Nidec

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User guide

MDX-PROFINET

Fieldbus communication module

LEROY-SOMER™

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-PROFINET 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 is 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-PROFINET.

For the variable speed drive commissioning, refer to the appropriate manuals.

Contents

1 Safety and operating instructions for variable speed drives

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

1.1 Warning

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

1.2 General

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

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

For further information, consult the documentation.

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

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

1.3 Use

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

When integrated in a machine, commissioning must not take place until it has been verified that the machine conforms with directive 2006/42/EC (Machinery Directive). It is also necessary to comply with standard EN 60204, which stipulates in particular that electrical actuators (which include variable speed drives) cannot be considered as circuit-breaking devices and certainly not as isolating switches.

Commissioning can take place only if the requirements of the Electromagnetic Compatibility Directive (EMC 2004/108/EC) are met.

The variable speed drives meet the requirements of the Low Voltage Directive 2006/95/EC. The harmonised standards of the DIN VDE 0160 series in connection with standard VDE 0660, part 500 and EN 60146/VDE 0558 are also applicable.

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

The STOP and SAFE TORQUE Off functions of the drive do not isolate dangerous voltages from the output of the drive or from any external option unit. The supply must be disconnected by an approved electrical isolation device before gaining access to the electrical connections. **With the sole exception of the SAFE TORQUE Off function, none of the drive functions must be used to ensure safety of personnel, i.e. they must not be used for safety-related functions.**

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 MDX-PROFINET ?

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

Figure 2.1 - MDX-PROFINET

2.2 Features

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

• POWERDRIVE FX and POWERDRIVE MD2.

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

• Dual 100 BASE-TX RJ45 connectors with support for shielded twisted pair, full duplex

• 100 M bps connectivity with auto crossover correction

• Both RJ45 ports operate in full duplex mode as a network switch

• PROFINET Real Time class RT_Class_1 and conformance class A

• Cycle times from 2 ms to 512 ms specified during configuration

• LED indication of network port activity

• Maximum 10 inputs parameters and 10 outputs parameters

• Identification and Maintenance functions I&M0 to I&M4 supported

MDX-PROFINET is powered from the host drive's internal power supply and draws 200mA from the supply.

2.3 Backup/auxiliary supply

The drives provide a method of powering up the control circuits (and therefore any options modules installed) if the AC supply is removed, this allows the MDX-PROFINET to continue operating when the main AC supply is switched off. For every MDX-PROFINET module installed allow for an extra 200mA of supply current to be drawn from the backup supply.

2.4 Option module identification

The MDX-PROFINET can be identified by the label located on the underside of the option module.

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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. If using a DC bus supply ensure this is fully discharged before working on any drive or options modules.

3.1 General Installation

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

Figure 3.1 - MDX-PROFINET
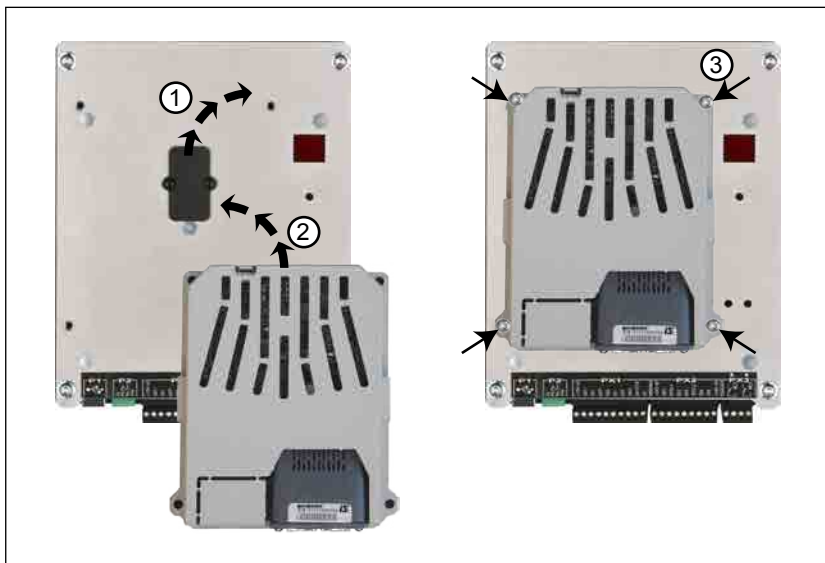
First, remove the mask which protects the option connector slot on the drive control board.

(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-PROFINET option module incorporates two 100 BASE-TX RJ45 interfaces operating in full duplex mode. MDX-PROFINET provides 4 diagnostic LEDs for status and information purposes. Figure 4-1 shows an overview of the module connections and indicators.

Figure 4.1 - MDX-PROFINET / overview

#	Items
1	Network status LED
2	Module status LED
3	Link/Activity Port 1
4	Link/Activity Port 2
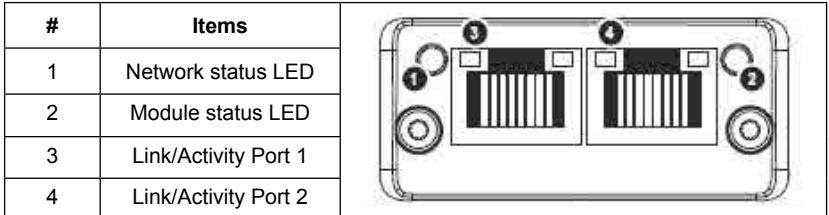
Figure 4.2 - RJ45 pin out detail

Not used — Transmit +
Not used — Transmit -
Receive - — Receive +
Not used — Not used
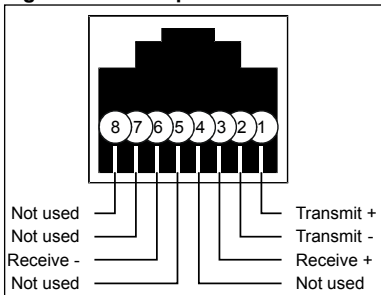
4.2   Cabling considerations

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

4.3   MDX-PROFINET cable shield connections

Standard Ethernet UTP or STP cables do not require supplementary grounding.

4.4   Cable

Copper cables should be shielded twisted pair (STP) and, as a minimum, meet TIA Cat 5e requirements and be certified for use on a PROFINET network. The coloring of the outer sheath is not critical but should be consistent (where possible) to simplify system maintenance and, preferably, for identification purposes comply with the standard PROFINET coloring (yellow/green).

PROFINET copper cables are categorized into three different types, the actual type used is mainly determined by the relevant application.

• Type A cables are designed for fixed installations where the cable is not subject to any movement.

• Type B cables are designed for flexible installations where the cable can be subject to occasional movement or vibration.

• Type C cables are designed for special applications where the cable will be subject to frequent or continuous movement or vibration.

Cable properties

The properties for all three types of cables are similar, the only difference between the three types are the size of the individual wires used.

Table 4.1 - Cable properties

Impedance	$100\,\Omega \pm 15\,\Omega$
Loop resistance	<115 Ω/km
Transmission rate	100 M Bit/s
Maximum length	100 m
Number of wires	4
Sheath color	Green
Insulation color	White, Blue, Yellow, Orange

	Type A	Type B	Type C
Wire diameter	0.64 m	0.75 mm	0.13 mm
Wire CSA	0.32 mm^2 (AWG 22/1)	0.36 mm^2 (AWG 22/7)	AWG 22/7 or AWG 22/19

NOTE   Special properties of some copper cables use flame retardant materials which can reduce the maximum length of the cable to less than 100 m. For more information please refer to the cable manufacturer's documentation.

4.5 Maximum network length

The main restriction imposed on Ethernet cabling is the length of a single segment of cable as detailed in Table 4.3. If distances greater than this are required it may be possible to extend the network with additional switches or by using a fiber optic converter.

Table 4.2 - Ethernet maximum network lenghts

Type of cable	Data rate (bit/s)	Maximum trunk length
Copper - UTP/STP CAT 5	10 M	100
Copper - UTP/STP CAT 5	100 M	100
Fiber optic - Multi mode	10 M	2000
Fiber optic - Multi mode	100 M	3000
Fiber optic - Single mode	10 M	No standard
Fiber optic - Single mode	100 M	Up to 100000

NOTE   The distances specified are absolute recommended maximums for reliable transmission of data. The distances for the fiber optic sections will be dependent on the equipment used on the network. The use of wireless networking products is not recommended for control systems, as performance may be affected by many external influences.

4.6 Minimum node to node cable length

There is no minimum length of cable recommended in the Ethernet standards for UTP or STP. For consistency across fieldbus modules, LEROY-SOMER recommends a minimum network device to device distance of 1 metre of cable. This minimum length helps to ensure good bend radii on cables and avoids unnecessary strain on connectors.

4.7   Network topology

4.7.1   Hubs

A hub provides a basic connection between network devices. Each device is connected to one port on the hub. Any data sent by a device is then sent to all ports on the hub. The use of hubs is not recommended for use within control systems due to the increased possibility of collisions. Collisions can cause delays in data transmission and are best avoided, in severe cases a single node can prevent other nodes on the same hub (or collision domain) from accessing the network. If using hubs or repeaters you must ensure that the path variability value and propagation equivalent values are checked. This is, however, beyond the scope of this document.

NOTE   LEROY-SOMER do not recommend the use of un-switched hubs.

4.7.2   Switches

Switches offer a better solution to hubs, because after initially learning the addresses of connected devices the switch will only send data to the port that has the addressed device connected to it, thus reducing network traffic and possible collisions. The difference in price between the hub and a switch means that in almost all cases the switch is the preferred choice. Some managed switches allow the switching of data to be controlled and monitored, this may be of particular importance on large or high performance systems.

NOTE   Some switches require a certain time to initialize (typically 30 to 60 seconds) if MDX-PROFINET is reset.

4.7.3   Routers

A router is used to communicate between two physical networks (or subnets) and provides some degree of security by allowing only defined connections between the two networks. A typical use would be connecting the office and manufacturing networks or connecting a network to an ISP (Internet Service Provider). A router is sometimes known as a gateway as it provides a «gateway» between two networks. It is generally recommended that a firewall is used when connecting networks as this provides additional security features.

4.7.4   Firewalls

A firewall allows separate networks to be connected together in a similar way to a router. The firewall however offers significantly more security features and control. Typical features include address translation, port filtering, protocol filtering, URL filtering, port mapping, service attack prevention, monitoring and virus scanning. This is usually the preferred method of allowing traffic from a manufacturing network to the business network. The setup and installation of the firewall should be done by a suitably qualified engineer and is beyond the scope of this document.

4.7.5 VPN

A VPN (Virtual Private Network) is a method of using a non-secure or public network that allows devices to be connected together as if they were connected on a private network. A typical example would be the connection of two remote offices such as London and New York. Each office would require a high speed Internet connection and a firewall (or VPN device). In order to configure the VPN, encryption keys are exchanged so that both offices can communicate. The data is then sent across the Internet (or shared network) in an encrypted form, giving the illusion of a single connected network (speed limitations may apply). This is generally used as a low-cost alternative to a private leased line. Configuration of VPNs is beyond the scope of the document.

4.8 Typical network connections

4.8.1 Single PC to MDX-PROFINET

Connecting a PC to the MDX-PROFINET requires a crossover cable. This allows the two devices to communicate without the use of a switch or hub.

Figure 4.3 - Connecting a single PC to MDX-PROFINET using a crossover cable
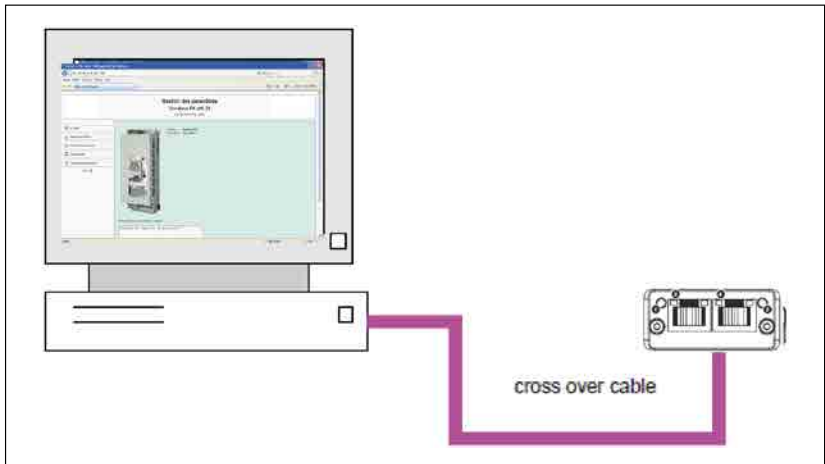
cross over cable

NOTE   When purchasing network cables it is recommended that a different color (e.g. pink) is used for crossover cables to allow easy recognition. If no cross-over cable you need to connect via a switch.

NOTE   Some PCs and network switches provide auto-crossover correction and therefore the need for a crossover cable may not be necessary. Refer to the PC or network switch documentation for confirmation.

4.8.2 Single PC to multiple MDX-PROFINET using a single switch

Connecting multiple MDX-PROFINET modules should be done using an industrial grade switch. Each MDX-PROFINET or PC is connected to the switch using a standard RJ45 lead (patch lead).

Figure 4.4 - Single PC to multiple MDX-PROFINET modules using a switch
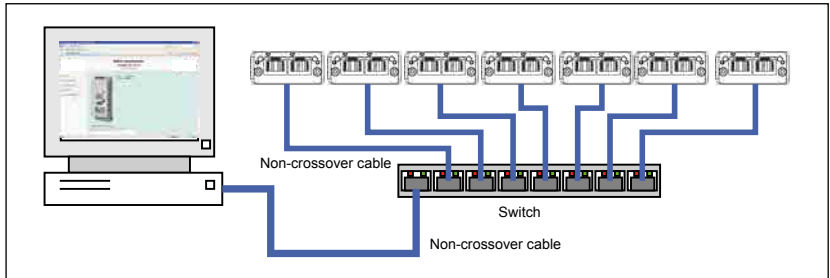
4.8.3 Single PC to multiple MDX-PROFINET using a daisy chain

Connecting multiple MDX-PROFINET modules should be done using daisy chain on networks (see figure 4-5). Other Ethernet network topologies can be used but care must be taken to ensure that the system still operates within the constraints specified by the designer.

Figure 4.5 - Connections with multiple switches (internal)
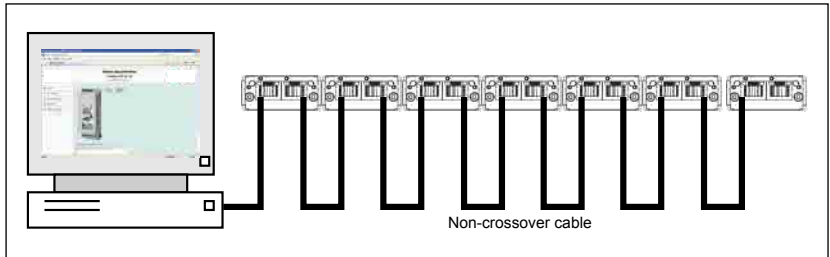
4.8.4 Connection of network subnets

When connecting multiple network subnets a router or firewall should be used to allow effective management of network traffic. A subnet is identified by the change in the network section of the IP address. A subnet boundary is usually designated by a router or firewall. The design of larger networks, however, is beyond the scope of this document.

5 Getting started

This section is intended to provide a generic guide for setting up MDX-PROFINET and a master controller. It 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 this entire chapter is read, before attempting to configure a system.

NOTE   Before contacting your supplier or LEROY-SOMER for support ensure you have read Chapter 12 Diagnostics of this manual and check you have configured all parameters correctly.
Ensure the following information is available before calling :
• A list of all parameters in MDX-PROFINET.
• The MDX-PROFINET firmware version.

5.1 GSDML Files

What are GSDML Files ?
GSDML files are text files that are used by the Profinet network configuration software tools. They contain information about the device timings, supported features and available data formats for the Profinet device. Drive icon files are also supplied for use with the Profinet configuration software. GSDML files are available from your supplier, LEROY-SOMER or the LEROY-SOMER website (www.leroy-somer.com).

Data configuration
The GSDML file describes the modules of input or output words that may be combined to configure the input and output configuration for a specific node. The complete input and output configuration for the node is built by adding the required modules until all of the node's inputs and outputs are defined.

NOTE   A module consists of a block of input or output data. Put simply this in a logical collection of data words.

The number of input or output words configured in the drive must match the number of input or output words defined in the master; if the master has eight IN and four OUT words the drive must use the same settings to communicate correctly.
The MDX-PROFINET module uses Pr **15.40** and Pr **15.39** to set the number of parameters. The configuration of the number of output and input bytes (8-bit) can be seen in parameters Pr **15.41** and Pr **15.38**.

NOTE   The master needs to declare firstly OUT words and after IN words. Also each parameter needs to be declared one by one (eg. By default master configuration declares 2 OUT + 2 OUT + 2 IN + 2 IN).

5.2 Configuring the PROFINET IO communications

MDX-PROFINET does not require the module parameters to be configured by the user in order to achieve PROFINET cyclic communications. All the necessary configuration is undertaken by the network controller or PLC during the start-up sequence, and after the network configuration is programmed into the network controller or PLC.

It must be noted that when configuring the cyclic data modules, if a module is configured but the associated drive parameter does not actually exist in the drive, then the PLC will not start up correctly and will indicate a configuration fault.

5.3 Setting the IP address

Each device on a network must have it's own unique IP address, if the network is not to be connected to other networks or the Internet, then the assignment of the IP addresses is not critical (although using a standard system is recommended). The issue of address assignment becomes more important when connecting multiple networks together or connecting to the Internet where there is a strong possibility of address duplication unless a standard addressing system is used.

The IP address and subnet mask will be determined during the network configuration setup and, along with the device name, programmed into the module during parameterization.
When selecting IP addresses, the following list details some points that should be considered:
• **Reserve address space** : Ensure you have enough reserve address space on your chosen addressing scheme to allow for future expansion.
• **Uniqueness** : Ensure your addresses are unique, every device on a subnet must have a unique address.
• **Avoid reserved addresses** : For example the address 127.0.0.1 is reserved as the loop back address.
• **Broadcast and system addresses** : The highest and lowest host address on a subnet are reserve addresses.
• **Use a system** : Have a scheme for assigning your addresses, for example typically servers may have a low IP address and routers a high IP address. It is not necessary to allocate consecutive IP addresses so it is possible to reserve ranges for specific uses such as servers, work stations or routers.

5.4 Class types
IP addresses are grouped into ranges called classes, each class has a specific set of addresses and has a typical situation where it is used. When selecting the class of IP address required, consideration must be given to how many subnets you need, how many hosts are required and if you will need a public (worldwide) or a private (local) addressing scheme. Table 5.1 shows an overview of how the class types are defined and Table 5.2 shows how each class separates the subnet and host ID.

Table 5.1 - Subnets and hosts supported by class type

Address Class	First Octet Decimal range	Number of subnets	Number of hosts
A	1-126.x.y.z	126	16,777,214
B	128-191.x.y.z	16,382	65,534
C	192-223.x.y.z	2,097,150	254

Table 5.2 - Address components

Address Class	First Octet Decimal range	Number of subnets	Number of hosts
A	w.x.y.z	w	x.y.z
B	w.x.y.z	w.x	y.z
C	w.x.y.z	w.x.y	z

NOTE   Using the subnet mask it is possible to modify the IP addressing such that the ratio of subnets and host addresses may be changed. This gives you the facility to "adjust" standard classes to suit your specific requirements.

5.4.1   Class A addresses

A class A address only uses the first octet to represent the subnet, the remaining octets are used to represent the host id. These addresses are intended for large organizations such as universities and the military. These addresses must be requested from the governing body (InterNIC) when using them publicly (on the Internet) to avoid duplication.

5.4.2 Class B addresses

A class B address uses the first two octets to represent the subnet, the remaining octets are used to represent the host id. These addresses are intended for medium to large size networks. These addresses must be requested from the governing body (InterNIC) when using them publicly (on the Internet) to avoid duplication. Class B addresses are generally used on public or private networks.

5.4.3 Class C addresses

Class C addresses use the first 3 octets as the subnet address and the remaining octet as the host id. A class C address is normally used on a private network only, due to the restriction on the number of hosts on the network. Class C addresses will not be routed onto the Internet.

5.4.4 Class D & E addresses

These addresses are reserved for multicasting and experimental use.

5.5 Subnet mask

The subnet mask defines which part of the IP address constitutes the subnet address and which part constitutes the host address.
The subnet mask is bit-wise ANDed with the IP address to give the network ID, the host ID portion of the IP address is bit-wise ORed with the subnet mask to give the host ID.

• A '1' in the subnet mask indicates that the corresponding bit in the IP address is part of the network or subnet ID address
• A '0' in the subnet mask indicates that the corresponding bit in the IP address is a part of the host ID address.
Figure 5.1 - Network and host ID illustrates an example with a class C IP address

Figure 5.1 - Network and host ID
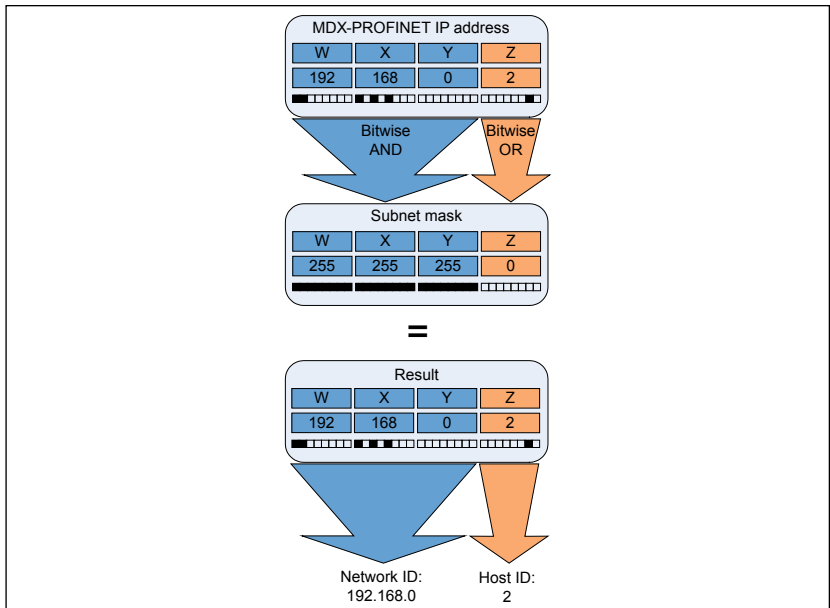
5.6   PROFINET device name

Every PROFINET device must have a unique device name assigned to it during network configuration. Device names are used by the PLC to communicate with the device for RT messages (cyclic data and alarms). Without a device name, the device will not enter data exchange with the PLC.

The actual choice of device name is not important to the PROFINET IO system itself, however a suitable name should be chosen so that it is easily recognized on the network and identifies the location and function of the device.

A typical device name may contain up to four labels, each label is separated by a dot (.) and may be up to 63 characters long. The device name must also satisfy DNS naming conventions, therefore the following rules must be observed when choosing a device name:
• Maximum length of 127 characters
• Characters must be either letters (lower case), numbers, dashes (-) or dots (.)
• The device name must start with a letter and end with either a letter or number
• The device name must not be of the format n.n.n.n (where n is a number from 0 to 999)
• The device name must not begin with the character sequence 'port-xyz-' (where x,y,z is a number from 0 to 9)
A typical example of a device name could be: motor-1.conveyor-2.line-3.ct-4

NOTE   The default name is specified in the GSDML file in the string value 'ABCC-PRT 2-Port'.

5.7   Set-up flow chart
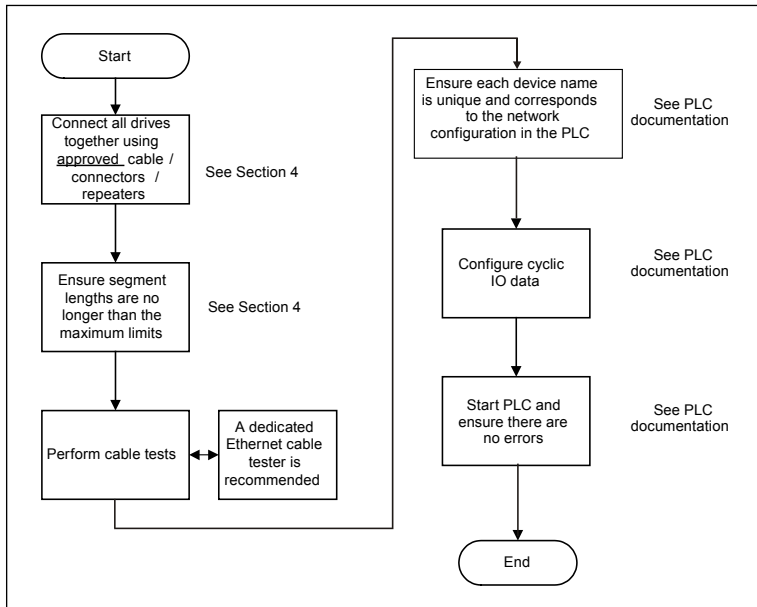
5.8 MDX-PROFINET operating status

Operating status

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

This parameter gives operating status of MDX-PROFINET, a value of 2 (inactive network process data) indicates that MDX-PROFINET is initialized and ready to communicate. For more information see section 12.6 Fieldbus option state.

5.9 Re-initializing MDX-PROFINET

Re-initializing

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

Changes to the MDX-PROFINET configuration will not take effect until the MDX-PROFINET has been re-initialized. To re-initialize MDX-PROFINET:
1. Set Pr **15.32** to ENABLED.
2. The MDX-PROFINET will re-initialize using the updated configuration.

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

5.10 Saving parameters to the drive

Drive parameters are automatically saved if changed by keypad or PC software. If parameters are changed by Ethernet : to avoid loss of the configured settings when the drive is powered down it is necessary to store the parameters. To store drive parameters:

• Set Pr **11.65** to 0. (See note regarding drive).
• Set Pr **11.64** to yes (1).
• if **11.64** returns to no (0), the storing is finished.

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

6 Additionnal features

This chapter provides information on the additional functions and features of the MDX-PROFINET option module.

6.1 Update time

In contrast to some other fieldbus networks, PROFINET has no single bus cycle where the slowest device determines the update rate for all devices, PROFINET allows differed update rates for each device. MDX-PROFINET can be configured with an update rate of between 2 ms to the slowest rate of 512 ms; the possible update rates are 2, 4, 8, 16, 32, 64, 128, 256 and 512 ms. When selecting the update time, it is recommended that the slowest rate necessary is used, this is to minimize the possibility of overloading the network.

6.2 PROFINET transmission cycle

The PROFINET transmission cycle is the time required to update all the devices on the PROFINET network; the length of the PROFINET transmission cycle (send cycle) is determined by the PROFINET device which has the slowest update rate. The transmission cycle can be split into a number of phases where each phase contains one or more devices with similar update rates, the duration of each phase will be equal to the fastest update rate.

Example:
In the following example (Figure 6-1 PROFINET transmission cycle example), a system uses four PROFINET devices, device 1 has an update rate of 8 ms, device 2 has an update rate of 4 ms, device 3 has an update rate of 2 ms and device 4 has an update rate of 1 ms.

Figure 6.1 - PROFINET transmision cycle example
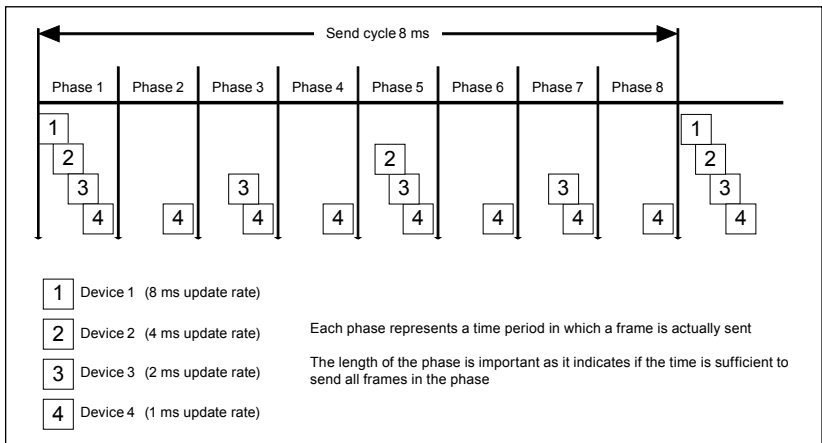
The PROFINET transmission cycle is effectively the slowest update rate (8 ms in this example), and the phase time is effectively the quickest update rate (1 ms in this example). The following information is provided for use when designing a PROFINET network to calculate the total and individual transmission cycle times.

6.2.1 Number of phases

The number of phases is determined by the formula:
Number Of Phases = Send Cycle / Fastest Update Rate = 8 ms / 1 ms = 8

6.2.2 Length of phase

The length of each phase is determined by the formula:
Length Of Phase = SendClockFactor x 31.25 μs = 32 x 31.25 μs = 1 ms
Where:
SendClockFactor is specified in the GSDML file as the 'MinDeviceInterval' value.

6.2.3 Reduction ratio

The reduction ratio acts as a multiplier of the minimum update time and is determined by the formula:
Reduction ratio = Send Cycle Device / Length Of Phase
In this example,
Reduction ratioDevice 1 = 8 ms / 1 ms = 8
Reduction ratioDevice 2 = 4 ms / 1 ms = 4
Reduction ratioDevice 3 = 2 ms / 1 ms = 2
Reduction ratioDevice 4 = 1 ms / 1 ms = 1

The MDX-PROFINET module allows the update rate to be configured in one of three ways:
1. **Automatic** - the update time selected is the time that the IO system calculates, based on the configuration, that can be reliably achieved.
2. **Fixed update time** - the user selects the device update rate directly from a selection.
3. **Fixed factor** - the user selects the reduction ratio to be used to multiply the minimum transmission cycle time by to give the device update rate.

6.3 Identification and Maintenance (I&M)

6.3.1 General Information

Identification & Maintenance (I&M) provides a standard way of gathering information about an MDX-PROFINET. The I&M information can be accessed by the IO Controller by means of acyclic Record Data Read/Write services. By default, the module implements support for I&M0 as follows:

Table 6.1 - Default I&M0 information

IM Manufacturer ID	010Ch (HMS Industrial Networks)
IM Order ID	'ABCC-PRT (2-Port)'
IM Serial Number	(unique serial number, set during manufacturing)
IM Hardware Revision	(hardware revision ID, set during manufacturing)
IM Software Revision	(software revision, set during manufacturing)
IM Revision Counter	(Revision counter)
IM Profile ID	F600h (Generic Device)
IM Profile Specific Type	0004h (No profile)
IM Version	0101h
IM Supported	0000h (IM0 supported)

6.3.2   I&M Data Structures

The I&M records uses the following data structures

Table 6.2 - I&M data structures

Record	Content	Size	Description
I&M0	Manufacturer Id	2 bytes	PROFINET IO Object (F6h), attribute #2 ('Vendor ID/I&M Vendor ID')
	Order Id	20 bytes	PROFINET IO Object (F6h), attribute #8 ('I&M Order ID')
	Serial number	16 bytes	PROFINET IO Object (F6h), attribute #9 ('I&M Serial number')
	Hardware revision	2 bytes	PROFINET IO Object (F6h), attribute #10 ('I&M Hardware revision)'
	Software revision	4 bytes	PROFINET IO Object (F6h), attribute #11 ('I&M Software revision')
	Revision counter	2 bytes	PROFINET IO Object (F6h), attribute #12 ('I&M Revision counter')
	Profile Id	2 bytes	PROFINET IO Object (F6h), attribute #13 ('I&M Profile ID')
	Profile specific type	2 bytes	PROFINET IO Object (F6h), attribute #14 ('I&M Profile specific type')
	IM version	2 bytes	PROFINET IO Object (F6h), attribute #15 ('I&M Version')
	IM version	2 bytes	PROFINET IO Object (F6h), attribute #15 ('I&M Version')
I&M1	Tag Function	32 bytes	Network Configuration Object (04h), attribute #16 ('I&M Tag Function')
	Tag Location	22 bytes	Network Configuration Object (04h), attribute #17 ('I&M Tag Location')
I&M2	Installation date	16 bytes	Network Configuration Object (04h), attribute #18 ('I&M Installation Date')
I&M3	Descriptor	54 bytes	Network Configuration Object (04h), attribute #19 ('I&M Descriptor')
I&M4[a]	Signature	54 bytes	Default: All bytes set to zero (00h)

a. Data of this field must only be accessed from the network by the IO Controller/Supervisor.

6.4   Web pages (HTTP)

Web page access is provided to allow configuration of the drive and option(s) module(s). The web pages also allow parameters to be monitored and configuration settings to be uploaded or downloaded.

To view web pages on MDX-PROFINET one of the following web browsers should be used :

- Microsoft Internet Explorer (version 5.0 or later).
- Netscape (version 6.0 or later).
- Mozilla (version 1 or later).
- Opera (version 8 or later).

The standard web pages provide access to the following features :

- Advanced Parameters.
- General configuration (network setting, e-mail, user settings).
- Backup (uploaded or downloaded parameters).
- Supervising menu (customers select parameters they want to supervise).
- Language support.

For details of the web pages please see Chapter 10 Web page basics.

7   Cyclic data

7.1   What is cyclic data?

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

NOTE The term OUT data refers to data that is transmitted out of the master to the slave.

- The term IN data refers to data that is returned from a slave into the master.

- Cyclic data mapping cannot be changed dynamically, as changes to the configuration (mapping parameters, etc.) will only take effect during initialization of the MDX-PROFINET.

- 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 mapping parameters that is possible is: 10 (20 words).

See section 13.2 Compression of Cyclic data for information on using data compression with 8 or 16-bit parameters.

7.2   Data formats

The MDX-PROFINET can be configured with up to ten 32-bit or ten 16-bit cyclic OUT and IN data. OUT and IN cyclic data are mapped using ten mapping (pointer) parameters, one for each mapping.

NOTE By default all drive parameters are cast as 32-bit (two 16-bit words) therefore twenty cyclic words give ten possible drive parameters. Data compression reduces the number of cyclic words required for drive parameters of 16-bit to 16-bit and 8-bit (or less) to 16-bits. Any 32-bit parameters mapped will still require two 16-bit words even with compression turned on.

Table 7.1 - IN/OUT cyclical data formats

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

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

MM = menu number of the target/source parameter,

PP = parameter number of the target/source parameter.

Table 7.2 - MDX-PROFINET mapping parameters

IN channel	Mapping parameter	OUT channel	Mapping parameter
0	Pr **15.10**	0	Pr **15.20**
1	Pr **15.11**	1	Pr **15.21**
2	Pr **15.12**	2	Pr **15.22**
3	Pr **15.13**	3	Pr **15.23**
4	Pr **15.14**	4	Pr **15.24**
5	Pr **15.15**	5	Pr **15.25**
6	Pr **15.16**	6	Pr **15.26**
7	Pr **15.17**	7	Pr **15.27**
8	Pr **15.18**	8	Pr **15.28**
9	Pr **15.19**	9	Pr **15.29**

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

If 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-PROFINET will indicate a configuration error by the mapping status parameter (Pr **15.49**). Refer to section 12.7 Cyclic parameter number (Mapping status) for more details. The following sections show some example data formats that can be selected, and the parameter mapping that will apply (by default) to each format.

7.2.1 Two cyclic channels only (default - compression off)

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

Table 7.3 - Mapping for cyclic data words

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

7.2.2 Three cyclic channels only (compression off)

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

Table 7.4 - Mapping for five cyclic channels

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

7.2.3 Three cyclic channels only (compression on)

This data format provides example of three cyclic data channels with compression on (Pr **15.34** = ENABLED). The total data length is four words OUT and five words IN.

To select this data format, set Pr **15.40** and Pr **15.39** = 3.

Table 7.5 - Mapping for five cyclic channels

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

7.3 Mapping conflicts

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

7.4 Cyclic data mapping errors

The MDX-PROFINET module will scan and check the PROFINET mapping parameter configuration for errors during initialization (ex. Pr **15.32** = ENABLED). If an error is detected, then the MDX-PROFINET configuration error detected will be indicated in mapping status parameter, Pr **15.49**. See section 12.7 Cyclic parameter number (Mapping status) for full details.

7.5 Mapping data sizes

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

Table 7.6 - Actual data sizes

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

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

The following settings are shown:
- Pr **15.38** = 6 (4 + 2),
- Pr **15.41** = 6 (4 + 2).

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

Input cyclical data bytes

Pr **15.38**	Default	8
	Range	0 to 127
	Access	RO

Output cyclical data bytes

Pr **15.41**	Default	8
	Range	0 to 127
	Access	RO

7.6 Disabling mappings

Any unused mapping parameters (Pr **15.10** to Pr **15.19** and Pr **15.20** to Pr **15.29**) are disabled by the number of parameter 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 value of parameters Pr **15.39** and Pr **15.40** include this unmapped channel.

8   Non-cyclic data (acyclic)

8.1   What is non-cyclic data?

Non-cyclic data allows access to any parameter without the need to use cyclic data transfers. This is particularly useful when accessing many different parameters for setup or archiving of drive settings. There is one method of using non-cyclic data on the MDX-PROFINET :

• Device Access Point (DAP)

8.2   PROFINET IO Parameter Access

Drive parameters can be accessed acyclically from the network by means of Record Data read/write services. If addressed through a given DAP and Index range, the module translates the service into standard object requests towards the Application Data Object.

The index affects the addressing of DAP on PROFINET:

There is a 1:1 correlation between DAP and index as long as the index number is less than – or equal to - 7FFFh. Index 0 (zero) is not associated with an DAP and cannot be used.

Table 8.1 - Examples

Drive parameter	DAP	Index
Pr **1.25**	125	125
Pr **21.30**	2130	2130

9 Control and status words

9.1 What are control and status words?

The control and status words allow the digital control and monitoring of the drive to be implemented using a single data word for each function. Each bit in the control word has a particular function and provides a method of controlling the output functions of the drive, such as run and direction. Each bit in the status word provides feedback about the drive's state of health and operational condition, such as drive healthy, drive at speed, etc...

9.2 Control word

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

Table 9.1 - Control word

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

⚠️ **WARNING**

Reserved bits must be kept at 0.

To enable fieldbus control the fieldbus enable signals must both 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. These terminals are normally controlled by an external "Emergency Stop" circuit to ensure that the drive is disabled in an emergency situation. The control word ANALOG REF/PRESET REF bit directly controls the drive parameter Pr **1.42**, the function of which is to select the digital speed reference as the source of the drive 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 the digital reference register. For further details on the drive digital speed reference, please refer to the appropriate drive user guide. Table 9.2 lists in detail the function of each control word bit. For further in-depth details about drive control words and sequencing bits please refer to the appropriate drive User and Advanced User Guides.

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

Table 9.2 control word bit functions

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

9.3   Status word

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

Table 9.3 - Status word

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

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

Table 9.4 - Drive status word bit functions

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

10   Web page basics

10.1   Connecting to MDX-PROFINET

In order to communicate, the PC must be on the same subnet as the drive or you must have a gateway specified for the host PC and the MDX-PROFINET module.

10.1.1 Making a connection

To connect to MDX-PROFINET, enter the address of the MDX-PROFINET module (see section 5.3 Setting the IP address) into the browser window as follows :
http://192.168.1.100 (for example).
Replacing the address (192.168.1.100) with the address of the MDX-PROFINET module you wish to communicate with.

10.2   Web page menu structure

The menu structure on MDX-PROFINET is logically grouped by function to allow for ease of navigation.

Figure 10.1 - Web page structure
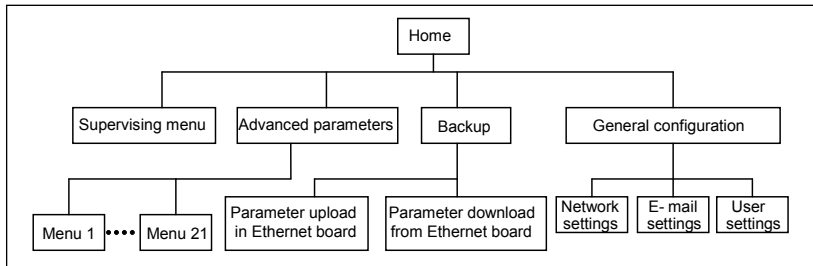
10.2.1 The home page

Figure 10-2 shows the initial home page when connected to MDX-PROFINET.

Figure 10.2 - Initial home page

Language   Top level menu   Storing details   Drive details   Drive name and version
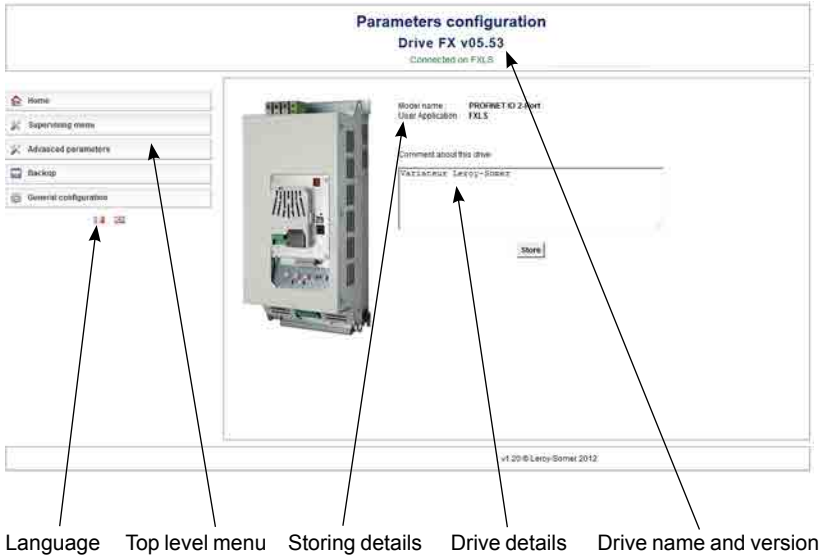
The home page contains the following main areas:
- Language: click on the image to select the language display.
- Top-level menu: this is the menu that is used to navigate to the menus on MDX-PROFINET. Click on the items to make a selection.
- Storing details: click on the Store button to storing drive details on the windows.
- Drive details: contains more details about the MDX-PROFINET usage.
- Drive name and version: this is the name allocated to MDX-PROFINET during set-up. The section also details the option module installed to the drive and its Web page firmware versions.

10.2.2 Logging in

Before you can view any additional screens you must login to MDX-PROFINET. The default username is admin and the default password is pass. The admin cannot be deleted, but a new password should be created. This account is not appropriate for day to day use, and an Administrator account should be created as soon as is practically possible. The password for the admin account should be noted in a secure place as this password is not reset when the module is defaulted. Figure 10-3 shows the login screen, after entering the details click the "OK" button to login. If you lose your passwords you need to login with the default passwords.

Figure 10.3 Log-in

When you have finished working with the module you should log-out using the log out option in the top-level menu. This prevents unauthorized access to MDX-PROFINET.

10.2.3 Advanced parameters

Displays a list of the menus within the host drive.

Figure 10.4 - Advanced parameters

Drive menu   Read only parameter   Read/Write parameter   Switch parameter
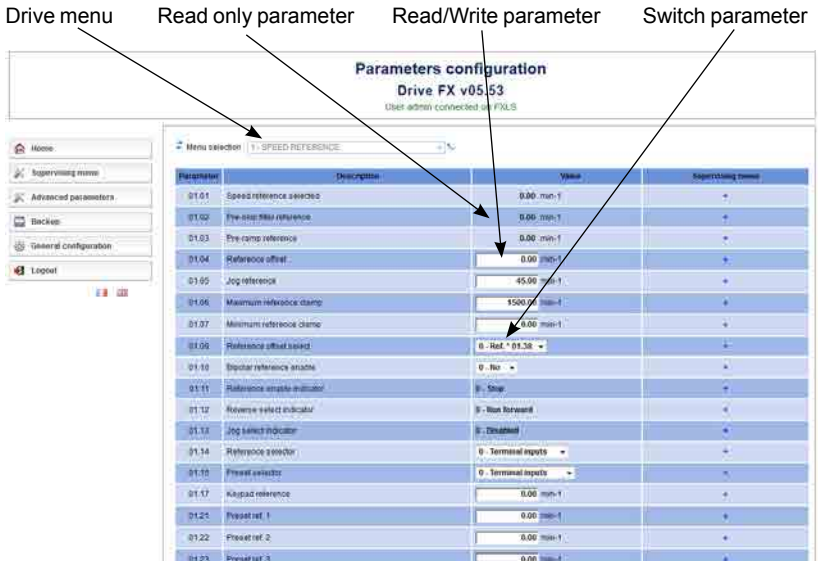
10.2.4 Backup

Allows data from the module to be uploaded for backup in module memory. This backup has all module parameter values. This backup can be downloaded to any MDX-PROFINET module in the same network with its Ethernet drive address.

Figure 10.5 - Send backup to another drive
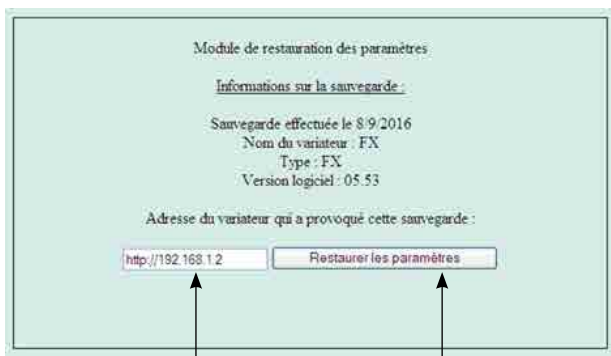
Drive IP address in which   Restore button
the backup will be sent

11   Security

11.1   Introduction

On open networked systems it is important that security is considered. Security covers aspects such as access to devices using passwords, network infrastructure, company procedures and backup procedures. The physical system security should be enforced with acceptable user policies and appropriate employee guidelines.

11.2   General site security issues

11.2.1   Connecting your computer

It is important to remember that when connecting your computer to an existing network you will have an impact on the data and services on that network. Particular care should be taken not to interrupt the flow of data by disconnecting cables, powering down switches/routers, or interrupting data flow by sending large amounts of data over the network.

11.2.2   Virus considerations

Connecting your computer to a network carries the risk of transferring computer viruses to other computers on that network. It is vital that when connecting to a network you ensure that your anti-virus software is up to date and activated. Many operating system vendors offer regular product updates to increase stability and reduce the risk of malicious programs causing damage to your corporate infrastructure.

NOTE   LEROY-SOMER recommends the use of a quality anti-virus solution on any networked system. The overall network security policy resides with the network administrators and any connections to a network should be approved by the network administrators.

11.2.3   Firewall issues

When a high level of security is required between the automation network and the business network a firewall should be used. This helps prevent unwanted traffic passing between the networks and can be used to restrict access to certain machines or users. NOTE Some managed switches provide control methods for network traffic, however a firewall offers significantly more features. Configuration of a switch or firewall is beyond the scope of this document.

11.3 Account management

A user account system is provided to allow an administrator to give access rights to different classes of user. The system provides accounts for administrator and user account types. The default username admin and password pass should be used to gain initial access to the module. Once logged on, additional accounts should be added as required, with key members of the engineering staff having supervisor access. It is recommended that a policy is put into place to ensure that passwords are recorded elsewhere. There is a limit of one active user account.

11.4 Adding new accounts

In order to add a new account you will need to follow the instructions below:
1. Log on to the web pages using the admin or an administrator account.
2. Choose the top level General Configuration menu then the User setting menu.
3. Enter the details as requested in the menu.
4. Click "Create user" to finish.

11.4.1 Administrator accounts

Administrator accounts are intended to provide a high level of access to the drive and module settings. An administrator account should be reserved for engineering staff who have a thorough understanding of the drive, MDX-PROFINET and the system. Where possible more than one person should be given administration privileges. An administrative account is required for adding/removing accounts.

11.4.2 Other user accounts

Other user accounts should be used for engineers that need to make changes to the system occasionally, different account types are available depending on the facilities and features required. For more information see section 11.6 Security levels.

11.5 Security levels

Security levels are provided to allow different types of users to be given different access rights to the drive and module parameters. Table 11.1 shows the access rights for specific user types.

Table 1.1 - Security levels

	View HOME page	View supervising menu page	View advanced parameter pages	Backup	View general configuration page
Level 0	Yes	Yes	No	No	No
Level 1	Yes	Yes	Yes	Yes	No
Administrator	Yes	Yes	Yes	Yes	Yes

12   Diagnostics

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

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

12.1   LED diagnostics

The MDX-PROFINET module is equipped with 2 LEDs on the front panel to aid in the diagnostics procedure. The functions of these LEDs are described in Figure 12.1 LED functionality below.

Figure 12.1 - LED functionality

#	Items
1	Network status LED
2	Module status LED
3	Link/Activity Port 1
4	Link/Activity Port 2
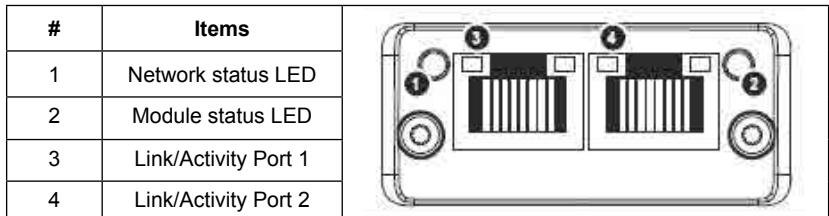
Table 12.1 - Network status LED (LED on the left)

NOTE   A test sequence is performed on this LED during startup.

LED State	Description	Comments
Off	Offline	- No power - No connection with IO Controller
Green	Online (RUN)	- Connection with IO Controller established - IO Controller in RUN state
Green, flashing	Online (STOP)	- Connection with IO Controller established - IO Controller in STOP state

Table 12.2 - Module status LED (LED on the right)

LED State	Description	Comments
Off	Not Initialized	No power - *or* - Module in 'SETUP' or 'NW_INIT' state
Green	Normal Operation	Module has shifted from the 'NW_INIT' state
Green, 1 flash	Diagnostic Event(s)	Diagnostic event(s) present
Green, 1 Hz	DCP Flash	Used by engineering tools to identify the node on the network
Red	Exception Error	Module in state 'EXCEPTION'
Red, 1 flash	Configuration Error	Expected Identification differs from Real Identification
Red, 2 flashes	IP Address Error	IP address not set
Red, 3 flashes	Station Name Error	Station Name not set
Red, 4 flashes	Internal Error	Module has encountered a major internal error

Table 12.3 - Link/Activity LED

LED State	Description	Comments
Off	No Link	No link, no communication present
Green	Link	Ethernet link established, no communication present
Green, flickering	Activity	Ethernet link established, communication present

12.2 Module ID code

Module ID code

	Default	150
Pr **15.01**	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-PROFINET is 150.

12.3 Module firmware version

Firmware - major version (xx.yy)

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

Firmware - minor version (zz)

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

The software version of the option module can be identified by looking at Pr **15.02** and Pr **15.51**. The software version takes the form of xx.yy.zz, where Pr **15.02** displays xx.yy and Pr **15.51** displays zz (e.g. for software version 01.01.00, Pr **15.02** will display 1.01 and Pr **15.51** will display 0).

12.4 Node address

Each node on a MDX-PROFINET network must be given a unique network node address. The MDX-PROFINET must be re-initialized to make a change of node address active. See section 5.3 Setting the IP address for more information.

12.5 Data format

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

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

12.6 Fieldbus option state

Fieldbus option state

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

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

If a mapping configuration error or network error is detected the drive may trip. Refer to Section 12.7 Cyclic mapping status for details about the trip display.

Table 12.4 - MDX-PROFINET operating status codes

Pr 15.06	LCD display	Description
0	Setup in progress	MDX 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	Wait web update	Wait a few minutes until Data base of new drive version is loaded in MDX option. Do not switch off the product during this period.
7	Host error	The module has ceased all network participation due to a host application-related error. This state is unrecoverable, i.e. the module must be restarted in order to be able to exchange network data.
8	Option bus loss	Communication between MDX option and Drive is lost.
9	reserved	
10	reserved	
11	reserved	
12	Host supervising	Module is supervised by another network device. Perform manual data handling.
13	reserved	
14	reserved	

12.7 Cyclic mapping status

Mapping status

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

The MDX-PROFINET mapping status parameter Pr **15.49** indicates a mapping configuration error. When a mapping error has been corrected, re-initialize the MDX-PROFINET by setting Pr **15.32** to ON (1). The mapping error codes are described in Table 12.5.

Table 12.5 - Mapping error codes

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

12.8 Drive trip display codes

If the MDX-PROFINET detects an error during operation, it will force a trip on the drive. However, the trip code displayed on the drive will only indicate that MDX option is in fault. The exact reason for the trip will be indicated in the MDX-PROFINET error code parameter, Pr **15.50**. Table 12.6 shows the possible trip codes that will be displayed on the drive when a problem is detected with the MDX-PROFINET or when the MDX-PROFINET initiates a trip.

12.9 Fieldbus trip

Fieldbus trip

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

If the MDX-PROFINET detects an error during operation, it will force a trip on the drive and update the error code parameter, Pr **15.50**. Table 12.6 shows the possible MDX-PROFINET error codes.

Table 12.6 - MDX-PROFINET error codes

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

12.10 Module serial number

Modules serial number

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

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

13 Advanced features

13.1 Data bytes order

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

When data is sent over the PROFINET network it is transmitted as 8-bit bytes. Therefore when a 32-bit word or 16-bit word is transmitted it is split into four or two 8-bit bytes. It is important that the receiving node reconstructs the received 8-bit bytes in the correct order to arrive at the 32-bit or 16-bit data value that was originally transmitted, this order is known as the Data Endian Format and is shown in Table 13.1.

Table 13.1 - Data endian format

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

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

13.2 Compression of cyclical data

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

By default, the MDX-PROFINET 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 PROFINET 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 1or 8 -bits wide 16-bits will be used for that particular data channel. This is shown in Table 13.2.

Table 13.2 - Actual data sizes

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

The following examples demonstrate setting up a network using five cyclic channels for both IN and OUT data with the cyclic data compression first disabled and then enabled. Table 13.3 shows the mapping parameters where five OUT and five IN cyclic data channels are required. With data compression disabled each data channel uses 32-bits (two data words, so a total of ten words (20 bytes) are required, Pr **15.41** = 20, Pr **15.39** = 20).

Table 13.3 - Example cyclic data channel mapping with compression disabled

Cyclic word	Data word configuration on master	Mapping
Out channel 0	2 OUT (Word 0,1)	Pr **6.42**, Control word
Out channel 1	2 OUT (Word 2,3)	Pr **1.21**, Digital speed reference 1
Out channel 2	2 OUT (Word 4,5)	Pr **2.11**, Ramp
Out channel 3	2 OUT (Word 6,7)	Pr **4.07**, 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 PROFINET 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 13.4.

Table 13.4 - Example cyclic data channel mapping with compression enabled

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

13.3 Restore defaults

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

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

• Set Pr **15.30** to 1 (ENABLED).

• PROFINET communications will be stopped.

• The host drive will load and store its default parameter values.

• Default parameter values for the MDX-PROFINET will be loaded.

• The MDX-PROFINET will reset and re-initialize using the default values.

14 Quick reference

14.1 Complete parameter reference

Table 14.1 lists all the MDX-PROFINET set-up parameters that are required to configure the module.

Table 14.1 - MDX-PROFINET parameter reference

Parameter	Default	Cross reference	Description
15.01	150	Page 40	plugged option ID code
15.02	---	Page 40	Module software version (XX,YY)
15.06	---	Page 41	Fieldbus option state
15.08	1 (MSB first)	Page 44	Data bytes order
15.10	1040	Page 25	IN cyclic mapping 0
15.11	201	Page 25	IN cyclic mapping 1
15.12	0	Page 25	IN cyclic mapping 2
15.13	0	Page 25	IN cyclic mapping 3
15.14	0	Page 25	IN cyclic mapping 4
15.15	0	Page 25	IN cyclic mapping 5
15.16	0	Page 25	IN cyclic mapping 6
15.17	0	Page 25	IN cyclic mapping 7
15.18	0	Page 25	IN cyclic mapping 8
15.19	0	Page 25	IN cyclic mapping 9
15.20	642	Page 25	OUT cyclic mapping 0
15.21	121	Page 25	OUT cyclic mapping 1
15.22	0	Page 25	OUT cyclic mapping 2
15.23	0	Page 25	OUT cyclic mapping 3
15.24	0	Page 25	OUT cyclic mapping 4
15.25	0	Page 25	OUT cyclic mapping 5
15.26	0	Page 25	OUT cyclic mapping 6
15.27	0	Page 25	OUT cyclic mapping 7
15.28	0	Page 25	OUT cyclic mapping 8
15.29	0	Page 25	OUT cyclic mapping 9
15.30	0 (Disabled)	Page 46	Return MDX module to default settings
15.32	0 (Disabled)	Page 20	Fieldbus option reset
15.34	0 (disabled)	Page 44	Compression of cyclical data
15.35	---	Page 43	Serial number
15.38	8	Page 27	Input cyclical data bytes
15.39	2	Page 24	IN cyclic, number of channel (parameter)
15.40	2	Page 24	OUT cyclic, number of channel (parameter)
15.41	8	Page 27	Output cyclical data bytes
15.49	---	Page 42	mapping status
15.50	0 (No error code)	Page 42	Fieldbus trip
15.51	---	Page 40	Option minor firmware sub-version

Parameter	Default	Cross reference	Description
15.60	192	---	IP address Wip
15.61	168	---	IP address Xip
15.62	1	---	IP address Yip
15.63	100	---	IP address Zip
15.64	255	---	IP subnet mask Wsubnet
15.65	255	---	IP subnet mask Xsubnet
15.66	255	---	IP subnet mask Ysubnet
15.67	0	---	IP subnet mask Zsubnet
15.68	192	---	IP default gateway Wgateway
15.69	168	---	IP default gateway Xgateway
15.70	1	---	IP default gateway Ygateway
15.71	254	---	IP default gateway Zgateway

15   Glossary of terms

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

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

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

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

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

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

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

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

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

DNS: Domain Name Server. This is a server that is used to convert a URL such as «www.leroy-somer.com» to an IP address such as 129.254.254.106.

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

GSDML File: Electronic Data Sheet file. A file which specifies the PROFINET IO device functionality.

Ethernet address: See MAC address.

Explicit data: See Non-cyclic data.

Firewall: A computer or piece of software that restricts connections between different ports. This can be useful when restricting data flow between two network segments.

FTP: File Transfer Protocol. Used for transferring files.

Gateway: A device that allows devices on different subnets or networks to communicate with each other.

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

Hub: A method of connecting computers together on Ethernet. An un-switched hub will repeat any data received on one port to all ports.

HTTP: Hypertext transfer protocol. This is a document specification protocol. Commonly used in web pages.

Implicit data: See Cyclic data.

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

IP: Internet Protocol, this is the protocol used to transmit bytes across an IP network. IP address: An address that identifies a node uniquely on a subnet or network.

IP subnet: A part of an IP network that consists of a range of addresses that may be accessed by all devices on the same network directly.

LED: Light Emitting Diode. Long word: A 32 bit data word that may be signed or unsigned.

LSB: Least Significant Bit/Byte.

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

MAC address: This is a unique address that is assigned to MDX-ETHERNET/IP at the time of manufacture. No other device will have this address. The address is used to make connections to the module before the IP address is assigned.

MSB: Most Significant Bit/Byte.

Network Loss Trip: A way to determine when a node has lost contact with the master. Node: A device on the network. This may be either a device such as a drive or part of the network such as a repeater.

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

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

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

PC: Personal Computer.

PLC: Programming Logic Controller.

Polled data: See Cyclic data.

RPI: Requested Packet Interval. Specifies the expected time for the device to respond to a request.

Router: A device that is used to connect different networks or subnets, in a similar way to a firewall, however a router generally allows significantly less control of the data.

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

Status word: A value that denotes the status of the drive. Each bit within the word will have a specific meaning. Subnet: A part of a network that has IP addresses in the same range. Devices on the same subnet may communicate directly with other devices on the same subnet without the use of a gateway.

Subnet mask: Defines which part of the IP address constitutes the subnet address and which part constitutes the host device address.

Switch: A device that allows Ethernet devices to be interconnected.

TCP: Transmission Control Protocol, this protocol is responsible for ensuring that the data on the network reaches it's destination.

URL: Uniform Resource Locator. A method used to give a web site a friendly name such as www.leroy-somer.com as an alternative to an IP address.
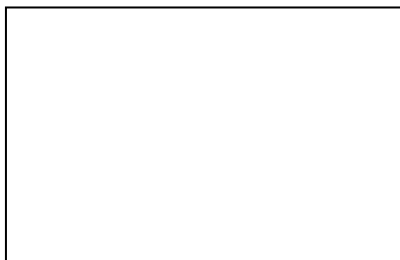
VPN: Virtual Private Network. A method of using a non-secure or public network that allows devices to be connected together as if they were a part of a private network.

Word: A collection of 16 binary digits.

Nidec

All for dreams

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