not zero.

| Trip              | Name Plate |
|-------------------|------------|
| Value             | 176        |
| Short description |            |

This trip is initiated if there is a problem detected when an electronic name plate transfer from the motor to the drive is initiated. The reasons for the trip are given below:

| Sub-trip | Reason  | Details  |
|----------|---|--|
| 1        | A communication error with the encoder has been detected.   | It is unlikely that this sub-trip will occur as most encoder errors will cause an encoder trip. It is possible that incorrect data in the nameplate could cause this trip, and so the nameplate data should be verified.   |
| 2        | A data error has been detected in the nameplate. This is either because the number of entries is out of range, i.e. less than 1 or greater than 168, or the calculated CRC does not match the CRC from the nameplate. | Either there is no valid nameplate in the position feedback device or there is a data error in the nameplate area.   |
| 3        | The exchange with the encoder has timed out.  | If the encoder is connected to a drive interface, then this occurs because the encoder is not connected to the drive or is not initialised.<br>If the encoder is connected to an option module interface, then this occurs because the position feedback interface (i.e. P1 or P2) is not present on the option module, or a suitable position feedback device is not selected, or because no device is connected, or it is not initialised. |

| Trip              | None |
|-------------------|------|
| Value             | 0    |
| Short description |      |

No trip has been stored in this position in the trip log.

| Trip              | Oht Brake |
|-------------------|-----------|
| Value             | 101       |
| Short description |           |

This trip indicates that braking IGBT over-temperature has been detected based on firmware thermal model.

**Recommended actions:**

- Check braking resistor value is greater than or equal to the minimum resistance value.

| Trip              | Oht Control |
|-------------------|-------------|
| Value             | 23          |
| Short description |             |

This trip indicates that a control stage over-temperature has been detected. From the sub-trip "xyzz", the cause of the trip can be identified as follows:

| Source         | xx | y | zz  |
|----------------|----|---|---|
| Control system | 00 | 0 | 01: Control board thermistor 1                          |
| Control system | 00 | 0 | 02: Control board thermistor 2                          |
| Control system | 00 | 0 | 03: I/O board thermistor (or brake resistor thermistor) |

**Recommended actions:**

- Check enclosure / drive fans are still functioning correctly.
- Check enclosure ventilation paths.
- Check enclosure door filters.
- Increase ventilation.
- Reduce the drive switching frequency.
- Check ambient temperature.

| Trip              | Oht dc bus |
|-------------------|------------|
| Value             | 27         |
| Short description |            |

This trip indicates a DC bus component over temperature based on a firmware thermal model. The drive includes a thermal protection system to protect the DC bus components within the drive. This includes the effects of the output current and DC bus ripple. The estimated temperature is displayed as a percentage of the trip level in *Percentage Of d.c. Link Thermal Trip Level* (07.035). If this parameter reaches 100% then an *Oht dc bus* trip with sub-trip 200 is initiated. The drive will

attempt to stop the motor before tripping. If the motor does not stop in 10 seconds then the drive trips immediately.

| Source         | xx | y | zz   |
|----------------|----|---|--|
| Control system | 00 | 2 | 00: D.c. link thermal model gives {Oht dc bus} trip with sub-trip 0. |

It is also possible in a multi-power module system for d.c. link over-temperature to be detected from within the power stage. From this source the estimated temperature as a percentage of trip is not available and the trip is indicated as follows:

| Source         | xx | y | zz   |
|----------------|----|---|--|
| Control system | 01 | 0 | 00: Power stage gives {Oht dc bus} trip with sub-trip 0. |

#### Recommended actions:

- Check the AC supply voltage balance and levels.
- Check the DC bus ripple level.
- Reduce duty cycle.
- Reduce motor load.
- Check output current stability. If unstable;
  - Check the motor map settings with motor nameplate (*Rated Frequency* (05.006), *Rated Current* (05.007), *Rated Speed* (05.008), *Rated Voltage* (05.009), *Rated Power Factor* (05.010) and *Number Of Motor Poles* (05.011)) - (All modes).
  - Disable slip compensation (*Enable Slip Compensation* (05.027) = Off (0)) - (Open-loop).
  - Disable dynamic V to F operation (*Dynamic V To F Select* (05.013) = Off (0)) - (Open-loop).
  - Select fixed boost (*Open-loop Control Mode* (05.014) = Fixed (2)) - (Open-loop).
  - Select high stability space vector modulation (*High Stability Space Vector Modulation* (05.019) = On (1)) - (Open-loop).
  - Disconnect the load and complete a rotating auto-tune (*Auto-tune* (05.012) = 2) - (RFC-A and RFC-S).
  - Auto-tune the rated speed value (*Rated Speed Optimisation Select* (05.016) = 1) - (RFC-A and RFC-S).
  - Reduce speed loop gains (*Speed Controller Proportional Gain Kp1* (03.010), *Speed Controller Integral Gain Ki1* (03.011) and *Speed Controller Differential Feedback Gain Kd1* (03.012)) - (RFC-A and RFC-S).
  - Add a speed feedback filter value (*P1 Feedback Filter* (03.042)) - (RFC-A and RFC-S).
  - Add a current demand filter (*Current Reference Filter 1 Time Constant* (04.012)) - (RFC-A and RFC-S).
  - Check encoder signals for noise with an oscilloscope - (RFC-A and RFC-S).
  - Check encoder mechanical coupling - (RFC-A and RFC-S).

| Trip              | Oht Inverter |
|-------------------|--------------|
| Value             | 21           |
| Short description |              |

This trip indicates that an IGBT junction over-temperature has been detected based on a firmware thermal model. The sub-trip indicates which model has initiated the trip in the form xxyzz as given below.

| Source         | xx | y | zz                             |
|----------------|----|---|--------------------------------|
| Control system | 00 | 1 | 00: Inverter thermal model     |
| Control system | 00 | 3 | 00: Braking IGBT thermal model |
| Control system | 00 | 4 | 00: Rectifier thermal model    |

#### Recommended actions with sub-trip 100:

- Reduce the selected drive switching frequency.
- Ensure *Auto-switching Frequency Change* (05.035) is set to Enabled (0).
- Reduce duty cycle.
- Decrease acceleration / deceleration rates.
- Reduce motor load.
- Check the DC bus ripple.
- Ensure all three input phases are present and balanced.

#### Recommended actions with sub-trip 300:

- Reduce the braking load.

#### Recommended actions with sub-trip 400:

- Check the AC supply voltage balance and levels.
- Check the DC bus ripple level.
- Reduce duty cycle.
- Reduce motor load.

| Trip              | Oht Power |
|-------------------|-----------|
| Value             | 22        |
| Short description |           |

This trip indicates that a power stage over-temperature has been detected. The sub-trip "xxyzz" indicates which thermistor is indicating the over-temperature. The thermistor numbering is different for a single module type drive (i.e. no parallel board fitted) and a multi-module type drive (i.e. parallel board fitted with one or more power modules) as shown below:

#### Single module type drive:

| Source       | xx | y                | zz   |
|--------------|----|------------------|--|
| Power system | 01 | 0                | zz: Thermistor location defined by zz in the power board |
| Power system | 01 | Rectifier number | zz: Thermistor location defined by zz in the rectifier   |

**Multi-module type system:**

| Source       | xx                  | y | zz                       |
|--------------|---------------------|---|--------------------------|
| Power system | Power module number | 0 | 01: U phase power device |
| Power System | Power module number | 0 | 02: V phase power device |
| Power system | Power module number | 0 | 03: W phase power device |
| Power system | Power module number | 0 | 04: Rectifier            |
| Power system | Power module number | 0 | 05: General power system |
| Power system | Power module number | 0 | 00: Braking IGBT         |

Note that the power module that has caused the trip cannot be identified except for the braking IGBT temperature measurement

**Recommended actions:**

- Check enclosure / drive fans are still functioning correctly.
- Force the heatsink fans to run at maximum speed.
- Check enclosure ventilation paths.
- Check enclosure door filters.
- Increase ventilation.
- Reduce duty cycle.
- Decrease acceleration / deceleration rates.
- Reduce motor loads.
- Check the derating tables and confirm the drive is correctly sized for the application.
- Use a drive with larger current / power rating.

| Trip              | OI ac |
|-------------------|-------|
| Value             | 3     |
| Short description |       |

This trip indicates that the instantaneous drive output current has exceeded the drive over current threshold.

| Source         | xx                  | y | zz   |
|----------------|---------------------|---|--|
| Control system | 00                  | 0 | 00: Instantaneous over-current trip when the measured a.c. current exceeds over current threshold  |
| Power system   | Power module number | 0 | 00: Instantaneous over-current trip when the measured a.c. current exceeds over current threshold. |

The over current threshold is the maximum current the drive can measure and is defined by VM\_DRIVE\_CURRENT[MAX].

**Recommended actions:**

- Acceleration / deceleration rate is too short.
- If seen during auto-tune reduce the voltage boost.
- Check for short circuit on the output cabling.
- Check integrity of the motor insulation using a Megger.
- Check feedback device wiring.
- Check feedback drive mechanical coupling.
- Check feedback signals are free from noise.
- Check motor cable is within limits for the frame size.
- Reduce the speed loop gains (*Speed Controller Proportional Gain Kp1* (03.010), *Speed Controller Integral Gain Ki1* (03.011), *Speed Controller Differential Feedback Gain Kd1* (03.012)).
- Check that the phase angle auto-tune has been completed (RFC-S mode only).
- Reduce the current loop gains (RFC-A and RFC-S modes only).

| Trip              | OI Brake |
|-------------------|----------|
| Value             | 4        |
| Short description |          |

This trip indicates that an over-current has been detected in braking IGBT or braking IGBT protection has been activated. The braking IGBT over-current trip is detected within the power system. If the drive is a single module drive then there is no sub-trip. If the drive is a multi-power module drive the following sub-trip is used to indicate the source of the trip.

| Source       | xx                  | y | zz   |
|--------------|---------------------|---|--|
| Power system | Power module number | 0 | 00: Braking IGBT instantaneous over-current trip |

**Recommended actions:**

- Check brake resistor wiring.
- Check braking resistor value is greater than or equal to the minimum resistance value.
- Check braking resistor insulation.



|                   |              |
|-------------------|--------------|
| <b>Trip</b>       | <b>OI dc</b> |
| Value             | 109          |
| Short description |              |

This trip indicates that the short circuit protection for the drive output stage has been activated. The table below shows where the trip has been detected.

|                |                     |          |           |
|----------------|---------------------|----------|-----------|
| <b>Source</b>  | <b>xx</b>           | <b>y</b> | <b>zz</b> |
| Control system | 00                  | 0        | 00        |
| Power system   | Power module number | 0        | 00        |

**Recommended actions:**

- Disconnect the motor cable at the drive end and check the motor and cable insulation with a Megger.
- Replace the drive.

|                   |                   |
|-------------------|-------------------|
| <b>Trip</b>       | <b>OI Snubber</b> |
| Value             | 92                |
| Short description |                   |

This trip indicates that an over-current condition has been detected in the rectifier snubbing circuit, The exact cause of the trip can be identified by the sub-trip number.

|               |           |                   |   |
|---------------|-----------|-------------------|---|
| <b>Source</b> | <b>xx</b> | <b>y</b>          | <b>zz</b>   |
| Power system  | 01        | Rectifier number* | 00: Rectifier snubber over-current trip detected. |

\*For a parallel power-module system the rectifier number will be one as it is not possible to determine which rectifier has detected the fault.

**Recommended actions:**

- Ensure the internal EMC filter is installed.
- Ensure the motor cable length does not exceed the maximum for selected switching frequency.
- Check for supply voltage imbalance.
- Check for supply disturbance such as notching from a DC drive.
- Check the motor and motor cable insulation with a Megger.
- Fit an output line reactor or sinusoidal filter.

|                   |                       |
|-------------------|-----------------------|
| <b>Trip</b>       | <b>Option Disable</b> |
| Value             | 215                   |
| Short description |                       |

During drive mode changeover option modules must acknowledge that they have stopped accessing the communications system between the option slots and the drive. If an option module does not do this in the allowed time then this trip is produced.

**Recommended actions:**

- Reset the trip.
- If the trip persists, replace the option module.

|                   |                       |
|-------------------|-----------------------|
| <b>Trip</b>       | <b>Out Phase Loss</b> |
| Value             | 98                    |
| Short description |                       |

This trip indicates that phase loss has been detected at the drive output.

| Sub-trip | Reason   |
|----------|--|
| 1        | U phase output not connected when drive is enabled*  |
| 2        | V phase output not connected when drive is enabled*  |
| 3        | W phase output not connected when drive is enabled*  |
| 4        | Output phase loss detected when the drive is running |
| 5        | U phase lower IGBT failure detection on drive enable |
| 6        | V phase lower IGBT failure detection on drive enable |
| 7        | W phase lower IGBT failure detection on drive enable |

\*These sub-trips could also indicate that the upper IGBT has failed in the indicated phase.

Note that if *Reverse Output Phase Sequence* (05.042) = 1 the physical output phases are reversed, and so sub-trip 3 refers to physical output phase V and sub-trip 2 refers to physical output phase W.

**Recommended actions:**

- Check motor and drive connections.
- To disable the trip set *Output Phase Loss Detection Enable* (06.059) to zero.

|                   |                   |
|-------------------|-------------------|
| <b>Trip</b>       | <b>Over Speed</b> |
| Value             | 7                 |
| Short description |                   |

In open-loop mode, if the *Output Frequency* (05.001) exceeds the threshold set in *Over Speed Threshold* (03.008) in either direction, an *Over Speed* trip is

produced. In RFC-A and RFC-S modes, if the *Speed Feedback* (03.002) exceeds the threshold set in *Over Speed Threshold* (03.008) in either direction, an *Over Speed* trip is produced. If *Over Speed Threshold* (03.008) is set to 0.0 the threshold is then equal to 1.2 x the value set in *Maximum Reference Clamp* (01.006).

In RFC-A and RFC-S modes if an SSI encoder is being used and *P1 SSI Incremental Mode* (03.047) is set to Off, an *Over Speed* trip will be produced when the encoder passes through the boundary between its maximum position and zero.

**Recommended actions:**

- Reduce the *Speed Controller Proportional Gain Kp1* (03.010) to reduce the speed overshoot (RFC-A and RFC-S modes only).
- If an SSI encoder is being used, set *P1 SSI Incremental Mode* (03.047) to On.

The above description relates to a standard over speed trip, however in RFC-S mode it is possible to produce an Overspeed trip with sub-trip 1. This is caused if the speed is allowed to exceed the safe level in RFC-S mode with flux weakening. See *Enable High Speed Mode* (05.022) for details.

| Trip              | Over Volts |
|-------------------|------------|
| Value             | 2          |
| Short description |            |

This trip indicates that the DC bus voltage has exceeded VM\_DC\_VOLTAGE[MAX] or VM\_DC\_VOLTAGE\_SET[MAX] for 15s. The trip threshold varies depending on voltage rating of the drive as shown below.

| Voltage rating | VM_DC_VOLTAGE[MAX] | VM_DC_VOLTAGE_SET[MAX] |
|----------------|--------------------|------------------------|
| 200            | 415                | 410                    |
| 400            | 830                | 815                    |
| 575            | 990                | 970                    |
| 690            | 1190               | 1175                   |

The exact cause of the trip can be identified by the sub-trip number.

| Source         | xx | y | zz   |
|----------------|----|---|--|
| Control system | 00 | 0 | 01: Instantaneous trip when the d.c. link voltage exceeds VM_DC_VOLTAGE[MAX].                |
| Control system | 00 | 0 | 02: Time delayed trip indicating that the d.c. link voltage is above VM_DC_VOLTAGE_SET[MAX]. |

**Recommended actions:**

- Increase deceleration ramp.
- Decrease the braking resistor value (staying above the minimum value).
- Check nominal AC supply level.
- Check for supply disturbances which could cause the DC bus level to rise.
- Check motor insulation using a Megger.

| Trip              | Phase Loss |
|-------------------|------------|
| Value             | 32         |
| Short description |            |

This trip indicates that the drive has detected an input phase loss or large supply imbalance. Phase loss can be detected directly from the supply where the drive has a thyristor base charge system (Frame size 7 and above). If phase loss is detected using this method the drive trips immediately and the xx part of the sub-trip is set to 01. In all sizes of drive phase loss is also detected by monitoring the ripple in the d.c. link voltage in which case the drive attempts to stop the drive before tripping unless bit 2 of *Action On Trip Detection* (10.037) is set to one. When phase loss is detected by monitoring the ripple in the d.c. link voltage the xx part of the sub-trip is zero.

| Source           | xx | y                    | zz   |
|------------------|----|----------------------|--|
| Control system   | 00 | 0                    | 00: Phase loss detected from d.c. link ripple    |
| Power system (1) | 01 | Rectifier number (2) | 00: Phase loss detected directly from the supply |

(1) Input phase loss detection can be disabled when the drive required to operate from the DC supply or from a single phase supply in *Input Phase Loss Detection Mode* (06.047).

(2) For a parallel power-module system the rectifier number will be one as it is not possible to determine which rectifier has detected the fault.

This trip does not occur in regen mode.

**Recommended actions:**

- Check that the input power supply connections are good and tightened correctly.
- Check the AC supply voltage balance and level at full load.
- Check the DC bus ripple level with an isolated oscilloscope.
- Check the output current stability.
- Reduce the duty cycle.
- Reduce the motor load.
- Disable the phase loss detection by setting *Input Phase Loss Detection Mode* (06.047) to Disabled.

| Trip              | Power Comms |
|-------------------|-------------|
| Value             | 90          |
| Short description |             |

A Power Comms trip indicates a communications problem within the power system of the drive. The reason for the trip can be identified by the sub-trip number.

| Type of drive              | xx | y                 | zz  |
|----------------------------|----|-------------------|---|
| Single power module system | 01 | Rectifier number* | 00: Excessive communications errors detected by the rectifier module. |

\*For a parallel power-module system the rectifier number will be one as it is not possible to determine which rectifier has detected the fault.

**Recommended actions:**

- Hardware fault - contact the supplier of the drive.

| Trip              | Power Data |
|-------------------|------------|
| Value             | 220        |
| Short description |            |

This trip can be generated either from the drive control system or from the power system.

This trip is produced if there is an error in the configuration data stored in the power system. If the source of the trip is the control system then the trip related to the table that is uploaded from the power system at power-up.

| Source         | xx | y | zz   |
|----------------|----|---|--|
| Control system | 00 | 0 | 02: There is no data table to be uploaded to the control board.  |
| Control system | 00 | 0 | 03: The power system data table is bigger than the space available in the control pod to store it.   |
| Control system | 00 | 0 | 04: The size of the table given in the table is incorrect  |
| Control system | 00 | 0 | 05: Table CRC error.   |
| Control system | 00 | 0 | 06: The version number of the generator software that produced the table is too low, i.e. a table from a newer generator is required that includes features that have been added to the table that may not be present. |
| Control system | 00 | 0 | 07: The power board data table does not match the power board hardware identifier.   |
| Power system   | 01 | 0 | 00: The power data table used internally by the power module has an error. (For a multi-power module drive this indicates any error with the code tables in the power system.)   |
| Power system   | 01 | 0 | 01: The power data table that should be uploaded to the control system on power up has an error.   |
| Power system   | 01 | 0 | 02: The power data table used internally by the power module does not match the hardware identification of the power module.   |

**Recommended actions:**

- Hardware fault - contact the supplier of the drive.

| Trip              | Power Down Save |
|-------------------|-----------------|
| Value             | 37              |
| Short description |                 |

This trip indicates that an error has been detected in the power down save parameters stored in non-volatile memory.

**Recommended actions:**

- Perform a 1001 save in Pr *mm.000* to ensure that the trip doesn't occur the next time the drive is powered up.

| Trip              | PSU |
|-------------------|-----|
| Value             | 5   |
| Short description |     |

This trip indicates that one or more internal power supply rails are outside limits or overloaded.

| Source         | xx                  | Y                 | zz  |
|----------------|---------------------|-------------------|---|
| Control system | 00                  | 0                 | 00: Internal power supply overload.           |
| Power system   | Power module number | Rectifier number* | 00: Rectifier internal power supply overload. |

\*For a parallel power-module system the rectifier number will be zero as it is not possible to determine which rectifier has detected the fault.

**Recommended actions:**

- Remove any option modules and perform a reset.
- Remove encoder connection and perform a reset.
- Hardware fault within the drive - return the drive to the supplier.

| Trip              | PSU 24V |
|-------------------|---------|
| Value             | 9       |
| Short description |         |

The total user load of the drive and option modules has exceeded the internal 24V power supply limit. The user load consists of the drive digital outputs and main

encoder supply.

**Recommended actions:**

- Reduce the load and reset.
- Provide an external 24V power supply on control terminal 2.
- Remove all option modules.

| Trip              | <i>Rating Mismatch</i> |
|-------------------|------------------------|
| Value             | 223                    |
| Short description |                        |

This trip indicates that there is a voltage rating or current rating mismatch in a multi-module drive system. This trip is only applicable to modular drives that are connected in parallel. A mixture of power modules with different voltage or current ratings within the same multi-module drive system is not allowed and will cause a *Rating Mismatch* trip.

**Recommended actions:**

- Ensure that all modules in a multi-modular drive system are of the same frame size and rating (voltage and current).
- Hardware fault - contact the supplier of the drive.

| Trip              | <i>Rectifier Set-up</i> |
|-------------------|-------------------------|
| Value             | 94                      |
| Short description |                         |

A rectifier has not been set-up correctly in a multi-power module system.

**Recommended actions:**

- Check the inter-power module wiring

| Trip              | <i>Reserved 001</i> |
|-------------------|---------------------|
| Value             | 1                   |
| Short description |                     |

This trip value is used in Unidrive SP for an under voltage trip. The under voltage condition is now a drive state, and so this trip is no longer used by the drive.

| Trip              | <i>Reserved 095</i> |
|-------------------|---------------------|
| Value             | 95                  |
| Short description |                     |

Reserved trip number.

| Trip              | <i>Reserved 104</i> |
|-------------------|---------------------|
| Value             | 104                 |
| Short description |                     |

Reserved trip number.

| Trip              | <i>Reserved 105</i> |
|-------------------|---------------------|
| Value             | 105                 |
| Short description |                     |

Reserved trip number.

| Trip              | <i>Reserved 106</i> |
|-------------------|---------------------|
| Value             | 106                 |
| Short description |                     |

Reserved trip number.

| Trip              | <i>Reserved 107</i> |
|-------------------|---------------------|
| Value             | 107                 |
| Short description |                     |

Reserved trip number.

| Trip              | <i>Reserved 108</i> |
|-------------------|---------------------|
| Value             | 108                 |
| Short description |                     |

Reserved trip number.

| Trip              | <i>Reserved 161</i> |
|-------------------|---------------------|
| Value             | 161                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 165</b> |
| Value             | 165                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 166</b> |
| Value             | 166                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 167</b> |
| Value             | 167                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 168</b> |
| Value             | 168                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 171</b> |
| Value             | 171                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 172</b> |
| Value             | 172                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 173</b> |
| Value             | 173                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 222</b> |
| Value             | 222                 |
| Short description |                     |

If this trip occurs please consult the drive supplier.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 228</b> |
| Value             | 228                 |
| Short description |                     |

If this trip occurs please consult the drive supplier.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 229</b> |
| Value             | 229                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 230</b> |
| Value             | 230                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 231</b> |
| Value             | 231                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 232</b> |
| Value             | 232                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 233</b> |
| Value             | 233                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 234</b> |
| Value             | 234                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 235</b> |
| Value             | 235                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 236</b> |
| Value             | 236                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 237</b> |
| Value             | 237                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 238</b> |
| Value             | 238                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 239</b> |
| Value             | 239                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 240</b> |
| Value             | 240                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 241</b> |
| Value             | 241                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 242</b> |
| Value             | 242                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 243</b> |
| Value             | 243                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 244</b> |
| Value             | 244                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 245</b> |
| Value             | 245                 |
| Short description |                     |

Reserved trip number.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>Reserved 246</b> |
| Value             | 246                 |
| Short description |                     |

Reserved trip number.

|                   |              |
|-------------------|--------------|
| <b>Trip</b>       | <b>Reset</b> |
| Value             | 100          |
| Short description |              |

This is not a valid trip number as this value is used in *User Trip* (10.038) to reset the drive.

|                   |                   |
|-------------------|-------------------|
| <b>Trip</b>       | <b>Reset Logs</b> |
| Value             | 255               |
| Short description |                   |

This is not a valid trip number as this value is used in *User Trip* (10.038) to reset the trip logs.

|                   |                   |
|-------------------|-------------------|
| <b>Trip</b>       | <b>Resistance</b> |
| Value             | 33                |
| Short description |                   |

This trip indicates that either the value being used for motor stator resistance is too high or that an attempt to do a test involving measuring motor stator resistance has failed. The maximum for the stator resistance parameters is generally higher than the maximum value that can be used in the control algorithms. If the value exceeds  $(V_{FS} / \sqrt{2}) / \text{Full Scale Current } Kc$  (11.061), where  $V_{FS}$  is the full scale d.c. link voltage defined by VM\_DC\_VOLTAGE, then this trip is initiated. If the value is the result of a measurement made by the drive then sub-trip 1 is applied, or if it is because the parameter has been changed by the user then sub-trip 3 is applied. During the stator resistance section of auto-tuning an additional test is performed to measure the drive inverter characteristics to provide the compensation necessary for dead-times. If the inverter characteristic measurement fails then sub-trip 2 is applied.

| Sub-trip | Reason   |
|----------|--|
| 1        | Measured stator resistance exceeded the allowed range  |
| 2        | It was not possible to measure the inverter characteristic                                       |
| 3        | The stator resistance associated with the presently selected motor map exceeds the allowed range |

**Recommended actions:**

- Check that a value has not been entered in the stator resistance for the presently selected motor map does not exceed the allowed range.
- Check the motor cable / connections.
- Check the integrity of the motor stator winding using an insulation tester.
- Check the motor phase to phase resistance at the drive terminals.
- Check the motor phase to phase resistance at the motor terminals.
- Ensure the stator resistance of the motor falls within the range of the drive model.
- Select fixed boost mode (*Open-loop Control Mode* (05.014) = Fixed) and verify the output current waveforms with an oscilloscope.
- Replace the motor.

|                   |                        |
|-------------------|------------------------|
| <b>Trip</b>       | <b>Slot1 Different</b> |
| Value             | 204                    |
| Short description |                        |

If the option module fitted in option slot 1 is different to the option module present at the last power-down then this trip is produced. The sub-trip number gives the identification code of the module that was originally fitted. The priority order for the option module different trips is *Slot1 Different* highest, then *Slot2 Different*, then *Slot3 Different* then *Slot4 Different*. Drive user parameters must be saved to prevent this trip on the next power-up if the module has changed. If the menus have been changed, but not the module, the trip will not occur on the next power-up. The sub-trip number gives the following indications of the reason for the trip.

| Sub-trip | Reason  |
|----------|---|
| 1        | No module was fitted previously   |
| 2        | A module with the same identifier is fitted, but the set-up menu for this option slot has been changed, and so default parameters have been loaded for this menu.                     |
| 3        | A module with the same identifier is fitted, but the applications menu for this option slot has been changed, and so default parameters have been loaded for this menu.               |
| 4        | A module with the same identifier is fitted, but the set-up and applications menu for this option slot have been changed, and so default parameters have been loaded for these menus. |
| >99      | Shows the identifier of the module previously fitted.   |

**Recommended actions:**

- Turn off the power, ensure the correct option modules are installed in the correct option slots and re-apply the power.
- Confirm that the currently installed option module is correct, ensure option module parameters are set correctly and perform a user save in Pr mm.000.

|                   |                    |
|-------------------|--------------------|
| <b>Trip</b>       | <b>Slot1 Error</b> |
| Value             | 202                |
| Short description |                    |

The option module in option slot 1 has indicated an error. The option module can give the reason for the error and this is shown in the sub-trip number. As default the sub-trip number is shown as a number on the display, however, it is possible for the option module to supply sub-trip number strings which will be displayed instead of the number if available.

**Recommended actions:**

- See relevant *Option Module User Guide* for details of the trip.

|                   |                 |
|-------------------|-----------------|
| <b>Trip</b>       | <b>Slot1 HF</b> |
| Value             | 200             |
| Short description |                 |

This trip indicates that there is a fault with the option module in option slot 1 that means that this module cannot operate. The possible causes of the trip are given by the sub-trip value.

| Sub-trip | Reason  |
|----------|---|
| 1        | The module category cannot be identified  |
| 2        | All the required customisable menu table information has not been supplied or the tables supplied are corrupt           |
| 3        | There is insufficient memory available to allocate the comms buffers for this module.                                   |
| 4        | The module has not indicated that it is running correctly during drive power-up   |
| 5        | The module has been removed after power-up or it has ceased to indicate to the drive processor that it is still active. |
| 6        | The module has not indicated that it has stopped accessing drive parameters during a drive mode change                  |
| 7        | The module has failed to acknowledge that a request has been made to reset the drive processor.                         |
| 8        | The drive failed to read correctly the menu table from the module during drive power-up.                                |
| 9        | The drive failed to upload menu tables from the module and timed-out (5s).  |
| 10       | Menu table CRC invalid.   |

**Recommended actions:**

- Ensure the option module is installed correctly.
- Replace the option module.
- Replace the drive.

|                   |                         |
|-------------------|-------------------------|
| <b>Trip</b>       | <b>Slot1 Not Fitted</b> |
| Value             | 203                     |
| Short description |                         |

Each option module fitted in the drive is identified at power-up and the option fitted is stored by the drive in its non-volatile memory. If an option module was fitted in slot 1 at power-down, but that option module has subsequently been removed before power up then this trip is produced. The sub-trip number gives the identification code of the option module that has been removed. The priority order for the option module not fitted trips is *Slot1 Not Fitted* highest, then *Slot2 Not Fitted*, then *Slot3 Not Fitted* then *Slot4 Not Fitted*. Drive user parameters must be saved to prevent this trip on the next power-up.

**Recommended actions:**

- Ensure the option module is installed correctly.
- Re-install the option module.
- To confirm that the removed option module is no longer required perform a save function in Pr *mm.000*.

|                   |                       |
|-------------------|-----------------------|
| <b>Trip</b>       | <b>Slot1 Watchdog</b> |
| Value             | 201                   |
| Short description |                       |

This trip indicates that the option module in option slot 1 has started the option watchdog function and then failed to service this watchdog correctly.

**Recommended actions:**

- Replace the option module.



|                   |                        |
|-------------------|------------------------|
| <b>Trip</b>       | <b>Slot2 Different</b> |
| Value             | 209                    |
| Short description |                        |

If the option module fitted in option slot 2 is different to the option module present at the last power-down then this trip is produced. The sub-trip number gives the identification code of the module that was originally fitted. The priority order for the option module different trips is *Slot1 Different* highest, then *Slot2 Different*, then *Slot3 Different* then *Slot4 Different*. Drive user parameters must be saved to prevent this trip on the next power-up if the module has changed. If the menus have been changed, but not the module, the trip will not occur on the next power-up. The sub-trip number gives the following indications of the reason for the trip.

| Sub-trip | Reason  |
|----------|---|
| 1        | No module was fitted previously   |
| 2        | A module with the same identifier is fitted, but the set-up menu for this option slot has been changed, and so default parameters have been loaded for this menu.                     |
| 3        | A module with the same identifier is fitted, but the applications menu for this option slot has been changed, and so default parameters have been loaded for this menu.               |
| 4        | A module with the same identifier is fitted, but the set-up and applications menu for this option slot have been changed, and so default parameters have been loaded for these menus. |
| >99      | Shows the identifier of the module previously fitted.   |

**Recommended actions:**

- Turn off the power, ensure the correct option modules are installed in the correct option slots and re-apply the power.
- Confirm that the currently installed option module is correct, ensure option module parameters are set correctly and perform a user save in Pr *mm.000*.

|                   |                    |
|-------------------|--------------------|
| <b>Trip</b>       | <b>Slot2 Error</b> |
| Value             | 207                |
| Short description |                    |

The option module in option slot 2 has indicated an error. The option module can give the reason for the error and this is shown in the sub-trip number. As default the sub-trip number is shown as a number on the display, however, it is possible for the option module to supply sub-trip number strings which will be displayed instead of the number if available.

**Recommended actions:**

- See relevant *Option Module User Guide* for details of the trip.

|                   |                 |
|-------------------|-----------------|
| <b>Trip</b>       | <b>Slot2 HF</b> |
| Value             | 205             |
| Short description |                 |

This trip indicates that there is a fault with the option module in option slot 2 that means that this module cannot operate. The possible causes of the trip are given by the sub-trip value.

| Sub-trip | Reason  |
|----------|---|
| 1        | The module category cannot be identified  |
| 2        | All the required customisable menu table information has not been supplied or the tables supplied are corrupt           |
| 3        | There is insufficient memory available to allocate the comms buffers for this module.                                   |
| 4        | The module has not indicated that it is running correctly during drive power-up   |
| 5        | The module has been removed after power-up or it has ceased to indicate to the drive processor that it is still active. |
| 6        | The module has not indicated that it has stopped accessing drive parameters during a drive mode change                  |
| 7        | The module has failed to acknowledge that a request has been made to reset the drive processor.                         |
| 8        | The drive failed to read correctly the menu table from the module during drive power-up.                                |
| 9        | The drive failed to upload menu tables from the module and timed-out (5s).  |
| 10       | Menu table CRC invalid.   |

**Recommended actions:**

- Ensure the option module is installed correctly.
- Replace the option module.
- Replace the drive.

|                   |                         |
|-------------------|-------------------------|
| <b>Trip</b>       | <b>Slot2 Not Fitted</b> |
| Value             | 208                     |
| Short description |                         |

Each option module fitted in the drive is identified at power-up and the option fitted is stored by the drive in its non-volatile memory. If an option module was fitted in slot 2 at power-down, but that option module has subsequently been removed before power up then this trip is produced. The sub-trip number gives the identification code of the option module that has been removed. The priority order for the option module not fitted trips is *Slot1 Not Fitted* highest, then *Slot2 Not Fitted*, then *Slot3 Not Fitted* then *Slot4 Not Fitted*. Drive user parameters must be saved to prevent this trip on the next power-up.

**Recommended actions:**

- Ensure the option module is installed correctly.
- Re-install the option module.
- To confirm that the removed option module is no longer required perform a save function in Pr *mm.000*.

|                   |                       |
|-------------------|-----------------------|
| <b>Trip</b>       | <b>Slot2 Watchdog</b> |
| Value             | 206                   |
| Short description |                       |

This trip indicates that the option module in option slot 2 has started the option watchdog function and then failed to service this watchdog correctly.

**Recommended actions:**

- Replace the option module.

|                   |                        |
|-------------------|------------------------|
| <b>Trip</b>       | <b>Slot3 Different</b> |
| Value             | 214                    |
| Short description |                        |

If the option module fitted in option slot 3 is different to the option module present at the last power-down then this trip is produced. The sub-trip number gives the identification code of the module that was originally fitted. The priority order for the option module different trips is *Slot1 Different* highest, then *Slot2 Different*, then *Slot3 Different* then *Slot4 Different*. Drive user parameters must be saved to prevent this trip on the next power-up if the module has changed. If the menus have been changed, but not the module, the trip will not occur on the next power-up. The sub-trip number gives the following indications of the reason for the trip.

| Sub-trip | Reason  |
|----------|---|
| 1        | No module was fitted previously   |
| 2        | A module with the same identifier is fitted, but the set-up menu for this option slot has been changed, and so default parameters have been loaded for this menu.                     |
| 3        | A module with the same identifier is fitted, but the applications menu for this option slot has been changed, and so default parameters have been loaded for this menu.               |
| 4        | A module with the same identifier is fitted, but the set-up and applications menu for this option slot have been changed, and so default parameters have been loaded for these menus. |
| >99      | Shows the identifier of the module previously fitted.   |

**Recommended actions:**

- Turn off the power, ensure the correct option modules are installed in the correct option slots and re-apply the power.
- Confirm that the currently installed option module is correct, ensure option module parameters are set correctly and perform a user save in Pr *mm.000*.

|                   |                    |
|-------------------|--------------------|
| <b>Trip</b>       | <b>Slot3 Error</b> |
| Value             | 212                |
| Short description |                    |

The option module in option slot 3 has indicated an error. The option module can give the reason for the error and this is shown in the sub-trip number. As default the sub-trip number is shown as a number on the display, however, it is possible for the option module to supply sub-trip number strings which will be displayed instead of the number if available.

**Recommended actions:**

- See relevant *Option Module User Guide* for details of the trip.

|                   |                 |
|-------------------|-----------------|
| <b>Trip</b>       | <b>Slot3 HF</b> |
| Value             | 210             |
| Short description |                 |

This trip indicates that there is a fault with the option module in option slot 3 that means that this module cannot operate. The possible causes of the trip are given by the sub-trip value.

| Sub-trip | Reason  |
|----------|---|
| 1        | The module category cannot be identified  |
| 2        | All the required customisable menu table information has not been supplied or the tables supplied are corrupt           |
| 3        | There is insufficient memory available to allocate the comms buffers for this module.                                   |
| 4        | The module has not indicated that it is running correctly during drive power-up   |
| 5        | The module has been removed after power-up or it has ceased to indicate to the drive processor that it is still active. |
| 6        | The module has not indicated that it has stopped accessing drive parameters during a drive mode change                  |
| 7        | The module has failed to acknowledge that a request has been made to reset the drive processor.                         |
| 8        | The drive failed to read correctly the menu table from the module during drive power-up.                                |
| 9        | The drive failed to upload menu tables from the module and timed-out (5s).  |
| 10       | Menu table CRC invalid.   |

**Recommended actions:**

- Ensure the option module is installed correctly.
- Replace the option module.
- Replace the drive.

| Trip              | <b>Slot3 Not Fitted</b> |
|-------------------|-------------------------|
| Value             | 213                     |
| Short description |                         |

Each option module fitted in the drive is identified at power-up and the option fitted is stored by the drive in its non-volatile memory. If an option module was fitted in slot 3 at power-down, but that option module has subsequently been removed before power up then this trip is produced. The sub-trip number gives the identification code of the option module that has been removed. The priority order for the option module not fitted trips is *Slot1 Not Fitted* highest, then *Slot2 Not Fitted*, then *Slot3 Not Fitted* then *Slot4 Not Fitted*. Drive user parameters must be saved to prevent this trip on the next power-up.

**Recommended actions:**

- Ensure the option module is installed correctly.
- Re-install the option module.
- To confirm that the removed option module is no longer required perform a save function in Pr *mm.000*.

| Trip              | <b>Slot3 Watchdog</b> |
|-------------------|-----------------------|
| Value             | 211                   |
| Short description |                       |

This trip indicates that the option module in option slot 3 has started the option watchdog function and then failed to service this watchdog correctly.

**Recommended actions:**

- Replace the option module.

| Trip              | <b>Slot4 Different</b> |
|-------------------|------------------------|
| Value             | 254                    |
| Short description |                        |

If the option module fitted in option slot 4 is different to the option module present at the last power-down then this trip is produced. The sub-trip number gives the identification code of the module that was originally fitted. The priority order for the option module different trips is *Slot1 Different* highest, then *Slot2 Different*, then *Slot3 Different* then *Slot4 Different*. Drive user parameters must be saved to prevent this trip on the next power-up if the module has changed. If the menus have been changed, but not the module, the trip will not occur on the next power-up. The sub-trip number gives the following indications of the reason for the trip.

| Sub-trip | Reason  |
|----------|---|
| 1        | No module was fitted previously   |
| 2        | A module with the same identifier is fitted, but the set-up menu for this option slot has been changed, and so default parameters have been loaded for this menu.                     |
| 3        | A module with the same identifier is fitted, but the applications menu for this option slot has been changed, and so default parameters have been loaded for this menu.               |
| 4        | A module with the same identifier is fitted, but the set-up and applications menu for this option slot have been changed, and so default parameters have been loaded for these menus. |
| >99      | Shows the identifier of the module previously fitted.   |

**Recommended actions:**

- Turn off the power, ensure the correct option modules are installed in the correct option slots and re-apply the power.
- Confirm that the currently installed option module is correct, ensure option module parameters are set correctly and perform a user save in Pr *mm.000*.

| Trip              | Slot4 Error |
|-------------------|-------------|
| Value             | 252         |
| Short description |             |

The option module in option slot 4 has indicated an error. The option module can give the reason for the error and this is shown in the sub-trip number. As default the sub-trip number is shown as a number on the display, however, it is possible for the option module to supply sub-trip number strings which will be displayed instead of the number if available.

**Recommended actions:**

- See relevant *Option Module User Guide* for details of the trip.

| Trip              | Slot4 HF |
|-------------------|----------|
| Value             | 250      |
| Short description |          |

This trip indicates that there is a fault with the option module in option slot 4 that means that this module cannot operate. The possible causes of the trip are given by the sub-trip value.

| Sub-trip | Reason  |
|----------|---|
| 1        | The module category cannot be identified  |
| 2        | All the required customisable menu table information has not been supplied or the tables supplied are corrupt           |
| 3        | There is insufficient memory available to allocate the comms buffers for this module.                                   |
| 4        | The module has not indicated that it is running correctly during drive power-up   |
| 5        | The module has been removed after power-up or it has ceased to indicate to the drive processor that it is still active. |
| 6        | The module has not indicated that it has stopped accessing drive parameters during a drive mode change                  |
| 7        | The module has failed to acknowledge that a request has been made to reset the drive processor.                         |
| 8        | The drive failed to read correctly the menu table from the module during drive power-up.                                |
| 9        | The drive failed to upload menu tables from the module and timed-out (5s).  |
| 10       | Menu table CRC invalid.   |

**Recommended actions:**

- Ensure the option module is installed correctly.
- Replace the option module.
- Replace the drive.

|                   |                         |
|-------------------|-------------------------|
| <b>Trip</b>       | <b>Slot4 Not Fitted</b> |
| Value             | 253                     |
| Short description |                         |

Each option module fitted in the drive is identified at power-up and the option fitted is stored by the drive in its non-volatile memory. If an option module was fitted in slot 4 at power-down, but that option module has subsequently been removed before power up then this trip is produced. The sub-trip number gives the identification code of the option module that has been removed. The priority order for the option module not fitted trips is *Slot1 Not Fitted* highest, then *Slot2 Not Fitted*, then *Slot3 Not Fitted* then *Slot4 Not Fitted*. Drive user parameters must be saved to prevent this trip on the next power-up.

**Recommended actions:**

- Ensure the option module is installed correctly.
- Re-install the option module.
- To confirm that the removed option module is no longer required perform a save function in Pr *mm.000*.

|                   |                       |
|-------------------|-----------------------|
| <b>Trip</b>       | <b>Slot4 Watchdog</b> |
| Value             | 251                   |
| Short description |                       |

This trip indicates that the option module in option slot 4 has started the option watchdog function and then failed to service this watchdog correctly.

**Recommended actions:**

- Replace the option module.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>Slot App Menu</b> |
| Value             | 216                  |
| Short description |                      |

This trip indicates that more than one option slot has requested to customize application menus 18, 19 and 20. The sub-trip number indicates which option slot has been allowed to customize the menus.

**Recommended actions:**

- Ensure that only one of the Application modules is configured to customize the application menus 18, 19 and 20.

|                   |                   |
|-------------------|-------------------|
| <b>Trip</b>       | <b>Soft Start</b> |
| Value             | 226               |
| Short description |                   |

This trip indicates that the soft start relay in the drive has failed to close or the soft start monitoring circuit has failed.

**Recommended actions:**

- Hardware fault - contact the supplier of the drive.

|                   |                  |
|-------------------|------------------|
| <b>Trip</b>       | <b>Stored HF</b> |
| Value             | 221              |
| Short description |                  |

If an HF01 to HF19 trip occurs then a *Stored HF* trip occurs each time the drive is powered up until this trip is reset. The sub-trip code is the number of the original HF trip. The *Stored HF* trip can only be reset by first writing 1299 to Pr *mm.000* and resetting the drive.

**Recommended actions:**

- Enter 1299 into Pr *mm.000* and press reset to clear the trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>Sub-array RAM</b> |
| Value             | 227                  |
| Short description |                      |

An option module, derivative image or user program image has requested more parameter RAM than is allowed. The RAM allocation is checked in order of resulting sub-trip numbers, and so the failure with the highest sub-trip number is given. The sub-trip is calculated as (parameter size x 1000) + (parameter type x 100) + sub-array number. Note that if this trip occurs, all menu customisation provided by option modules, the derivative image or the user program image is not used. The tables below show the values corresponding to the parts of the sub-trip number.

| Parameter size | Value |
|----------------|-------|
| 1 bit          | 1     |
| 8 bit          | 2     |
| 16 bit         | 3     |
| 32 bit         | 4     |
| 64 bit         | 5     |

| Parameter type  | Value |
|-----------------|-------|
| Volatile        | 0     |
| User save       | 1     |
| Power-down save | 2     |

| Sub-array                  | Menus | Value |
|----------------------------|-------|-------|
| Applications menus         | 18-20 | 1     |
| Derivative image           | 29    | 2     |
| User program image         | 30    | 3     |
| Option slot 1 set-up       | 15    | 4     |
| Option slot 1 applications | 25    | 5     |
| Option slot 2 set-up       | 16    | 6     |
| Option slot 2 applications | 26    | 7     |
| Option slot 3 set-up       | 17    | 8     |
| Option slot 3 applications | 27    | 9     |
| Option slot 4 set-up       | 24    | 10    |
| Option slot 4 applications | 28    | 11    |

| Trip              | <i>Temp Feedback</i> |
|-------------------|----------------------|
| Value             | 218                  |
| Short description |                      |

This trip indicates a fault with a thermistor in the drive (i.e. open circuit or short circuit).

| Source        | xx                  | y                 | zz   |
|---------------|---------------------|-------------------|--|
| Control board | 00                  | 00                | 01: Control board thermistor 1<br>02: Control board thermistor 2<br>03: I/O board thermistor:                        |
| Power system  | Power module number | 0                 | Zero for temperature feedback provided via power system comms.<br>21, 22 and 23 for direct ELV temperature feedback. |
| Power system  | 01                  | Rectifier number* | Always zero  |

\*For a parallel power-module system the rectifier number will be one as it is not possible to determine which rectifier has detected the fault.

**Recommended actions:**

- Hardware fault - contact the supplier of the drive.

| Trip              | Th Brake Res |
|-------------------|--------------|
| Value             | 10           |
| Short description |              |

If hardware based braking resistor thermal monitoring is provided and the resistor overheats this trip is initiated. If the braking resistor is not present then this trip must be disabled with bit 3 of *Action On Trip Detection* (10.037) to prevent this trip.

**Recommended actions:**

- Check braking resistor wiring.
- Check braking resistor value is greater than or equal to the minimum resistance value.
- Check braking resistor insulation.

| Trip              | Th Short Circuit |
|-------------------|------------------|
| Value             | 25               |
| Short description |                  |

This trip indicates that a temperature sensor connected to an analogue input or terminal 15 on the position feedback interface has a low impedance (i.e. < 50 Ohms). The cause of the trip can be identified by the sub-trip number.

| Sub-trip | Source                      |
|----------|-----------------------------|
| 1        | Analogue input 1            |
| 2        | Analogue input 2            |
| 3        | Analogue input 3            |
| 4        | Position feedback interface |

**Recommended actions:**

- Check temperature feedback connection.
- Replace sensor.

| Trip              | Thermistor |
|-------------------|------------|
| Value             | 24         |
| Short description |            |

This trip indicates that a temperature sensor connected to one of the analogue inputs or terminal 15 on the position feedback interface (15 way D-type connector) has indicated an over-temperature. The source of the trip can be identified by the sub-trip number.

| Sub-trip | Source                      |
|----------|-----------------------------|
| 1        | Analogue input 1            |
| 2        | Analogue input 2            |
| 3        | Analogue input 3            |
| 4        | Position feedback interface |

**Recommended actions:**

- Check why the temperature measured by the sensor is too high temperature.
- Check temperature sensor connection.

|                   |                  |
|-------------------|------------------|
| <b>Trip</b>       | <b>Undefined</b> |
| Value             | 110              |
| Short description |                  |

This trip indicates that the power system has generated but did not identify the trip from the power system. The cause of the trip is unknown.

**Recommended actions:**

- Hardware fault - contact the supplier of the drive.

|                   |                 |
|-------------------|-----------------|
| <b>Trip</b>       | <b>User 24V</b> |
| Value             | 91              |
| Short description |                 |

This trip is initiated if *User Supply Select* (06.072) = 1 or *Low Under Voltage Threshold Select* (06.067) = 1 or *Backup Supply Mode Enable* (06.068) = 1 and no user 24V present on the user 24V input.

**Recommended actions:**

- Ensure that the user 24V supply is present on the control terminals.

|                   |                       |
|-------------------|-----------------------|
| <b>Trip</b>       | <b>User Prog Trip</b> |
| Value             | 96                    |
| Short description |                       |

This trip can be initiated from within an onboard user program using a function call which defines the sub-trip number.

**Recommended actions:**

- Check the user program.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Program</b> |
| Value             | 249                 |
| Short description |                     |

An error has been detected in the onboard user program image. The sub-trip indicated the reason for the trip.



| Sub-trip | Reason  | Comments   |
|----------|---|--|
| 1        | Divide by zero  |  |
| 2        | Undefined trip  |  |
| 3        | Attempted fast parameter access set-up with non-existent parameter  |  |
| 4        | Attempted access to non-existent parameter  |  |
| 5        | Attempted write to read-only parameter  |  |
| 6        | Attempted an over-range write   |  |
| 7        | Attempted read from write-only parameter  |  |
|          |   |  |
| 30       | The image has failed because either its CRC is incorrect, or there are less than 6 bytes in the image or the image header version is less than 5. | Occurs when the drive powers-up or the image is programmed. The image tasks will not run.  |
| 31       | The image requires more RAM for heap and stack than can be provided by the drive.   | As 30.   |
| 32       | The image requires an OS function call that is higher than the maximum allowed.   | As 30.   |
| 33       | The ID code within the image is not valid   | As 30.   |
|          |   |  |
| 40       | The timed task has not completed in time and has been suspended.  | <i>Onboard User Program: Enable (11.047)</i> is reset to zero when the trip is initiated.  |
| 41       | Undefined function called, i.e. a function in the host system vector table that has not been assigned.  | As 40.   |
|          |   |  |
| 52       | Customisable menu table CRC check failed  | As 30.   |
| 53       | Customisable menu table changed   | Occurs when the drive powers-up or the image is programmed and the table has changed. Defaults are loaded for the user program menu and the trip will keep occurring until drive parameters are saved. |
|          |   |  |
| 80       | *Image is not compatible with the control board   | Initiated from within the image code.  |
| 81       | *Image is not compatible with the control board serial number   | As 80.   |
|          |   |  |
| 100      | Image has detected and prevented attempted pointer access outside of the IEC task's heap area.  |  |
| 101      | Image has detected and prevented misaligned pointer usage.  |  |
|          |   |  |

|     |   |  |
|-----|---|--|
| 102 | Image has detected an array bounds violation and prevented its access.  |  |
| 103 | Image has attempted to convert a data type to or from an unknown data type, has failed and has shut itself down.  |  |
| 104 | Image has attempted to use an unknown user service function.  |  |
|     |   |  |
| 200 | User program has invoked a "divide" service with a denominator of zero. (Note that this is raised by the downloaded image and has therefore been given a distinct error code despite being the same fundamental problem as sub-trip 1.) |  |
| 201 | Parameter access is not supported. An attempt to read database other than the host drive.   |  |
| 202 | Parameter does not exist. Database was host drive but the specified parameter does not exist.   |  |
| 203 | Parameter is read-only.   |  |
| 204 | Parameter is write-only.  |  |
| 205 | Unknown parameter error.  |  |
| 206 | Invalid bit present in parameter. The parameter does not contain the specified bit.   |  |
| 207 | Parameter format lookup failed. Failed to get parameter information data.   |  |
| 208 | An over-range write has been attempted.   |  |

The following table gives the differences when compared to the derivative product image.

| Sub-trip | Difference  |
|----------|---|
| 40, 41   | <i>Onboard User Program: Enable (11.047)</i> is reset to zero when the trip is initiated.   |
| 51       | Not applicable as core menu customisation not allowed   |
| 6x       | Not applicable as option module restrictions not allowed  |
| 7x       | Not applicable as option module restrictions not allowed  |
| 100      | Image has detected and prevented attempted pointer access outside of the IEC task's heap area.  |
| 101      | Image has detected and prevented misaligned pointer usage.  |
| 102      | Image has detected an array bounds violation and prevented its access.  |
| 103      | Image has attempted to convert a data type to or from an unknown data type, has failed and has shut itself down.  |
| 104      | Image has attempted to use an unknown user service function.  |
| 200      | User program has invoked a "divide" service with a denominator of zero. (Note that this is raised by the downloaded image and has therefore been given a distinct error code despite being the same fundamental problem as sub-trip 1.) |

| Trip              | User Save |
|-------------------|-----------|
| Value             | 36        |
| Short description |           |

This trip indicates that an error has been detected in the user save parameters saved in non-volatile memory. For example, following a user save command, if the power to the drive was removed when the user parameters were being saved.

**Recommended actions:**

- Perform a user save in Pr *mm.000* to ensure that the trip doesn't occur the next time the drive is powered up.
- Ensure that the drive has enough time to complete the save before removing the power to the drive.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 40</b> |
| Value             | 40                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 41</b> |
| Value             | 41                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 42</b> |
| Value             | 42                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 43</b> |
| Value             | 43                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 44</b> |
| Value             | 44                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 45</b> |
| Value             | 45                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 46</b> |
| Value             | 46                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 47</b> |
| Value             | 47                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 48</b> |
| Value             | 48                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 49</b> |
| Value             | 49                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 50</b> |
| Value             | 50                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 51</b> |
| Value             | 51                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 52</b> |
| Value             | 52                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 53</b> |
| Value             | 53                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 54</b> |
| Value             | 54                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 55</b> |
| Value             | 55                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 56</b> |
| Value             | 56                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 57</b> |
| Value             | 57                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 58</b> |
| Value             | 58                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 59</b> |
| Value             | 59                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 60</b> |
| Value             | 60                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 61</b> |
| Value             | 61                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 62</b> |
| Value             | 62                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 63</b> |
| Value             | 63                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 64</b> |
| Value             | 64                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 65</b> |
| Value             | 65                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 66</b> |
| Value             | 66                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 67</b> |
| Value             | 67                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 68</b> |
| Value             | 68                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 69</b> |
| Value             | 69                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 70</b> |
| Value             | 70                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 71</b> |
| Value             | 71                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 72</b> |
| Value             | 72                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 73</b> |
| Value             | 73                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 74</b> |
| Value             | 74                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 75</b> |
| Value             | 75                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 76</b> |
| Value             | 76                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 77</b> |
| Value             | 77                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 78</b> |
| Value             | 78                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 79</b> |
| Value             | 79                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 80</b> |
| Value             | 80                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 81</b> |
| Value             | 81                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 82</b> |
| Value             | 82                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 83</b> |
| Value             | 83                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 84</b> |
| Value             | 84                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 85</b> |
| Value             | 85                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 86</b> |
| Value             | 86                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 87</b> |
| Value             | 87                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 88</b> |
| Value             | 88                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                     |
|-------------------|---------------------|
| <b>Trip</b>       | <b>User Trip 89</b> |
| Value             | 89                  |
| Short description |                     |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 112</b> |
| Value             | 112                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 113</b> |
| Value             | 113                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 114</b> |
| Value             | 114                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 115</b> |
| Value             | 115                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 116</b> |
| Value             | 116                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 117</b> |
| Value             | 117                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 118</b> |
| Value             | 118                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 119</b> |
| Value             | 119                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 120</b> |
| Value             | 120                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 121</b> |
| Value             | 121                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 122</b> |
| Value             | 122                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 123</b> |
| Value             | 123                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 124</b> |
| Value             | 124                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 125</b> |
| Value             | 125                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 126</b> |
| Value             | 126                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 127</b> |
| Value             | 127                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 128</b> |
| Value             | 128                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 129</b> |
| Value             | 129                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 130</b> |
| Value             | 130                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 131</b> |
| Value             | 131                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 132</b> |
| Value             | 132                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 133</b> |
| Value             | 133                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 134</b> |
| Value             | 134                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 135</b> |
| Value             | 135                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 136</b> |
| Value             | 136                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 137</b> |
| Value             | 137                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 138</b> |
| Value             | 138                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 139</b> |
| Value             | 139                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.



|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 140</b> |
| Value             | 140                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 141</b> |
| Value             | 141                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 142</b> |
| Value             | 142                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 143</b> |
| Value             | 143                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 144</b> |
| Value             | 144                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 145</b> |
| Value             | 145                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 146</b> |
| Value             | 146                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 147</b> |
| Value             | 147                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 148</b> |
| Value             | 148                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 149</b> |
| Value             | 149                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 150</b> |
| Value             | 150                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 151</b> |
| Value             | 151                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 152</b> |
| Value             | 152                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 153</b> |
| Value             | 153                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 154</b> |
| Value             | 154                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 155</b> |
| Value             | 155                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 156</b> |
| Value             | 156                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 157</b> |
| Value             | 157                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 158</b> |
| Value             | 158                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>User Trip 159</b> |
| Value             | 159                  |
| Short description |                      |

This trip is not used by the drive and can be used for a user trip.

|                   |                      |
|-------------------|----------------------|
| <b>Trip</b>       | <b>Voltage Range</b> |
| Value             | 169                  |
| Short description |                      |

This trip is initiated if the *Regen Minimum Voltage* (03.026) is set to a non-zero value and the supply voltage is outside the range defined by *Regen Maximum Voltage* (03.027) for more than 100ms.

**Recommended actions:**

- Ensure the supply voltage is operating within the drive specification.
- Ensure *Regen Minimum Voltage* (03.026) and *Regen Maximum Voltage* (03.027) are set correctly.
- Check the supply voltage waveform using an oscilloscope.
- Reduce the level of supply disturbance.
- Set *Regen Maximum Voltage* (03.027) to zero to disable this trip.

|                   |                 |
|-------------------|-----------------|
| <b>Trip</b>       | <b>Watchdog</b> |
| Value             | 30              |
| Short description |                 |

This trip indicates that the control word watchdog has been enabled and has timed out.