



*Parameter Reference Guide*

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***Unidrive M600***

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*RFC-S Mode*

# About Parameter Reference Guide

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Issue Number: 01.19.00

Unidrive M600 Firmware Version: V01.19.00.00

Unidrive M600 Project Last Modified: 30-Aug-2018 15:58:03

HTML Generator Version: 3.4.3.23943

## 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 mm.000 (mm.000) 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 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. I is the interface: 1=P1 position feedback interface, 2=P2 position feedback interface. 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. Note: Any parameter changes that have not been saved will be lost during this action.	No action if the drive is enabled. No action if there is no program present. 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. 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. 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. 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.
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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). OR A drive reset with 1001 in <i>Parameter mm.000</i> (mm.000). OR After parameters are transferred from a non-volatile media card. OR After the drive mode is changed. OR After default parameters are loaded. OR 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. OR 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). OR A drive reset with 1001 in <i>Parameter mm.000</i> (mm.000). OR 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). OR After the drive mode is changed. OR 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 (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 (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 RFC-A, RFC-S: 0.000
Range of [MAX]	Open-loop: 0.0 to 3200.0 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 RFC-A, RFC-S: rpm or mm/s
Range of [MIN]	Open-loop: -599.0 to 0.0 RFC-A, RFC-S: -550 x 60 / Motor pole pairs to 0.0
Range of [MAX]	Open-loop: 0.0 to 599.0 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 RFC-A, RFC-S: rpm or mm/s
Range of [MIN]	Open-loop: -599.0 to 0.0 RFC-A, RFC-S: -550 x 60 / Motor pole pairs to 0.0
Range of [MAX]	Open-loop: 0.0 to 599.0 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 RFC-A, RFC-S: rpm or mm/s
Range of [MIN]	Open-loop: 0.0 RFC-A, RFC-S: 0.0
Range of [MAX]	Open-loop: 0.0 to 599.0 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 (500kHz x linear line pitch in mm) mm/s
FD, FR, FD Servo, FR Servo	(500kHz x 60 / rotary lines per revolution)/2 rpm (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 (500kHz x linear line pitch in mm) mm/s
Resolver	30000 rpm* (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 RFC-A, RFC-S: rpm or mm/s
Range of [MIN]	Open-loop: -599.0 to 599.0 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 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 RFC-A, RFC-S: rpm or mm/s
Range of [MIN]	Open-loop: -599.0 to 0.0 RFC-A, RFC-S: -550 x 60 / Motor pole pairs to 0.0
Range of [MAX]	Open-loop: 0.0 to 599.0 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 RFC-A, RFC-S: rpm or mm/s
Range of [MIN]	Open-loop: 0.0 RFC-A, RFC-S: 0.0
Range of [MAX]	Open-loop: 0.0 to 599.0 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 RFC-A, RFC-S: rpm or mm/s
Range of [MIN]	Open-loop: -599.00 to 599.00 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 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

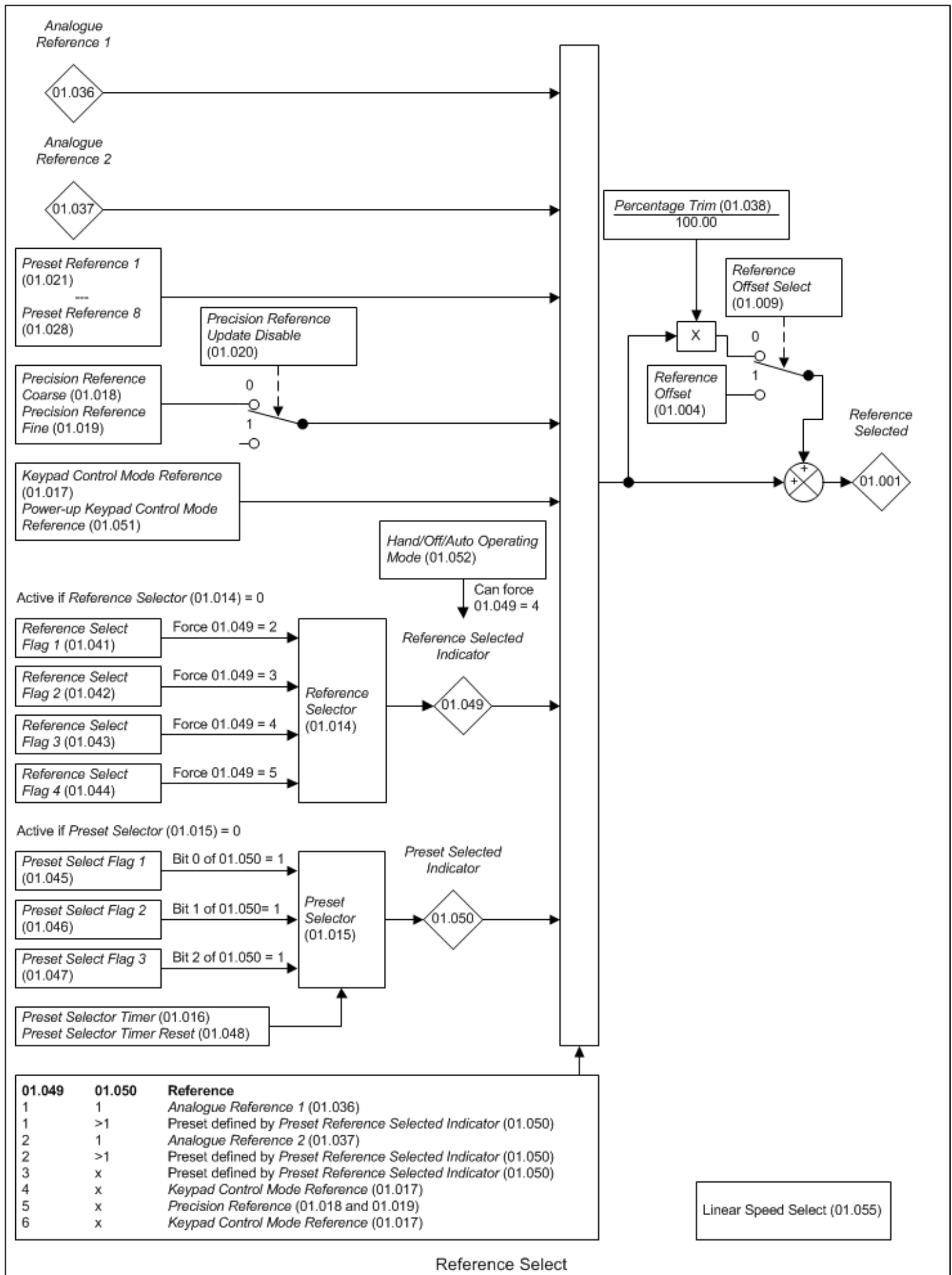
Mode: RFC-S

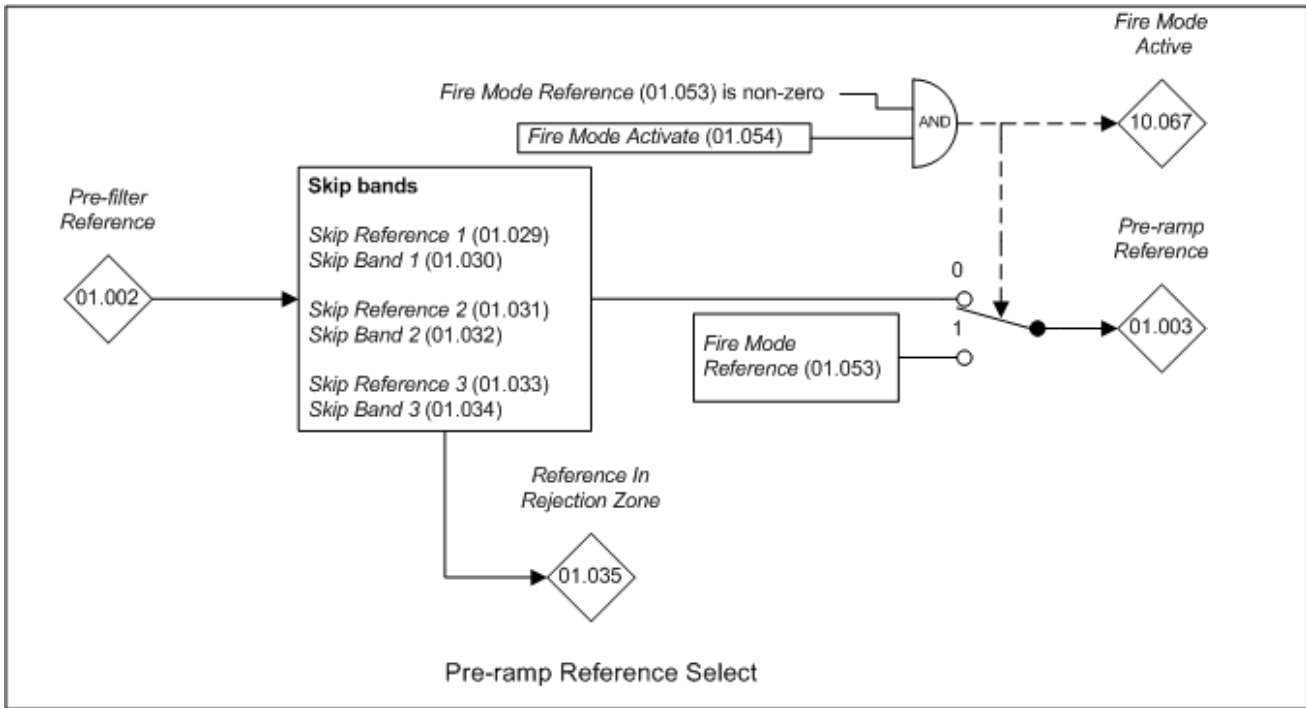
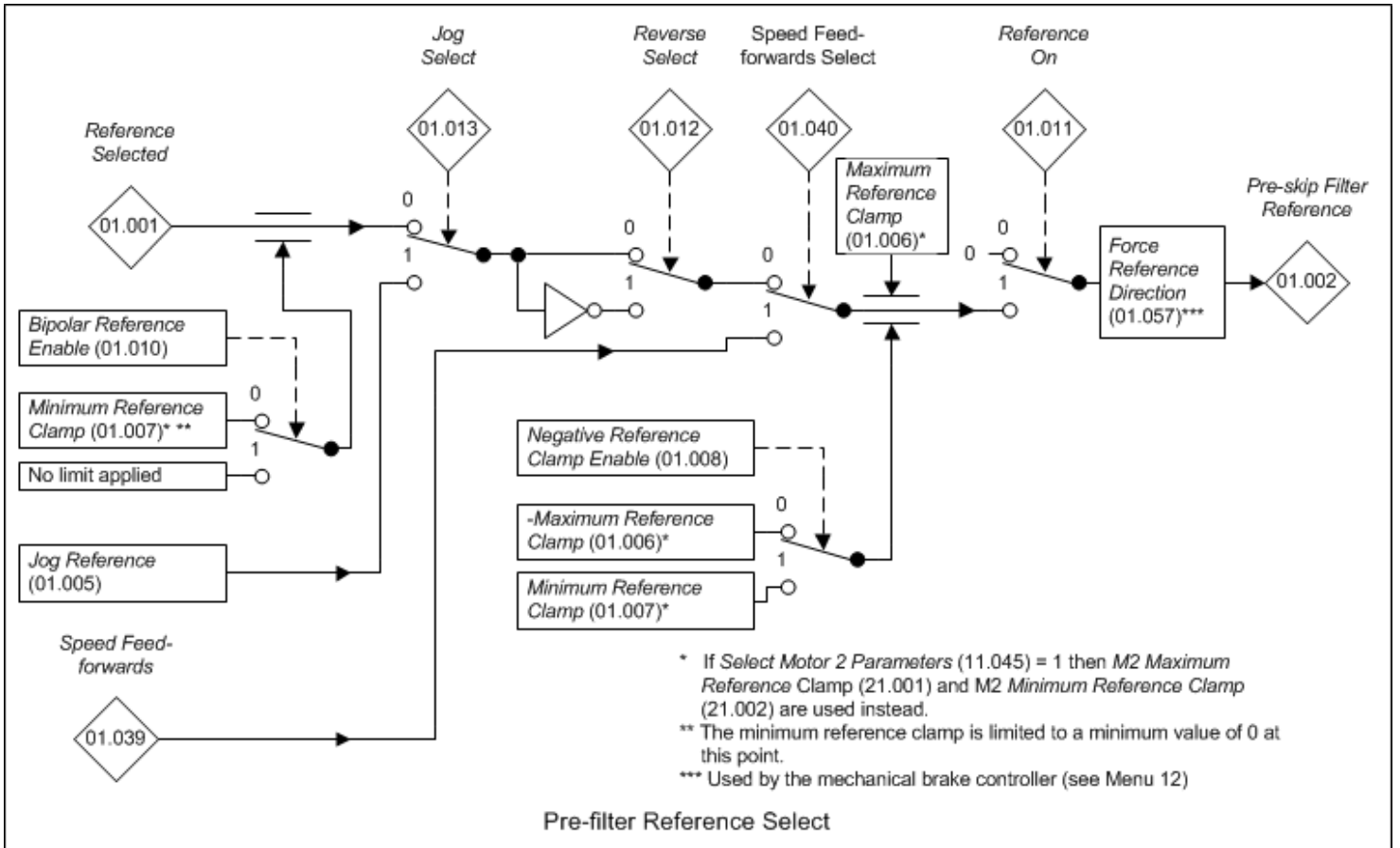
Parameter		Range	Default	Type					
01.001	Reference Selected	±VM_SPEED_FREQ_REF		RO	Num	ND	NC	PT	
01.002	Pre-skip Filter Reference	±VM_SPEED_FREQ_REF		RO	Num	ND	NC	PT	
01.003	Pre-ramp Reference	±VM_SPEED_FREQ_REF		RO	Num	ND	NC	PT	
01.004	Reference Offset	±VM_SPEED_FREQ_REF	0.0	RW	Num				US
01.005	Jog Reference	0.0 to 4000.0	0.0	RW	Num				US
01.006	Maximum Reference Clamp	±VM_POSITIVE_REF_CLAMP1	50Hz: 1500.0 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), Preset (3), Keypad (4), Precision (5), Keypad Ref (6)	A1 A2 (0)	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
01.057	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-S





Parameter	01.001 Reference Selected		
Short description	Displays the basic reference selected from the available sources		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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 Minimum Reference Clamp		
Short description	Defines the minimum value for the reference		
Mode	RFC-S		
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 Negative Reference Clamp Enable		
Short description	Set to 1 to allow the minimum reference clamp value to be negative		
Mode	RFC-S		
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 Reference Offset Select		
Short description	Enables the use of the reference offset		
Mode	RFC-S		
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 Bipolar Reference Enable		
Short description	Enables the minimum value of the reference to be negative		
Mode	RFC-S		
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 Reference On		
Short description	Indicates that the reference from the reference system is active		
Mode	RFC-S		
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 Reverse Select		
Short description	Indicates when the reverse function is active		
Mode	RFC-S		
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-S			
Minimum		Maximum	
0		1	
Default		Units	
Type		Update Rate	
1 Bit Volatile		2ms write	
Display Format		Decimal Places	
Standard		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-S			
Minimum		Maximum	
0		6	
Default		Units	
0			
Type		Update Rate	
8 Bit User Save		4ms read	
Display Format		Decimal Places	
Standard		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 (01.047)	Preset Select Flag 2 (01.046)	Preset Select Flag 1 (01.045)	Preset Selected Indicator (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 (01.049)	Preset Selected Indicator (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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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).

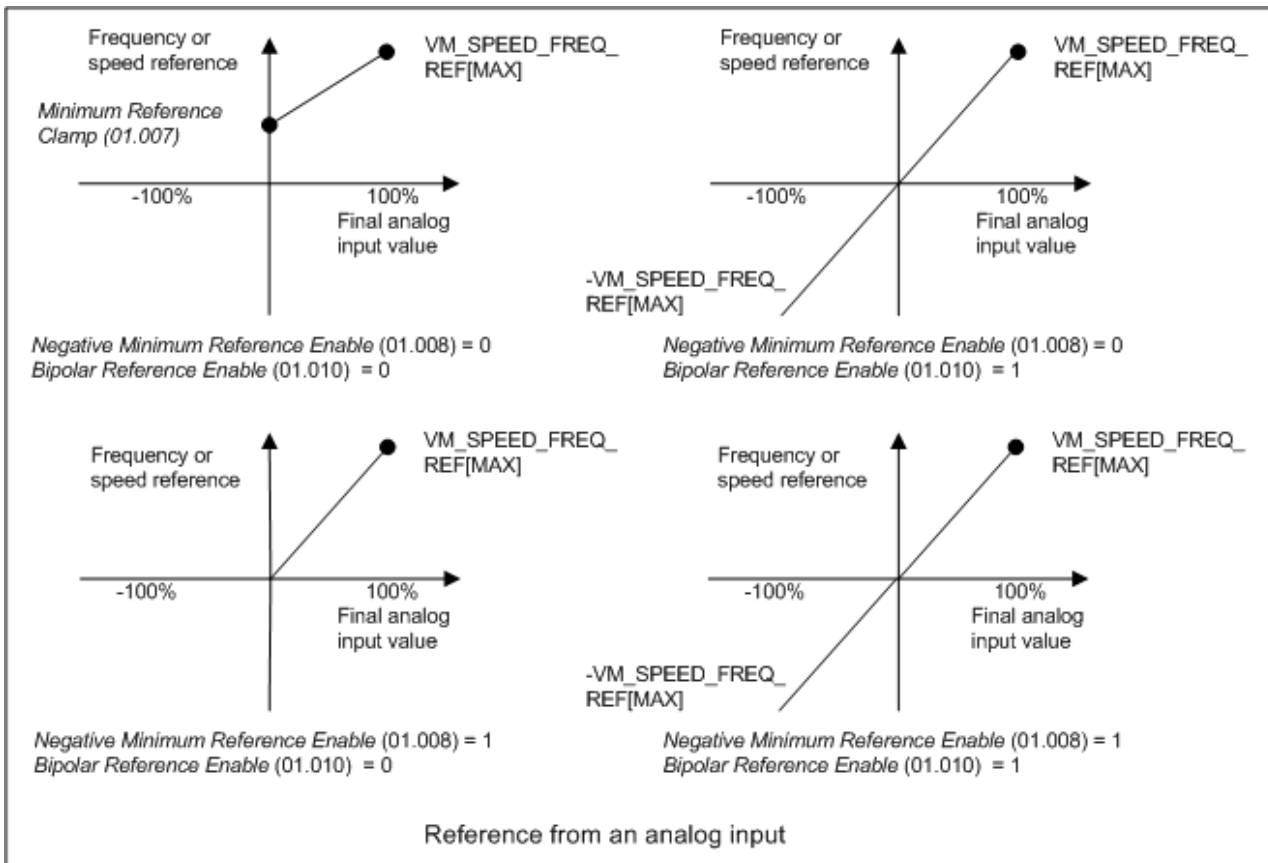
Parameter	01.035 Reference In Rejection Zone		
Short description	Displays when the reference is in 1 of the pre-defined rejection zones		
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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	01.057 Force Reference Direction		
Short description	Defines the direction of the reference		
Mode	RFC-S		
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

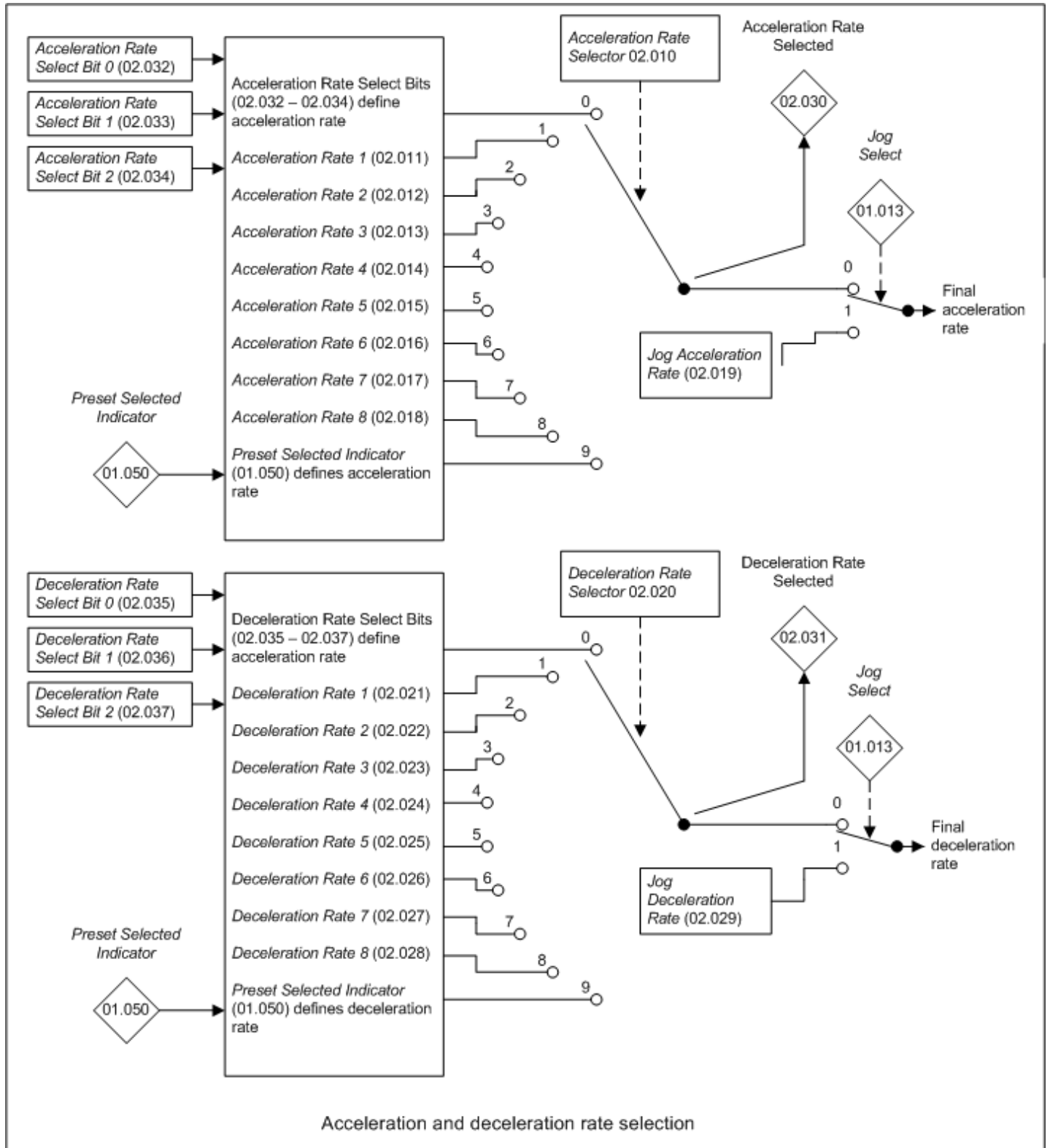
Mode: RFC-S

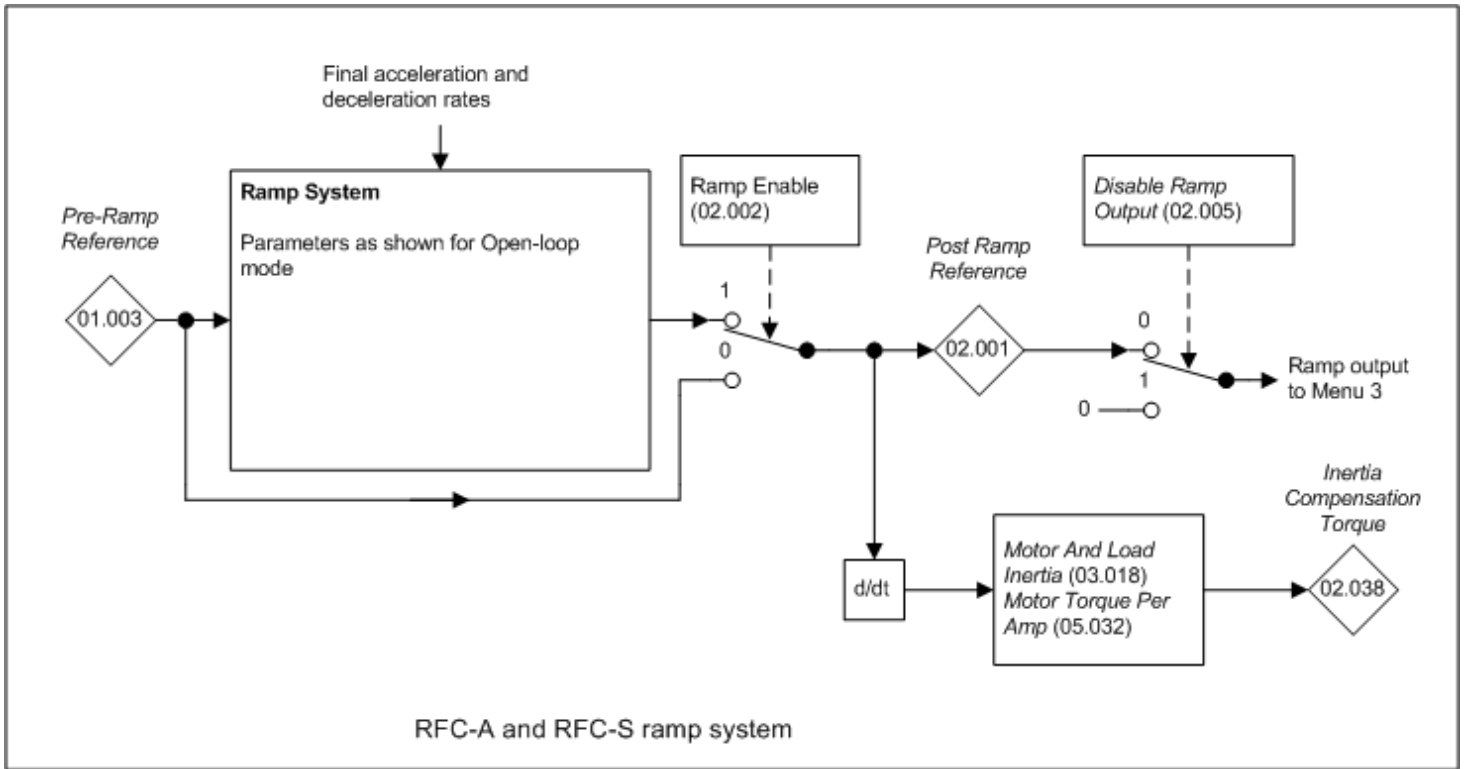
Parameter		Range	Default	Type					
02.001	Post Ramp Reference	±VM_SPEED_FREQ_REF		RO	Num	ND	NC	PT	
02.002	Ramp Enable	Off (0) or On (1)	On (1)	RW	Bit				US
02.003	Ramp Hold	Off (0) or On (1)	Off (0)	RW	Bit				US
02.004	Ramp Mode	Fast (0), Standard (1)	Standard (1)	RW	Txt				US
02.005	Disable Ramp Output	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 400V drive 50Hz: 750 V 400V drive 60Hz: 775 V 575V drive: 895 V 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), 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-S





Parameter	02.001 Post Ramp Reference		
Short description	Displays the output of the ramp system		
Mode	RFC-S		
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-S		
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-S		
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-S		
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

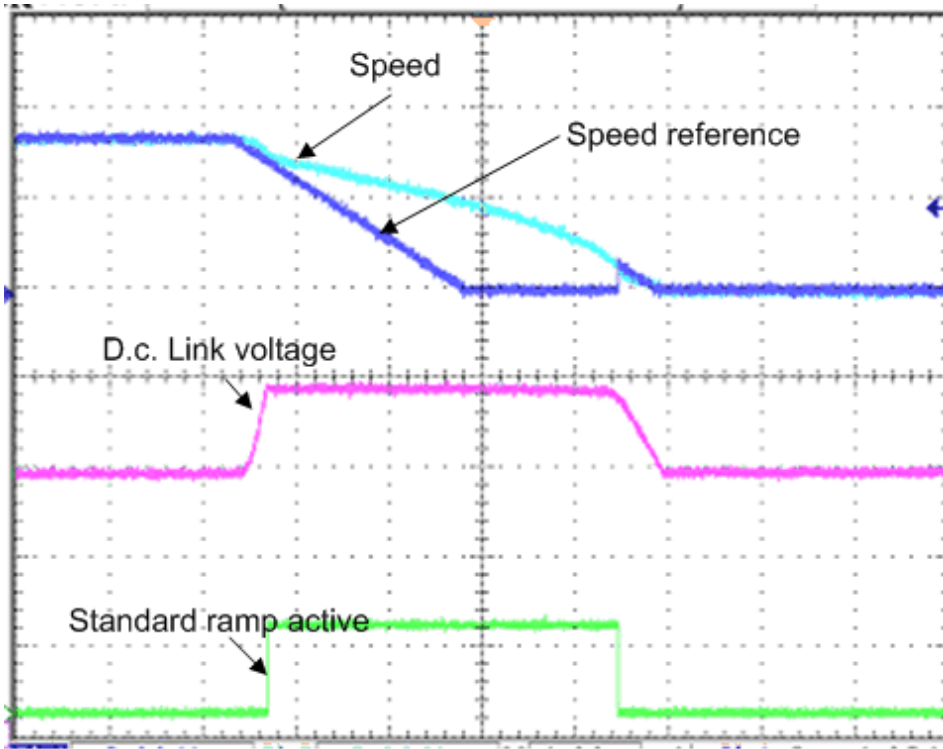
Acceleration is defined as a positive (forward) or negative (reverse) frequency or speed change away from zero, and deceleration is defined as a change towards zero. *Ramp Mode* (02.004) defines the ramp mode used for deceleration. During acceleration the frequency or speed changes are based on the final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

#### 0: Fast ramp

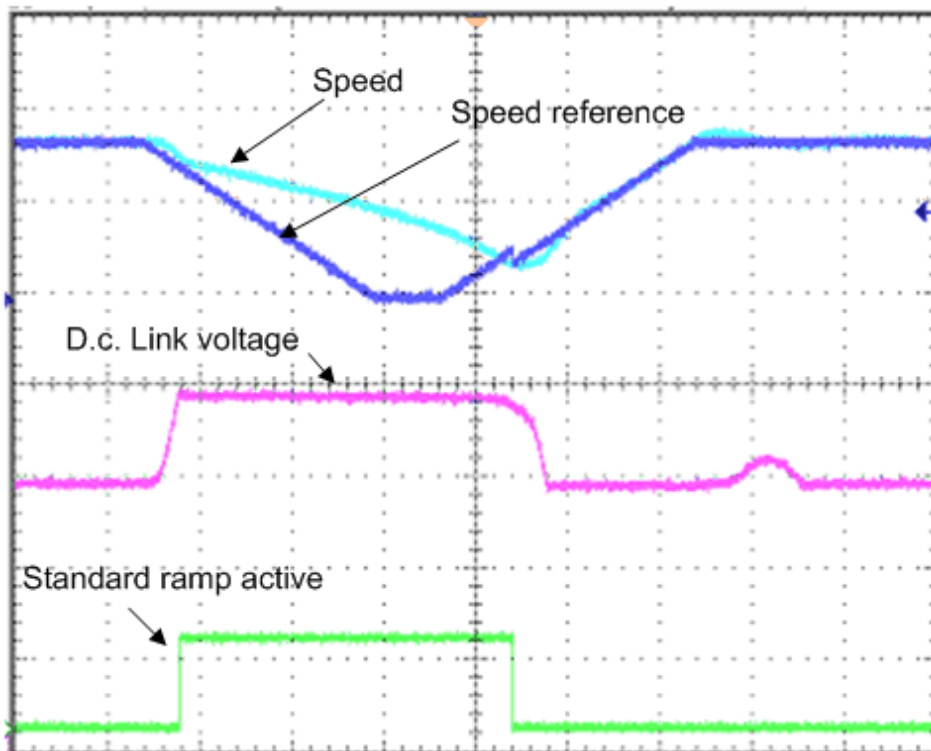
During deceleration the frequency or speed changes are based on the final deceleration rate.

#### 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-S		
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-S		
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-S		
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.

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

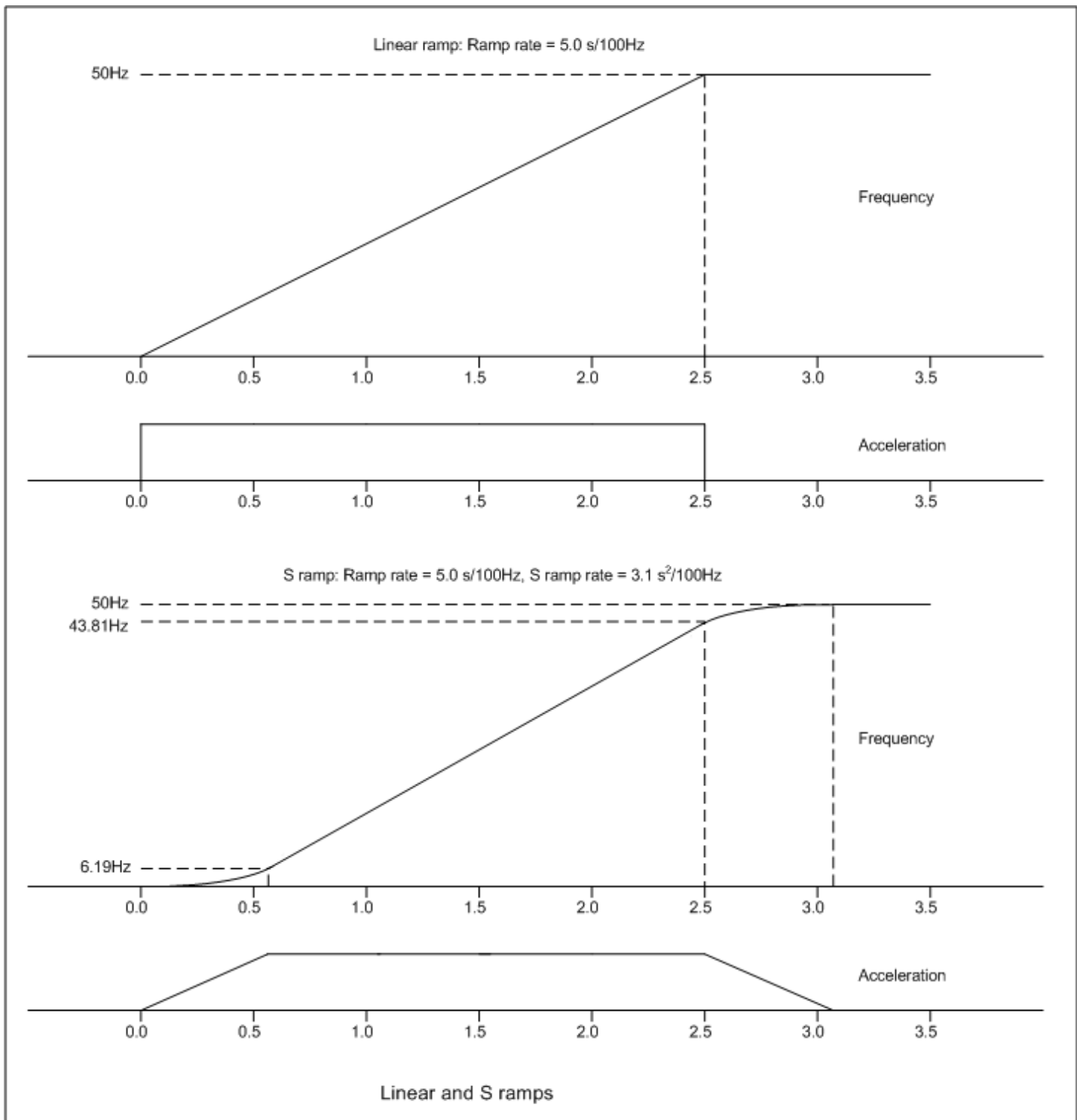
If the required frequency or speed change is less than  $2w_B$ , i.e.  $\Delta w < 2w_B$ , then the acceleration never reaches its limit and the ramp does not contain a linear ramp section and the time for the ramp is given by

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

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:

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

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

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

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

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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S					
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-S					
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-S					
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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	02.036 <i>Deceleration Rate Select Bit 1</i>		
Short description	Defines which deceleration rate is used if deceleration rate selector = 0		
Mode	RFC-S		
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	02.037 <i>Deceleration Rate Select Bit 2</i>		
Short description	Defines which deceleration rate is used if deceleration rate selector = 0		
Mode	RFC-S		
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	02.038 <i>Inertia Compensation Torque</i>		
Short description	Displays the torque as a percentage of rated torque		
Mode	RFC-S		
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	02.039 <i>Ramp Rate Units</i>		
Short description	Defines the units used by the ramp system		
Mode	RFC-S		
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.

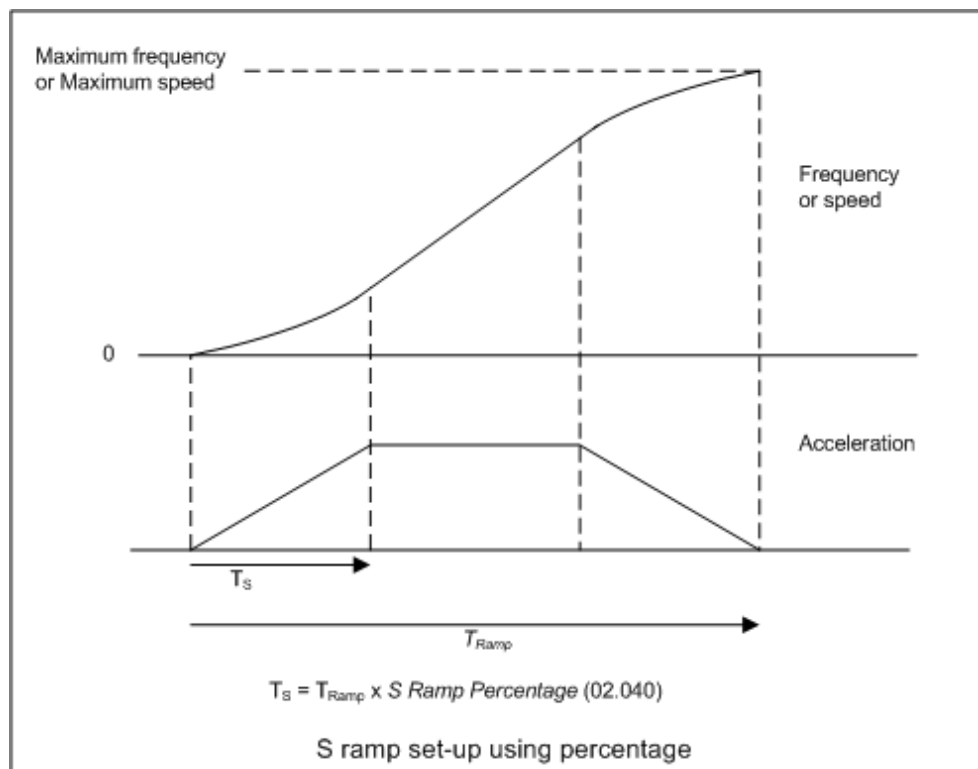
Ramp Rate Units (02.039)	Open-loop Ramp rate frequency	RFC-A and RFC-S mode Ramp rate speed
0	100Hz	1000rpm or 1000mm/s
1	Maximum frequency	Maximum speed

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	02.040 <i>S Ramp Percentage</i>		
Short description	Defines the profile of the S ramp system as a percentage		
Mode	RFC-S		
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-S		
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

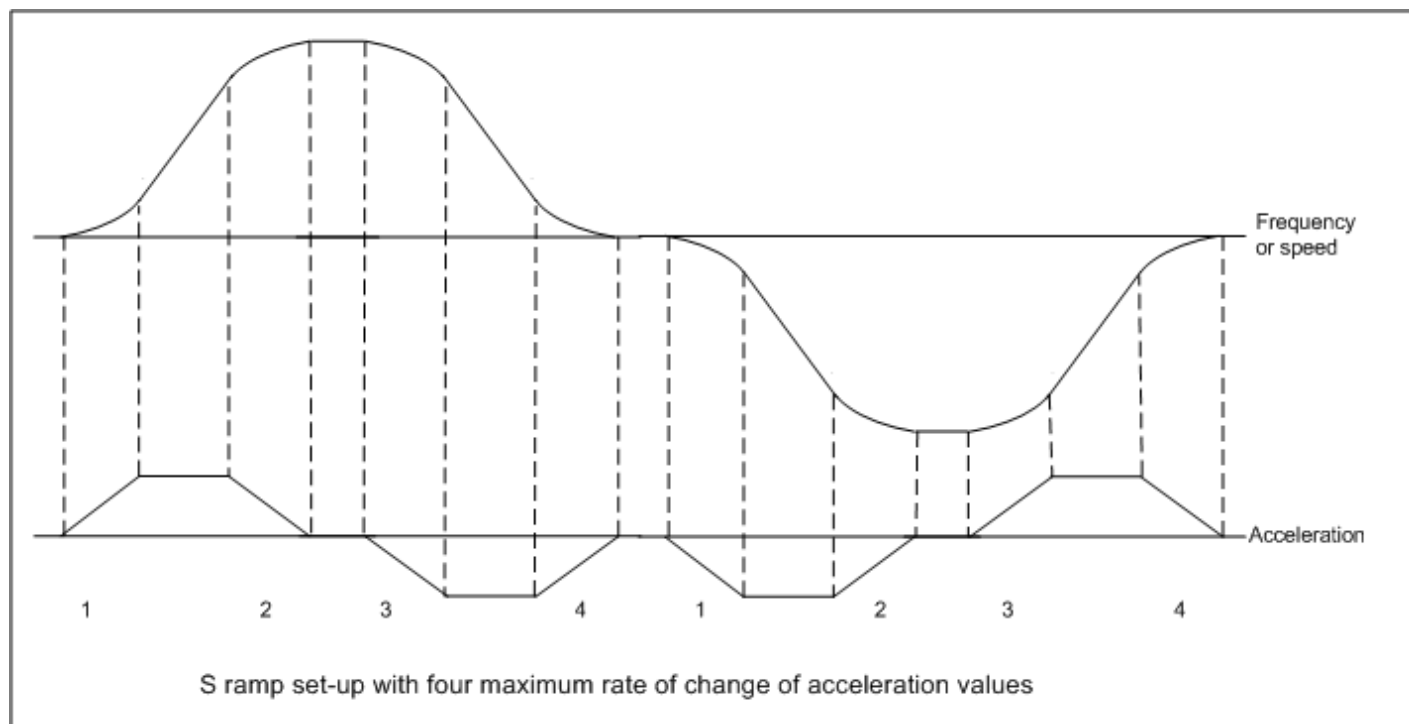
The maximum rate of change of acceleration can be specified as four independent values. See *Maximum Rate Of Change Of Acceleration 1* (02.042).

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-S		
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-S		
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-S		
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-S		
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

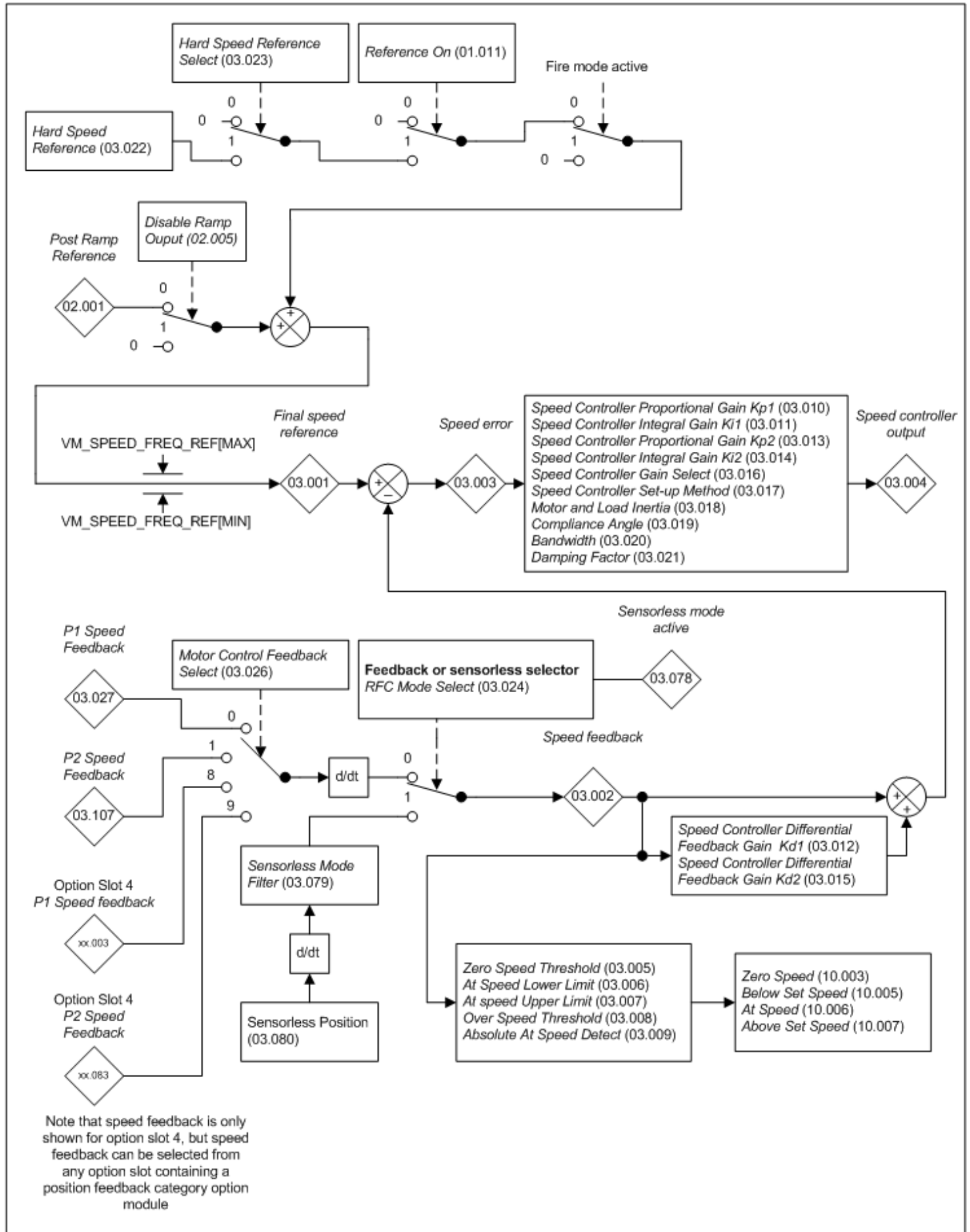
Mode: RFC-S

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	0.0100 s/rad	RW	Num				US
03.011	Speed Controller Integral Gain Ki1	0.00 to 655.35 s <sup>2</sup> /rad	0.05 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	0.0100 s/rad	RW	Num				US
03.014	Speed Controller Integral Gain Ki2	0.00 to 655.35 s <sup>2</sup> /rad	0.05 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), Comp Angle (2), Kp Gain Times 16 (3), Low Performance (4), Std Performance (5), High Performance (6), 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
03.075	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), 64 (4) ms	64 (4) ms	RW	Txt				US
03.080	Sensorless Position	-2147483648 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 3 – Speed Control and Position Feedback

Mode: RFC-S



Parameter	03.001 Final Speed Reference		
Short description	Shows the reference at the input to the speed controller		
Mode	RFC-S		
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-S		
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:

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

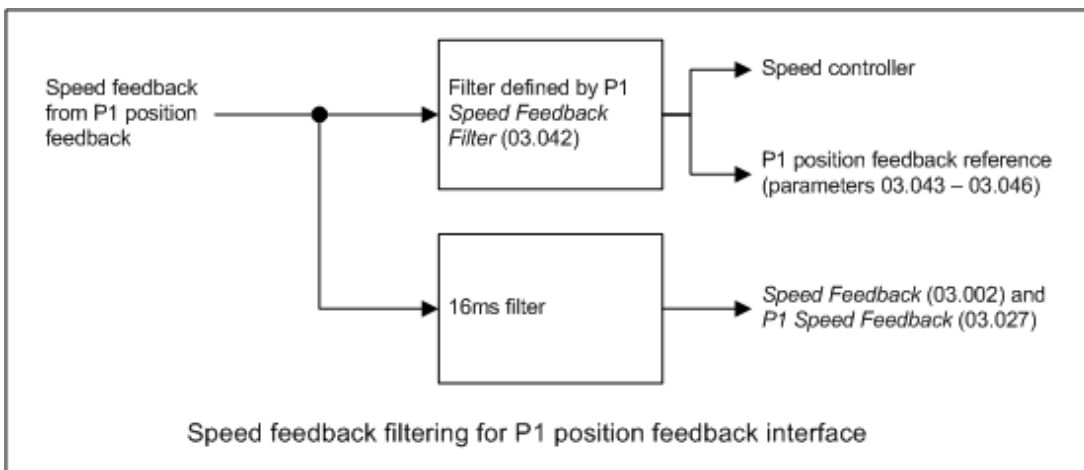
The ripple for a linear system is given by the following equation in mm/s:

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

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 / Speed controller sample time / Position resolution

Ripple for a linear system in mm/s = Pole pitch in mm / Speed controller sample time / 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 / Filter time / Position resolution

Ripple for a linear system in mm/s = Pole pitch in mm / Filter time / 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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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  $1.2 \times \text{VM\_SPEED\_FREQ\_REF}[\text{MAX}]$ . As the over-speed trip provides the ultimate protection against the motor operating beyond the maximum allowable speed, the trip function is time deterministic and will disable the drive within 4ms of the over-speed condition being detected.

The motor speed and the motor voltage can be monitored to detect if the motor is accelerating in an uncontrolled way because position feedback is being used and the *Position Feedback Phase Angle* (03.025) has not been set up correctly. If the *Over Speed Threshold* (03.008) = 0 then position feedback phase angle error monitoring is enabled and a *Phasing Error* trip is initiated if a failure is detected. If the *Over Speed Threshold* (03.008) is not equal to 0 this feature is disabled, and the over-speed trip is the only protection against high motor speed due to an incorrect value of *Position Feedback Phase Angle* (03.025). It should be noted that phase angle error monitoring is not possible with high saliency motors, and so if *Active Saliency Torque Mode* (05.066) = 1 then phase angle error detection is suppressed and the over-speed trip must be used to provide protection.

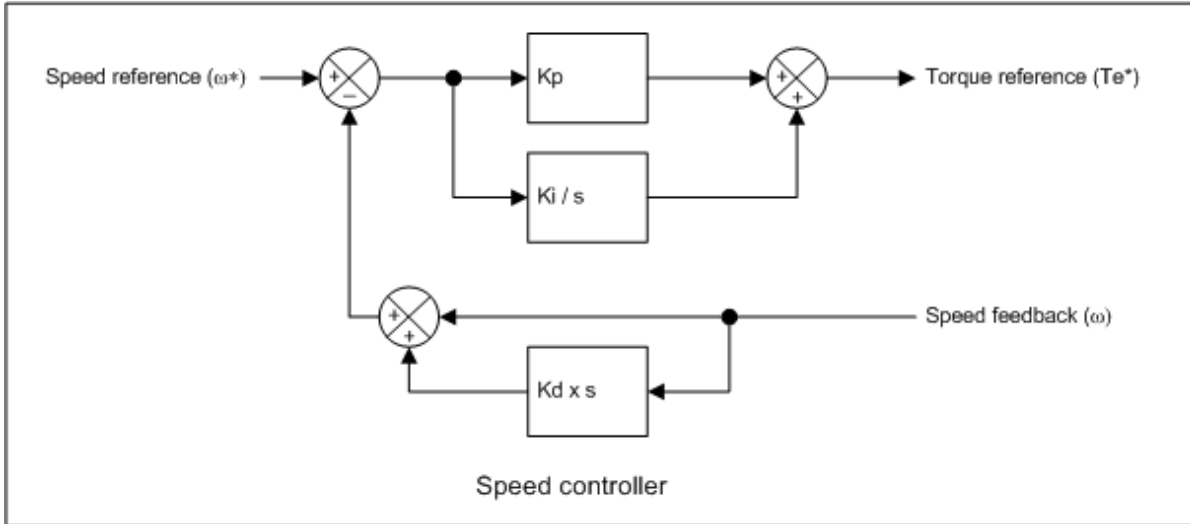
If sensorless control is being used, a *Phasing Error* trip is also initiated if loss of control is detected. This trip is also suppressed if *Over Speed Threshold* (03.008) is set to a non-zero value.

Parameter	03.009 Absolute At Speed Select		
Short description	Indicates when the motor is running at speed		
Mode	RFC-S		
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).

<b>Parameter</b>	<b>03.010 Speed Controller Proportional Gain Kp1</b>		
Short description	Defines the proportional gain for the speed controller		
Mode	RFC-S		
Minimum	0.0000	Maximum	200.0000
Default	0.0100	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.

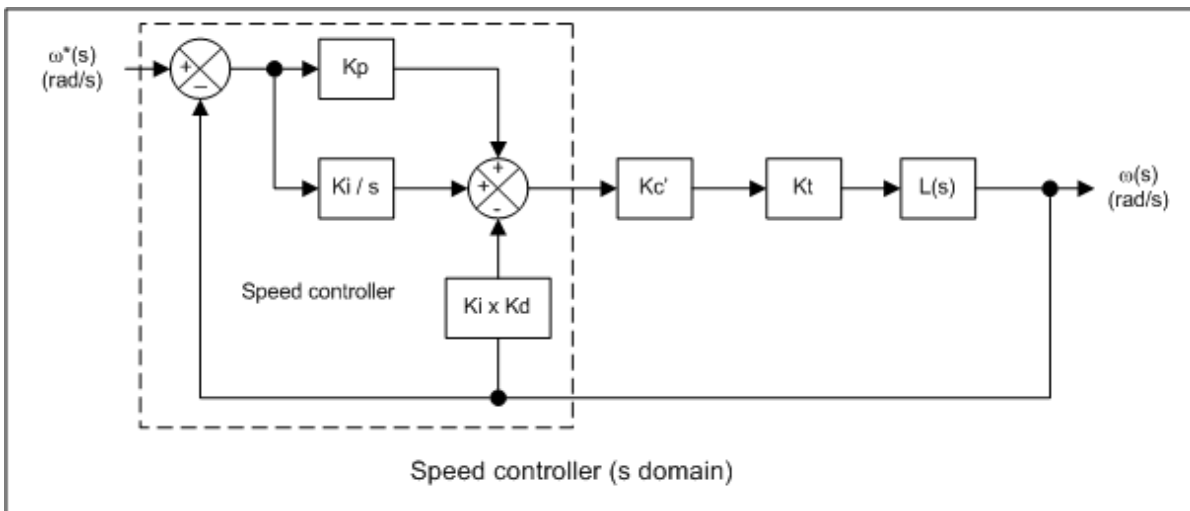
**Integral gain ( $K_i$ ) - Speed Controller Integral Gain Ki1** (03.011)

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.



$K_c'$  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  $K_c'$ . The drive automatically compensates the torque producing current reference for flux variations in field weakening, and so  $K_c'$  can be assumed to have a constant value even in field weakening.  $K_c' = \text{Full Scale Current } K_c (11.061) \times 0.45$ .

$K_t$  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 intergral 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-S		
Minimum	0.00	Maximum	655.35
Default	0.05	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-S		
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-S		
Minimum	0.0000	Maximum	200.0000
Default	0.0100	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-S		
Minimum	0.00	Maximum	655.35
Default	0.05	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-S		
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-S		
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 is set up		
Mode	RFC-S		
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:

Kc' = Full Scale Current Kc (11.061) x 0.45

J = Motor And Load Inertia (03.018)

Kt = Torque Per Amp (05.032)

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

$\xi$  = Damping Factor (03.021)

Kwb =  $\sqrt{(2\xi^2 + 1) + \sqrt{(2\xi^2 + 1)^2 + 1}}$

#### 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.

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

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

where:

Kc' = Full Scale Current Kc (11.061) x 0.45

J = Motor And Load Inertia (03.018)

Kt = 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-S		
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-S		
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 <i>Bandwidth</i>		
Short description	Defines the theoretical 3dB point on the closed-loop gain characteristic of the speed controller as a second order system		
Mode	RFC-S		
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 <i>Damping Factor</i>		
Short description	Defines the factor for the response of the system to a torque transient		
Mode	RFC-S		
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 <i>Hard Speed Reference</i>		
Short description	Defines a speed reference value which does not pass through the ramp system		
Mode	RFC-S		
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 <i>Hard Speed Reference Select</i>		
Short description	Set to 1 to enable the use of the hard speed reference		
Mode	RFC-S		
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	03.075 <i>Initialise Position Feedback</i>		
Short description	Set to 1 to re-initialise any position feedback device connected		
Mode	RFC-S		
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-S		
Minimum	0 (Display: 0000000000)	Maximum	1023 (Display: 1111111111)
Default	0 (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 Resolver	None. Initialisation is immediate and is always successful. The position feedback is set to zero on initialisation.
AB Servo FD Servo FR Servo 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 SC EnDat SC SSI	Auto-configuration if required except SC SSI. The absolute position must be obtained via comms. This may cause a large change in position feedback. The SINCOS interpolation system must be initialised. This may have a small effect on the position feedback.
EnDat BiSS SSI	Auto-configuration if required except SSI. 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-S		
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	Defines the filter for the estimated motor speed when sensorless mode is active		
Mode	RFC-S		
Minimum	0	Maximum	4
Default	4	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 estimated motor speed can include some unwanted noise. Some motors have concentrated windings which results in flux distortion when the motor is loaded, which in turn causes ripple in the motor currents and additional unwanted components in the calculated speed feedback. This usually has a more significant effect if the motor is running at high speed when the voltage controller may be active to limit the motor voltage. A filter is applied to the speed feedback with a time constant defined by *Sensorless Mode Filter* (03.079). The default value for this parameter gives the maximum amount of filtering, so that motors which introduce unwanted feedback noise will operate correctly. If the motor does not introduce this type of noise it is possible to reduce the filter time constant to give better dynamic performance when speed control is required.

Parameter	03.080 <i>Sensorless Position</i>		
Short description	Displays the motor position when sensorless mode is active		
Mode	RFC-S		
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.

## Menu 4 Single Line Descriptions – Torque and current control

Mode: RFC-S

Parameter		Range	Default	Type					
04.001	Current Magnitude	±VM_DRIVE_CURRENT_UNIPOLAR A		RO	Num	ND	NC	PT	FI
04.002	Iq	±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	1.0 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	850.0 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	Id	±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	1.0 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
04.033	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
04.049	Magnetising Current Limit	0.0 to 100.0 %	100.0 %	RW	Num				US

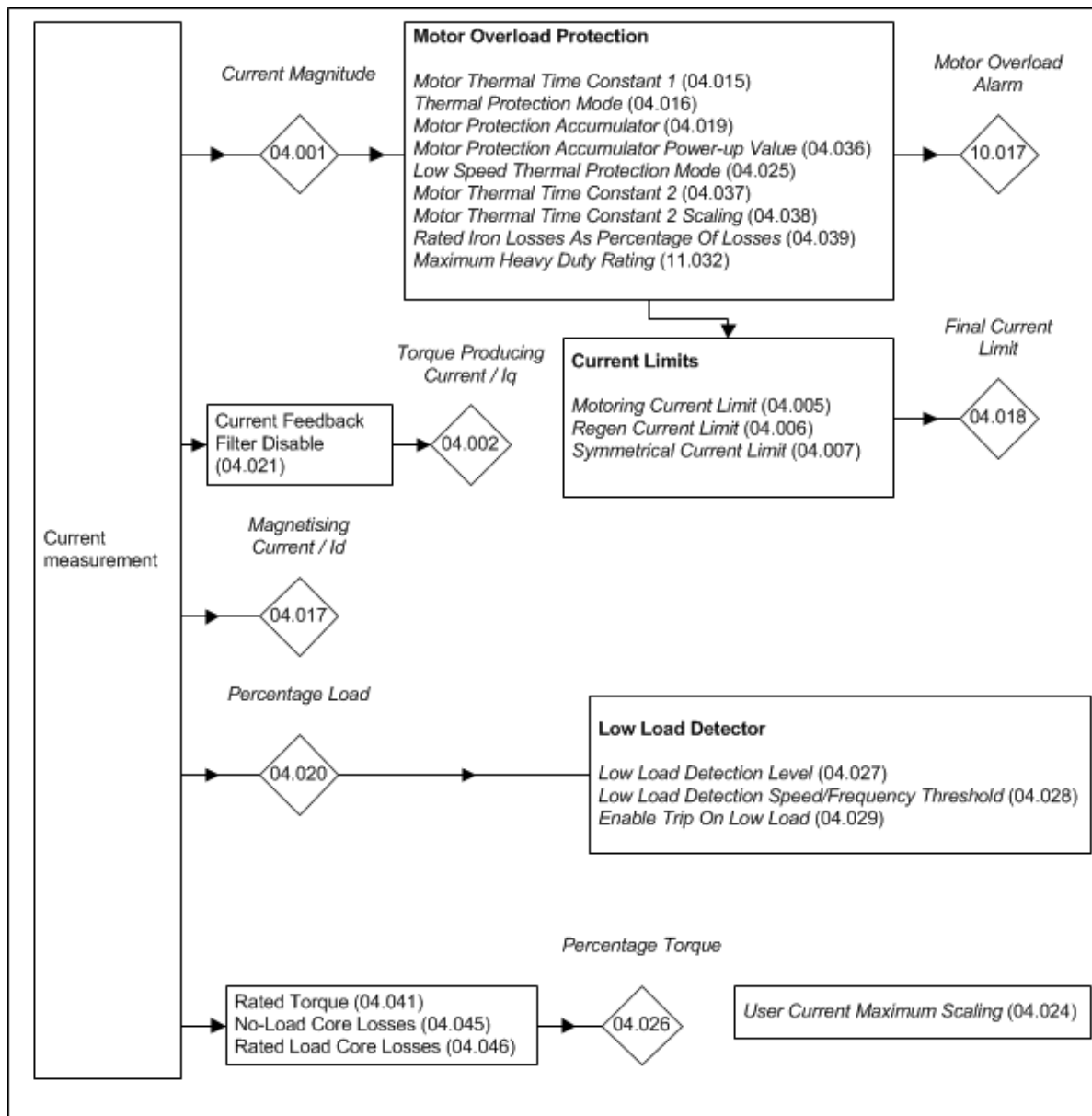
RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC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

## Menu 4 – Torque and current control

Mode: RFC-S

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.

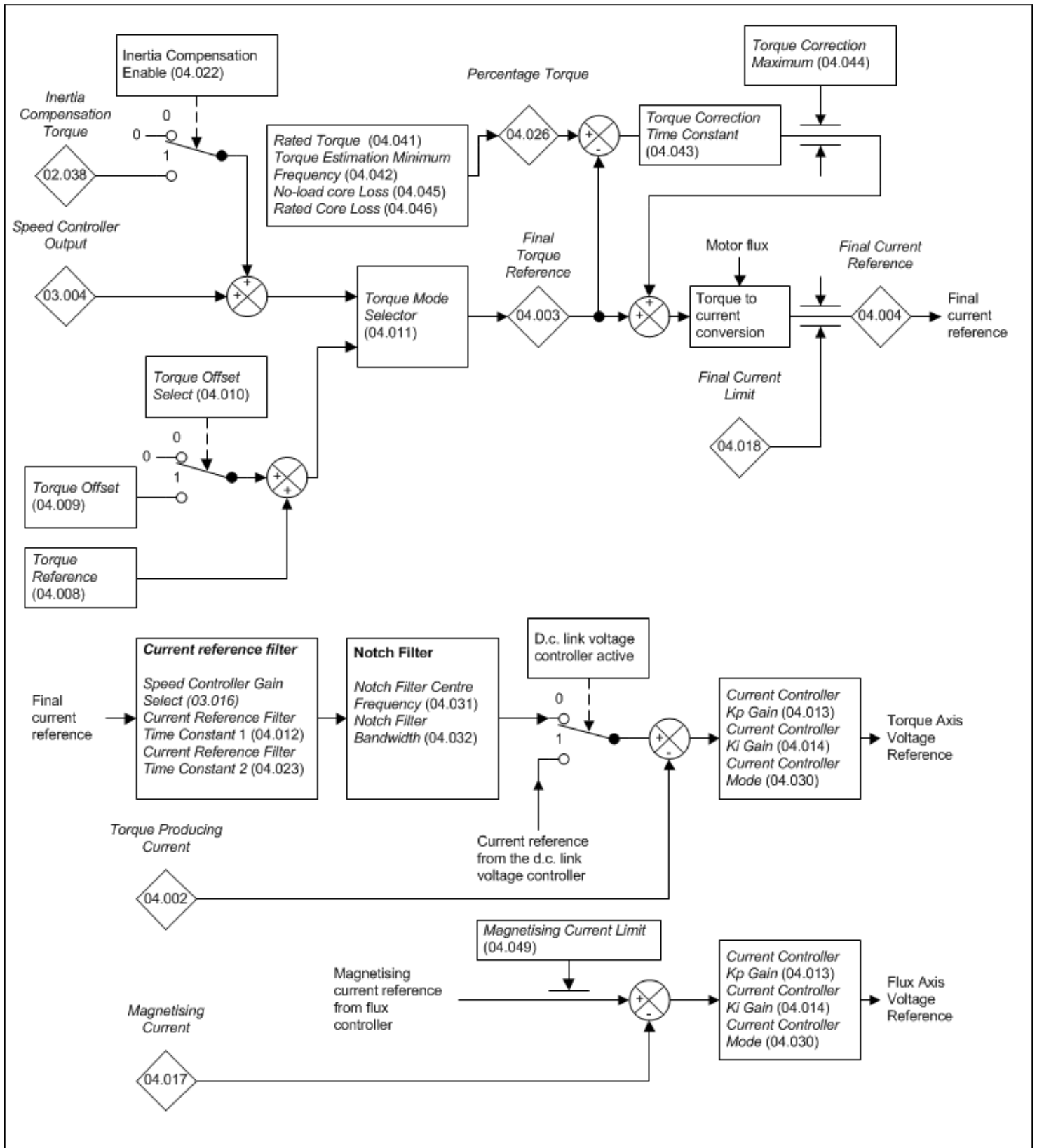
Conditions	Possible duty ratings
<i>Maximum Heavy Duty Rating</i> (11.032) = 0.00	Normal duty operation only
<i>Maximum Heavy Duty Rating</i> (11.032) < <i>Maximum Rated Current</i> (11.060)	Heavy duty operation if rated current > MAX, otherwise normal duty operation
<i>Maximum Heavy Duty Rating</i> (11.032) = <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

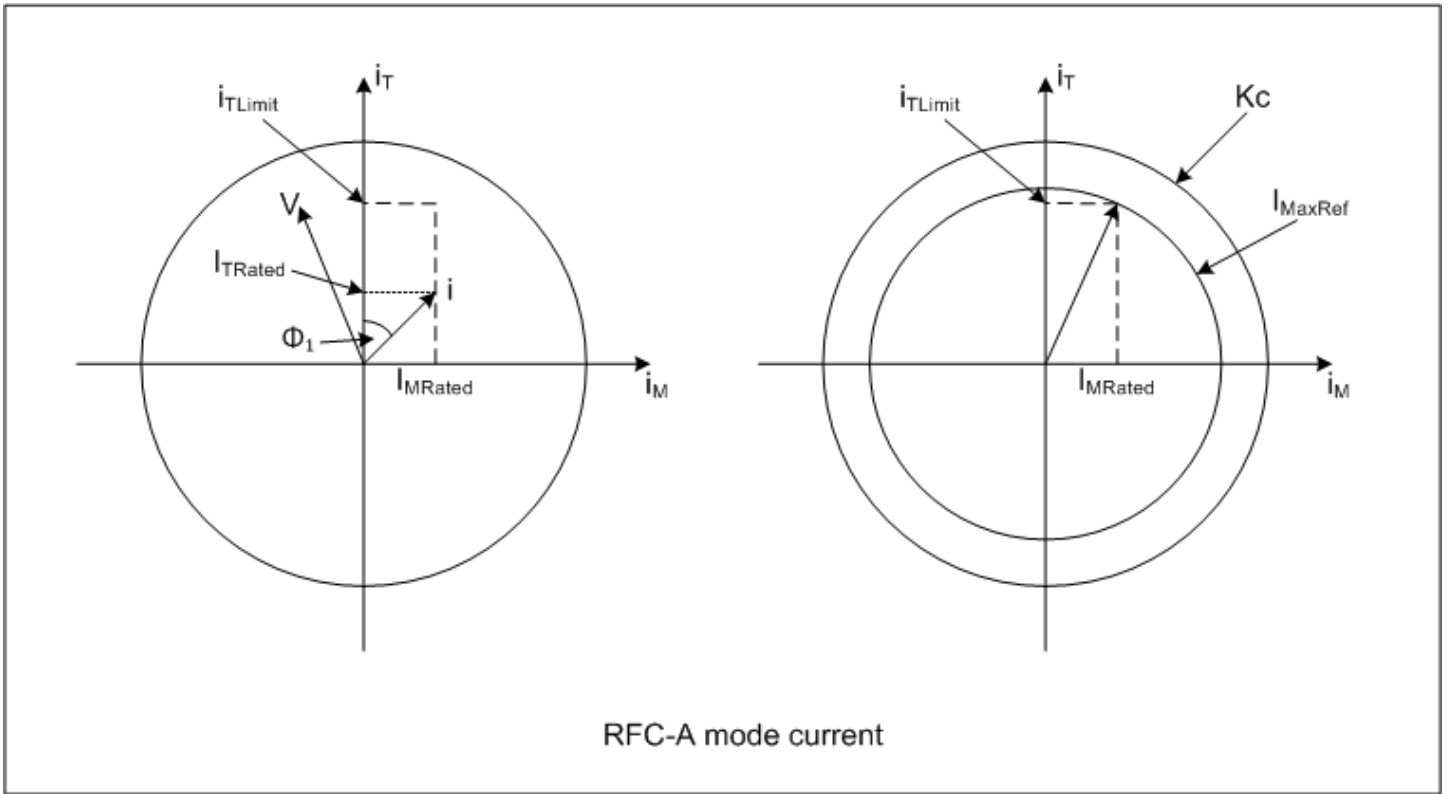




The torque reference is normally provided by the speed controller, or from the torque reference, or as a combination of both depending on the value of the *Torque Mode Selector* (04.011). During supply loss or when standard ramp mode is selected and the motor is regenerating it is possible that the torque 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.

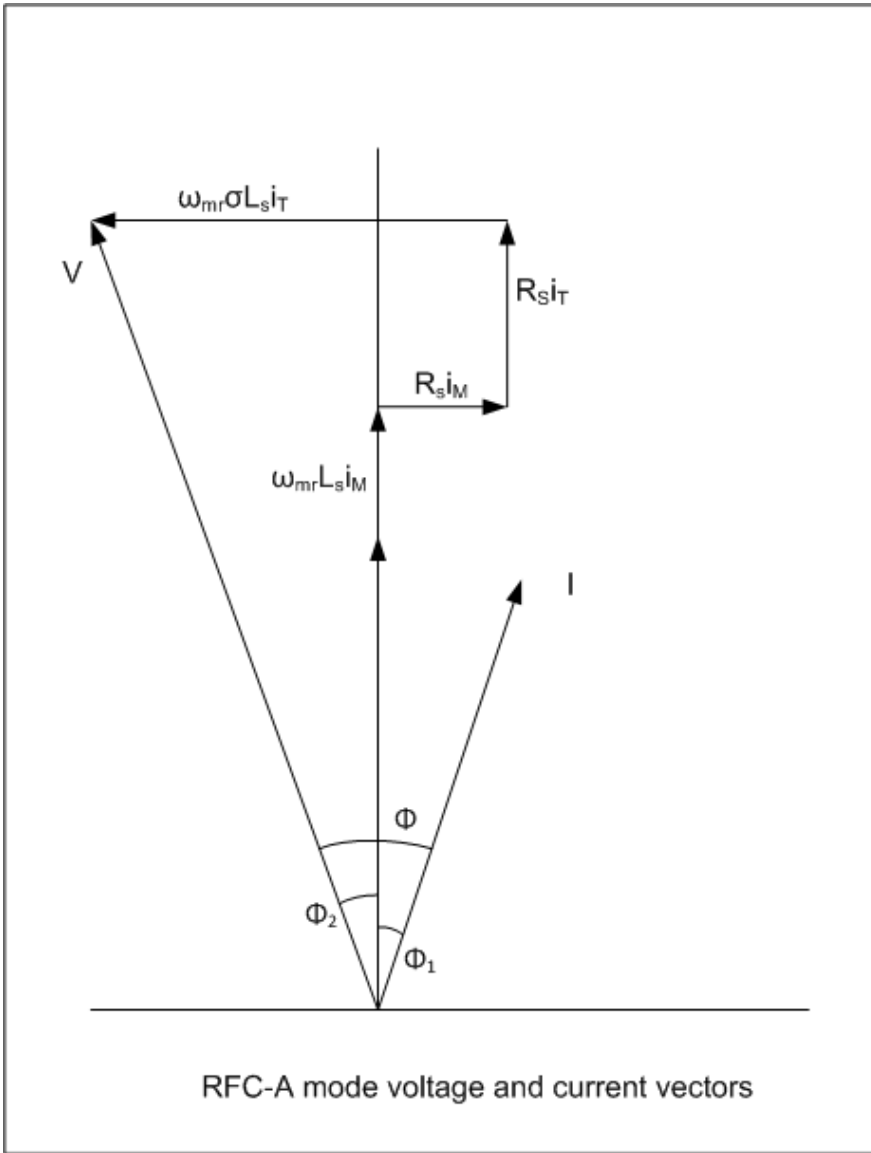
#### Variable Maximums applied to the current limits

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  $\cos \varphi_1$  which in turn will be used to provide a more accurate estimate of  $I_{\text{Trated}}$  and  $I_{\text{Mrated}}$ .

$\cos \varphi$  = Rated Power Factor (05.010)

Initial estimates for the rated magnetising and torque producing currents are:

$$I_{\text{Mrated}}' = I_{\text{Rated}} \times \sin \varphi$$

$$I_{\text{Trated}}' = I_{\text{Rated}} \times \cos \varphi$$

$\cos \varphi_1$  can then be calculated from the power factor ( $\cos \varphi$ ) and  $\varphi_2$  as shown in the diagram above. It can be seen that under rated conditions:

$$\varphi_2 = \sin^{-1}((R_s I_{\text{Mrated}}' - 2\pi F_{\text{Rated}} \sigma L_s I_{\text{Trated}}') / V_{\text{Rated}})$$

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

$$\varphi_1 = \varphi + \varphi_2$$

Note that in most cases  $\varphi_2$  is negative, and so  $\varphi_1$  is smaller than  $\varphi$ .  $\varphi_1$  can then be used to give more accurate values of the current components in the rotor flux reference frame.

$$I_{\text{Mrated}} = I_{\text{Rated}} \sin \varphi_1$$

$$I_{T\text{Rated}} = I_{\text{Rated}} \cos \phi_1$$

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  $I_{M\text{Rated}} = K I_{M\text{Rated}}'$ .

$$K = (V_{\text{Rated}} - R_s I_{T\text{Rated}}) / V_{\text{Rated}}$$

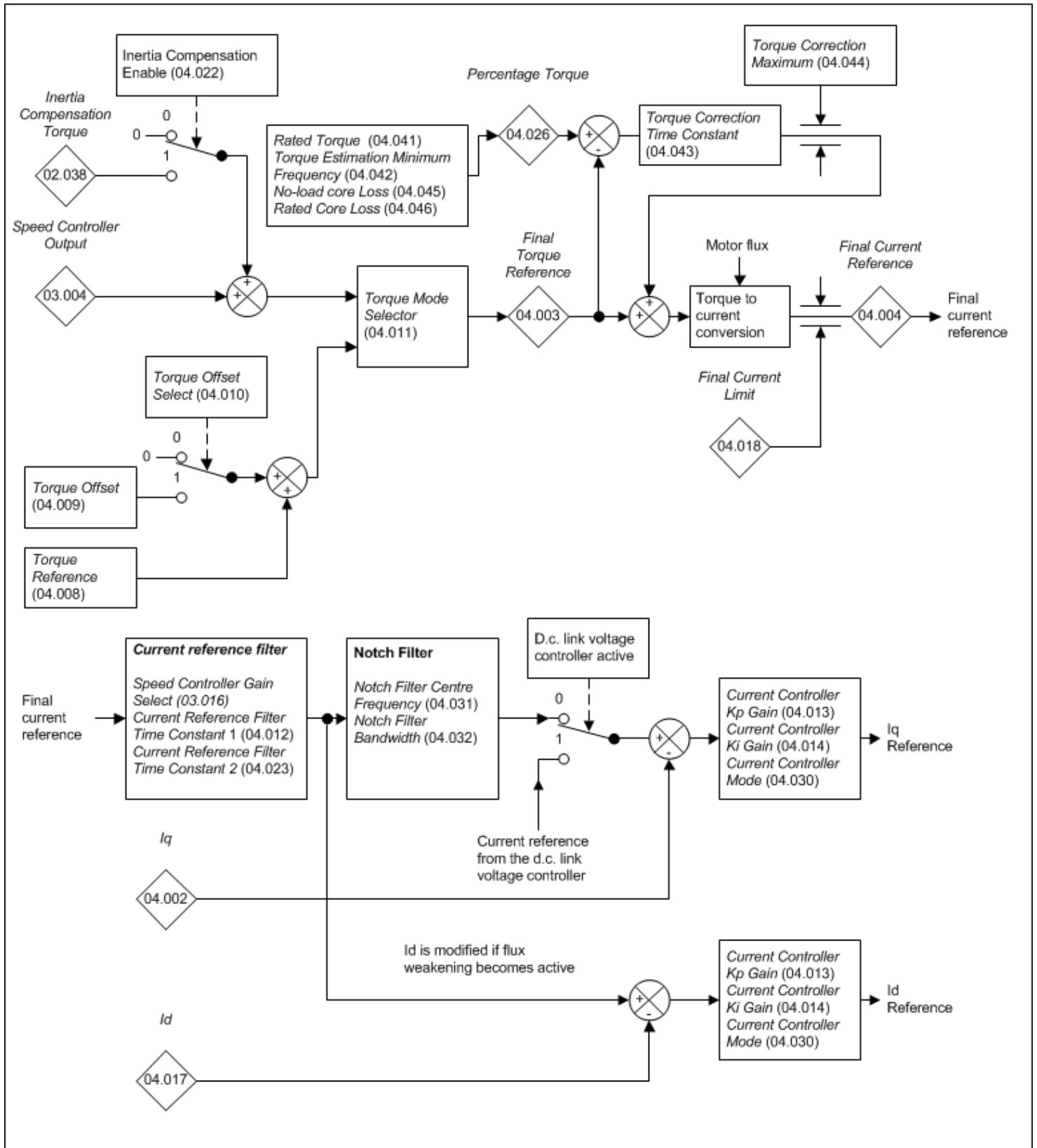
$$\text{where } I_{T\text{Rated}}' = I_{\text{Rated}} \cos \phi_1'$$

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 <i>Current Magnitude</i>		
Short description	Shows the instantaneous drive output current		
Mode	RFC-S		
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 <i>Iq</i>		
Short description	Shows the instantaneous level of q axis current		
Mode	RFC-S		
Minimum	-VM_DRIVE_CURRENT	Maximum	VM_DRIVE_CURRENT
Default		Units	A
Type	32 Bit Volatile	Update Rate	250us Write
Display Format	Standard	Decimal Places	3
Coding	RO, FI, VM, ND, NC, PT		

The current in the motor is separated into d and q axis current where d axis current is aligned with the flux from the magnets and the q axis current is aligned with an axis at right angles to the flux. If motor saliency is not being exploited (i.e. *Saliency Torque Control Select* (05.065) = 0) then there will only be q axis current, and no d axis current, if flux weakening is not active. If saliency torque is not being exploited then *Iq, Torque Producing Current* (04.002) is always proportional to the torque produced by the motor. If saliency torque is being exploited (i.e. *Saliency Torque Control Select* (05.065) is non-zero) then the torque is produced by a combination of q axis current and negative d axis current. In this case *Iq, Torque Producing Current* (04.002) is not directly proportional to torque. The sign of *Iq, Torque Producing Current* (04.002) is defined in the table below.

Sign of <i>Iq, Torque Producing Current</i> (04.002)	Sign of frequency or speed	Direction of motor torque
+	+	Accelerating
-	+	Decelerating
+	-	Decelerating
-	-	Accelerating

Parameter	04.003 <i>Final Torque Reference</i>		
Short description	Shows the final torque reference		
Mode	RFC-S		
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 <i>Final Current Reference</i>		
Short description	Shows the final current reference after the current limits		
Mode	RFC-S		
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) using rotor temperature compensation if required (see *Rotor Temperature Coefficient* (05.054)) and applying the current limits.

Parameter	04.005 <i>Motoring Current Limit</i>		
Short description	Defines the current limit used when the motor is being accelerated away from standstill		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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**

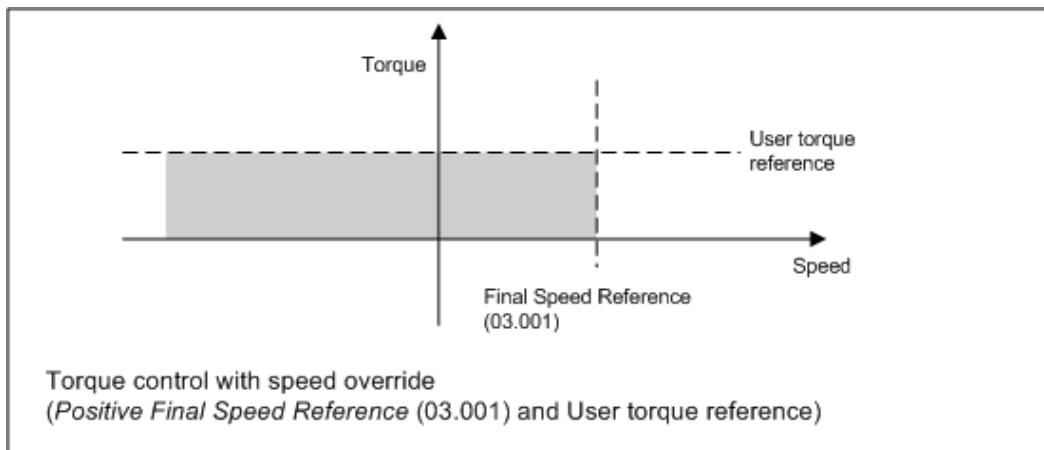
The *Final Torque Reference* (04.003) is the Speed controller torque reference.

**1: Torque control**

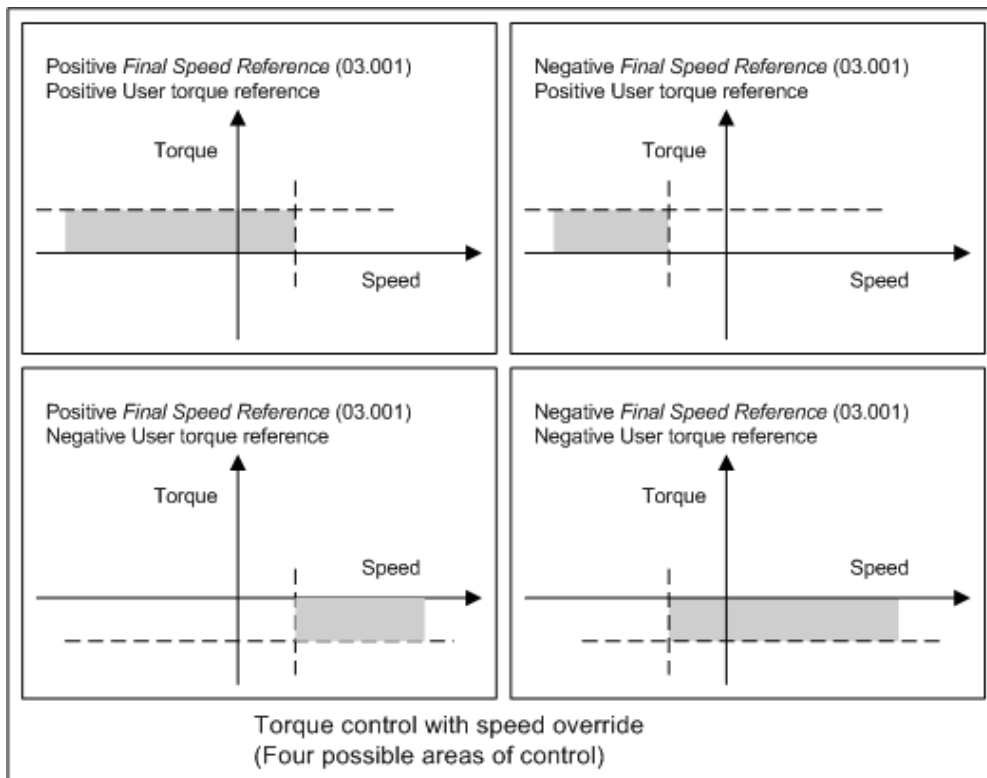
The *Final Torque Reference* (04.003) is the User torque reference. The speed is not limited by the drive but, the drive will trip at the over-speed threshold if runaway occurs.

**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.

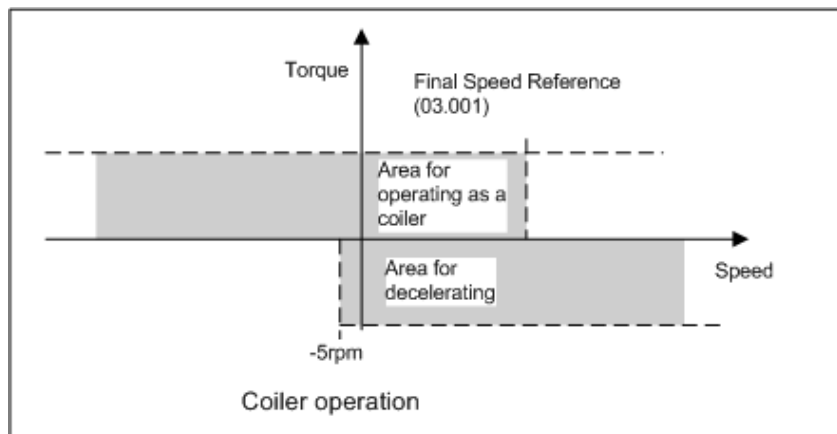
Negative *Final Speed Reference* (03.001): Negative User torque reference gives torque control with a negative speed limit defined by the *Final Speed Reference* (03.001). A positive User torque reference gives torque control with a positive speed limit of +5rpm.

*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

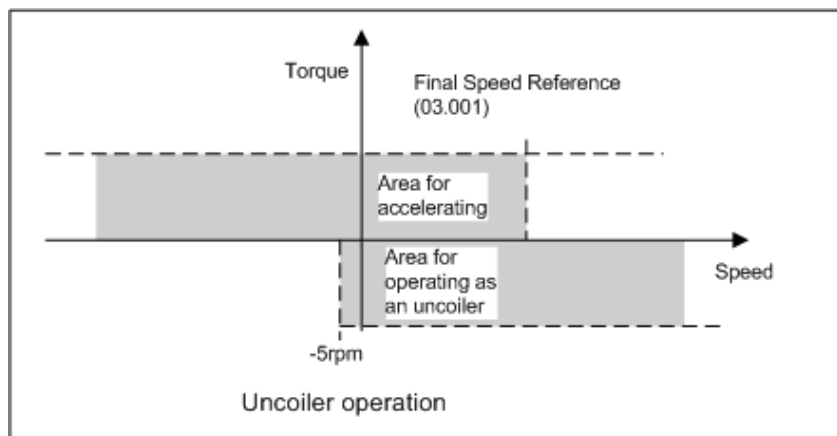


speed. If the User torque reference is positive the coiler operates with a limited speed, so that if the material breaks the speed does not exceed a level just above the reference. It is also possible to decelerate the coiler with a negative User torque reference. The coiler will decelerate down to -5rpm 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:

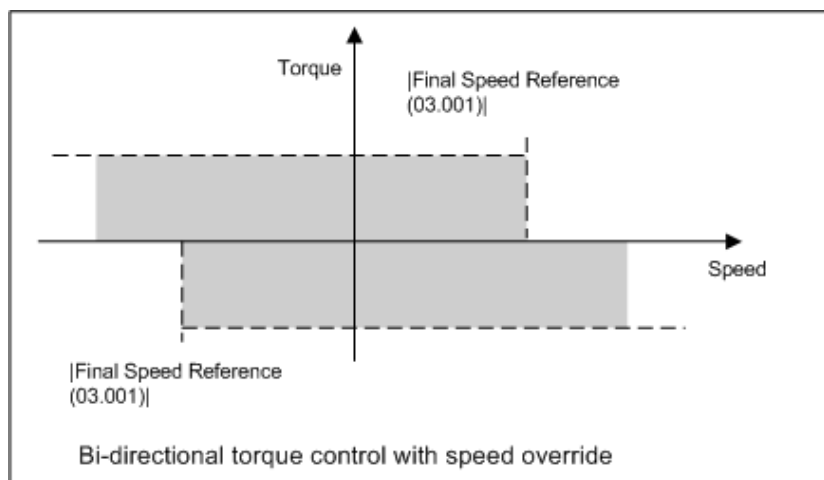


**4: Speed control with torque feed-forward**

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 with a safe speed limit 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-S		
Minimum	0.0	Maximum	25.0
Default	1.0	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-S		
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 *Ld* (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 (σLs). 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 *Ld* (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-S		
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-S		
Minimum	1.0	Maximum	3000.0
Default	850.0	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

$$T = \text{Motor Protection Accumulator (04.019)}$$

$$K_2 = \text{Motor Thermal Time Constant 2 Scaling (04.038)} / 100\%$$

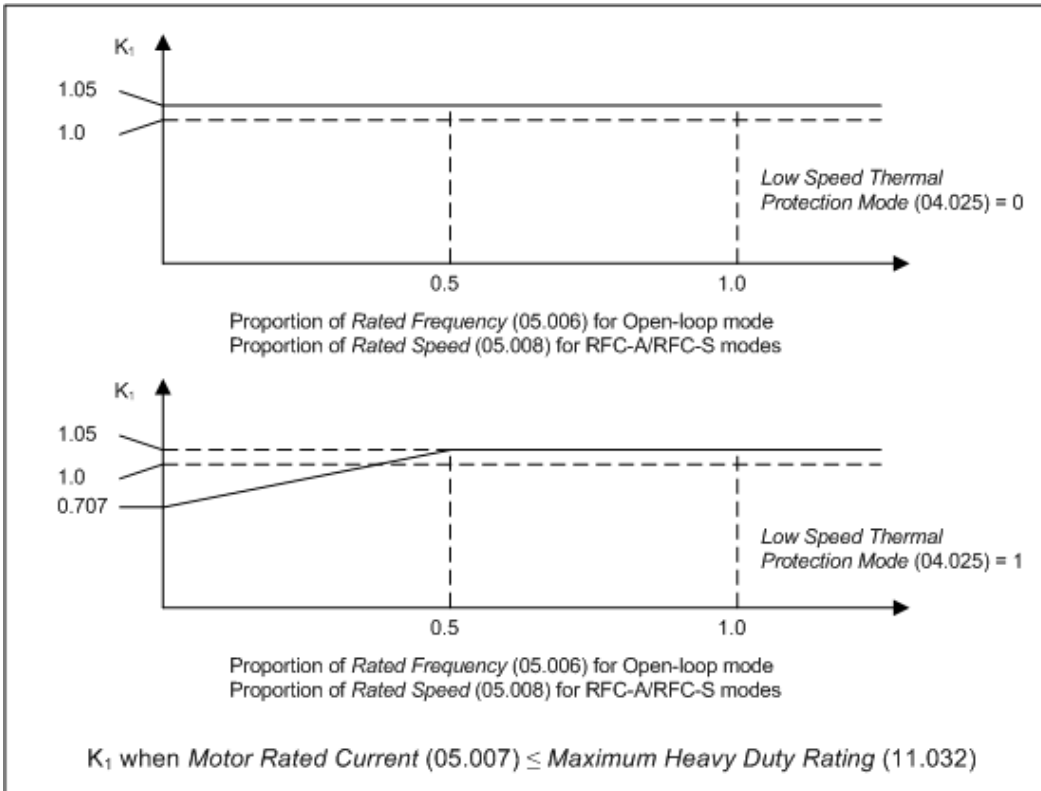
$$\tau_1 = \text{Motor Thermal Time Constant 1 (04.015)}$$

$$\tau_2 = \text{Motor Thermal Time Constant 2 (04.037)}$$

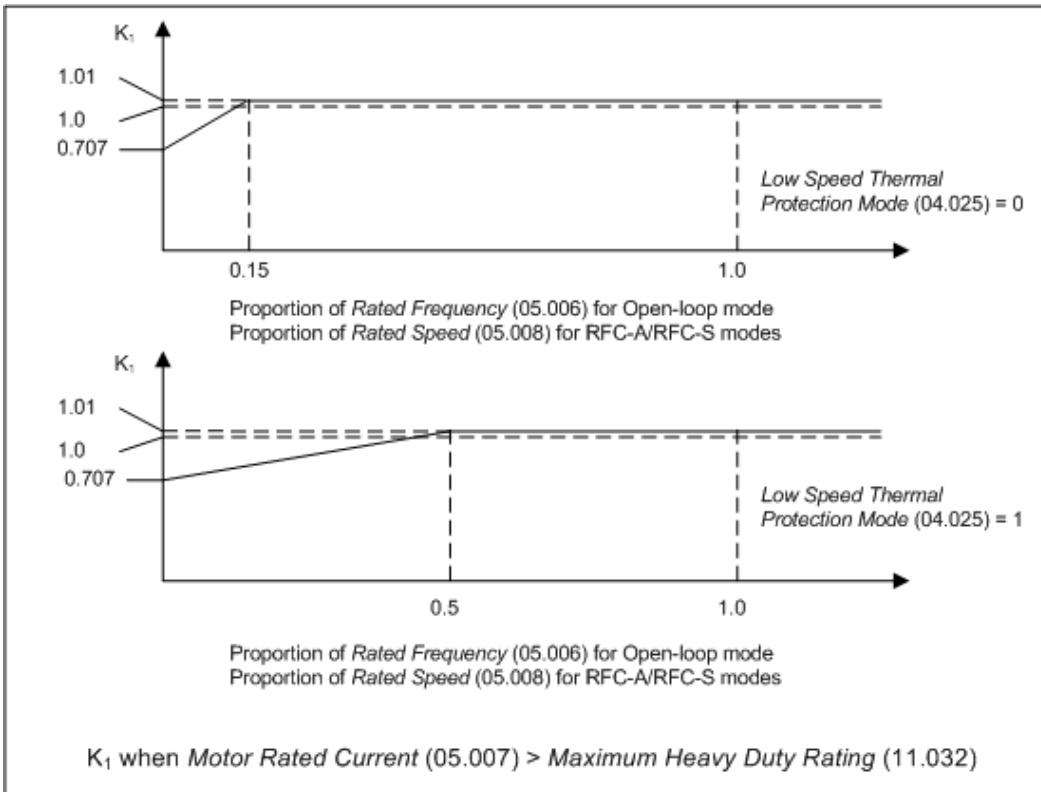
$[(1 - K_2)(1 - e^{-t/\tau_1}) + K_2(1 - e^{-t/\tau_2})]$  gives the effects of the thermal time constants in the motor.  $K_2$  defines the ratio of the contribution to the *Motor Protection Accumulator* (04.019) value from each of the time constants. If  $K_2$  is set to its default value of 0 then 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.  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.

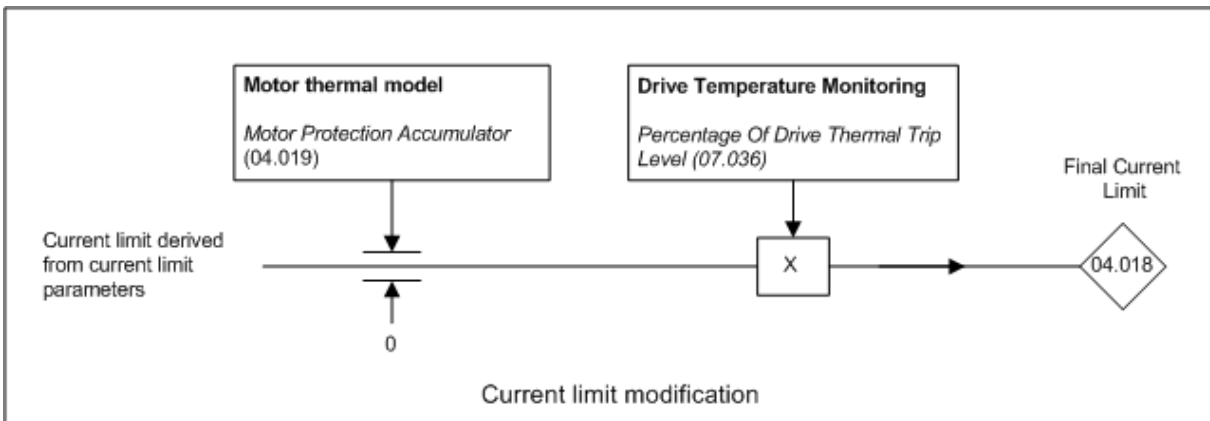
Parameter	04.016 Thermal Protection Mode		
Short description	Set to the require thermal protection mode		
Mode	RFC-S		
Minimum	0	Maximum	4
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

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%. No current limiting. <i>Motor Protection Accumulator</i> (04.019) is limited to 100.0%.
Motor Current Limit (1)	<i>Motor Too Hot</i> trip is disabled. Current limiting on motor overload as described below. <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%. Current limiting on drive thermal monitoring as described below. <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. Current limiting on motor overload and drive thermal monitoring as described below. <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. No current limiting. <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 <i>I<sub>d</sub></i>		
Short description	Shows the instantaneous level of d axis current		
Mode	RFC-S		
Minimum	-VM_DRIVE_CURRENT	Maximum	VM_DRIVE_CURRENT
Default		Units	A
Type	32 Bit Volatile	Update Rate	250us Write
Display Format	Standard	Decimal Places	3
Coding	RO, FI, VM, ND, NC, PT		

*I<sub>d</sub>*, *Magnetising Current* (04.017) is the instantaneous level of d axis current scaled so that it represents the r.m.s. level of d axis current under steady state conditions.

Parameter	04.018 <i>Final Current Limit</i>		
Short description	Shows the final current limit that is applied to the torque producing current		
Mode	RFC-S		
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-S		
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 Iq as a percentage of rated Iq for the motor		
Mode	RFC-S		
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 *Iq, Torque Producing Current* (04.002) as a percentage of the rated Iq for the motor. Positive values indicate motoring and negative values represent regenerating. It should be noted that if *Active Saliency Torque Mode* (05.066) = 1 indicating that the high saliency motor control system is being used in RFC-S mode that compensation is provided to give a linear relationship between the torque reference and the actual motor torque. This has the effect of making *Percentage Load* (04.020) higher than the torque reference between zero and rated torque reference.

Parameter	04.021 Current Feedback Filter Disable		
Short description	Disables the 4ms filter applied to current feedback parameters		
Mode	RFC-S		
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 *Iq, Torque Producing Current* (04.002) and *Id, 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 250us.

Parameter	04.022 Inertia Compensation Enable		
Short description	Set to enable inertia compensation		
Mode	RFC-S		
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-S		
Minimum	0.0	Maximum	25.0
Default	1.0	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-S		
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-S		
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-S		
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	04.033 Inertia Times 1000		
Short description	Inertia is in 1000kgm <sup>2</sup> units		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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	04.049 Magnetising Current Limit		
Short description	Magnetising Current Limit		
Mode	RFC-S		
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

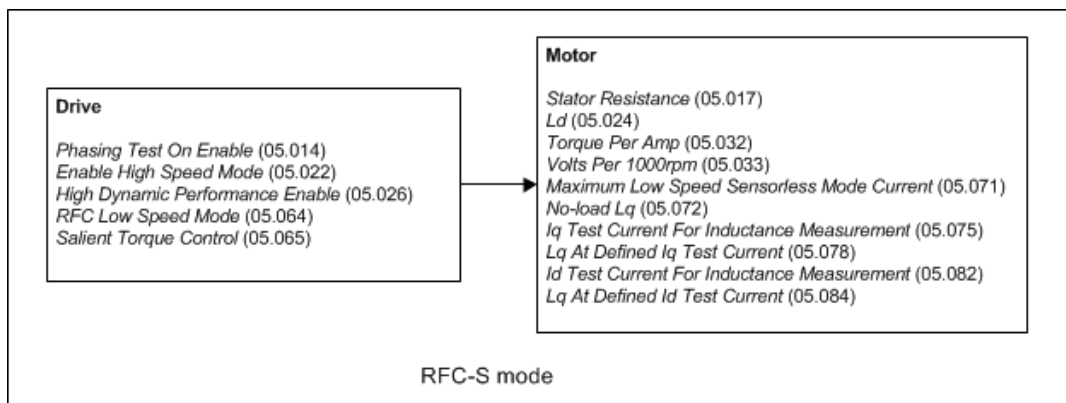
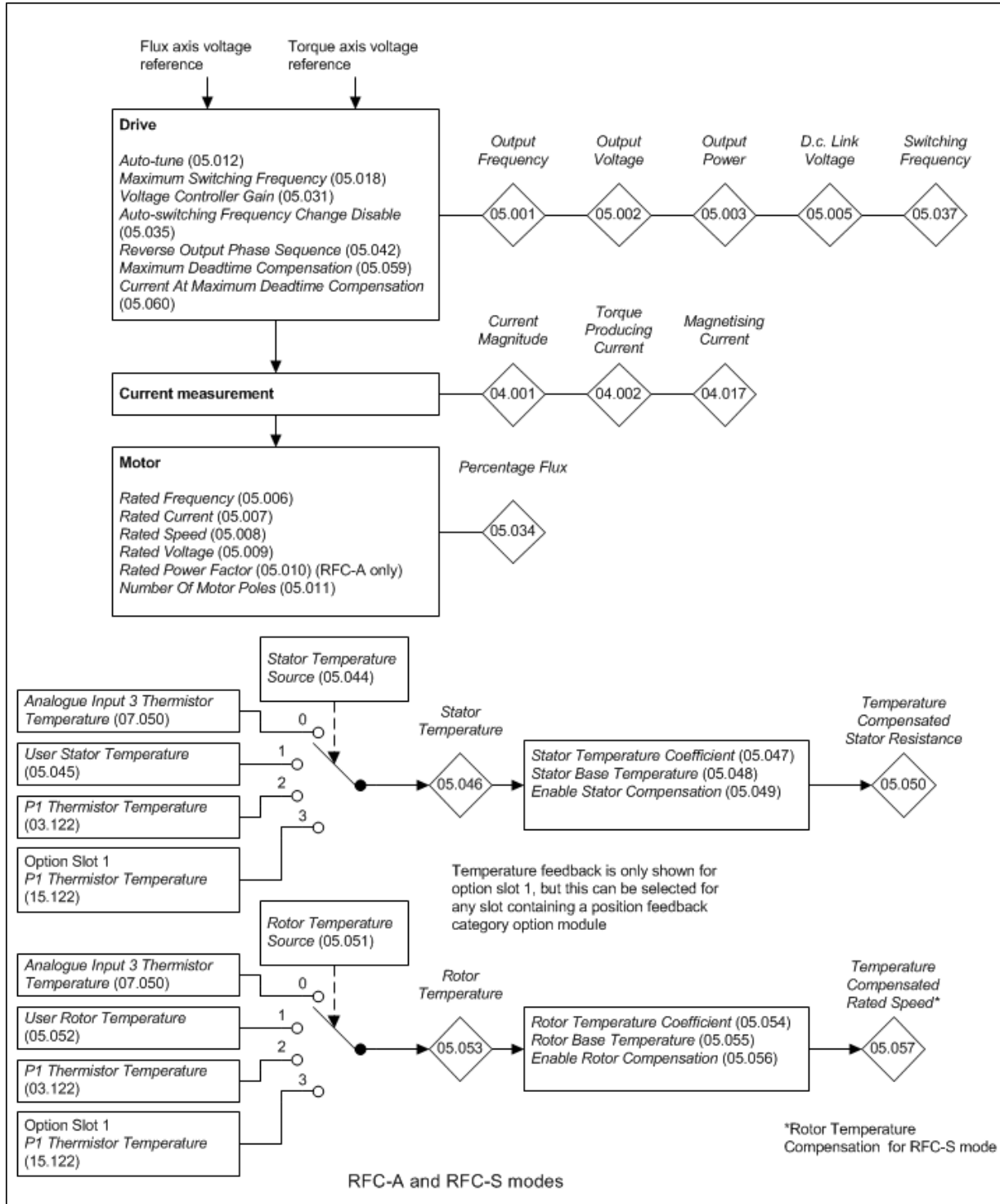
Mode: RFC-S

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
05.007	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 60Hz: 1800.00 rpm	RW	Num				US
05.009	Rated Voltage	±VM_AC_VOLTAGE_SET V	200V drive: 230 V 400V drive 50Hz: 400 V 400V drive 60Hz: 460 V 575V drive: 575 V 690V drive: 690 V	RW	Num		RA		US
05.011	Number Of Motor Poles	Automatic (0) to 480 (240) Poles	8 (4) Poles	RW	Txt				US
05.012	Auto-tune	None (0), Stationary (1), Rotating (2), Inertia 1 (3), Inertia 2 (4), Full Stationary (5)	None (0)	RW	Txt		NC		
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
05.021	Mechanical Load Test Level	0 to 100 %	0 %	RW	Num				US
05.022	Enable High Speed Mode	Limit (-2), Limit (Servo) (-1), Disable (0), Enable (Servo) (1), Enable (2)	Limit (-2)	RW	Txt				US
05.023	D.c. Bus Voltage High Range	±VM_HIGH_DC_VOLTAGE V		RO	Num	ND	NC	PT	FI
05.024	Ld	0.000 to 500.000 mH	0.000 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	0.1 to 10.0	1.0	RW	Num				US
05.028	Torque Linearisation Disable	Off (0) or On (1)	On (1)	RW	Bit				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	1.60 Nm/A	RW	Num				US
05.033	Volts Per 1000rpm	0 to 10000 V	98 V	RW	Num				US
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
05.041	Voltage Headroom	0 to 20 %	10 %	RW	Num				US
05.042	Reverse Output Phase Sequence	Off (0) or On (1)	Off (0)	RW	Bit				US
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
05.063	Sensorless Mode Current Ramp	0.00 to 1.00 s	0.20 s	RW	Num				US
05.064	RFC Low Speed Mode	Injection (0), Current (1), Current (2), Current No Test (3), Current Step (4), Current Only (5)	Current (2)	RW	Txt				US
05.065	Saliency Torque Control Select	Disabled (0), Low (1), High (2), Auto (3)	Disabled (0)	RW	Txt				US
05.066	Active Saliency Torque Mode	Disabled (0), Low (1), High (2)		RO	Txt	ND	NC	PT	
05.067	Over-current Trip Level as Percentage Kc	0 to 100 %	0 %	RW	Num				US
05.068	Actual Over-current Trip Level	0 to 500 %		RO	Num	ND	NC	PT	
05.069	Over-current Trip Level as Percentage of Rated Current	0 to 1000 %	150 %	RW	Num				US
05.070	Inverted Saturation Characteristic	Off (0) or On (1)	Off (0)	RW	Bit				US
05.071	Low Speed Sensorless Mode Current	0.0 to 1000.0 %	100.0 %	RW	Num		RA		US
05.072	No-load Lq	0.000 to 500.000 mH	0.000 mH	RW	Num		RA		US
05.075	q Axis Current For Inductance Values With Current	0 to 200 %	100 %	RW	Num				US
05.077	Phase Offset At Defined Iq Current	±90.0 °	0.0 °	RW	Num		RA		US
05.078	Lq At The Defined Iq Current	0.000 to 500.000 mH	0.000 mH	RW	Num		RA		US
05.082	d Axis Current For Inductance Values With Current	-100 to 0 %	-100 %	RW	Num				US
05.084	Lq At The Defined Id Current	0.000 to 500.000 mH	0.000 mH	RW	Num		RA		US
05.087	User Defined Rated Torque Angle	0 to 90 °	0 °	RW	Num				US
05.088	Estimated Lq	0.000 to 500.000 mH		RO	Num	ND	NC	PT	FI
05.089	Rated Torque Angle	0 to 90 °		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 5 – Motor Control

Mode: RFC-S



Parameter	05.001 Output Frequency		
Short description	Displays the frequency applied to the motor		
Mode	RFC-S		
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-S		
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-S		
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-S		
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	05.007 Rated Current		
Short description	Set to the rated current of the motor		
Mode	RFC-S		
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.
Sensorless low speed mode	The current for low speed sensorless is set-up as a percentage of rated current.
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-S		
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

*Rated Speed* (05.008) is used in conjunction with *Number Of Motor Poles* (05.011) to define the rated frequency and this is used as described in the table below.

Function	Details
Sensorless control thresholds	The thresholds for changes from low speed starting mode to high speed normal operation and vice versa.
Flux controller gain	Rated frequency is to define the gain of the flux controller.

The units for *Rated Speed* (05.008) are always rpm even if a linear motor is used and *Linear Speed Select* (01.055) = 1.

Parameter	05.009 Rated Voltage		
Short description	Set to the rated voltage of the motor		
Mode	RFC-S		
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		

Voltage	Region	Default Value
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. Some headroom must be allowed if high performance is required at higher speeds. It should be noted that this limit is not applied unless *Enable High Speed Mode* (05.022) is set to 1.

*Rated Voltage* (05.009) is used as described in the table below.

Function	Details
Maximum motor voltage	Unless the motor voltage is limited by the maximum output voltage of the inverter the rated voltage value is used as the reference for the flux controller to limit the motor voltage.

Parameter	05.011 Number Of Motor Poles		
Short description	Set to the number of poles of the motor		
Mode	RFC-S		
Minimum	0	Maximum	240
Default	4	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 x 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 = 3 (6 Poles).

Parameter	05.012 Auto-tune		
Short description	Defines the auto-tune test to be performed		
Mode	RFC-S		
Minimum	0	Maximum	5
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	Stationary
2	Rotating
3	Inertia 1
4	Inertia 2
5	Full Stationary

The following describes how an auto-tune test can be initiated and normal operation can be resumed after the test for RFC-S mode:

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.

1. 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.
2. 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.
3. 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 re-applying 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.
4. 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.
5. 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-S 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 are 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 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>Number Of Motor Poles</i> (05.011)	Basic control	User set-up
<i>Stator Resistance</i> (05.017)	Basic control	1, 2, 5
<i>Ld</i> (05.024)	Basic control	1, 2, 5
<i>Maximum Deadtime Compensation</i> (05.059)	Basic control	1, 2, 5
<i>Current At Maximum Deadtime Compensation</i> (05.060)	Basic control	1, 2, 5
<i>Current Controller Kp Gain</i> (04.013)	Basic control	1, 2, 5
<i>Current Controller Ki Gain</i> (04.014)	Basic control	1, 2, 5
<i>Volts Per 1000rpm</i> (05.033)	Basic control	Not currently measured
<i>Inverted Saturation Characteristic</i> (05.070)	Sensorless control using current injection mode	Not currently measured
<i>Phase Offset At Defined Iq Current</i> (05.077)	Sensorless control using current injection mode	Not currently measured
<i>Low Speed Sensorless Mode Current</i> (05.071)	Sensorless control using current injection mode	Not currently measured
<i>No-load Lq</i> (05.072)	Sensorless control and high performance current control	1, 2, 5
<i>Lq At The Defined Iq Current</i> (05.078)	Sensorless control	Not currently measured
<i>Lq At The Defined Id Current</i> (05.084)	Sensorless control	Not currently measured
<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>Torque Per Amp</i> (05.032)	Speed controller set-up and torque feed-forwards	Not currently measured
<i>Position Feedback Phase Angle</i> (03.025)	Basic control with position feedback	1, 2, 5

## 1: Stationary

This test can be used to measure all the necessary parameters for basic control.

1. A test is performed to locate the flux axis of the motor. If *Minimal Movement Phasing Test Angle* (05.016) = 0 then motor inductance measurement is used and the motor should not move, otherwise a minimal movement method is used. See *Minimal Movement Phasing Test Mode* (05.013) for details. If sensorless control is being used (i.e. *Sensorless Mode Active* (03.078) = 1) then inductance measurement is always used.
2. A stationary test is performed to measure *Stator Resistance* (05.017), *Maximum Deadtime Compensation* (05.059) and *Current At Maximum Deadtime Compensation* (05.060).
3. If *Enable Stator Compensation* (05.049) = 1 then *Stator Base Temperature* (05.048) is made equal to *Stator Temperature* (05.046).
4. A stationary test is performed to locate the flux axis of the motor again in case the motor has moved during the previous test.
5. If sensorless mode is not selected (i.e. *Sensorless Mode Active* (03.078) = 0) then the position feedback phasing angle measured during stage 1 of this test is compared with the value measured during this stage of the test. If there is a difference of 30° or more then a *Autotune 1.6* trip is initiated. Otherwise *Position Feedback Phase Angle* (03.025) is set up for the position from the position feedback interface selected with *Motor Control Feedback Select* (03.026). Whether inductance measurement or minimal movement was used to locate the flux *Minimal Movement Phasing Test Angle* (05.016), *Minimal Movement Phasing Test Current* (05.015) and *Minimal Movement Phasing Test Mechanical Load Phase* (05.019) are saved. If inductance measurement is used then the values are set to their default levels. If minimal movement is used then the values are set as a result of the test.
6. A stationary test is performed to measure *Ld* (05.024) and *No-load Lq* (05.072).
7. *Stator Resistance* (05.017) and *Ld* (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.

It should be noted that because this is a stationary or minimal movement test, it is not possible to check the direction of the position feedback. If the motor power connection phase sequence is incorrect so that the position feedback counts in reverse when the drive applies a phase sequence U-V-W to operate in the forward direction then when the drive is enabled after the auto-tune the motor will jump through 90° electrical and stop with a current in the motor defined by the current limits. This can be corrected by changing the drive output phase sequence with *Reverse Output Phase Sequence* (05.042) and then repeating the auto-tuning. This will make the motor rotate correctly in the direction defined by the position feedback rotation. If the position feedback direction is correct the motor will then rotate under control in the required direction, but if the position feedback direction is incorrect the motor will then rotate under control in the wrong direction.

When using any type of encoder with digital commutation signals (i.e. AB Servo) the absolute position is not fully defined until the motor has moved by between 1 and 2 electrical revolutions (i.e. between 120° and 240° mechanical for a 6 pole motor). This means that *Position Feedback Phase Angle* (03.025) can only be measured correctly using motor inductance measurement (i.e. *Minimal Movement Phasing Test Angle* (05.016) = 0). Also if *Position Feedback Phase Angle* (03.025) is measured for a motor using this type of position feedback using a stationary test when the motor has not moved since power-up, or after the position feedback is re-initialised, there can be an error of +/-30° in the result. When the motor subsequently moves, the drive synchronises more accurately to the commutation signal edges and adjusts *Position Feedback Phase Angle* (03.025) to be correct and then saves the value in the drive. If a stationary auto-tune is performed and the motor is not moved by at least 2 electrical revolutions before powering down again this process is not carried out and the auto-tune should be repeated. When an encoder with digital commutation signals is used there is always an error of up to 30° in the phasing angle during starting until the motor has rotated by 1/3 of an electrical revolution. It should be noted that the +/-30° error in the phasing angle can increase this error to 60° and reduce the possible torque by up to 50%. Once the motor has rotated by 2 electrical revolutions full torque will be available.

The stationary test cannot be used with commutation only type devices, and test 2 below should be used instead.

If inductance measurement is being used to locate the flux axis of the motor (see *Minimal Movement Phasing Test Mode* (05.013)) and the motor inductance is very high (i.e. low speed motor with high pole number), or the inductance is moderately high and the drive has a much higher power rating than the motor, then the drive may find it difficult to locate the flux axis. If this is a problem and position feedback is being used then the minimal movement method can be performed instead.

## 2: Rotating

This test can be used to measure all the necessary parameters for basic control. The motor must be unloaded for this test. This test is likely to give a more accurate value for *Position Feedback Phase Angle* (03.025) than auto-tune test 1 for motors with low saliency or no saliency. If  $\text{Volts Per 1000rpm (05.033)} / (\text{Number Of Motor Poles (05.011)} \times (\text{No-load Lq (05.072)} - (\text{Ld (05.024)}) \times \text{Rated Current (05.007)})) < 200$  then the reluctance torque (due to saliency) compared to the torque derived from the magnet flux is too high and this test cannot be used. Note that if sensorless mode is selected Auto-tune 1 test is performed.

1. A rotating test is performed to locate the flux axis of the motor and *Position Feedback Phase Angle* (03.025) is set up for the position from the position feedback interface selected with *Motor Control Feedback Select* (03.026). This is done by rotating the motor by 2 electrical revolutions (i.e. up to 2 mechanical revolutions) in the required direction. *Minimal Movement Phasing Test Angle* (05.016), *Minimal Movement Phasing Test Current* (05.015) and *Minimal Movement Phasing Test Mechanical Load Phase* (05.019) are set to their default values and saved.
2. A stationary test is performed to measure *Stator Resistance* (05.017), *Maximum Deadtime Compensation* (05.059) and *Current At Maximum Deadtime Compensation* (05.060).
3. If *Enable Stator Compensation* (05.049) = 1 then *Stator Base Temperature* (05.048) is made equal to *Stator Temperature* (05.046).
4. A stationary test is performed to measure *Ld* (05.024) and *No-load Lq* (05.072).
5. *Stator Resistance* (05.017) and *Ld* (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.

### 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 (including *Torque Per Amp* (05.032)) 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. *Motor And Load Inertia* (03.018) and *Inertia Times 1000* (04.033) are 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 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  $3/4 \times \text{Rated Speed}$  (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.

### 5: Full Stationary

This test is intended to measure as many parameters as possible without rotating the motor. *Minimal Movement Phasing Test Mode* (05.013) should be set to indicate whether the motor is free or constrained. The test is carried out as follows:

1. The stationary test described above is performed using inductance measurement.
2. If Stage 1 is successful the test is now complete. If position feedback is being used and the test has failed because the saturation characteristic of the motor cannot be measured (*Inductance.004*), the position feedback phasing angle is different by more than  $30^\circ$  between the first and second time the motor flux is located (*Autotune 1.006*), or the motor is not salient enough to use inductance measurement to locate the motor flux (*Inductance.003*) then the stationary test is repeated using minimal movement instead of inductance measurement to locate the motor flux. If *Minimal Movement Phasing Test Angle* (05.016) has a value of zero when the test is started *Minimal Movement Phasing Test Angle* (05.016) is set to an angle equivalent to at least 75 counts from the position feedback device if it is a rotary device and is connected to the P1 position feedback interface on the drive, subject to a minimum of  $0.05^\circ$  if the motor is constrained or  $1.0^\circ$  if the motor is free to rotate. The table below shows how the angle is calculated, subject to a maximum of  $0.5^\circ$  if the motor is constrained or  $5.0^\circ$  if it is free to rotate. If the device is not included in the table, is a linear device or is not connected to the P1 interface then the minimum values are used. If *Minimal Movement Phasing Test Angle* (05.016) is non-zero when the test is started then this value is used. If position feedback is not being used or any other trips occurred during the first stationary test the test is aborted and the drive is tripped.
3. If Stage 2 is successful the test is now complete.

**NOTE: Further stages will be added to this test in the future, and so it should not be assumed that the test will be complete after the stages given above in future software versions.**

Position feedback type	Calculation of minimal movement phasing test angle
AB, FD, FR, AB Servo, FD Servo, FR Servo	$6750 / P1 \text{ Rotary Lines Per Revolution}$ (03.034)
SC, SC Hiperface, SC EnDat, SC SSI, SC Servo, SC SC	$6750 / (P1 \text{ Rotary Lines Per Revolution} \times 256)$
Resolver	$5^\circ$
EnDat, SSI, BiSS	$27000 / 2^{(P1 \text{ Comms Bits} (03.035) - P1 \text{ Rotary Turns Bits} (03.033))}$

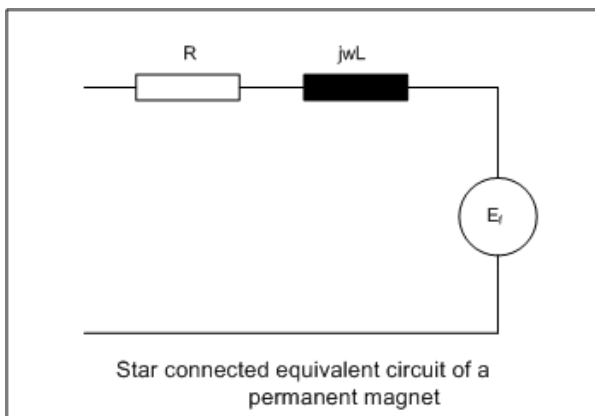
The table below shows the trips that can occur during an auto-tune test:



Trip	Reason
Autotune Stopped	The final drive enable or the final drive run were removed before the test was completed.
Resistance.001	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.
Resistance.002	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).
Autotune 1.001	The position feedback did not change when position feedback is being used.
Autotune 1.002	The motor did not reach the required speed.
Autotune 1.003	The required commutation signal edge could not be found with commutation signal only position feedback.
Autotune 1.004	The required angular movement did not occur during a minimal movement test.
Autotune 1.005	The fine location of the motor flux during a minimal movement test failed.
Autotune 1.006	The phasing offset angle is measured twice during a stationary auto-tune and the two values were not within 30degrees.
Autotune 1.007	The motor was rotating when a minimal movement test was performed to find the phasing offset angle on enable.
Autotune 1.009	During the final stage of the minimal movement phasing test with a constrained motor it was not possible to achieve the required movement.
Autotune 2.001	Position feedback direction is incorrect when position feedback is being used.
Autotune 2.002	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.
Autotune 3.001	The measured inertia exceeds the parameter range.
Autotune 3.003	The mechanical load test has failed to identify the inertia.
Autotune 3.002	A position feedback device with commutation signals is being used (i.e. AB Servo, FD Servo, FR Servo, SC Servo) and the commutation signals changed in the wrong direction.
Autotune 4	A position feedback device with commutation signals is being used (i.e. AB Servo, FD Servo, FR Servo, SC Servo) and U signal did not change.
Autotune 5	A position feedback device with commutation signals is being used (i.e. AB Servo, FD Servo, FR Servo, SC Servo) and V signal did not change.
Autotune 6	A position feedback device with commutation signals is being used (i.e. AB Servo, FD Servo, FR Servo, SC Servo) and W signal did not change.
Autotune 7	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).
Inductance.003	The difference between the d and q axis inductance is not large enough to correctly determine the location of the motor flux. 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. The test is completed and all the parameters saved to non-volatile memory in the drive, but the user should note that the measured results may not be correct. It should be noted that this trip is not produced if sensorless mode is selected and active (i.e. <i>Sensorless Mode Active</i> (03.078) = 1).
Inductance.004	During auto-tune test 1 when position feedback is being used (i.e. <i>Sensorless Mode Active</i> (03.078) = 0), the direction of the flux in the motor must be detected by the change of inductance with different currents. This trip is initiated if the change cannot be detected.

Parameter	05.017 Stator Resistance		
Short description	Defines the resistance of the motor stator		
Mode	RFC-S		
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 motor parameters used by the drive are derived from the star connected per phase equivalent circuit of a permanent magnet motor shown below. Although one value of inductance is shown, for many synchronous motors the flux or direct axis inductance ( $L_d$ ) and the torque or quadrature axis inductance ( $L_q$ ) can be significantly different. Also the q axis inductance can vary significantly with motor current.



Stator Resistance (05.017) = R

$L_d$  (05.024) = L in the d (flux) axis

No-load  $L_q$  (05.072) = L in the q (torque) axis with no current in the motor

$L_q$  At The Defined  $I_q$  Current (05.078) = L in the q axis with  $I_d = 0$  and  $I_q = L_q$  At The Defined  $I_q$  Current (05.078)

$L_q$  At The Defined  $I_d$  Current (05.084) = L in the q axis with  $I_d = L_q$  At The Defined  $I_d$  Current (05.084) and  $I_q = 0$ .

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-S		
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	05.021 <i>Mechanical Load Test Level</i>		
Short description	Mechanical Load Test Level		
Mode	RFC-S		
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	05.022 <i>Enable High Speed Mode</i>		
Short description	Set to 1 to enable high speed mode		
Mode	RFC-S		
Minimum	-2	Maximum	2
Default	-2	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
-2	Limit
-1	Limit (Servo)
0	Disable
1	Enable (Servo)
2	Enable

Care must be taken when high speed mode is not set to Disable (0) to avoid damaging the drive. The voltage produced by the magnet flux is proportional to speed. For high speed operation the drive must apply currents to the motor to counter-act the flux produced by the magnets. It is possible to operate the motor at very high speeds that would give a very high motor terminal voltage, but this voltage is prevented by the action of the drive. If however, the drive is disabled (or tripped) when the motor voltages would be higher than the rating of the drive without the currents to counter-act the flux from the magnets, it is possible to damage the drive. If high speed mode is enabled the motor speed must be limited to the levels given in the table below unless an additional hardware protection system is used to limit the voltages applied to the drive output terminals to a safe level.

Drive voltage rating	Maximum motor speed (rpm)	Maximum safe line to line voltage at the motor terminals (V r.m.s.)
200	$400 \times 1000 / (K_e \times \sqrt{2})$	$400 / \sqrt{2}$
400	$800 \times 1000 / (K_e \times \sqrt{2})$	$800 / \sqrt{2}$
575	$955 \times 1000 / (K_e \times \sqrt{2})$	$955 / \sqrt{2}$
690	$1145 \times 1000 / (K_e \times \sqrt{2})$	$1145 / \sqrt{2}$

$K_e$  is the ratio between r.m.s. line to line voltage produced by the motor and the speed in V/1000rpm.

**Disabled (0):**

The motor flux is not modified to limit the motor voltage to the level defined by *Rated Voltage* (05.009). The motor voltage will increase as the speed is increased until the motor line to line voltage  $\times \sqrt{2}$  is equal to the d.c. link voltage (*D.c. Bus Voltage* (05.005)). It will not be possible to further increase the speed significantly. This mode is safe because the motor voltage with no current flowing in the motor cannot exceed a level that can damage the drive. It should be noted that if Disable mode is selected, but saliency torque is being exploited (i.e. *Active Saliency Torque Mode* (05.066) is non-zero) then the drive automatically provides protection against damage by operating in Limit (Servo) mode as described below.

**Limit (Servo) (-1):**

The motor flux is modified to limit the motor voltage to the level defined by *Rated Voltage* (05.009). An *Over Speed.1* trip is initiated if the measured motor speed exceeds the levels defined in the table above to protect the drive. This mode is intended for dynamic servo type applications with motors that have relatively low saliency. If control using saliency is disabled, or it is enabled but the motor has low saliency (i.e. *Active Saliency Torque Mode* (05.066) is showing disabled or low saliency operation) then the drive will not restrict the torque requested from the motor to prevent the motor from exceeding its voltage based torque limit. If the motor is operated at or close to this limit it can become unstable, or the drive can lose control of the motor. This is not generally a problem for servo motors as they do not go close to their torque limit or only operate transiently in flux weakening during the last part of their acceleration to maximum speed, and so the flux controller is too slow to provide much flux weakening. Limit (Servo) mode should not be used with high saliency motors (i.e. *Active Saliency Torque Mode* (05.066) is showing high saliency operation), and so if this is selected for a high saliency motor the drive will automatically operate in Limit mode as described below.

**Limit (-2):**

This is similar to Limit (Servo) mode except that the motor torque is restricted to prevent the drive from operating close to, or beyond, the voltage based torque limit of the motor. This prevents the motor from operating in a region where it could become unstable, or the drive could lose control of the motor. This is not generally a problem for servo motors as they do not go close to their torque limit or only operate transiently in flux weakening during the last part of their acceleration to maximum speed, and so the flux controller is too slow to provide much flux weakening. However, for more general purpose motors for slower applications, such as fans and pumps, it may be necessary for the drive to prevent the motor from operating close to its voltage based torque limit.

**Enable (Servo) (1):**

This is similar to Limit (Servo) mode except that a trip is not produced if the motor speed exceeds the maximum safe level. An indication that cannot be cleared is stored in *Potential Drive Damage Conditions* (10.106) and saved on power-down. The motor manufacturer should always be consulted before using this mode as care must be taken not to de-magnetise the motor.

**Enable (2):**

This is similar to Limit mode except that a trip is not produced if the motor speed exceeds the maximum safe level. An indication that cannot be cleared is stored in *Potential Drive Damage Conditions* (10.106) and saved on power-down. The motor manufacturer should always be consulted before using this mode as care must be taken not to de-magnetise the motor.

Parameter			
<b>05.023 D.c. Bus Voltage High Range</b>			
Short description			
Displays the d.c. bus level but with a higher range			
Mode			
RFC-S			
Minimum		Maximum	
-VM_HIGH_DC_VOLTAGE		VM_HIGH_DC_VOLTAGE	
Default		Units	
		V	
Type		Update Rate	
16 Bit Volatile		Background read	
Display Format		Decimal Places	
Standard		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			
<b>05.024 Ld</b>			
Short description			
Defines the inductance in the flux axis			
Mode			
RFC-S			
Minimum		Maximum	
0.000		500.000	
Default		Units	
0.000		mH	
Type		Update Rate	
32 Bit User Save		Background read	
Display Format		Decimal Places	
Standard		3	
Coding			
RW, RA			

Flux or direct axis inductance.

*Ld* (05.024) is used as described in the table below.

Function	Details
Current controller gain set-up	During auto-tuning <i>Ld</i> is used in calculating the current controller gains.
High performance current control	If high performance current control is selected ( <i>Current Controller Mode</i> (04.030) = 1) <i>Ld</i> is used by the controller in d axis.
Low speed operation with sensorless control	If injection mode is used ( <i>RFC Low Speed Mode</i> (05.064) = 0) for low speed operation <i>Ld</i> defines the gain of the system.
Flux controller gain	<i>Ld</i> is used in deriving the gain of the controller which controls the motor voltage at high speed.
Motor torque limit	<i>Ld</i> is used in defining the torque limit for high saliency motors.
High saliency motor torque linearisation	<i>Ld</i> is used to linearise the torque if <i>Torque Linearisation Disable</i> (05.028) = 0.

The torque or quadrature axis inductance is defined in other parameters. See *No-load Lq* (05.072) for more details.

Parameter			
<b>05.026 High Dynamic Performance Enable</b>			
Short description			
Set to 1 to enable High Dynamic Performance			
Mode			
RFC-S			
Minimum		Maximum	
0		1	
Default		Units	
0			
Type		Update Rate	
1 Bit User Save		Background read	
Display Format		Decimal Places	
Standard		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-S		
Minimum	0.1	Maximum	10.0
Default	1.0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW		

If *Flux Control Gain* (05.027) is set to the default value of unity the system that controls the motor voltage is automatically set up based on the motor parameters to give stable operation under most conditions. Some motors which have concentrated windings can cause significant harmonic currents which in turn disturb the voltage controller at higher speeds where the voltage controller is active to limit the motor voltage. To reduce this effect the gain can be reduced. The gain can also be increased for applications with fast acceleration to improve the response of the voltage controller in limiting the motor voltage.

Parameter	05.028 Torque Linearisation Disable		
Short description	Torque Linearisation Disable		
Mode	RFC-S		
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		

If high saliency control is active (i.e. *Active Saliency Torque Mode* (05.066) = 2) the drive applies compensation to give approximately a linear relationship between the torque reference and actual torque for speed and torque control modes. In some cases this may introduce unacceptable system noise. If *Torque Linearisation Disable* (05.028) is left at its default value of 0 the linearisation system is active. If *Torque Linearisation Disable* (05.028) is set to 1 then the linearisation system is disabled. Torque linearisation is disabled if sensorless mode is active, i.e. *Sensorless Mode Active* (03.078) = 1.

Parameter	05.031 Voltage Controller Gain		
Short description	Defines the proportional gain of the d.c. link voltage controller		
Mode	RFC-S		
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	Defines the torque per amp constant (Kt) for the motor		
Mode	RFC-S		
Minimum	0.00	Maximum	500.00
Default	1.60	Units	Nm/A
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW, BU		

*Torque Per Amp* (05.032) is used for automatic speed controller gain set up and to calculate the inertia in autotune tests 3 and 4, and so the correct value for the motor should be entered if these features are used.

Parameter	05.033 Volts Per 1000rpm		
Short description	Volts per 1000rpm		
Mode	RFC-S		
Minimum	0	Maximum	10000
Default	98	Units	V
Type	16 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

*Volts Per 1000rpm* (05.033) defines the r.m.s. line voltage produced by the motor flux at 1000rpm, i.e. running at this speed with no current in the motor.

*Volts Per 1000rpm* (05.033) is used as described in the table below.

Function	Details
Voltage feed-forwards	Provides voltage feed-forwards for the current control system.
Over-speed protection	Ke is used to determine the trip speed if <i>Enable High Speed Mode</i> (05.022) is set to Limit mode
Rated torque angle	If the drive defines <i>Rated Torque Angle</i> (05.089) no-load Lq is used in the calculation.
Spin start	Ke is used to define a threshold to detect when the motor is at standstill and spin start is not required.

Parameter	05.035 Auto-switching Frequency Change		
Short description	Defines auto-switching frequency control with thermal model		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
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	05.041 Voltage Headroom		
Short description	Voltage Headroom		
Mode	RFC-S		
Minimum	0	Maximum	20
Default	10	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-S		
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	05.059 Maximum Deadtime Compensation		
Short description	Shows the deadtime compensation used to compensate for dead-time effects in the inverter		
Mode	RFC-S		
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-S		
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 Disable Deadtime Compensation		
Short description	Disable Deadtime Compensation		
Mode	RFC-S		
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	05.063 Sensorless Mode Current Ramp		
Short description	Sensorless Mode Current Ramp		
Mode	RFC-S		
Minimum	0.00	Maximum	1.00
Default	0.20	Units	s
Type	8 Bit User Save	Update Rate	Background Write
Display Format	Standard	Decimal Places	2
Coding	RW		

See *RFC Low Speed Mode* (05.064).

Parameter	05.064 RFC Low Speed Mode		
Short description	Defines the low speed mode of the drive when position feedback is not being used		
Mode	RFC-S		
Minimum	0	Maximum	5
Default	2	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text	Description
0	Injection	High frequency injection mode
1	Current	Current vector mode with initial test to determine the rotor position
2	Current	Current vector mode with initial test to determine the rotor position
3	Current No Test	Current vector mode without initial test to determine the rotor position
4	Current Step	Current vector mode with no test and step changes in current between low/high speed modes
5	Current Only	Current vector mode always active

If sensorless mode is being used and is active (i.e. *Sensorless Mode Active* (03.078) = 1) and the motor is operating at low speed then a low speed algorithm must be used to control the motor. The change between the low speed and normal operation algorithms is related to the drive output frequency. An upper threshold is provided for the change from low speed to normal operation, and a lower threshold is provided for the change back from normal to low speed operation as given in the table below. These values are a percentage of *Rated Speed* (05.008). If high saliency control is being used (*Active Saliency Torque Mode* (05.066) = 2) then the lower threshold is always 15% and the upper threshold is 20%.

Switching Frequency (05.037)	Lower Threshold	Upper Threshold
2kHz	5%	10%
3kHz	5%	10%
4kHz	5%	10%
6kHz	10%	15%
8kHz	10%	15%
12kHz	15%	20%
16kHz	15%	20%

*RFC Low Speed Mode* (05.064) is used to select the algorithm to be used as described below. The following should be noted:

1. Current modes should not be used for motors with high saliency.
2. Torque control can be used with the "Injection" starting method in the same way as with position feedback. However if torque control is to be used in an application where the other starting methods are used then the following should be considered: Torque control should not be enabled until the low speed algorithm is no longer active and the motor speed must not drop to a level where the low speed mode will become active again while torque control is active. This means that the motor must be started in speed control and torque control should only be selected when the speed is high enough. To stop the motor the drive can simply be disabled or the run command should be removed for the drive to stop the motor. Removing the run causes the drive to switch from torque control to speed control, and so the motor speed can be reduced back down though the range where the low speed algorithm is active.

#### 0: Injection

A high frequency signal is injected into the motor to detect the motor flux axis. For this to operate correctly the motor must remain salient while the low speed mode is active. The no-load inductance parameters are checked by the drive on enable and if the motor is not sufficiently salient then a *Inductance* trip is initiated. See the details of this trip for the inductances required. Generally the q axis inductance falls as the q axis current is increased, i.e. the motor is loaded. While low speed operation is active the drive will apply a current limit defined by *Low Speed Sensorless Mode Current* (05.071) to prevent the q axis inductance from falling to a level that would cause the motor to become non-salient. It will be necessary to limit the bandwidth of the speed controller to a level of 10Hz or less for stable operation particularly at low speeds. Provided these conditions are met this method can be used in the same way as control with position feedback, but the control performance is limited.

#### 1 or 2: Current

This method, which applies a rotating current vector at the frequency defined by the speed reference, can be used with any motor with no saliency or moderate saliency. It should only be used with motors where more of the torque is produced in conjunction with the magnet flux rather than from saliency torque. This mode does not provide the same level of control at low speed as injection mode, but is easier to set up and more flexible than "Non-salient" mode. The following should be considered:

1. Only speed control can be used when low speed mode operation is active.
2. A current specified by *Low Speed Sensorless Mode Current* (05.071) is applied when low speed mode is active. This current should be sufficient to start the motor with the highest expected load. If the motor has some saliency with no-load applied, and a suitable saturation characteristic, the drive can detect the rotor position and apply the current at the correct angle to avoid starting transient. If the motor is non-salient as defined by the conditions for *Inductance* trip then the drive will not attempt to detect the rotor position and the current will be applied at an arbitrary angle. This could cause a starting transient if the level of current applied is high, and so *Low Speed Sensorless Mode Current* (05.071) should not be set to a higher level than necessary. To minimise the movement as a result of applying the current, it is increased over the period defined by *Sensorless Mode Current Ramp* (05.063) in the form of a squared characteristic (i.e. it is increased with a low rate of change at the beginning and the rate of change is gradually increased).
3. It is not possible to measure the motor inertia using auto-tuning with *Auto-tune* (05.012) = 4.
4. As the level of current when low speed mode is active is not dependent on the applied load, but is as defined by *Low Speed Sensorless Mode Current* (05.071), and so the motor may become too hot if low speed mode is active for a prolonged period of time.
5. Generally *Low Speed Sensorless Mode Current* (05.071) should be set to a level higher than the expected maximum load, and can be set to a much higher level than the load if the saliency and saturation characteristic allow the position of the rotor to be detected on starting. However, *Low Speed Sensorless Mode Current* (05.071) should be matched more closely to the expected load under the following conditions: the load inertia is high compared to the motor inertia, or there is very little damping/loss in the load system, or where the q axis inductance of the motor changes significantly with load.

#### 3: Current no test

The "Current" method is used, but no attempt is made to determine the position of the rotor before applying the current. This can be selected for example, if the motor does not have a suitable saturation characteristic to allow the rotor position to be determined during starting, or if faster starting is required. The initial current vector angle will be at an arbitrary position with respect to the actual rotor position. As the vector sweeps round it must make the rotor start to rotate. If the ramp rate is too high the rotor may not keep up with the current vector and the motor may not start. If this is the case then the ramp rate should be reduced and/or the current used to start the motor should be increased.

#### 4: Current step

The current starting modes normally provide a smooth transition between the low speed current mode and normal running at higher speeds. If the drive accelerates very rapidly and only spends short periods of time in each mode the transition smoothing can malfunction. "Current step" mode is similar to "Current no test" mode except that the transition smoothing is disabled. It is not advisable to use this mode unless it is necessary as torque transients will occur when changing between low speed and normal running operation.

#### 5: Current only

The "Current" method is used, but no attempt is made to determine the position of the rotor before applying the current. The system remains in this starting mode at all speeds and does not change to the normal operating algorithms. This provides a very basic open-loop control method, that is not recommended for most applications. Flux weakening is not possible, and so this method will not operate correctly when the motor voltage approaches the maximum voltage available from the drive.

The current applied to the motor is always the level defined by *Low Speed Sensorless Mode Current* (05.071) and the frequency is defined by the frequency reference. The following should be noted:

1. It is possible that the motor may become unstable especially on light load.
2. The current in the motor will always be at the level defined by *Low Speed Sensorless Mode Current* (05.071) whatever the load. Care should be taken not to overheat the motor.
3. The speed feedback provided is derived from the reference, and so it does not necessarily represent the actual speed of the motor.

Parameter	05.065 Saliency Torque Control Select		
Short description	Set the required saliency torque control mode		
Mode	RFC-S		
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	Disabled
1	Low
2	High
3	Auto

Most permanent magnet motors include some saliency due to saturation and physical construction. Torque is normally produced by interaction between the magnet flux and the stator current, but any saliency can be exploited to produce additional torque, which can increase the torque per amp produced by the motor. If *Saliency Torque Control Select* (05.065) = 0 (disabled) torque is only produced from the magnet flux. If *Saliency Torque Control Select* (05.065) = 3 (auto) then torque can be produced from saliency and the mode to do this is selected automatically based on the value of *Rated Torque Angle* (05.089). If the torque produced by the magnet flux is more than twice the torque produced by saliency under rated conditions then *Rated Torque Angle* (05.089) < 30°, and under these conditions low saliency mode is selected, otherwise high saliency mode is selected. It is possible to specifically choose the saliency mode, *Saliency Torque Control Select* (05.065) = 1 gives low saliency mode and *Saliency Torque Control Select* (05.065) = 2 gives high saliency mode. It should be noted that if *Rated Torque Angle* (05.089) = 0 that the saliency mode remains disabled. *Active Saliency Torque Mode* (05.066) shows which mode is active.

Low saliency mode is for motors where a majority of the torque is produced from magnet flux, and high saliency mode is for motors where significant torque is produced from saliency. The following are affected by the mode used:

1. At higher speeds there is a limit on the amount of torque that can be produced by the motor for a given motor terminal voltage. Different algorithms are used to impose this limit depending on which mode is selected. The method used with low saliency mode can be enabled or disabled depending on the setting of *Enable High Speed Mode* (05.022).
2. Different methods are used during flux weakening at higher speeds to control the motor.
3. Different sensorless control algorithms are used. The parameters required for the sensorless algorithms are similar except for the q axis inductance when the motor is operating on load. See *No-load Lq* (05.072) for more details.

Parameter	05.066 Active Saliency Torque Mode		
Short description	Active Saliency Torque Mode		
Mode	RFC-S		
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	Disabled
1	Low
2	High

*Active Saliency Torque Mode* (05.066) shows which saliency torque control mode is active. See *Saliency Torque Control Select* (05.065) for more details.

Parameter	05.067 Over-current Trip Level as Percentage Kc		
Short description	Over-current trip level as a percentage of Kc		
Mode	RFC-S		
Minimum	0	Maximum	100
Default	0	Units	%
Type	8 Bit User Save	Update Rate	Background Read When Drive Not Active
Display Format	Standard	Decimal Places	0
Coding	RW, BU		



The drive provides an over-current trip to disable the inverter quickly if the instantaneous current from the drive exceeds a specific level. This trip is provided to protect the drive in case a short circuit is applied to the outputs, but it also prevents the current into the motor from exceeding a specific maximum level. If *Over-current Trip Level as Percentage Kc* (05.067) and *Over-current Trip Level as Percentage of Rated Current* (05.069) are left at their default values of zero then the default over-current trip level is used (which is provided to protect the drive) and is set to the maximum possible safe level of current. The trip occurs when the r.m.s. output current corresponds to *Full Scale Current Kc* (11.061) (plus a margin for cable charging currents with smaller drives). The instantaneous trip level is  $\sqrt{2}$  times the r.m.s. level. Unless there is a reason to limit the peak current in the motor further then these parameters should be left at their default values.

If *Over-current Trip Level as Percentage of Rated Current* (05.069) is set to a non-zero value it defines the over-current trip level as a percentage of the rated current (where the rated current is defined by *Rated Current* (05.007) or *M2 Rated Current* (21.007)). If *Over-current Trip Level as Percentage of Rated Current* (05.069) is non-zero then *Over-current Trip Level as Percentage Kc* (05.067) has no effect. The actual setting of the over-current trip in the hardware is relatively coarse, and so the trip level may be less than the selected setting. For this reason *Actual Over-current Trip Level* (05.068) shows the actual trip level as a percentage of rated current when *Over-current Trip Level as Percentage of Rated Current* (05.069) is used to define the trip level. As the over-current trip is normally reduced to protect a motor, using *Over-current Trip Level as Percentage of Rated Current* (05.069) to define this is the preferred method.

If required, the over-current trip level can be set as a percentage of *Full Scale Current Kc* (11.061) using *Over-current Trip Level as Percentage Kc* (05.067). Again due to the coarse setting in the drive hardware the actual over-current trip level may be less than the required level, and so *Actual Over-current Trip Level* (05.068) shows the actual trip level as a percentage of *Full Scale Current Kc* (11.061) when *Over-current Trip Level as Percentage Kc* (05.067) is used to define this. Either a value of zero should be used, so that the default level is applied (assuming *Over-current Trip Level as Percentage of Rated Current* (05.069) = 0) or a value from 10% to 100% should be used to define the level as a percentage of Kc. (Note there are settings from 1 to 9 which are only provided for legacy reasons and should not normally be used where the percentage is given by (*Over-current Trip Level as Percentage Kc* (05.067) + 1) x 10%.)

It should be noted that if the over-current trip level is reduced, it may be necessary to reduce the current limits from their default levels so that the maximum controllable current in the drive does not exceed the over-current trip level during normal operation, or else spurious trips will be produced.

Parameter 05.068 Actual Over-current Trip Level			
Short description		Actual Over-current Trip Level	
Mode		RFC-S	
Minimum	0	Maximum	500
Default		Units	%
Type	16 Bit Volatile	Update Rate	Background Write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *Over-current Trip Level as Percentage Kc* (05.067).

Parameter 05.069 Over-current Trip Level as Percentage of Rated Current			
Short description		Over-current trip level as a percentage of rated current	
Mode		RFC-S	
Minimum	0	Maximum	1000
Default	150	Units	%
Type	16 Bit User Save	Update Rate	Background Read When Drive Not Active
Display Format	Standard	Decimal Places	0
Coding	RW		

If this parameter has a non-zero value it overrides *Over-current Trip Level as Percentage Kc* (05.067) and the over-current trip level is calculated as a percentage of the motor rated current. See *Over-current Trip Level as Percentage Kc* (05.067) for more details. For some drive derivatives the default for *Over-current Trip Level as Percentage of Rated Current* (05.069) is non-zero. If this is the case, the lower level has been provided to protect motors where the demagnetisation level is relatively low. Before increasing this parameter the maximum allowed motor current MUST be checked to ensure that the over-current trip level is not above this level or else the motor may be PERMANENTLY DAMAGED.

Parameter 05.070 Inverted Saturation Characteristic			
Short description		The motor has an inverted saturation characteristic	
Mode		RFC-S	
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 change of motor inductance with flux producing current is used to determine the flux direction in a permanent magnet motor. To do this the drive must know what type of saturation characteristic the motor has. Normally an increase in flux producing current reduces  $L_d$  because the motor becomes more saturated. For some motors increasing the flux producing current can modify the flux path and  $L_d$  increases with increased flux producing current. For normal motors *Inverted Saturation Characteristic* (05.070) should be left at its default value of zero, however, for motors with an apparent inverse saturation characteristic *Inverted Saturation Characteristic* (05.070) should be set to one. *Inverted Saturation Characteristic* (05.070) has an affect on the following:

Function	Details
Stationary auto-tune with position feedback	The saturation characteristic is used when the drive determines the angle between the position feedback and the motor flux <i>Position Feedback Phase Angle</i> (03.025). If the saturation characteristic is incorrect there will be an error of 180° in the result.
Measurement of the position feedback phase angle during starting with position feedback	If <i>Minimal Movement Phasing Test Angle</i> (05.016) is set to zero then inductance measurement is used to location the motor flux on starting. If <i>Inverted Saturation Characteristic</i> (05.070) is incorrect then there will be a 180° error in the value of <i>Position Feedback Phase Angle</i> (03.025).
Starting in sensorless mode using injection starting	If <i>RFC Low Speed Mode</i> (05.064) = 0 (Injection) the saturation characteristic is used to correctly align the system with the motor flux. If this is incorrect the operation when starting will be very unstable and the motor may operate in the wrong direction.

Parameter 05.071 Low Speed Sensorless Mode Current			
Short description		Maximum current limit for low speed injection mode or magnetising current for low speed non-salient mode	
Mode		RFC-S	
Minimum	0.0	Maximum	1000.0
Default	100.0	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, RA		

See *RFC Low Speed Mode* (05.064).

Parameter	05.072 No-load Lq		
Short description	q axis inductance with no motor current		
Mode	RFC-S		
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		

The torque or quadrature axis inductance (Lq) is used for a number of functions in the drive as shown in the table below.

Function	Details
High performance current control	If high performance current control is selected ( <i>Current Controller Mode</i> (04.030) = 1) Lq is used by the controller in q axis.
Low speed operation with sensorless control	If injection mode is used ( <i>RFC Low Speed Mode</i> (05.064) = 0) for low speed operation Lq defines the gain of the system.
Control above low speeds with sensorless control	No-load Lq is used in the system that actively calculates the value of Lq with changing motor currents which is used to calculate the rotor position. See below this table.
Rated torque angle	If the drive defines <i>Rated Torque Angle</i> (05.089) , because it has not been defined (i.e. <i>User Defined Rated Torque Angle</i> (05.087) = 0) then the dynamically calculated value of Lq (see below this table) is used in the calculation.
Motor torque limit	No-load Lq (not the dynamic value described below this table) is used in calculating the torque limit for high saliency motors.
High saliency motor torque linearisation	Lq at the motor operating point under rated conditions is used to linearise the torque if <i>Torque Linearisation Disable</i> (05.028) = 0.

The value of Lq is usually affected by the level of d and q axis motor current, and so the drive can estimate Lq dynamically as the current levels change. The following parameters are also used in the system that calculates the value of Lq with different levels of motor current:

*q Axis Current For Inductance Values With Current* (05.075)  
*Lq At The Defined Iq Current* (05.078)  
*d Axis Current For Inductance Values With Current* (05.082)  
*Lq At The Defined Id Current* (05.084)

Lq is estimated using a flat 3D surface (plane) based on the level of Id and Iq. Id is always assumed to be negative. The effect of Iq is the same whether it is positive or negative, and so |Iq| is used. The plane is defined by

$$Lq = A + B \times Id + C \times |Iq|$$

where

$$\Delta Id = d \text{ Axis Current For Inductance Values With Current (05.082)} \times \text{Rated Current (05.007)} / 100\%$$

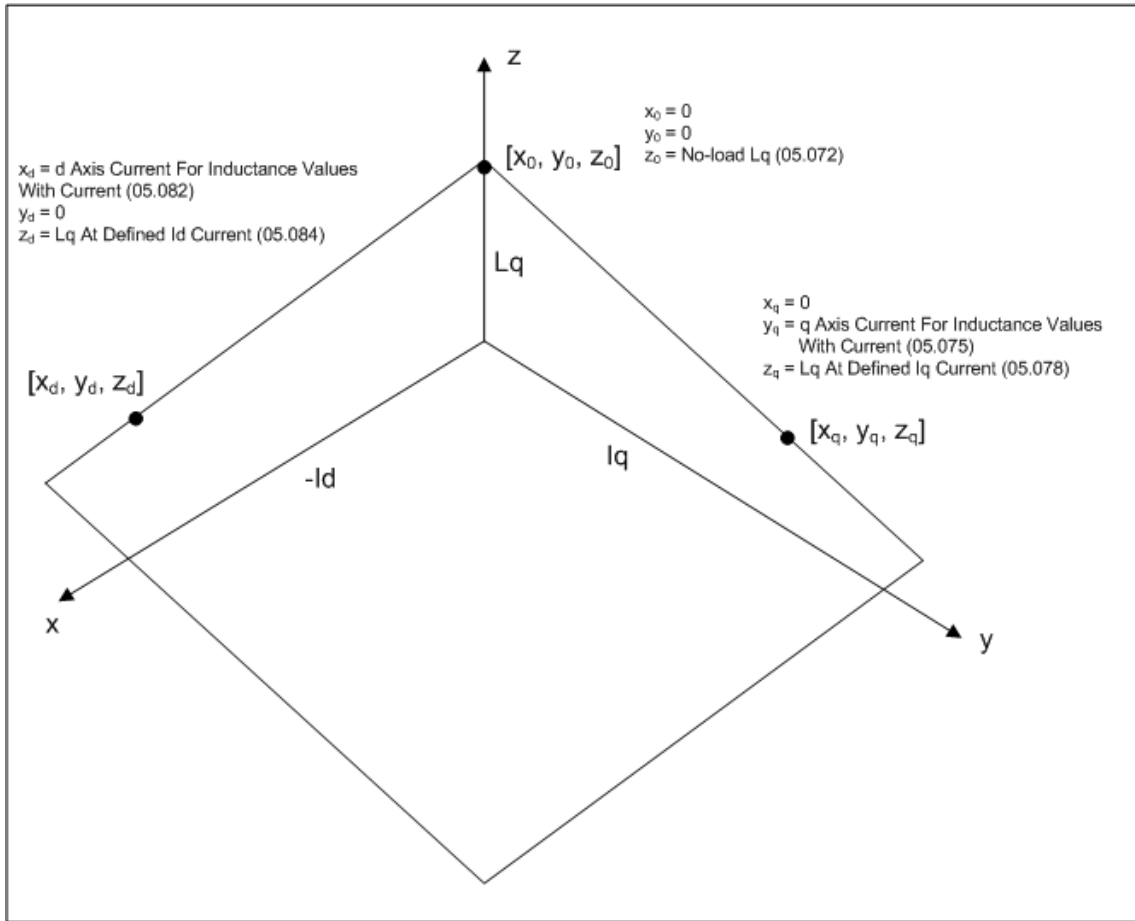
$$\Delta Iq = q \text{ Axis Current For Inductance Values With Current (05.075)} \times \text{Rated Current (05.007)} / 100\%$$

$$A = \text{No-load Lq (05.072)}$$

$$B = (Lq \text{ At The Defined Id Current (05.084)} - \text{No-load Lq (05.072)}) / \Delta Id$$

$$C = (Lq \text{ At The Defined Iq Current (05.078)} - \text{No-load Lq (05.072)}) / \Delta Iq$$

The default current levels for *Lq At The Defined Id Current* (05.084) and *Lq At The Defined Iq Current* (05.078) are -100% (of rated current) and 100% (of rated current) respectively. This ensures that the operating point for the motor (i.e. at rated current) is always on the flat surface within the range of the three points that define it (*No-load Lq* (05.072), (*Lq At The Defined Id Current* (05.084) and (*Lq At The Defined Iq Current* (05.078))). The plane extends beyond the range covered, but the estimated value of Lq is never allowed to go below zero.



No-load Lq (05.072) should be set to the correct value or measured using auto-tuning. For some motors it is not necessary to set Lq At The Defined Id Current (05.084) or Lq At The Defined Iq Current (05.078) because of the behaviour of the drive with specific values.

Parameter value for specific behaviour	Effect	Suitable for...
Lq At The Defined Iq Current (05.078) = 0.000mH Default = 0.000mH	$C = -0.2 \times \text{No-load } Lq (05.072) / \Delta Iq$	Low saliency motors where the change in Lq is less than or equal to 20% of the no-load value under rated conditions.
q Axis Current For Inductance Values With Current (05.075) = 0% Default = 100%	$C = 0$	Low saliency motors where the change in Lq is minimal.
Lq At The Defined Id Current (05.084) = 0.000mH Default = 0.000mH	$B = 0$	All motors where the change in Lq where the change in Lq with Id is relatively small.
Lq At The Defined Id Current (05.084) = 0% Default = 100%	$B = 0$	All motors where the change in Lq where the change in Lq with Id is relatively small.

Parameter	05.075 q Axis Current For Inductance Values With Current		
Short description	q axis current level corresponding to the inductance values with current		
Mode	RFC-S		
Minimum	0	Maximum	200
Default	100	Units	%
Type	8 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

See No-load Lq (05.072).

Parameter	05.077 Phase Offset At Defined Iq Current		
Short description	Defines the change in electrical angle between the point of minimum inductance around the motor as load is applied		
Mode	RFC-S		
Minimum	-90.0	Maximum	90.0
Default	0.0	Units	°
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	1
Coding	RW, RA		

Phase Offset At Defined Iq Current (05.077) defines the offset of the point of minimum inductance as an electrical angle from the point with no current in the motor to the point with a level of Iq equivalent to q Axis Current For Inductance Values With Current (05.075). When the value is left at its default value of zero no compensation for phase offset with changes in Iq are made. Phase Offset At Defined Iq Current (05.077) is used for low speed RFC sensorless control using injection mode. A positive value advances the point of minimum inductance with positive Iq. See RFC Low Speed Mode (05.064). For most motors a value of zero is acceptable.

Parameter	05.078 Lq At The Defined Iq Current		
Short description	q axis inductance at the defined Iq current for the inductance values		
Mode	RFC-S		
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 *No-load Lq* (05.072).

Parameter	05.082 d Axis Current For Inductance Values With Current		
Short description	d axis current level corresponding to the inductance values with current		
Mode	RFC-S		
Minimum	-100	Maximum	0
Default	-100	Units	%
Type	8 Bit User Save	Update Rate	Background Read
Display Format	Standard	Decimal Places	0
Coding	RW		

See *No-load Lq* (05.072).

Parameter	05.084 Lq At The Defined Id Current		
Short description	q axis inductance at the defined Id current for the inductance values		
Mode	RFC-S		
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 *No-load Lq* (05.072).

Parameter	05.087 User Defined Rated Torque Angle		
Short description	User defined rated torque angle which will override the drive auto-calculated value.		
Mode	RFC-S		
Minimum	0	Maximum	90
Default	0	Units	°
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

*Rated Torque Angle* (05.089) defines the amount of torque and flux producing current required to give maximum torque from the motor with rated current (i.e. *Rated Current* (05.007)) including any torque produced from saliency. The torque angle is the angle between the q axis of the motor and the current vector required to produce the torque. This is also referred to as the current angle or phase advance angle. If *Saliency Torque Control Select* (05.065)  $\geq 1$  the drive will try and exploit the saliency torque of the motor by applying some negative d axis current. If *User Defined Rated Torque Angle* (05.087) is changed from its default value of zero and *Saliency Torque Control Select* (05.065)  $\geq 1$ , the value entered in *User Defined Rated Torque Angle* (05.087) is written directly to *Rated Torque Angle* (05.089) and defines the angle used for the applied current from the q axis. As the torque angle is increased the amount of negative d axis current increases. This angle should be set to the level to give maximum torque per Amp with rated current in the motor.

It is possible for the drive to automatically calculate the rated torque angle from motor set-up parameters and those measured during autotuning. The drive will calculate and set up *Rated Torque Angle* (05.089) if *Saliency Torque Control Select* (05.065)  $\geq 1$  and *User Defined Rated Torque Angle* (05.087) = 0. The following parameters are used in the calculation:

*Rated Current* (05.007)

*Ld* (05.024)

*No-load Lq* (05.072)

*Volts Per 1000rpm* (05.033)

*q Axis Current For Inductance Values With Current* (05.075)

*Lq At The Defined Iq Current* (05.078)\*

*d Axis Current For Inductance Values With Current* (05.082)

*Lq At The Defined Id Current* (05.084)\*

\*The value of Lq used in the calculation is the value estimated using the same algorithm when the drive is running. See *No-load Lq* (05.072) for the effect of leaving these parameters at their default values.

Parameter	05.088 Estimated Lq		
Short description	Estimated value of Lq including the effects of Id and Iq		
Mode	RFC-S		
Minimum	0.000	Maximum	500.000
Default		Units	mH
Type	32 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	3
Coding	RO, FI, ND, NC, PT		

*Estimated Lq* (05.088) shows the calculated value of Lq. See *No-load Lq* (05.072).

Parameter	05.089 <i>Rated Torque Angle</i>		
Short description	Rated Torque Angle		
Mode	RFC-S		
Minimum	0	Maximum	90
Default		Units	°
Type	8 Bit Volatile	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *User Defined Rated Torque Angle* (05.087).

## Menu 6 Single Line Descriptions – *Sequencer and Clock*

Mode: RFC-S

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)	Disable (0)	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 400V drive: 410 V 575V drive: 540 V 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
06.058	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 400V drive: 330 V 575V drive: 435 V 690V drive: 435 V	RW	Num		RA		US
06.066	Low Under Voltage Threshold	±VM_LOW_UNDER_VOLTS V	200V drive: 175 V 400V drive: 330 V 575V drive: 435 V 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 400V drive: 780 V 575V drive: 930 V 690V drive: 1120 V	RW	Num		RA			US
06.074	Braking IGBT Upper Threshold	±VM_DC_VOLTAGE_SET V	200V drive: 390 V 400V drive: 780 V 575V drive: 930 V 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

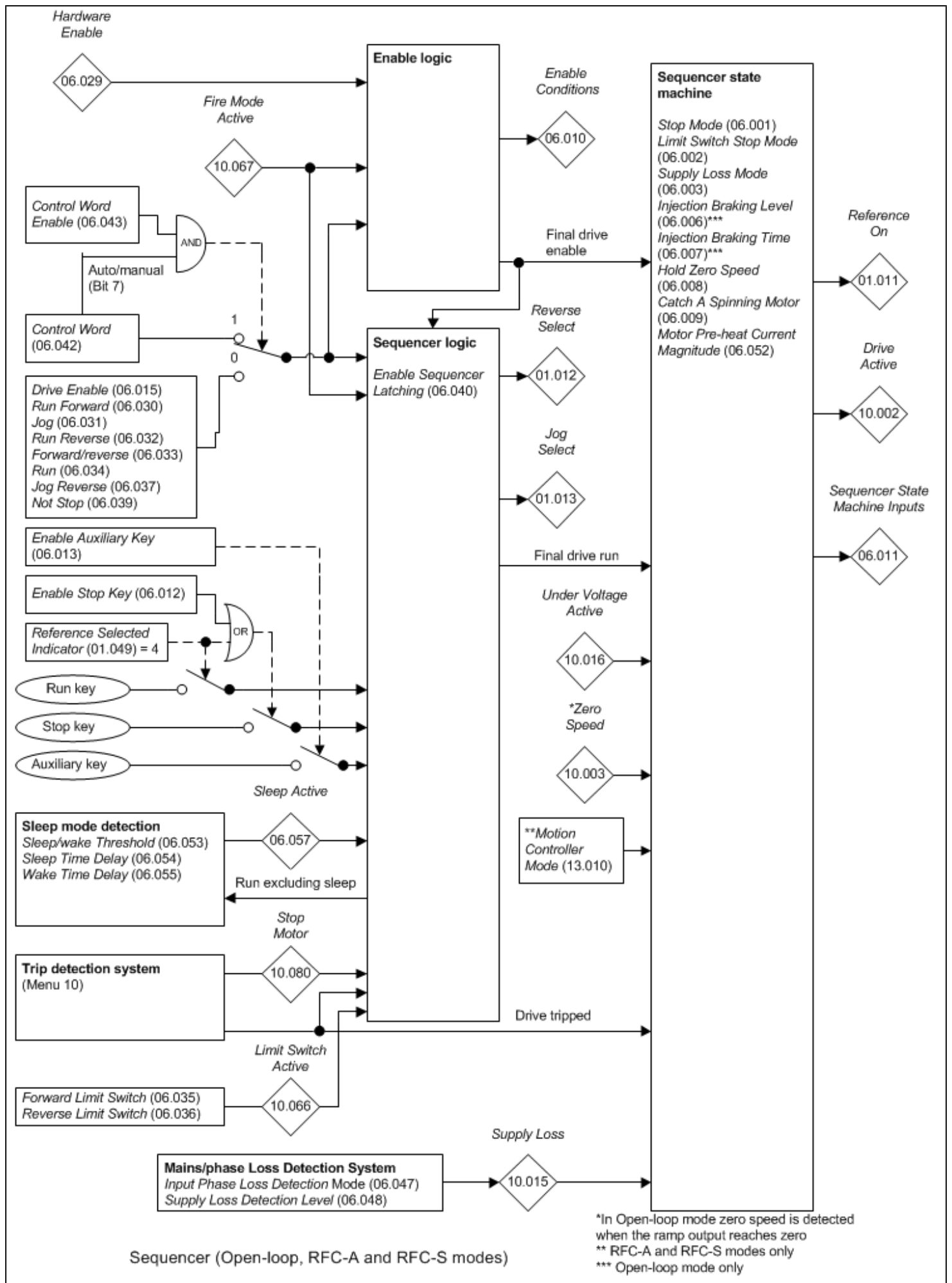
RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC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



## Menu 6 – Sequencer and Clock

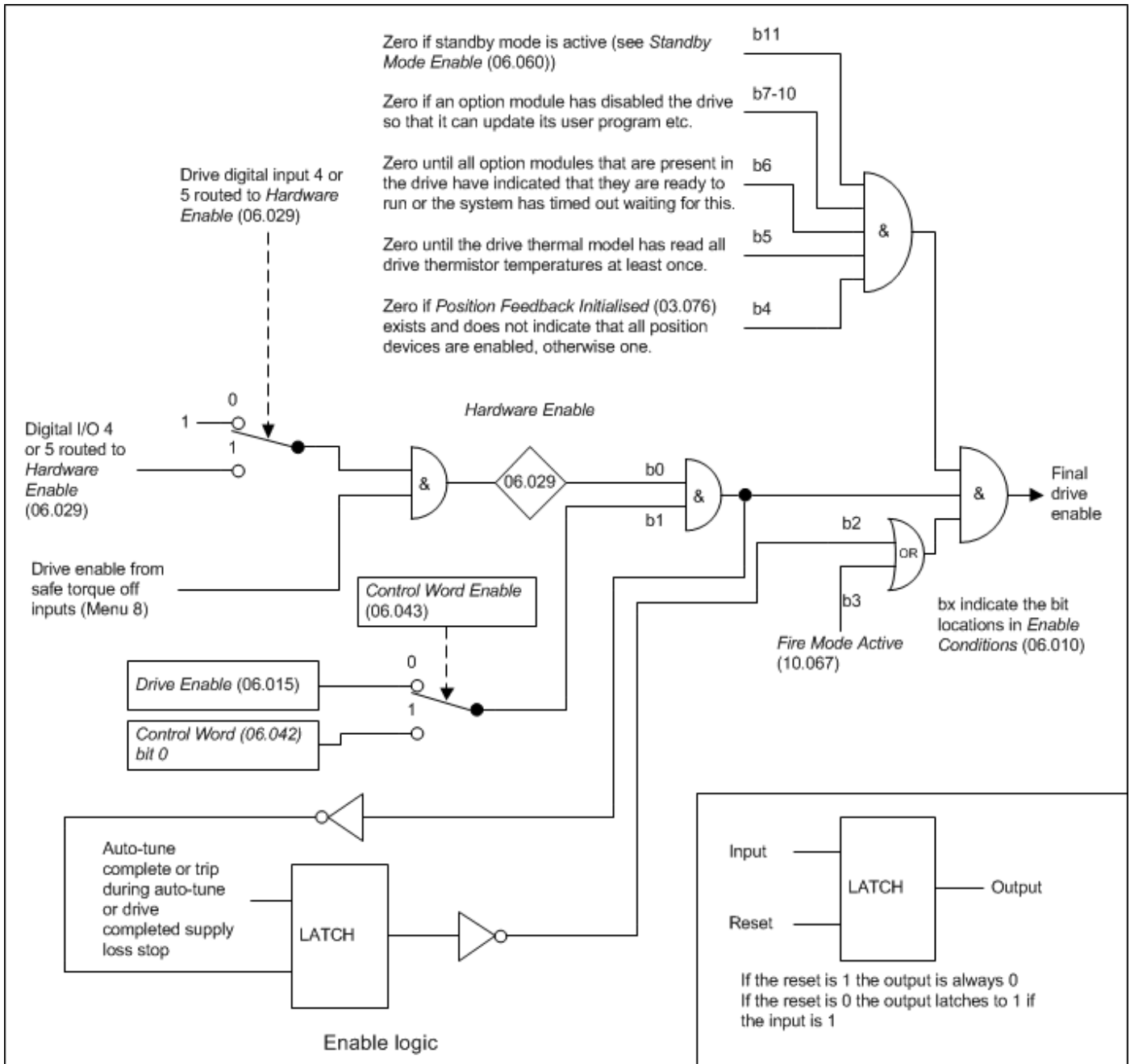
Mode: RFC-S

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

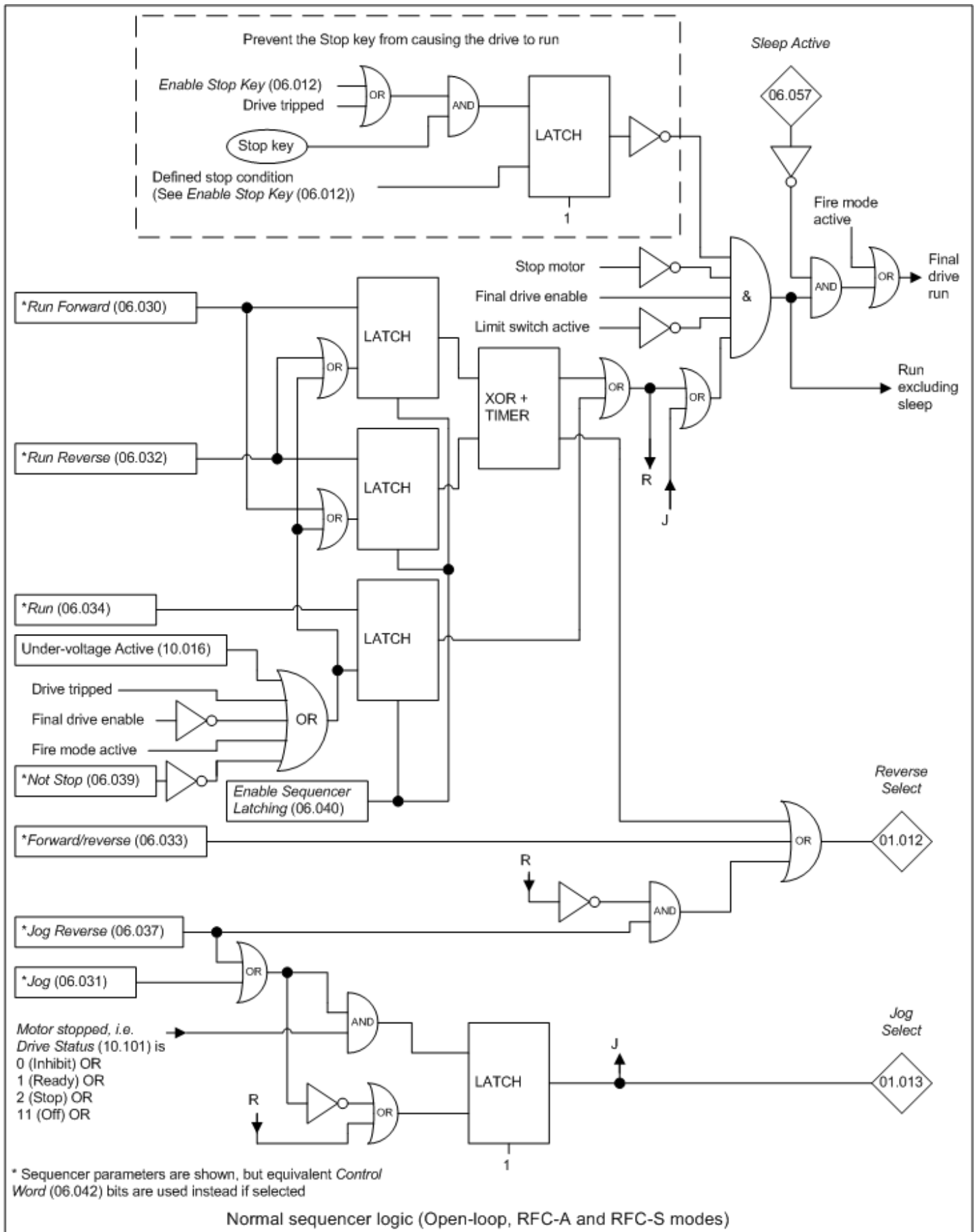
and consists of static logic elements. The second stage is a state machine with internal states.



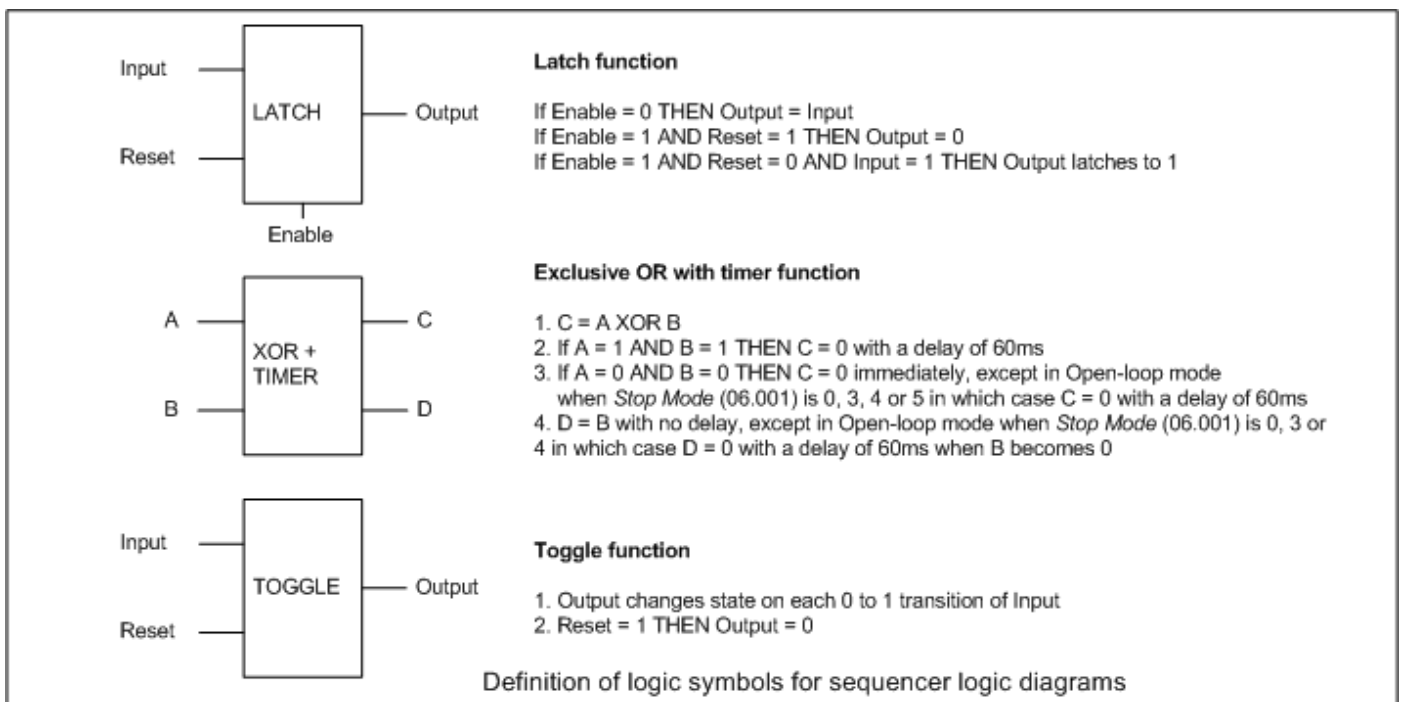
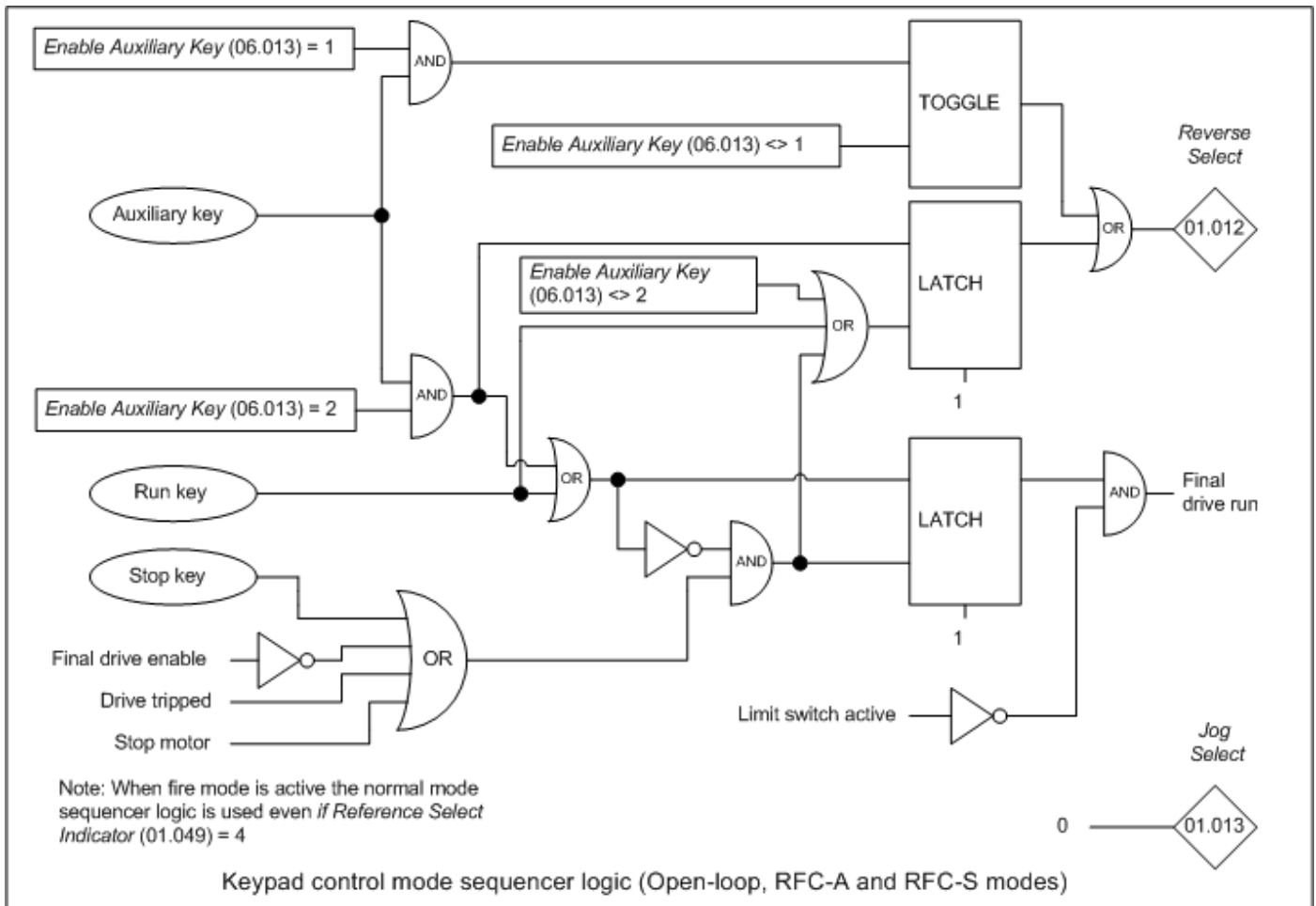
*Hardware Enable* (06.029) follows the safe torque off enable signal provided none of the digital inputs that are integral to the drive are routed to the *Hardware Enable* (06.029). The safe torque off hardware includes a delay in detecting a change from the enable to disable state of up to 20ms, but 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-S		
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-S		
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-S		
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-S		
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-S		
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	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

Parameter	06.010 Enable Conditions		
Short description	Displays all the conditions needed to change the state of the final drive enable		
Mode	RFC-S		
Minimum	0 (Display: 000000000000)	Maximum	4095 (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.

<b>Enable Conditions (06.010) bits</b>	<b>Enable condition</b>
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)

<b>Parameter</b>	<b>06.011 Sequencer State Machine Inputs</b>		
Short description	Displays the states of inputs into the sequencer state machine		
Mode	RFC-S		
Minimum	0 (Display: 000000)	Maximum	63 (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.

<b>Sequencer State Machine Inputs (06.011)</b>	<b>Signal</b>	<b>Indicates</b>
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.

<b>Parameter</b>	<b>06.012 Enable Stop Key</b>		
Short description	Set to 1 to enable the use of the stop key		
Mode	RFC-S		
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 Enable* (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-S			
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-S			
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-S			
Minimum		0 (Display: 00-00-00)		Maximum		311299 (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.

$$\text{Value} = (\text{day}[1..31] \times 10000) + (\text{month}[1..12] \times 100) + \text{year}[0..99]$$

Parameter				06.017 Time			
Short description				Displays the current time			
Mode				RFC-S			
Minimum		0 (Display: 00:00:00)		Maximum		235959 (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-S		
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-S		
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.

Date/Time Selector (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.

Parameter	06.020 Date Format		
Short description	Defines if the US date format is used or not		
Mode	RFC-S		
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	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.

Parameter	06.021 Time Between Filter Changes		
Short description	Defines the time between filter changes		
Mode	RFC-S		
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.

Parameter	06.022 Filter Change Required / Change Done		
Short description	Set to 0 when a filter change has taken place		
Mode	RFC-S		
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).

Parameter	06.023 Time Before Filter Change Due		
Short description	Displays the time before a filter change is required		
Mode	RFC-S		
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-S		
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. A positive energy value indicates net

transfer of energy from the drive to the motor. 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.

Parameter	06.025 Energy Meter: MWh		
Short description	Displays the energy accumulated by through the drive in MWh		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
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.

Parameter	06.030 Run Forward		
Short description	Set to 1 to give the drive a run forward signal		
Mode	RFC-S		
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.

Parameter	06.031 Jog		
Short description	Set to 1 to give the drive a jog signal		
Mode	RFC-S		
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.

Parameter	06.032 Run Reverse		
Short description	Set to 1 to give the drive a run reverse signal		
Mode	RFC-S		
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.

Parameter	06.033 Forward/Reverse		
Short description	Set to 1 to reverse the direction of the motor		
Mode	RFC-S		
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.

Parameter	06.034 Run		
Short description	Set to 1 to give the drive a run signal		
Mode	RFC-S		
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-S		
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)
Pre-ramp Reference (01.003) + Hard Speed Reference (03.022) > 0.0	Enabled	Not enabled
Pre-ramp Reference (01.003) + Hard Speed Reference (03.022) < 0.0	Not enabled	Enabled
Pre-ramp Reference (01.003) + Hard Speed Reference (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-S		
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-S		
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-S		
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 Enable Sequencer Latching		
Short description	Set to 1 to enable sequencer latching		
Mode	RFC-S		
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 Drive Event Flags		
Short description	Displays if certain actions have occurred within the drive		
Mode	RFC-S		
Minimum	0 (Display: 00)	Maximum	3 (Display: 11)
Default	0 (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 Control Word		
Short description	Controls the sequencer state machine inputs if the control word is enabled		
Mode	RFC-S		
Minimum	0 (Display: 0000000000000000)	Maximum	32767 (Display: 1111111111111111)
Default	0 (Display: 0000000000000000)	Units	
Type	16 Bit Volatile	Update Rate	Bits 9,7-0: 2ms read. Other bits: 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 bit 8 = 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-S		
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-S		
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.

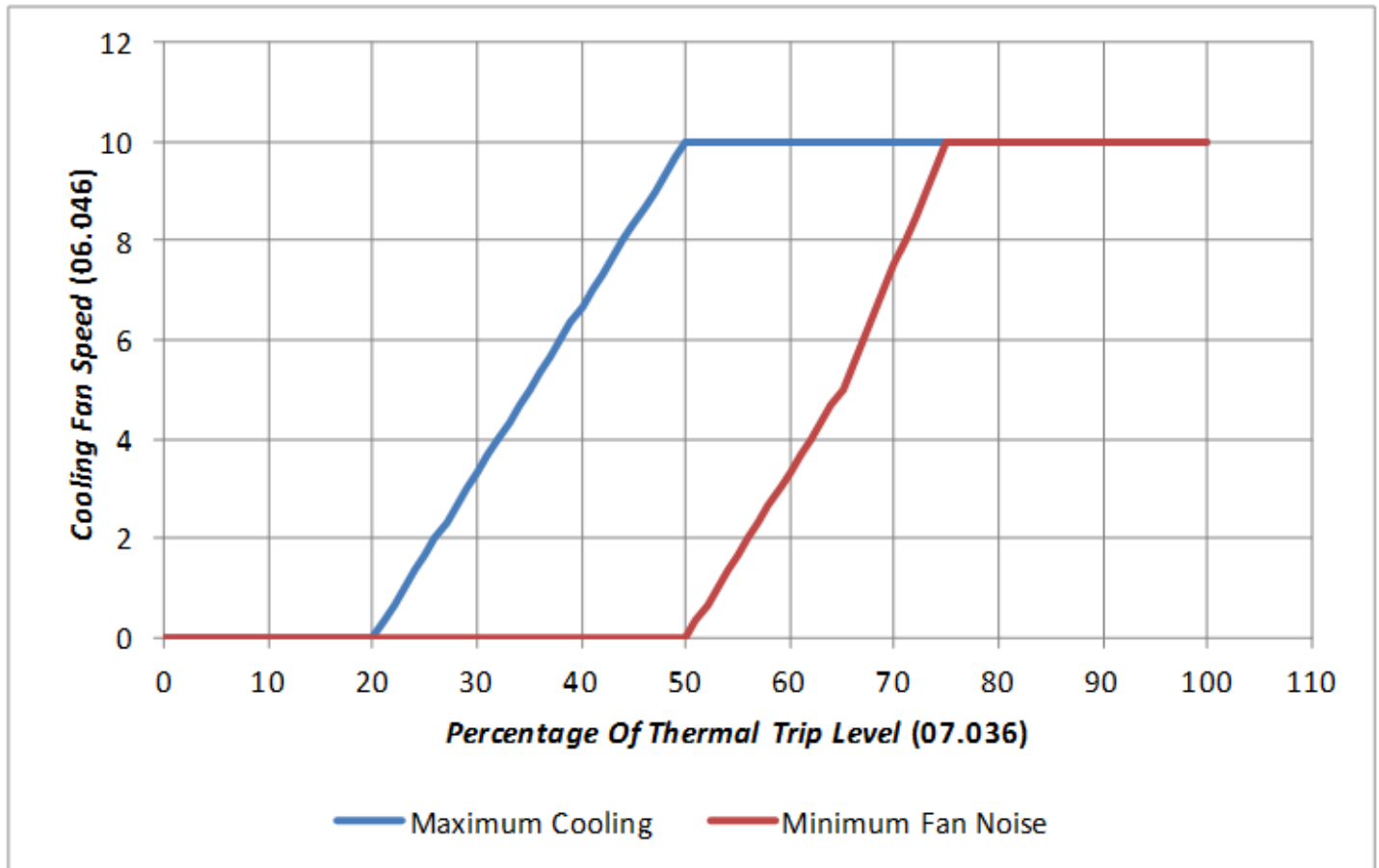
Parameter	06.045 Cooling Fan control		
Short description	Defines the maximum speed of the drive cooling fan		
Mode	RFC-S		
Minimum	-10	Maximum	11
Default	10	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

*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.

<i>Cooling Fan control</i> (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-S		
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-S		
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 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-S		
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-S		
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-S		
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>06.058 Output Phase Loss Detection Time</b>		
Short description	Output Phase Loss Detection Time		
Mode	RFC-S		
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 <i>Output Phase Loss Detection Enable</i>		
Short description	Set to non-zero value to enable output phase loss detection		
Mode	RFC-S		
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 a *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).

#### 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 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 a *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 <i>Standby Mode Enable</i>		
Short description	Set to 1 enable standby mode		
Mode	RFC-S		
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.

<i>Standby Mode Mask</i> (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

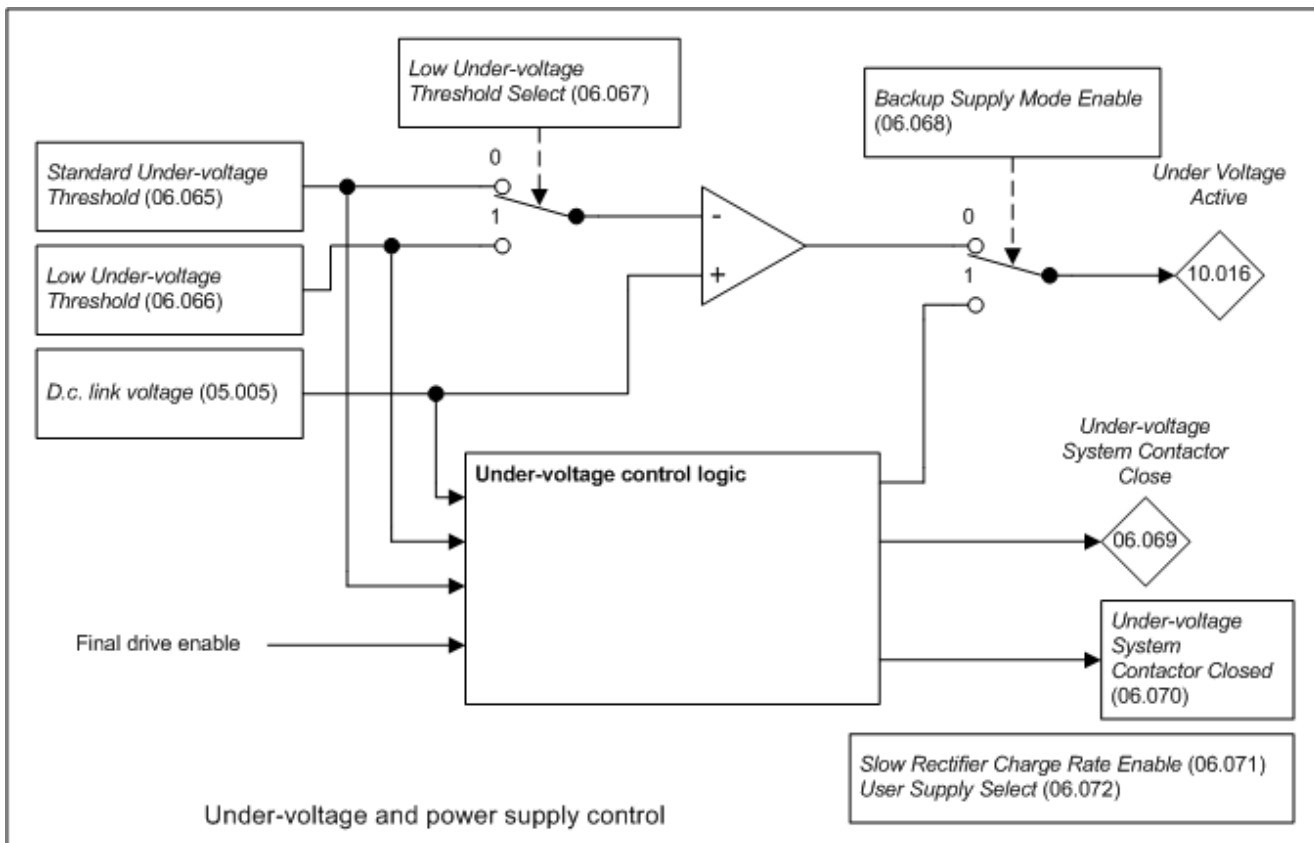
<b>Parameter</b>	<b>06.061 Standby Mode Mask</b>		
Short description	Defines the actions of the drive with standby mode is enabled		
Mode	RFC-S		
Minimum	0 (Display: 0000000)	Maximum	127 (Display: 1111111)
Default	0 (Display: 0000000)	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Binary	Decimal Places	0
Coding	RW		

See *Standby Mode Enable* (06.060).

<b>Parameter</b>	<b>06.065 Standard Under Voltage Threshold</b>		
Short description	Defines the standard under voltage threshold		
Mode	RFC-S		
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%

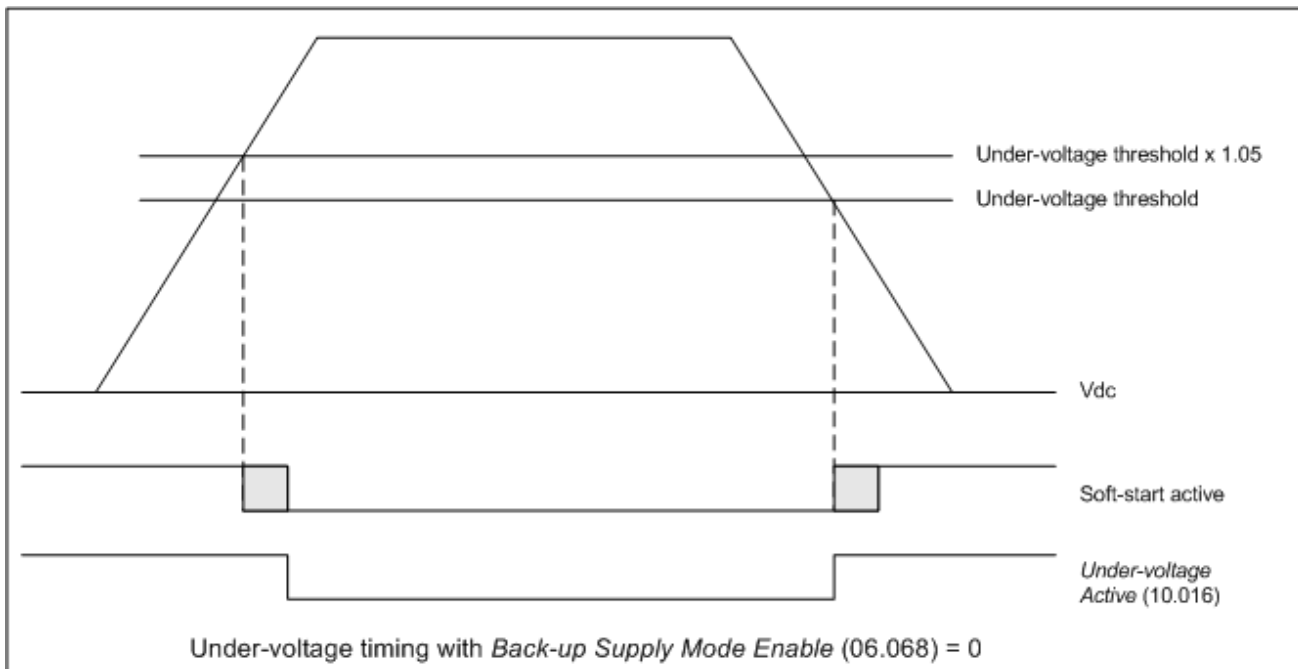
The peak of the maximum allowed supply voltage =  $480 \times 1.1 \times \sqrt{2} = 747V$

The difference between the under-voltage threshold and the peak supply voltage =  $747 - 330 = 417V$

Therefore for this drive voltage rating the peak line to line voltage must never be higher than *Low Under Voltage Threshold* (06.066) + 417V.

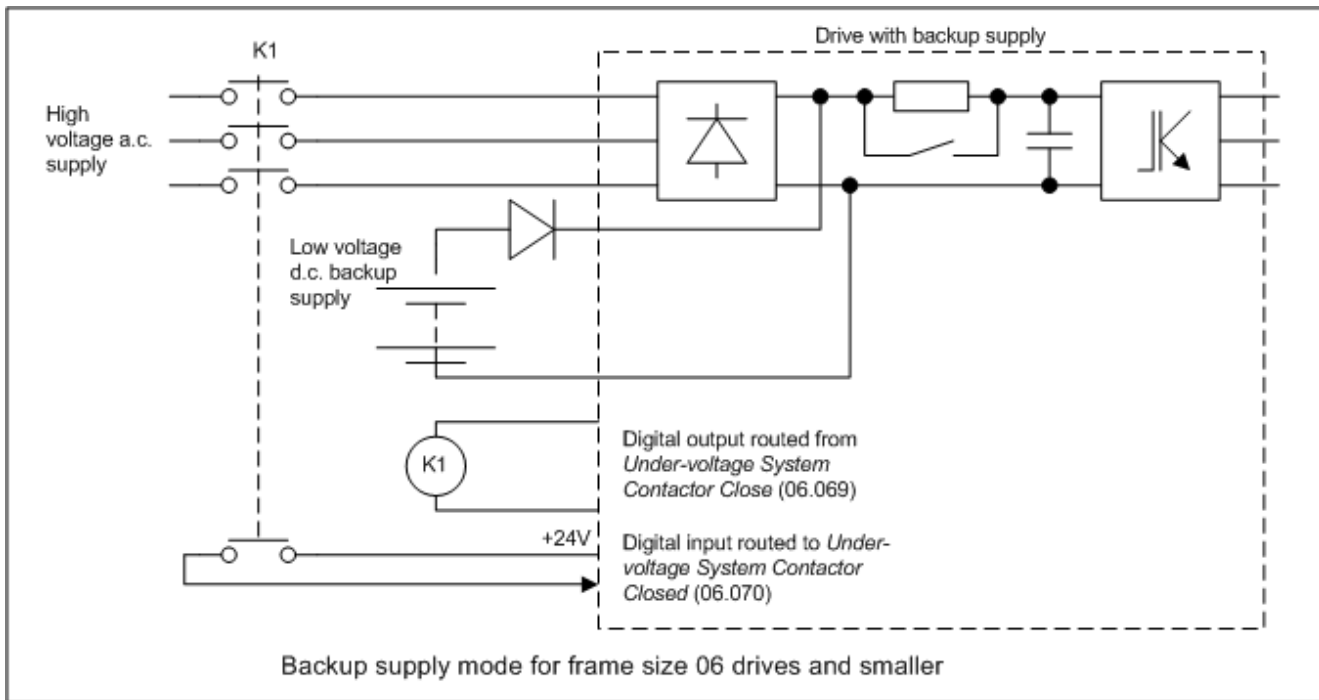
If *Low Under Voltage Threshold Select* (06.067) is set to one and *Low Under Voltage Threshold* (06.066) is reduced below the variable maximum level VM\_STD\_UNDER\_VOLTAGE[MIN], or if *Backup Supply Mode Enable* (06.068) is set to one, an indication is stored in *Potential Drive Damage Conditions* (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.

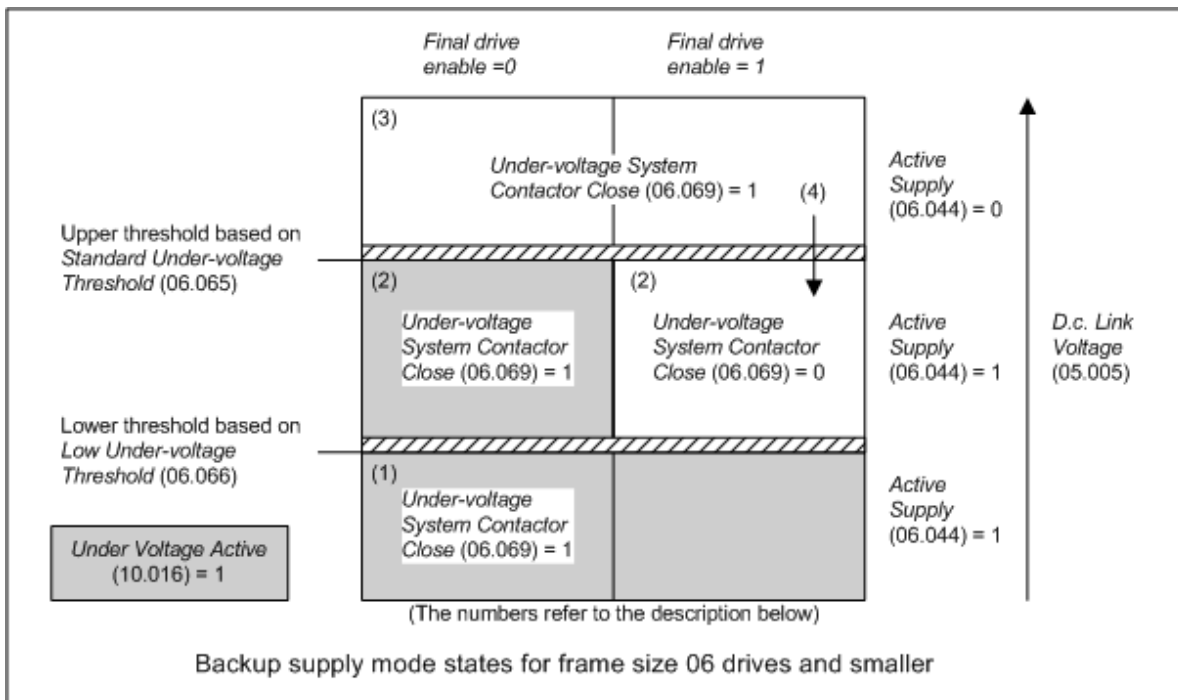


**Backup Supply Mode for frame size 06 drives and smaller: Backup Supply Mode Enable (06.068) = 1**

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.

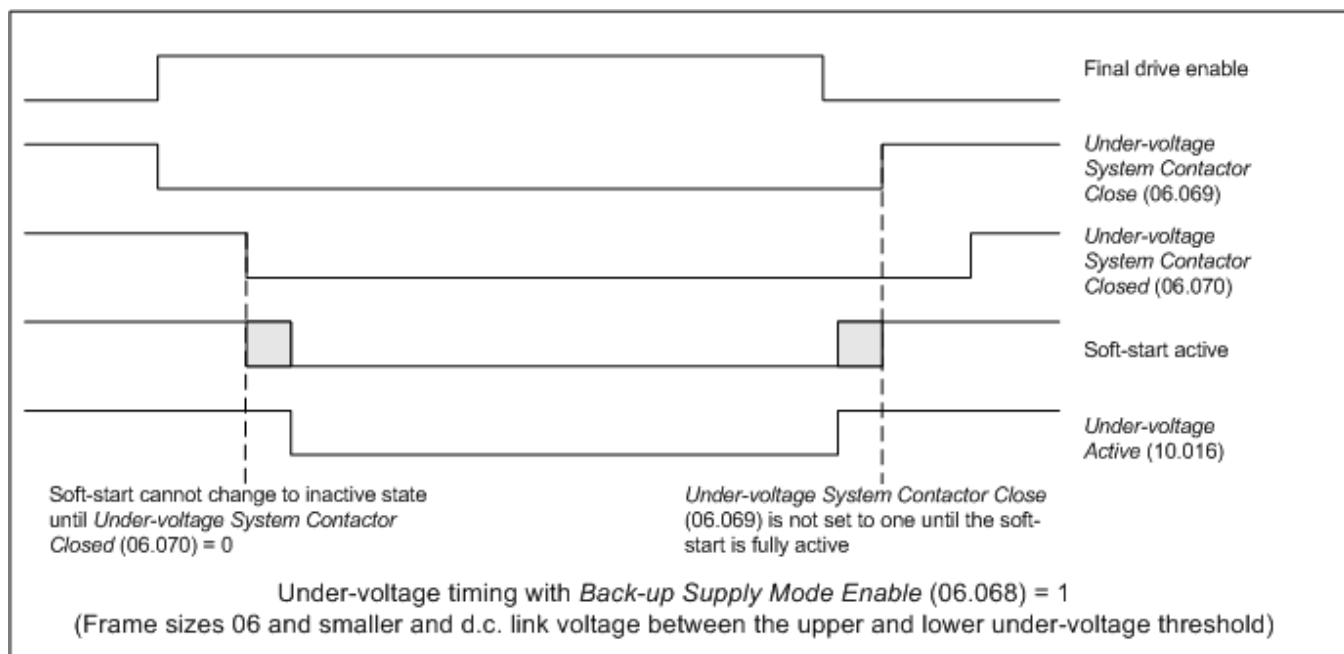


The numbers below correspond to the numbers shown in the diagram:

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.

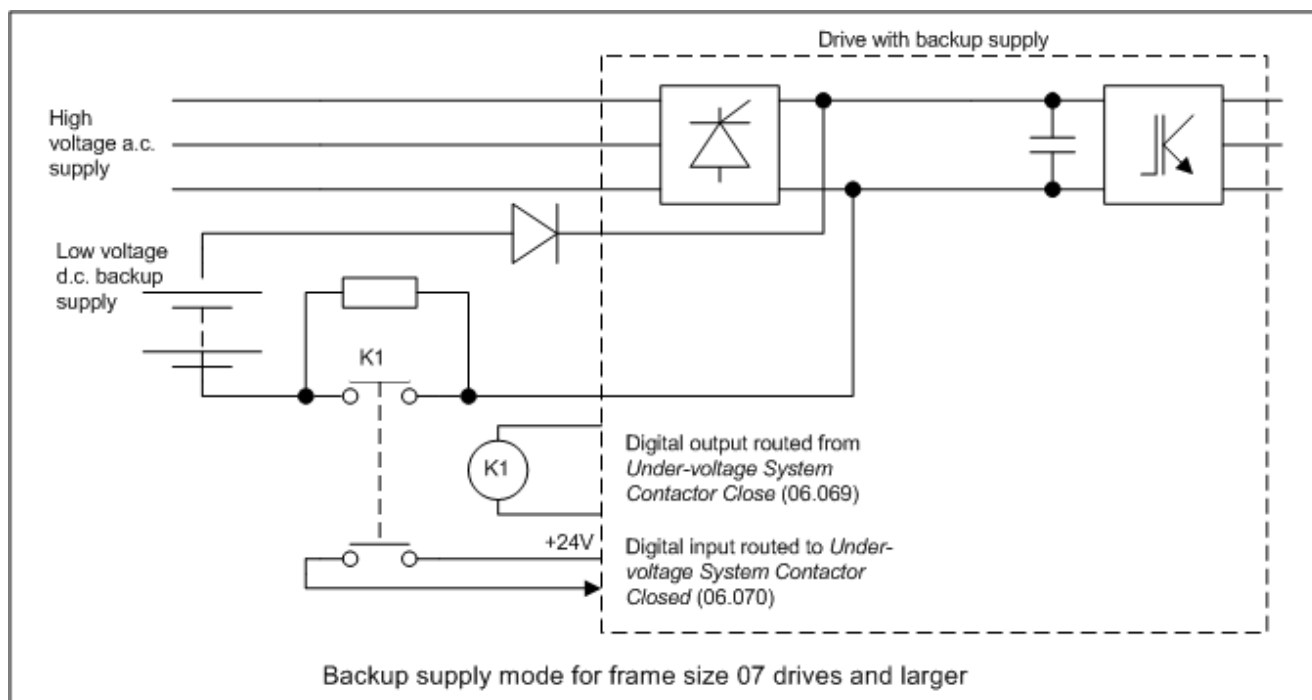
To ensure that the soft-start is in the correct state to protect the drive the following additional restrictions are applied:

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.

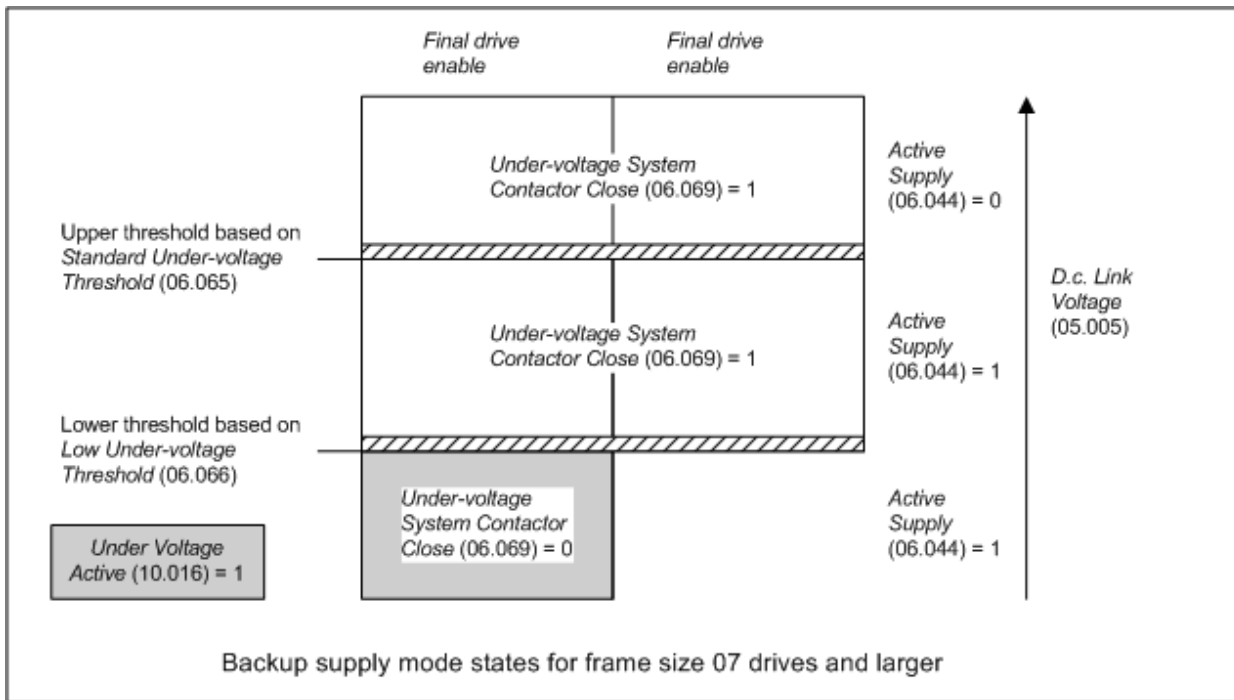


**Backup Supply Mode for frame size 07 drives and larger: (*Backup Supply Mode Enable* (06.068) = 1)**

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.



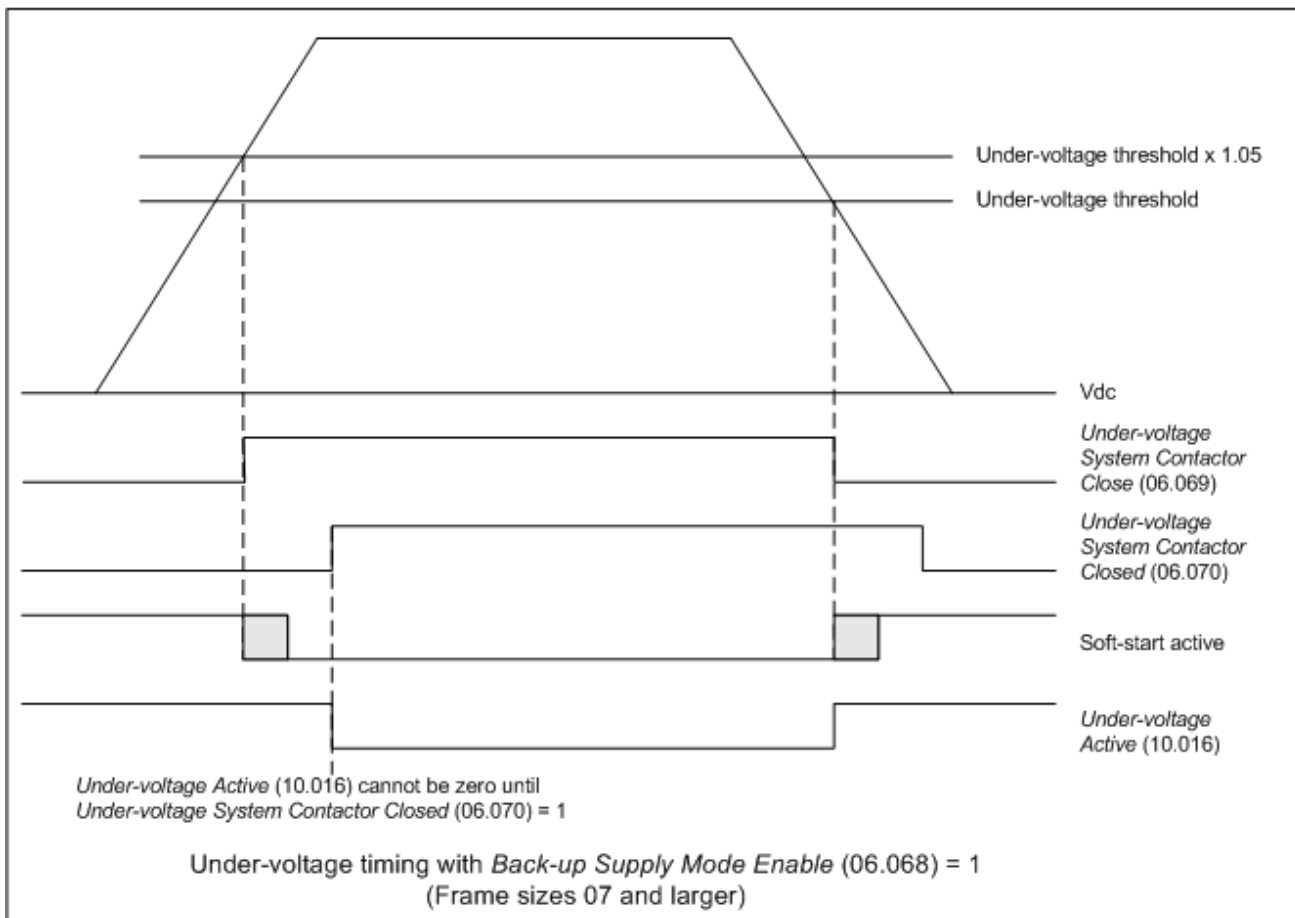
The diagram below shows the state of *Under Voltage Active* (10.016) and the control signal to the external contactor (*Under-voltage System Contactor Close* (06.069)).



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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S

Parameter		Range	Default	Type					
07.001	Analog Input 1	±100.00 %		RO	Num	ND	NC	PT	FI
07.002	Analog Input 2	±100.00 %		RO	Num	ND	NC	PT	FI
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	
07.007	Analog Input 1 Mode	4-20mA Low (-4), 20-4mA Low (-3), 4-20mA Hold (-2), 20-4mA Hold (-1), 0-20mA (0), 20-0mA (1), 4-20mA Trip (2), 20-4mA Trip (3), 4-20mA (4), 20-4mA (5), Volt (6)	Volt (6)	RW	Txt				US
07.008	Analog Input 1 Scaling	0.000 to 10.000	1.000	RW	Num				US
07.009	Analog Input 1 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
07.010	Analog Input 1 Destination	0.000 to 59.999	1.036	RW	Num	DE		PT	US
07.011	Analog Input 2 Mode	4-20mA Low (-4), 20-4mA Low (-3), 4-20mA Hold (-2), 20-4mA Hold (-1), 0-20mA (0), 20-0mA (1), 4-20mA Trip (2), 20-4mA Trip (3), 4-20mA (4), 20-4mA (5), Volt (6)	Volt (6)	RW	Txt				US
07.012	Analog Input 2 Scaling	0.000 to 10.000	1.000	RW	Num				US
07.013	Analog Input 2 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
07.014	Analog Input 2 Destination	0.000 to 59.999	1.037	RW	Num	DE		PT	US
07.015	Analog Input 3 Mode	Volt (6), Therm Short Cct (7), Thermistor (8), Therm No Trip (9)	Volt (6)	RW	Txt				US
07.016	Analog Input 3 Scaling	0.000 to 10.000	1.000	RW	Num				US
07.017	Analog Input 3 Invert	Off (0) or On (1)	Off (0)	RW	Bit				US
07.018	Analog Input 3 Destination	0.000 to 59.999	0.000	RW	Num	DE		PT	US
07.019	Analog Output 1 Source	0.000 to 59.999	3.002	RW	Num			PT	US
07.020	Analog Output 1 Scaling	0.000 to 10.000	1.000	RW	Num				US
07.022	Analog Output 2 Source	0.000 to 59.999	4.002	RW	Num			PT	US
07.023	Analog Output 2 Scaling	0.000 to 10.000	1.000	RW	Num				US
07.025	Calibrate Analog Input 1 Full Scale	Off (0) or On (1)	Off (0)	RW	Bit		NC		
07.026	Analogue Input 1 Fast Update Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
07.027	Analogue Input 2 Fast Update Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
07.028	Analog Input 1 Current Loop Loss	Off (0) or On (1)		RO	Bit	ND	NC	PT	
07.029	Analog Input 2 Current Loop Loss	Off (0) or On (1)		RO	Bit	ND	NC	PT	
07.030	Analog Input 1 Offset	±100.00 %	0.00 %	RW	Num				US
07.031	Analog Input 2 Offset	±100.00 %	0.00 %	RW	Num				US
07.032	Analog Input 3 Offset	±100.00 %	0.00 %	RW	Num				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
07.040	Analog Input 1 Minimum	±100.00 %	-100.00 %	RW	Num				US
07.041	Analog Input 2 Minimum	±100.00 %	-100.00 %	RW	Num				US
07.042	Analog Input 3 Minimum	±100.00 %	-100.00 %	RW	Num				US
07.043	Analog Input 1 Maximum	±100.00 %	100.00 %	RW	Num				US
07.044	Analog Input 2 Maximum	±100.00 %	100.00 %	RW	Num				US
07.045	Analog Input 3 Maximum	±100.00 %	100.00 %	RW	Num				US
07.046	Analog Input 3 Thermistor Type	DIN44082 (0), KTY84 (1), PT100 (4W) (2), PT1000 (4W) (3), PT2000 (4W) (4), 2.0mA (4W) (5), PT100 (2W) (6), PT1000 (2W) (7),	DIN44082 (0)	RW	Txt				US

		PT2000 (2W) (8), 2.0mA (2W) (9)											
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	
07.051	Analog Input 1 Full Scale	0 to 65535						RO	Num	ND	NC	PT	PS
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-S

### 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:

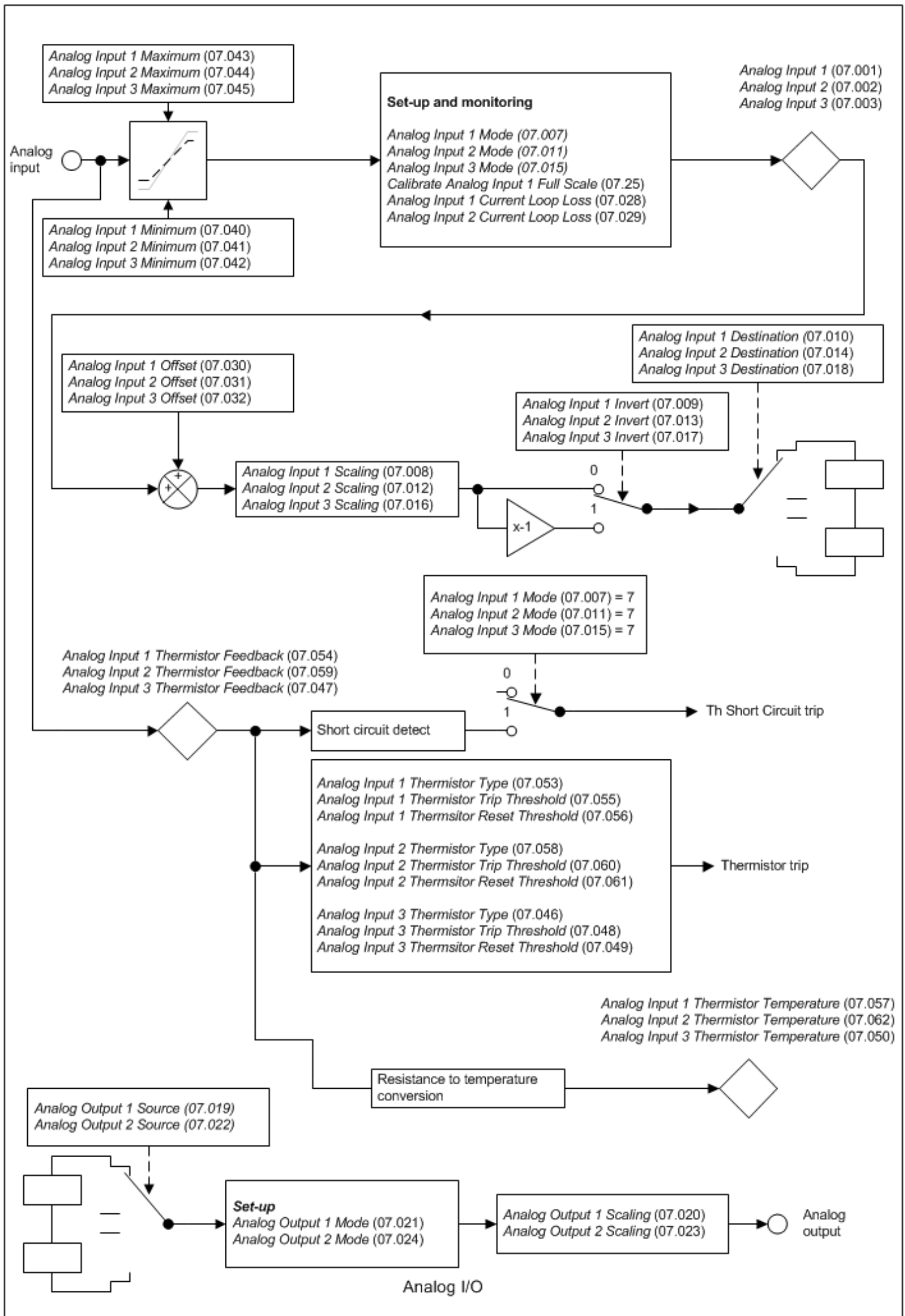
1. The maximum and the minimum for the input are at their default values of 100.00% and -100.00% respectively.
2. The input is set to voltage mode.
3. One of the destinations given in the table below must be selected.
4. If the destination is *Analog Reference 1* (01.036) or *Analog Reference 2* (01.037) 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, 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, 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, RFC-S	
<i>Torque Reference</i> (04.008)	RFC-A, RFC-S	
<i>Power Input 1</i> (03.010) <i>Power Input 2</i> (03.013) <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	07.001 Analog Input 1		
Short description	Displays the value of analog input 1		
Mode	RFC-S		
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		

Each analogue input has a resolution of 11 bits plus sign. The inputs can operate in different modes (defined by *Analog Input 1 Mode* (07.007) for analogue input 1). These modes include voltage, current and thermistor modes. The available modes depend on the hardware configuration and are given in the table below.

Internal I/O Identifier (11.068)	Analogue Input 1	Analogue Input 2	Analogue Input 3
0: Standard Analogue and Digital I/O	Bipolar Voltage, Current	Bipolar Voltage, Current	Bipolar Voltage, Thermistor
1: Digital I/O	Not present	Not present	Thermistor, Disabled
2: HVAC Analogue and Digital I/O	Unipolar Voltage, Current, Thermistor	Unipolar Voltage, Current, Thermistor	Not present

The "Input Level" is defined for the different modes in the table below.

Mode	Input Level
Voltage	(Input Voltage / 10V) x 100.00%
0-20mA	(Input Current / 20mA) x 100.00%
20-0mA	((20mA - Input Current) / 20mA) x 100.00%
4-20mA	((Input Current - 4mA) / 16mA) x 100.00%
20-4mA	((20mA - Input Current) / 16mA) x 100.00%
Thermistor	(Input resistance / 10K Ohm) x 100%

*Analog Input 1* (07.001) is derived as follows:

#### Limits

$A_1$  is the value after the minimum and maximum limits are applied.

If *Analog Input 1 Minimum* (07.040)  $\geq$  *Analog Input 1 Maximum* (07.043) then:  
 $A_1 = 0.00\%$  whatever the input level.

If *Analog Input 1 Minimum* (07.040)  $< 0.00\%$  and *Analog Input 1 Maximum* (07.043)  $> 0.00\%$  then:  
 $A_1 = \text{Input Level} \times (100.00\% / \text{Analog Input 1 Maximum (07.043)})$   
 $A_1$  is then limited between  $-100\%$  and  $+100\%$ .

Otherwise:

Input Level is limited between *Analog Input 1 Minimum* (07.040) and *Analog Input 1 Maximum* (07.043)  
 $A_1 = [\text{Input Level} - \text{Analog Input 1 Minimum (07.040)}] \times 100.00\% / (\text{Analog Input 1 Maximum (07.043)} - \text{Analog Input 1 Minimum (07.040)})$

For thermistor modes it should be noted that *Analog Input 1 Minimum* (07.040) and *Analog Input 1 Maximum* (07.043) have no effect and that the input resistance is limited between 0 and 5k $\Omega$ .

Parameter	07.002 Analog Input 2		
Short description	Displays the value of analog input 2		
Mode	RFC-S		
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).

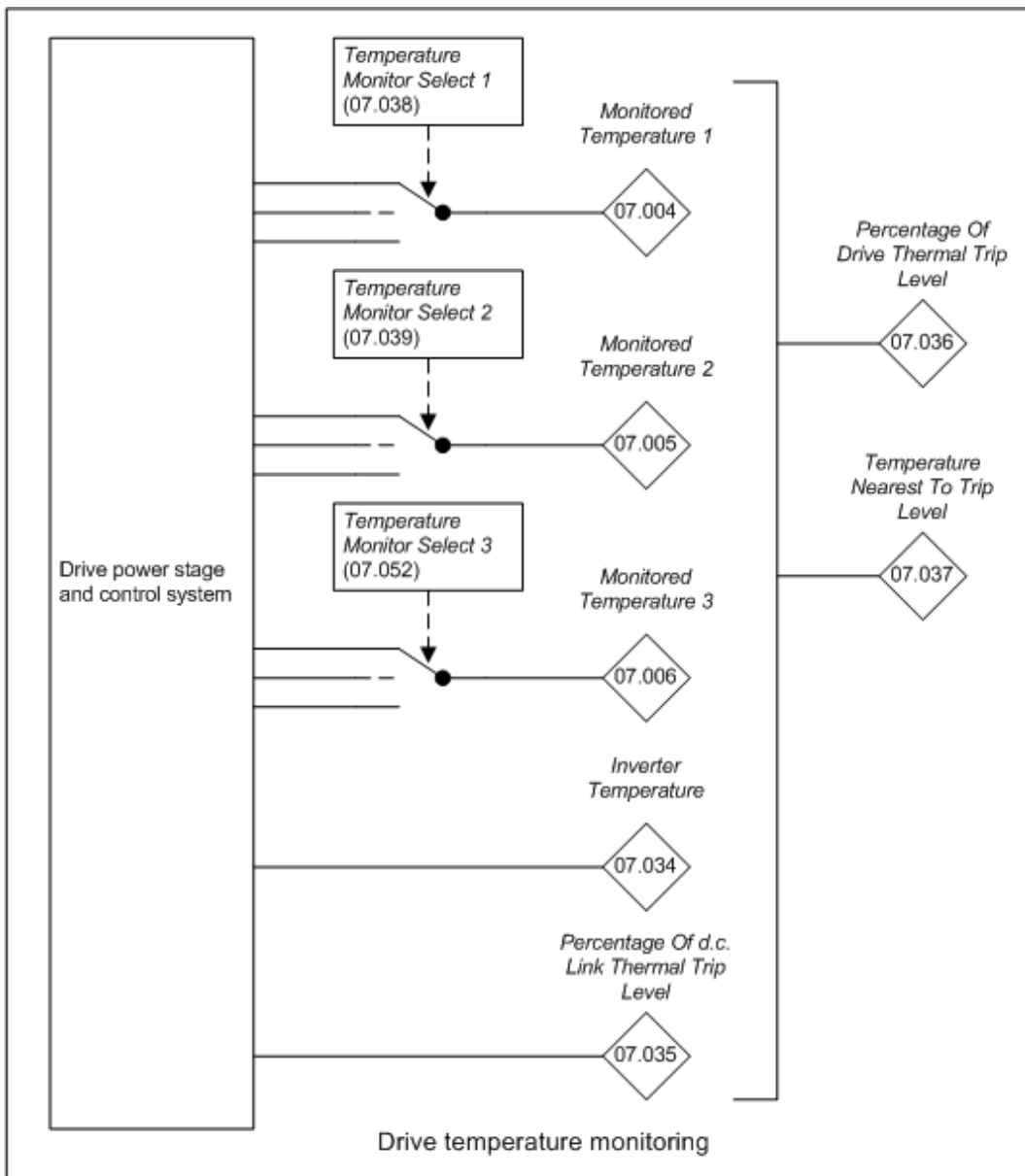
Parameter	07.003 Analog Input 3		
Short description	Displays the value of analog input 3		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default		Units	%
Type	16 Bit Volatile	Update Rate	4ms write
Display Format	Standard	Decimal Places	2
Coding	RO, FI, ND, NC, PT		

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-S		
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-S		
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-S		
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	07.007 Analog Input 1 Mode		
Short description	Defines the mode of analog input 1		
Mode	RFC-S		
Minimum	-4	Maximum	6
Default	6	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text	Description
-4	4-20mA Low	4-20mA low value on current loss. Analog input level is 0.00% if the current is below 3mA.
-3	20-4mA Low	20-4mA low value on current loss. Analog input level is 0.00% if the current is below 3mA.
-2	4-20mA Hold	4-20mA hold at level before loss on current loss. Analog input level remains at the value it had in the previous sample before the current fell below 3mA.
-1	20-4mA Hold	20-4mA hold at level before loss on current loss. Analog input level remains at the value it had in the previous sample before the current fell below 3mA.
0	0-20mA	0-20mA
1	20-0mA	20-0mA
2	4-20mA Trip	4-20mA trip on current loss. Analog input level is 0.00% and an 'An Input 1/2 Loss' trip is initiated if the current is below 3mA.
3	20-4mA Trip	20-4mA trip on current loss. Analog input level is 0.00% and an 'An Input 1/2 Loss' trip is initiated if the current is below 3mA.
4	4-20mA	4-20mA no action on loss. Analog input level is 0.00% if the current is below 3mA.
5	20-4mA	20-4mA no action on loss. Analog input level is 0.00% if the current is below 3mA.
6	Volt	Voltage

This parameter defines the possible input modes for analog input 1.

Parameter	07.008 Analog Input 1 Scaling		
Short description	Defines the scaling factor of analog input 1		
Mode	RFC-S		
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		

*Analog Input 1* (07.001) is modified by *Analog Input 1 Scaling* (07.008), *Analog Input 1 Offset* (07.030) and *Analog Input 1 Invert* (07.009) before it is routed to its destination as follows:

$$A_{10} = \text{Analog Input 1 (07.001)} + \text{Analog Input 1 Offset (07.030)}$$

$A_{10}$  is the value after the offset has been applied and is limited between -100.00% and 100.00%

$$A_{1S} = A_{10} \times \text{Analog Input 1 Scaling (07.008)}$$

$A_{1S}$  is the value after the scaling and the offset have been applied and is limited between -100.00% and 100.00%

If *Analog Input 1 Invert* (07.009) = 0 then  $A_{1I} = A_{1S}$  otherwise  $A_{1I} = -A_{1S}$

$A_{1I}$  is the value after the invert, scaling and offset have been applied and is the final value that is routed to the destination defined by *Analog Input 1 Destination* (07.010).

Parameter	07.009 Analog Input 1 Invert		
Short description	Inverts the signal for analog input 1		
Mode	RFC-S		
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 *Analog Input 1 Scaling* (07.008).

Parameter	07.010 Analog Input 1 Destination		
Short description	Defines the output parameter for analog input 1		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	1.036	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Analog Input 1 Scaling* (07.008).

Parameter	07.011 Analog Input 2 Mode		
Short description	Defines the mode for analog input 2		
Mode	RFC-S		
Minimum	-4	Maximum	6
Default	6	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text	Description
-4	4-20mA Low	4-20mA low value on current loss. Analog input level is 0.00% if the current is below 3mA.
-3	20-4mA Low	20-4mA low value on current loss. Analog input level is 0.00% if the current is below 3mA.
-2	4-20mA Hold	4-20mA hold at level before loss on current loss. Analog input level remains at the value it had in the previous sample before the current fell below 3mA.
-1	20-4mA Hold	20-4mA hold at level before loss on current loss. Analog input level remains at the value it had in the previous sample before the current fell below 3mA.
0	0-20mA	0-20mA
1	20-0mA	20-0mA
2	4-20mA Trip	4-20mA trip on current loss. Analog input level is 0.00% and an 'An Input 1/2 Loss' trip is initiated if the current is below 3mA.
3	20-4mA Trip	20-4mA trip on current loss. Analog input level is 0.00% and an 'An Input 1/2 Loss' trip is initiated if the current is below 3mA.
4	4-20mA	4-20mA no action on loss. Analog input level is 0.00% if the current is below 3mA.
5	20-4mA	20-4mA no action on loss. Analog input level is 0.00% if the current is below 3mA.
6	Volt	Voltage

This parameter defines the possible input modes for analog input 2.

Parameter	07.012 Analog Input 2 Scaling		
Short description	Defines the scaling factor for analog input 2		
Mode	RFC-S		
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		

The scaling, offset and invert functions for analog input 2 are defined in the same way as for analog input 1. See *Analog Input 1 Scaling* (07.008).

Parameter	07.013 Analog Input 2 Invert		
Short description	Inverts the signal for analog input 2		
Mode	RFC-S		
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 scaling, offset and invert functions for analog input 2 are defined in the same way as for analog input 1. See *Analog Input 1 Scaling* (07.008).

Parameter	07.014 Analog Input 2 Destination		
Short description	Defines the output parameter for analog input 2		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	1.037	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

The scaling, offset and invert functions for analog input 2 are defined in the same way as for analog input 1. See *Analog Input 1 Scaling* (07.008).

Parameter	07.015 Analog Input 3 Mode		
Short description	Defines the mode of analog input 3		
Mode	RFC-S		
Minimum	6	Maximum	9
Default	6	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text	Description
6	Volt	Voltage
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

This parameter defines the possible input modes for analog input 3.

Parameter	07.016 Analog Input 3 Scaling		
Short description	Defines the scaling factor for analog input 3		
Mode	RFC-S		
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		

The scaling, offset and invert functions for analog input 3 are defined in the same way as for analog input 1. See *Analog Input 1 Scaling* (07.008).

Parameter	07.017 Analog Input 3 Invert		
Short description	Inverts the signal of analog input 3		
Mode	RFC-S		
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 scaling, offset and invert functions for analog input 3 are defined in the same way as for analog input 1. See *Analog Input 1 Scaling* (07.008).

Parameter	07.018 Analog Input 3 Destination		
Short description	Defines the output parameter for analog input 3		
Mode	RFC-S		
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		

The scaling, offset and invert functions for analog input 3 are defined in the same way as for analog input 1. See *Analog Input 1 Scaling* (07.008).

Parameter	07.019 Analog Output 1 Source		
Short description	Defines the input parameter for analog output 1		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	3.002	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

*Analog Output 1 Source* (07.019) defines the source parameter for analog output 1. The value of the source parameter is scaled with *Analog Output 1 Scaling* (07.020) and if the scaling is greater than 1.000 the value is clamped between -100% and +100% or between 0% and 100% depending on whether the output is bipolar or unipolar. The resulting value is then used to control the output. It should be noted that the normal rules for parameter routing do not apply, but the scaling always makes -100% to +100% correspond to the range from minus source parameter maximum to plus source parameter maximum, and 0% corresponds to the source parameter value of zero. This means for example that a parameter with a minimum of 1 and a maximum of 10 will produce an output that changes from 10% to 100% as the parameter is change from minimum to maximum.

The outputs provided with different hardware are given in the table below.

Internal I/O Identifier (11.068)	Analogue Output 1	Analogue Output 2
0: Standard Analogue and Digital I/O	Bipolar Voltage	Bipolar Voltage
1: Basic I/O	No output	No output
2: HVAC Analogue and Digital I/O	Unipolar Voltage or Current	Unipolar Voltage or Current

The output mode is defined by *Analogue Output 1 Mode* (07.021) as shown in the table below.

Analogue Output 1 Mode (07.021)	Standard Analogue and Digital I/O	HVAC Analogue and Digital I/O
Volt	-10V to + 10V	0V to +10V
0-20mA	Not possible	0mA to 20mA
20-0mA	Not possible	20mA to 0mA
4-20mA	Not possible	4mA to 20mA
20-4mA	Not possible	20mA to 4mA

Parameter	07.020 Analog Output 1 Scaling		
Short description	Defines the scaling factor for analog output 1		
Mode	RFC-S		
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		

See *Analog Output 1 Source* (07.019).

Parameter	07.022 Analog Output 2 Source		
Short description	Defines the input source for analog output 2		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	4.002	Units	
Type	16 Bit User Save	Update Rate	Drive reset read
Display Format	Standard	Decimal Places	3
Coding	RW, PT, BU		

*Analog Output 2 Source* (07.022) defines the source parameter for analog output 1. The value of the source parameter is scaled with *Analog Output 2 Scaling* (07.023) and if the scaling is greater than 1.000 the value is clamped between -100% and +100% or between 0% and 100% depending on whether the output is bipolar or unipolar. The resulting value is then used to control the output. The outputs provided with different hardware are given in the table below.

Internal I/O Identifier (11.068)	Analogue Output 1	Analogue Output 2
0: Standard Analogue and Digital I/O	Bipolar Voltage	Bipolar Voltage
1: Basic I/O	No output	No output
2: HVAC Analogue and Digital I/O	Unipolar Voltage or Current	Unipolar Voltage or Current

The output mode is defined by *Analogue Output 2 Mode* (07.024) as shown in the table below.

<i>Analogue Output 2 Mode</i> (07.024)	Standard Analogue and Digital I/O	HVAC Analogue and Digital I/O
Volt	-10V to + 10V	0V to +10V
0-20mA	Not possible	0mA to 20mA
20-0mA	Not possible	20mA to 0mA
4-20mA	Not possible	4mA to 20mA
20-4mA	Not possible	20mA to 4mA

Parameter	07.023 Analog Output 2 Scaling		
Short description	Defines the scaling factor for analog output 2		
Mode	RFC-S		
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		

See *Analog Output 2 Source* (07.022).

Parameter	07.025 Calibrate Analog Input 1 Full Scale		
Short description	Calibrates the input level for analog input 1		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

For analog input 1, and in voltage mode only, the full scale value used to determine the input level can be changed from 10V by calibrating the input. The calibration process is triggered by setting *Calibrate Analog Input 1 Full Scale* (07.025) to one. *Calibrate Analog Input 1 Full Scale* (07.025) is cleared automatically when the calibration process is complete. After calibration the actions are as follows:

Input voltage during calibration	Result
$V < 1.5V$	The calibration result is ignored and the full scale is set to 10V. <i>Analog Input 1 Full Scale</i> (07.051) is set to zero.
$1.5V < V < 2.5V$	The calibration result is ignored and the full scale or <i>Analog Input 1 Full Scale</i> (07.051) are not affected.
$V > 2.5V$	The calibration result is used to set full scale and the value is also stored in <i>Analog Input 1 Full Scale</i> (07.051).

It should be noted that *Analog Input 1 Full Scale* (07.051) is a power-down save parameter, and so the result is automatically retained after power-down.



Parameter	07.026 Analogue Input 1 Fast Update Active		
Short description	Analogue Input 1 Fast Update Active		
Mode	RFC-S		
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		

*Analogue Input 1 Fast Update Active (07.026)* is one if the destination for analogue input 1 is being updated at the fast rate of 250us.

Parameter	07.027 Analogue Input 2 Fast Update Active		
Short description	Analogue Input 2 Fast Update Active		
Mode	RFC-S		
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		

*Analogue Input 2 Fast Update Active (07.027)* is one if the destination for analogue input 1 is being updated at the fast rate of 250us.

Parameter	07.028 Analog Input 1 Current Loop Loss		
Short description	Displays when analog input 1 falls below 3mA		
Mode	RFC-S		
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 *Analog Input 1 Mode (07.007)* is set to any of the 4-20mA or 20-4mA modes and the current falls below 3mA then *Analog Input 1 Current Loop Loss (07.028)* is set to one. If the current is more than 3mA or any other mode is selected then *Analog Input 1 Current Loop Loss (07.028)* is set to zero.

Parameter	07.029 Analog Input 2 Current Loop Loss		
Short description	Displays when analog input 2 falls below 3mA		
Mode	RFC-S		
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 *Analog Input 1 Current Loop Loss (07.028)*.

Parameter	07.030 Analog Input 1 Offset		
Short description	Defines the offset of analog input 1		
Mode	RFC-S		
Minimum	-100.00	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 *Analog Input 1 Scaling (07.008)*.

Parameter	07.031 Analog Input 2 Offset		
Short description	Defines the offset of analog input 2		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default	0.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

The scaling, offset and invert functions for analog input 2 are defined in the same way as for analog input 1. See *Analog Input 1 Scaling (07.008)*.

Parameter	07.032 Analog Input 3 Offset		
Short description	Defines the offset of analog input 3		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default	0.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

The scaling, offset and invert functions for analog input 3 are defined in the same way as for analog input 1. See *Analog Input 1 Scaling* (07.008).

Parameter	07.033 Power Output		
Short description	Instant output power		
Mode	RFC-S		
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-S		
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-S		
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-S		
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 <i>Temperature Nearest To Trip Level</i>		
Short description	Displays the thermistor location or the model that corresponds to the value shown in <i>Percentage Of Drive Thermal Trip Level</i>		
Mode	RFC-S		
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 xyyzz 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 <i>Temperature Monitor Select 1</i>		
Short description	Defines the temperature to be monitored in <i>Monitored Temperature 1</i>		
Mode	RFC-S		
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-S		
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	07.040 Analog Input 1 Minimum		
Short description	Defines the minimum value for analog input 1		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default	-100.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Analog Input 1* (07.001).

Parameter	07.041 Analog Input 2 Minimum		
Short description	Defines the minimum value for analog input 2		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default	-100.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Analog Input 1* (07.001).

Parameter	07.042 Analog Input 3 Minimum		
Short description	Defines the minimum value for analog input 3		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default	-100.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Analog Input 1* (07.001).

Parameter	07.043 Analog Input 1 Maximum		
Short description	Defines the maximum value for analog input 1		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default	100.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Analog Input 1* (07.001).

Parameter	07.044 Analog Input 2 Maximum		
Short description	Defines the maximum value for analog input 2		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default	100.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Analog Input 1* (07.001).

Parameter	07.045 Analog Input 3 Maximum		
Short description	Defines the maximum value for analog input 3		
Mode	RFC-S		
Minimum	-100.00	Maximum	100.00
Default	100.00	Units	%
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW		

See *Analog Input 1* (07.001).

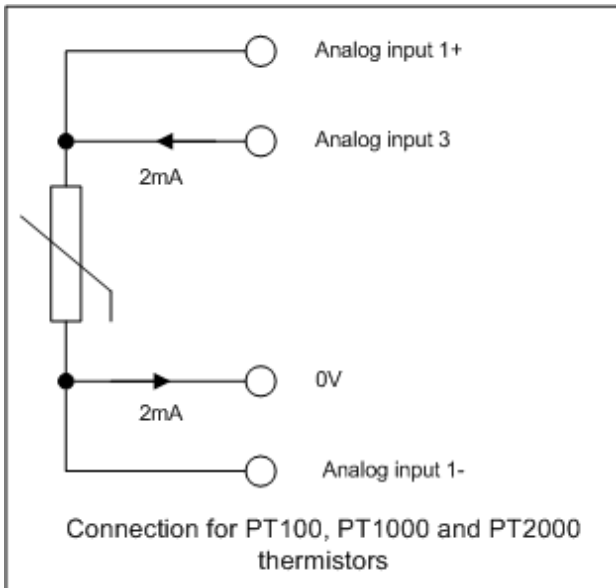
Parameter	07.046 Analog Input 3 Thermistor Type		
Short description	Defines the thermistor type for analog input 3		
Mode	RFC-S		
Minimum	0	Maximum	9
Default	0	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	DIN44082
1	KTY84
2	PT100 (4W)
3	PT1000 (4W)
4	PT2000 (4W)
5	2.0mA (4W)
6	PT100 (2W)
7	PT1000 (2W)
8	PT2000 (2W)
9	2.0mA (2W)

*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	07.047 Analog Input 3 Thermistor Feedback		
Short description	Displays the measured resistance of analog input 3		
Mode	RFC-S		
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	07.048 Analog Input 3 Thermistor Trip Threshold		
Short description	Defines the thermistor trip threshold for analog input 3		
Mode	RFC-S		
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	07.049 Analog Input 3 Thermistor Reset Threshold		
Short description	Defines the thermistor reset threshold for analog input 3		
Mode	RFC-S		
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 Analog Input 3 Thermistor Temperature		
Short description	Displays the temperature of the device based on the resistance to temperature characteristic for the specified device		
Mode	RFC-S		
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	07.051 <i>Analog Input 1 Full Scale</i>		
Short description	Displays the full scale value of analog input 1		
Mode	RFC-S		
Minimum	0	Maximum	65535
Default		Units	
Type	16 Bit Power Down Save	Update Rate	Background write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

See *Calibrate Analog Input 1 Full Scale* (07.025).

Parameter	07.052 <i>Temperature Monitor Select 3</i>		
Short description	Defines the temperature to be monitored in Monitored Temperature 3		
Mode	RFC-S		
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-S

Parameter		Range	Default	Type					
08.001	Digital I/O 01 State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
08.002	Digital I/O 02 State	Off (0) or On (1)		RO	Bit	ND	NC	PT	
08.003	Digital I/O 03 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	
08.006	Digital Input 06 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), STO 1 OR STO 2 (3)	Disable (0)	RW	Txt				US
08.011	Digital I/O 01 Invert	Not Invert (0), Invert (1)	Not Invert (0)	RW	Txt				US
08.012	Digital I/O 02 Invert	Not Invert (0), Invert (1)	Not Invert (0)	RW	Txt				US
08.013	Digital I/O 03 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
08.016	Digital Input 06 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 I/O 01 Source/Destination	0.000 to 59.999	10.003	RW	Num	DE		PT	US
08.022	Digital I/O 02 Source/Destination	0.000 to 59.999	10.033	RW	Num	DE		PT	US
08.023	Digital I/O 03 Source/Destination	0.000 to 59.999	6.030	RW	Num	DE		PT	US
08.024	Digital Input 04 Destination	0.000 to 59.999	6.032	RW	Num	DE		PT	US
08.025	Digital Input 05 Destination	0.000 to 59.999	1.041	RW	Num	DE		PT	US
08.026	Digital Input 06 Destination	0.000 to 59.999	6.031	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
08.029	Input Logic Polarity	Negative Logic (0), Positive Logic (1)	Positive Logic (1)	RW	Txt				US
08.031	Digital I/O 01 Output Select	Off (0) or On (1)	On (1)	RW	Bit				US
08.032	Digital I/O 02 Output Select	Off (0) or On (1)	Off (0)	RW	Bit				US
08.033	Digital I/O 03 Output Select	Off (0) or On (1)	Off (0)	RW	Bit				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
Fl	Filtered	US	User save	PS	Power-down save						



# Menu 8 – Digital I/O

Mode: RFC-S

## 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

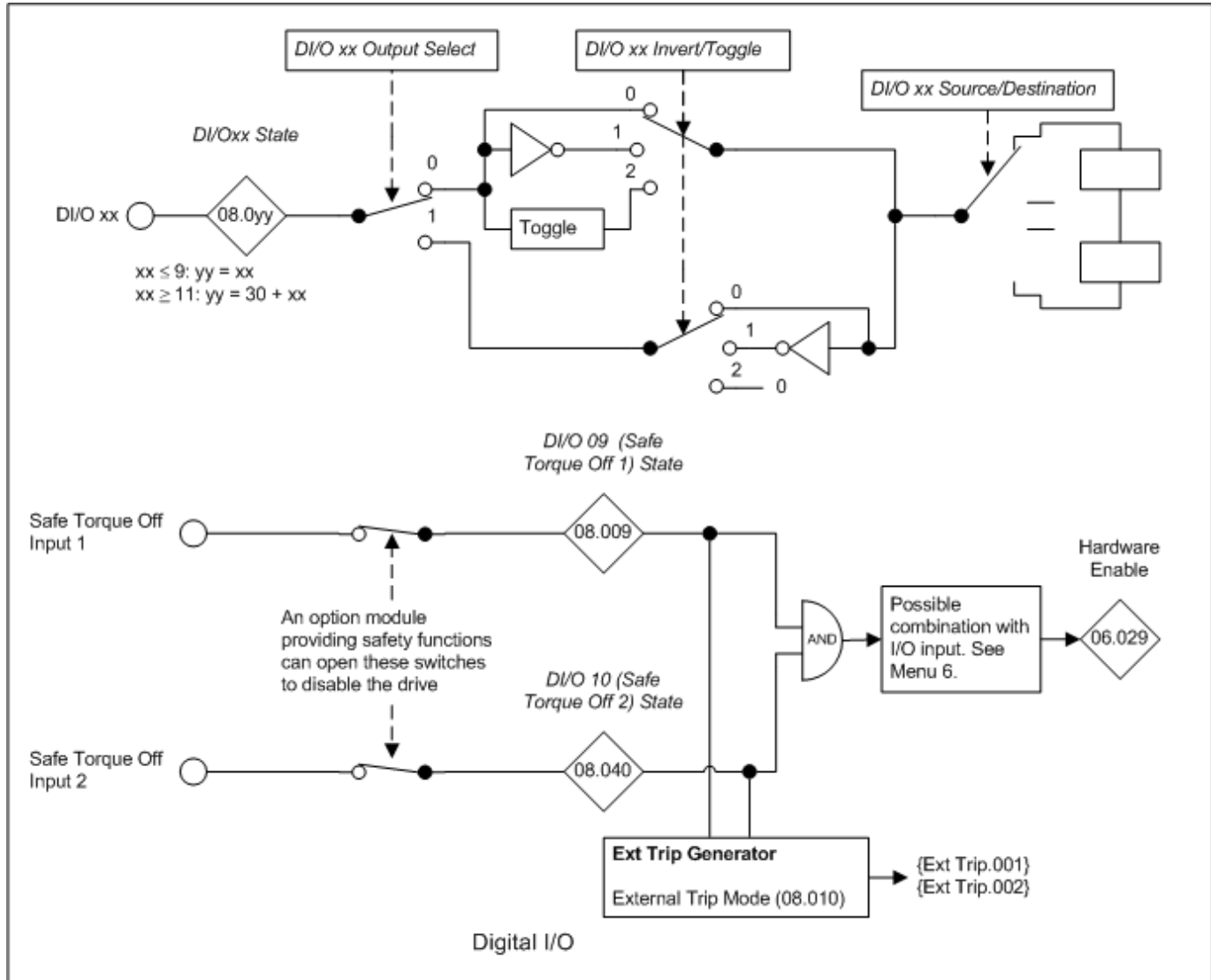
Digital I/O Output Enable Register 1 (08.071), Digital I/O Input Register 1 (08.072) and Digital I/O Output Register 1 (08.073) provide direct access to read/control the digital I/O that is integral to the drive.

## 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 I/O 01 State		
Short description	Displays the state for digital input/output 1		
Mode	RFC-S		
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 I/O 02 State		
Short description	Displays the state for digital input/output 2		
Mode	RFC-S		
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 I/O 01 State* (08.001).

Parameter	08.003 Digital I/O 03 State		
Short description	Displays the state for digital input/output 3		
Mode	RFC-S		
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 I/O 01 State* (08.001).

Parameter	08.004 Digital Input 04 State		
Short description	Displays the state for digital input 4		
Mode	RFC-S		
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 I/O 01 State* (08.001).

Parameter	08.005 Digital Input 05 State		
Short description	Displays the state for digital input 5		
Mode	RFC-S		
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 I/O 01 State* (08.001).

Parameter	08.006 Digital Input 06 State		
Short description	Displays the state for digital input 6		
Mode	RFC-S		
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 I/O 01 State* (08.001).

Parameter	08.007 Relay Output State		
Short description	Displays the state for relay output		
Mode	RFC-S		
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 I/O 01 State* (08.001).

Parameter	08.008 24V Supply Output State		
Short description	Displays the state for 24V supply output		
Mode	RFC-S		
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 I/O 01 State* (08.001).

Parameter	08.009 STO Input 01 State		
Short description	Displays the state for Safe Torque Off 1 input		
Mode	RFC-S		
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 I/O 01 State* (08.001).

Parameter	08.010 External Trip Mode		
Short description	Defines behaviour of drive if STOs are low		
Mode	RFC-S		
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.

External Trip Mode (08.010)	Actions
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 OR <i>External Trip.002</i> if Safe Torque Off Input 2 is low

Parameter	08.011 Digital I/O 01 Invert		
Short description	Set to invert Digital I/O 01		
Mode	RFC-S		
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

A value of 0 or 1 allows the digital I/O to be non-inverted or inverted respectively.

Parameter	08.012 Digital I/O 02 Invert		
Short description	Set to invert Digital I/O 02		
Mode	RFC-S		
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 I/O 01 Invert* (08.011).

Parameter	08.013 Digital I/O 03 Invert		
Short description	Set to invert Digital I/O 03		
Mode	RFC-S		
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 I/O 01 Invert* (08.011).

Parameter	08.014 Digital Input 04 Invert		
Short description	Set to invert Digital Input 04		
Mode	RFC-S		
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 I/O 01 Invert* (08.011).

Parameter	08.015 Digital Input 05 Invert		
Short description	Set to invert Digital Input 05		
Mode	RFC-S		
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 I/O 01 Invert* (08.011).

Parameter	08.016 Digital Input 06 Invert		
Short description	Set to invert Digital Input 06		
Mode	RFC-S		
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 I/O 01 Invert* (08.011).

Parameter	08.017 Relay Invert		
Short description	Set to invert the Relay Output		
Mode	RFC-S		
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 I/O 01 Invert* (08.011).

Parameter	08.018 24V Supply Output Invert		
Short description	Set to invert 24V Supply Output		
Mode	RFC-S		
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 I/O 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-S		
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 I/O 01 Source/Destination		
Short description	Defines the source or destination parameter for Digital I/O 1		
Mode	RFC-S		
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 I/O 02 Source/Destination		
Short description	Defines the source or destination parameter for Digital I/O 2		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	10.033	Units	
Type	16 Bit User Save	Update Rate	Drive Reset Read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Digital I/O 01 Source/Destination* (08.021).

Parameter	08.023 Digital I/O 03 Source/Destination		
Short description	Defines the source or destination parameter for Digital I/O 3		
Mode	RFC-S		
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 I/O 01 Source/Destination* (08.021).

Parameter	08.024 Digital Input 04 Destination		
Short description	Defines the destination parameter for Digital Input 4		
Mode	RFC-S		
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 I/O 01 Source/Destination* (08.021).

Parameter	08.025 Digital Input 05 Destination		
Short description	Defines the destination parameter for Digital Input 5		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	1.041	Units	
Type	16 Bit User Save	Update Rate	Drive Reset Read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Digital I/O 01 Source/Destination* (08.021).

Parameter	08.026 Digital Input 06 Destination		
Short description	Defines the destination parameter for Digital Input 6		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	6.031	Units	
Type	16 Bit User Save	Update Rate	Drive Reset Read
Display Format	Standard	Decimal Places	3
Coding	RW, DE, PT, BU		

See *Digital I/O 01 Source/Destination* (08.021).

Parameter	08.027 Relay Output Source		
Short description	Defines the source parameter for the Relay Output		
Mode	RFC-S		
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 I/O 01 Source/Destination* (08.021).

Parameter	08.028 24V Supply Output Source		
Short description	Defines the source parameter for 24V Supply Output		
Mode	RFC-S		
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 I/O 01 Source/Destination* (08.021).

Parameter	08.029 Input Logic Polarity		
Short description	Defines the polarity of the input logic		
Mode	RFC-S		
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, BU		

Value	Text
0	Negative Logic
1	Positive Logic

See *Digital I/O 01 State* (08.001).

Parameter	08.031 Digital I/O 01 Output Select		
Short description	Defines if Digital I/O 1 is an input or output. 0 = input, 1 = output		
Mode	RFC-S		
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		

The Digital I/O Output Select parameters allow the I/O to be selected as an input (0) or an output (1). These parameters are only present for digital I/O that can be used as an input or output.

Parameter	08.032 Digital I/O 02 Output Select		
Short description	Defines if Digital I/O 2 is an input or output. 0 = input, 1 = output		
Mode	RFC-S		
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 *Digital I/O 01 Output Select* (08.031).

Parameter	08.033 Digital I/O 03 Output Select		
Short description	Defines if Digital I/O 3 is an input or output. 0 = input, 1 = output		
Mode	RFC-S		
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 *Digital I/O 01 Output Select* (08.031).



Parameter	08.040 STO Input 02 State		
Short description	Displays the state for the Safe Torque Off 2 input		
Mode	RFC-S		
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 I/O 01 State* (08.001).

Parameter	08.041 Keypad Run Button State		
Short description	Displays the state for the Keypad Run Forward button		
Mode	RFC-S		
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 I/O 01 State* (08.001).

Parameter	08.042 Keypad Auxiliary Button State		
Short description	Displays the state for the Keypad Auxiliary button		
Mode	RFC-S		
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 I/O 01 State* (08.001).

Parameter	08.043 24V Supply Input State		
Short description	Displays the state for the 24V Supply Input		
Mode	RFC-S		
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 I/O 01 State* (08.001).

Parameter	08.044 Keypad Stop Button State		
Short description	Displays the state for the Keypad Stop button		
Mode	RFC-S		
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 I/O 01 State* (08.001).

Parameter	08.051 Keypad Run Button Invert/Toggle		
Short description	Set to invert/toggle Keypad Run Button		
Mode	RFC-S		
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-S		
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-S		
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 I/O 01 Source/Destination* (08.021).

Parameter	08.061 Keypad Run Button Destination		
Short description	Defines the destination parameter for the keypad run button		
Mode	RFC-S		
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 I/O 01 Source/Destination* (08.021).

Parameter	08.062 Keypad Auxiliary Button Destination		
Short description	Defines the destination parameter for the keypad auxiliary button		
Mode	RFC-S		
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 I/O 01 Source/Destination* (08.021).

Parameter	08.063 24V Supply Input Destination		
Short description	Defines the destination parameter for the 24V input		
Mode	RFC-S		
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 I/O 01 Source/Destination* (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-S		
Minimum	0 (Display: 0000000000000000)	Maximum	65535 (Display: 1111111111111111)
Default	0 (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-S		
Minimum	0 (Display: 0000000000000000)	Maximum	65535 (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 <i>Digital I/O Output Register 1</i>		
Short description	Displays the binary form of the DI/O output register		
Mode	RFC-S		
Minimum	0 (Display: 0000000000000000)	Maximum	65535 (Display: 1111111111111111)
Default	0 (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-S

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), Week (3), Month (4), Year (5), 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), Week (3), Month (4), Year (5), 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-S

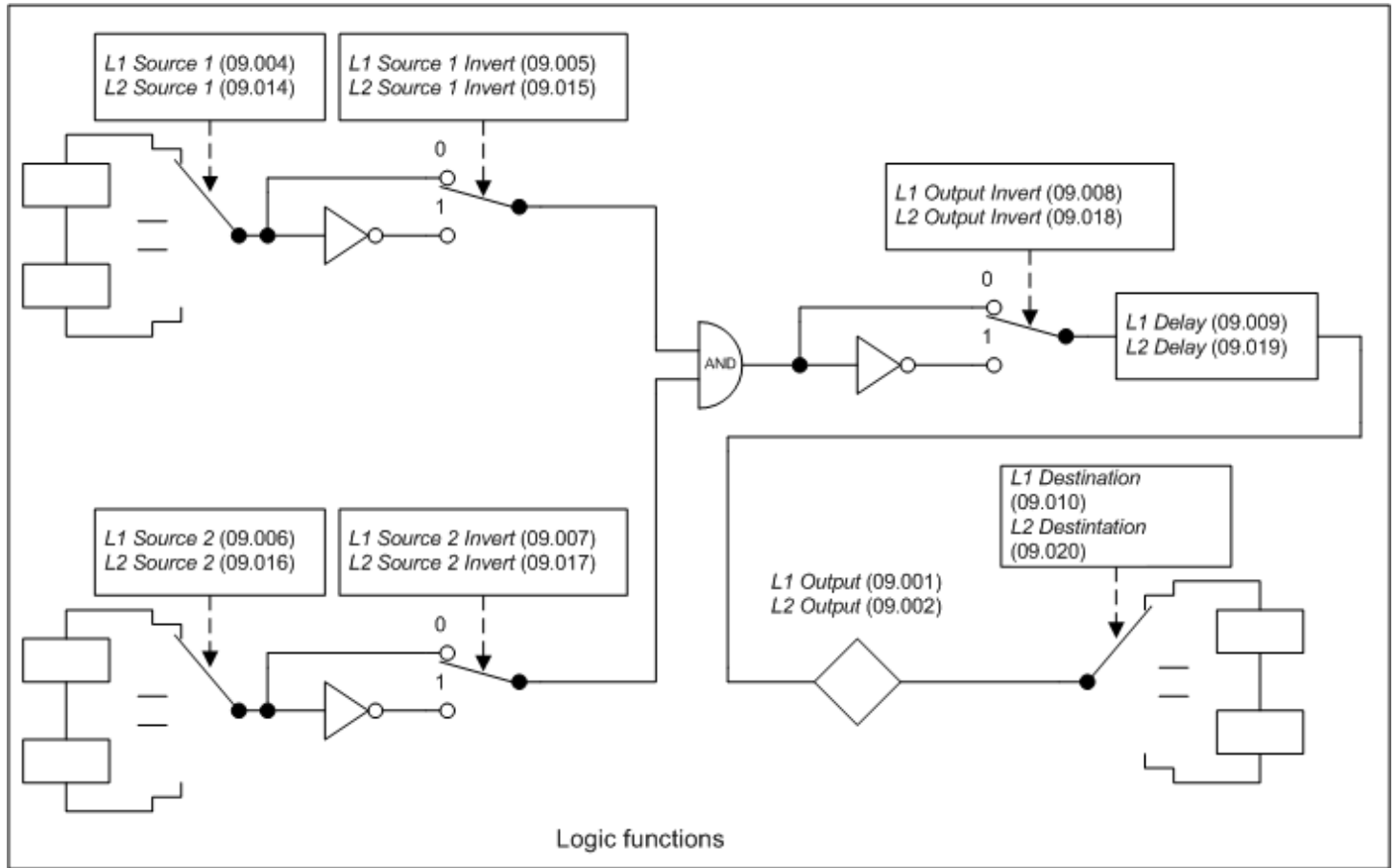
Menu 9 provides the parameters for the following features:

1. Logic functions
2. Motorised Pot
3. Binary Sum
4. Timers
5. Scope function



## Logic functions

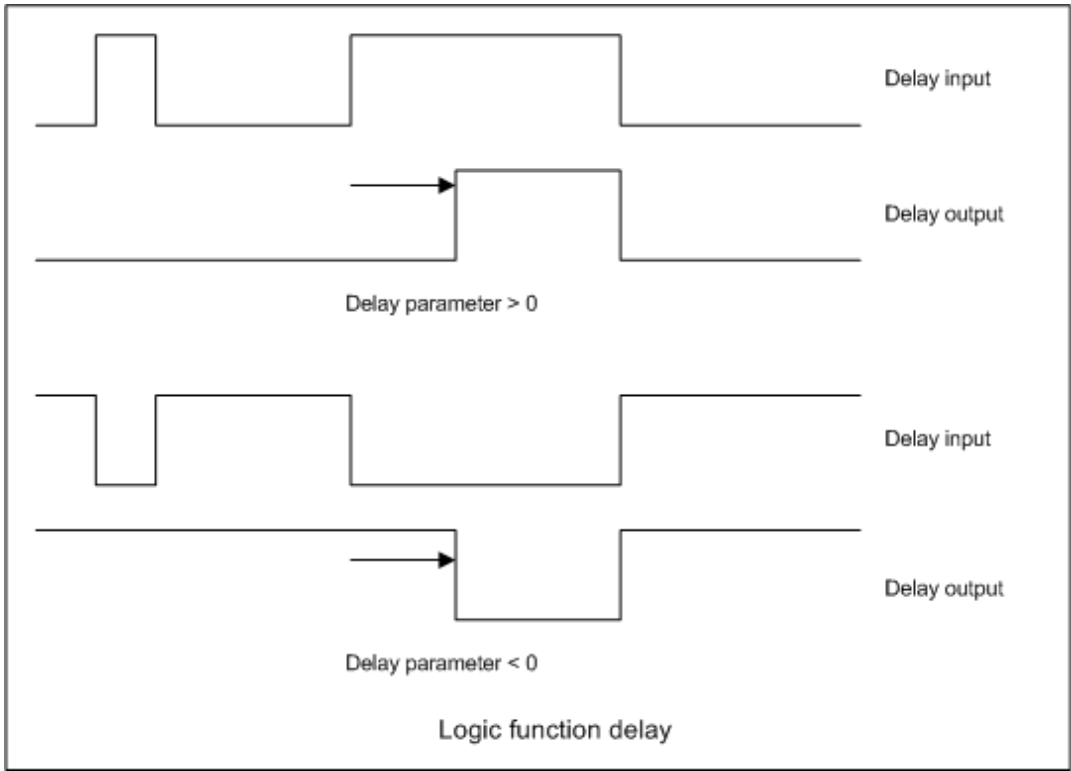
The logic functions are always active even if the sources and destinations are not routed to valid parameters. If the sources are not valid parameters then the source values are taken as 0. The update rate for each of the logic functions is always 4ms.



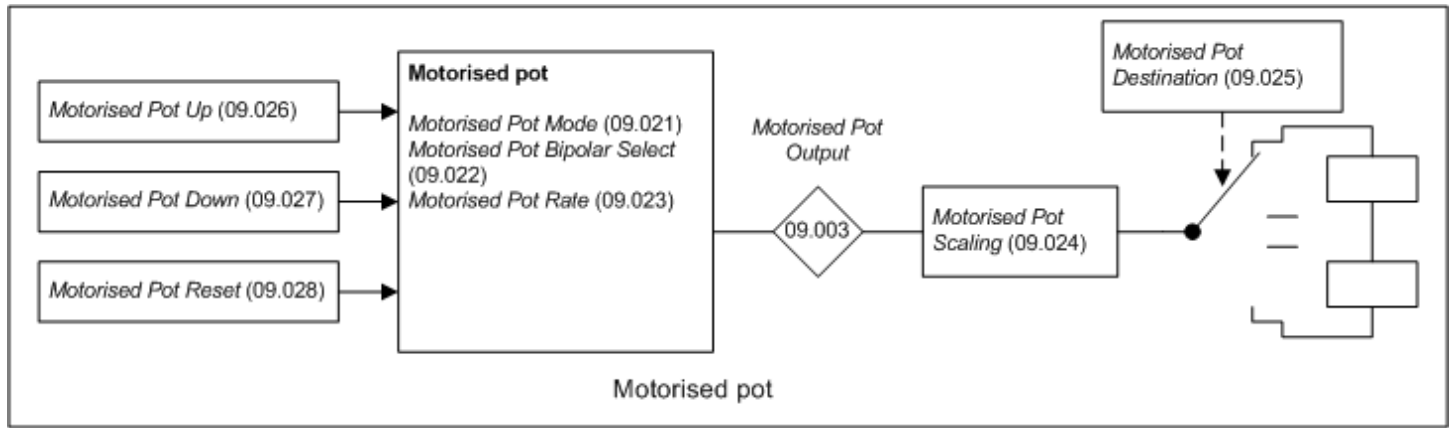
The logic function consists of an AND gate with inverters on each input and an inverter on the output. Some of the other standard logic functions can be produced as shown in the table below.

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%.

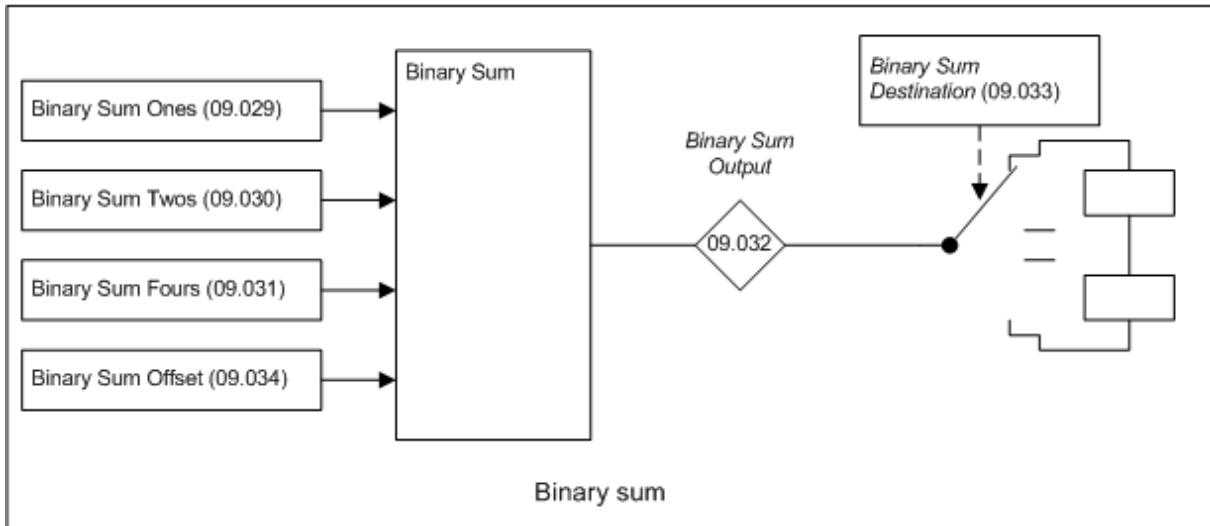
*Motorised Pot Mode* (09.021) defines the mode of operation as given in the table below.

<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:

$$\text{Binary Sum Output (09.032)} = \text{Binary Sum Offset (09.034)} + (\text{Binary Sum Ones (09.029)} \times 1) + (\text{Binary Sum Twos (09.030)} \times 2) + (\text{Binary Sum Fours (09.031)} \times 4)$$

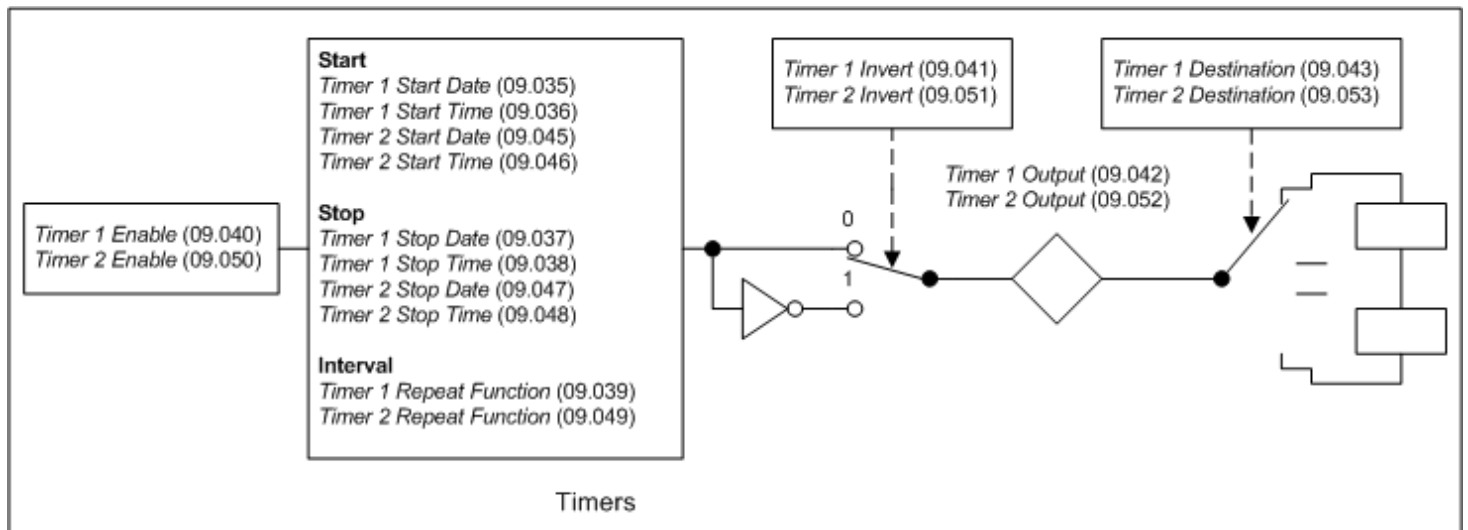
*Binary Sum Destination (09.033)* defines the destination for the binary sum output. The routing for this destination is special if the maximum of the destination parameter  $\leq 7 + \text{Binary Sum Offset (09.034)}$  as follows:

Destination parameter = *Binary Sum Output (09.032)*, subject to the parameter minimum.

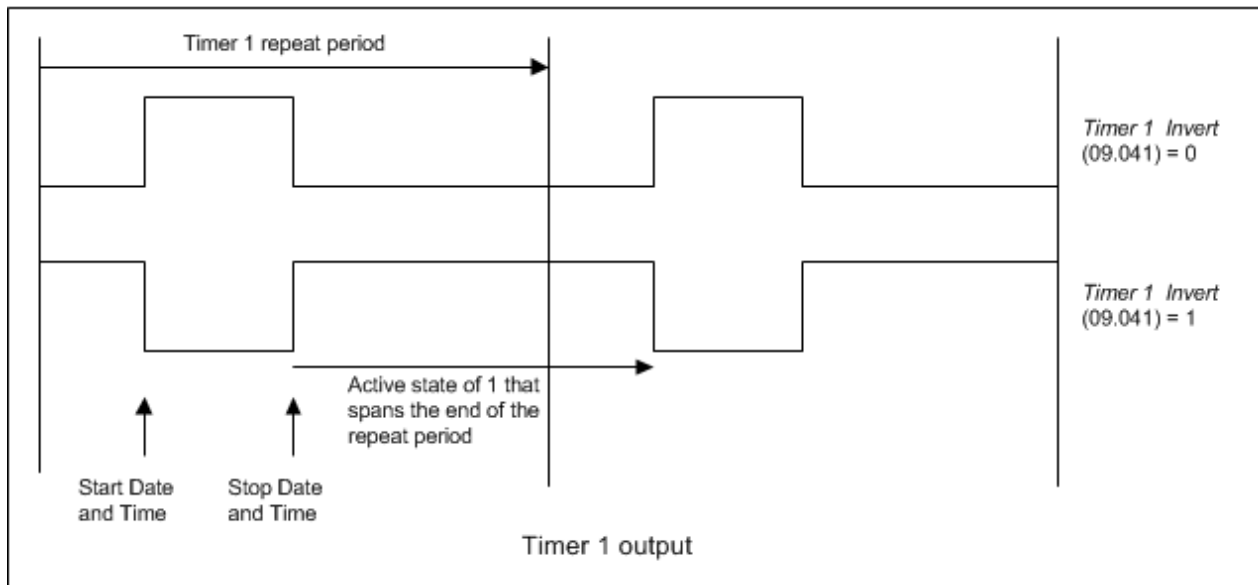
If the maximum of the destination parameter  $> 7 + \text{Binary Sum Offset (09.034)}$ , *Binary Sum Output (09.032)* is routed in the same way as any other destination where the destination target is at its full scale value when the *Binary Sum Output (09.032)* =  $7 + \text{Binary Sum Offset (09.034)}$ .

## 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.



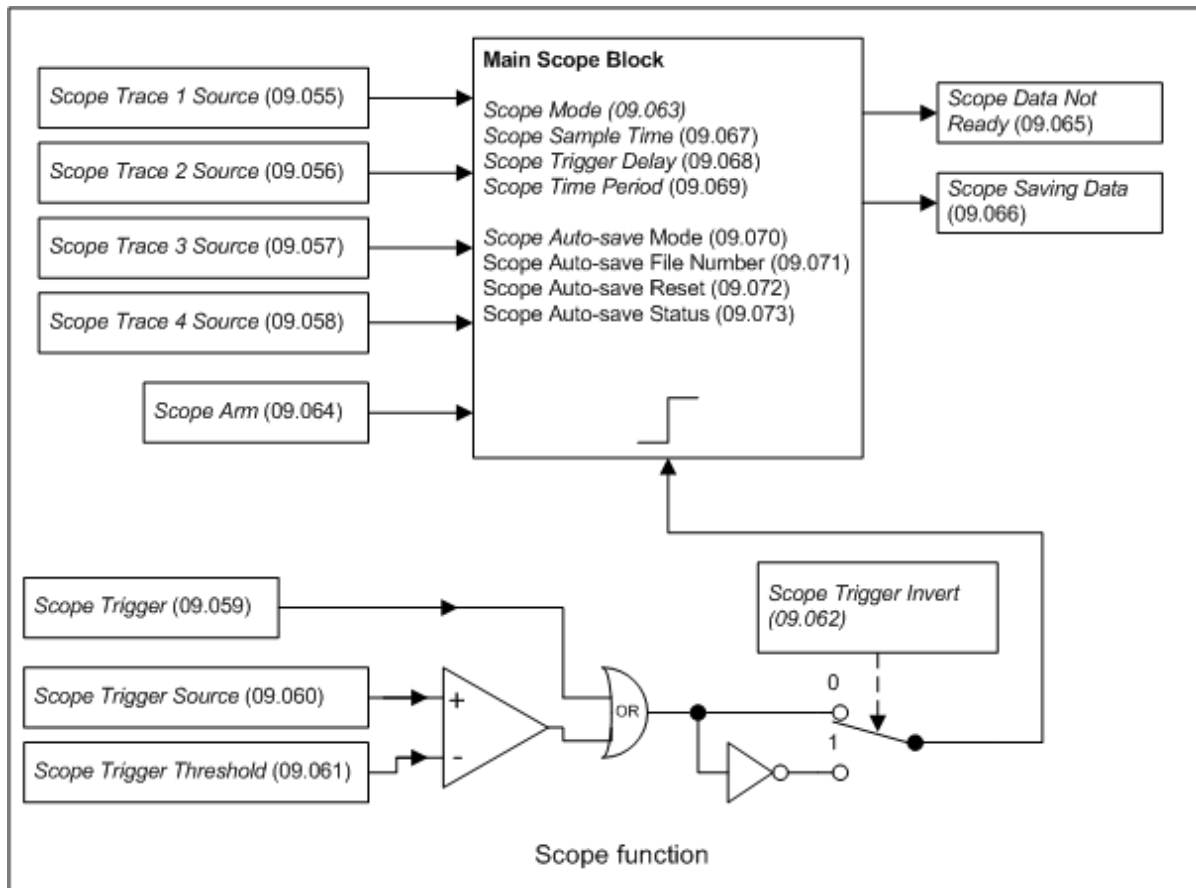
*Timer 1 Repeat Function* (09.039) defines the length of the repeat period. For example, if *Timer 1 Repeat Function* (09.039) = 2 then the repeat period is one day. The output is inactive until the time reaches the hour, minute and second defined in *Timer 1 Start Time* (09.036), and remains active 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).

<b>Timer 1 Repeat Function (09.039)</b>	<b>Repeat period</b>	<b>Second</b>	<b>Minute</b>	<b>Hour</b>	<b>Day</b>	<b>Month</b>	<b>Year</b>	<b>Day of week</b>
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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.

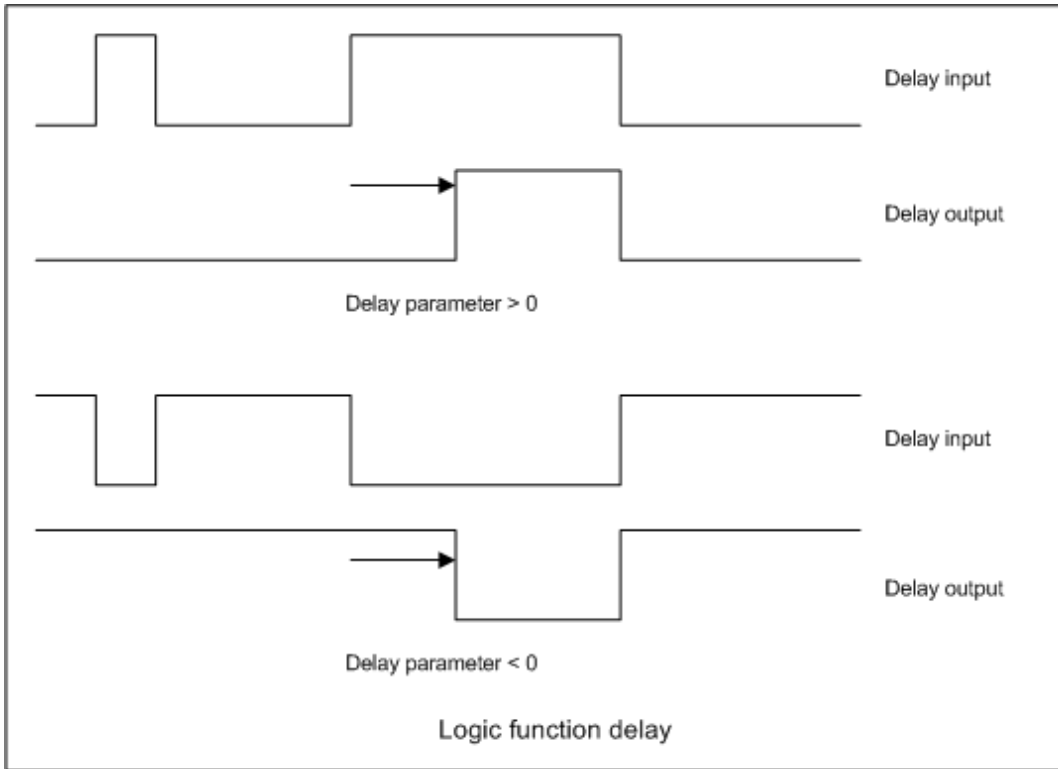
Parameter	09.008 Logic Function 1 Output Invert		
Short description	Set to invert the output of logic function 1		
Mode	RFC-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

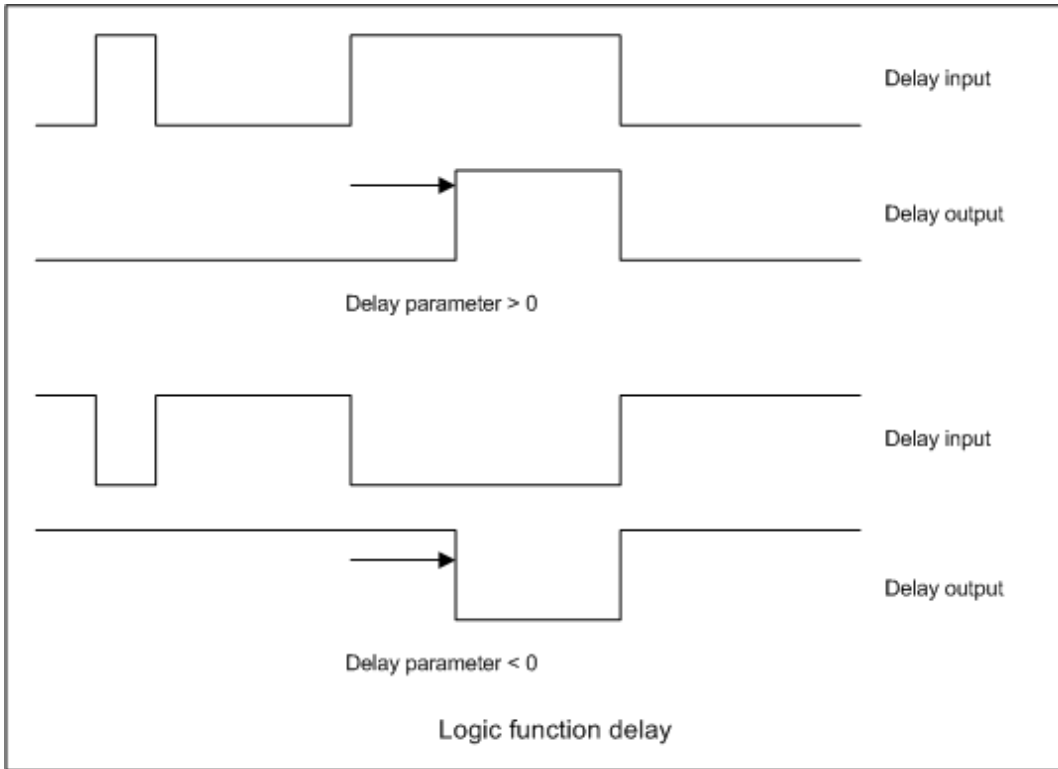
Setting Logic Function 2 Source 2 Invert (09.017) inverts input 2 of logic function 2.

Parameter	09.018 Logic Function 2 Output Invert		
Short description	Set to invert the output of logic function 2		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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)  $>$  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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default	0 (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-S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default	0 (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-S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default	0 (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 <i>Timer 1 Stop Time</i>		
Short description	Defines the stop time for timer 1		
Mode	RFC-S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default	0 (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 <i>Timer 1 Repeat Function</i>		
Short description	Defines the length of the repeat period		
Mode	RFC-S		
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).

<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	.						

Parameter	09.040 <i>Timer 1 Enable</i>		
Short description	Set to enable the timer 1 function		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default	0 (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-S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default	0 (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-S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (Display: 31-12-99)
Default	0 (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-S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (Display: 23:59:59)
Default	0 (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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

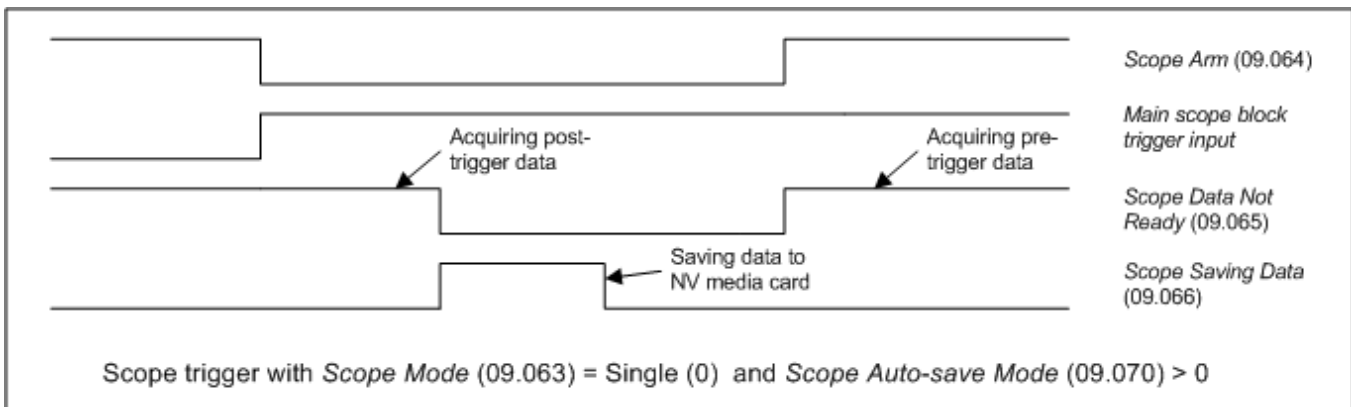
See *Scope Trigger* (09.059).

Parameter	09.063 Scope Mode		
Short description	Defines the mode of the scope		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S



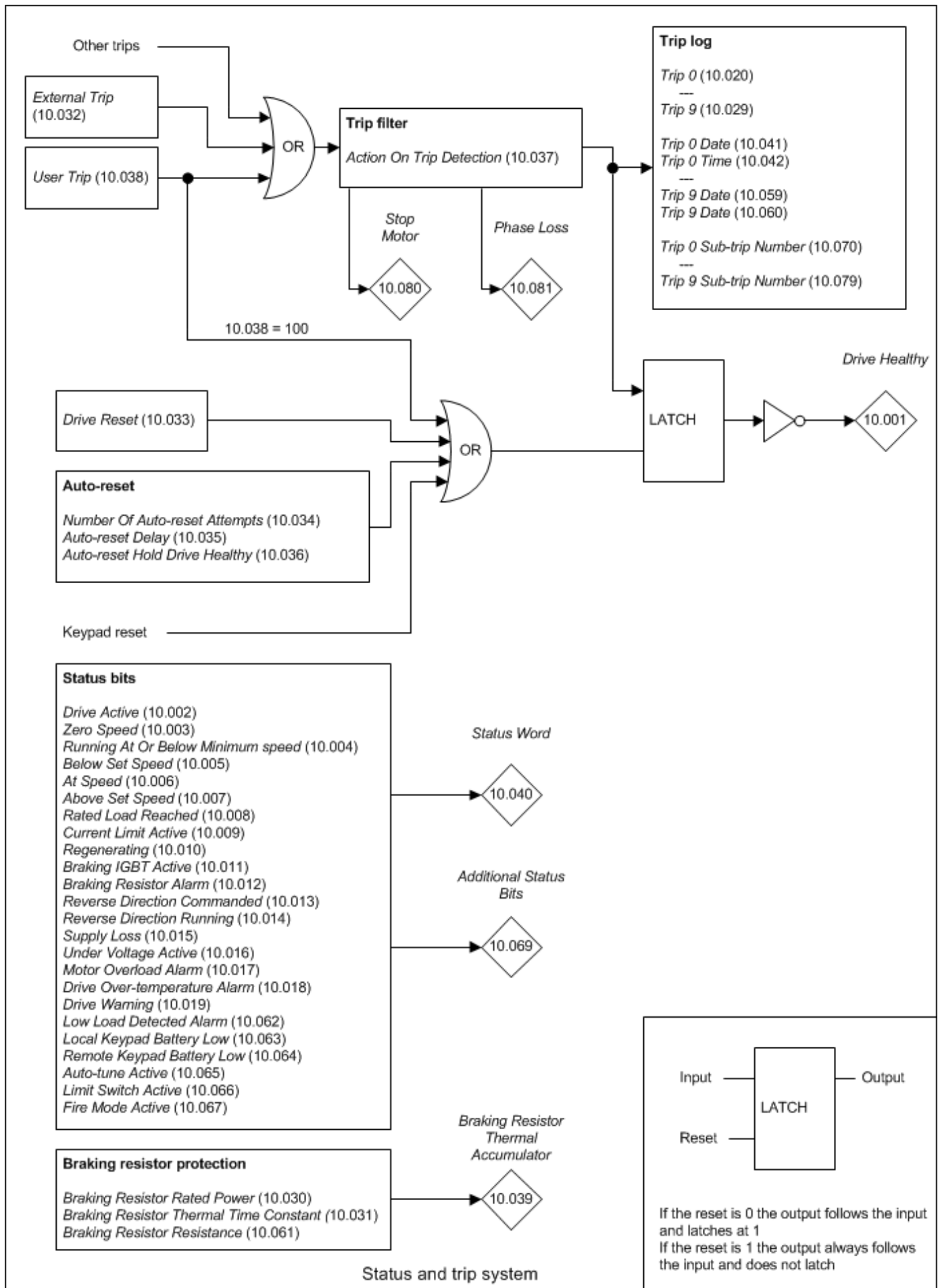
Parameter		Range	Default	Type					
10.001	Drive Healthy	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.002	Drive Active	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.003	Zero Speed	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.004	Running At Or Below Minimum Speed	Off (0) or On (1)		RO	Bit	ND	NC	PT	
10.005	Below Set Speed	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	
10.068	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	
10.106	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-S



Parameter				10.001 Drive Healthy			
Short description				Indicates that the drive is healthy			
Mode				RFC-S			
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-S			
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-S			
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-S			
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-S			
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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
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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: 1 – background tasks 2 – timed tasks 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. Sub-trip is shown to indicate which failure: 1 - Programming error while writing menu in flash 2 - Erase flash block containing setup menus failed 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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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		

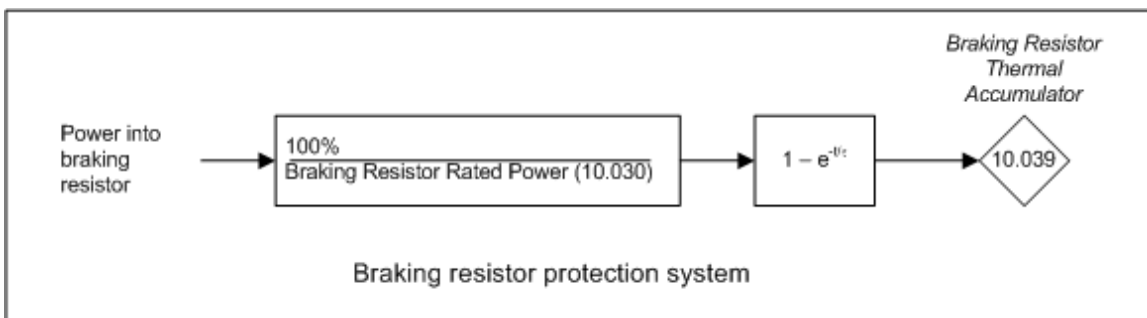
See *Trip 0* (10.020).

Parameter	10.030 Braking Resistor Rated Power		
Short description	Set to the rated power of the braking resistor		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
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 <i>Auto-reset Delay</i>		
Short description	Set to the required auto-reset delay		
Mode	RFC-S		
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 <i>Auto-reset Hold Drive Healthy</i>		
Short description	Set to hold drive healthy if further auto-reset attempts are possible		
Mode	RFC-S		
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 <i>Action On Trip Detection</i>		
Short description	Defines the action of the drive on detection of a trip		
Mode	RFC-S		
Minimum	0 (Display: 00000)	Maximum	31 (Display: 11111)
Default	0 (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-S		
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-S		
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-S		
Minimum	0 (Display: 0000000000000000)	Maximum	32767 (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	Drive Healthy (10.001)
1	Drive Active (10.002)
2	Zero Speed (10.003)
3	Running At Or Below Minimum Speed (10.004)
4	Below Set Speed (10.005)
5	At Speed (10.006)
6	Above Set Speed (10.007)
7	Rated Load Reached (10.008)
8	Current Limit Active (10.009)
9	Regenerating (10.010)
10	Braking IGBT Active (10.011)
11	Braking Resistor Alarm (10.012)
12	Reverse Direction Commanded (10.013)
13	Reverse Direction Running (10.014)
14	Supply Loss (10.015)

Parameter	10.041 Trip 0 Date		
Short description	Shows the date at which trip 0 occurred		
Mode	RFC-S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (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-S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (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-S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (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-S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (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-S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (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-S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (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-S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (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-S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (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-S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (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-S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (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-S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (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-S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (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-S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (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-S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (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-S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (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-S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (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-S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (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-S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (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-S		
Minimum	0 (Display: 00-00-00)	Maximum	311299 (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-S		
Minimum	0 (Display: 00:00:00)	Maximum	235959 (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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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	10.068 <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-S		
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-S		
Minimum	0 (Display: 0000000000)	Maximum	1023 (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 <i>Trip 0 Sub-trip Number</i>		
Short description	Shows the sub-trip number for trip 0		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
Minimum	0 (Display: 0000000000000000)	Maximum	65535 (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-S		
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 <i>Trip Reset Source</i>		
Short description	Indicates whether a trip in the trip log has been reset.		
Mode	RFC-S		
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 <i>Trip Time Identifier</i>		
Short description	Shows time in milliseconds since the drive powered up when a trip occurred		
Mode	RFC-S		
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 <i>Active Alarm</i>		
Short description	Shows the value of the active alarm		
Mode	RFC-S		
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	10.106 <i>Potential Drive Damage Conditions</i>		
Short description	Indicates that the user has put the drive in a condition that could potentially damage the drive		
Mode	RFC-S		
Minimum	0 (Display: 0000)	Maximum	15 (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-S		
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
4	Locate rotor flux
5	Locate rotor flux repeat
6	Ld and Lq measurement with no-load
7	Lq measurement with load
8	Ke measurement
9	Inertia measurement

# Menu 11 Single Line Descriptions – *Miscellaneous*

Mode: RFC-S

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
11.020	Reset Serial Communications	Off (0) or On (1)		RW	Bit	ND	NC			
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
11.023	Serial Address	1 to 247	1	RW	Num					US
11.024	Serial Mode	8 2 NP (0), 8 1 NP (1), 8 1 EP (2), 8 1 OP (3), 8 2 NP M (4), 8 1 NP M (5), 8 1 EP M (6), 8 1 OP M (7), 7 2 NP (8), 7 1 NP (9), 7 1 EP (10), 7 1 OP (11), 7 2 NP M (12), 7 1 NP M (13), 7 1 EP M (14), 7 1 OP M (15)	8 2 NP (0)	RW	Txt					US
11.025	Serial Baud Rate	300 (0), 600 (1), 1200 (2), 2400 (3), 4800 (4), 9600 (5), 19200 (6), 38400 (7), 57600 (8), 76800 (9), 115200 (10)	19200 (6)	RW	Txt					US
11.026	Minimum Comms Transmit Delay	0 to 250 ms	2 ms	RW	Num					US
11.027	Silent Period	0 to 250 ms	0 ms	RW	Num					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),	1234 (0)	RW	Txt			PT		



		3421 (21), 4231 (22), 4321 (23)									
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	1295396912 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-S

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) Speed Controller Integral Gain Ki1 (03.011) Speed Controller Proportional Gain Kp2 (03.013) 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) M2 Speed Controller Integral Gain Ki (21.018)	
Current Controller Kp Gain (04.013) 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) 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-S		
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-S		
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-S		
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-S		
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	11.020 Reset Serial Communications		
Short description	Set to one to update communications set-up		
Mode	RFC-S		
Minimum	0	Maximum	1
Default		Units	
Type	1 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, ND, NC		

When *Serial Address* (11.023), *Serial Mode* (11.024), *Serial Baud Rate* (11.025), *Minimum Comms Transmit Delay* (11.026) or *Silent Period* (11.027) are modified the changes do not have an immediate effect on the serial communications system. The new values are used after the next power-up or if *Reset Serial Communications* (11.020) is set to one. *Reset Serial Communications* (11.020) is automatically cleared to zero after the communications system is updated.

Parameter	11.021 Parameter 00.030 Scaling		
Short description	Defines the scaling for Pr 00.030		
Mode	RFC-S		
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-S		
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	11.023 Serial Address		
Short description	Defines the serial address of the drive		
Mode	RFC-S		
Minimum	1	Maximum	247
Default	1	Units	
Type	8 Bit User Save	Update Rate	Read on serial communications reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

*Serial Address* (11.023) defines the node address for the serial comms interface in the range from 1 to 247.

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (11.020) for more details.

Parameter	11.024 Serial Mode		
Short description	Defines the serial mode of the drive		
Mode	RFC-S		
Minimum	0	Maximum	15
Default	0	Units	
Type	8 Bit User Save	Update Rate	Read on serial communications reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
0	8 2 NP
1	8 1 NP
2	8 1 EP
3	8 1 OP
4	8 2 NP M
5	8 1 NP M
6	8 1 EP M
7	8 1 OP M
8	7 2 NP
9	7 1 NP
10	7 1 EP
11	7 1 OP
12	7 2 NP M
13	7 1 NP M
14	7 1 EP M
15	7 1 OP M

The core drive always uses the Modbus rtu protocol and is always a slave. *Serial Mode* (11.024) defines the data format used by the serial comms interface. The bits in the value of *Serial Mode* (11.024) define the data format as follows. Bit 3 is always 0 in the core product as 8 data bits are required for Modbus rtu. The parameter value can be extended in derivative products which provide alternative communications protocols if required.

Bits	3	2	1 and 0
Format	Number of data bits 0 = 8 bits 1 = 7 bits	Register mode 0 = Standard 1 = Modified	Stop bits and Parity 0 = 2 stop bits, no parity 1 = 1 stop bit, no parity 2 = 1 stop bit, even parity 3 = 1 stop bit, odd parity

Bit 2 selects either standard or modified register mode. The menu and parameter numbers are derived for each mode as given in the table below. Standard mode is compatible with Unidrive SP. Modified mode is provided to allow register numbers up to 255 to be addressed. If any menus with numbers above 63 should contain more than 99 parameters, then these parameters cannot be accessed via Modbus rtu.

Register mode	Register address
Standard	$(mm \times 100) + ppp - 1$ where $mm \leq 162$ and $ppp \leq 99$
Modified	$(mm \times 256) + ppp - 1$ where $mm \leq 63$ and $ppp \leq 255$

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (11.020) for more details.

<b>Parameter</b>			
<b>11.025 Serial Baud Rate</b>			
Short description	Defines the serial baud rate of the drive		
Mode	RFC-S		
Minimum	0	Maximum	10
Default	6	Units	
Type	8 Bit User Save	Update Rate	Read on serial communications reset
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

<b>Value</b>	<b>Text</b>
0	300
1	600
2	1200
3	2400
4	4800
5	9600
6	19200
7	38400
8	57600
9	76800
10	115200

*Serial Baud Rate* (11.025) defines the baud rate used by the serial comms interface.

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (11.020) for more details.

<b>Parameter</b>			
<b>11.026 Minimum Comms Transmit Delay</b>			
Short description	Defines the minimum delay between the host and drive		
Mode	RFC-S		
Minimum	0	Maximum	250
Default	2	Units	ms
Type	8 Bit User Save	Update Rate	Read on serial communications reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

There will always be a finite delay between the end of a message from the host (master) and the time at which the host is ready to receive the response from the drive (slave). The drive does not respond until at least 1ms after the message has been received from the host allowing 1ms for the host to change from transmit to receive mode. This initial delay can be extended using *Minimum Comms Transmit Delay* (11.026) if required.

<b>Minimum Comms Transmit Delay (11.026)</b>	<b>Action</b>
0	The transmitters are turned on and data transmission begins immediately after the initial delay ( $\geq 1$ ms)
1	The transmitters are turned on after the initial delay ( $\geq 1$ ms) and data transmission begins 1ms later
2 or more	The transmitters are turned on after a delay of at least the time specified by <i>Minimum Comms Transmit Delay</i> (11.026) and data transmission begins 1ms later

The drive holds its own transmitters active for up to 1ms after it has transmitted data before switching to the receive mode; the host should not send any data during this time.

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (11.020) for more details.

<b>Parameter</b>			
<b>11.027 Silent Period</b>			
Short description	Defines the idle time required to detect the end of a received data message		
Mode	RFC-S		
Minimum	0	Maximum	250
Default	0	Units	ms
Type	8 Bit User Save	Update Rate	Read on serial communications reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

The silent period defines the idle time required to detect the end of a received data message. If *Silent Period* (11.027) = 0 then the silent period is at least 3.5 characters at the selected baud rate. This is the standard silent period for Modbus rtu. If *Silent Period* (11.027) is non-zero it defines the minimum silent period in milliseconds.

Changing the parameters does not immediately change the serial communications settings. See *Reset Serial Communications* (11.020) for more details.

Parameter	11.028 Drive Derivative		
Short description	Displays the drive derivative identifier		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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:

<i>Number Of Power Modules Test</i> (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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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 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-S		
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 then 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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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 to 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-S		
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-S		
Minimum	0 (Display: 000000000)	Maximum	999999999 (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  $((11.053 * 1000000000) + 11.052)$ .

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-S		
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-S		
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-S		
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 Option Slot Identifiers		
Short description	Defines the order that option slots are used by the drive		
Mode	RFC-S		
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 Maximum Rated Current		
Short description	Displays the maximum rated current or normal duty rating of the drive		
Mode	RFC-S		
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 Full Scale Current Kc		
Short description	Displays the full scale current Kc		
Mode	RFC-S		
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-S		
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-S		
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-S		
Minimum	1295396912	Maximum	2147483647
Default		Units	
Type	32 Bit Volatile	Update Rate	Power-up write
Display Format	String	Decimal Places	0
Coding	RO, ND, NC, PT		

Background Read

Parameter	11.065 Drive Rating And Configuration		
Short description	Displays the drive rating and configuration		
Mode	RFC-S		
Minimum	0 (Display: 00000000)	Maximum	99999999 (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-S		
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-S		
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-S		
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.

A/I/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	

DI/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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S

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
12.045	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
12.054	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
FI	Filtered	US	User save	PS	Power-down save						



# Menu 12 – User Functions 2 and Brake Control

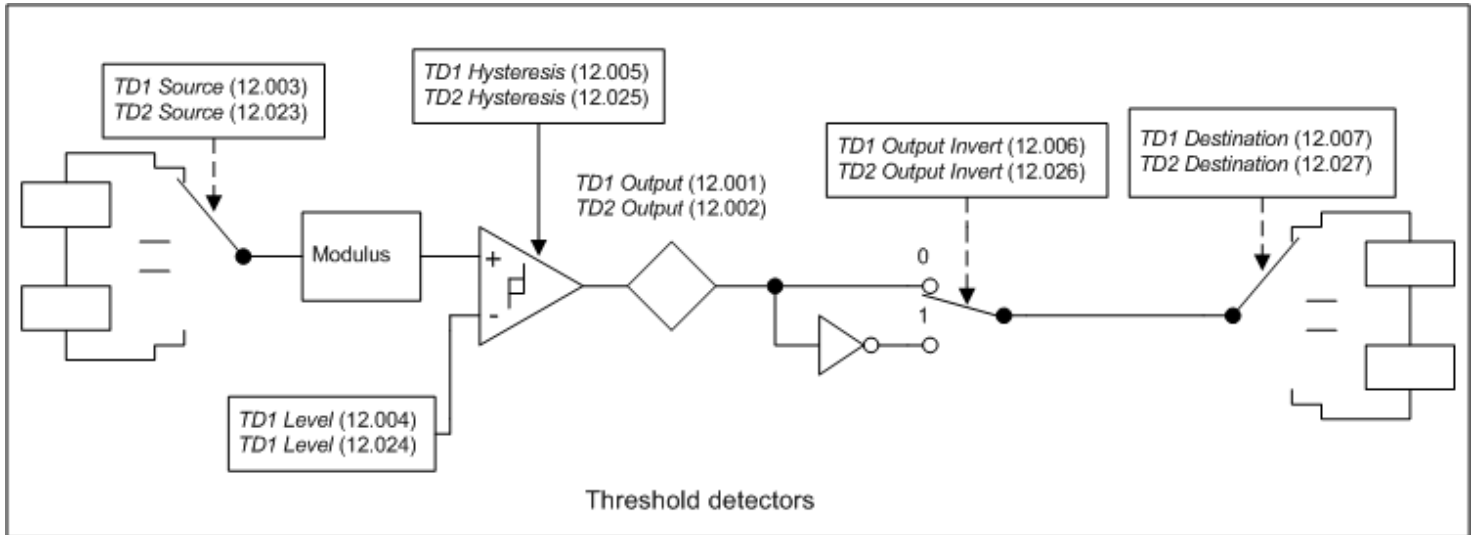
Mode: RFC-S

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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	4ms read
Display Format	Standard	Decimal Places	0
Coding	RW		

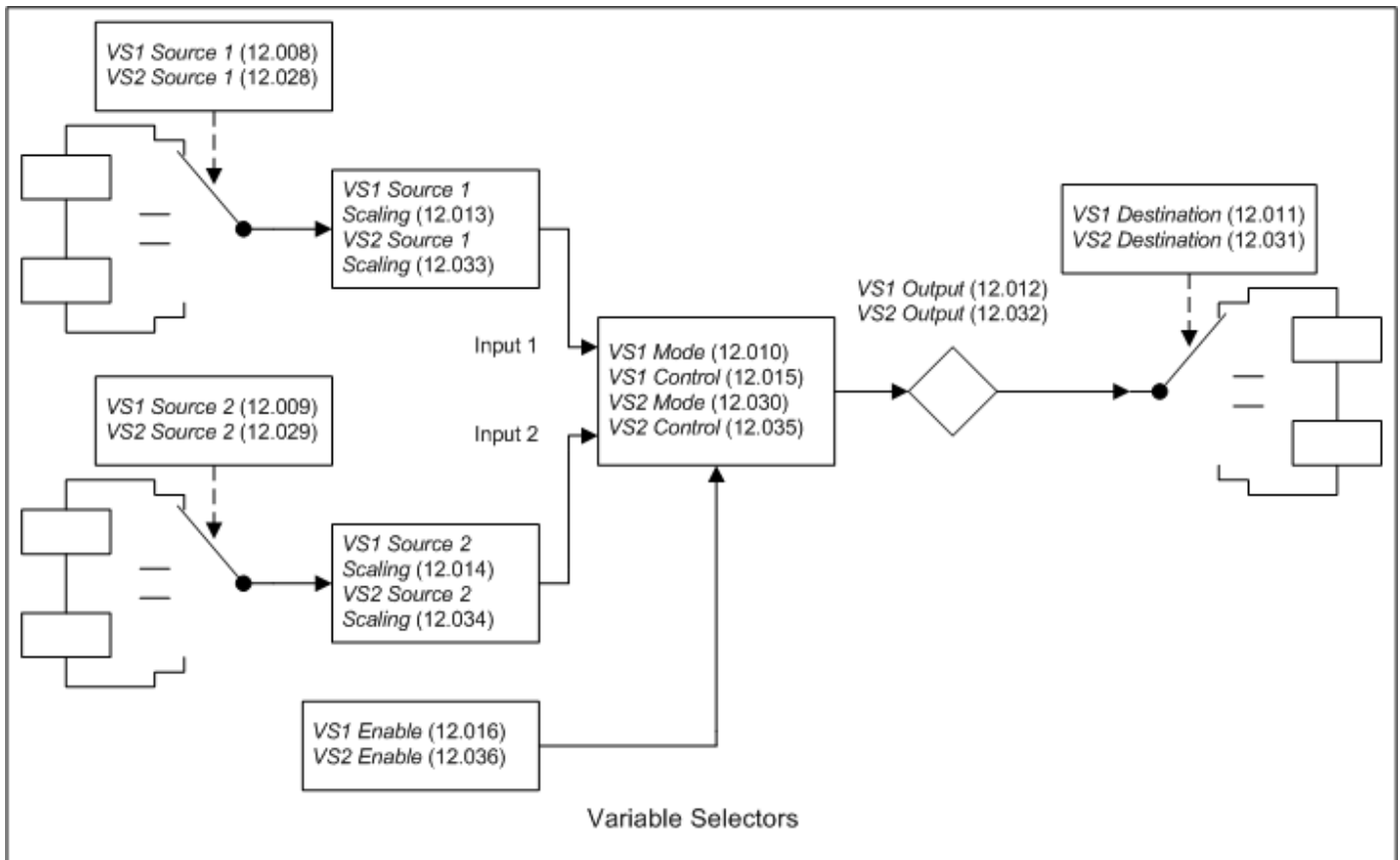
See *Threshold Detector 1 Output* (12.001).

Parameter	12.007 <i>Threshold Detector 1 Destination</i>		
Short description	Defines the destination parameter for threshold detector 1		
Mode	RFC-S		
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-S		
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.



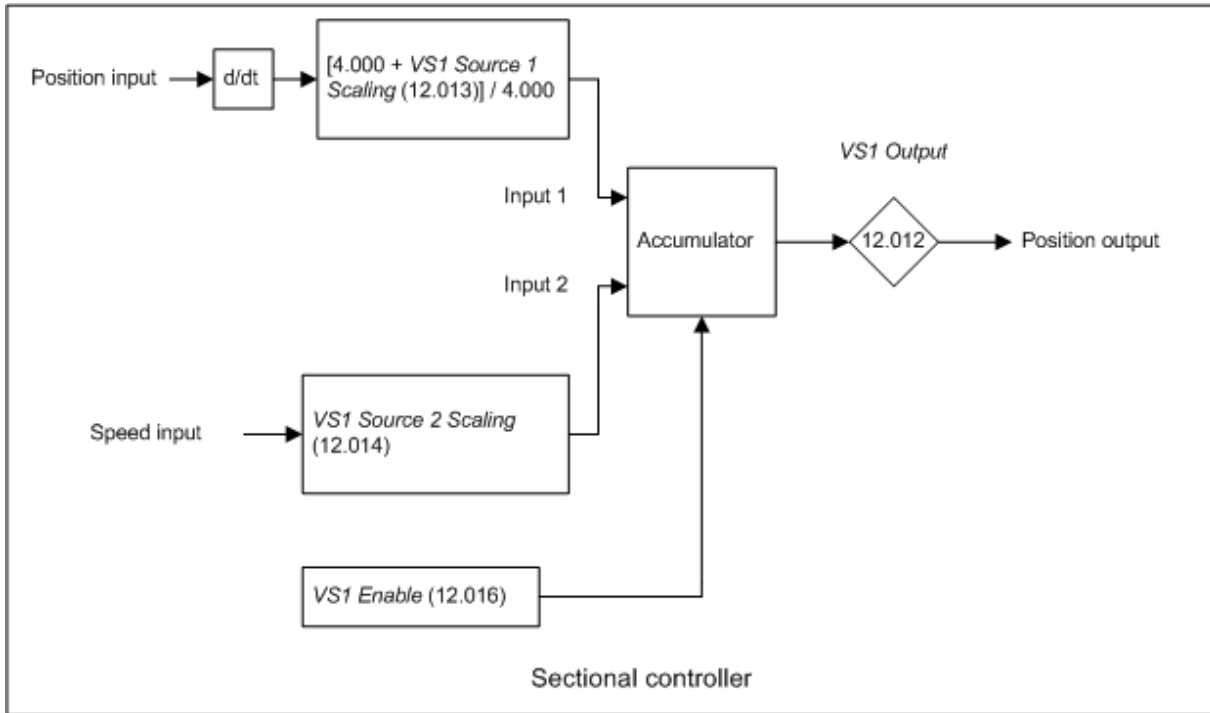
The following description is for variable selector 1, but variable selector 2 operates in the same way. The source parameters selected with *Variable Selector 1 Source 1* (12.008) and *Variable Selector 1 Source 2* (12.009) are converted to a percentage value, scaled with *Variable Selector 1 Source 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% Else if <i>Variable Selector 1 Control</i> (12.015) = 0.03 then Input <sup>3</sup> / 100.00% 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.

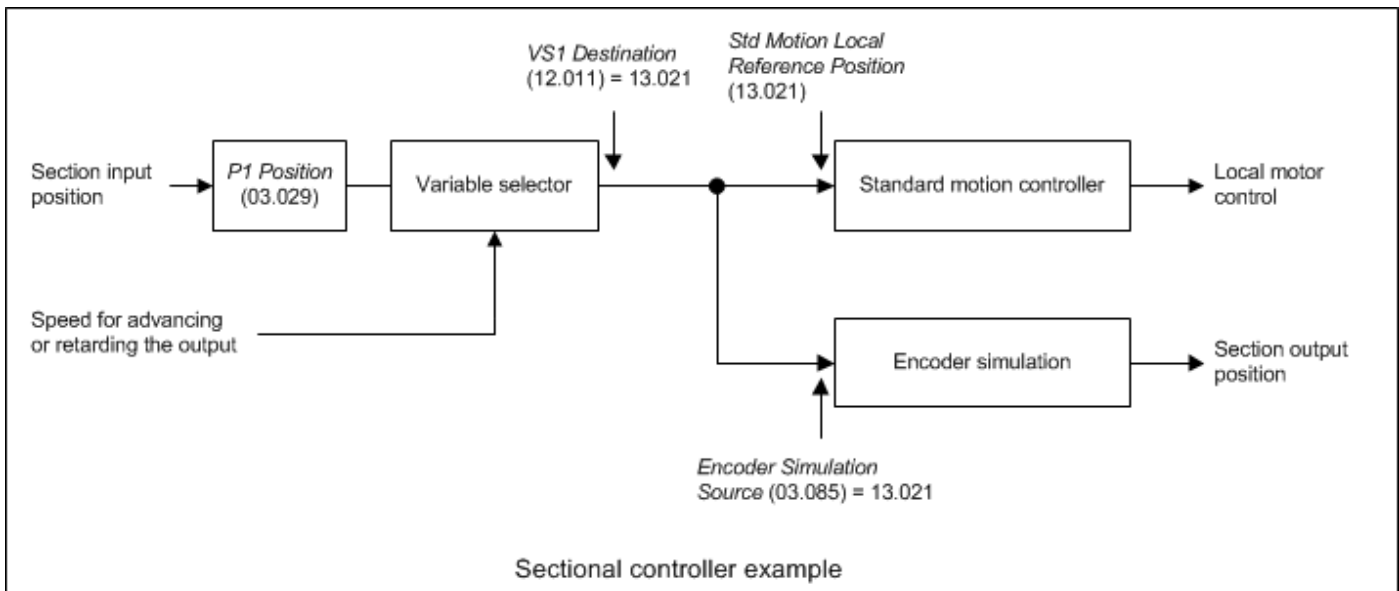
Although the sectional controller is intended to use a source parameter with a range from 0 to 65535, it is possible to use parameters with a different range provided the maximum is a power of two minus 1, i.e.  $2^{31} - 1$ . It should be noted that the change of position is scaled based on the maximum 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).



<b>Parameter</b>				<b>12.009 Variable Selector 1 Source 2</b>			
Short description				Defines the 2nd source parameter for variable selector 1			
Mode				RFC-S			
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).

<b>Parameter</b>				<b>12.010 Variable Selector 1 Mode</b>			
Short description				Defines the mode for variable selector 1			
Mode				RFC-S			
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			

<b>Value</b>	<b>Text</b>
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).

<b>Parameter</b>				<b>12.011 Variable Selector 1 Destination</b>			
Short description				Defines the destination parameter for variable selector 1			
Mode				RFC-S			
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).

<b>Parameter</b>				<b>12.012 Variable Selector 1 Output</b>			
Short description				Displays the output of variable selector 1			
Mode				RFC-S			
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).

<b>Parameter</b>				<b>12.013 Variable Selector 1 Source 1 Scaling</b>			
Short description				Defines the scaling for the 1st input for variable selector 1			
Mode				RFC-S			
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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 <i>Threshold Detector 2 Output Invert</i>		
Short description	Set to 1 to invert the output of threshold detector 2		
Mode	RFC-S		
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 <i>Threshold Detector 2 Destination</i>		
Short description	Defines the destination parameter for threshold detector 2		
Mode	RFC-S		
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 <i>Variable Selector 2 Source 1</i>		
Short description	Defines the 1st source parameter for variable selector 2		
Mode	RFC-S		
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 <i>Variable Selector 2 Source 2</i>		
Short description	Defines the 2nd source parameter for variable selector 2		
Mode	RFC-S		
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 <i>Variable Selector 2 Mode</i>		
Short description	Defines the mode for variable selector 2		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
Minimum	0	Maximum	1
Default	0	Units	
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW		

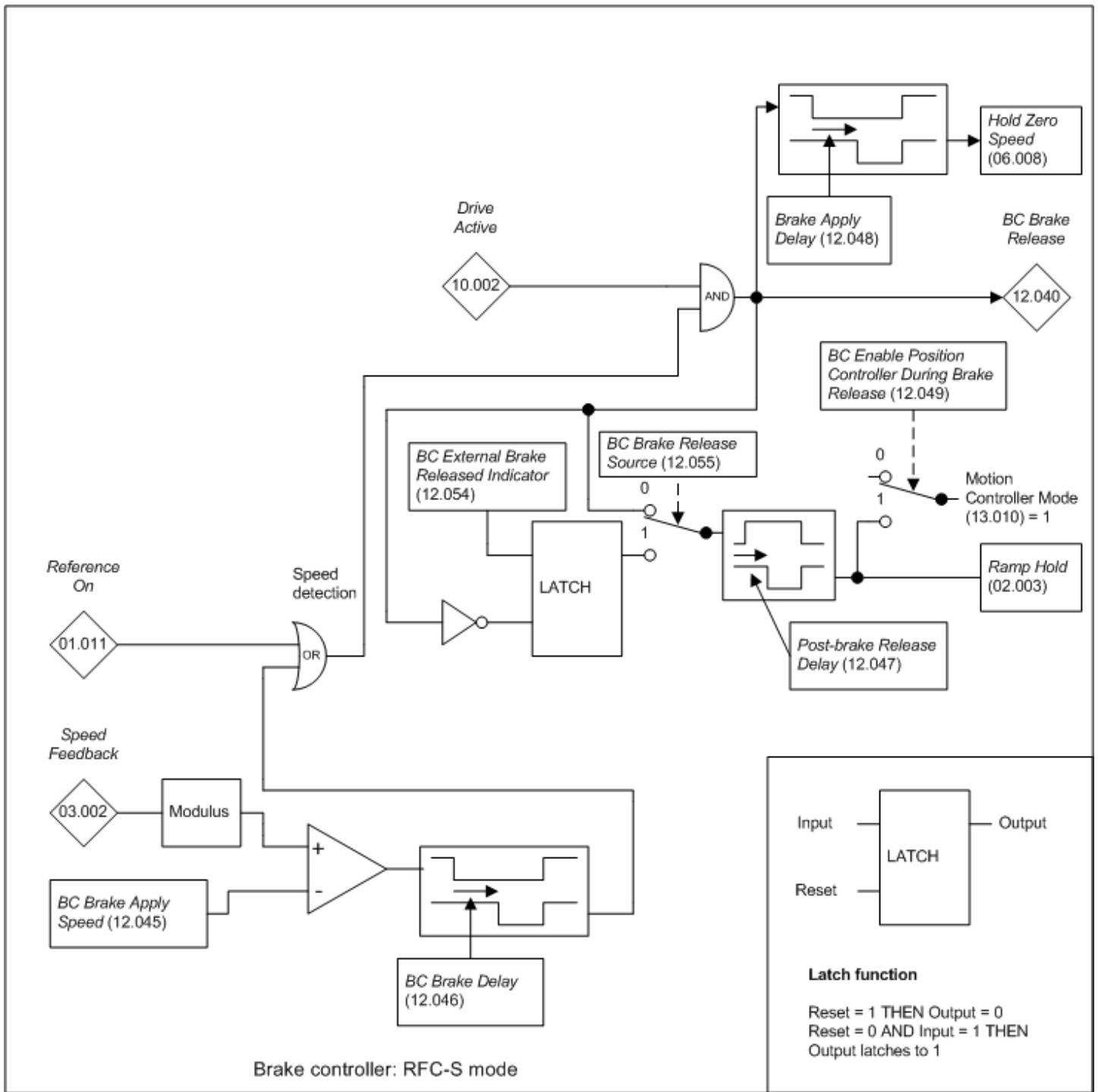
If *Brake Control: Enable* (12.041) = 0 then the brake controller is disabled. The following parameters which are used by the brake controller to operate the drive are reset to 0 on the transition of *Brake Control: Enable* (12.041) from 1 to 0.

Parameter
<i>Ramp Hold</i> (02.003)
<i>Hold Zero Speed</i> (06.008)
<i>Standard Motion Reference Source</i> (13.004) *
<i>Standard Motion Controller Mode</i> (13.010) *

\* If *Brake Control: Enable Position Control During Brake Release* (12.049) = 1

#### RFC-S mode

In RFC-S mode the following brake controller is provided.

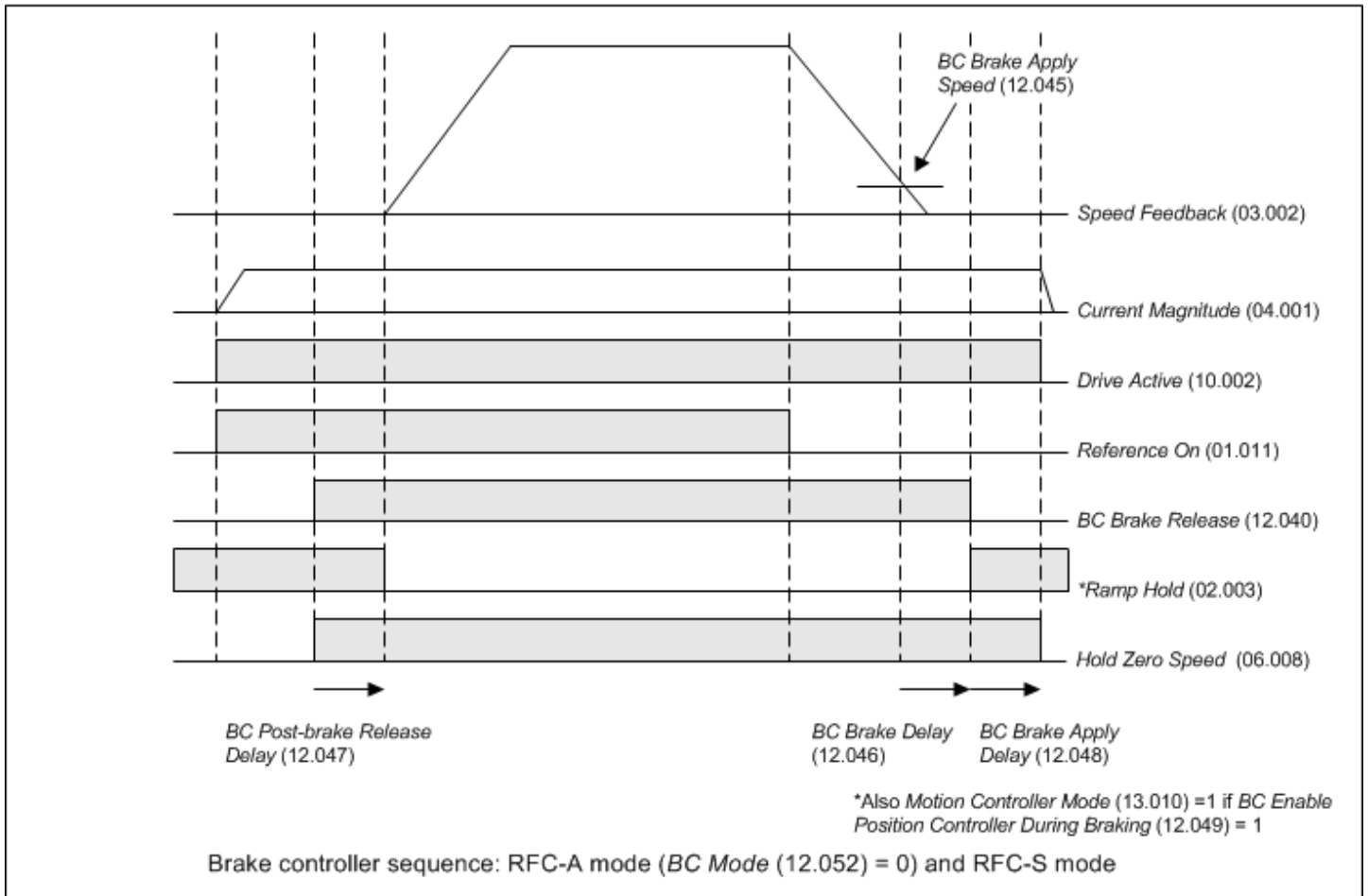


**Speed detection**

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 *Drive Active* (10.002) = 1 and speed detection is active. 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.

Parameter	12.043 Brake Control: Lower Current Threshold		
Short description	Defines the lower current limit for the brake		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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	12.054 External Brake Released Indicator		
Short description	External Brake Released Indicator		
Mode	RFC-S		
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-S		
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-S

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 Slot1 (2), P2 Slot1 (3), P1 Slot2 (4), P2 Slot2 (5), P1 Slot3 (6), P2 Slot3 (7), Local (10)	P1 Slot3 (6)	RW	Txt				US
13.005	Standard Motion Feedback Source	P1 Slot1 (2), P2 Slot1 (3), P1 Slot2 (4), P2 Slot2 (5), P1 Slot3 (6), P2 Slot3 (7), Sensorless (10)	Sensorless (10)	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

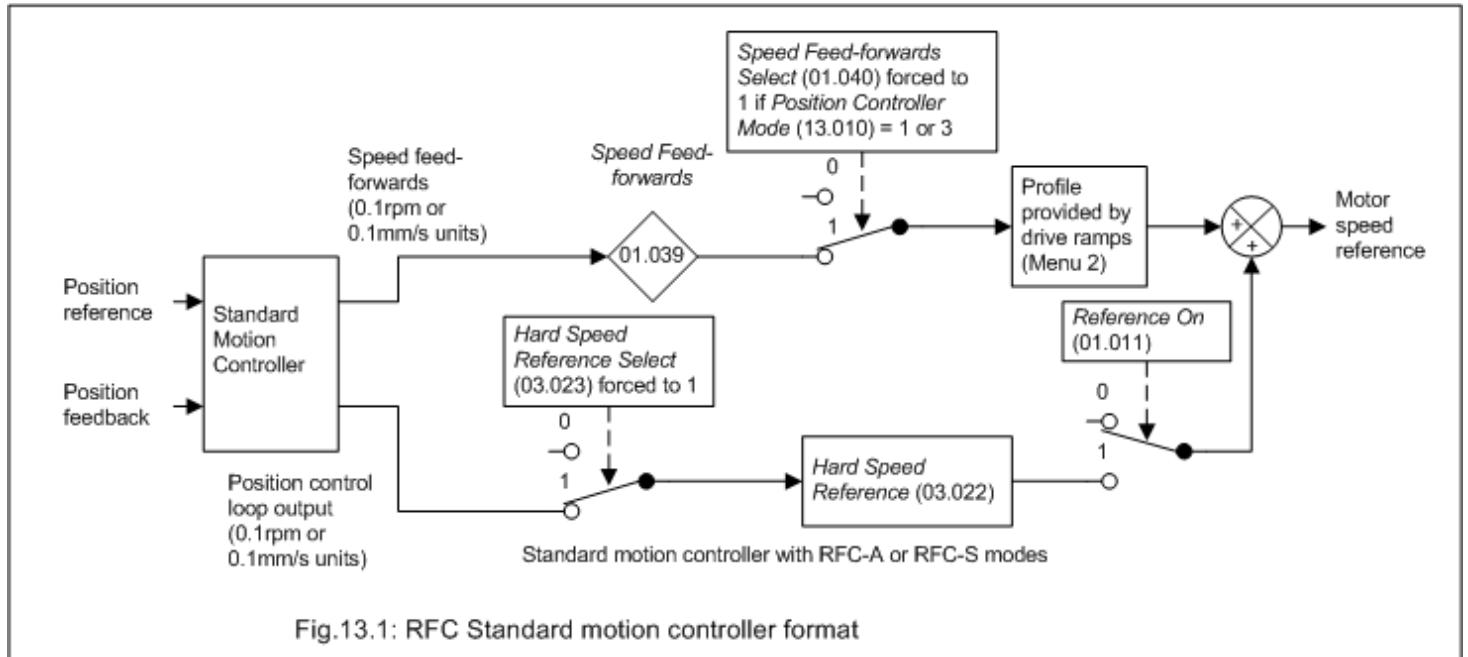
RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC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

# Menu 13 – Standard Motion Controller

Mode: RFC-S

## 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.

<i>Standard Motion Controller Mode</i> (13.010)	Action
0	On changing from any value to 0: <i>Speed Feed-forwards</i> (01.039) = 0 <i>Speed Feed-forwards Select</i> (01.040) = 0 <i>Hard Speed Reference</i> (03.022) = 0 <i>Hard Speed Reference Select</i> (03.023) = 0
1 or 3	<i>Speed Feed-forwards</i> (01.039) = speed feed-forward <i>Speed Feed-forwards Select</i> (01.040) = 1 <i>Hard Speed Reference</i> (03.022) = position control loop output <i>Hard Speed Reference Select</i> (03.023) = 1
2,4,5 or 6	<i>Speed Feed-forwards</i> (01.039) = 0 <i>Speed Feed-forwards Select</i> (01.040) = 0 <i>Hard Speed Reference</i> (03.022) = position control loop output <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.

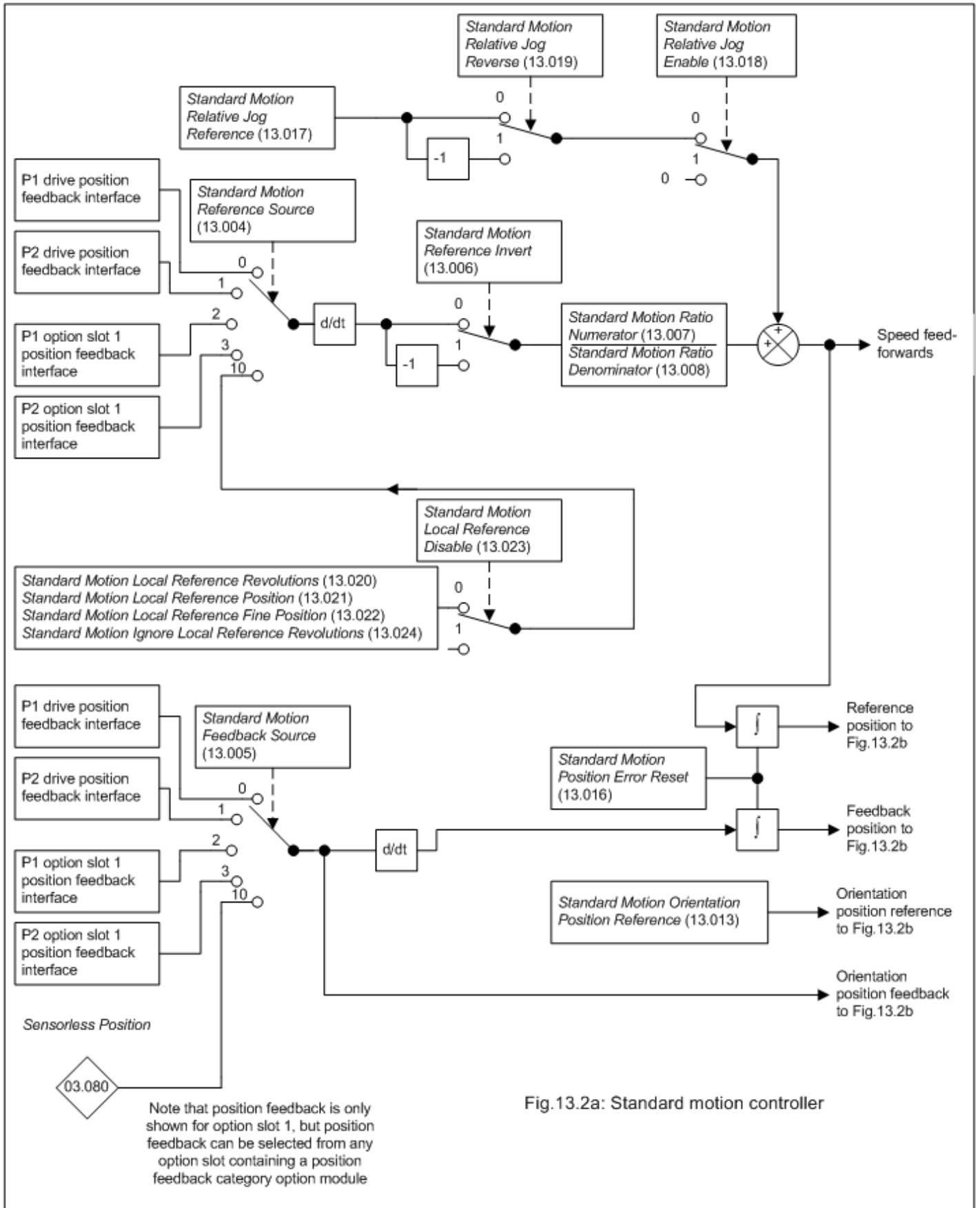


Fig.13.2a: Standard motion controller

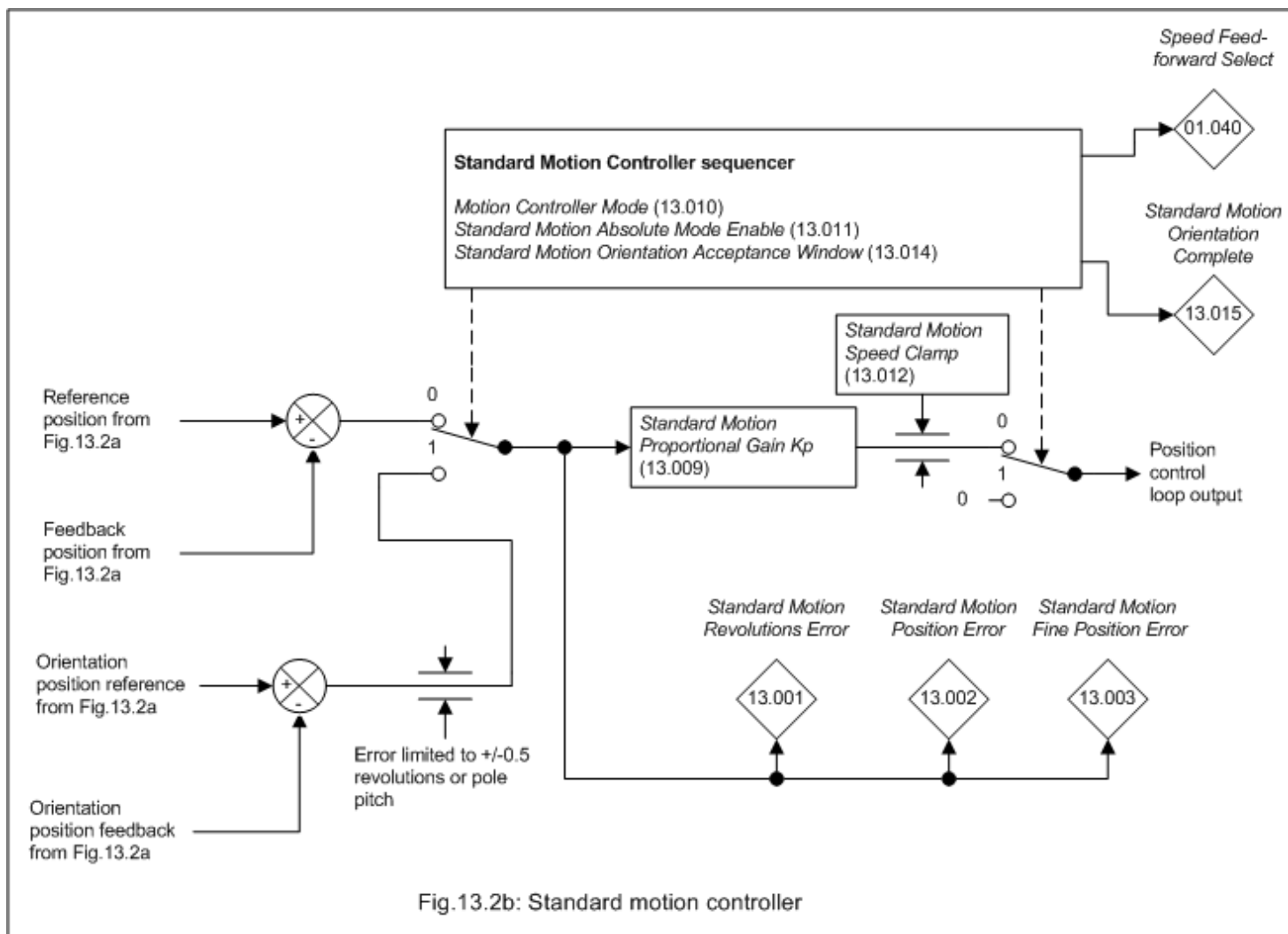


Fig.13.2b: Standard motion controller

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-S		
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-S		
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-S		
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-S		
Minimum	0	Maximum	10
Default	6	Units	
Type	8 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, TE		

Value	Text
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-S		
Minimum	0	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
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-S		
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 Standard Motion Ratio Numerator		
Short description	Defines the numerator for the Standard Motion Controller ratio		
Mode	RFC-S		
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 Standard Motion Ratio Denominator		
Short description	Defines the denominator for the Standard Motion Controller ratio		
Mode	RFC-S		
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 Standard Motion Proportional Gain Kp		
Short description	Defines the Kp gain used by the Standard Motion Controller		
Mode	RFC-S		
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 Standard Motion Controller Mode		
Short description	Defines the mode of the Standard Motion Controller		
Mode	RFC-S		
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	Oriente Stop
6	Oriente

#### 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.

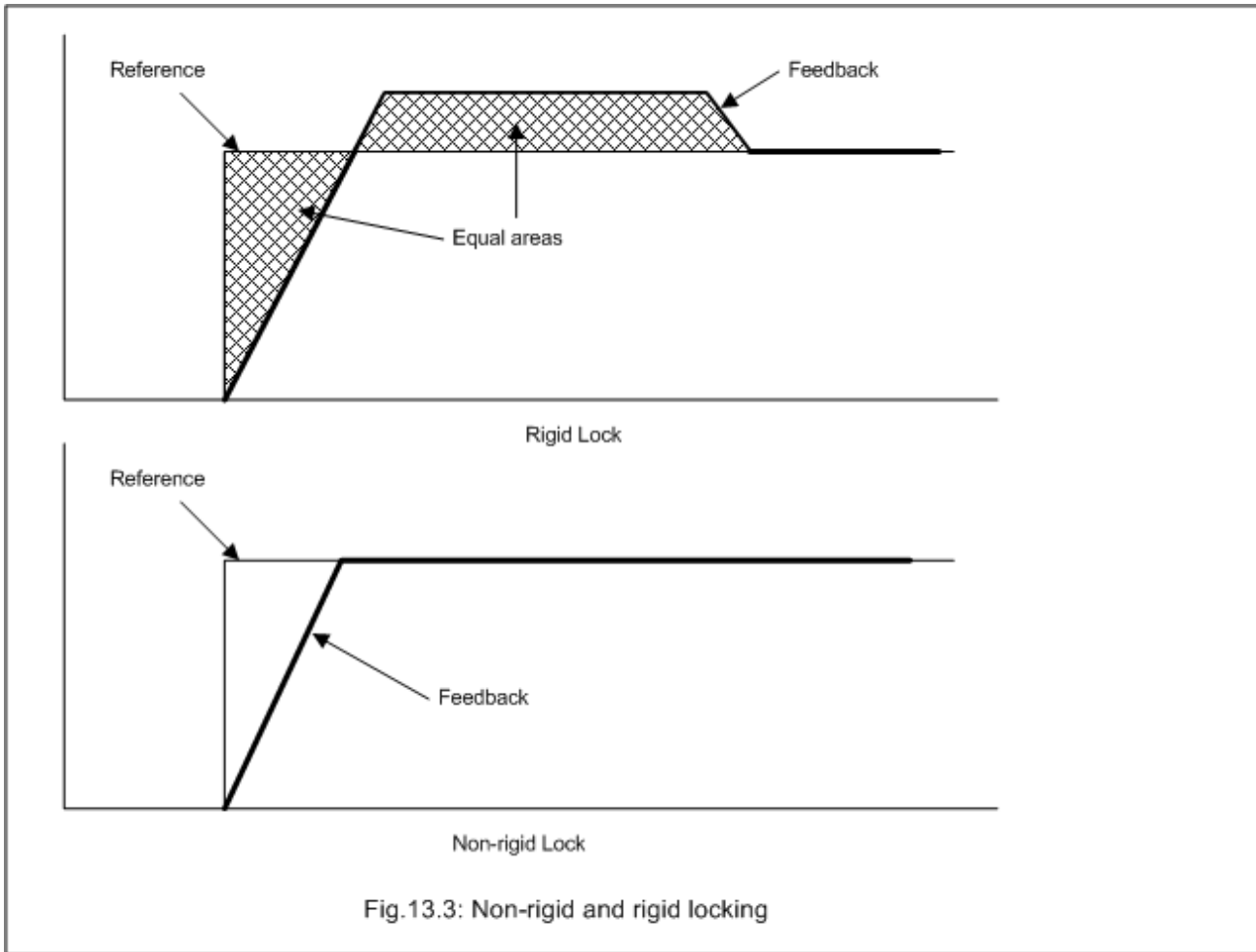


Fig.13.3: Non-rigid and rigid locking

## 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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S

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

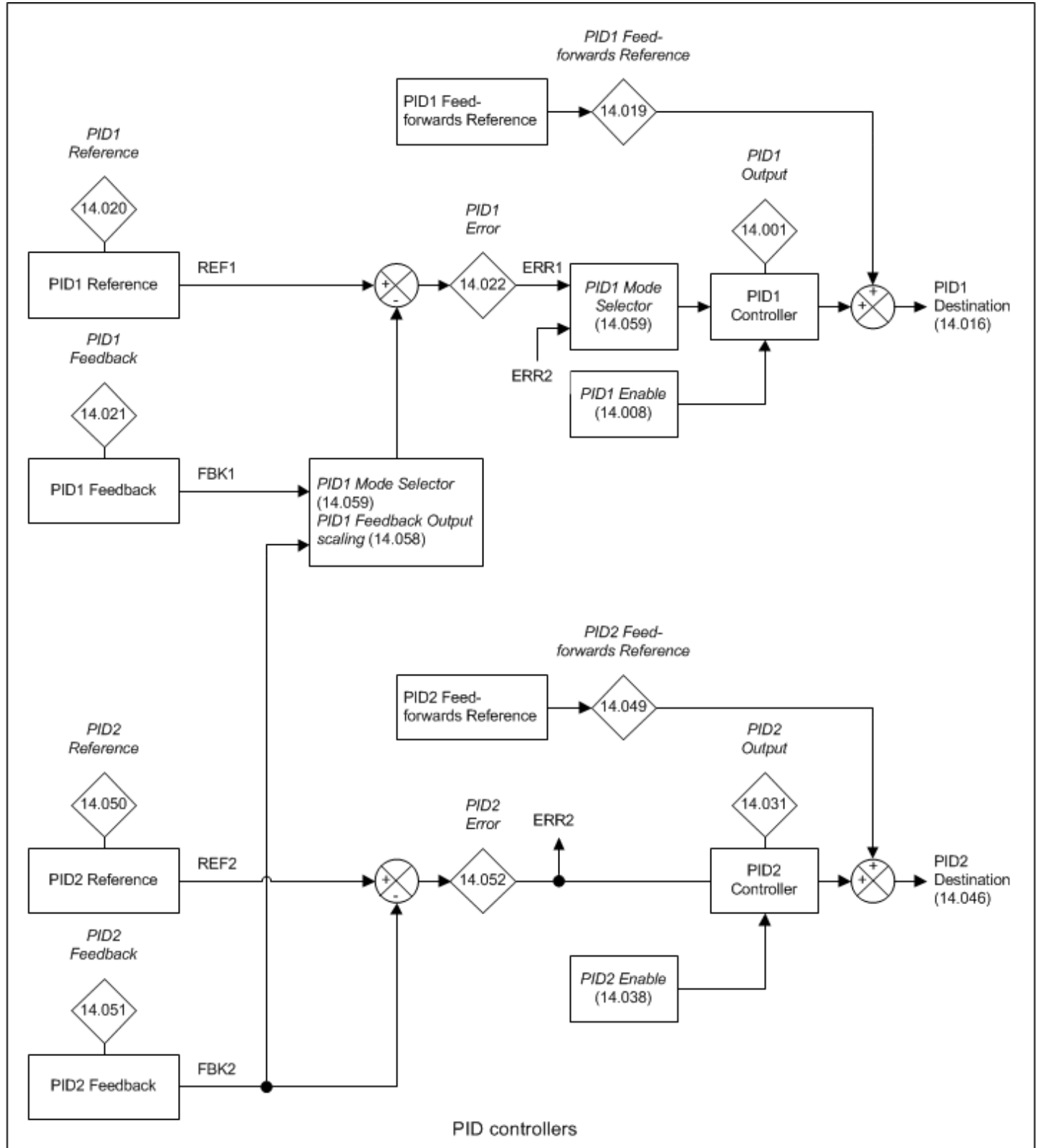
RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC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

# Menu 14 – User PID Controller

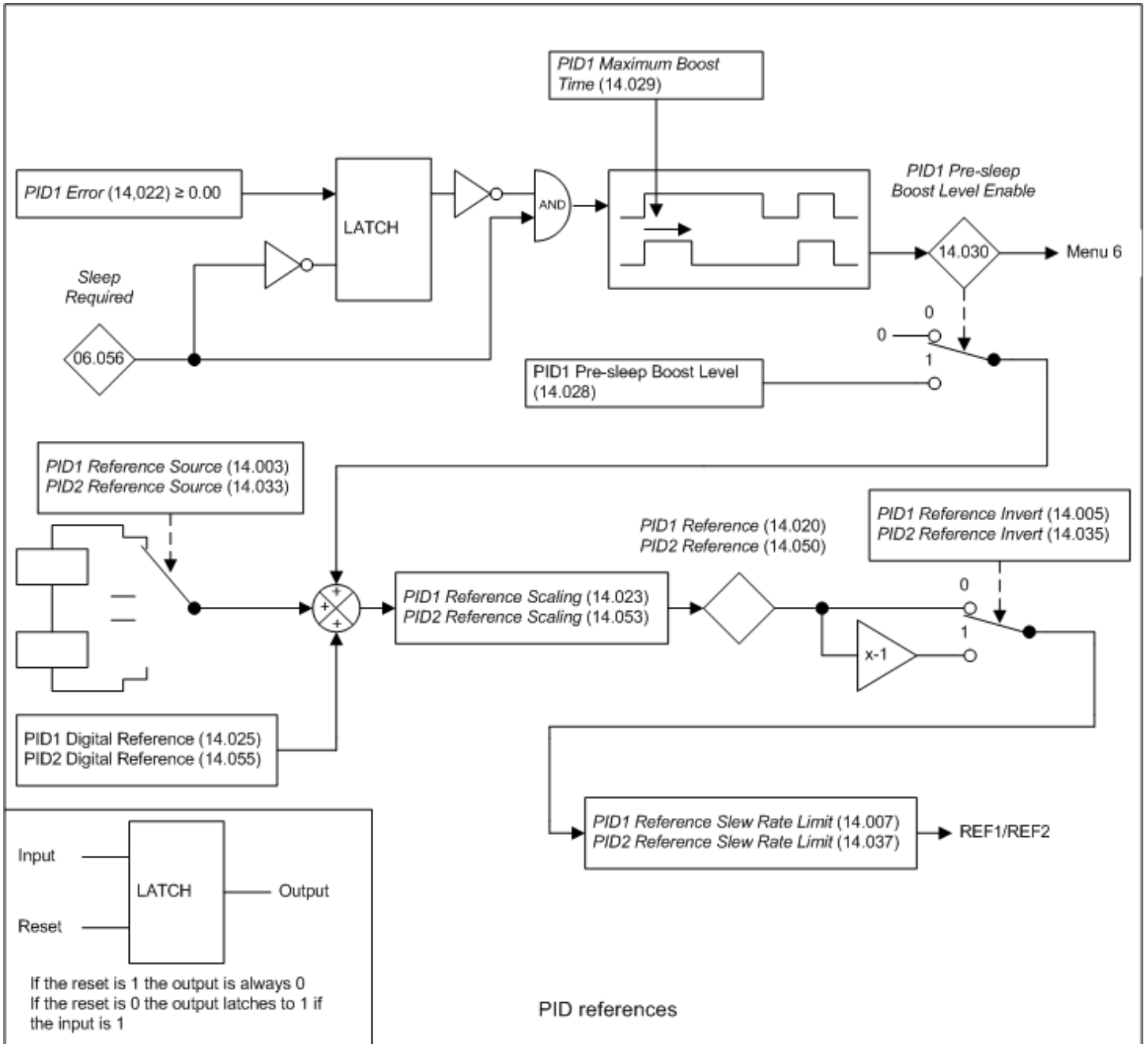
Mode: RFC-S

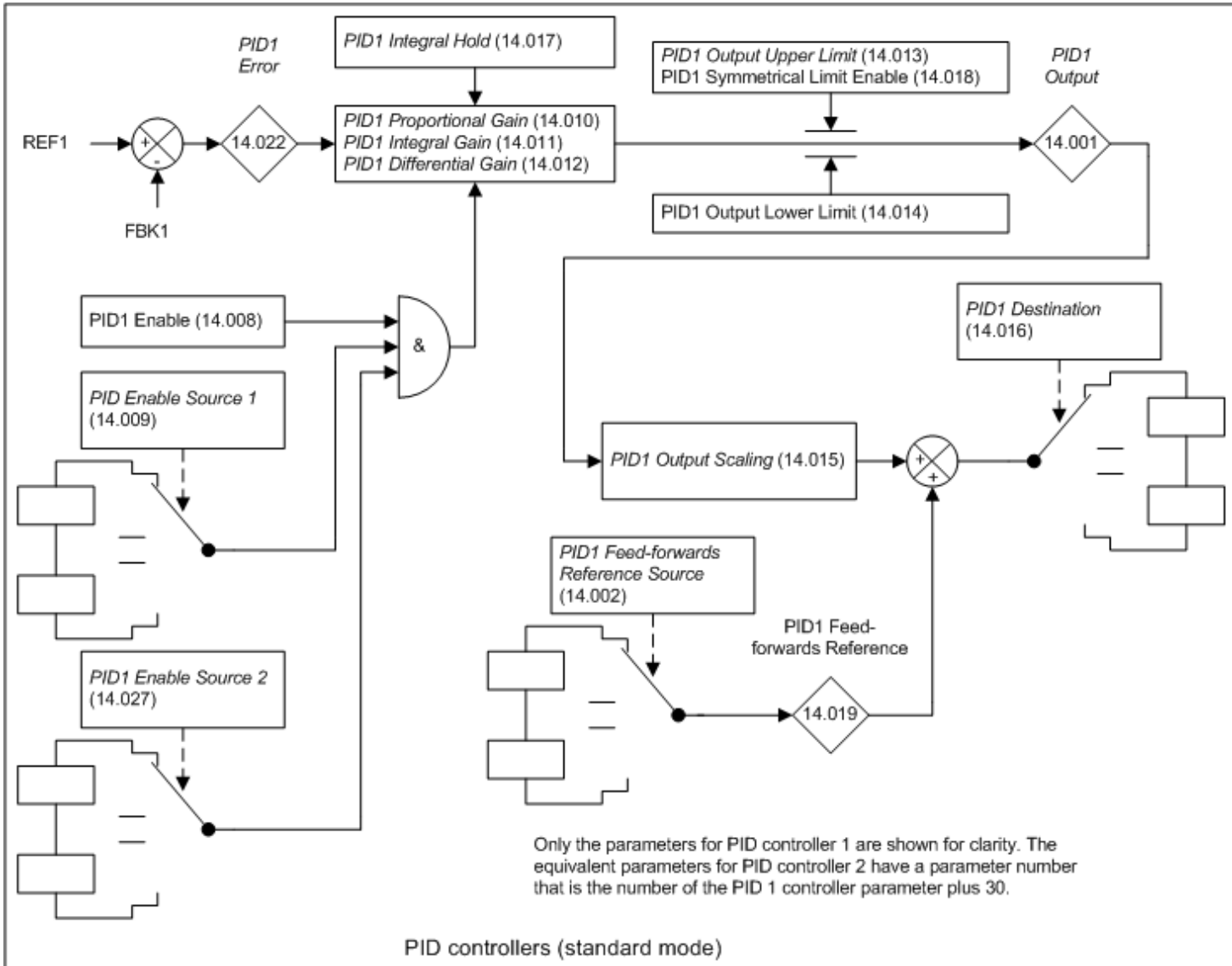
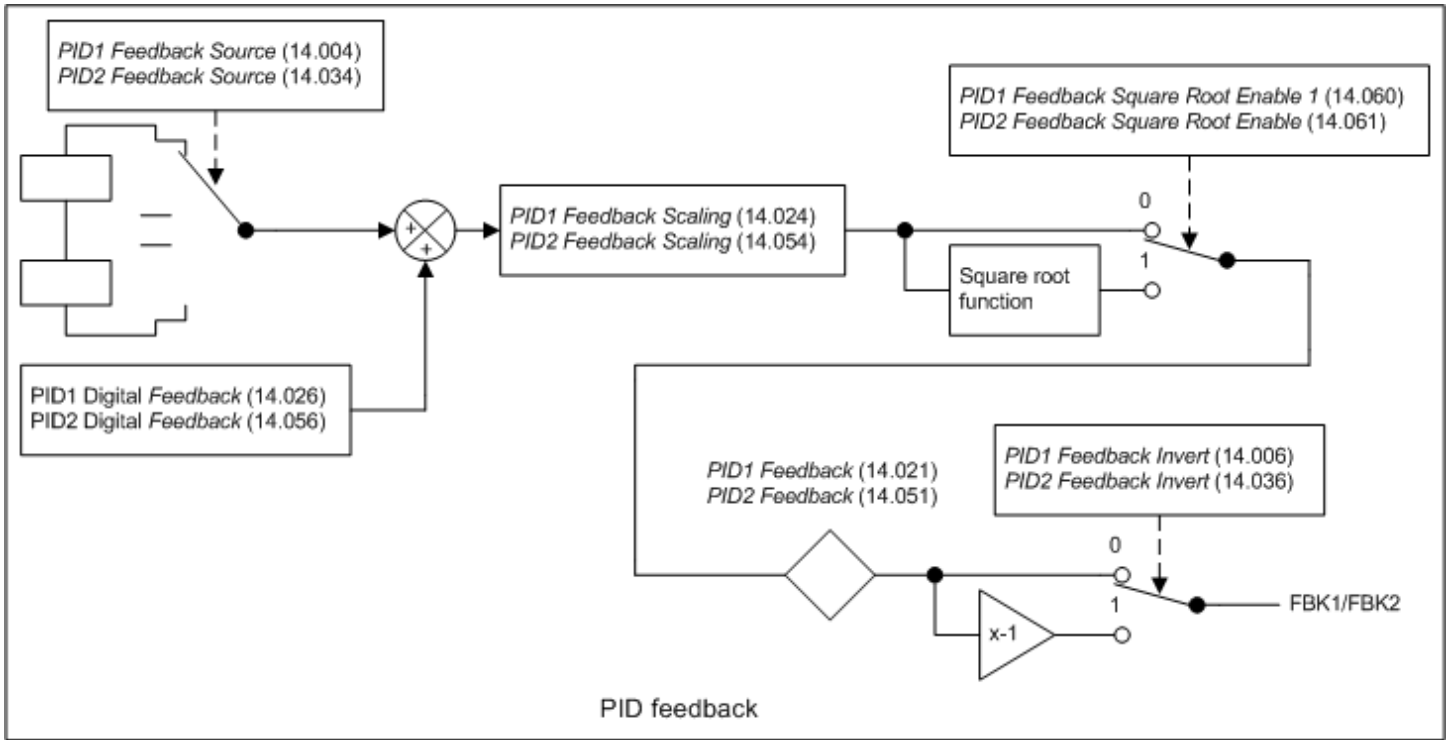
## PID controllers

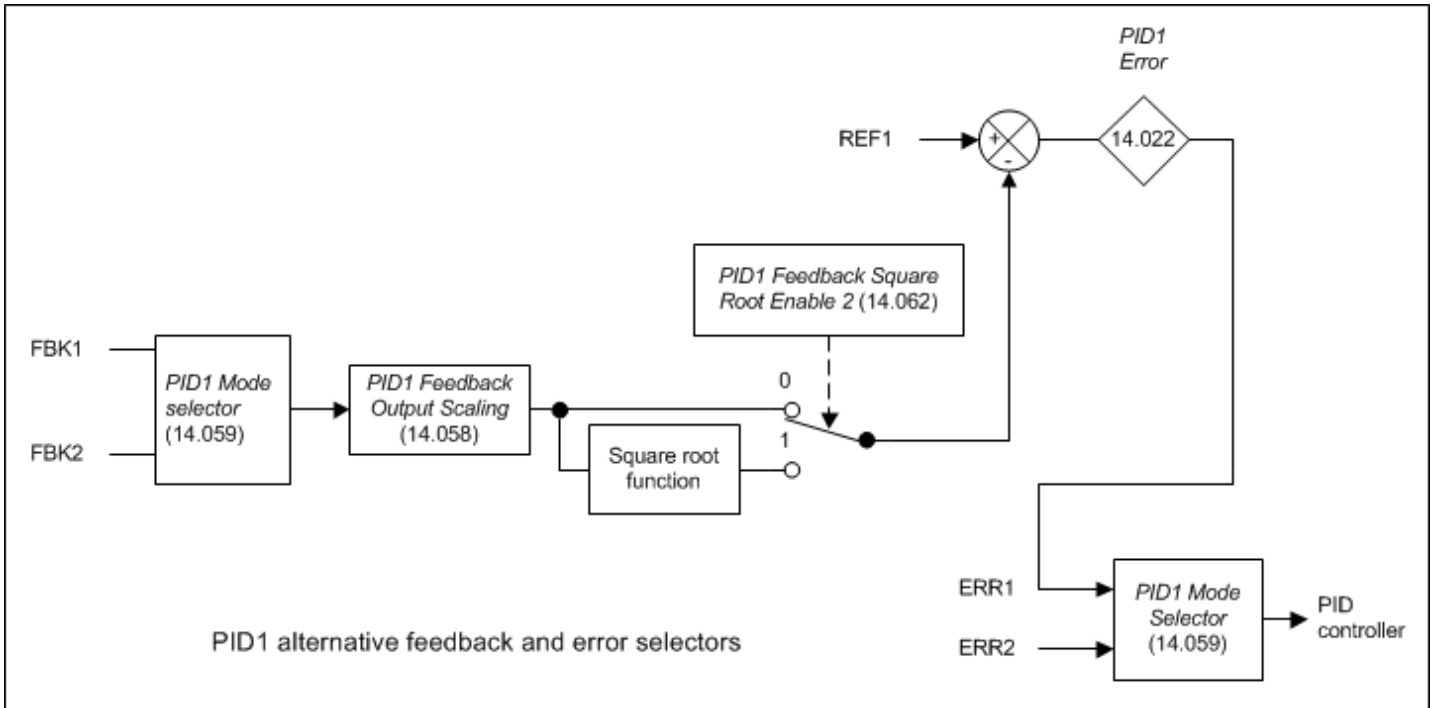
Two general purpose PID controllers are provided as shown in the diagram below. Both operate in the same way except that PID controller 2 does not include a pre-sleep boost reference or alternative feedback and error selection. In the following sections a description is given for PID controller 1. The 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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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).



# Menu 18 Single Line Descriptions – *Application Menu 1*

Mode: RFC-S

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-S

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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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>18.027 Application Menu 1 Read-write Integer 27</b>			
Short description			
General read-write integer application parameter			
Mode			
RFC-S			
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>18.028 Application Menu 1 Read-write Integer 28</b>			
Short description			
General read-write integer application parameter			
Mode			
RFC-S			
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>18.029 Application Menu 1 Read-write Integer 29</b>			
Short description			
General read-write integer application parameter			
Mode			
RFC-S			
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>18.030 Application Menu 1 Read-write Integer 30</b>			
Short description			
General read-write integer application parameter			
Mode			
RFC-S			
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>18.031 Application Menu 1 Read-write bit 31</b>			
Short description			
General read-write bit application parameter			
Mode			
RFC-S			
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>18.032 Application Menu 1 Read-write bit 32</b>			
Short description			
General read-write bit application parameter			
Mode			
RFC-S			
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>18.033 Application Menu 1 Read-write bit 33</b>			
Short description			
General read-write bit application parameter			
Mode			
RFC-S			
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S

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-S

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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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	19.007 Application Menu 2 Read-only Integer 7		
Short description	General read-only integer application parameter		
Mode	RFC-S		
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	19.008 Application Menu 2 Read-only Integer 8		
Short description	General read-only integer application parameter		
Mode	RFC-S		
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	19.009 Application Menu 2 Read-only Integer 9		
Short description	General read-only integer application parameter		
Mode	RFC-S		
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	19.010 Application Menu 2 Read-only Integer 10		
Short description	General read-only integer application parameter		
Mode	RFC-S		
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	19.011 Application Menu 2 Read-write Integer 11		
Short description	General read-write integer application parameter		
Mode	RFC-S		
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	19.012 Application Menu 2 Read-write Integer 12		
Short description	General read-write integer application parameter		
Mode	RFC-S		
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	19.013 Application Menu 2 Read-write Integer 13		
Short description	General read-write integer application parameter		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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	19.042 Application Menu 2 Read-write bit 42		
Short description	General read-write bit application parameter		
Mode	RFC-S		
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	19.043 Application Menu 2 Read-write bit 43		
Short description	General read-write bit application parameter		
Mode	RFC-S		
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	19.044 Application Menu 2 Read-write bit 44		
Short description	General read-write bit application parameter		
Mode	RFC-S		
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	19.045 Application Menu 2 Read-write bit 45		
Short description	General read-write bit application parameter		
Mode	RFC-S		
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	19.046 Application Menu 2 Read-write bit 46		
Short description	General read-write bit application parameter		
Mode	RFC-S		
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	19.047 Application Menu 2 Read-write bit 47		
Short description	General read-write bit application parameter		
Mode	RFC-S		
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	19.048 Application Menu 2 Read-write bit 48		
Short description	General read-write bit application parameter		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S

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-S

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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S

Parameter		Range	Default	Type					
21.001	M2 Maximum Reference Clamp	±VM_POSITIVE_REF_CLAMP2	50Hz: 1500.0 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), A2 Preset (2), Preset (3), Keypad (4), Precision (5), Keypad Ref (6)	A1 A2 (0)	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
21.007	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 60Hz: 1800.00 rpm	RW	Num				US
21.009	M2 Rated Voltage	±VM_AC_VOLTAGE_SET V	200V drive: 230 V 400V drive 50Hz: 400 V 400V drive 60Hz: 460 V 575V drive: 575 V 690V drive: 690 V	RW	Num		RA		US
21.011	M2 Number Of Motor Poles	Automatic (0) to 480 (240) Poles	8 (4) 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 Ld	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	850.0 s	RW	Num				US
21.017	M2 Speed Controller Proportional Gain Kp1	0.0000 to 200.0000 s/rad	0.0100 s/rad	RW	Num				US
21.018	M2 Speed Controller Integral Gain Ki1	0.00 to 655.35 s <sup>2</sup> /rad	0.05 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
21.022	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
21.027	M2 Motoring Current Limit	±VM_MOTOR2_CURRENT_LIMIT %	0.0 %	RW	Num		RA		US
21.028	M2 Regenerating Current Limit	±VM_MOTOR2_CURRENT_LIMIT %	0.0 %	RW	Num		RA		US
21.029	M2 Symmetrical Current Limit	±VM_MOTOR2_CURRENT_LIMIT %	0.0 %	RW	Num		RA		US
21.030	M2 Volts Per 1000rpm	0 to 10000 V	98 V	RW	Num				US
21.032	M2 Current Reference Filter Time Constant 1	0.0 to 25.0 ms	1.0 ms	RW	Num				US
21.033	M2 Low Speed Thermal Protection Mode	0 to 1	0	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
21.043	M2 Torque Per Amp	0.00 to 500.00 Nm/A	1.60 Nm/A	RW	Num				US
21.046	M2 Inverted Motor Saturation Characteristic	Off (0) or On (1)	Off (0)	RW	Bit				US
21.048	M2 No-load Lq	0.000 to 500.000 mH	0.000 mH	RW	Num		RA		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 21 – Motor 2 Parameters

Mode: RFC-S

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-S		
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-S		
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-S		
Minimum	0	Maximum	6
Default	0	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-S		
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-S		
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	21.007 M2 Rated Current		
Short description	Defines the motor rated used for motor map 2		
Mode	RFC-S		
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-S		
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-S		
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		

Voltage	Region	Default Value
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).

Parameter	21.011 M2 Number Of Motor Poles		
Short description	Defines the number of motor poles used for motor map 2		
Mode	RFC-S		
Minimum	0	Maximum	240
Default	4	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).



Parameter	21.012 M2 Stator Resistance		
Short description	Defines the stator resistance used for motor map 2		
Mode	RFC-S		
Minimum	0.000000	Maximum	1000.000000
Default	0.000000	Units	Ω
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).

Parameter	21.014 M2 Ld		
Short description	Defines the value of inductance in the flux axis for motor map 2		
Mode	RFC-S		
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 *Ld* (05.024).

Parameter	21.015 Motor 2 Active		
Short description	Indicates if motor 2 parameters are being used by the drive		
Mode	RFC-S		
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-S		
Minimum	1.0	Maximum	3000.0
Default	850.0	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-S		
Minimum	0.0000	Maximum	200.0000
Default	0.0100	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-S		
Minimum	0.00	Maximum	655.35
Default	0.05	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	<b>21.019 M2 Speed Controller Differential Feedback Gain Kd1</b>		
Short description	Defines the Kd value of the speed controller used for motor map 2		
Mode	RFC-S		
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	<b>21.022 M2 Current Controller Kp Gain</b>		
Short description	Defines the Kp value of the current controller used for motor map 2		
Mode	RFC-S		
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	<b>21.023 M2 Current Controller Ki Gain</b>		
Short description	Defines the Ki value of the current controller used for motor map 2		
Mode	RFC-S		
Minimum	0	Maximum	30000
Default	2000	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 Ki Gain* (04.014).

Parameter	<b>21.027 M2 Motoring Current Limit</b>		
Short description	Defines the motoring current limit used for motor map 2		
Mode	RFC-S		
Minimum	-VM_MOTOR2_CURRENT_LIMIT	Maximum	VM_MOTOR2_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		

This is the motor map 2 equivalent parameter for *Motoring Current Limit* (04.005).

Parameter	<b>21.028 M2 Regenerating Current Limit</b>		
Short description	Defines the regenerating current limit used for motor map 2		
Mode	RFC-S		
Minimum	-VM_MOTOR2_CURRENT_LIMIT	Maximum	VM_MOTOR2_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		

This is the motor map 2 equivalent parameter for *Regenerating Current Limit* (04.006).

Parameter	<b>21.029 M2 Symmetrical Current Limit</b>		
Short description	Defines the symmetrical current limit used for motor map 2		
Mode	RFC-S		
Minimum	-VM_MOTOR2_CURRENT_LIMIT	Maximum	VM_MOTOR2_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		

This is the motor map 2 equivalent parameter for *Symmetrical Current Limit* (04.007).

<b>Parameter</b>	<b>21.030 M2 Volts Per 1000rpm</b>		
Short description	M2 Volts Per 1000rpm		
Mode	RFC-S		
Minimum	0	Maximum	10000
Default	98	Units	V
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 *Volts Per 1000rpm* (05.033).

<b>Parameter</b>	<b>21.032 M2 Current Reference Filter Time Constant 1</b>		
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-S		
Minimum	0.0	Maximum	25.0
Default	1.0	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).

<b>Parameter</b>	<b>21.033 M2 Low Speed Thermal Protection Mode</b>		
Short description	Set to enable low speed thermal protection mode		
Mode	RFC-S		
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).

<b>Parameter</b>	<b>21.039 M2 Motor Thermal Time Constant 2</b>		
Short description	Can be used to define an additional motor thermal time constant for motor map 2		
Mode	RFC-S		
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).

<b>Parameter</b>	<b>21.040 M2 Motor Thermal Time Constant 2 Scaling</b>		
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-S		
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).

<b>Parameter</b>	<b>21.043 M2 Torque Per Amp</b>		
Short description	Displays the torque per amp of the motor used for motor map 2		
Mode	RFC-S		
Minimum	0.00	Maximum	500.00
Default	1.60	Units	Nm/A
Type	16 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	2
Coding	RW, BU		

This is the motor map 2 equivalent parameter for *Torque Per Amp* (05.032).

Parameter	21.046 M2 Inverted Motor Saturation Characteristic		
Short description	The motor has an inverted saturation characteristic		
Mode	RFC-S		
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 *Inverted Saturation Characteristic* (05.070).

Parameter	21.048 M2 No-load Lq		
Short description	Defines the inductance in the q axis with no current in the motor		
Mode	RFC-S		
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 *No-load Lq* (05.072).

## Menu 22 Single Line Descriptions – *Menu 0 Set-up*

Mode: RFC-S

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	3.029	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	0.000	RW	Num			PT	US
22.019	Parameter 00.019 Set-up	0.000 to 59.999	7.011	RW	Num			PT	US
22.020	Parameter 00.020 Set-up	0.000 to 59.999	7.014	RW	Num			PT	US
22.021	Parameter 00.021 Set-up	0.000 to 59.999	7.015	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	0.000	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	11.024	RW	Num			PT	US
22.036	Parameter 00.036 Set-up	0.000 to 59.999	11.025	RW	Num			PT	US
22.037	Parameter 00.037 Set-up	0.000 to 59.999	11.023	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	0.000	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	5.033	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	11.020	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	5.064	RW	Num			PT	US
22.055	Parameter 00.055 Set-up	0.000 to 59.999	5.071	RW	Num			PT	US
22.056	Parameter 00.056 Set-up	0.000 to 59.999	5.072	RW	Num			PT	US
22.057	Parameter 00.057 Set-up	0.000 to 59.999	5.075	RW	Num			PT	US
22.058	Parameter 00.058 Set-up	0.000 to 59.999	5.077	RW	Num			PT	US
22.059	Parameter 00.059 Set-up	0.000 to 59.999	5.078	RW	Num			PT	US
22.060	Parameter 00.060 Set-up	0.000 to 59.999	5.082	RW	Num			PT	US
22.061	Parameter 00.061 Set-up	0.000 to 59.999	5.084	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-S

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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
Minimum	0.000	Maximum	59.999
Default	3.029	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	22.012 Parameter 00.012 Set-up		
Short description	Defines the parameter to be shown in 00.012		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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	22.019 Parameter 00.019 Set-up		
Short description	Defines the parameter to be shown in 00.019		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	7.011	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	22.020 Parameter 00.020 Set-up		
Short description	Defines the parameter to be shown in 00.020		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	7.014	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	22.021 Parameter 00.021 Set-up		
Short description	Defines the parameter to be shown in 00.021		
Mode	RFC-S		
Minimum	0.000	Maximum	59.999
Default	7.015	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	22.022 Parameter 00.022 Set-up		
Short description	Defines the parameter to be shown in 00.022		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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	22.034 Parameter 00.034 Set-up		
Short description	Defines the parameter to be shown in 00.034		
Mode	RFC-S		
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-S		
Minimum	0.000	Maximum	59.999
Default	11.024	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-S		
Minimum	0.000	Maximum	59.999
Default	11.025	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-S		
Minimum	0.000	Maximum	59.999
Default	11.023	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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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	22.044 Parameter 00.044 Set-up		
Short description	Defines the parameter to be shown in 00.044		
Mode	RFC-S		
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-S		
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-S		
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-S		
Minimum	0.000	Maximum	59.999
Default	5.033	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	22.048 Parameter 00.048 Set-up		
Short description	Defines the parameter to be shown in 00.048		
Mode	RFC-S		
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-S		
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-S		
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-S		
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-S		
Minimum	0.000	Maximum	59.999
Default	11.020	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-S		
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-S		
Minimum	0.000	Maximum	59.999
Default	5.064	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-S		
Minimum	0.000	Maximum	59.999
Default	5.071	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-S		
Minimum	0.000	Maximum	59.999
Default	5.072	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-S		
Minimum	0.000	Maximum	59.999
Default	5.075	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-S		
Minimum	0.000	Maximum	59.999
Default	5.077	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-S		
Minimum	0.000	Maximum	59.999
Default	5.078	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-S		
Minimum	0.000	Maximum	59.999
Default	5.082	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-S		
Minimum	0.000	Maximum	59.999
Default	5.084	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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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-S		
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 31 Single Line Descriptions – AMC General Set-up

Mode: RFC-S

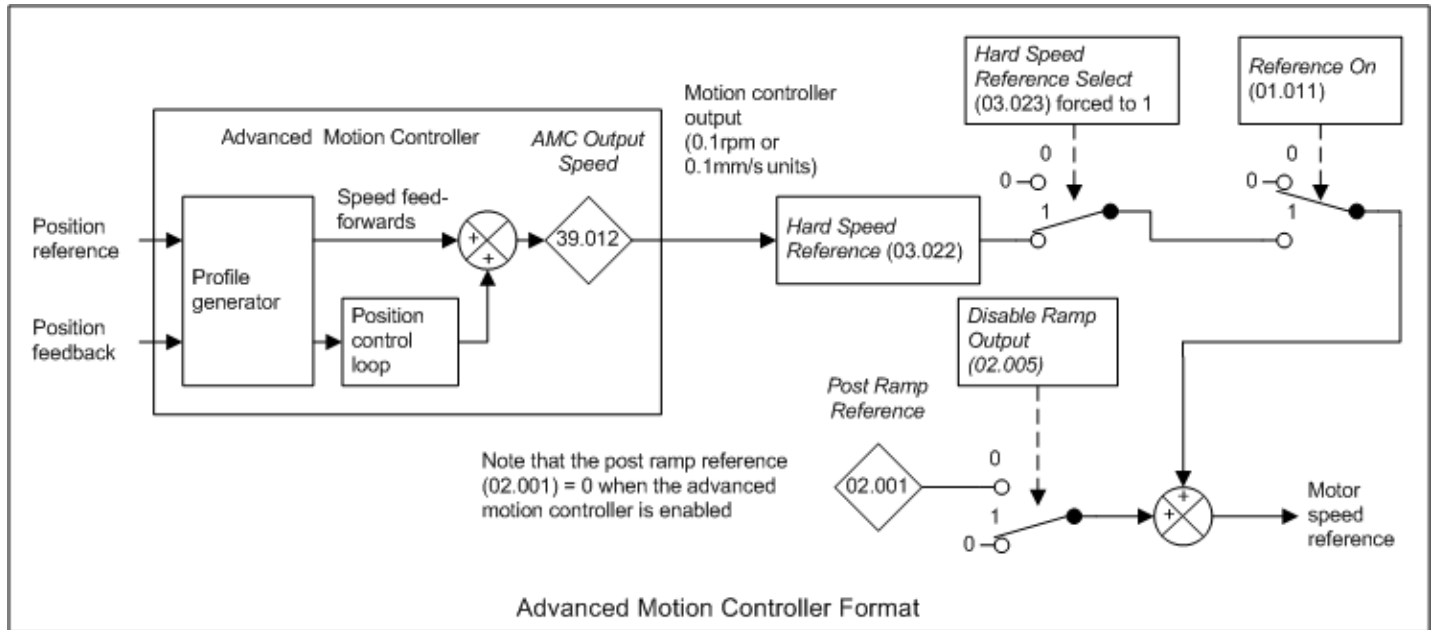
Parameter		Range			Default			Type			
RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No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

# Menu 31 – AMC General Set-up

Mode: RFC-S

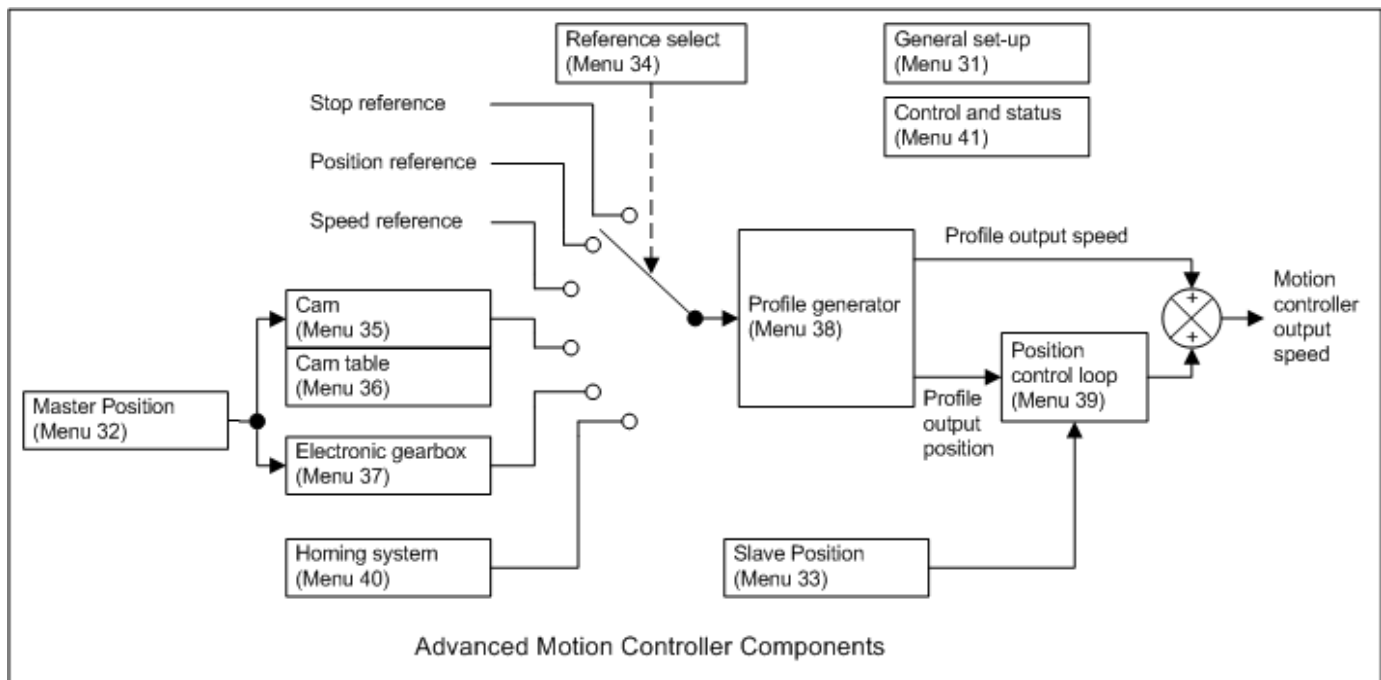
## System components

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.

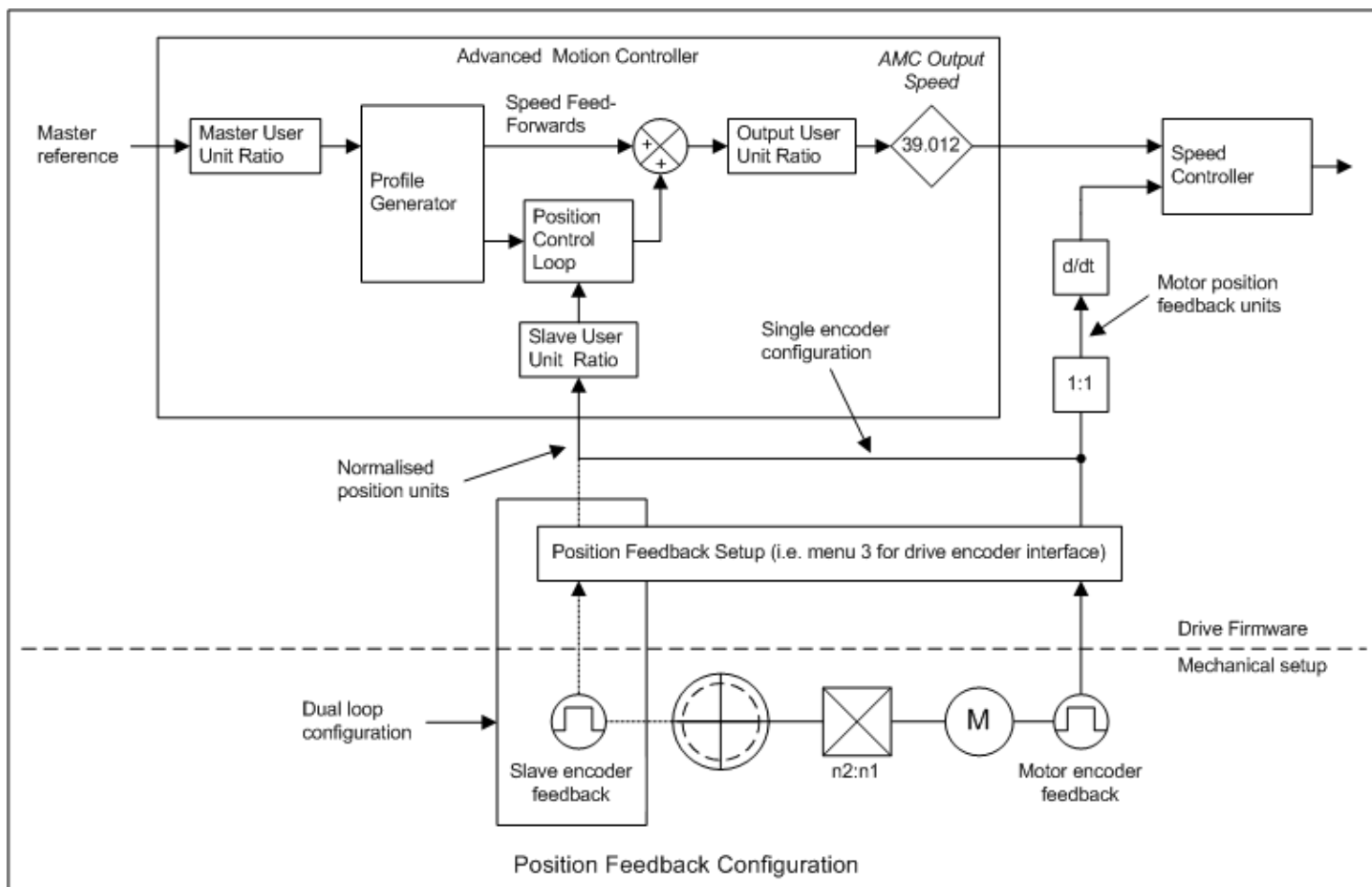


Function	Description
Master Position	The master position can be used as the input to the Cam or electronic gearbox functions and can be derived as follows: From a position feedback interface in the drive or a position feedback interface in an option module. As a speed (normally fixed) so that it can be used to create a time based profile. 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: From a position feedback interface in the drive or a position feedback interface in an option module. 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 =  $2^{\text{Position bits}}$

$$\text{AMC Slave User Units Ratio Numerator (31.006)} = 10^7$$

$$\text{AMC Slave User Units Ratio Denominator (31.007)} = 2^{16} \times 357 = 23396352$$

The output ratio is the inverse of the input ratio:

$$\text{AMC Output User Units Ratio Numerator (31.008)} = 2^{16} \times 357 = 23396352$$

$$\text{AMC Output User Units Ratio Denominator (31.009)} = 10^7$$

#### 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

$$\begin{aligned}
 &= 0.01 \text{ user units/ms} \\
 &= (0.01 / \text{User units ratio}) \text{ PosBits/ms} \\
 &= (0.01 / 2^{\text{PosBits}} / \text{User units ratio}) \text{ revs/ms} \\
 &= (10 / 2^{\text{PosBits}} / \text{User units ratio}) \text{ revs/s} \\
 &= (600 / 2^{\text{PosBits}} / \text{User units ratio}) \text{ rpm}
 \end{aligned}$$

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.

Speed parameter value = Speed of position feedback device / 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) = 250 $\mu$ s.

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	$\text{Resolution} \times 2^{30} - 1$	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	$\text{Resolution} \times 2^{30} - 1$	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:

$$\text{Acceleration parameter value} = \text{Acceleration of position feedback device} / \text{Resolution}$$

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>

## Menu 32 Single Line Descriptions – AMC Master Position

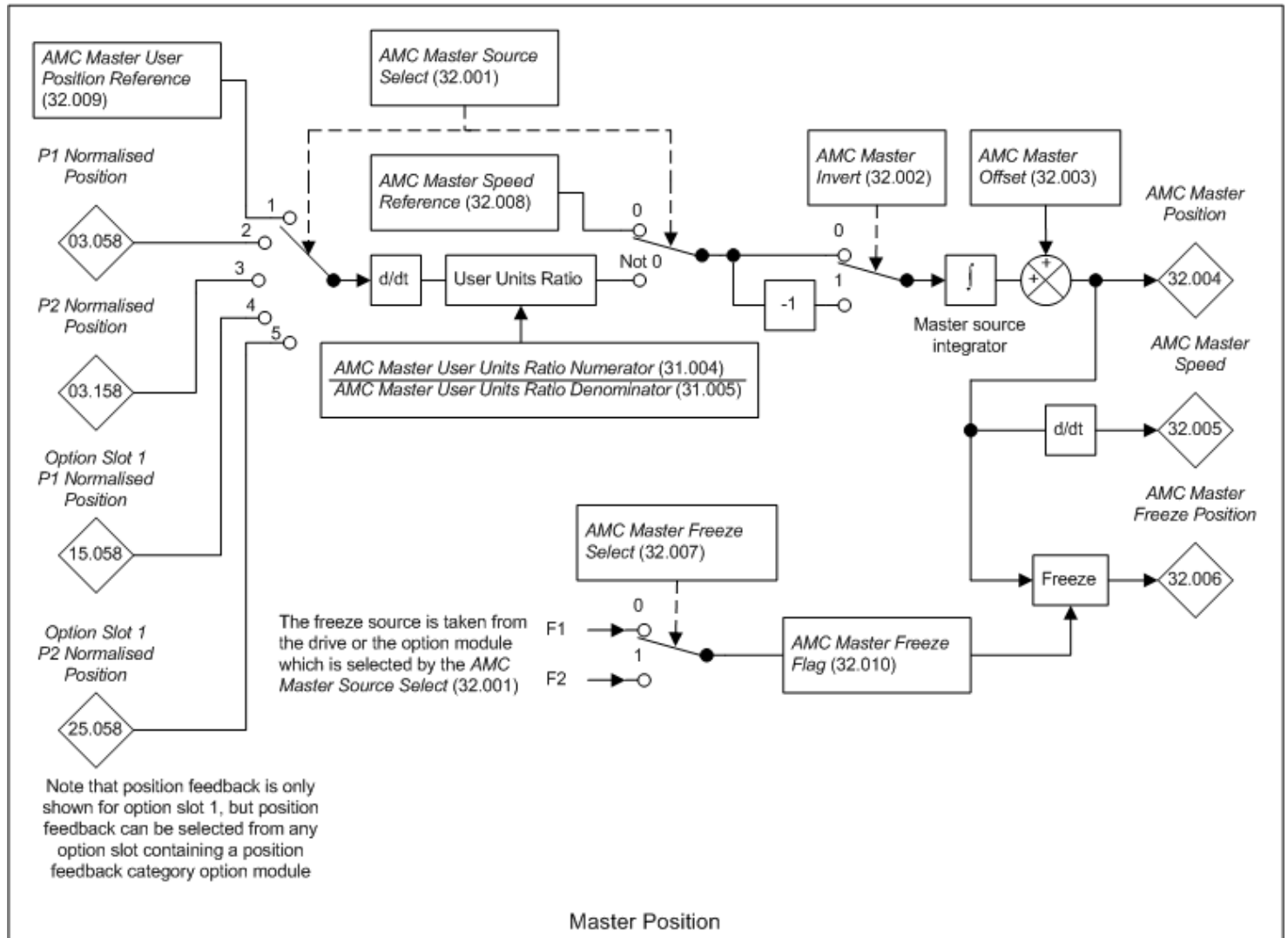
Mode: RFC-S

Parameter		Range			Default			Type			
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 32 – AMC Master Position

Mode: RFC-S

### Master position



## Menu 33 Single Line Descriptions – AMC Slave Position

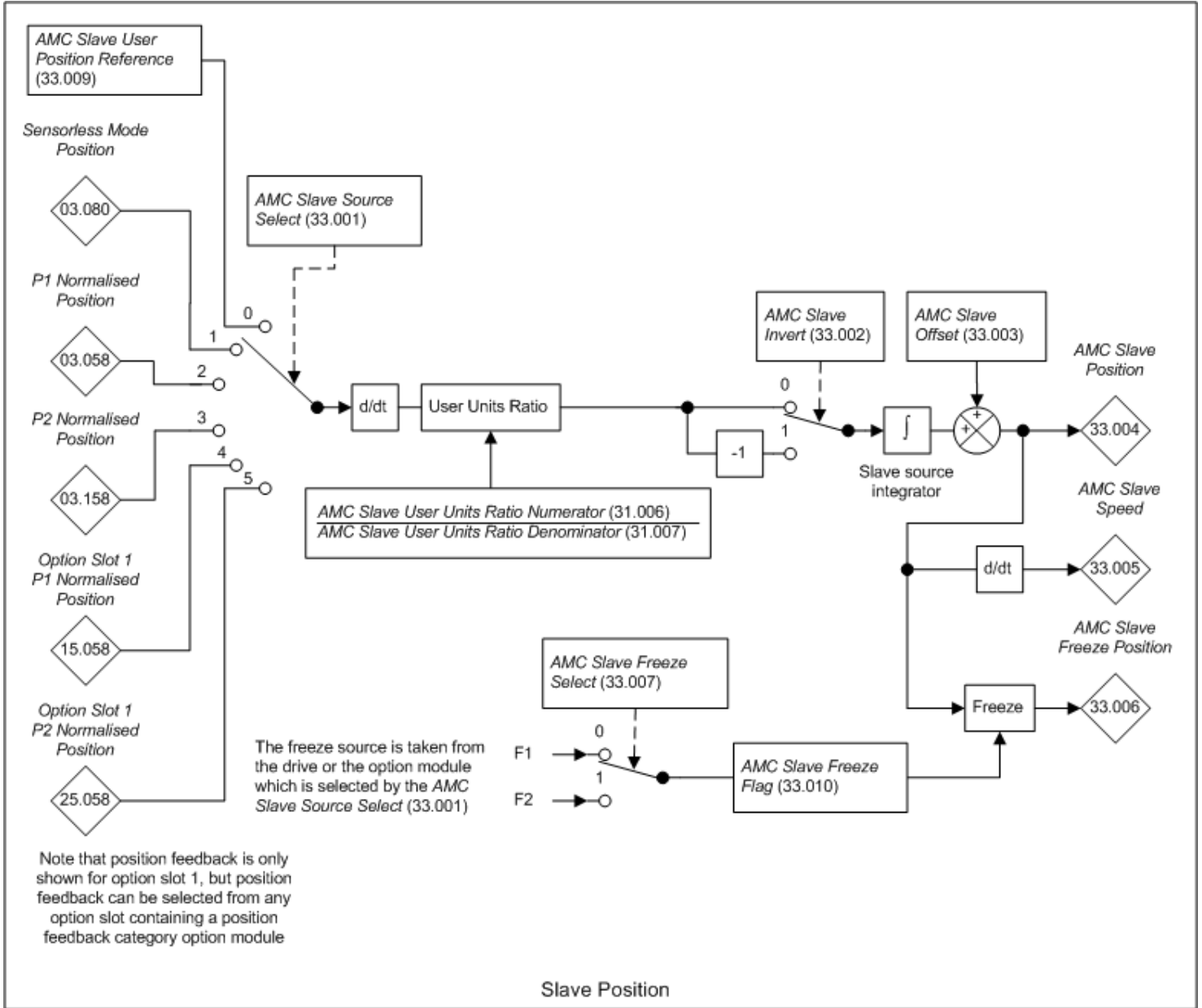
Mode: RFC-S

Parameter		Range			Default			Type			
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 33 – AMC Slave Position

Mode: RFC-S

## Slave position





## Menu 34 Single Line Descriptions – AMC Reference Selector

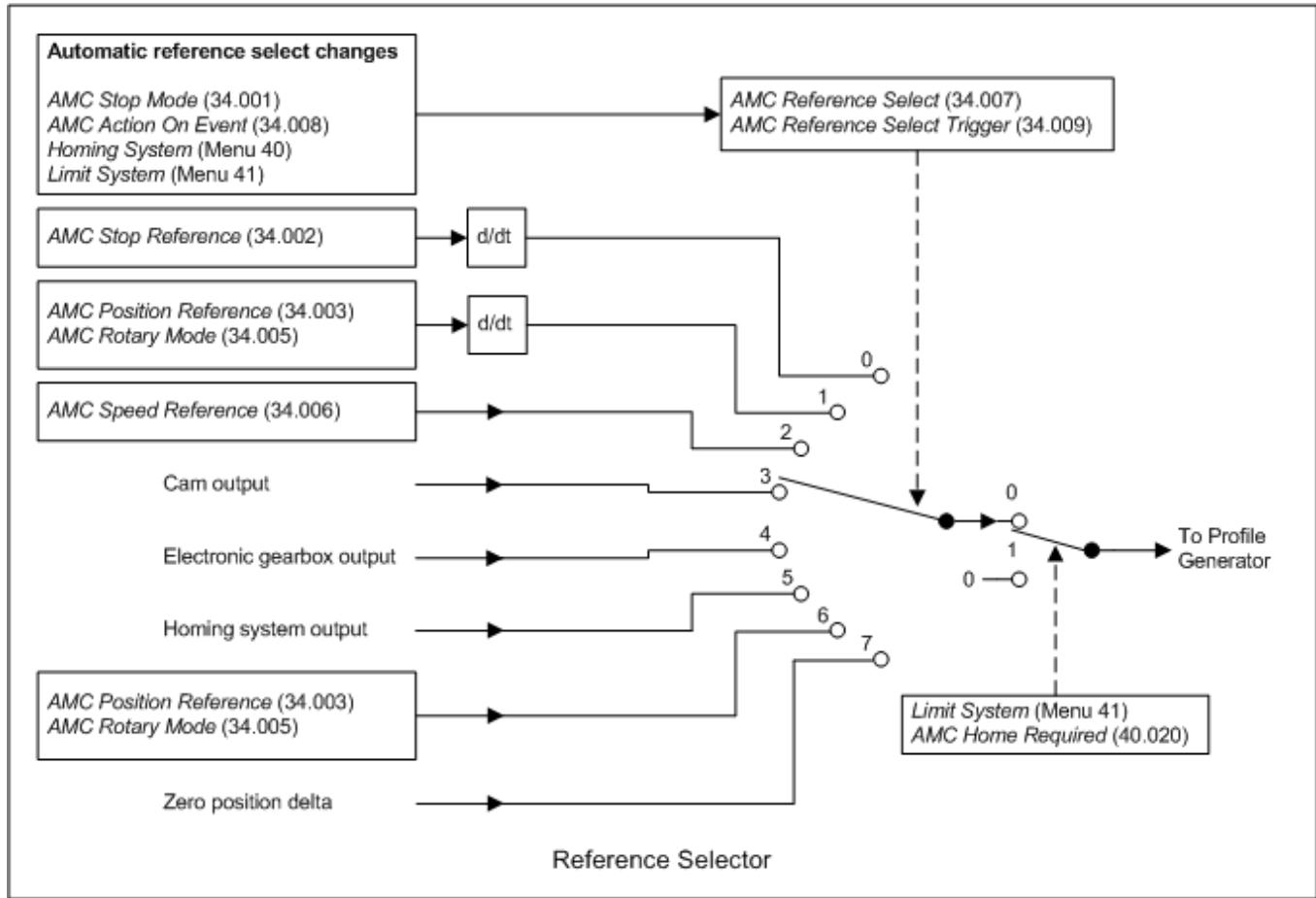
Mode: RFC-S

Parameter		Range			Default			Type			
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 34 – AMC Reference Selector

Mode: RFC-S

## Reference selector



# Menu 35 Single Line Descriptions – AMC Cam

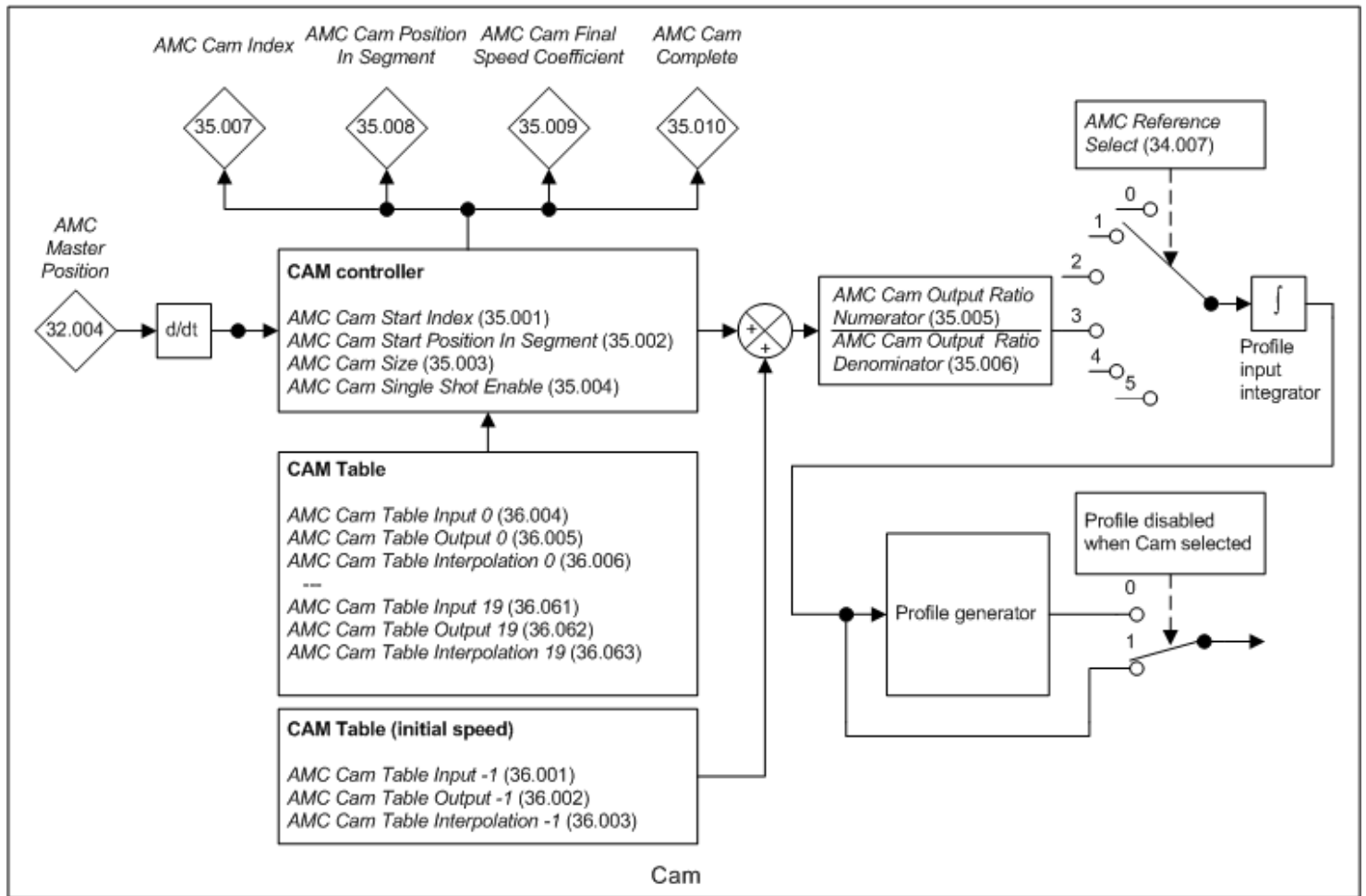
Mode: RFC-S

Parameter		Range			Default			Type			
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-S

## Cam



## Menu 36 Single Line Descriptions – AMC Cam Table

Mode: RFC-S

Parameter		Range			Default			Type			
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 36 – *AMC Cam Table*

Mode: RFC-S

# Menu 37 Single Line Descriptions – AMC Electronic Gear Box

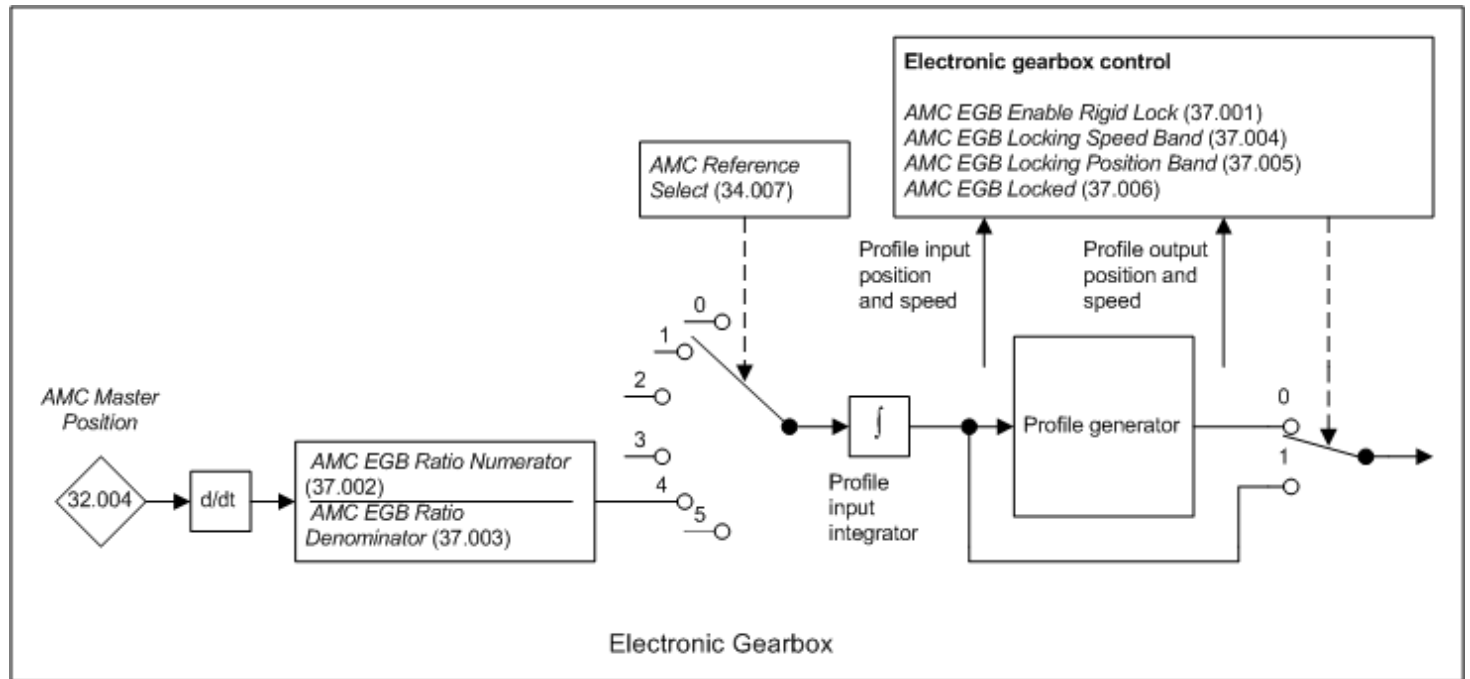
Mode: RFC-S

Parameter		Range			Default			Type			
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 37 – AMC Electronic Gear Box

Mode: RFC-S

## Electronic gearbox





## Menu 38 Single Line Descriptions – AMC Profile Generator

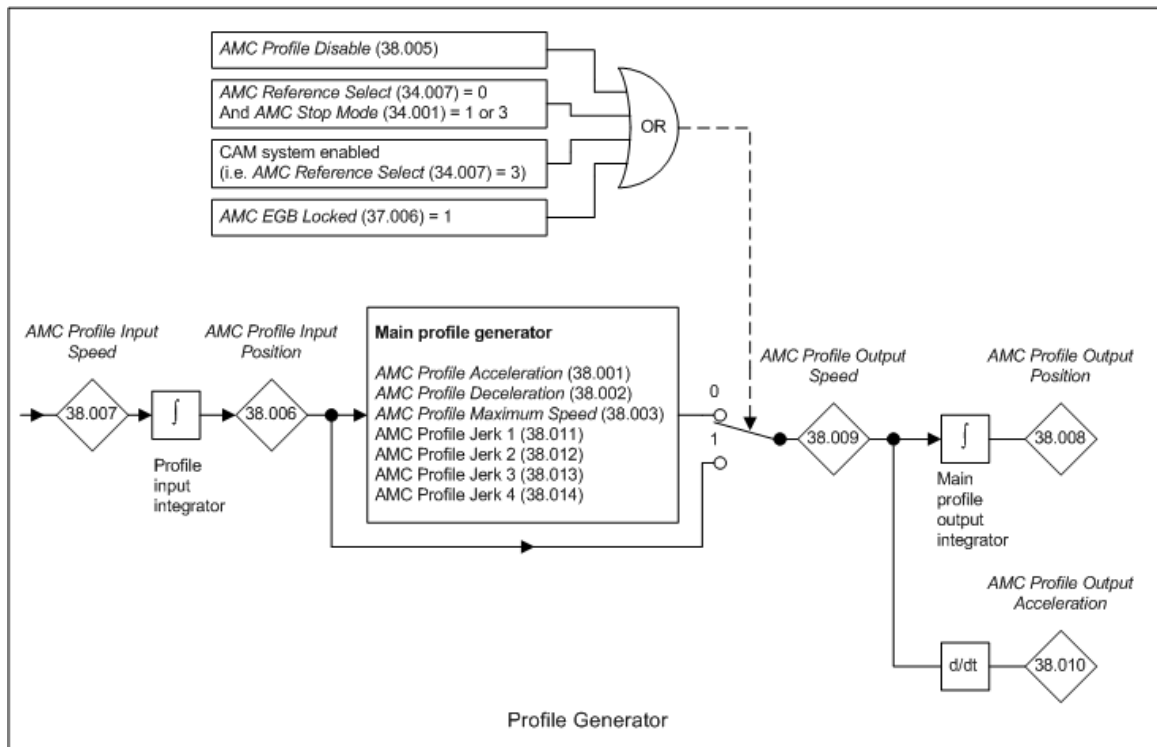
Mode: RFC-S

Parameter		Range			Default			Type			
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 38 – AMC Profile Generator

Mode: RFC-S

### 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
<b>AMC Stop Reference</b> (34.002)	Stop reference at zero speed
<b>AMC Position Reference</b> (34.003) ( <b>AMC Reference Select</b> (34.007) = 1 or 6)	Position reference at zero speed
<b>AMC Speed Reference</b> (34.006)	Speed reference
Cam	Profile disabled
Electronic gearbox with non-rigid lock	Input speed when not locked Profile disabled when locked
Electronic gearbox with rigid lock	Input speed and position when not locked Profile disabled when locked
Homing system	Input speed while finding home position Input position at zero speed when moving to home reset position
Profile input position ( <b>AMC Reference Select</b> (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
<b>AMC Profile Disable</b> (38.005) = 1	Profile disabled by the user
<b>AMC Reference Select</b> (34.007) = 0 and <b>AMC Stop Mode</b> (34.001) = 1 or 3	Stop reference selected and no profile stop required
Cam system enabled (i.e. <b>AMC Reference Select</b> (34.007) = 3)	The Cam system provides its own profile, and so the profile generator is not required
<b>AMC EGB Locked</b> (37.006) = 1	Electronic gearbox output is locked and should follow the master position without any delay

## Menu 39 Single Line Descriptions – AMC Position Control Loop

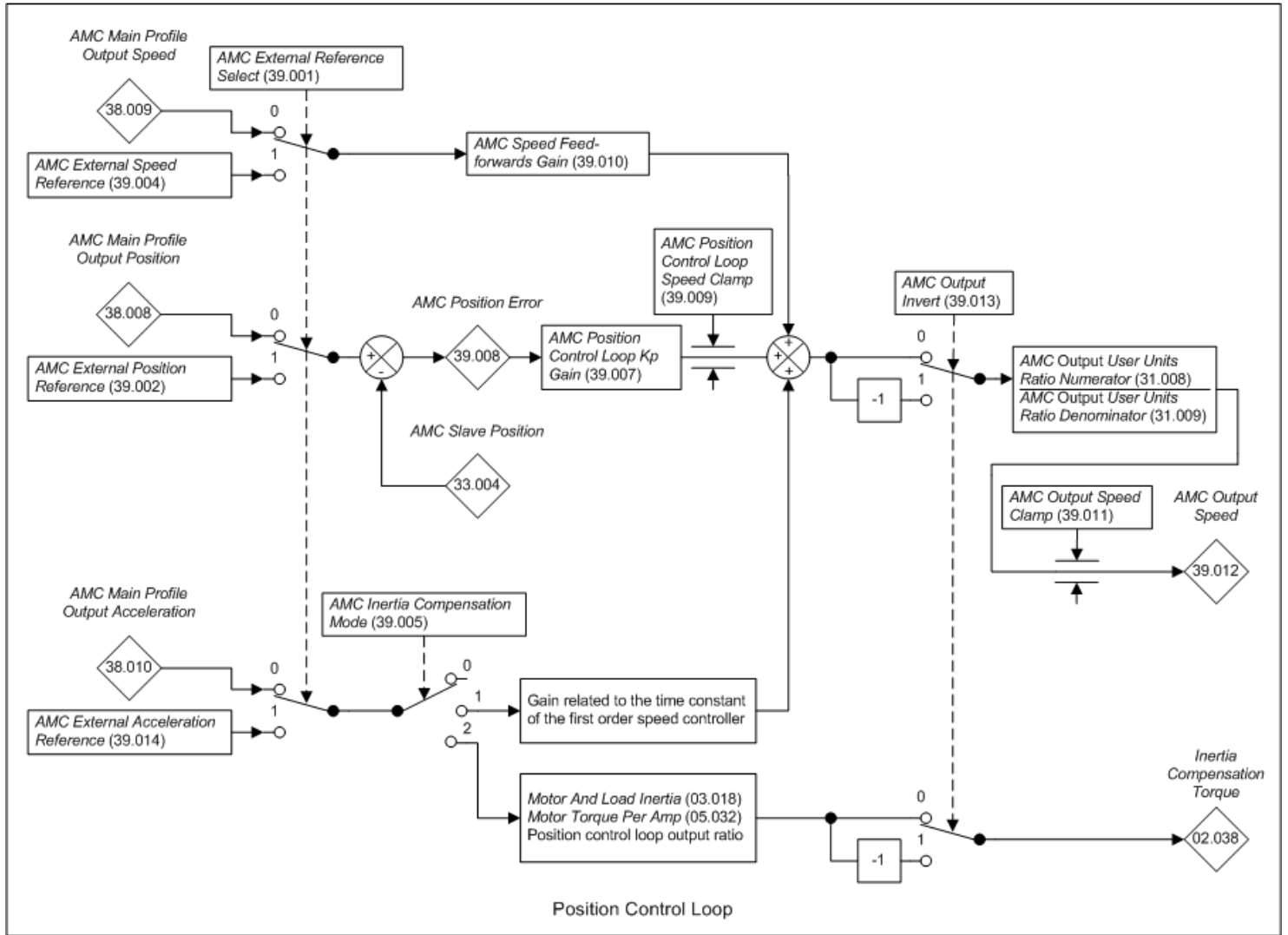
Mode: RFC-S

Parameter		Range			Default			Type			
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 39 – AMC Position Control Loop

Mode: RFC-S

## Position control loop



# Menu 40 Single Line Descriptions – AMC Homing System

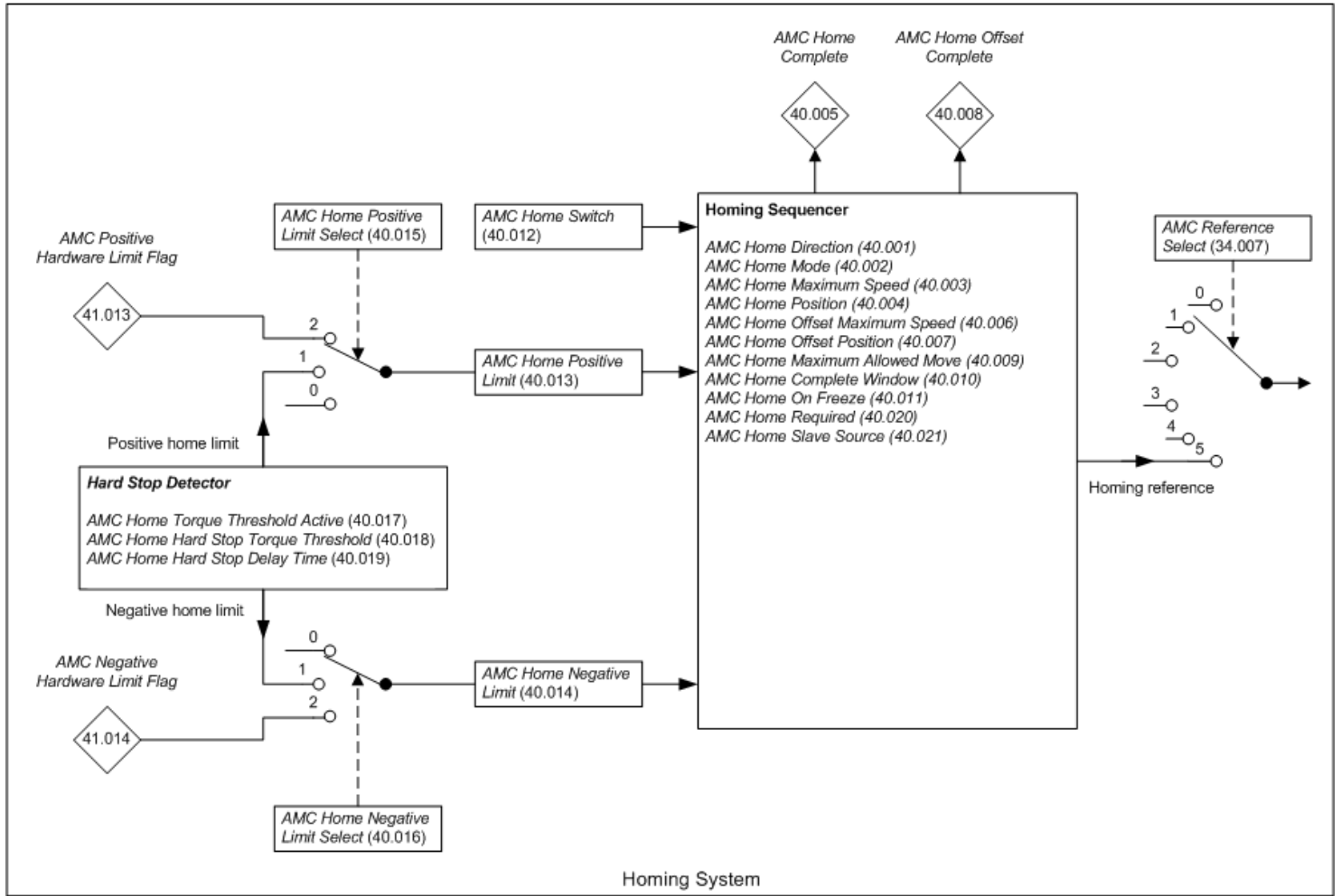
Mode: RFC-S

Parameter		Range			Default				Type		
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-S

## Homing system



# Menu 41 Single Line Descriptions – AMC Control and Status

Mode: RFC-S

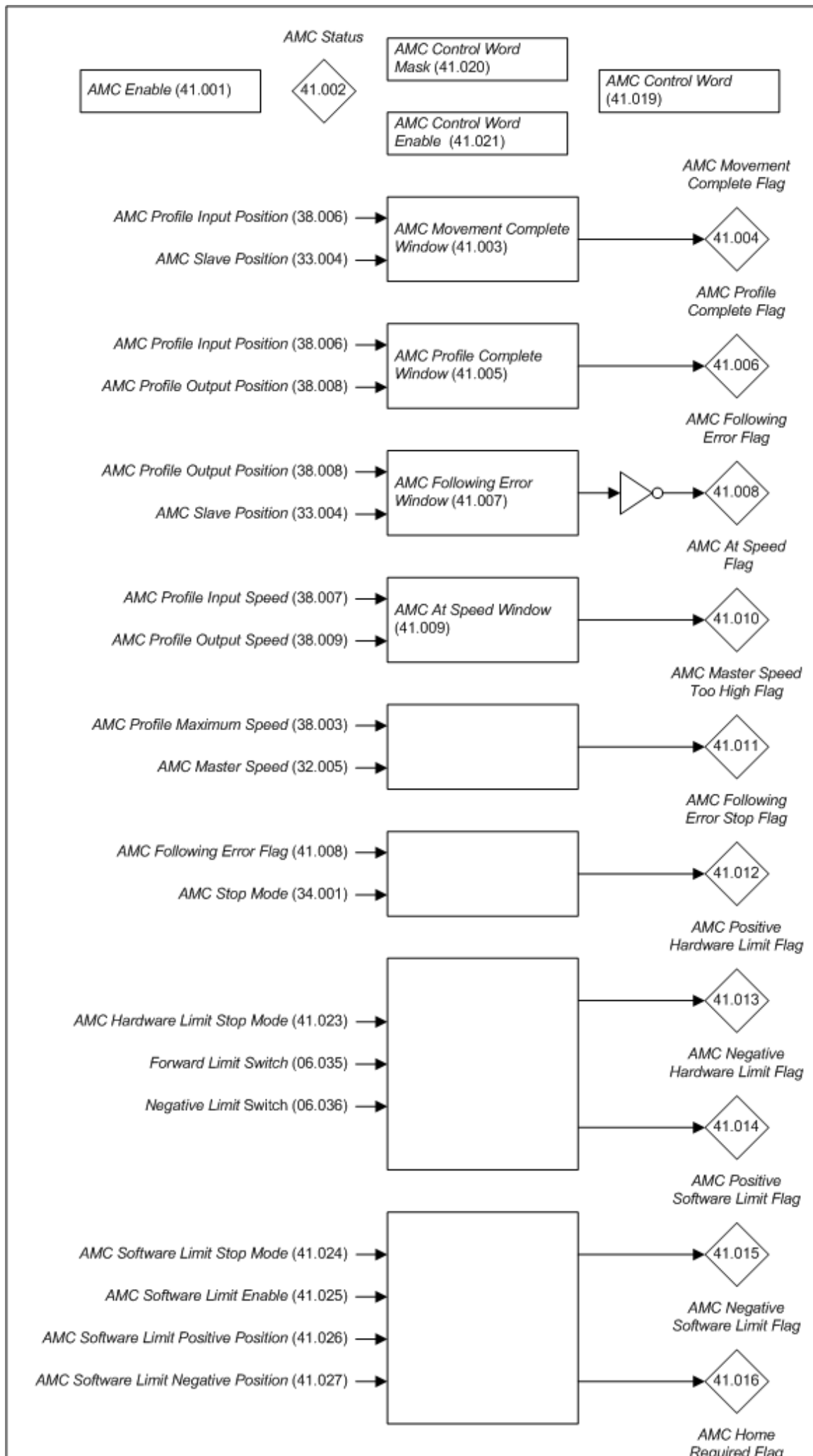
Parameter		Range			Default			Type			
RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No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

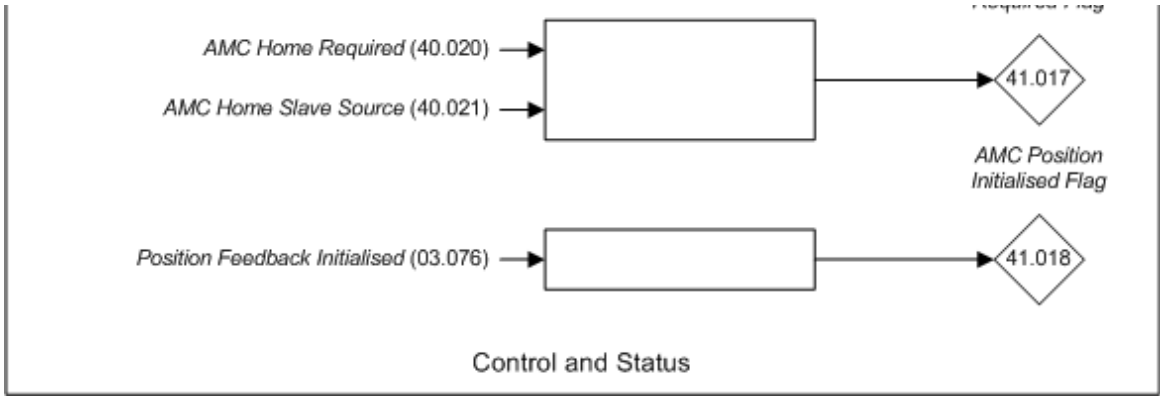
## **Menu 41 – *AMC Control and Status***

Mode: RFC-S

**Control and status**







# Trips

Mode: RFC-S

*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: 1 – background tasks 2 – timed tasks 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. Sub-trip is shown to indicate which failure: 1 - Programming error while writing menu in flash 2 - Erase flash block containing setup menus failed 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
198	Phasing Error
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)

<b>Trip</b>	<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.

<b>Trip</b>	<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.

Trip	<i>An Output Calib</i>
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.

Trip	<i>App Menu Changed</i>
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.

Trip	<i>Autotune 1</i>
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). 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.

Trip	<i>Autotune 2</i>
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.

Trip	Card No Data
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.

Trip	Card Option
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.

Trip	Card Product
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.

Trip	Card Rating
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.

Trip	Card Read Only
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. 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	Phasing Error
Value	198
Short description	

If position feedback is being used this trip indicates that the phase offset angle in *Position Feedback Phase Angle* (03.025) (or *M2 Position Feedback Phase Angle* (21.020) if the second motor map is being used) is incorrect and that the drive is unable to control the motor correctly.

**Recommended actions:**

- Check the encoder wiring.
- Check the encoder signals for noise with an oscilloscope.
- Check encoder mechanical coupling.
- Perform an auto-tune to measure the encoder phase angle or manually enter the correct phase angle into *Position Feedback Phase Angle* (03.025).
- Spurious Phasing Error trips can sometimes be seen in very dynamic applications. This trip can be disabled by setting *Over Speed Threshold* (03.008) to a value greater than zero.

If sensorless control is being used this indicates that significant instability has occurred and the motor has accelerated without control. For low saliency motors (*Active Saliency Torque Mode* (05.066) < 2) this operates in the same way as when position feedback is used, based on the speed of the motor and the voltages applied. For high saliency motors (*Active Saliency Torque Mode* (05.066) = 2) this type of detection cannot be used and the over-speed trip should be used instead. However this trip is used for high saliency motors when low speed control using current injection is being used (*Active Saliency Torque Mode* (05.066) = 2) and control is lost because the motor has become non-salient. The saliency of most permanent magnet motors reduces with load, and so *Low Speed Sensorless Mode Current* (05.071) must be set to a level to limit the current so that the motor remains salient enough for control.

**Recommended actions:**

- Ensure that the motor parameters are set-up correctly.
- Reduce the speed controller gains.
- If high saliency control is being used ensure that *Low Speed Sensorless Mode Current* (05.071) is set to a low enough level, so that the motor remains salient at low speeds and higher loads.
- This trip can be disabled by setting *Over Speed Threshold* (03.008) to a value greater than zero.

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.

<b>Trip</b>	<b>Power Down Save</b>
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.

<b>Trip</b>	<b>PSU</b>
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.

<b>Trip</b>	<b>PSU 24V</b>
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.

<b>Trip</b>	<b>Rating Mismatch</b>
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.

<b>Trip</b>	<b>Rectifier Set-up</b>
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

<b>Trip</b>	<b>Reserved 001</b>
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.

<b>Trip</b>	<b>Reserved 095</b>
Value	95
Short description	

Reserved trip number.

<b>Trip</b>	<b>Reserved 104</b>
Value	104
Short description	

Reserved trip number.

<b>Trip</b>	<b>Reserved 105</b>
Value	105
Short description	

Reserved trip number.

<b>Trip</b>	<b>Reserved 106</b>
Value	106
Short description	

Reserved trip number.

<b>Trip</b>	<b>Reserved 107</b>
Value	107
Short description	

Reserved trip number.

<b>Trip</b>	<b>Reserved 108</b>
Value	108
Short description	

Reserved trip number.

<b>Trip</b>	<b>Reserved 161</b>
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 measured 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.

Trip	<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*.

Trip	<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.

Trip	<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*.

Trip	Slot2 Error
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.

Trip	Slot2 HF
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	Temp Feedback
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 02: Control board thermistor 2 03: I/O board thermistor:
Power system	Power module number	0	Zero for temperature feedback provided via power system comms. 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.