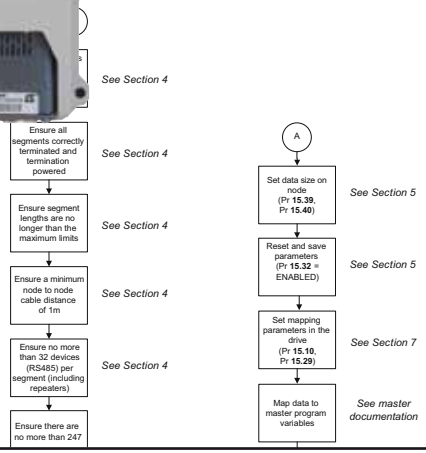
LEROY SOMER

4580 en - 2011.11 / a

POWERDRIVE MD

POWERDRIVE FX

This manual is to be given to the end user



MDX-MODBUS

Module drive for fieldbus communication

User guide

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.

The MDX-MODBUS is an optional module which is intended to be fitted in a variable speed drive. For the user's own safety, this variable speed drive must be connected to an approved earth (⏚ terminal).

If accidentally starting the installation is likely to cause a risk to personnel or the machines being driven, it is essential to comply with the power connection diagrams recommended in the drive installation manual.

The variable speed drive is fitted with safety devices which can, in the event of a problem, 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 intended for use with the module 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.

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

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This manual only describes the general features, characteristics and installation of the MDX-MODBUS. For the variable speed drive commissioning, refer to the appropriate manuals.

Contents

1 Safety and operating instructions for variable speed drives

(In accordance with the low voltage directive 73/23/EEC modified by 93/68/EEC).

1.1 Warning

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.

1.2 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 documentation.

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.

1.3 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 2006/42/EC (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 (EMC 2004/108/EC) are met.

The variable speed drives meet the requirements of the Low Voltage Directive 2006/95/EC. 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.

The SAFE TORQUE OFF (SECURE DISABLE) function meets the requirements of EN954-1 category 3 for the prevention of unexpected starting of the drive, which allows it to be used in a safety-related application. **The system designer is responsible for ensuring that the complete system is safe and designed correctly according to the relevant safety standards.**

1.4 Transportation storage

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

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

1.5 Installation

The installation and cooling of equipment must comply with the specifications in the documentation 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!).

1.6 Electrical connection

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

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 documentation.

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.

1.7 Operation

Installations in which variable speed drives are to be 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.

1.8 Servicing and maintenance

Refer to the manufacturer's documentation.

This manual is to be given to the end user.

2 Introduction

2.1 What is MDX-MODBUS?

The MDX-MODBUS is a fieldbus option module that can be fitted to the expansion slot in the drives to provide slave MODBUS on RS485 and RS232 connectivity.

Figure 2-1 MDX-MODBUS

2.2 Features

The MDX-MODBUS is an option module that can be used on the following products to provide RTU slave connectivity :

- POWERDRIVE FX.
- POWERDRIVE MD.

The following list gives an overview of the functionality available within MDX-MODBUS.

- Galvanically isolated bus electronics.
- Supports all common baud rates up to 115200bps.
- 1 unit load to the communications network.
- Supports RS485 (2 wire) and RS232.
- Modbus message.

MDX-MODBUS is powered from the host drive's internal power supply and draws 210mA from the supply.

2.3 Backup/auxiliary supply

The drives provide a method of powering up the control circuits (and therefore any option module installed) if the AC supply is removed, this allows the MDX-MODBUS to continue operating when the main AC supply is switched off.
For every MDX-MODBUS module installed allow for an extra 210mA of supply current to be drawn from the backup supply.

2.4 Option module identification

The MDX-MODBUS can be identified by the label located on the option module.

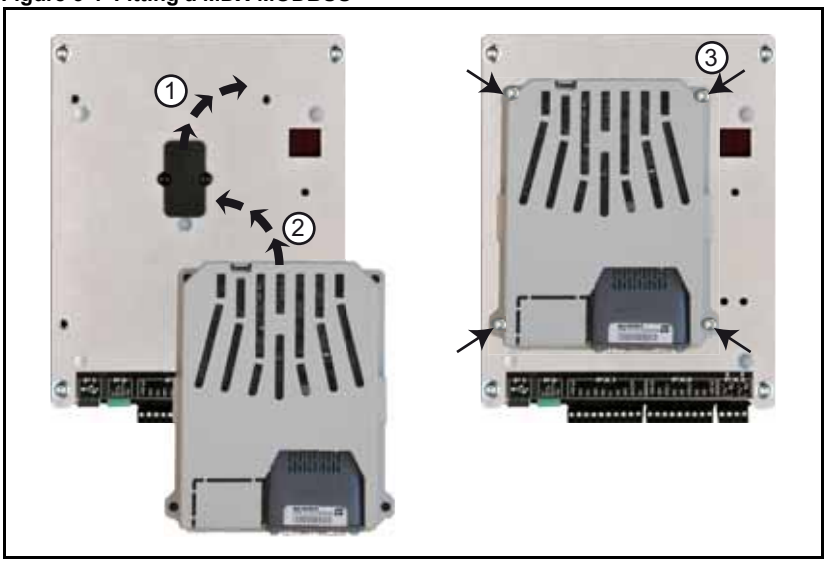
3 Mechanical installation

Before installing or removing an option module in any drive, ensure the AC supply has been disconnected for at least 10 minutes and refer to Chapter 1 Safety and operating instructions. If using a DC bus supply ensure this is fully discharged before working on any drive or option module.

3.1 General Installation

The installation of an option module is illustrated in Figure 3-1.

Figure 3-1 Fitting a MDX-MODBUS



First, remove the mask which protects the option connector slot on the drive control board (1). The option module connector is located on the underside of the module.
Push this into the option module slot located on the drive until it clicks into place (2).
Screw the module to secure it onto the drive (3).
For further information, refer to the appropriate drive manual.

4 Electrical installation

4.1 Terminal descriptions

MDX-MODBUS provides a standard RS485/RS232 9 way male D-type connector. MDX-MODBUS provides 2 diagnostic LEDs for status and information purposes. Figure 4-1 shows an overview of the module connections and indicators.

Figure 4-1 MDX-MODBUS terminals

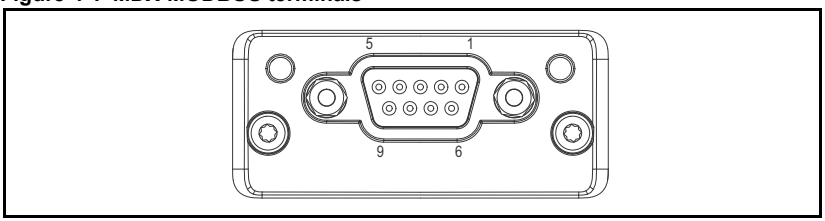


Table 4.1 9 way D-type connector details

Pin	Direction	Signal	Comment
Housing	-	PE	Protective Earth
1	-	GND	Bus polarisation, ground (isolated)
2	Output	5V	Bus polarisation power +5V DC (isolated)
3	Input	PMC	Connect to pin #2 for RS-232 operation. Leave unconnected for RS-485 operation.
4	-	-	-
5	Bidirectional	B-Line	RS-485 B-Line (non-inverting, RX TX)
6	-	-	-
7	Input	Rx	RS-232 Data receive
8	Output	Tx	RS-232 Data Transmit
9	Bidirectional	A-Line	RS-485 A-Line (inverting, /RX /TX)

4.2 Cabling considerations

To ensure long-term reliability it is recommended that any cables used to connect a system together are tested, this is of particular importance when cables are constructed on site.

4.3 MDX-MODBUS cable shield connections

Standard RS485 with shielded cable must be used at all times.

4.4 Cable

The network should be a daisy chain arrangement and not a star, although short stubs to the drive are allowed.

NOTE Cabling issues are the single biggest cause of network down-time. Ensure cabling is correctly routed, wiring is correct, connectors are correctly installed for industrial use.

4.5 Maximum network length

4.5.1 RS485 network

The maximum cable length for a RS485 link is 1200 metres. If distances greater than this are required it may be possible to extend the network with repeaters.
The maximum number of nodes that can be connected to a single RS485 network segment is 32.

4.5.2 RS232 network

The maximum cable length for a RS232 link is around 15 metres. If you need more use RS485 network.
The maximum number of nodes that can be connected to a single RS232 network segment is 2, Master and drive.

4.6 Termination resistors for RS485 network

If a drive is on the end of the network chain, 120 Ohms termination should be connected between RS485 A-line and RS485 B-line.
The purpose of termination is to prevent the reflection of data at the ends of the cable. This is especially important the higher the transmission rate of the network.

If the host is connected to a single drive then termination resistors should not be used unless the baud rate is high.

NOTE Failure to terminate a network correctly can seriously affect the operation of the network. If the correct termination networks are not fitted, the noise immunity of the network is greatly reduced. Each network segment must be correctly terminated.

4.7 RS485 Connections

The minimum connections are pin 5 (B line = non-inverting RX TX), pin 9 (A line = inverting) and the shield.
See Table 4.1 9 way D-type connector details.

NOTE Leave unconnected pin 2 to pin 3 for RS-485 operation.

4.8 RS232 Connections

Connect pin 2 to pin 3 for RS-232 operation.
The minimum connections are pins 7 (RX), 1 (GND), 8 (TX) and the shield.
See Table 4.1 9 way D-type connector details.

4.9 Minimum node to node cable length

The minimum recommended node to node distance is one metre of network cable. This distance is necessary to avoid multiple nodes generating a single large reflection on the network, using less than one metre of cable between nodes can have serious implications for network reliability.

5 Getting started

This section is intended to provide a generic guide for setting up MDX-MODBUS and a master controller. Figure 5-1 is intended as a guide only and is provided to detail the stages that are required to achieve a functioning network. It is recommended that all of this chapter is read, before attempting to configure a system.

NOTE Due to the large number of PLCs/masters that support Modbus-RTU only generic details can be provided. Support is available through your supplier or LEROY-SOMER.

NOTE Before contacting your supplier or LEROY-SOMER for support ensure you have read Chapter 10 Diagnostics of this manual and check you have configured all parameters correctly.

Ensure the following information is available before calling:

- A list of all parameters in MDX-MODBUS.
- The drive firmware version (see the relevant drive user guide).
- The MDX-MODBUS firmware version.

5.1 Network design considerations

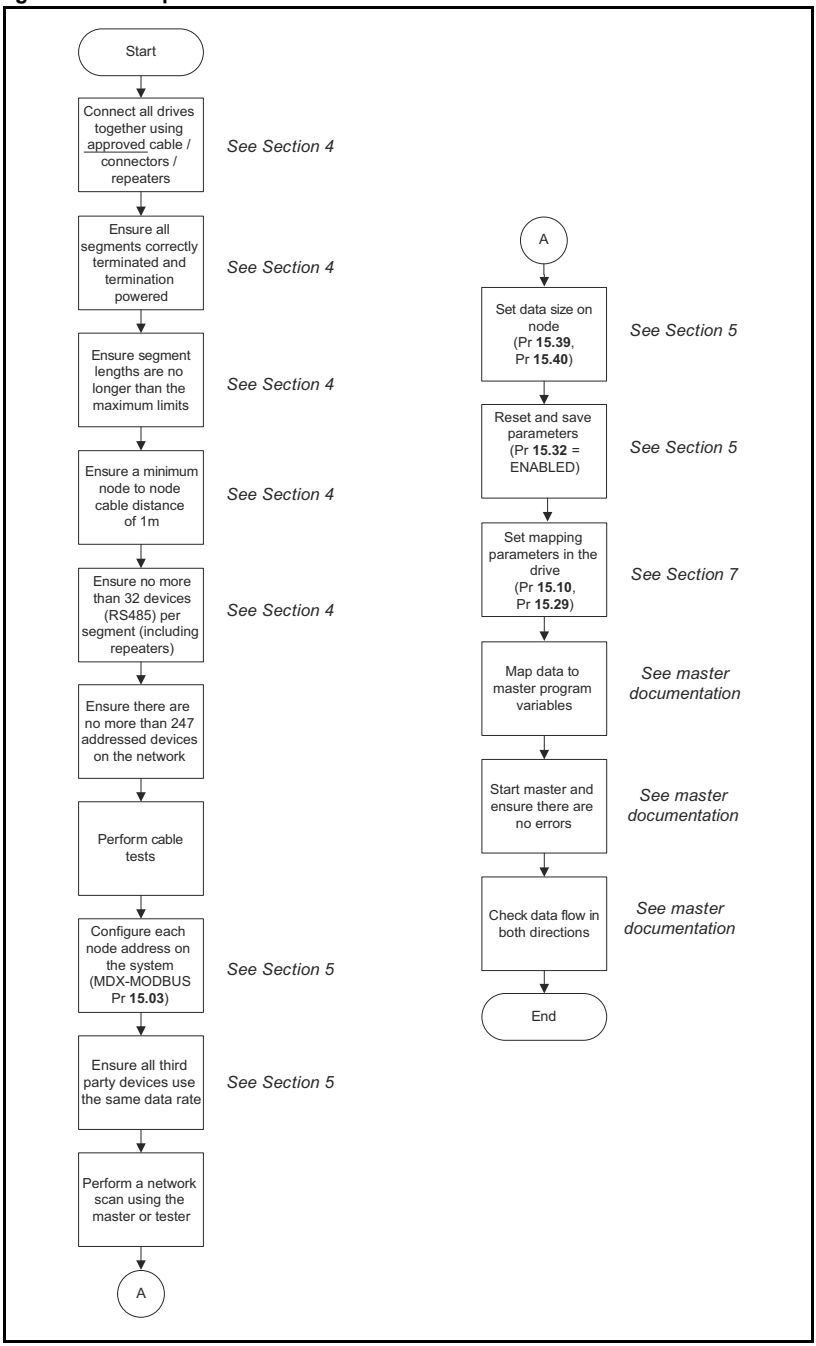
RS485 or RS232 is an open system allowing many different vendors to design and supply equipment. When designing an industrial network you must carefully consider the topology and data traffic on the network to avoid potential problems.

5.2 Conventions used in this guide

The configuration of the host drive and option module is done using menus and parameters. A menu is a logical collection of parameters that have similar functionality. In the case of a MDX option, the parameters will appear in menu 15. The menu is determined by the number before the decimal point and the parameter by the number following the decimal point.

5.3 Set-up flow chart

Figure 5-1 Set-up flow chart



5.4 Node address

RTU node address

Pr **15.03**	**Default**	1
	Range	1 to 247
	Access	RW

Every node on a modbus RTU network must be given a unique network node address. To activate a change in the node address value the MDX-MODBUS must be re-initialised (Pr **15.32** = ON). Address 0 is used to globally address all slaves, and so this address should not be set in this parameter.

5.5 Modbus data rate

All nodes on Modbus/RTU must be configured to run at the same data rate.
The range of data rates available is shown in the table below.

Modbus data rate

Pr **15.04**	**Default**	6 (57600)
	Range	0 to 8
	Access	RW

Table 5.1 data rate

Parameter value	LCD display (baud rate)
0	1200
1	2400
2	4800
3	9600
4	19200
5	38400
6	57600
7	76800
8	115200

5.6 Modbus Parity type and number of stops

Parity type, number of stops

Pr **15.05**	**Default**	0 (No parity, 2 stop bits)
	Range	0 to 3
	Access	RW

Table 5.2 Parity type, number of stops

Parameter value	LCD display
0	No parity, 2 stop bits
1	No parity, 1 stop bit 1
2	Even parity, 1 stop bit 2
3	Odd parity, 1 stop bit 3

NOTE Modbus RTU is 1 start bit + 8 data bits. It is possible to change parity and stop bits with parameter Pr **15.05**.

5.7 Modbus cyclic Data format

Read OUT cyclic, number of data bytes

Pr **15.41**	**Default**	8
	Range	0 to 20
	Access	RO

Write OUT cyclic, number of channel (parameter).

Pr **15.40**	**Default**	2
	Range	0 to 10
	Access	RW

Read IN cyclic, number of data bytes.

Pr **15.38**	**Default**	8
	Range	0 to 20
	Access	RO

Write IN cyclic, number of channel (parameter).

Pr **15.39**	**Default**	2
	Range	0 to 10
	Access	RW

The default data format is four cyclic words (8 bytes), each cyclic data channel is mapped to a drive parameter. The default mappings are shown in Table 5.3.

NOTE The maximum number of parameter data that is possible is 10 with only cyclic data.

Table 5.3 Default data mapping

Cyclic word	Data word	Default mapping status
OUT channel 0	Word 0, 1	Pr **6.42**, Control word
OUT channel 1	Word 2,3	Pr **1.21**, Digital speed reference 1
IN channel 0	Word 0,1	Pr **10.40**, Status word
IN channel 1	Word 2, 3	Pr **2.01**, post-ramp speed reference

Other data formats are also supported. For further details see section 7.2 Data Formats. The directions specified in Table 5.3 relate to the data direction as seen by the master.

5.8 MDX-MODBUS operating status

Operating status

Pr **15.06**	**Default**	N/A
	Range	0 to 14
	Access	RW

This parameter gives operating status of MDX-MODBUS, a value of 2 (inactive network process data) indicates that MDX-MODBUS is initialised and ready to communicate. For more information see section 9.8 Fieldbus option state.

5.9 Re-initialising MDX-MODBUS

Re-initialising MDX

Pr **15.32**	**Default**	0 (DISABLED)
	Range	0 to 1
	Access	RW

Changes to the MDX-MODBUS configuration will not take effect until the MDX-MODBUS has been re-initialised.
To re-initialise MDX-MODBUS:
1. Set Pr **15.32** to ENABLED.
2. Before the reset takes place Pr **15.32** will be reset to DISABLED.
3. The MDX-MODBUS will re-initialise using the updated configuration.

NOTE This sequence does NOT store the MDX-MODBUS configuration parameters in the host drive.
Pr **15.32** will revert to DISABLED immediately and may not be visible on the display.

5.10 Saving parameters to the drive

Drive parameters are automatically stored if they are changed by keypad or PC software.

If parameters are change by RS485 or RS232:
To avoid loss of the configured settings when the drive is powered down it is necessary to store the parameters.

To store drive parameters:
- Set Pr **11.65** to 0. (See note regarding drive).
- Set Pr **11.64** to yes (1).

If Pr **11.64** returns to no (0) the storing is finished.

NOTE The drive will store all the drive parameters but the operation of MDX-MODBUS will not be affected. Any changes made to the MDX-MODBUS configuration parameters (mapping etc.) will not take effect until the MDX-MODBUS module is reset.

6 PROTOCOL

MDX-MODBUS supports a Modbus RTU protocol for communicating over RS485 or RS232.

6.1 Modbus RTU

Modbus RTU is one of the most widely supported industrial RS485 or RS232 based protocols offering the functionality and simplicity of the Modbus protocol, with the flexibility of RS485. Table 6.1 shows the supported Modbus function codes.
The MDX-MODBUS implementation of Modbus RTU follows the specification provided by the Modbus organization.

Table 6.1 Supported Modbus RTU function codes

Code	Description
FC1	Read Coils
FC2	Read Discrete Inputs
FC3	Read holding Registers
FC4	Read Input Registers
FC5	Write Single Coil
FC6	Write Single Register
FC15	Write Multiple Coils
FC16	Write Multiple Registers
FC23	Read/Write Multiple Registers

A timer is available under the MODBUS Pr **15.07** to allow loss of MODBUS communications to be managed (see Chapter 12 Advanced features).

7 Cyclic data

Modbus does not feature a dedicated cyclic data channel in the same sense as many other networks. In the MDX-MODBUS implementation, cyclic data can however still be accessed from the network via dedicated entries in the Modbus register map. Just as with regular Parameter's, the cyclic data is converted to a format suitable for Modbus.

Cyclic data is more easy and fast access than acyclic, when various parameters is needed (no contiguous). It is strongly recommended to use cyclic.

7.1 What is cyclic data?

Cyclic data transfer is a method of transferring data on a regular time period, often known as 'polled data'. High-speed data transfer is achieved by transmitting only data bytes over the Modbus RS485 network and using local mapping information within the MDX-MODBUS and Modbus RS485 master controller to ensure that the correct data is sent to the correct locations. The flexibility of the MDX-MODBUS means that each cyclic data OUT channel can be directed to any read/write drive parameter. Similarly each cyclic data IN channel can use any drive parameter as a source of data.

NOTE

- The term OUT data refers to data that is transmitted out of the master to the slave.
- The term IN data refers to data that is returned from a slave into the master.
- Cyclic data mapping cannot be changed dynamically, as changes to the configuration (mapping parameters, etc.) will only take effect during initialisation of the MDX-MODBUS.
- The maximum number of 1 to 16-bit mappings parameters that is possible is: 10 (10 words if cyclic data compression is on and 20 words if cyclic data compression is off).
- The maximum number of 32-bit mappings parameters that is possible is: 10 (20 words). See section 11.2 Compression of Cyclic data for information on using data compression with 1 to 16-bit parameters.

7.2 Data formats

The MDX-MODBUS can be configured with up to ten 32-bit or ten 16-bit cyclic OUT and IN data.

OUT and IN cyclic data are mapped using ten mapping (pointer) parameters, one for each mapping.

NOTE By default all drive parameters are cast as 32-bit (two 16-bit words) therefore twenty cyclic words gives ten possible drive parameters. Data compression reduces the number of cyclic words required for drive parameters of 16-bit (or less) to 16-bits. Any 32-bit parameters mapped will still require two 16-bit words even with compression turned on.

Table 7.1 IN/OUT cyclical data formats

Pr **15.40** Output cyclical data parameters	Default	2
And	Range	0 to 10
Pr **15.39** Input cyclical data parameters	Access	RW

The method used to map data to and from the MDX-MODBUS module is similar to the method used in the drive for mapping analog and digital I/O. The reference for the source or target parameter is entered in the mapping parameter in the form **MMPP**, where :
MM = menu number of the target/source parameter.
PP = parameter number of the target/source parameter.

Table 7.2 MDX-MODBUS mapping parameters

IN channel	Mapping parameter
0	Pr **15.10**
1	Pr **15.11**
2	Pr **15.12**
3	Pr **15.13**
4	Pr **15.14**
5	Pr **15.15**
6	Pr **15.16**
7	Pr **15.17**
8	Pr **15.18**
9	Pr **15.19**

OUT channel	Mapping parameter
0	Pr **15.20**
1	Pr **15.21**
2	Pr **15.22**
3	Pr **15.23**
4	Pr **15.24**
5	Pr **15.25**
6	Pr **15.26**
7	Pr **15.27**
8	Pr **15.28**
9	Pr **15.29**

NOTE A cyclic data channel does not use decimal points. For example digital speed reference 1 (Pr **1.21**) has units of Rpm, accurate to 2 decimal place. To write a value of 2.46 RPM to Pr **1.21**, the value must be transmitted as 246.

If the number of channels (Pr **15.39** or Pr **15.40**) is set to an invalid value (e.g. Pr **15.39** = 3 and Pr **15.10** = 1040, Pr **15.11** = 201 and Pr **15.12** = 0), the MDX-MODBUS will indicate a configuration error by the mapping status parameter (Pr **15.49**).
Refer to section 10.8 Cyclic parameter number (Mapping status) for more details. The following sections show some example data formats that can be selected, and the parameter mapping that will apply (by default) to each format.

7.2.1 Two cyclic channels only (default - compression off)

This data format provides two cyclic data channels with no non-cyclic data. The total data length is four words OUT and four words IN.
To select this data format, set Pr **15.40** and Pr **15.39** = 2. This data format is selected by default.

Table 7.3 Mapping for four cyclic data words

Cyclic word	Cyclic Data word length on master	Mapping
Out channel 0	2 OUT (Word 0, 1)	Pr **15.20** = 642 Pr **6.42**, Control word
Out channel 1	2 OUT (Word 2, 3)	Pr **15.21** = 121 Pr **1.21**, Digital speed reference 1
In channel 0	2 IN (Word 0, 1)	Pr **15.10** = 1040 Pr **10.40**, Status word
In channel 1	2 IN (Word 2, 3)	Pr **15.11** = 201 Pr **2.01**, Post ramp speed reference

NOTE 1 Modbus register = 1 word = 16 bits.

7.2.2 Three cyclic channels only (compression off)

This data format provides example of three cyclic data channels.
The total data length is six words OUT and six words IN.
To select this data format, set Pr **15.40** and Pr **15.39** = 3.

Table 7.4 Mapping for five cyclic channels

Cyclic word	Cyclic Data word length on master	Mapping
Out channel 0	2 OUT (Word 0, 1)	Pr **15.20** = 642 Pr **6.42**, Control word
Out channel 1	2 OUT (Word 2, 3)	Pr **15.21** = 121 Pr **1.21**, Digital speed reference 1
Out channel 2	2 OUT (Word 3, 4)	Pr **15.22** = 211 Pr **2.11**, Ramp
In channel 0	2 IN (Word 0, 1)	Pr **15.10** = 1040 Pr **10.40**, Status word
In channel 1	2 IN (Word 2, 3)	Pr **15.11** = 201 Pr **2.01**, Post ramp speed reference
In channel 2	2 IN (Word 3, 4)	Pr **15.12** = 402 Pr **4.02**, Current

7.2.3 Three cyclic channels only (compression on)

This data format provides example of three cyclic data channels with compression on (Pr **15.34** = ENABLED).
The total data length is four words OUT and five words IN.
To select this data format, set Pr **15.40** and Pr **15.39** = 3.

Table 7.5 Mapping for five cyclic channels

Cyclic word	Cyclic Data word length on master	Mapping
Out channel 0	1 OUT (Word 0)	Pr **15.20** = 642 Pr **6.42**, Control word
Out channel 1	2 OUT (Word 1, 2)	Pr **15.21** =121 Pr **1.21**, Digital speed reference 1
Out channel 2	1 OUT (Word 3)	Pr **15.22** = 211 Pr **2.11**, Ramp
In channel 0	1 IN (Word 0)	Pr **15.10** = 1040 Pr **10.40**, Status word
In channel 1	2 IN (Word 1, 2)	Pr **15.11** = 201 Pr **2.01**, Post ramp speed reference
In channel 2	2 IN (Word 3, 4)	Pr **15.12** = 402 Pr **4.02**, Current

7.3 Mapping conflicts

The Drive indicate if there is a mapping conflict like other MDX-MODBUS cyclic OUT channels, analog inputs or other.

7.4 Cyclic data mapping errors

The MDX-MODBUS module will scan and check the Modbus mapping parameter configuration for errors during initialisation (ex. Pr **15.32** = ENABLED). If an error is detected, then the MDX-MODBUS configuration error detected will be indicated in mapping status parameter, Pr **15.49**.
See section 10.8 Cyclic parameter number (Mapping status) for full details.

7.5 Mapping data sizes

The data size depends on the size of the mapped parameter and if data compression is turned on or not (see Table 7.6).

Table 7.6 Actual data sizes

Parameter size (bits)	Actual data size (bits) Compression enabled (Pr 15.34)	Actual data size (bits) Compression disabled (Pr 15.34)
1	16	32
8	16	32
16	16	32
32	32	32

Consider the following example :

- Mapping Pr **15.10** to a 32-bit value and Pr **15.11** to a 16-bit value.
- Mapping Pr **15.20** to a 32-bit value and Pr **15.21** to a 1-bit value.
- Data compression turned on (Pr **15.34** set to ENABLED).
- The mapping length is 2 (Pr **15.39** and Pr **15.40**).

Pr **15.38** and Pr **15.41** settings are then automatically modified:

- Pr **15.38** = 6 (4 + 2).
- Pr **15.41** = 6 (4 + 2).

Pr **15.38** and Pr **15.41** allow to know the number of data bytes for input and output mapping.

Input cyclical data bytes

Pr **15.38**	**Default**	8
	Range	1 to 127
	Access	RO

Output cyclical data bytes

Pr **15.41**	**Default**	8
	Range	1 to 127
	Access	RO

7.6 Disabling mappings

Any unused mapping parameters (Pr **15.10** to Pr **15.19** and Pr **15.20** to Pr **15.29**) are disabled by the number of parameters in the mapping (Pr **15.39** and Pr **15.40**).

NOTE - Having unmapped channels between valid mapped channels is not permitted.
- Having unmapped channels (mapping to 0) is not permitted if the number of parameters (Pr **15.39** and Pr **15.40**) include this unmapped channel.

7.7 How to read and write cyclic Modbus

MDX-MODBUS supports various Modbus function codes to write and read cyclic. The modbus address for IN and OUT cyclic is dependent of the function used, see table 7.7 for more information.

Table 7.7 Cyclic Modbus address for IN and OUT

Drive mode is in default parameter Pr 15.09 = 2 registers or Pr 15.09 = 1 register	First address for cyclic IN data (Pr 15.10 to Pr 15.19) Master PLC ← Drive	First address for cyclic OUT data (Pr 15.20 to Pr 15.29) Master PLC → Drive	Register Type and Address range
FC1 Read Coils		Modbus address = 000	Coils (0x) 000-FFF cyclic area
FC2 Read Discrete Inputs	Modbus address = 000		Discrete Inputs (1x) 000-FFF cyclic area
FC3 Read holding Registers	Modbus address = 256	Modbus address = 000	Holding Registers (4x) 000 -1FF cyclic area 210 -FFFF non-cyclic area
FC4 Read Input Registers	Modbus address = 000		Input Registers (3x) 000-FFF cyclic area
FC5 Write Single Coil		Modbus address = 000	Coils (0x) 000-FFF cyclic area
FC6 Write Single Register	Modbus address = 256	Modbus address = 000	Holding Registers (4x) 000 -1FF cyclic area 210 -FFFF non-cyclic area
FC15 Write Multiple Coils		Modbus address = 000	Coils (0x) 000-FFF cyclic area
FC16 Write Multiple Registers	Modbus address = 256	Modbus address = 000	Holding Registers (4x) 000 -1FF cyclic area 210 -FFFF non-cyclic area
FC23 Read/Write Multiple Registers	Modbus address = 256	Modbus address = 000	Holding Registers (4x) 000 -1FF cyclic area 210 -FFFF Non-cyclic area

NOTE - Parameter Pr **15.34** (Compression of cyclical data) defines if each parameter takes 1 or 2 words in only cyclic data.
- Parameter Pr **15.09** (Modbus register number by acyclic parameter) defines if each parameter takes 1 or 2 words in only non-cyclic data.

Example with function code FC16:
If drive mode is in default configuration (Pr **15.34** = disabled, Pr **15.20** = 642 and Pr **15.21** = 121), Modbus address 0 allows to write to Pr **6.42** and address 2 to Pr **1.21**.

NOTE With Master PLC, LEROY-SOMER advises to use Function 03 to read and Function 16 to write (these functions are generally used in all PLC).

8 Non-cyclic data (acyclic)

8.1 What is non-cyclic data?

Non-cyclic data allows access to any parameter without the need to use cyclic data transfers. This is particularly useful when accessing many different parameters for setup or archiving of drive settings.

8.2 Modbus register number by acyclic parameter

Modbus register number by acyclic parameter

Pr **15.09**	**Default**	1 (2 registers by parameter)
	Range	0 (1 register by parameter) or 1 (2 registers by parameter)
	Access	RW

This parameter defines if a register takes one or two words in modbus (for read or write non-cyclic).

NOTE If Pr **15.09** = 1 register, it is not possible to access at all parameters 32 bits.

8.3 How to read and write non-cyclic Modbus

MDX-MODBUS supports various Modbus function codes to write and read non-cyclic:

- Function 03 (FC3) Read holding Registers.
- Function 06 (FC6) Write Single Register.
- Function 16 (FC16) Write Multiple Registers.
- Function 23 (FC23) Read/Write Multiple Registers.

The modbus address for read and write non-cyclic is dependent of the parameter Pr **15.09** and if the master manages address -1. See table 8.1 for more information. Menu 0 cannot be used for Modbus address.

Table 8.1 How to define non-Cyclic Modbus address

Drive mode	**Calculate Modbus address**	**Example 1:** - Modbus address for read or write to Pr **1.21** - Master software with no management of address -1 (modbus address = real address)	**Example 2:** - Modbus address for read or write to Pr **1.21** - Master software with management of address -1 (modbus address = real address -1)
Pr **15.09** = 2 registers (drive default parameter)	First address non-cyclic = 0x210 = 528 Address = 528 + [(parameter - 1) *2]	528 + [(121-1)*2] = 768 Modbus address = 768	528 + [(121-1)*2] +1 = 769 Modbus address = 769
Pr **15.09** = 1 register	First address non-cyclic = 0x210 = 528 Address = 528 + parameter -1	528 + 121-1 = 648 Modbus address = 648	528 + 121 = 649 Modbus address = 649

NOTE - Function 06 (FC06) does not work with parameter 32 bits.
- All Functions do not work with 32 bit parameter if length access is less than 32 bits.

NOTE With PLC Master, LEROY-SOMER advises to used Function 03 to read and Function 16 to write (this functions is generally used in all PLC).

NOTE At the first read or write acyclic function and if Cyclic is not used, OUT mapping parameters (see Pr **15.20** to Pr **15.29**) are set to zero.

9 Control and status words

9.1 What are control and status words?

The control and status words allow the digital control and monitoring of the drive to be implemented using a single data word for each function. Each bit in the control word has a particular function and provides a method of controlling the output functions of the drive, such as run and direction.

Each bit in the status word provides feedback about the drive's state of health and operational condition, such as drive healthy, drive at speed, etc...

9.2 Control word

The MDX-MODBUS control word consists of sixteen control bits some of which are reserved. See Table 9.1 for the individual bit function descriptions.

Table 9.1 Control word

Control word bits Pr 6.42	Decimal conversion	Functions	Equivalent parameter
0	1	Drive enable	Pr **6.15**
1	2	Run forward	Pr **6.30**
2	4	Jog	Pr **6.31**
3	8	Run reverse	Pr **6.32**
4	16	Forward/Reverse	Pr **6.33**
5	32	Run	Pr **6.34**
6	64	Reserved	
7	128	Reserved	
8	256	Analog ref./Preset ref.	Pr **1.42**
9	512	Reserved	
10	1024	Reserved	
11	2048	Reserved	
12	4096	Reserved	
13	8192	Drive reset	Pr **10.33**
14	16384	Reserved	

Reserved bits must be kept at 0.

To enable fieldbus control the fieldbus enable signal must be set to '1' (change Pr **6.43** Run/Stop source by FIELDBUS). When for safety reasons, the external HARDWARE ENABLE (STO-1 and STO-2) signal must be present before the fieldbus control word can be used to start the drive. These terminals are normally controlled by an external "Emergency Stop" circuit to ensure that the drive is disabled in an emergency situation.

The control word ANALOG REF/PRESET REF bit directly controls the drive parameter Pr **1.42**, the function of which is to select the digital speed reference as the source of the drive's speed reference. When the ANALOG REF/PRESET REF bit is reset to 0 the drive will revert to using the external analog speed reference.

The actual digital speed reference selected when ANALOG REF/PRESET REF is set to 1 will be Pr **1.21**, which is also the default mapping for the fieldbus speed reference. However Pr **1.15** can be used to change which of the digital references is selected. For further details on the drive digital speed reference, please refer to the appropriate drive user guide.

Table 9.2 lists in detail the function of each control word bit. For further in-depth details about drive control words and sequencing bits please refer to the appropriate drive User and Advanced User Guides.

NOTE By default data compression is off and therefore the control word will be cast as 32-bit with bits 16 to 31 reserved.

Table 9.2 Control word bit functions

Bit	Function	Description
0	ENABLE	Set to 1 to enable the drive. Resetting to 0 will immediately disable the drive, and the motor will coast to a stop. The external HARDWARE ENABLE signal must also be present before the drive can be enabled.
1	RUN FWD	Set to 1 (with ENABLE set to 1) to run the motor in the forward direction. When reset to 0, the drive will decelerate the motor to a controlled stop.
2	JOG FWD	Set to 1 to jog the motor forward. This signal needs to be used in conjunction with the ENABLE bit. This signal is overridden by a RUN, RUN REV or RUN FWD signal.
3	RUN REV	Set to 1 (with ENABLE set to 1) to run the motor in the reverse direction. When reset to 0, the drive will decelerate the motor to a controlled stop.
4	FWD REV	Set to 1 to select the reverse direction. Set to 0 to run in the forward direction. The RUN signal is used to start and stop the motor.
5	RUN	Set to 1 to run the motor. FWD REV is used to select the direction of motor rotation. When reset to 0, the drive will decelerate the motor to a controlled stop.
6	Reserved	
7	Reserved	
8	Analog ref./ Preset ref.	Set to 1 to select digital speed reference 1 (Pr **1.21**), and reset to 0 to select analog reference 1 (Pr **1.36**). ANALOG REF/PRESET REF directly controls Pr **1.42**, so reference selector (Pr **1.14**) and preset selector (Pr **1.15**) must both be set to 0 (default) for the ANALOG REF/PRESET REF bit to work properly.
9	Reserved	
10	Reserved	
11	Reserved	
12	Reserved	
13	Drive reset	A 0-1 transition of the RESET bit will reset the drive from a trip condition. If the reason for the trip is still present, or another fault condition has been detected, the drive will immediately trip again. When resetting the drive, it is recommended to check the status word to ensure that the reset was successful, before attempting to re-start the drive.
14	Reserved	
15	Reserved	

9.3 Status word

The MDX-MODBUS status word consists of sixteen control bits some of which are reserved. See Table 9.3 for the individual bit function descriptions.

Table 9.3 Status word

Status word bits Pr 10.40	Decimal conversion	Functions	Equivalent parameter
0	1	Drive healthy	Pr **10.01**
1	2	Drive active	Pr **10.02**
2	4	Zero speed	Pr **10.03**
3	8	Running at minimum speed	Pr **10.04**
4	16	Below set speed	Pr **10.05**
5	32	At speed	Pr **10.06**
6	64	Above set speed	Pr **10.07**
7	128	Nominal load reached	Pr **10.08**
8	256	Drive out at current limit	Pr **10.09**
9	512	Drive regenerating	Pr **10.10**
10	1024	Braking IGBT active	Pr **10.11**
11	2048	Braking resistor alarm	Pr **10.12**
12	4096	Direction commanded	Pr **10.13**
13	8192	Direction running	Pr **10.14**
14	16384	Mains loss	Pr **10.15**
15	32768	Reserved	

The fieldbus status word is mapped directly from the drive status word, Pr **10.40**.
Pr **10.40** is generated by the values of several individual drive status bits.
Table 9.4 shows the function indicated by each bit in the status word when set to 1.

Table 9.4 Drive status word bit functions

Bit	Parameter	Description
0	Pr **10.01**	**bit 0 = 0 :** Drive in stop mode. **bit 0 = 1 :** Drive in ready state.
1	Pr **10.02**	**Drive active** When bit 1 = 1, the drive is in run mode.
2	Pr **10.03**	**Zero speed** Zero speed indicates that the absolute value of the speed is at or below the zero speed threshold defined by Pr **3.05**.
3	Pr **10.04**	**Running at or below minimum speed** In bipolar mode (Pr **1.10** = 1) Pr **10.04** is the same as zero speed, Pr **10.03**. (See above). In unipolar mode, Pr **10.04** is set if the absolute value of the post-ramp speed reference (Pr **2.01**) is at or below minimum speed (minimum speed is defined by Pr **1.07**.) This parameter is only set if the drive is running.
4	Pr **10.05**	**Below set speed** Only set if the drive is running at below set speed. Refer to Pr **3.06** in the drive User Guide for more details.
5	Pr **10.06**	**At speed** Only set if the drive is running at set speed. Refer to Pr **3.06**, Pr **3.07** and Pr **3.09** in the drive user guide.
6	Pr **10.07**	**Above set speed** Only set if the drive is running at above set speed. Refer to Pr **3.06** in the drive user guide for more details.
7	Pr **10.08**	**Nominal load reached** Indicates that the modulus of the active current is greater or equal to the rated active current, as defined in menu 4. Refer to the drive Advanced User Guide for more details.
8	Pr **10.09**	**Drive out at current limit** Indicates that the current limits are active.
9	Pr **10.10**	**Drive regenerating** This parameter is set to ENABLED (1) when the power is being transferred from the motor to the DC Bus.
10	Pr **10.11**	**Braking IGBT active** Indicates that the braking IGBT is active. If the IGBT becomes active, this parameter will remain on for at least one second.
11	Pr **10.12**	**Braking resistor alarm** Dynamic brake alarm is set when the braking IGBT is active, and the braking energy accumulator is greater than 75%.
12	Pr **10.13**	**Direction commanded** Direction commanded is set to 1 if the Pre-ramp speed reference (Pr **1.03**) is negative and reset to 0 if the Pre-ramp speed reference is zero or positive.
13	Pr **10.14**	**Direction running** A 0 indicates forward direction and a 1 indicates reverse direction. The source of this bit is Pr **2.01**.
14	Pr **10.15**	**Mains loss** Mains loss indicates that the drive has detected a mains loss from the level of the DC bus voltage. This parameter can only become active if mains loss ride through or mains loss stop modes are selected. Refer to Pr **6.03** in the drive Advanced User Guide for more details.
15	Not Used	Reserved

10 Diagnostics

This section of the manual provides basic diagnostic information intended to enable resolution of the most common problems encountered when setting up a MDX-MODBUS module on a RS485 network.
A high percentage of problems reported are basic setup problems that can be avoided by using the following pages. If after that you are still experiencing problems please contact your supplier or local drive supplier for support.

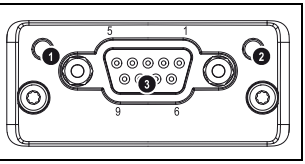
NOTE Please note that support will be limited to the setting up and networking of the drive and not network infrastructure design.

10.1 LED diagnostics

The MDX-MODBUS module is equipped with 2 LEDs on the front panel to aid in the diagnostics procedure. The functions of these LEDs are described in Table 10.1 LED functionality below.

Table 10.1 LED functionality

#	Item
1	Communication LED
2	Device status LED
3	Modbus interface



Communication LED (LED on the left)

LED State	Description
Off	No power or no traffic.
Yellow	Frame reception or transmission.
Red	A fatal error has occurred.

Device status LED (LED on the right)

LED State	Description
Off	initialising or no power.
Green	Module initialised, no error.
Red	Internal error or major unrecoverable fault.
Red single flash	Communication fault or configuration error Case 1: Invalid settings in network configuration object. Case 2: Settings in network configuration object has been changed during runtime (i.e. the settings does not match the currently used configuration).
Red double flash	Application diagnostics available.

10.2 Module ID code

Module ID code

Pr **15.01**	**Default**	69
	Range	0 to 499
	Access	RO

The module ID code indicates the type of module fitted in to the drive corresponding to menu 15. The module ID code for MDX-MODBUS is 69.

10.3 Module firmware version

Firmware - major version (xx.yy)

Pr **15.02**	**Default**	N/A
	Range	00.00 to 99.99
	Access	RO

Firmware - minor version (zz)

Pr **15.51**	**Default**	N/A
	Range	0 to 99
	Access	RO

The software version of the option module can be identified by looking at Pr **15.02** and Pr **15.51**.

The software version takes the form of xx.yy.zz, where Pr **15.02** displays xx.yy and Pr **15.51** displays zz (e.g. for software version 01.01.00, Pr **15.02** will display 1.01 and Pr **15.51** will display 0).

10.4 Node address

Each node on a Modbus network must be given a unique network node address. The MDX-MODBUS must be re-initialised to make a change of node address active. See section 5.4 node address for more information. By default node address parameter Pr **15.03** =1.

10.5 MDX-MODBUS baud rate

All nodes on Modbus/RTU must be configured to run at the same data rate.
The range of data rates available is shown in the table below.

Modbus data rate

Pr **15.04**	**Default**	6 (57600)
	Range	0 to 8
	Access	RW

Table 10.2 Data rate

Parameter value	LCD display (baud rate)
0	1200
1	2400
2	4800
3	9600
4	19200
5	38400
6	57600
7	76800
8	115200

10.6 Modbus Parity type and number of stops

Parity type, number of stops

Pr **15.05**	**Default**	0 (No parity, 2 stop bit 0)
	Range	0 to 3
	Access	RW

Table 10.3 Parity type, number of stops

Parameter value	LCD display (baud rate)
0	No parity, 2 stop bit 0
1	No parity, 1 stop bit 1
2	Even parity, 1 stop bit 2
3	Odd parity, 1 stop bit 3

10.7 Data format

The default data format is 2 cyclic channel OUT and IN, each cyclic data channel is mapped to a drive parameter. See section 7 cyclic data and 8 non cyclic data for more information.

NOTE The maximum number of parameter data that is possible is 10 with only cyclic data.

10.8 Fieldbus option state

Fieldbus option state

Pr **15.06**	**Default**	N/A
	Range	0 to 14
	Access	RO

The operating status of the MDX-MODBUS can be viewed in the fieldbus option state parameter (Pr **15.06**). When the MDX-MODBUS is communicating successfully with the master controller, Pr **15.06** will give Master read.

Table 10.4 MDX-MODBUS operating status codes

Pr 15.06	LCD display	Description
0	Setup in progress	MDX-MODBUS setup in progress.
1	Network init	The module is currently performing network-related initialisation tasks. Telegrams now contain Process Data (if such data is mapped), however the network Process Data channel is not yet active.
2	Network Process Data inactive	The network Process Data channel is temporarily inactive, wait cyclic.
3	IDLE	The network interface is idle. The exact interpretation of this state is network specific. Depending on the network type, the Read Process Data may be either updated or static (unchanged).
4	Process active	The network Process Data channel is active and error free.
5	Bus error	There is at least one serious network error.
6	Wait web update	Wait a few minutes until Data base of the new drive version is loaded in MDX option.
7	Host error	The module has ceased all network participation due to a host application-related error. This state is unrecoverable, i.e. the module must be restarted in order to be able to exchange network data.
8	Option bus loss	Communication between MDX option and drive lost.
9	reserved	
10	reserved	
11	reserved	
12	Host supervising	Module is supervised by another network device. Perform normal data handing.
13	reserved	
14	reserved	

If a mapping configuration error or network error is detected the drive may trip. Refer to Section 10.9 Cyclic parameter number (mapping status) for details about the trip display.

10.9 Cyclic (mapping status)

Mapping status

Pr **15.49**	**Default**	N/A
	Range	0 to 2
	Access	RO

The MDX-MODBUS mapping status parameter, Pr **15.49** indicates a mapping configuration error. When a mapping error has been corrected, re-initialise the MDX-MODBUS by setting Pr **15.32** to ON (1).
The mapping error codes are described in Table 10.5.

Table 10.5 Mapping error code

Pr 15.49	LCD display	Description
0	I/O good	Mapping channel is good
1	Input bad	IN Mapping channel is faulty (Pr **15.10** to Pr **15.19**)
2	Out bad	OUT Mapping channel is faulty (Pr **15.20** to Pr **15.29**)

10.10 Drive trip display codes

If the MDX-MODBUS detects an error during operation, it will force a trip on the Drive. However, the trip code displayed on the drive will only indicates that MDX option is in fault. The exact reason for the trip will be indicated in the MDX-MODBUS error code parameter, Pr **15.50**.

Table 10.6 shows the possible trip codes that will be displayed on the drive when a problem is detected with the MDX-MODBUS or when the MDX-MODBUS initiates a trip.

10.11 Fieldbus trip

Fieldbus trip

Pr **15.50**	**Default**	N/A
	Range	0 to 2
	Access	RO

If the MDX-MODBUS detects an error during operation, it will force a trip on the drive and update the error code parameter, Pr **15.50**. Table 10.6 shows the possible MDX-MODBUS error codes.

Table 10.6 MDX-MODBUS error codes

Error code	Fault display on LCD	Description
0	No error code	Indicates that the MDX-MODBUS module is healthy. It is possible to trip the drive externally via various communication channels.
1	bus loss	No new messages have been received for the specified network loss trip time.
2	Option loss	An inter-option communications time-out has occurred, but MDX-MODBUS is unable to determine the reason for the error.

10.12 Module serial number

Module serial number

Pr **15.35**	**Default**	N/A
	Range	32 bit
	Access	RO

The serial number is loaded into the MDX-MODBUS during manufacture and cannot be changed. It contains the ten digit serial number on the label.

11 Advanced features

11.1 Data bytes order

Data bytes order

Pr **15.08**	**Default**	0 (LSB first)
	Range	0 to 1
	Access	RW

When data is sent over the Modbus RS485 network it is transmitted as 8-bit bytes. Therefore when a 32-bit word or 16-bit word is transmitted it is split into four or two 8-bit bytes. It is important that the receiving node reconstructs the received 8-bit bytes in the correct order to arrive at the 32-bit or 16-bit data value that was originally transmitted, this order is known as the Data Endian Format and is shown in Table 11.1.

Table 11.1 Data endian format

Data endian format	Pr 15.08	16-bit value	32-bit value	
		Byte order	Word order	Byte order
Big	1 (MSB first)	High byte first Low byte second	High word first Low word second	High byte first Mid-high byte second Mid-low byte third Low byte fourth
Little	0 (LSB first)	Low byte first High byte second	Low word first High word second	Low byte first Mid-low byte second Mid-high byte third High byte fourth

Most Modbus RS485 master controllers use little endian format by default, many also support big endian.

11.2 Compression of cyclical data

Compression of cyclic data enable

Pr **15.34**	**Default**	0 (disable)
	Range	0 to 1
	Access	RW

By default, the MDX-MODBUS uses 32-bits for each data channel, even if the target parameter in the drive is a 16-bit, 8 bit or 1 bit parameter. This strategy (known as casting) ensures that the cyclic data transmitted over the Modbus RS485 network is kept aligned with memory locations in 32-bit PLCs. When cyclic data compression is enabled (Pr **15.34** = ENABLED) a data channel will only use 32-bits if the target drive parameter is a 32-bit parameter. If the target drive parameter is 1 to16-bits wide 16-bits will be used. This is shown in Table 11.2.

Table 11.2 Actual data sizes

Parameter size (bits)	Actual data size (bits) Compression enable (Pr 15.34)	Actual data size (bits) Compression disabled (Pr 15.34)
1	16	32
8	16	32
16	16	32
32	32	32

The following examples demonstrate setting up a network using five cyclic channels for both IN and OUT data with the cyclic data compression first disabled and then enabled.

Table 11.3 shows the mapping parameters where five OUT and five IN cyclic data channels are required. With data compression disabled each data channel uses 32-bits (two data words, so a total of ten words (20 bytes) are required, Pr **15.41** = 20, Pr **15.39** = 20).

Table 11.3 Example cyclic data channel mapping with compression disabled

Cyclic word	Data word configuration on master	Mapping
Out channel 0	2 OUT (Word 0,1)	Pr **6.42**, Control word
Out channel 1	2 OUT (Word 2,3)	Pr **1.21**, Digital speed reference 1
Out channel 2	2 OUT (Word 4,5)	Pr **2.11**, Ramp
Out channel 3	2 OUT (Word 6,7)	Pr **4.07**, Symmetrical Current Limit
Out channel 4	2 OUT (Word 8,9)	Pr **4.10**, Torque Offset Selection
In channel 0	2 IN (Word 0,1)	Pr **10.40**, Status word
In channel 1	2 IN (Word 2,3)	Pr **2.01**, Post ramp speed reference
In channel 2	2 IN (Word 4,5)	Pr **4.02**, Current
In channel 3	2 IN (Word 6,7)	Pr **10.16**, DC Bus undervoltage
In channel 4	2 IN (Word 8,9)	Pr **10.17**, Motor overload alarm

It is advisable to keep 16-bit parameters paired together. This prevents mis-alignment of cyclic data with 32-bit PLC registers when using auto-mapping facilities to configure the Modbus RS485 network. By swapping the mappings for output channel 1 with output channel 2 and moving input channel 3 and 4 to input channel 1and 2, the data channel structure will appear as shown in Table 11.4.

Table 11.4 Example cyclic data channel mapping with compression enabled

Cyclic word	Data word configuration on master	Mapping
Out channel 0	1 OUT (Word 0)	Pr **6.42**, Control word
Out channel 1	1 OUT (Word 1)	Pr **2.11**, Ramp
Out channel 2	2 OUT (Word 2,3)	Pr **1.21**, Digital speed reference 1
Out channel 3	1 OUT (Word 4)	Pr **4.07**, Symmetrical Current Limit
Out channel 4	1 OUT (Word 5)	Pr **4.10**, Torque Offset Selection
In channel 0	1 IN (Word 0)	Pr **10.40**, Status word
In channel 1	1 IN (Word 1)	Pr **10.16**, DC Bus undervoltage
In channel 3	2 IN (Word 2,3)	Pr **2.01**, Post ramp speed reference
In channel 4	2 IN (Word 4,5)	Pr **4.02**, Current
In channel 2	1 IN (Word 6)	Pr **10.17**, Motor overload alarm

11.3 Restore defaults

Restore defaults

Pr **15.30**	**Default**	0 (DISABLED)
	Range	0 to 1
	Access	RW

If the host drive is defaulted (see the drive user guide for details) it will also clear the current configuration of the fitted MDX-MODBUS. Setting Pr **15.30** to 1 additionally clears the backup copy of the MDX-MODBUS configuration stored.
This can be performed as follows:

- Set Pr **15.30** to 1 (ENABLED).
- Modbus RS485 communications will be stopped.
- The host drive will load and store its default parameter values.
- Default parameter values for the MDX-MODBUS will be loaded.
- The MDX-MODBUS will reset and re-initialise using the default values.

11.4 Disable full write access with acyclic

Disable full write access

Pr **15.36**	**Default**	0 (Read, Write)
	Range	0 to 1
	Access	RW

This parameter will restrict a remote user's access to the drive. Pr **15.36** = read only ensures that write access to the drive is disabled. Pr **15.36** = read write allows full access to the drive parameters. With this parameter enabled access with acyclic is not allowed.

11.5 Supported Modbus function codes

Table 11.5 below details the supported Modbus function codes on MDX-MODBUS.

Table 11.5 Supported function codes

Code	Description
FC1	Read Coils
FC2	Read Discrete Inputs
FC3	Read holding Registers
FC4	Read Input Registers
FC5	Write Single Coil
FC6	Write Single Register
FC15	Write Multiple Coils
FC16	Write Multiple Registers
FC23	Read/Write Multiple Registers

11.6 Network loss trip

The network loss trip provides a method on the drive to ensure that communication with the master is still present. The MDX-MODBUS resets an internal timer when a valid message is received from the RS485 Modbus network, if a message is not received within the specified period in ms, the network loss trip is triggered. If the trip is generated by MDX-MODBUS, the trip displays on the drive will be 'TR 34". The MDX-MODBUS error code parameter (Pr **15.50**) will show "Fieldbus loss" when a network loss trip has occurred.

Network loss trip timeout

Pr **15.07**	**Default**	1000
	Range	0 to 10000
	Access	RW

The network loss trip can be disabled by setting Pr **15.07** to 0. In this case, the drive will continue to operate using the last received values. It is the user's responsibility to ensure that adequate safety precautions are taken to prevent damage or injury by disabling the drive in the event of a loss of communications.

12 Quick reference

12.1 Complete parameter reference

Table 12.1 lists all the MDX-MODBUS set-up parameters that are required to configure the module.

Table 12.1 MDX-MODBUS parameter reference

Parameter	Default	Cross reference	Description
Pr **15.01**	128	Page 27	Plugged option ID code
Pr **15.02**	----	Page 28	Module software version (XX,YY)
Pr **15.03**	1	Page 13	Node address
Pr **15.04**	0 (57600)	Page 28	MDX-MODBUS baud rate
Pr **15.05**	0 (No parity, 2 stop bit 0)	Page 13	Parity type, number of stop
Pr **15.06**	---	Page 29	Fieldbus option state
Pr **15.07**	1000	Page 33	Network loss trip timeout in millisecond
Pr **15.08**	0 (LSB first)	Page 31	Data bytes order
Pr **15.09**	1 (2 registers by parameter)	Page 22	Modbus register number by acyclic parameter
Pr **15.10**	1040	Page 18	IN cyclic mapping 0
Pr **15.11**	201	Page 18	IN cyclic mapping 1
Pr **15.12**	0	Page 18	IN cyclic mapping 2
Pr **15.13**	0	Page 18	IN cyclic mapping 3
Pr **15.14**	0	Page 18	IN cyclic mapping 4
Pr **15.15**	0	Page 18	IN cyclic mapping 5
Pr **15.16**	0	Page 18	IN cyclic mapping 6
Pr **15.17**	0	Page 18	IN cyclic mapping 7
Pr **15.18**	0	Page 18	IN cyclic mapping 8
Pr **15.19**	0	Page 18	IN cyclic mapping 9
Pr **15.20**	642	Page 18	OUT cyclic mapping 0
Pr **15.21**	121	Page 18	OUT cyclic mapping 1
Pr **15.22**	0	Page 18	OUT cyclic mapping 2
Pr **15.23**	0	Page 18	OUT cyclic mapping 3
Pr **15.24**	0	Page 18	OUT cyclic mapping 4
Pr **15.25**	0	Page 18	OUT cyclic mapping 5
Pr **15.26**	0	Page 18	OUT cyclic mapping 6
Pr **15.27**	0	Page 18	OUT cyclic mapping 7
Pr **15.28**	0	Page 18	OUT cyclic mapping 8
Pr **15.29**	0	Page 18	OUT cyclic mapping 9
Pr **15.30**	0 (Disabled)	Page 32	Return MDX module to default settings
Pr **15.32**	0 (Disabled)	Page 15	Fieldbus option reset
Pr **15.34**	0 (disabled)	Page 31	Compression of cyclical data
Pr **15.35**	---	Page 30	Serial number
Pr **15.36**	0 (Read write)	Page 33	Disable full write access
Pr **15.38**	8	Page 20	Input cyclical data bytes
Pr **15.39**	2	Page 18	IN cyclic, number of channel (parameter)

Parameter	Default	Cross reference	Description
Pr **15.40**	2	Page 18	OUT cyclic, number of channel (parameter)
Pr **15.41**	8	Page 20	Output cyclical data bytes
Pr **15.49**	---	Page 30	mapping status
Pr **15.50**	0 (No error code)	Page 30	Fieldbus trip
Pr **15.51**	---	Page 28	

13 Glossary of terms

Address: This is the unique network identification given to a networked device to allow communication on a network. When a device sends or receives data the address is used to determine the source and the destination of the message.

Auto-crossover detection: A method used to automatically detect if a crossover or non-crossover network cable is connected.

Bit: A binary digit, this may have the value of 1 or 0.

Byte: A collection of 8 binary digits that collectively store a value. This may be signed or unsigned.

Casting: The process of changing between data sizes without changing the value represented, e.g. changing from 16-bit to 32-bit.

Compression: By default MDX-MODBUS transmits values as 32-bits on the network. It is possible by using data compression to reduce the number of bits transmitted when sending 16-bit (or smaller) values on the network to 16-bit (32-bit values will still be transmitted as 32-bit values). This has the advantage of reducing the volume of traffic on the network.

Control word: A collection of binary digits that are used to control the drive. Features typically include directional controls, run controls and other similar functions.

Data rate: Determines the communication speed of the network, the higher the value the more data can be sent across the network in the same time period.

Device: A piece of equipment connected to a network, this may be any type of equipment including repeaters, hubs, masters or slaves.

Double word: A 32 bit word, this may be signed or unsigned.

Grounding: Describes the electrical safety or shielding connections for the module.

IN data: Data that is returned from a slave device to the RS485 master.

LED: Light Emitting Diode.

Long word: A 32 bit data word that may be signed or unsigned.

LSB: Least Significant Bit/Byte.

Master: The controlling device on the network, generally this will include programming features.

Modbus: A protocol that allows Modbus to be sent over RS485. The modbus protocol allows manipulation of the parameters within the host drive and MDX-MODBUS.

MSB: Most Significant Bit/Byte.

Network Loss Trip: A way to determine when a node has lost contact with the master.

Node: A device on the network. This may be either a device such as a drive or part of the network such as a repeater.

Non-Cyclic Data: Data that is requested or sent by the master as required. This is not sent on a regular basis and generally allows access to any parameter. This is useful for occasional changes or configuration purposes.

Octet: A collection of 8 binary digits which form a byte.

Patch lead: A network cable where the terminal connections at one end of the cable are connected straight through to the other end on a pin to pin basis. Normally used to connect a network device to a network switch.

PC: Personal Computer.

PLC: Programming Logic Controller.

Poll rate: The rate at which cyclic data is sent and received on the network.

Polled data: See Cyclic data.

Shielding: A connection to provide additional immunity to noise used on a network cable.

Status word: A value that denotes the status of the drive. Each bit within the word will have a specific meaning.

Word: A collection of 16 binary digits.

Note

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