

## PX-MODBUS

Communication module for  
**POWERDRIVE, PROXIDRIVE, VARMECA 33/34**

Installation

**PX-MODBUS****Communication module for POWERDRIVE, PROXIDRIVE, VARMECA 33/34****NOTE**

LEROY-SOMER reserves the right to modify the characteristics of its products at any time in order to incorporate the latest technological developments. The information contained in this document may therefore be changed without notice.

**CAUTION**

For the user's own safety, this variable speed drive must be connected to an approved earth ( $\perp$  terminal).

If accidentally starting the installation is likely to cause a risk to personnel or the machines being driven, it is essential to supply the equipment via an isolating switch and a circuit-breaking device (power contactor) which can be controlled via an external safety system (emergency stop, detection of errors on the installation).

The variable speed drive is fitted with safety devices which, in the event of a fault, control stopping and thus stop the motor. The motor itself can become jammed for mechanical reasons. Voltage fluctuations, and in particular power cuts, may also cause the motor to stop.

The removal of the causes of the shutdown can lead to restarting, which may be dangerous for certain machines or installations.

In such cases, it is essential that the user takes appropriate precautions against the motor restarting after an unscheduled stop.

The variable speed drive is designed to be able to supply a motor and the driven machine above its rated speed.

If the motor or the machine are not mechanically designed to withstand such speeds, the user may be exposed to serious danger resulting from their mechanical deterioration.

Before programming a high speed, it is important that the user checks that the installation can withstand it.

The variable speed drive which is the subject of this manual is designed to be integrated in an installation or an electrical machine, and can under no circumstances be considered to be a safety device. It is therefore the responsibility of the machine manufacturer, the designer of the installation or the user to take all necessary precautions to ensure that the system complies with current standards, and to provide any devices required to ensure the safety of equipment and personnel.

Using the drive for hoisting: when using this application, it is essential to follow the special instructions in an application-specific manual which is available on request. It is the responsibility of the user to obtain this manual from his usual LEROY-SOMER contact.


LEROY-SOMER declines all responsibility in the event of the above recommendations not being observed.

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## SAFETY AND OPERATING INSTRUCTIONS FOR VARIABLE SPEED DRIVES (in accordance with the low voltage directive 73/23/EEC modified by 93/68/EEC)

 • Throughout the manual, this symbol warns of consequences which may arise from inappropriate use of the drive, since electrical risks may lead to material or physical damage as well as constituting a fire hazard.

### 1 - General

Depending on their degree of protection, the variable speed drives may contain unprotected live parts, which may be moving or rotating, as well as hot surfaces, during operation.

Unjustified removal of protection devices, incorrect use, faulty installation or inappropriate operation could represent a serious risk to personnel and equipment.

For further information, consult the manual. All work relating to transportation, installation, commissioning and maintenance must be performed by experienced, qualified personnel (see IEC 364 or CENELEC HD 384, or DIN VDE 0100 and national specifications for installation and accident prevention).

In these basic safety instructions, qualified personnel means persons competent to install, mount, commission and operate the product and possessing the relevant qualifications.

### 2 - Use

Variable speed drives are components designed for integration in installations or electrical machines.

When integrated in a machine, commissioning must not take place until it has been verified that the machine conforms with directive 89/392/EEC (Machinery Directive). It is also necessary to comply with standard EN 60204, which stipulates in particular that electrical actuators (which include variable speed drives) cannot be considered as circuit-breaking devices and certainly not as isolating switches.

Commissioning can take place only if the requirements of the Electromagnetic Compatibility Directive (89/336/EEC, modified by 92/31/EEC) are met.

The variable speed drives meet the requirements of the Low Voltage Directive 73/23/EEC, modified by 93/68/EEC. The harmonised standards of the DIN VDE 0160 series in connection with standard VDE 0660, part 500 and EN 60146/VDE 0558 are also applicable.

The technical characteristics and instructions concerning the connection conditions specified on the nameplate and in the documentation provided must be observed without fail.

### 3 - Transportation, storage

All instructions concerning transportation, storage and correct handling must be observed.

The climatic conditions specified in the technical manual must be observed.

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## 4 - Installation

The installation and cooling of equipment must comply with the specifications in the manual supplied with the product.

The variable speed drives must be protected against any excessive stress. In particular, there must be no damage to parts and/or modification of the clearance between components during transportation and handling. Avoid touching the electronic components and contact parts.

The variable speed drives contain parts which are sensitive to electrostatic stresses and may be easily damaged if handled incorrectly. Electrical components must not be exposed to mechanical damage or destruction (risks to health!).

## 5 - Electrical connection

When work is performed on variable speed drives which are powered up, the national accident prevention regulations must be observed.

The electrical installation must comply with the relevant specifications (for example conductor cross-sections, protection via fused circuit-breaker, connection of protective conductor). More detailed information is given in the manual.

Instructions for an installation which meets the requirements for electromagnetic compatibility, such as screening, earthing, presence of filters and correct insertion of cables and conductors, are given in the documentation supplied with the variable speed drives. These instructions must be followed in all cases, even if the variable speed drive carries the CE mark. Adherence to the limits given in the EMC legislation is the responsibility of the manufacturer of the installation or the machine.

## 6 - Operation

Installations in which variable speed drives are integrated must be fitted with additional protection and monitoring devices as laid down in the current relevant safety regulations, such as the law on technical equipment, accident prevention regulations, etc. Modifications to the variable speed drives using control software are permitted.

Active parts of the device and the live power connections must not be touched immediately after the variable speed drive is powered down, as the capacitors may still be charged. In view of this, the warnings fixed to the variable speed drives must be observed.

During operation, all doors and protective covers must be kept closed.

## 7 - Servicing and maintenance

Refer to the manufacturer's documentation.

**This manual is to be given to the end user.**

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**PX-MODBUS****Communication module for POWERDRIVE, PROXIDRIVE, VARMECA 33/34****Notes**

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## 1 - GENERAL INFORMATION

### 1.1 - General

**PX-Modbus** is a Modbus RTU option designed for Powerdrive, Proxidrive and Varmeca 33/34 drives.

As standard, these drives incorporate a Modbus RTU serial link port, type RS485 2-wire, non-isolated, accessible via the RJ45 connector. When the user wishes to keep the keypad (KEYPAD-LCD) permanently connected, or if he requires an isolated link, the Modbus RTU option with 2 or 4-wire isolated RS485 serial link port should be added.

Colour of the option label: blue.

### 1.2 - Dimensions

The **PX-Modbus** module can be incorporated in POWERDRIVE, PROXIDRIVE and VARMECA 33/34 drives, and does not alter the drive dimensions.

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## 2 - INSTALLATION

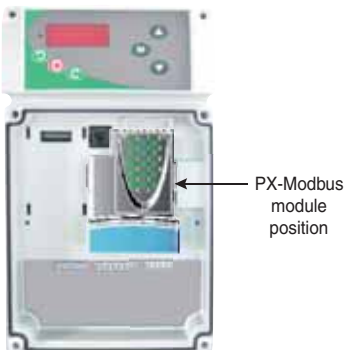
**⚠** • Always switch off the drive before connecting/disconnecting the option to/from the drive. Check that the D.C. bus has fully discharged (this takes over a minute on Powerdrives).

### 2.1 - Mounting position on POWERDRIVE drive



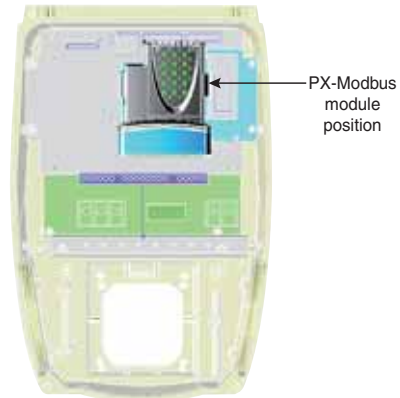
Offer the module to the special connector slot, push gently until you hear a "click" as it locks in place.

### 2.2 - Mounting position on PROXIDRIVE drive



Offer the module to the special connector slot, push gently until you hear a "click" as it locks in place.

### 2.3 - Mounting position on VARMECA 33/34 drive



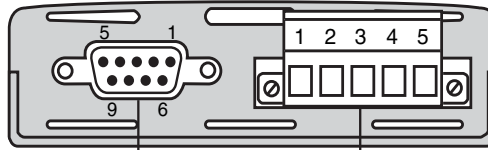
Offer the module to the special connector slot, push gently until you hear a "click" as it locks in place.



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### 3 - ELECTRICAL CONNECTIONS



9-pin female SUB-D		5-pin screw terminal block	
Pin	Description	Pin	Description
1	0V "com"	1	0V "com"
2	TX\	2	RX\
3	RX\	3	RX
4	not connected	4	TX\
5	not connected	5	TX
6	TX		
7	RX		
8	not connected		
9	not connected		
Shielding: 0V "com"			

#### WARNING:

Always switch off the drive before connecting/disconnecting the option to/from the drive. Check that the D.C. bus has fully discharged (this takes over a minute on Powerdrives).

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### 4 - SETTING THE COMMUNICATION PARAMETERS

From version v2.20 of Powerdrive and version v3.00 of Proxidrive and Varmeca 33/34, the **PX-Modbus** card parameters are set from menu 15.

**Note:** Modbus configuration of the RJ45 is still in menu 11. On subsequent versions, Modbus configuration of the RJ45 is completely independent from Modbus configuration of the **PX-Modbus** module. On older software versions, menu 11 configures both Modbus modules (no menu 15 in this case).

#### 15.04 : Modbus speed

Adjustment range : 300 (0) to 115200 (9)

Factory setting : 19200 (6)

Used to select the data transfer speed in Modbus RTU.

Speed (Bauds)	15.04
300	0
600	1
1200	2
2400	3
4800	4
9600	5
19200	6
38400*	7
57600*	8
115200*	9

\*: These speeds are non-operational on the PROXIDRIVE and VARMECA 33/34.

This parameter is the equivalent of 11.25 for the RJ45.

#### 15.05 : Parity, number of stop bits

Adjustment range : NONE, 2STOP (0);

NONE, 1STOP (1);

EVEN, 1STOP (2);

ODD, 1STOP (3)

Factory setting : NONE, 2STOP (0)

NONE, 2STOP (0): no parity,  
2 stop bits.

NONE, 1STOP (1): no parity,  
1 stop bit.

EVEN, 1STOP (2): even parity,  
1 stop bit.

ODD, 1STOP (3): odd parity,  
1 stop bit.

This parameter is the equivalent of 11.27 for the RJ45.

#### 15.01 : Option code

Value 352 for Modbus.

#### 15.03 : PX-Modbus address

Adjustment range : 0 to 247

Factory setting : 1

Used to define the drive address in the case of control or monitoring via the serial link in Modbus RTU. Avoid values including a zero since these are used for addressing groups of drives. This parameter is the equivalent of 11.23 for the RJ45.

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### 15.06 : Minimum comms transmit delay

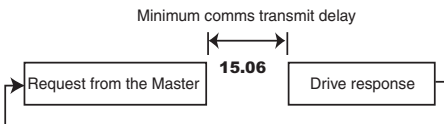
Adjustment range : 0 to 250 ms

Factory setting : 10 ms

The adjustment step is 2 ms.

Used to insert a time between data reception and feedback. The delay between a request from the master and the response from the slave drive is at least 1.5 ms.

This parameter is the equivalent of 11.26 for the RJ45.



### 15.07 : Modbus timeout

Adjustment range : 0.0 to 25 s

Factory setting : 0 s

This parameter is used to generate a "fieldbus" fault if no data has travelled on Modbus in the time period set by this parameter. It can thus be used to detect a problem on the Modbus network.

The value 0 disables Modbus monitoring.

This parameter is the equivalent of 11.63 for the RJ45.

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## 5 - MODBUS RTU OPERATION

### 5.1 - General

The MODBUS RTU protocol is a master-slave type protocol (a single master per network).

Description	Characteristics
Normal physical layer for multi-drop operation	2-wire RS485
Bit stream	Standard UART asynchronous symbols with Non-Return to Zero (NRZ)
Symbol	Each symbol consists of:
	1 start bit
	8 data bits (least significant bit transmitted first)
	1 or 2 stop bits according to 15.05
Baud rate	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 baud

### 5.2 - Description of exchanges

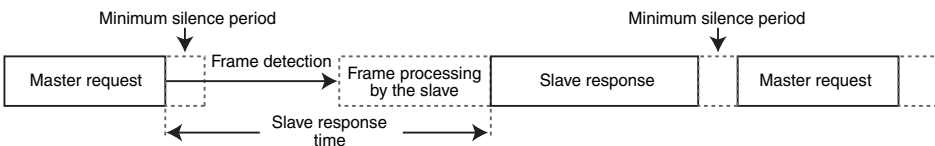
Exchanges are initiated by the master, which sends its request: if the slave concerned has understood it, it sends its response. Each frame (question or response) contains four types of information:

- The address of the slave concerned which receives the question frame (request from the master) or the address of the slave which sends the response frame (encoded in one byte)
- The function code which selects a command (read or write words, bits, etc.) for the question and response frames (encoded in one byte)
- The data field containing the parameters relating to the command (encoded in "n" bytes)
- The CRC for the frame, calculated in sixteen bits, which is used to detect transmission errors

The frame is terminated with a minimum silence period, equivalent to the transmission time for 3.5 characters (e.g. at 19200 baud, the silence period must be at least  $1/19200 \times 11 \text{ bits} \times 3.5$ , i.e. 2 ms). This silence period indicates the end of the message, and the slave can start to process the transmitted data.

Address slave	Code Function	Message data	CRC 16-bit	Interval Silence
---------------	---------------	--------------	------------	------------------

All requests from the master will result in a response from a single slave. The slave will respond within the maximum permitted time (the minimum response time will never be less than the silence period).



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### 5.3 - Parameter assignment

POWERDRIVE, PROXIDRIVE and VARMECA 33/34 drives are configured using a **menu.parameter** notation.

The "menu" and "parameter" indices can take the values 0 to 99. Menu.parameter is assigned to a MODBUS RTU register **menu x 100 + parameter**.

**In order to assign the parameters correctly, the slave increments (+1) the address of the received register.**

Example: X = menu; Y = parameter

Drive parameter	Register address (protocol level)
X.Y	$(X \times 100) + (Y - 1)$
<b>Examples:</b>	
1.02	101
1.00	99
0.01	0
12.33	1232

### 5.4 - Data encoding

MODBUS RTU uses a "big-endian" representation for the addresses and data items (except for the CRC which is "little-endian"). This means that, when a numerical quantity "bigger" than one byte is transmitted, the most significant byte is sent first.

For example:

16 – bits 0x1234 would be:  $1^{st}$   $2^{nd}$  ...  
0x12 0x34

### 5.5 - Control word and status word

Drive control commands can be managed using a single parameter 6.42, called the "control word".

This is because the value of 6.42 corresponds to a word in which each bit is associated with a command. The command is enabled when the bit is at 1, and disabled when the bit is at 0.

To enable commands using the control word, set 6.43 = 1 (control commands via the terminals are no longer active), when the drive is disabled.

Parameter 10.40, called the status word, is used to group together data on the drive. The value of 10.40 corresponds to a 15-bit word, and each bit is associated with a drive status parameter.

#### 6.42: Control word

Bits of control word 6.42	Corresponding parameters	Functions
0	6.15	Drive unlocking
1	6.30	Run forward
2	6.31	Jog
3	6.32	Run reverse
4	6.33	Forward/
5	6.34	Run
6	-	Reserved
7	-	Reserved
8	1.42	Analog reference/ preset reference
9	-	Reserved
10	-	Reserved
11	-	Reserved
12	-	Reserved
13	10.33	Drive reset/ Reset
14	-	Reserved

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## 10.40: Status word

Bits of status word 10.40	Corresponding parameters	Drive status
0	10.01	Drive healthy
1	10.02	Drive active
2	10.03	Zero speed
3	10.04	Running at or
4	10.05	Below set speed
5	10.06	At speed
6	10.07	Above set speed
7	10.08	Load reached
8	10.09	Drive output is at current limit
9	10.10	Dynamic braking
10	10.11	Braking IGBT active
11	10.12	Braking resistor, overload alarm
12	10.13	Direction commanded
13	10.14	Direction running
14	10.15 (1)	Mains loss

(1) Parameter not used on PROXIDRIVE and VARMECA 33/34.

## 5.6 - Function codes

The function code determines the context and data format of the message.

Function code		Description
Decimal	Hexadecimal	
3	03	Read multiple 16-bit registers or words
6	06	Write single 16-bit register or word
16	10	Write multiple 16-bit registers or words
23	17	Read and write multiple 16-bit registers or words

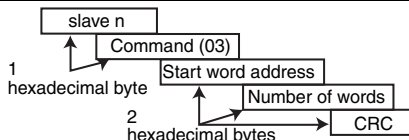
## • Function code 3: Read multiple

Reading of a contiguous register or word area. The slave sets an upper limit on the number of registers or words that can be read. If the limit is exceeded, the slave does not respond.

**Note:** 20 drive parameters maximum can be read.

### Frame sent by the Master:

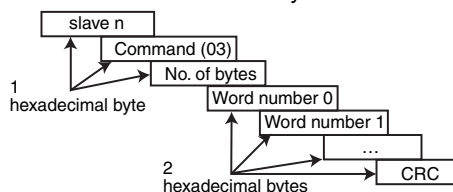
Bytes	Description
0	Slave address (1 to 247)
1	Function code 0x03
2	Start word or register address MS byte
3	Start word or register address LS byte
4	Number of words or registers to be read MS byte
5	Number of words or registers to be read LS byte
6	CRC LS byte
7	CRC MS byte



### Frame returned by the slave:

Bytes	Description
0	Slave address
1	Function code 0x03
2	Number of bytes to be read
3	Word or register 0 MS byte
4	Word or register 0 LS byte
5	Word or register 1 MS byte
6	Word or register 1 LS byte
...	...
n	CRC LS byte
n + 1	CRC MS byte

Where n = 3 + number of bytes to be read.



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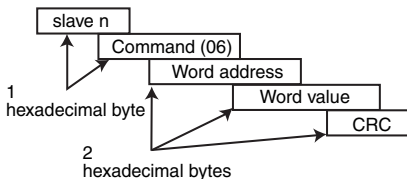
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### • Function code 6: Write single register or word

Writing of a value to a single 16-bit register or word. The normal response is an "echo" of the request, after the register or word has been written to.

#### Frame sent by the Master:

Bytes	Description
0	Slave address (0 to 247)
1	Function code 0x06
2	Word or register address MS byte
3	Word or register address LS byte
4	Word or register value MS byte
5	Word or register value LS byte
6	CRC LS byte
7	CRC MS byte



#### Frame sent by the slave:

Bytes	Description
0	Slave address
1	Function code 0x06
2	Word or register address MS byte
3	Word or register address LS byte
4	Word or register value MS byte
5	Word or register value LS byte
6	CRC LS byte
7	CRC MS byte

### • Function code 16: Write multiple

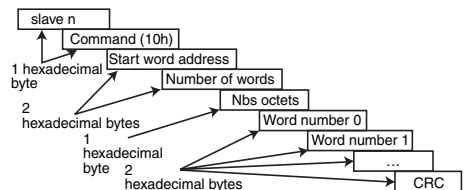
Writing of a contiguous register or word area. The slave sets an upper limit on the number of registers or words that can be written. If the limit is exceeded, the slave does not respond.

**Note:** 12 drive parameters maximum can be written.

#### Frame sent by the Master:

Bytes	Description
0	Slave address (1 to 247)
1	Function code 0x10
2	Start word or register address MS byte
3	Start word or register address LS byte
4	Number of words or registers to be written MS byte
5	Number of words or registers to be written LS byte
6	Number of bytes to be written
7	Word or register 0 to be written MS byte
8	Word or register 0 to be written LS byte
9	Word or register 1 to be written MS byte
10	Word or register 1 to be written LS byte
...	...
n	CRC LS byte
n + 1	CRC MS byte

Where n = 7 + number of bytes to be written.



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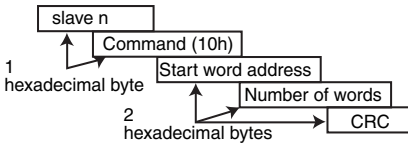
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## Frame returned by the slave:

Bytes	Description
0	Slave address (1 to 247)
1	Function code 0x10
2	Start word or register address MS byte
3	Start word or register address LS byte
4	Number of words or registers written MS byte
5	Number of words or registers written LS byte
6	CRC LS byte
7	CRC MS byte

## Frame sent by the Master:

Bytes	Description
0	Slave address (1 to 247)
1	Function code 0x17
2	Start word or register address to be read MS byte
3	Start word or register address to be read LS byte
4	Number of words or registers to be read MS byte
5	Number of words or registers to be read LS byte
6	Start word or register address to be written MS byte
7	Start word or register address to be written LS byte
8	Number of words or registers to be written MS byte
9	Number of words or registers to be written LS byte
10	Number of bytes to be written
11	Word or register 0 MS byte
12	Word or register 0 LS byte
13	Word or register 1 MS byte
14	Word or register 1 LS byte
...	...
n	CRC LS byte
n + 1	CRC MS byte



### • Function code 23: Read/write

Writing and reading of two contiguous register or word areas. The slave sets an upper limit on the number of registers or words that can be written. If the limit is exceeded, the slave does not respond.

**Note:** 20 drive parameters maximum can be read and 10 drive parameters maximum can be written.

Where n = 11 + number of bytes to be written.

## Frame returned by the slave:

Bytes	Description
0	Slave address (1 to 247)
1	Function code 0x17
2	Number of bytes to be read
3	Word or register 0 MS byte
4	Word or register 0 LS byte
5	Word or register 1 MS byte
6	Word or register 1 LS byte
...	...
n	CRC LS byte
n + 1	CRC MS byte

Where n = 3 + number of bytes to be read.



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### 5.7 - Example

Drive address = 1 (Default address).

Reading of 3 drive parameters from 1.05.

1.05 becomes 1.04 which is equal to 68 in hexadecimal (Modbus address = parameter address - 1).

#### • Request

	Example (hex)	RTU (binary)
Slave address	1	0000 0001
Function	03	0000 0011
Start word or register address (MS byte)	00	0000 0000
Start word or register address (LS byte)	68	0110 1000
Number of words or registers (MS byte)	00	0000 0000
Number of words or registers (LS byte)	03	0000 0011
CRC check: LS byte	84	1000 0100
MS byte	17	0001 0111
Total bytes:		8

#### • Response

	Example (hex)	RTU (binary)
Slave address	1	0000 0001
Function	03	0000 0011
Number of bytes	06	0000 0110
Word or register 0 (MS byte)	00	0000 0000
Word or register 0 (LS byte)	2D	0010 1101
Word or register 1 (MS byte)	05	0000 0101
Word or register 1 (LS byte)	DC	1101 1100
Word or register 2 (MS byte)	00	0000 0000
Word or register 2 (LS byte)	00	0000 0000
CRC check: LS byte	4C	0100 1100
MS byte	45	0100 0101
Total bytes:		11

### 5.8 - Wait time

In MODBUS RTU, when the master sends a message to a slave, it sets a wait time between the end of its request and the start of the response from the slave, which makes it possible to detect any missing response.

### 5.9 - Exceptions

If the message is incorrect and the frame is not received, or if the CRC is faulty, then the slave will not produce an exception, and in this case the master will not obtain a response from the slave ("timeout"). If a write request (function code 16 or 23) exceeds the maximum size accepted by the slave, then the slave will reject the message. No exception will be transmitted and the master will not obtain a response.

**PX-MODBUS****Communication module for POWERDRIVE, PROXIDRIVE, VARMECA 33/34****5.10 - CRC**

This control word is used to detect transmission errors. It is calculated in 16 bits from all the bytes of the question and response frames.

Algorithm:

START

CRC = 0xFFFF

Number of bytes processed = 0

Next byte = first byte

REPEAT

{

Byte to be processed = next byte;

CRC = CRC XOR byte to be  
processed

REPEAT eight times

{

IF (CRC odd) then

CRC = CRC/2 XOR

0xA001

else

CRC = CRC/2

}

Number of bytes processed =

Number of bytes processed + 1

}

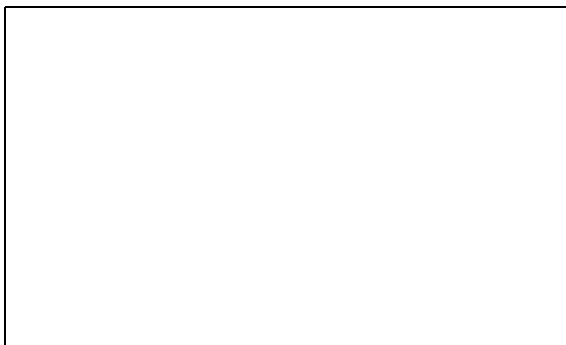
WHILE(Number of bytes processed ≤  
Number of bytes to be  
processed)

END.





IMP297NO483



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