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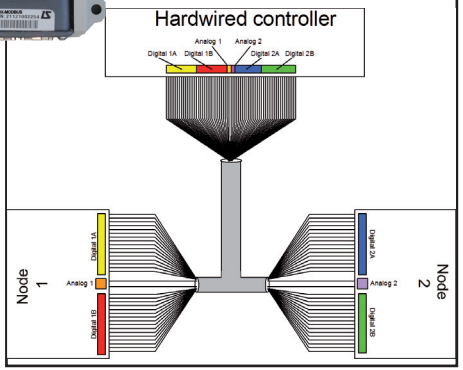
POWERDRIVE MD2

POWERDRIVE FX

This manual is to be given to the end user



MDX-CANopen

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-CANopen 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.

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

Issue Number : 10

Contents

1 Safety and operating instructions for variable speed drives

SAFETY AND OPERATING INSTRUCTIONS FOR VARIABLE SPEED DRIVES

(In accordance with the low voltage directive 2006/95/EC)

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 as well as 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.

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.

Permanent magnet motors generate electrical energy while they are rotating, even when the drive is switched off. In this case, the drive continues to be powered by the motor terminals. If the load is capable of turning the motor, a switching device must be provided upstream of the motor to isolate the drive during maintenance operations.

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 CANopen?

CANopen (Decentralized Peripheral) is a networking system that falls into the generic category of fieldbus. Fieldbuses are generally defined as industrial networking systems that are intended to replace traditional wiring systems. Figure 2-1 shows the traditional cabling requirements to transfer signals a controller and two nodes.

Figure 2-1 Traditional cable layout

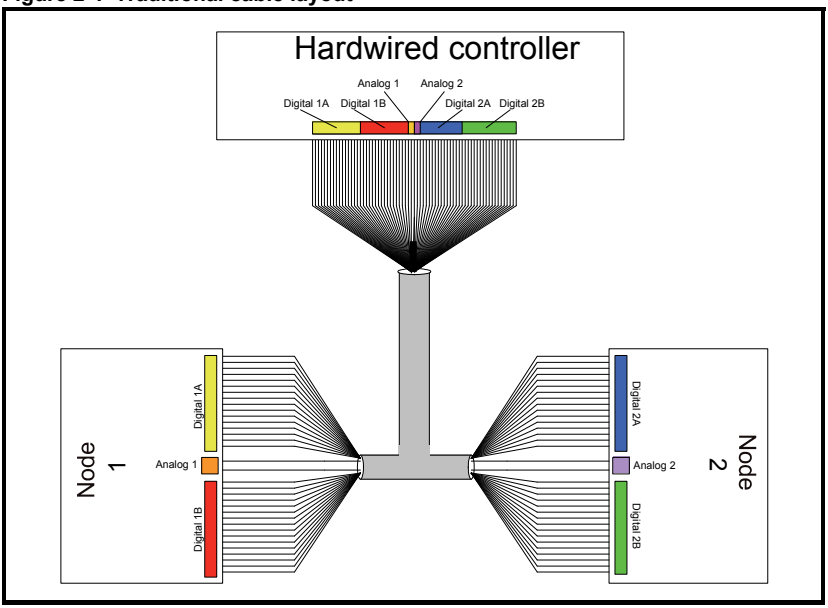


Table 2.1 details how the wiring is used to communicate data between the controller and the nodes. Each signal that is communicated requires one signal wire giving a total of 66 signal wires plus a 0V return.

Table 2.1 Traditional wiring details

Number of signals	Type	Source / Destination	Description
16	digital Inputs	node 1 to controller	status signals
16	digital outputs	controller to node 1	control signals
1	analog output	controller to node 1	control signal
16	digital inputs	node 2 to controller	status signals
16	digital outputs	controller to node 2	control signals
1	analog output	controller to node 2	control signal

A fieldbus topology such as CANopen allows the same configuration to be realized using only two signal wires plus a shield. This method of communication saves significantly on the amount of cabling required and can improve overall system reliability as the number of interconnections is greatly reduced.

Figure 2-2 shows a typical CANopen network system transferring the same signals as given in the traditionally wired example. The signals are now transmitted by converting them into a serial data stream which is received by the master as if they were connected using traditional wiring. The data stream on CANopen allows up to 40 (20 inputs and 20 outputs) independent values to be sent or received by the master, in addition to a single channel allowing for random access to drive parameters.

Figure 2-2 CANopen cable layout

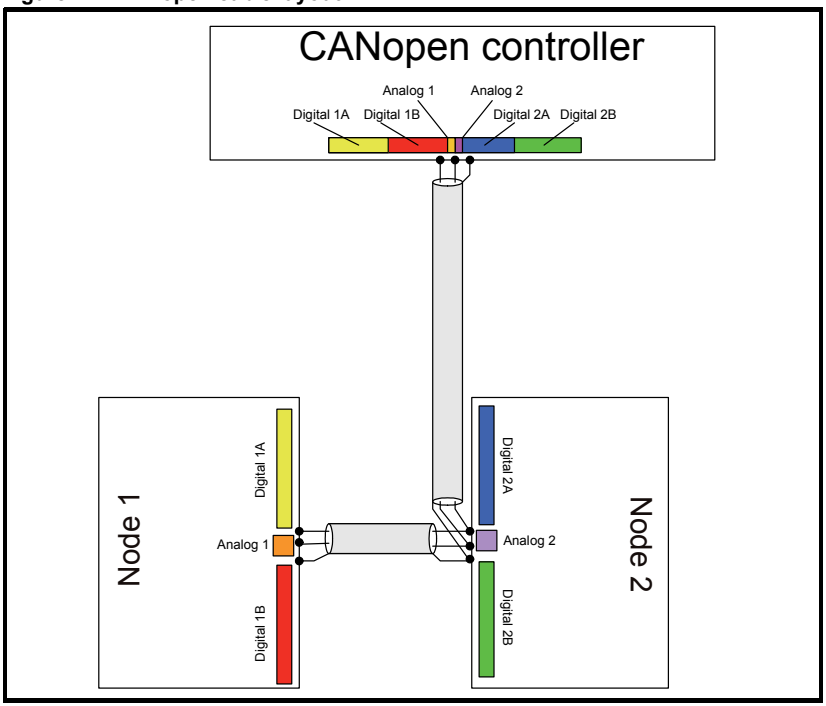


Table 2.2 details the number of data words used to communicate the signals using the CANopen network. It can be seen that the resulting reduction in cabling is significant.

Table 2.2 Data mappings for MDX-CANopen

Number of network words	Type	Source / Destination	Description
1	digital Inputs	node 1 to controller	status signals
1	digital outputs	controller to node 1	control signals
1	analog output	controller to node 1	control signal
1	digital inputs	node 2 to controller	status signals
1	digital outputs	controller to node 2	control signals
1	analog output	controller to node 2	control signal

CANopen can transfer data using two distinct modes. The first of these modes is cyclic where signals are sent in predefined blocks at regular intervals. This is the equivalent of the hard-wired example in Figure 2-1.

The second method of transfer is called non-cyclic data and is used for sending values that only need to be changed occasionally or where the source or destination of the signal changes. This is the equivalent of a temporary patch lead that is removed after use.

2.2 What is MDX-CANopen?

The MDX-CANopen is a fieldbus option module that can be fitted to the expansion slot in the Powerdrive to provide CANopen slave connectivity.

Figure 2-3 MDX-CANopen

2.3 General specification

MDX-CANopen has been designed to offer as much flexibility as possible, in particular the PDO numbering system has been specifically designed to offer maximum versatility while maintaining conformance to CiA specifications.

- Supported data rates (bits/s): 1M, 800k, 500k, 250k, 125k, 100k, 50k, 20k and 10k.
- Automatic baud rate detection.
- 10 transmit and 10 receive PDOs (process data objects) supported.
- Independently configurable transmit and receive PDO numbers (1-31) for maximum application flexibility.
- All synchronous and asynchronous PDO communication modes supported.
- Total of 40 bytes (20 words) in each direction using PDOs (ten TxPDOs of 64 bits and ten RxPDOs of 64 bits).
- Heartbeat protocol supported to guard against loss of communications.
- Consumer heartbeat.
- Emergency message completed flag.
- RxPDO, SYNC and missed heartbeat event handling.
- RxPDO event triggers.
- TxPDO event triggers.

2.4 Option module identification

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

2.5 Backup / Auxiliary Supply

The drive can be connected to a back-up power supply. This keeps the control electronics and option module powered up, allowing the MDX-CANopen to continue communicating with the CANopen master controller when the main supply to the Powerdrive is switched off. For every MDX-CANopen fitted allow for an extra 230mA of supply current to be drawn from the backup supply.

2.6 Conventions used for MDX-CANOPEN

When referring to PDOs (process data objects), a PDO normally refers to both TxPDO (transmit process data object) and RxPDO (receive process data object). Where the differences are important this is quantified using the terms TxPDO and RxPDO.

3 Mechanical installation

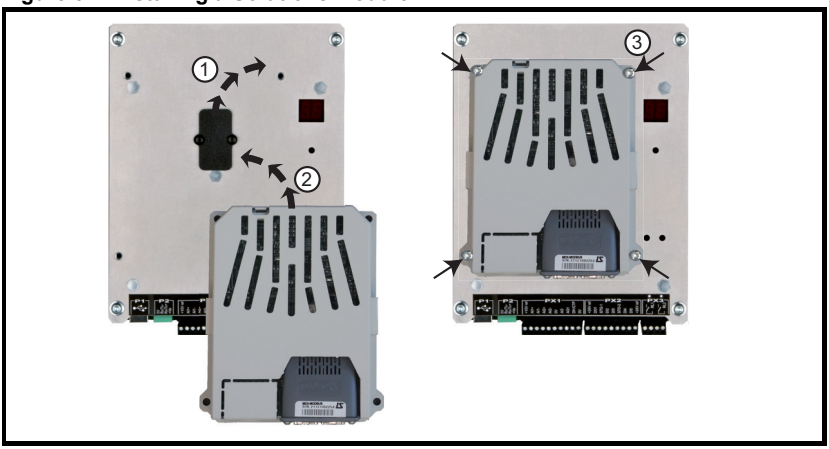
WARNING

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 for variable speed drives* on page 6. 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 Installing a Solutions Module



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.

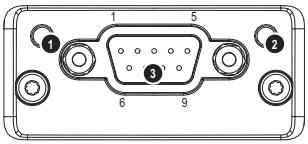
4 Electrical installation

4.1 Terminal descriptions

The MDX-CANopen has a standard 9-way female D-type connector for the CANopen network.

Figure 4-1 MDX-CANopen terminals

#	Item
1	RUN LED[a]
2	ERROR LED[a]
3	CANopen Interface



a. The flash sequences for these LEDs are defined in DR303-3 (CiA).

Figure 4-2 RUN LED signification

LED State	Indication	Description
Off	-	No power.
Green	OPERATIONAL	The module is in the 'operational' state.
Green, blinking	PRE-OPERATIONAL	The module is in the 'pre-operational' state.
Green, single flash	STOPPED	The module is in the 'stopped' state.
Green, flickering	Autobaud	Baudrate detection in progress.
Red[a]	EXCEPTON state (Fatal Event)	The module has shifted into the EXCEPTION state.

a. If both LEDs turns red, this indicates a fatal event; the bus interface is shifted into a physically passive state.

Figure 4-3 ERROR LED signification

LED State	Indication	Description
Off	-	No power - or- device is in working condition.
Red, single flash	Warning limit reached	A bus error counter reached or exceeded its warning level.
Red, flickering	LSS	LSS services in progress.
Red, double flash	Error Control Event	A guard- (NMT-Slave or NMT-master) or heartbeat event (Heartbeat consumer) has occurred.
Red[a]	Bus off (Fatal Event)	Bus off.

a. If both LEDs turns red, this indicates a fatal event; the bus interface is shifted into a physically passive state.

Figure 4-4 CANopen interface

Pin	Signal
1	-
2	CAN_L
3	CAN_GND
4	-
5	CAN_SHIELD
6	
7	CAN_H
8	-
9	-
Housing	CAN_SHIELD

4.2 CANopen cable

CANopen cable has a single twisted pair with overall shielding. CANopen has a specified color code and it is strongly recommended that this is adhered to.

Table 4.1 CANopen color codes

Cable	Data signal	Terminal	Description
Blue	CAN-L	2	Negative data line
Braided shield	Shield	3,5	Cable shield
White	CAN-H	7	Positive data line

CANopen networks run at high data rates and require cable specifically designed to carry high frequency signals. Low quality cable will attenuate the signals, and may render the signal unreadable for the other nodes on the network. Cable specifications and a list of approved manufacturers of cable for use on CANopen networks is available on the CAN In Automation (CiA) CANopen web site at *www.can-cia.de*.

NOTE LEROY-SOMER can only guarantee correct and reliable operation of the MDX-CANopen if all other equipment on the CANopen network (including the network cable) has been approved by the CAN In Automation (CiA) is correctly installed

4.3 Cable network termination

It is very important with CANopen that the network communications cable is installed with the specified termination resistor network at each end of the cable segment. This prevents signals from being reflected back down the cable and causing interference. Termination resistors (120Ω 0.25W) should be connected across the CAN-H and CAN-L lines at BOTH ends of a network segment.

Failure to terminate a network correctly can seriously affect the operation of the network. If the correct termination resistors are not installed, the noise immunity of the network is greatly reduced. If too many termination resistors are installed on a CANopen network, the network will be over-loaded, causing reduced signal levels which will result in potential transmission errors.

4.4 CANopen cable shield connections

It is essential that good grounding is provided not only for network stability but more importantly electrical safety. In all instances electrical regulations should be adhered to. As a guide the network cable should be grounded at least once per cabinet, ideally on each drive.

NOTE The CANopen cable can be tie-wrapped to the grounding bar or a local convenient mounting point that is not live to provide strain relief, but the CANopen cable shield **must** be kept isolated from ground at each node. The only exception to this is the CANopen ground point. Refer to section 4.5 *CANopen ground point.*

4.5 CANopen ground point

The CANopen ground point is the place on a network segment where the cable shield is grounded for electrical safety.

The CANopen cable shield must be grounded AT ONE POINT only, usually near the centre point of the cable run. This is to prevent the cable shield from becoming live in the event of catastrophic failure of another device on the CANopen network. The CANopen ground point is for electrical safety and must not be omitted.

4.6 Maximum network length

The maximum number of nodes that can be connected to a single CANopen network segment is 32. The maximum length of network cable for a CANopen network is dependant on the data rate used see Table 4.2.

Table 4.2 CANopen maximum segment lengths

Data rate (bits/sec)	Maximum network length (m)
1M	30
800k	50
500k	100
250k	250
125k	500
100k	700
50k	1000
20k	2500
10k	5000

4.7 Spurs

LEROY-SOMER do not recommend the use of spurs on a CANopen network. For more detailed information please consult the CiA at www.can-cia.org.

4.8 Minimum node to node cable length

The CANopen specification does not specify a minimum node to node distance, however, LEROY-SOMER advises a minimum distance of 1m (3.3 ft) between nodes to prevent excessive mechanical stress and to reduce network reflections.

5 Getting started

This section is intended to provide a generic guide for setting up MDX-CANopen 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 CANopen 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* on page 34 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-CANopen.
- The drive firmware version (*see the relevant drive user guide*).
- The MDX-CANopen firmware version.

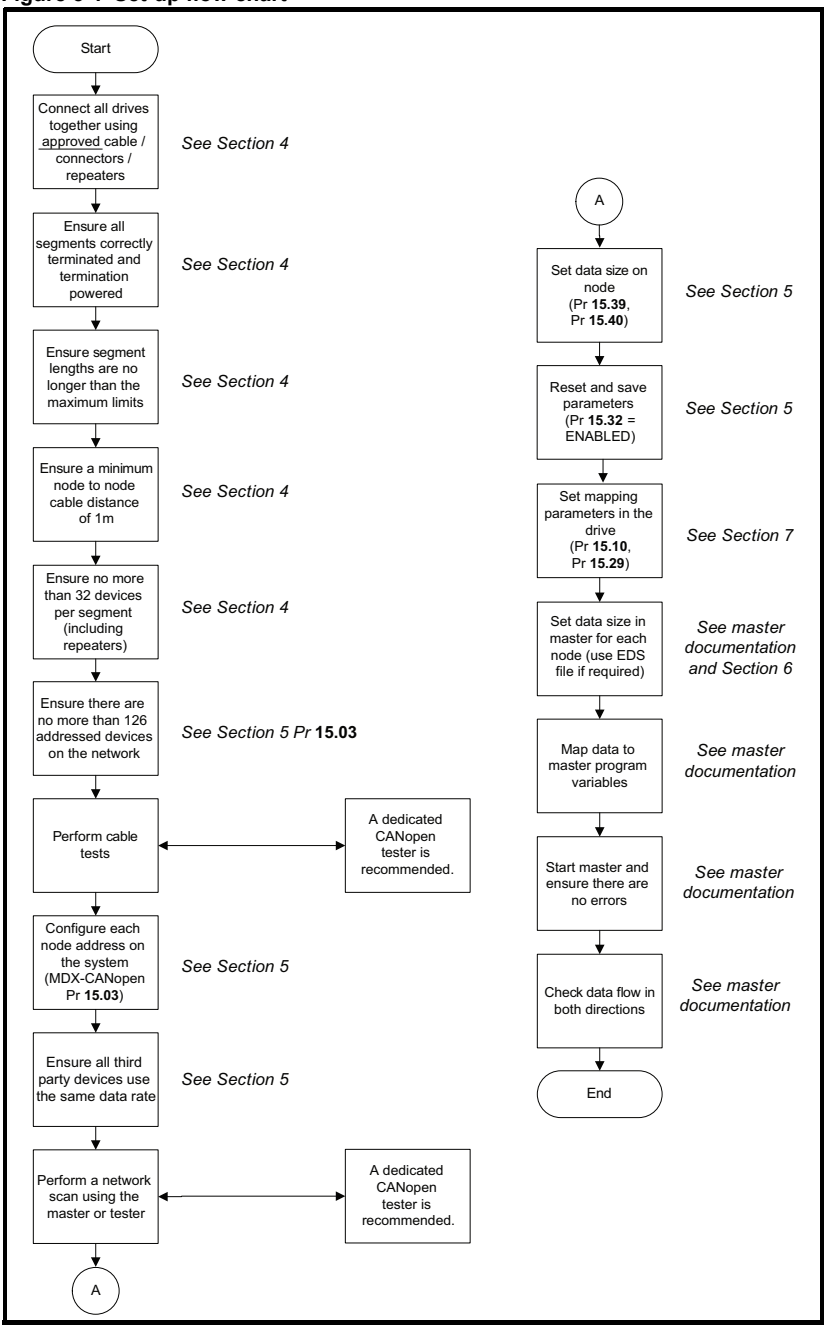
5.1 Conventions used in this guide

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 Module, 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.

5.2 Set-up flow chart

Figure 5-1 Set-up flow chart



5.3 MDX-CANopen node address

Table 5.1 MDX-CANopen node address

Pr **15.03**	**Default**	7
	Range	0 to 125
	Access	RW

Every node on a CANopen network must be given a unique network node address. If two or more nodes are assigned the same node address, network errors may result as 2 nodes attempt to transmit at the same time. The valid range for the node address is 0 to 125, with a default address of 0. MDX-CANopen must be reset to make a change of a node.

5.4 MDX-CANopen data rate

Table 5.2 MDX-CANopen baud rate

Pr **15.04**	**Default**	9 (automatic)
	Range	0 (10k) to 9 (automatic)
	Access	RW

Every node on a CANopen network must be configured to run at the same network data rate. If a node is configured with the wrong data rate, it may cause errors on the CANopen network and eventually trip. MDX-CANopen must be reset to make a change of data rate take effect.

Table 5.3 MDX-CANopen baud rate parameter

Pr 15.04	bits/s
0	10k
1	20k
2	50k
3	100k
4	125k

Pr 15.04	bits/s
5	250k
6	500k
7	800k
8	1M
9	auto

5.5 MDX-CANopen data format

The MDX-CANopen can be configured with up to ten 32-bit or ten cyclic OUT and IN data. OUT and IN cyclic data are mapped using ten mapping (pointer) parameters, one for each mapping.

Each OUT or IN cyclic data take one PDO if configuration by default.

NOTE By default all drive parameters are cast as 32-bits (two 16-bit words). Data compression is possible Chapter 11.2 *Cyclic Data compression* on page 38 and reduces the number of cyclic words required for drive parameters of 16-bits to 16-bits and 8-bits (or less) to 16-bits.

Table 5.4 Read OUT cyclic format, number of data bytes

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

Table 5.5 Write OUT cyclic data format, number of channels (parameter)

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

Table 5.6 Read IN cyclic data format, number of data bytes

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

Table 5.7 Write IN cyclic data format, number of channels (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 5.8.

The method used to map data to and from the MDX-CANopen 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 5.8 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

Each Channel takes 1 PDO (by default).

Table 5.9 PDO address with Pr 15.40=Pr 15.39=10

IN channel	Mapping parameter	PDO
0	Pr 15.10	TxPDO1
1	Pr 15.11	TxPDO2
2	Pr 15.12	TxPDO3
3	Pr 15.13	TxPDO4
4	Pr 15.14	TxPDO5
5	Pr 15.15	TxPDO6
6	Pr 15.16	TxPDO7
7	Pr 15.17	TxPDO8
8	Pr 15.18	TxPDO9
9	Pr 15.19	TxPDO10

OUT channel	Mapping parameter	PDO
0	Pr 15.20	RxPDO1
1	Pr 15.21	RxPDO2
2	Pr 15.22	RxPDO3
3	Pr 15.23	RxPDO4
4	Pr 15.24	RxPDO5
5	Pr 15.25	RxPDO6
6	Pr 15.26	RxPDO7
7	Pr 15.27	RxPDO8
8	Pr 15.28	RxPDO9
9	Pr 15.29	RxPDO10

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 places. To write a value of 1000.50 RPM to Pr **1.21**, the value must be transmitted as 100050.

If the number of channels (Pr **15.39** or Pr **15.40**) is set to an invalid value (e.g. Pr **15.39** has a value of 3 and Pr **15.10** =1040, Pr **15.11**=201 and Pr **15.12**=0) the MDX-CANopen will indicate a configuration error by the mapping status parameter (Pr **15.49**).

Refer to *Chapter 10.5 Cyclic mapping status* on page 36 for more details. These section shows data formats that can be selected, and the parameter mapping that will apply (by default) to each format.

5.6 Network operating status

Table 5.10 Fielbus option state

Pr **15.06**	**Default**	N/A
	Range	0 (set up in progress) to 14 (Reserved)
	Access	RO

The CANopen network activity can be monitored in the MDX-CANopen operating status parameter, Pr **15.06**. When the MDX-CANopen is communicating successfully with the CANopen master controller, Pr **15.06** will give «Host supervising». For further details, see Chapter 10.4 *Fieldbus option state* on page 35.

5.7 Re-initialising the MDX-CANopen

Table 5.11 MDX-CANopen re-initialize

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

Changes to the MDX-CANopen configuration in menu 15 parameters will not take effect until the MDX-CANopen has been re-initialised.

To re-initialise MDX-CANopen :

- Set Pr **15.32** to ENABLED.
- When the sequence has been completed, Pr **15.32** will be reset to DISABLED.
- The MDX-CANopen will re-initialise using the updated configuration.

5.8 Default COB-IDs

Default COB-IDs are assigned to RxPDO, TxPDO and SDO transfers these in accordance with CiA Draft Standard 301 Version 4.1 and are shown below.

Table 5.12 Default COB-ID PDO

• RPDO default COB ID's

RPDO no.	Default COB ID	Default Transmission Type	Description
1	200h+Node ID	254	Default enabled to DS301
2	300h+Node ID		
3	400h+Node ID		
4	500h+Node ID		
5...32	8000 06E0h		Default Disabled

• TPDO default COB ID's

RPDO no.	Default COB ID	Default Transmission Type	Description
1	180h+Node ID	254	Default enabled to DS301
2	280h+Node ID		
3	380h+Node ID		
4	480h+Node ID		
5...32	8000 06E0h		Default Disabled

Table 5.13 Default COB ID SDO

SDO (tx)	0x580 + node address
SDO (rx)	0x600 + node address

5.9 Saving parameters

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

If parameters are changed by CANopen :

To avoid loss of the configured settings when the drive is powered down it is necessary to write 0 to Pr **11.65** followed by Pr **11.64** to Yes (1).

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 the MDX-CANopen will not be affected. Any changes made to the MDX-CANopen configuration parameters (mapping etc.) will not take effect until the MDX-CANopen module is reset.

6 EDS files

6.1 What are EDS files?

An EDS (Electronic Data Sheet) file is an ASCII text file, which can be opened, edited, and saved in a simple text editor such as Microsoft Notepad. Before altering an EDS file ensure you have saved a copy of the original file. To maintain good backup practice it is recommended that you rename a copy of the file you wish to edit in the following format:

OriginalName_YourCompanyName_RevisionNumber.EDS

EDS files are used by some CANopen network configuration tools. They contain information about the objects supported by the drive. EDS files are normally only used during network configuration (some CANopen master controllers do not use EDS files at all).

NOTE Some specific EDS files exist according to the manufacturer. For further information, please contact Leroy-Somer.

7 Cyclic data

7.1 What is a “Process Data Object”?

Cyclic data is implemented on CANopen networks by using “Process Data Objects” or PDOs. Separate data objects are used for transmitting (TxPDOs) and receiving (RxPDOs) data. PDO configuration objects are usually pre-configured in the CANopen master controller and downloaded to the MDX-CANopen at network initialisation using SDOs.

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-CANopen.
- The maximum number of 8-bit mappings parameters that is possible is: 10 (10 bytes if cyclic data compression is on and 20 words if cyclic data compression is off).
- The maximum number of 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 *Chapter 11.2 Cyclic Data compression* on page 38 for information on using data compression with 8 or 16-bit parameters.

7.2 Data formats

The MDX-CANopen can be configured with up to ten 32-bit, ten 16-bit or ten 8-bit cyclic OUT and IN data words. OUT and IN cyclic data words 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 give ten possible drive parameters. Data compression reduces the number of cyclic words required for drive parameters of 16-bit to 16-bits and 8-bit (or less) to 8-bits.

Any 32-bit parameters mapped will still require two 16-bit words even with compression turned on.

Table 7.1 Valid CANopen data formats

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

The method used to map data to and from the CANopen network 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-CANopen mapping parameters (Pr **15.40 and** Pr **13.39=10)**

OUT channel	Mapping parameter	Mapping address(*)	RxPDOs
0	Pr **15.20**	2001	**RxPDO1**
1	Pr **15.21**	2002	**RxPDO2**
2	Pr **15.22**	2003	**RxPDO3**
3	Pr **15.23**	2004	**RxPDO4**
4	Pr **15.24**	2005	**RxPDO5**
5	Pr **15.25**	2006	**RxPDO6**
6	Pr **15.26**	2007	**RxPDO7**
7	Pr **15.27**	2008	**RxPDO8**
8	Pr **15.28**	2009	**RxPDO9**
9	Pr **15.29**	200A	**RxPDO10**

IN channel	Mapping parameter	Mapping address(*)	TxPDOs
0	Pr **15.10**	200B	**TxPDO1**
1	Pr **15.11**	200C	**TxPDO2**
2	Pr **15.12**	200D	**TxPDO3**
3	Pr **15.13**	200E	**TxPDO4**
4	Pr **15.14**	200F	**TxPDO5**
5	Pr **15.15**	2010	**TxPDO6**
6	Pr **15.16**	2011	**TxPDO7**
7	Pr **15.17**	2012	**TxPDO8**
8	Pr **15.18**	2013	**TxPDO9**
9	Pr **15.19**	2014	**TxPDO10**

(*): This mapping address is assigned according to the length configured in Pr **15.39** and Pr **15.40.**

Table 7.3 MDX-CANopen mapping parameters by default (Pr 15.40, Pr 15.39=2)

OUT channel	Mapping parameter	Mapping address	RxPDOs
0	**Pr 15.20**	**2001**	**RxPDO1**
1	**Pr 15.21**	**2002**	**RxPDO2**

IN channel	Mapping parameter	Mapping address	TxPDOs
0	**Pr 15.10**	**2003**	**TxPDO1**
1	**Pr 15.11**	**2004**	**TxPDO2**

(*): This mapping address is assigned according to the length configured in Pr **15.39** and Pr **15.40**.

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 places. To write a value of 1000.50 RPM to Pr **1.21**, the value must be transmitted as 100050.

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-CANopen will indicate a configuration error by the mapping status parameter (Pr **15.49**).

Refer to Chapter 10.5 *Cyclic mapping status* on page 36 for more details. The following sections show examples of 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 7.4 Mapping for four cyclic data words

Cyclic word	Data word configuration on master	Parameter	Mapping	Mapping address (*)
Out channel 0	2 OUT (Word 0, 1)	Pr **15.20**	Pr **6.42** Control word	2001
Out channel 1	2 OUT (Word 2, 3)	Pr **15.21**	Pr **1.21** Digital speed reference 1	2002
In channel 0	2 IN (Word 0, 1)	Pr **15.10**	Pr **10.40** Status word	2003
In channel 1	2 IN (Word 2, 3)	Pr **15.11**	Pr **2.01** Post ramp speed reference	2004

(*): This mapping address is assigned according to the length configured in Pr **15.39** and Pr **15.40**

7.2.2 Three cyclic channels only (default - 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 7.5 Mapping for three cyclic channels

Cyclic word	Data word configuration on master	Parameter	Mapping	Mapping address (*)
Out channel 0	2 OUT (Word 0, 1)	Pr **15.20**	Pr **6.42**, Control word	2001
Out channel 1	2 OUT (Word 2, 3)	Pr **15.21**	Pr **1.21**, Digital speed reference 1	2002
Out channel 2	2 OUT (Word 3, 4)	Pr **15.22**	Pr **2.11** Ramp	2003
In channel 0	2 IN (Word 0, 1)	Pr **15.10**	Pr **10.40** status word	2004
In channel 1	2 IN (Word 2, 3)	Pr **15.11**	Pr **2.01** Post ramp speed reference	2005
In channel 2	2 IN (Word 3, 4)	Pr **15.12**	Pr **4.02** Current	2006

(*): This mapping address is assigned according to the length configured in Pr **15.39** and Pr **15.40**.

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.

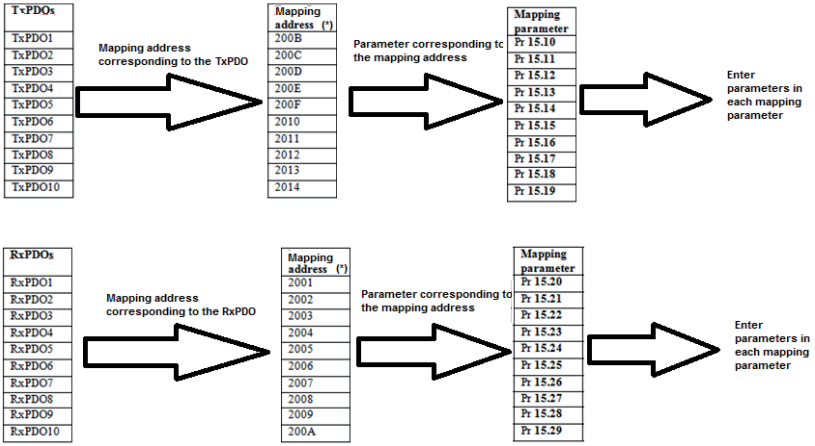
Table 7.6 Mapping for three cyclic channels

Cyclic word	Data word configuration on master	Parameter	Mapping	Mapping address (*)
Out channel 0	1 OUT (Word 0)	Pr **15.20**	Pr **6.42**, Control word	2001
Out channel 1	2 OUT (Word 1, 2)	Pr **15.21**	Pr **1.21**, Digital speed reference 1	2002
Out channel 2	1 OUT (Word 3)	Pr **15.22**	Pr **2,11,** Ramp	2003
In channel 0	1 IN (Word 0)	Pr **15.10**	Pr **10,40,** status word	2004
In channel 1	2 IN (Word 1, 2)	Pr **15.11**	Pr **2,01**, Post ramp speed reference	2005
In channel 2	2 IN (Word 3, 4)	Pr **15.12**	Pr **4,02**, Current	2006

(*): This mapping address is assigned according to the length configured in Pr **15.39** and Pr **15.40**

NOTE The master needs to declare firstly OUT words and after IN words. Also each parameter needs to be declared one by one according to their number of bytes (eg. 1 OUT + 2 OUT + 1 OUT + 1 IN + 2 IN + 1 IN).

Table 7.7 Overview PDOs mapping (Pr 15.40 and Pr 15.39=10)



7.3 Mapping conflicts

The drive indicates if there is a mapping conflict like MDX-CANopen channel configuration error, analog input error or other.

7.4 Cyclic data mapping errors

The MDX-CANopen module will scan and check the CANopen mapping parameter configuration for errors during initialisation (ex: Pr **15.32** = ENABLED). If an error is detected, then the MDX-CANopen configuration error detected will be indicated in mapping status parameter, Pr **15.49**. See Chapter 10.5 *Cyclic mapping status* on page 36 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 7.8).

Table 7.8 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	8	32
8	8	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** = 5 (4 + 1)

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 in the mapping (Pr **15.39** and Pr **15.40**) is in this configuration channels.

8 Non-cyclic data

MDX-CANopen provides one method to implement non-cyclic data. The “Service Data Object” or SDO provides the non-cyclic data channel on a CANopen system and allows access to all objects in the MDX-CANopen object dictionary. Object access using SDO is controlled entirely by the controller/PLC.

Non-cyclic data transfer is implemented entirely in the CANopen controller/PLC. LEROY-SOMER is unable to offer any specific technical support with regard to the implementation of non-cyclic data transfer with any particular CANopen system..

NOTE The non-cyclic data channel does not use decimal points. For example, in open loop mode, digital speed reference 1 (Pr **1.21**) has units of Hertz, accurate to one decimal place. To write a value of 24.6Hz to Pr **1.21**, the value must be transmitted as 246.

8.1 Service data object (SDO) parameter access

The service data object (SDO) provides access to all objects in the CANopen object dictionary and the drive parameters are mapped into the object dictionary as 0x2XXX objects in the following way:

Index: 0x2000 + *parameter*

For example Pr **20.19** would be index *0x27E3.* The values are usually expressed in base 16, so care must be taken to enter the correct parameter number.

All other supported entries in the MDX-CANopen object dictionary can also be accessed using SDOs. See Chapter 12 *CANopen reference* on page 41 for a full list of supported objects. Refer to the master controller documentation for full details about implementing SDO transfers within the particular master controller.

When accessing drive parameters using an SDO, all parameters must be treated as signed 32-bit parameters. If the target parameter is a 16-bit parameter, the data value will be cast to a 32-bit integer. The sign of the 16-bit value will be preserved.

The following SDO services are supported:

- Initiate SDO Download (*Write*)
- Initiate SDO Upload (*Read*)
- Abort SDO Transfer (*Error*)

8.1.1 SDO abort codes (errors)

SDO messages use a request-response mechanism and the CANopen master will always expect a response from the slave device. If an error occurs with an SDO transfer MDX-CANopen will return an SDO abort code to indicate the reason for the failure, the SDO abort codes are listed in Table 8.1.

Table 8.1 SDO abort codes

Abort code (in hex.)	Description
0x05030000	Toggle bit not alternated.
0x05040000	SDO protocol timed out.
0x05040001	Client/server command specifier not valid or unknown.
0x05040002	Invalid block size (block mode only).
0x05040003	Invalid sequence number (block mode only).
0x05040004	CRC error (block mode only).
0x05040005	Out of memory.
0x06010000	Unsupported access to an object.
0x06010001	Attempt to read a write only object.
0x06010002	Attempt to write a read only object.
0x06020000	Object does not exist in the object dictionary.
0x06040041	Object cannot be mapped to the PDO.
0x06040042	The number and length of the objects to be mapped would exceed PDO length.
0x06040043	General parameter incompatibility.
0x06040047	General internal incompatibility in the device.
0x06060000	Access failed due to a hardware error.
0x06070010	Data type does not match, length of service parameter does not match.
0x06070012	Data type does not match, length of service parameter too high.
0x06070013	Data type does not match, length of service parameter too low.
0x06090011	Sub-index does not exist.
0x06090030	Value range of parameter exceeded (only for write access).
0x06090031	Value of parameter written too high.
0x06090032	Value of parameter written too low.
0x06090036	Maximum value is less than minimum value.
0x08000000	General error.
0x08000020	Data cannot be transferred or stored to the application.
0x08000021	Data cannot be transferred or stored to the application because of local control.
0x08000022	Data cannot be transferred or stored to the application because of the present device state.
0x08000023	Object dictionary dynamic generation fails or no object dictionary is present.

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 drives state of health and operational condition, such as drive ok, drive at speed, etc.

9.2 Control word

The MDX-CANopen 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 6.42	Decimal conversion	Functions	Equivalent parameter
0	1	Drive enable	**6.15**
1	2	Run forward	**6.30**
2	4	Jog	**6.31**
3	8	Run reverse	**6.32**
4	16	Forward/Reverse	**6.33**
5	32	Run	**6.34**
6	64	Reserved	
7	128	Reserved	
8	256	Analog ref./Preset ref.	**1.42**
9	512	Reserved	
10	1024	Reserved	
11	2048	Reserved	
12	4096	Reserved	
13	8192	Drive reset	**10.33**
14	16384	Reserved	
15	32768	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). 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. This terminal is 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 drives 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 references, 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 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-CANopen status word consists of sixteen control bits some of which are reserved. See the table below for the individual bit function descriptions.

Table 9.3 Status word

Status word bits 10.40	Decimal conversion	Functions	Equivalent parameter
0	1	Drive healthy	**10.01**
1	2	Drive active	**10.02**
2	4	Zero speed	**10.03**
3	8	Running at minimum speed	**10.04**
4	16	Below set speed	**10.05**
5	32	At speed	**10.06**
6	64	Above set speed	**10.07**
7	128	Nominal load reached	**10.08**
8	256	Drive out at current limit	**10.09**
9	512	Drive regenerating	**10.10**
10	1024	Braking IGBT active	**10.11**
11	2048	Braking resistor alarm	**10.12**
12	4096	Direction commanded	**10.13**
13	8192	Direction running	**10.14**
14	16384	Mains loss	**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 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 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** 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 transfered 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** for open loop mode and Pr **3.02** for closed loop and servo modes.
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. In regen mode, mains loss is the inverse of Pr **3.07**.
15	Not used	Reserved.

10 Diagnostics

This section provides basic diagnostic information intended to enable resolution of the most common problems encountered when setting up a MDX-CANOPEN on a CANOPEN network. A high percentage of problems reported are basic set-up problems that can be avoided by using the information in this chapter.

NOTE Please note that support will be limited to the setting up and networking of the drive.

10.1 Module ID code

Table 10.1 Module ID code

Pr **15.01**	**Default**	32
	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-CANopen is 32.

10.2 Firmware version

Table 10.2 MDX-CANopen Firmware- major version (xx.yy)

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

Table 10.3 MDX-CANopen firmware-minor version (zz)

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

Table 10.4 MDX-CANopen Firmware version

Major version	Minor version	Firmware version
03.02	1	V03.02.01

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, see the table 10.4).

10.3 MDX-CANopen node address

Table 10.5 MDX-CANopen node adress

Pr **15.03**	**Default**	7
	Range	0 to 125
	Access	RW

Each node on a CANopen network must be given a unique network node address. The MDX-CANopen must be re-initialised to make a change of node address active. Addresses 0 and 125 are reserved for system use and should not be used.

10.4 Fieldbus option state

Table 10.6 fieldbus option state

Pr **15.06**	**Default**	N/A
	Range	0 (set up in progress) to 14 (reserved)
	Access	RO

The operating status of the MDX-CANOPEN can be viewed in the fieldbus option state parameter (Pr **15.06**).

Table 10.7 MDX-CANopen operating status codes

Pr **15.06**	LCD display	Description
0	Set up in progress	MDX-CANopen Setup in progress
1	Network init.	The module is currently performing network-related initialisation tasks. Telegrams now contains 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	Reserved	
7	Host error	The module had 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-CANopen option and drive is lost.
9	Reserved	
10	Reserved	
11	Host supervising and IDLE	Perform normal data handing, but master progress is turned off.
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 10.6 Drive trip display codes for details about the drive trip display.

10.5 Cyclic mapping status

Table 10.8 MDX-CANopen mapping status

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

The MDX-CANopen mapping status parameter Pr **15.49** indicates a mapping configuration error. When a mapping error has been corrected, re-initialize the MDX-CANopen by setting Pr **15.32** to ON (1). The mapping error codes are described in Table 10.8.

Table 10.9 Mapping error codes

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

10.6 Drive trip display codes

If the MDX-CANopen detects an error during operation, it will force a trip on the Drive. However, the trip code displayed on the drive will only indicate the trip on MDX fieldbus. The exact reason for the trip will be indicated in the MDX-CANopen error code parameter, Pr **15.50**.

Table 10.10 shows the possible trip codes that will be displayed on the drive when a problem is detected with the MDX-CANopen or when the MDX-CANopen initiates a trip.

10.7 Fieldbus trip

Table 10.10 Fieldbus trip

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

If the MDX-CANopen detects an error during operation, it will force a trip on the drive and update the error code parameter, Pr **15.50**.

Table 10.10 shows the possible MDX-CANopen error codes.

Table 10.11 MDX-CANopen error codes

Error code	Trip display on LCD	Description
0	No error code	Indicates that the MDX-CANopen module is healthy. It is possible to trip drive externally via various communication channels.
1	Fieldbus 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-CANopen is unable to determine the reason for the error.

10.8 Module serial number

Table 10.12 Module serial number

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

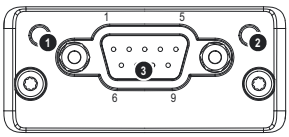
The serial number is loaded into the MDX-CANopen during manufacture and cannot be changed. It contains the eight digit serial number on the label.

10.9 LED diagnostics

The MDX-CANopen 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 10.13 and Table 10.14.

Table 10.13 Front view

#	Item
1	RUN LED[a]
2	ERROR LED[a]
3	CANopen Interface



a. The flash sequences for these LEDs are defined in DR303-3 (CiA).

Table 10.14 RUN LED signification

RUN LED

LED State	Indication	Description
Off	**-**	**No power.**
Green	**OPERATIONAL**	**The module is in the operational state.**
Green, blinking	**PRE-OPERATIONAL**	**The module is in the pre-operational state.**
Green, single flash	**STOPPED**	**The module is in the stopped state.**
Green, flickering	**Autobaud**	**Baudrate detection in progress.**
Red[a]	**EXCEPTION state (Fatal Event)**	**The module has shifted into the EXCEPTION state.**

a-The frash sequences for these LEDs are defined in DR303-3 (CiA).

Table 10.15 ERROR LED signification

ERROR LED

LED State	Indication	Description
Off	**-**	**No power.**
Red, single flash	**Warning limit reached**	**A bus error-or-device is in working level.**
Red, flickering	**LSS**	**LSS services in progress.**
Red, double flash	**Error Control Event**	**A guard-(NMT-Slave or NMT-master) or heartbeat event (heartbeat consumer) has occured.**
Red[a]	**Bus off (Fatal Event)**	**Bus off.**

a-If both LEDs turns red, this indicatesa fatal event: the bus interface is shifted into a physically passive state.

11 Advanced features

11.1 Data bytes order

Table 11.1 Data bytes order

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

When data is sent over the CANOPEN 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 Table 11.2 *Data endian format* on page 38

Table 11.2 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

11.2 Cyclic Data compression

Table 11.3 Compression of cyclic data enable

Pr **15.34**	**Default**	OFF (disabled)
	Range	OFF or ON
	Access	RW

By default, the MDX-CANopen 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 CANopen 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 16-bits wide 16-bits will be used. If the target drive parameter is only 1 or 8-bits wide 8-bits will be used for that particular data channel. This is shown in Table 11.3 *Compression of cyclic data enable* on page 38.

Table 11.4 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	8	32
8	8	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 11.4 *Actual data sizes* on page 38 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 11.5 Example of 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**, Symetric 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 CANopen 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 11.5 *Example of cyclic data channel mapping with compression disabled* on page 39

Table 11.6 Example of 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**, Symetric Current Limit
Out channel 4	1 BYTE (Byte 0 of Word 5)	Pr **4.10**, Torque Offset Selection
In channel 0	1 IN (Word 0)	Pr **10.40**, Status word
In channel 1	1 BYTE (Byte 0 of Word 1)	Pr **10.16**, DC Bus undervoltage
In channel 2	1 BYTE (Byte 1 of Word 1)	Pr **10.17**, Motor overload alarm
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

NOTE The master needs to declare firstly OUT words and after IN words. Also each parameter needs to be declared one by one according to their number of bits.

11.3 Restore defaults

Table 11.7 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), settings will clear the current configuration of the MDX-CANopen. Putting Pr **15.30** to 1 additionally clears the backup copy of the MDX-CANopen configuration stored.

This can be performed as follows:

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

11.4 Disable full write access with acyclic

Table 11.8 Disable full write access

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

This parameter will restrict a remote user access to the drive. Pr **15.36** = read 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.

12 CANopen reference

CANopen object dictionary

The CANopen Object Dictionary defines a serie of objects that contain data values with which to configure MDX-CANopen.

12.1 Communication profile objects supported

Quick reference links to all communication object sections can be found in Chapter 13 *Quick reference* on page 62.

Table 12.1 Profil objects

Index	Object Name	Sub-Index	Description	Type	Access
0005h	Dummy Object	00h	Dummy Object	U8	WO
0006h	Dummy Object	00h	Dummy Object	U16	WO
0007h	Dummy Object	00h	Dummy Object	U32	WO
1000h	Device Type	00h	Device Type	U32	RO
1001h	Error register	00h	Error register	U8	RO
1003h	Pre-defined error field	00h	Number of errors	U8	RW
		01h...06h	Error field[a]	U32	RO
1005h	COB-ID Sync	00h	COB-ID Sync[b]	U32	RW
1008h	Manufacturer device name	00h	Manufacturer device name	Visible string	RO
1009h[c]	Manufacturer hardware version	00h	Manufacturer hardware version	Visible string	RO
100Ah	Manufacturer software version	00h	Manufacturer software version	Visible string	RO
100Ch	Guard time	00h	Guard time	U16	RW
100Dh	Life time factor	00h	Life time factor	U8	RW
1010h	Store Parameters[d]	00h	Largest sub index supported	U8	RO
		01h	Store all parameters	U32	RW
		02h	Store Communication parameters	U32	RW
1011h	Restore parameters	00h	Largest sub index supported	U8	RO
		01h	Restore all default parameters	U32	RW
		02h	Restore communication default parameters	U32	RW
		04h	Restore manufacturer parameters to Default.	U32	RW
1014h	COB ID EMCY	00h	COB ID EMCY	U32	RO
1015h	Inhibit Time EMCY	00h	Inhibit Time EMCY	U16	RW

Index	Object Name	Sub-Index	Description	Type	Access
1016h	Consumer Heartbeat Time	00h	Number of entries	U8	RO
		01h	Consumer Heartbeat Time	U32	RW
1017h	Producer Heart-beat Time	00h	Producer Heartbeat Time	U16	RW
1018h	Identity object	00h	Number of entries	U8	RO
		01h	Vendor ID	U32	RO
		02h	Product Code	U32	RO
		03h	Revision Number	U32	RO
		04h	Serial Number	U32	RO
1400h ... 141Fh	Receive PDO parameter	00h	Largest sub-index sup-ported	U8	RO
		01h	COB ID used by PDO	U32	RW
		02h	Transmission type.	U8	RW
1600h ... 161Fh	Receive PDO mapping	00h	No. of mapped applica-tion objects in PDO	U8	RW
		01h	Mapped object #1	U32	RW
		02h	Mapped object #2	U32	RW
		03h	Mapped object #3	U32	RW
		04h	Mapped object #4	U32	RW
1A00h ... 1A1Fh	Transmit PDO mapping	00h	No. of mapped applica-tion objects in PDO	U8	RW
		01h	Mapped object #1	U32	RW
		02h	Mapped object #2	U32	RW
		03h	Mapped object #3	U32	RW
		04h	Mapped object #4	U32	RW
		05h	Mapped object #5	U32	RW
		06h	Mapped object #6	U32	RW
		07h	Mapped object #7	U32	RW
		08h	Mapped object #8	U32	RW

12.2 Device type

Index	0x1000	Sub-index	0	Access	RO
Default	N/A	Data type	Unsigned32	Object code	VAR

The ***device type*** indicates the current configuration of the drive and MDX-CANopen. The parameter is used by CANopen master controllers to ensure that the correct EDS file is being used.

12.3 Error register

Index	0x1001	Sub-index	0	Access	RO
Default	N/A	Data type	Unsigned8	Object code	VAR

The ***error register*** is used by MDX-CANopen to indicate that an error has occurred. If a bit is set to 1, the specified error has occurred (see CANopen specification CiA Draft Standard 301 Version 4.1). The ***error register*** is part of the emergency object refer to Table 12.18

12.4 Pre-defined error field

Index	0x1003
Object code	ARRAY
Data type	UNSIGNED32

The ***pre-defined error field*** returns a 32-bit error code containing data from the last four emergency messages that were sent. If less than four emergency objects have been sent, the higher sub-indexes will not exist.

Table 12.2 Pre-defined error field

Byte 2	Byte 1	Byte 0
Drive trip code	Emergency object error code	

Number of errors

Index	0x1003	Sub-index	0	Access	RO
Default	4	Data type	Unsigned8	Object code	VAR

Sub-index 0 is an unsigned8 data type which indicates the highest sub-index for the ***pre-defined error field***. The rest of the array are unsigned32 data types.

Error field 1

Index	0x1003	Sub-index	0	Access	RO
Default	4	Data type	Unsigned8	Object code	VAR

Returns the last emergency object codes.

Error field 2

Index	0x1003	Sub-index	4	Access	RO
Default	N/A	Data type	Unsigned32	Object code	VAR

Returns the 2nd last emergency object codes.

Error field 3

Index	0x1003	Sub-index	4	Access	RO
Default	N/A	Data type	Unsigned32	Object code	VAR

Returns the 3rd last emergency object codes.

Error field 4

Index	0x1003	Sub-index	4	Access	RO
Default	N/A	Data type	Unsigned32	Object code	VAR

Returns the 4th last emergency object codes.

12.5 COB-ID SYNC

Index	0x1005	Sub-index	4	Access	RW
Default	0x00000080	Data type	Unsigned32	Object code	VAR

COB-ID SYNC defines the COB-ID that will be used for the synchronization (SYNC) object. The MDX-CANopen receives the SYNC message, but it cannot be used to generate the SYNC object.

b31	b30	b29	b28-b11	b10-b0
Default	0x00000080	Data type	0000000000000000	11- bit Can-ID

The upper 3 bits (b31-b29) are used to specify the SYNC behavior of MDX-CANopen.

Table 12.3 COB-ID SYNC configuration

Bit	Value	Comment
31	0	Reserved.
30	0	MDX-CANopen consumes the SYNC message.
29	0	11-bit CAN identifier.

Refer to section 12.19.3*RxPDO transmission type* on page 52 and 12.21.3*TxPDO transmission type* on page 55 for details of the transmission types that use the SYNC object.

12.6 Manufacturer device name

Index	0x1008	Sub-index	0	Access	Const
Default		Data type	STRING	Object code	VAR

Returns the string “Anybus-CC CANopen” to indicate the product name.

12.7 Manufacturer hardware version

Index	0x1009	Sub-index	0	Access	Const
Default		Data type	STRING	Object code	VAR

Indicates the product hardware.

12.8 Manufacturer software version

Index	0x100A	Sub-index	0	Access	Const
Default		Data type	STRING	Object code	VAR

Returns a string to indicate the firmware version installed. The string will be formatted as “Vxxyyzz” where xxyy is the major firmware version and zz is the minor firmware version.

12.9 Guard time

The objects at index 100Ch and 100Dh include the guard time in milliseconds and the life time factor.The life time factor multiplied with the guard time gives the life time for the Life Guarding Protocol. It is 0 if not used.

INDEX	100Ch
Name	guard time
Object Code	VAR
Data type	UNSIGNED16
Category	Conditional; Mandatory, if heartbeat is not supported

12.10 Life Time Factor

The life time factor multiplied with the guard time gives the life time for the node guarding protocol. It is 0 if not used.

Index	100Dh
Name	life time factor
Object Code	VAR
Data type	UNSIGNED8
Category	Conditional; Mandatory, if heartbeat is not supported

12.11 Store parameters

This object (0x1010) supports the saving of parameters in non-volatile memory.

Number of sub-index supported

Sub -Index	0h
Description	largest subindex supported
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	1h-2Fh
Default Value	No

Store all parameters

Sub -Index	1h
Description	save all parameters
Entry Category	Mandatory
Access	rw
PDO Mapping	No
Value Range	UNSIGNED32 (Figure 55 for write access; Figure 56 for read access)
Default Value	No

Store all Communication parameters

Sub -Index	2h
Description	save communication parameters
Entry Category	Optional
Access	rw
PDO Mapping	No
Value Range	UNSIGNED32 (Figure 55 for write access; Figure 56 for read access)
Default Value	No

In order to avoid storage of parameters by mistake, storage is only executed when a specific signature is written to the appropriate Sub-Index. The signature is «save».

Figure 55: Storage write access signature

	MSB			LSB
Signature ISO 8859 («ASCII») hex	e	v	a	s
	65h	76h	61h	73h

On reception of the correct signature in the appropriate sub-index the device stores the parameter and then confirms the SDO transmission (initiate download response). If the storing failed, the device responds with an Abort SDO Transfer (abort code: 0606 0000h).

If a wrong signature is written, the device refuses to store and responds with Abort SDO Transfer (abort code: 0800 002xh).

On read access to the appropriate Sub-Index the device provides information about its storage functionality with the following format:

Figure 56: Storage read access structure

	UNSIGNED32		
Bits	**MSB**	**LSB**	
	31-2	1	0
	Reserved (=0)	0/1	0/1

12.12 Restore default parameters

With this object (0x1011) the default values of parameters according to the communication or device profile are restored.

Number of sub-index supported

Sub -Index	0h
Description	largest subindex supported
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	1h - 4Fh
Default Value	No

Restore all default parameters

Sub -Index	1h
Description	restore all default parameters
Entry Category	Mandatory
Access	rw
PDO Mapping	No
Value Range	UNSIGNED32 (Figure 57)
Default Value	No

Restore communication default parameters

Sub -Index	2h
Description	restore communication default parameters
Entry Category	Optional
Access	rw
PDO Mapping	No
Value Range	UNSIGNED32 (Figure 57)
Default Value	No

Restore manufacturer parameters to Default

Sub -Index	4h
Description	restore manufacturer defined default parameters
Entry Category	Optional
PDO Mapping	No
Value Range	UNSIGNED32 (Figure 57)

In order to avoid the restoring of default parameters by mistake, restoring is only executed when a specific signature is written to the appropriate sub-index. The signature is «load».

Figure 57: Restoring write access signature

	MSB			LSB
Signature ASCI hex	d	a	o	l
	64h	61h	6Fh	6Ch

On reception of the correct signature in the appropriate sub-index the device restores the default parameters and then confirms the SDO transmission (initiate download response). If the restoring failed, the device responds with an Abort SDO Transfer (abort code: 0606 0000h). If a wrong signature is written, the device refuses to restore the defaults and responds with an Abort SDO Transfer (abort code: 0800 002xh).

12.13 COD-ID EMCY

Index	0x1014	Sub-index	0	Access	RW
Default	0x00000080 + node address	Data type	UNSIGNED32	Object code	VAR

COB-ID EMCY defines the COB-ID to be used for the emergency object

b31	b30	b29	b28 - b11	b10 - b0
0	0	0	00000000000000000	11-bit ID

The upper 3 bits (b31-b29) are used to specify the emergency object behavior of MDX-CANopen.

Table 12.4 *COB-ID SYNC* configuration

Bit	Value	Comment
31	0	EMERGENCY object always exists
30	0	Reserved
29	0	11-bit CAN identifier

Refer to section 12.26 *Emergency object* on page 60 for full details about the emergency object.

12.14 Inhibit Time EMCY

The inhibit time for the EMCY message can be adjusted via this entry. If this entry exists it must be writable in the object dictionary. The time has to be a multiple of 100µs.

Index	1015h
Name	Inhibit Time EMCY
Object Code	VAR
Data type	UNSIGNED16
Category	Optional

12.15 Consumer heartbeat Time

The “heartbeat protocol” is a node protection system or error control service. A “heartbeat producer” is usually a CANopen slave device which transmits a heartbeat message cyclically. This message is received by one or more “heartbeat consumer” devices, usually the CANopen master controller, and indicates to the master controller that the slave device is communicating successfully.

If the heartbeat message is not received within the defined time period, a “heartbeat event” will be generated in the master controller, allowing it to take appropriate action to ensure system safety is maintained.

Figure 62: Structure of consumer heartbeat time entry			
UNSIGNED32	**MSB**		**LSB**
Bits	31-24	23-16	15-0
Value	Reserved	Node-ID	Heartbeat time
Encoded as	-	UNSIGNED8	UNSIGNED16

Number of entries

Sub -Index	0h
Description	number entries
Entry Category	Mandatory
Access	ro
PDO Mapping	No
Value Range	1-127
Default Range	No

Consumer Heartbeat Time

Sub -Index	1h
Description	Consumer Heartbeat Time
Entry Category	Mandatory
Access	rw
PDO Mapping	No
Value Range	UNSIGNED32 (Figure 62)
Default Range	0

12.16 Producer Heartbeat time

Index	0x1017	**Sub-index**	0	**Access**	RW
Default	0	**Data type**	UNSIGNED16	**Object code**	VAR

The producer heartbeat time defines the cyclic time period (in milliseconds) for MDX-CANopen to transmit the heartbeat message. A value of 0 disables the heartbeat message. The heartbeat message also includes the current NMT state of the MDX-CANopen.

Table 12.5 MDX-CANopen operating states

State	Operating state
0	BOOTUP
4	STOPPED
5	OPERATIONAL
127	PRE-OPERATIONAL

The MDX-CANopen will start transmitting the heartbeat message as soon as it is enabled. If the ***producer heartbeat time*** is set >0 at power up, MDX-CANopen will start transmitting the heartbeat message when the transition from BOOTUP to PREOPERATIONAL occurs. In this case, the boot-up message is regarded as the first heartbeat message.

12.17 Identity object

Index	0x1018
Object code	RECORD
Data type	UNSIGNED32

Identity object returns general information about the MDX-CANopen.

Number of entries

Index	0x1018	**Sub-index**	0	**Access**	RO
Default	4	**Data type**	UNSIGNED8		

Returns the highest sub-index available for the identity object.

Vendor ID

Index	0x1018	**Sub-index**	1	**Access**	RO
Default		**Data type**	UNSIGNED32		

Returns the CANopen vendor ID (0x1B).

Product code

Index	0x1018	**Sub-index**	2	**Access**	RO
Default		**Data type**	UNSIGNED32		

Returns the MDX-CANopen module ID code of 10.

Revision number

Index	0x1018	**Sub-index**	3	**Access**	RO
Default	N/A	**Data type**	UNSIGNED32		

Returns the CANopen firmware version.

Serial number

Index	0x1018	**Sub-index**	4	**Access**	RO
Default	N/A	**Data type**	UNSIGNED32		

Returns the MDX-CANopen serial number. This value is programmed during manufacture and cannot be changed.

12.18 Mapping parameter values

When setting up cyclic data to contain specific parameters this may be done in two ways:

1. The first method is to use the mapping parameters Pr **15.10 -** Pr **15.19 and** Pr **15.20 -** Pr **15.29**;
2. The second is to use SDOs to set the mappings.

These are used with object 0x1600 - 0x161F and object 0x1A00 - 0x1A1F for RxPDO and TxPDO mapping respectively. To map RxPDOA to Pr **1.21,** the mapping parameter would be set to 0x20790020 (index = 0x2079, sub-index = 0, object length = 0x20, i.e. 32 bits).
Refer to section 8.1 *Service data object (SDO) parameter access* on page 28 for more details on how to access drive parameters.

12.18.1 RxPDO number configuration

This parameter will be used for configuring the available RxPDO.

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

12.18.2 TxPDO number configuration

This parameter will be used for configuring the available TxPDO.

Pr 15.39 **Intput cyclical data parameters**	**Default**	2
	Range	0 to 10
	Access	RW

12.18.3 Communication information for RxPDO

This section contains the communication parameters for the receive PDOs.

Index	0x1400-0x141F	**Sub-index**	0	**Access**	RO
Largest sub-index supported		Size			

Index	0x1400-0x141F	**Sub-index**	1	**Access**	RO
COB-ID used by PDO		Size			

Index	0x1400-0x141F	**Sub-index**	2	**Access**	RW
Transmission type		Size			

12.19 RxPDO communication parameters

This section contains the communication parameters for the RxPDOs.
MDX-CANopen supports a total of four RxPDOs. Each PDO has a main index assigned to it, with individual parameters for the PDO accessed using sub-indexes.

Each RPDO is assigned to one element of parameters Pr **15.20** to Pr **15.29**. Thus, we have to enter which parameter is chosen in this section Pr **15.20** to Pr **15.29**.

Table 12.6 Supported RxPDOs (Pr 15.39=10 & Pr 15.40=10)

OUT channel	Mapping parameter	Mapping address (*)	RxPDOs
0	**Pr 15.20**	2001	RxPDO1
1	**Pr 15.21**	2002	RxPDO2
2	**Pr 15.22**	2003	RxPDO3
3	**Pr 15.23**	2004	RxPDO4
4	**Pr 15.24**	2005	RxPDO5
5	**Pr 15.25**	2006	RxPDO6
6	**Pr 15.26**	2007	RxPDO7
7	**Pr 15.27**	2008	RxPDO8
8	**Pr 15.28**	2009	RxPDO9
9	**Pr 15.29**	200A	RxPDO10

(*): This mapping address is assigned according to the length configured in Pr **15.39** and Pr **15.40**.

All RxPDO configuration parameters are dynamic (any changes made to these parameters will take effect immediately).

12.19.1 Number of entries

Index	0x1400-0x141F	**Sub-index**	0
Data type	UNSIGNED8	**Access**	RO

Defines the largest sub-index supported for the specified RxPDO.

The value for each RxPDO with Sub-index= 0 is «2».

12.19.2 RxPDO COB-ID

Index	0x1400-0x141F	**Sub-index**	0
Data type	UNSIGNED32	**Access**	RO

The COB-ID is the CAN identifier used by the CANopen master controller to send RxPDO messages over the CANopen network. The COB-ID is usually calculated using the target slave node address, allowing each node to determine which RxPDO message it should use.

RxPDO COB-IDs do not have to be unique in slave devices on a CANopen network, as they can only originate from the CANopen master controller. It is common for a master controller to send a single RxPDO message containing four different speed or position references and have four different slave nodes configured to receive the same RxPDO. Each node simply extracts the reference it requires and discards the remaining data.

This makes efficient use of the available bandwidth of the CANopen network, as a single message is used to update four slave devices with new speed or position references, instead of four messages.

b31	b30	b29	b28 - b11	b10 - b0
RxPDO Disable	RTR Disable	29-bit ID Enable	00000000000000000	11-bit ID

The upper 3 bits (b31-b29) are used to enable certain functions of the RxPDO.

Table 12.7 RxPDO COB-ID configuration

Bit number	Value	Meaning
31 (MSB)	0	PDO exists/ is valid
	1	PDO does not exist/ is not valid
30	0	RTR allowed on this PDO
	1	no RTR allowed on this PDO
29	0	11-bit ID (CAN 2.0A)
	1	29-bit ID (CAN 2.0B)
28-11	0	if bit 29=0
	X	if bit 29=1: bits 28-11 of 29-bit-COB-ID
10-0 (LSB)	X	bits 10-0 of COB-ID

The PDO valid/not valid allows to select which PDOs are used in the operational state.

There may be PDOs fully configured (e.g. by default) but not used, and therefore set to "not valid" (deleted). The feature is necessary for devices supporting more than 4 RPDOs or 4 TPDOs, because each device has only default identifiers for the first four RPDOs/TPDOs.

Devices supporting the standard CAN frame type only or do not support Remote Frames, an attempt to set bit 29 to 1 or bit 30 to 0 is responded with an abort message (abort code: 0609 0030h).

It is not allowed to change bit 0-29 while the PDO exists (Bit 31=0).

12.19.3 RxPDO transmission type

Index	0x1400-0x141F	Sub-index	2
Data type	UNSIGNED8	ACCESS	RW

The transmission type defines when data received in an RxPDO is processed and passed though to the target parameters. MDX-CANopen does not support all CANopen transmission modes.

Table 12.8 Supported RxPDO transmission types

Transmission type	Timing	Description
0 - 240	Synchronous	The RxPDO data is written to the target parameters when the next SYNC message is received.
241 - 251		Reserved.
252 - 253		Not used for RxPDOs.
254-255	Asynchronous	The RxPDO data is written immediately to the target parameters.

Default values of the RxPDO COB-ID is 255.

12.20 RxPDO mapping parameters

The configuration maximal for MDX-CANopen is RxPDOs 1 to 10 and TxPDOs 1 to 10. This however may be changed (section 12.18.1 *RxPDO number configuration* on page 50). The destination parameters for data received from an RxPDO are specified in the RxPDO mapping parameters.

Eight mapping parameters (8bits) are provided for each RxPDO, allowing data to be mapped to all drive (64 bits). RxPDO data can also be mapped to all CANopen object dictionary entries that allow PDO mapping.

The default mappings for RxPDOA are derived from the mapping parameters (Pr **15.20** to Pr **15.29**) during initialisation, however, the CANopen object dictionary mapping for all RxPDO are dynamic, so changes can be realized using SDO communication.

Table 12.9 RxPDOs default mapping (Pr 15.39=10 & Pr 15.40=10)

Index	Object Name	Sub-Index	Description	Type	Access
1600h 161Fh	Receive PDO mapping	00h	No. of mapped application objects in PDO	U32	RW
		01h	Mapped object #1	U32	RW
		02h	Mapped object #2	U32	RW
		03h	Mapped object #3	U32	RW
		04h	Mapped object #4	U32	RW
		05h	Mapped object #5	U32	RW
		06h	Mapped object #6	U32	RW
		07h	Mapped object #7	U32	RW
		08h	Mapped object #8	U32	RW

Eight parameters are available to transfer but of 8 bits (or four parameters of 16 bits).
64 bits of data can be sent.
Ex : 1600 sub-index 01 = 2001

12.21 TxPDO communication parameters

This section contains the communication parameters for the TxPDOs.
MDX-CANopen supports a total of 10 TxPDOs. Each PDO has a main index assigned to it, with individual parameters for the PDO accessed using sub-indexes.

Each TxPDO is assigned to one element of parameters Pr **15.10** to Pr **15.19**. Thus, we have to enter which parameter chosen in this section Pr **15.10** to Pr **15.19**.

Table 12.10 Supported TxPDOs

IN channel	Mapping parameter	Mapping address (*)	RxPDOs
0	**Pr 15.10**	200B	TxPDO1
1	**Pr 15.11**	200C	TxPDO2
2	**Pr 15.12**	200D	TxPDO3
3	**Pr 15.13**	200E	TxPDO4
4	**Pr 15.14**	200F	TxPDO5
5	**Pr 15.15**	2010	TxPDO6
6	**Pr 15.16**	2011	TxPDO7
7	**Pr 15.17**	2012	TxPDO8
8	**Pr 15.18**	2013	TxPDO9
9	**Pr 15.19**	2014	TxPDO10

12.21.1 Number of entries

Index	0x1800-0x191F	**Sub-index**	0	**Access**	RO
Default	5	**Data type**	UNSIGNED8		

Defines the largest sub-index supported for the specified TxPDO.
The value for each TxPDO is ‘5’.

12.21.2 TxPDO COB-ID

Index	0x1800-0x191F	**Sub-index**	1
Data type	UNSIGNED32	**Access**	RW

The COB-ID is the CAN identifier used by MDX-CANopen to transmit TxPDO messages over the CANopen network. The COB-ID is usually calculated using the node address, as this will ensure that the TxPDO COB-ID is unique on the CANopen network.

b31	b30	b29	b28 - b11	b10 - b0
PDO Disable	RTR Disable	29-bit ID Enable	00000000000000000	11-bit ID

The upper 3 bits (b31-b29) are used to enable certain functions of the TxPDO.

Table 12.11 PDO COB-ID configuration

Bit number	Value	Meaning
31 (MSB)	0	PDO exists/ is valid
	1	PDO does not exist/ is not valid
30	0	RTR allowed on this PDO
	1	no RTR allowed on this PDO
29	0	11-bit ID (CAN 2.0A)
	1	29-bit ID (CAN 2.0B)
28-11	0	if bit 29=0
	X	if bit 29=1: bits 28-11 of 29-bit-COB-ID
10-0 (LSB)	X	bits 10-0 of COB-ID

The PDO valid/not valid allows to select which PDOs are used in the operational state.

There may be PDOs fully configured (e.g. by default) but not used, and therefore set to "not valid" (deleted) before the configuration. And after that, set to “valid”.

Devices supporting the standard CAN frame type only or do not support Remote Frames, an attempt to set bit 29 to 1 or bit 30 to 0 is responded with an abort message (abort code: 0609 0030h).

It is not allowed to change bit 0-29 while the PDO exists (Bit 31=0).

12.21.3 TxPDO transmission type

Index	0x1800-0x191F	**Sub-index**	2
Data type	UNSIGNED8	**Access**	RW

The transmission type defines when the TxPDO data is read from the source parameters and when it is transmitted over the CANopen network. MDX-CANopen supports all CANopen transmission modes.

Table 12.12 Supported TxPDO transmission types

Transmission type	Timing	Description
0	Acyclic, synchronous	The source data is read when the SYNC message is received. If the source data has changed, the TxPDO is transmitted.
1 - 240	Cyclic, synchronous	The source data is read and the TxPDO is transmitted every n SYNC messages, where n = transmission type.
254	Asynchronous, event trigger	The source data is read and the TxPDO is transmitted in response to 2 events: 1. An OFF-to-ON (0-to-1) transition 2. Event timer. Refer to section 12.21.5 *TxPDO event timer* on page 56 for more details.
255	Asynchronous timer trigger / Acyclic	The source data is read and the TxPDO is transmitted in response to the event timer. Refer to section 12.21.5*TxPDO event timer* on page 56 for more details.

If a TxPDO has transmission type 0 to 240, 254 or 255, the CANopen master controller can use an RTR message (with the COB-ID of the required PDO) to get the MDX-CANopen to re-transmit the required TxPDO. MDX-CANopen does NOT update the data values for the requested TxPDO; data update will only occur when specified for the TxPDO transmission type.
Default values for the TxPDO COB-ID is 255.

12.21.4 TxPDO inhibit time

Index	0x1800-0x191F	**Sub-index**	3	**Access**	RW
Default	0	**Data type**	UNSIGNED16		

The TxPDO time inhibit time specifies the time period (in multiples of 100µs) of the minimum interval between PDO transmissions of the same PDO. The inhibit time defines the minimum time that has to elapse between two consecutive invocations of a PDOs service. This can be used to help limit traffic on the network.

12.21.5 TxPDO event timer

Index	0x1800-0x191F	**Sub-index**	5	**Access**	RW
Default	0	**Data type**	UNSIGNED16		

The TxPDO event timer specifies the time period (in ms) between transmission of TxPDOs with transmission type 254 or 255 (see section 12.28 TxPDO transmission type default values on page 116). Set the TxPDO event timer to 0 to disable the event timer.

12.22 TxPDO mapping parameters

The source parameters for data transmitted on a TxPDO are specified in the TxPDO mapping parameters. Eight mapping parameters (64 bits max) are provided for each TxPDO, allowing data to be mapped to all drive and SM-Applications parameters. TxPDO data can also be mapped to all CANopen object dictionary entries that allow PDO mapping.

The default mappings for TxPDOA are derived from the mapping parameters (Pr **15.10** to Pr **15.19**) during initialisation and configured via the menu, therefore changes made via these parameters will require a reset in order to take effect. However, the mappings for all four TxPDOs can be changed via the appropriate CANopen object dictionary mapping objects (using SDO communications), changes made via this method will take effect immediately.

Table 12.13 RxPDOs default mapping

Index	Object Name	Sub-Index	Description	Type	Access
1600h 161Fh	Receive PDO mapping	00h	No. of mapped application objects in PDO	U32	RW
		01h	Mapped object #1	U32	RW
		02h	Mapped object #2	U32	RW
		03h	Mapped object #3	U32	RW
		04h	Mapped object #4	U32	RW
		05h	Mapped object #5	U32	RW
		06h	Mapped object #6	U32	RW
		07h	Mapped object #7	U32	RW
		08h	Mapped object #8	U32	RW

NOTE Read/write only if the number of mapped application objects in TxPDO (index 0x1A00 sub-index 0) is set to 0.

Eight parameters are available to transfer but of 8 bits (or four parameters of 16 bits).

64 bits of data can be sent.

By default, there is only one parameter by PDO (mapped object #1) and the others are not used.

12.23 Network management objects (NMT)

MDX-CANopen uses the standard CANopen network management state machine to determine the behavior of the communication objects. Figure 12-1 shows the NMT state machine, and the different state transitions that are possible.

Figure 12-1 NMT state machine

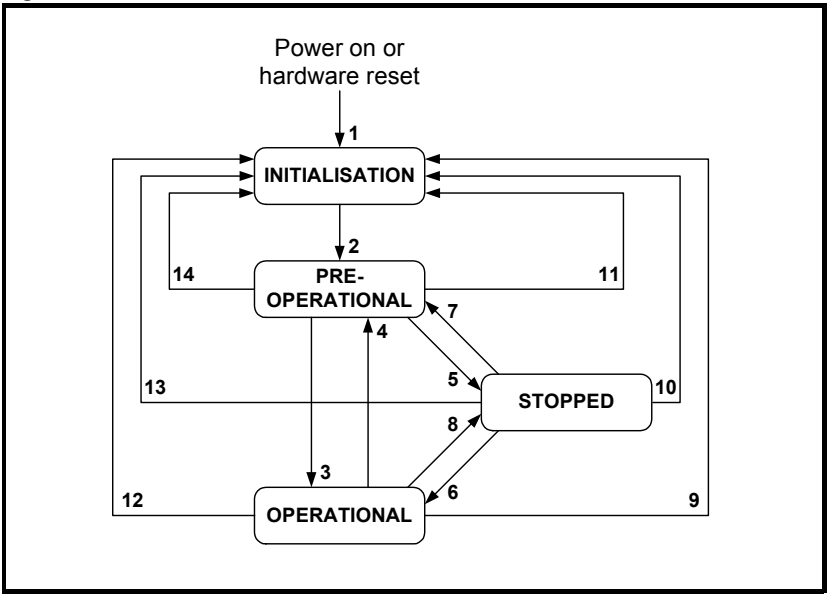


Table 12.14 NMT state machine transitions

Transition	Transition initiated by
1	At power on or hardware reset, enter INITIALISATION automatically
2	INITIALISATION complete, enter PRE-OPERATIONAL automatically
3, 6	START_REMOTE_NODE
4, 7	ENTER_PRE_OPERATIONAL
5, 8	STOP REMOTE NODE
9, 10, 11	RESET_NODE
12, 13, 14	RESET_COMMUNICATION

12.23.1 NMT states

CANopen has various different communication objects, but some objects are only active in certain NMT states. Table 12.15 lists the communication objects supported by MDX-CANopen, and the NMT states in which each object is active.

Table 12.15 NMT states and active messages

Object	INITIALISATION	PRE-OPERATIONAL	OPERATIONAL	STOPPED
PDO	-	-	Active	-
SDO	-	Active	Active	-
SYNC	-	Active	Active	-
Emergency	-	Active	Active	-
Boot-up	Active	-	-	-
NMT		Active	Active	Active

12.23.2 Initialisation

MDX-CANopen may be switched into ***Initialization*** from any other state using the RESET_NODE or RESET_COMMUNICATION commands.

12.23.3 Pre-operational

The synchronization object, emergency object, NMT objects and SDO communications are all active in the PRE-OPERATIONAL state, allowing device configuration to take place. PDOs do not exist in the PRE-OPERATIONAL state and are inactive. This allows PDO configuration and mapping objects to be configured without interfering with active communications.

MDX-CANopen may be switched into PRE-OPERATIONAL from OPERATIONAL (transition 4) or STOPPED (transition 7) using the ENTER_PRE-OPERATIONAL command.

12.23.4 Operational

All communication objects are active in the OPERATIONAL state. All configured PDOs are created when MDX-CANopen enters the OPERATIONAL state, using the parameter values in the object dictionary. SDO communications remain active in the OPERATIONAL state.

MDX-CANopen may be switched into OPERATIONAL from PRE-OPERATIONAL (transition 3) or STOPPED (transition 6) using the START_REMOTE-NODE command.

12.23.5 Stopped

All communications (except NMT and heartbeat) are stopped when the MDX-CANopen is switched into the STOPPED state. MDX-CANopen will only respond to NMT messages while in the STOPPED state, so it must be switched into the PRE-OPERATIONAL or OPERATIONAL state to re-start communications. The heartbeat error control protocol remains active during the STOPPED state.

MDX-CANopen may be switched into STOPPED from PRE-OPERATIONAL (transition 5) or OPERATIONAL (transition 8) using the STOP_REMOTE_NODE command.

12.24 NMT commands

Network Management (NMT) commands are low-level CANopen commands that are used to switch MDX-CANopen between the different NMT states. NMT messages always have a CAN identifier of 0x000 and contain 2 data bytes.

Table 12.16 NMT message structure

CAN identifier	Command (See Table 12.17)	Node ID
0x000	See Table 12.17	Target node

Table 12.17 NMT commands

Command	Code
START_REMOTE_NODE	1
STOP_REMOTE_NODE	2
ENTER_PRE_OPERTATIONAL	128
RESET_NODE	129
RESET_COMMUNICATION	130

12.25 Layer setting services (LSS)

MDX-CANopen supports the complete CANopen Layer Setting Service protocol, as defined in DSP205 V1.1. LSS provides the ability for a CANopen device with LSS Master capabilities to enquire and change the settings of certain parameters of the local layers on a LSS Slave CANopen device via the CAN network.

The module supports the Layer Setting Service (LSS). This service can be used to set the Baud Rate and Device Address via the network, and may address the module by it's Vendor-ID, Product Code, Revision number and serial number.

It is possible to enforce LSS during startup by setting the 'Device Address' instance (parameter Pr **15.03**) to 255.

12.26 Emergency object

12.26.1 What is the emergency object?

Emergency objects are transmitted by the MDX-CANopen when it detects that the drive has tripped. They are high priority messages that inform the CANopen master controller that some sort of error has occurred. It is up to the CANopen master controller to take appropriate action.

Emergency objects are suitable for interrupt-type error alerts. An emergency object is transmitted only once per error event and provided that no new errors occur, no further emergency objects will be transmitted.

12.26.2 Emergency object format

The emergency object consists of a total of eight data bytes. The first 3 bytes are defined by the CANopen specification, and the remaining five bytes are manufacturer-specific.
MDX-CANopen will return the drive trip code and the MDX-CANopen error code, allowing the CANopen master controller to determine exactly what fault has occurred.

Bytes 5 to 7 are always transmitted, but will always be set to 0.

Table 12.18 Emergency object format

COB-ID	Byte				
	0	1	2	3	4
COB-ID EMCY (Index 0x1014)	Emergency error code (See Table 12.21)		Error register (Index 0x1001)	Drive trip code	«00»

The CANopen specification defines a list of standard error codes. Supported CANopen emergency error codes (and the drive trips that will produce the emergency error code) are listed in Table 12.19. All other drive trips will produce the generic error code, 0x1000.

NOTE An internal 6th instance is reserved for internal CANopen diagnostics. This includes the following EMCY error codes:

Table 12.19 Emergency error codes

EMCY Error Code	Description
8110h	CAN controller signalled a lost message.
8120h	CAN controller reached the warning limit due to error frames.
8210h	A received PDO was smaller than specified by the valid mapping table.
8220h	The DLC of a received PDO exceeded the length specified by the valid mapping table.
8130h	An error control event has occured (either a life guarding event or a heartbeat event).
8140h	CAN controller has recovered from a BUS OFF state.
8150h	COB-ID collision detected.
FF01h	The saved PDO configuration has no corresponding process data map.

13 Quick reference

13.1 Drive menu parameter reference

Table 13.1 MDX-CANopen parameter reference

Menu	Default	Cross reference	Description
15.01	32	Page 34	Module ID code
15.02	----	Page 34	Firmware-major version (xx.yy)
15.03	7	Page 34	MDX-CANopen node address
15.04	9	Page 18	MDX-CANopen baud rate
15.06	---	Page 35	Fieldbus option state
15.08	MSB first	Page 39	Data bytes order
15.10	1040	Page 19	IN cyclic mapping 0
15.11	201	Page 19	IN cyclic mapping 1
15.12	0	Page 19	IN cyclic mapping 2
15.13	0	Page 19	IN cyclic mapping 3
15.14	0	Page 19	IN cyclic mapping 4
15.15	0	Page 19	IN cyclic mapping 5
15.16	0	Page 19	IN cyclic mapping 6
15.17	0	Page 19	IN cyclic mapping 7
15.18	0	Page 19	IN cyclic mapping 8
15.19	0	Page 19	IN cyclic mapping 9
15.20	642	Page 19	OUT cyclic mapping 0
15.21	121	Page 19	OUT cyclic mapping 1
15.22	0	Page 19	OUT cyclic mapping 2
15.23	0	Page 19	OUT cyclic mapping 3
15.24	0	Page 19	OUT cyclic mapping 4
15.25	0	Page 19	OUT cyclic mapping 5
15.26	0	Page 19	OUT cyclic mapping 6
15.27	0	Page 19	OUT cyclic mapping 7
15.28	0	Page 19	OUT cyclic mapping 8
15.29	0	Page 19	OUT cyclic mapping 9
15.30	DISABLED (0)	Page 41	Restore defaults
15.32	DISABLED (0)	Page 20	Re-initialising the MDX-CANopen
15.34	DISABLED (0)	Page 39	Cyclical data compression
15.35	---	Page 37	Module Serial number
15.36	Read write	Page 41	Disable full write access
15.38	8	Page 19	Read IN cyclic data format
15.39	2	Page 19	Write IN cyclic data format
15.40	2	Page 19	Write OUT cyclic data format
15.41	8	Page 18	Read OUT cyclic format
15.49	---	Page 36	Cyclic mapping status
15.50	---	Page 36	Fieldbus trip
15.51	---	Page 34	Mdx-Canopen firmware-minor version (zz)

13.2 Object reference

Table 13.2 MDX-CANopen object dictionary

Index	Name And Link	Description	Link
0x1001	***Device Type***	Indicates the current configuration of the MDX-CANopen	Section 12.2 on page 43
0x1001	***Error Register***	Used by the MDX-CANopen to indicate that an error has occurred.	Section 12.3 on page 43
0x1003	***Pre-Defined Error***	Returns 32-bit error code containing data from the last four emergency messages that were sent.	Section 12.4 on page 43
0x1005	***COB-ID SYNC***	Defines the COB-ID that will be used for the synchronization (SYNC) object.	Section 12.5 on page 44
0x1008	***Manufacturer Device Name***	Returns a string value to indicate the product name.	Section 12.6 on page 44
0x1009	***Manufacturer Hardware Version***	Returns the product hardware.	Section 12.7 on page 44
0x100A	***Manufacturer Software Version***	Returns a string to indicate the firmware version installed.	Section 12.8 on page 44
0x100C	***Guard time***	Defines the Guard time factor for the Life Guarding protocol.	Section 12.9 on page 45
0x100D	***Life time factor***	Defines the Life Time factor for the Life Guarding protocol.	Section 12.10 on page 45
0x1010	***Store parameters***	This object is used to save the communication parameters.	Section 12.11 on page 45
0x1011	***Restore default values***	This object is used to restore default values.	Section 12.12 on page 46
0x1014	***COB-ID EMCY***	Defines the COB-ID to be used for the emergency object.	Section 12.13 on page 48
0x1015	***Inhibit Time EMCY***	Defines the inhibit time for the emergency object.	Section 12.14 on page 48
0x1016	***Consumer Heartbeat Time***	The «heartbeat protocol» is a node protection system or error control service.	Section 12.15 on page 48
0x1017	***Producer Heartbeat Time***	The «heartbeat protocol» is a node protection system or error control service.	Section 12.16 on page 49
0x1018	***Identity object***	Returns general information about the MDX-CANopen.	Section 12.17 on page 49
0x1400 0x141F	***RxPDO Communication parameters***	Communication information for TxPDOn	Section 12.19 on page 51
0x1600 0x161F	***RxPDO mapping parameters***	Mapping information for RxPDOn	Section 12.20 on page 53
0x1800 0x181F	***TxPDO Communication parameters***	Communication information for TxPDOn	Section 12.21 on page 54
0x1A00 0x1A1F	***TxPDO mapping parameters***	Mapping information for TxPDOn	Section 12.22 on page 56

14 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.

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.

CAN: The base network used for CANopen. The CANopen module does not support CAN commands.

CANopen: Builds on the basic CAN protocol by offering higher level functionality.

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-CANOPEN transmits values as 32 bits on the network. It is possible by using 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 and allowing more parameters to be mapped within MDX-CANopen.

Consistency: Describes how data is transmitted between nodes on the network. If data is consistent it is transmitted from node to node as a single entity. Thus preventing data corruption where multiple bytes are transmitted or received individually.

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.

Cyclic data: This consists of values that are sent at regular or cyclic intervals across the network. A typical use of cyclic data would be the transmission of a speed reference or a control word.

Data format: Determines the quantity and function of the data sent and received across the network.

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.

Object Dictionary: A collection of the objects that are supported by the product.

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

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

Endian format: When a value uses more than 8 bits to represent it's value it needs to be sent in sets of 8 bits (bytes) across the network, the endian format determines the order the bytes that constitute the whole value are transmitted.

Event task: A special way to use a message or change of state to trigger a software routine.

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

Mapping: The process of linking CANopen values to parameters within the drive.

Network loss trip: A method to determine when a node has lost communication 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.

PDO: Process Data Object. This is the method that CANopen uses to transmit and receive cyclic data.

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

Response ID: The response code of the message received when using PPO4 word non-cyclic communication.

Scan rate: See Poll rate in this section.

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

SDO: Service Data Object. These provide non-cyclic access to the CANopen object dictionary in each slave.

Segment: An electrically separate part of the network. Each segment requires correct termination to ensure reliable operation. Due to electrical limitations the maximum number of devices on a segment is limited to 32.

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

Stuff Bits: Stuff bits are used by CANopen to ensure that each CANopen device does not transmit a long stream of consecutive 1s or 0s.

Telegram: A message used within mode 1 non-cyclic data communication. This term is sometimes used to represent a generic message on the network.

Termination: This is used at both ends of a network segment to prevent reflections and reduce noise.

Watchdog: A method used to determine if a communication system is ok. A typical watchdog scheme uses a handshaking system to check both the master and slave are participating in communications.

Word: A collection of 16 binary digits.

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