



User Guide

SM-PROFINET

Solutions Module for:

- Unidrive SP
- Commander SK
- Digitax ST
- Mentor MP
- Affinity

Part Number: 0471-0163-03

Issue Number: 3

General Information

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation or adjustment of the optional parameters of the equipment or from mismatching the variable speed drive with the motor.

The contents of this guide are believed to be correct at the time of printing. In the interests of commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the product or its performance, or the content of the guide without notice.

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The electronic variable speed drives manufactured by EPA have the potential to save energy and (through increased machine/process efficiency) reduce raw material consumption and scrap throughout their long working lifetime. In typical applications, these positive environmental effects far outweigh the negative impacts of product manufacture and end-of-life disposal.

Nevertheless, when the products eventually reach the end of their useful life, they must not be discarded but should instead be recycled by a specialist recycler of electronic equipment. Recyclers will find the products easy to dismantle into their major component parts for efficient recycling. Many parts snap together and can be separated without the use of tools, whilst other parts are secured with conventional fasteners. Virtually all parts of the product are suitable for recycling.

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When preparing to recycle or dispose of any product or packaging, please observe local legislation and best practice.

Software Statement

This Solutions Module (SM) is supplied with the latest software version. When retro-fitting to an existing system, all software versions should be verified to confirm the same functionality as Solutions Modules of the same type already present. This also applies to products returned from a EPA Service Centre or Repair Centre. If there is any doubt please contact the supplier of the product.

The software version of the Solutions Module can be identified by looking at Pr **MM.02** and Pr **MM.51**, where **MM** is the relevant menu number for the Solutions Module slot being used.

See Pr **MM.02** and Pr **MM.51** description later in this manual for more information.

The software version takes the form of xx.yy.zz, where Pr **MM.02** displays xx.yy and Pr **MM.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).

REACH legislation

EC Regulation 1907/2006 on the Registration, Evaluation, Authorisation and restriction of Chemicals (REACH) requires the supplier of an article to inform the recipient if it contains more than a specified proportion of any substance which is considered by the European Chemicals Agency (ECHA) to be a Substance of Very High Concern (SVHC) and is therefore listed by them as a candidate for compulsory authorisation.

For current information on how this requirement applies in relation to specific EPA products, please approach your usual contact in the first instance. EPA position statement can be viewed at: <http://www.epa.de>

How to use this guide

This user guide provides complete information for installing and operating the Solutions Module.

The information is in logical order, taking the reader from receiving the Solutions Module through to configuring the module specific parameters.

There are specific safety warnings throughout this guide, located in the relevant sections. In addition, Chapter 1 *Safety information* on page 6 contains general safety information. It is essential that the warnings are observed and the information considered when working with or designing a system using the Solutions Module.

This map of the user guide helps to find the right sections for the task you wish to complete, but for specific information, refer to Contents on page 4.

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4 Electrical installation			●		●
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6 Additional features	●	●	●	●	
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1 Safety information

1.1 Warnings, Cautions and Notes



WARNING

A Warning contains information which is essential for avoiding a safety hazard.



CAUTION

A Caution contains information which is necessary for avoiding a risk of damage to the product or other equipment.

NOTE

A Note contains information which helps to ensure correct operation of the product.

1.2 Electrical safety - general warning

The voltages used in the drive can cause severe electrical shock and/or burns, and could be lethal. Extreme care is necessary at all times when working with or adjacent to the drive. Specific warnings are given at the relevant places in this User Guide.

1.3 System design and safety of personnel

The drive is intended as a component for professional incorporation into complete equipment or a system. If installed incorrectly, the drive may present a safety hazard.

The drive uses high voltages and currents, carries a high level of stored electrical energy, and is used to control equipment which can cause injury.

Close attention is required to the electrical installation and the system design to avoid hazards either in normal operation or in the event of equipment malfunction. System design, installation, commissioning/start-up and maintenance must be carried out by personnel who have the necessary training and experience. They must read this safety information and this User Guide carefully.

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.

NOTE

The SAFE TORQUE OFF function is only available as standard on the Unidrive SP / Digitax ST. The Affinity, Commander SK and Mentor MP drives do not have such a feature.

Careful consideration must be given to the functions of the drive which might result in a hazard, either through their intended behavior or through incorrect operation due to a fault. In any application where a malfunction of the drive or its control system could lead to or allow damage, loss or injury, a risk analysis must be carried out, and where necessary, further measures taken to reduce the risk - for example, an over-speed protection device in case of failure of the speed control, or a fail-safe mechanical brake in case of loss of motor braking.

The SAFE TORQUE OFF function has been approved by BGIA as meeting the requirements of the following standards, for the prevention of unexpected starting of the drive:

EN 61800-5-2:2007 SIL 3

EN ISO 13849-1:2006 PL e

EN 954-1:1997 Category 3

The SAFE TORQUE OFF function may be used in a safety-related application. The system designer is responsible for ensuring that the complete system is safe and designed correctly according to the relevant safety standards.

1.4 Environmental limits

Instructions in the *Unidrive SP User Guide*, *Mentor MP User Guide*, *Affinity User Guide*, *Commander SK Getting Started Guide*, *Commander SK Technical Data Guide*, *Digitax ST Getting Started Guide* and *Digitax ST Technical Data Guide* regarding transport, storage, installation and use of the drive must be complied with, including the specified environmental limits. Drives must not be subjected to excessive physical force.

1.5 Access

Drive access must be restricted to authorized personnel only. Safety regulations which apply at the place of use must be complied with.

1.6 Fire protection

The drive enclosure is not classified as a fire enclosure. A separate fire enclosure must be provided.

1.7 Compliance with regulations

The installer is responsible for complying with all relevant regulations, such as national wiring regulations, accident prevention regulations and electromagnetic compatibility (EMC) regulations. Particular attention must be given to the cross-sectional areas of conductors, the selection of fuses or other protection, and protective earth (ground) connections. Instructions for achieving compliance with specific EMC standards may be found in the relevant drive documentation.

The *Appropriate drive documentation* contains instructions for achieving compliance with specific EMC standards.

Within the European Union, all machinery in which this product is used must comply with the following directives:

2006/42/EC: Safety of machinery.

2004/108/EC: Electromagnetic Compatibility.

1.8 Motor

Ensure the motor is installed in accordance with the manufacturer's recommendations.

Ensure the motor shaft is not exposed. Standard squirrel cage induction motors are designed for single speed operation. If it is intended to use the capability of the drive to run a motor at speeds above its designed maximum, it is strongly recommended that the manufacturer is consulted first.

Low speeds may cause the motor to overheat because the cooling fan becomes less effective. The motor should be installed with a protection thermistor. If necessary, an electric forced vent fan should be used.

The values of the motor parameters set in the drive affect the protection of the motor.

The default values in the drive should not be relied upon.

It is essential that the correct value is entered in the motor rated current parameter, Pr **5.07** (or Pr **0.46** in Unidrive SP, Affinity and Digitax ST, or Pr **0.28** in Mentor MP, or Pr **0.06** in Commander SK). This affects the thermal protection of the motor.

1.9 Adjusting parameters

Some parameters and/or objects have a profound effect on the operation of the drive. They must not be altered without careful consideration of the impact on the controlled system. Measures must be taken to prevent unwanted changes due to error or tampering especially if a remote user can access the drive parameters.

1.10 General safety considerations for remote operation

SM-PROFINET enables the possibility of remotely controlling a machine from a distance. It is vital that when connecting to a machine remotely, adequate safety procedures are implemented to prevent damage to the machine or injury to personnel.

Any connection to a live system has the possibility of altering the state of the machine, adequate procedures must be implemented to cover this situation. It is the responsibility of the machine builder to ensure that such a system is safe and complies with current legislation.

2 Introduction

2.1 What is PROFINET?

PROFINET is an Ethernet based industrial network protocol adapting Ethernet hardware and protocols to the real time needs of industrial automation. It is similar to PROFIBUS in that it enables distributed IO control from a PLC.

2.2 Introduction to SM-PROFINET

SM-PROFINET is a Solutions Module that allows any suitable EPA variable speed drive to be connected to a PROFINET network as a PROFINET IO slave device.

Table 2-1 SM-PROFINET firmware releases

Firmware version	Drive compatibility	Description
V99.20.00 to V99.20.03	Unidrive SP	Beta releases with menus 19 and 20 used to specify the RT data exchange mappings.
V01.00.00 and later	Unidrive SP	Production release with RT data exchange mappings by configuration software and GSDML file.
V01.00.02 and later	Unidrive SP Commander SK Digitax ST	Production update with Commander SK and Digitax ST support.
V01.01.00 and later	Unidrive SP Commander SK Digitax ST Mentor MP Affinity	Production update with Mentor MP and Affinity support

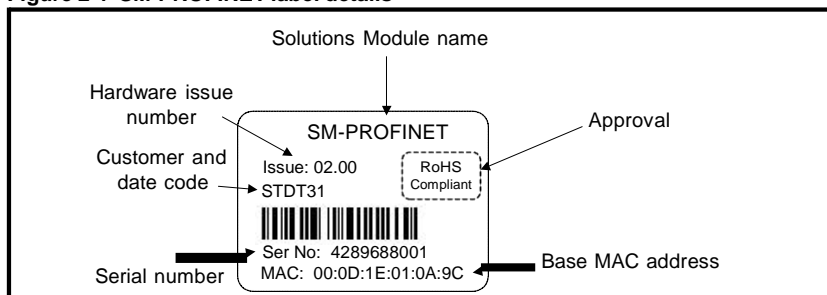
It is possible to use more than one SM-PROFINET or a combination of SM-PROFINET and other Solutions Modules to add additional functionality such as extended I/O, gateway functionality, or additional PLC features.

2.3 Solutions Module identification

The SM-PROFINET module can be identified by:

1. The label located on the underside of the Solutions Module.
2. The color coding across the front of the SM-PROFINET (yellow/green).

Figure 2-1 SM-PROFINET label details



2.3.1 Date code format

The date code is split into two sections: a letter followed by a number.

The letter indicates the year, and the number indicates the week number (within the year) in which the Solutions Module was built. The letters start with A for 1991 (B for 1992, C for 1993 etc.).

Example: A date code of T31 would correspond to week 31 of year 2010.

2.4 Features / specification

The following features are included in the SM-PROFINET Solutions Module:

- Dual 100 BASE-TX RJ45 connectors with support for shielded twisted pair, full-duplex 100 Mbps 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 B
- Cycle times from 1 ms to 512 ms specified during configuration
- Automatic device replacement using the LLDP and SNMP protocols
- LED indication of network port activity
- Up to 64 cyclic IO module slots (configured by network configuration tool and GSDML file)
- Identification and Maintenance functions I&M0 to I&M4 supported

2.5 Conventions used in this guide

The configuration of the host drive and Solutions Module is done using menus and parameters. A menu is a logical collection of parameters that have similar functionality.

In the case of a Solutions Module, the parameters will appear in one of three menus 15, 16 or 17 depending on the drive type and slot the module is installed into as shown in Table 2-2 Drive menu availability below. The menu is denoted by the number before the decimal point.

The method used to determine the menu or parameter is as follows:

- Pr **xx.00** signifies any menu and parameter number 00.
- Pr **MM.xx** where **MM** signifies the menu allocated to the solutions module (as shown in Table 2-2) and **xx** signifies the parameter number.

Table 2-2 Drive menu availability

Drive Type	Slot 1 15.xx	Slot 2 16.xx	Slot 3 17.xx
Unidrive SP	Yes	Yes	Yes
Affinity			No
Mentor MP			Yes
Commander SK		No	No
Digitax ST		Yes	

NOTE

Solutions Modules with on-board processors mirror the slot configuration parameters (menu 15, 16 or 17) in menu 60, this document will use menu 60 when referring to the slot configuration menus.

Menus 15, 16 and 17 are Solutions Module slot dependent configuration menus allocated to the Solutions Module slot configuration setup parameters.

Unidrive SP (Sizes 1 to 6) / Unidrive SPM / Mentor MP

Slot 3 (menu 17) is the lowest position slot nearest the control terminal connections, slot 2 (menu 16) is the middle slot and slot 1 (menu 15) is the highest position slot nearest the display keypad.

Unidrive SP (Size 0) / Digitax ST

Slot 1 (menu 15) being the position nearest the control terminal connections, slot 2 (menu 16) is the slot nearest the AC Supply terminals.

Commander SK (Sizes B to D and 2 to 6)

Slot 1 (menu 15) is the only slot available.

Affinity

Slot 2 (menu 16) is the lowest position slot nearest the control terminal connections and slot 1 (menu 15) is the highest position slot nearest the display keypad.

2.6**SM-PROFINET conventions**

When referring to the cyclic data, the terms input and output are with respect to the PROFINET IO controller (PLC).

NOTE

All references in this manual to SM-Applications/Plus should also extend to SM-Applications Lite/Lite V2. The exceptions to this are references to SM-Applications/Plus input/output, CTSync or the EIA-485 port, as these are not supported on SM-Applications Lite/Lite V2. For full details of the differences see the *SM-Applications Modules* and *Motion Processors User Guide*.

2.7**PROFINET network controller or PLC?**

The terms 'network controller' and 'PLC' are mutually used in this manual to refer to the PROFINET network controller. This is generally a PLC with a PROFINET interface and possibly a programming interface to connect to the programming device or PC.

However this interface is not necessary, as the PROFINET interface can be used to program the PLC.

3 Mechanical installation

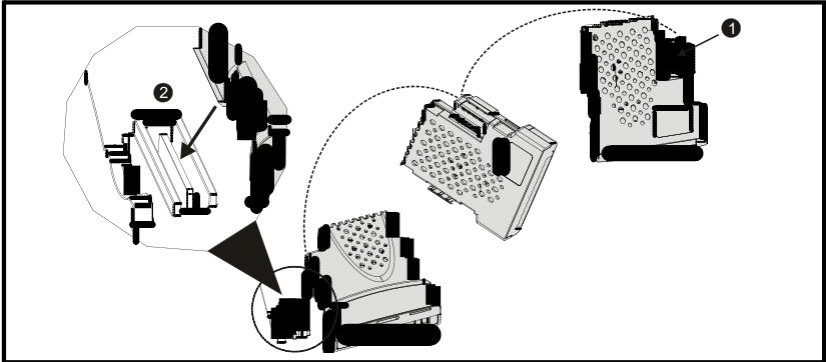


Before installing or removing a Solutions Module in any drive, ensure the AC supply has been disconnected for at least 10 minutes and refer to chapter 1 Safety information on page 6. If using a DC bus supply ensure this is fully discharged before working on any drive or Solutions Module.

3.1 General Installation

The installation of a Solutions Module is illustrated in Figure 3-1.

Figure 3-1 Installing a Solutions Module



- The Solutions Module connector is located on the underside of the module (1).
- Push this on to the Solutions Module slot located on the drive until it clicks firmly into place (2).

NOTE

Some drives require a protective tab to be removed from the Solutions Module slot. For further information, refer to the appropriate drive documentation.

4 Electrical installation

4.1 Bus media

The SM-PROFINET Solutions Module incorporates two 100 BASE-TX RJ45 interfaces operating in full duplex mode with auto crossover correction.

Both ports have integrated switches and can be connected to other PROFINET devices to create a line network.

4.2 Cabling considerations

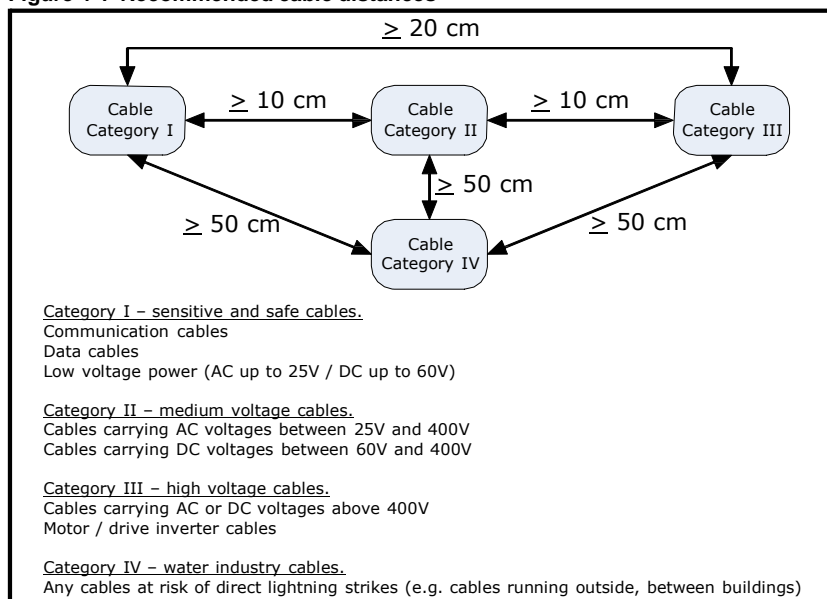
To ensure long-term reliability it is recommended that any cable used is tested using a suitable Ethernet cable tester, this is of particular importance when cables are constructed on site.

When installing fieldbus or communications cables (especially high speed data cables such as PROFINET), consideration should be given to the physical layout and positioning of the cables, in particular the positioning with regards to other cables (power cables etc.). The recommended distances between different category cables is shown in Table 4-1 *Cable properties* on page 14.

Cables belonging to the same category may be placed adjacent to each other with no danger of cross-interference.

Similar category cables can be installed in an earthed metal cable tray / trunking separated from other category cables by earthed metal partitions, provided the cable tray or trunking has a lid so the cables are completely surrounded in an earthed metal enclosure.

Figure 4-1 Recommended cable distances



Cables should not be distorted, stretched, crushed or otherwise damaged in any way as this may cause future reliability issues.

Avoid excessive bending during installation, the maximum recommended bending radius is 10 times the cable diameter 75 mm (3.0 in).

NOTE

Cabling issues are the single most frequent cause of network downtime.

- Ensure cables are correctly routed i.e. not adjacent to high-power cables etc.
- Wiring must be correct, and the connectors should be of industrial grade with metal shielding.
- Routers or switches must be of industrial and not 'office' quality, as they do not provide the same degree of noise immunity as their industrial counterparts.

4.3 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.

4.3.1 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 Ω \pm 15 Ω		
Loop resistance	<115 Ω /km		
Transmission rate	100 MBit/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 mm	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.

4.4 Maximum network length

The main restriction imposed on Ethernet cabling is the length of a single segment of cable. The SM-PROFINET module has two 100 BASE-TX Ethernet ports, which support segment lengths of up to 100 m. This means that the maximum cable length which can be used between one SM-PROFINET port and another 100 BASE-TX port is 100 m, however it is not recommended that the full 100 m cable length is used.

NOTE

The total network length is not restricted by the Ethernet standard, but depends on the number of devices on the network and the transmission media (copper, fibre optic, etc).

4.5 SM-PROFINET terminal descriptions

The SM-PROFINET module has two RJ45 Ethernet ports for connection to a PROFINET network. Each Ethernet port operates in full duplex mode as a network switch and has an LED associated with it to indicate the connection status as shown in Table 4-2.

Table 4-2 LED functionality

State	Meaning
OFF	No Ethernet network connection detected
Steady green	Ethernet connection established
Flashing green	Ethernet message frame detected

Figure 4-2 SM-PROFINET connections

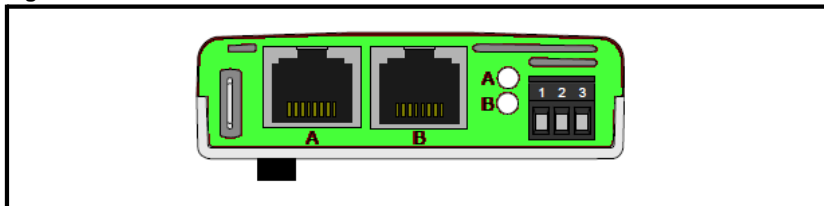
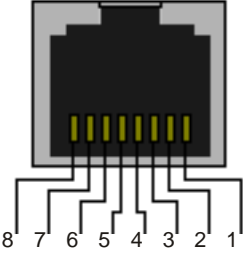


Table 4-3 SM-PROFINET user terminals

Terminal Number	Description
1	0 V
2	Not implemented in this application
3	Not implemented in this application

Table 4-4 SM-PROFINET Ethernet connections

Port A / B		
Pin	Function	
1	Transmit +	
2	Transmit -	
3	Receive +	
4	Not used	
5	Not used	
6	Receive -	
7	Not used	
8	Not used	

4.6 Module grounding

SM-PROFINET is supplied with a grounding tag on the module that should be connected to the closest possible grounding point using the minimum length of cable. This will greatly improve the noise immunity of the module.

NOTE

For information on the drive grounding arrangement refer to the relevant drive documentation.

4.7 Network topology

The SM-PROFINET module has two PROFINET ports with integrated switches to allow the use of line networks (see Figure 4-3 *SM-PROFINET network topology*). However, when using line networks, a break in the connection (for example when replacing a device) will cause all devices downstream from the failure to also stop communicating with the controller.

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. Generally a star or tree network structure using separate switches gives improved availability in the event of device failure or replacement. Also, managed switches have a web page interface which can be used to configure the switch to monitor the data traffic on specific ports using any appropriate protocol analyzer.

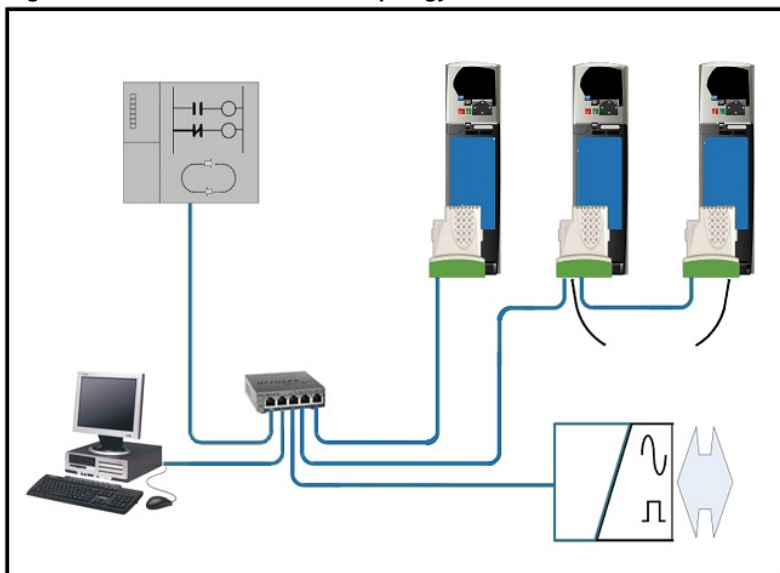
Although the PROFINET protocol does support all major topologies, line topology networks are normally used for practical and financial reasons, other Ethernet topologies (e.g. star) may not be suitable for real time communications due to their inherent use of switches or other network equipment.

Any network devices used, such as switches, must be capable of RT communications and ideally, also IRT (Isochronous Real Time) communications, although SM-PROFINET does not currently support this protocol. Standard office equipment is not normally suitable and should not be used.

NOTE

For the device replacement feature to work, the physical network topology must be configured in the PLC, for further information please refer to the PLC documentation.

Figure 4-3 SM-PROFINET network topology



NOTE

Although Figure 4-3 illustrates the use of a star and a line network, it must be emphasized that only line networks are normally used, and any switches used must be suitable for real time communications.

4.8 Minimum node-to-node cable length

There is no minimum length of cable recommended in the Ethernet standards. To avoid possible cabling problems, it is recommended that sufficient cable length is provided to ensure adequate bend radii on cables and avoid unnecessary strain on the connectors.

4.9 24 Vdc back-up supply

A 24 Vdc back-up power supply can be connected to Unidrive SP, Digitax ST or Affinity drives which will keep the control electronics and Solutions Module powered up, allowing SM-PROFINET to continue communicating with the controller when the main supply to the drive is switched off.

NOTE

Refer to the required drive documentation for information regarding the connection of the 24 Vdc back-up supply.

5 Getting started

This chapter is intended to provide a generic guide for setting up SM-PROFINET on a PROFINET network. The setup flowchart (Figure 5-2 *SM-PROFINET setup flowchart* on page 22) 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.

5.1 SM-PROFINET version compatibility

SM-PROFINET has been tested and approved for the following drives and firmware versions.

Previous drive firmware versions have not been tested and may need to be updated to work with SM-PROFINET.

Table 5-1 SM-PROFINET version compatibility

Drive type	Drive firmware	SM-PROFINET firmware
Unidrive SP	V01.08.00 or later	V01.00.00 or later
Digitax ST	V01.00.00 or later	V01.00.02 or later
Commander SK	V01.06.00 or later	V01.00.02 or later
Mentor MP	V01.06.00 or later	V01.01.00 or later
Affinity	V01.07.00 or later	

NOTE

It is strongly recommended that the latest firmware be used where possible to ensure that all available features are supported.

NOTE

Due to the large number of different network controllers that are available, details cannot be provided for any specific controller. Generic support is available through your supplier or local EPA Drive Centre. Before contacting your supplier or local EPA Drive Centre for support please ensure you have read section 8 *Diagnostics* on page 49.

5.2 SM-PROFINET XML file (or GSDML file)

A GSDML (General Station Description Markup Language) file is required to describe the drive interface to a PROFINET controller or PLC. This is an XML file, the structure of which is specified by the PROFIBUS INTERNATIONAL organization (www.profibus.org).

The GSDML file is used in conjunction with the network configuration software to configure the SM-PROFINET module for cyclic data exchange. All relevant drive parameters are available as a 'module' to be added to the cyclic data 'slots'.

A non-specific 'module' is also provided so that the user can allocate a parameter within the drive (or Solutions Module) that is not directly available as a specific 'module'. Some 'modules' require the slot position to be specified and some 'modules' require the menu and parameter to be specified, these options will be available from a drop-down selection list within the 'Parameters' tab of the 'module' properties.

The GSDML file for SM-PROFINET can be downloaded from the EPA support website (www.epa.de).

NOTE

For further information regarding the use of the GSDML file please refer to the PLC documentation.

5.3 Configuring the PROFINET IO communications

SM-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.

If a cyclic module which requires the drive slot position is used, but the drive slot position is not specified, then no fault indication will be indicated on the PLC and no data will be returned by the module.

5.4 Setting the IP address

Each device on a network must have its 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.

It is not necessary to set the SM-PROFINET IP address or subnet mask before configuring the module on the network. These parameters 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 points should be considered:

- **Reserve adequate address space:** Ensure you have enough reserve address space on your chosen addressing scheme to allow for future expansion
- **Uniqueness:** Ensure all your addresses are unique
- **Avoid reserved addresses:** Some addresses are reserved and should not be used. (e.g. 127.0.0.1 is a loop-back address)
- **Broadcast and system addresses:** The highest and lowest host addresses are used for broadcasts and system addressing and should not be used
- **Use a system:** Adopt a scheme to assign IP addresses, for example, reserve ranges of addresses for specific uses such as servers, routers, work stations etc.

5.5 IP address classes

IP addresses are grouped into five classes, each class has a specific set of addresses and typical situation where it is used. When selecting the class of IP addresses to use, consideration must be given to the number of subnets and hosts that are required.

Table 5-2 *IP address class configuration* on page 20 shows how the class types are defined.

Table 5-2 IP address class configuration

Class	First byte range	Valid networks	Number of subnets	Host component	Number of hosts
A	1 - 126	1.0.0.1 to 126.255.255.254	126	x.y.z	16,777,214
B	128 - 191	128.0.0.1 to 191.254.255.254	16,382	y.z	65,534
C	192 - 223	192.0.0.1 to 223.255.254.254	2,097,150	z	254
D	224 - 239	Multicast group ID			
E	240 - 255	Reserved			

NOTE

Network ID's and host ID's with all 0's or all 1's specify a broadcast address and are therefore not included as valid networks.

Table 5-3 IP address classes

	W				X	Y	Z
Class A	0	Net ID (7 bits)			Host ID (24 bits)		
Class B	1	0	Net ID (14 bits)			Host ID (16 bits)	
Class C	1	1	0		Net ID (21 bits)		Host ID (8 bits)
Class D	1	1	1	0	Multicast group ID (28 bits)		
Class E	1	1	1	1	Reserved (28 bits)		

5.6 Subnet mask

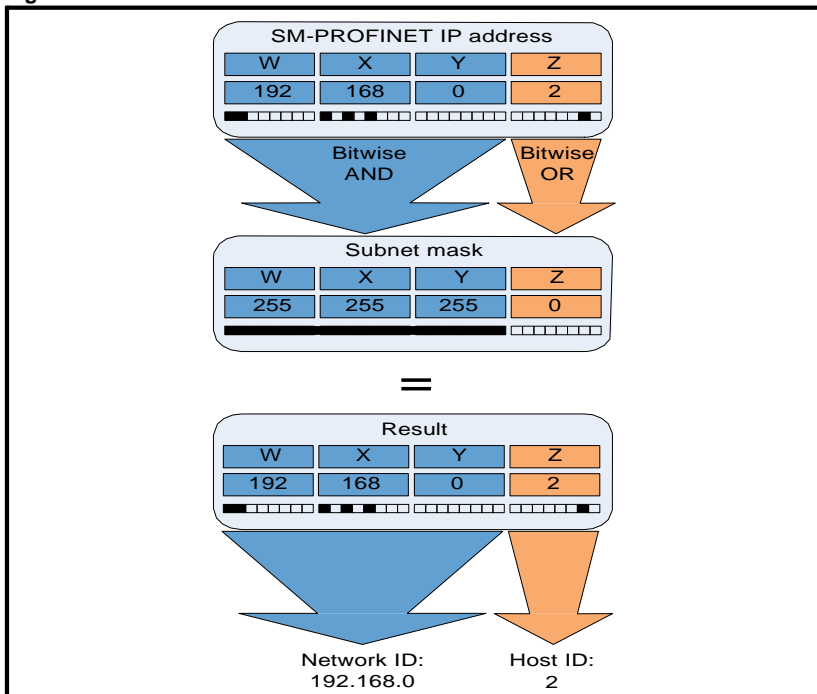
The subnet mask defines which part of the IP address constitutes the subnet address and which part constitutes the host address.

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



5.7 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:

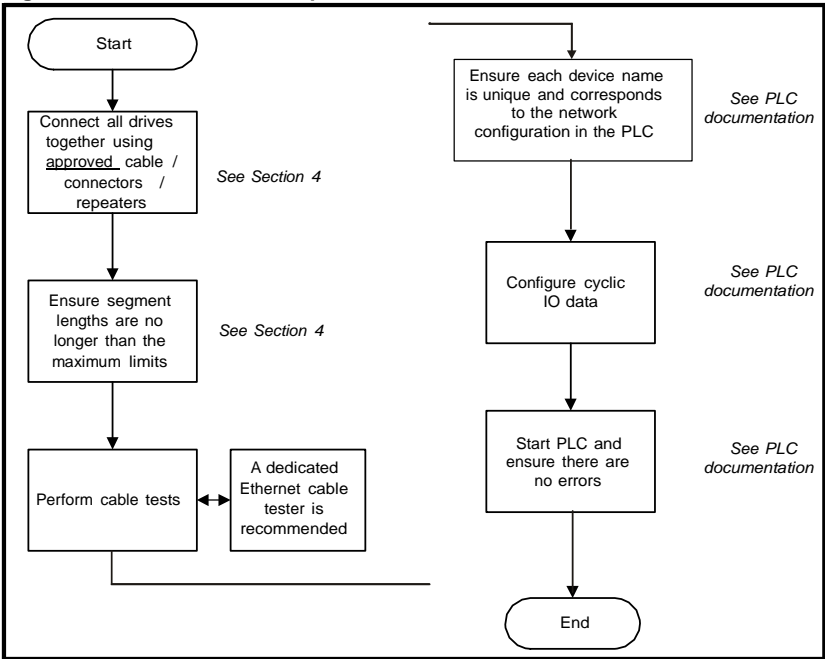
- Maximum length of 127 characters
- Characters must be either letters (lower case), numbers, dashes (-) or dots (.)
- The device name must start with a letter and end with either a letter or number
- The device name must not be of the format n.n.n.n (where n is a number from 0 to 999)
- The device name 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 'DNS_CompatibleName'.

Figure 5-2 SM-PROFINET setup flowchart



6 Additional features

This chapter provides information on the additional functions and features of the SM-PROFINET Solutions 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 different update rates for each device. SM-PROFINET can be configured with an update rate from the fastest of 1 ms to the slowest of 512 ms; the possible update rates are 1, 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

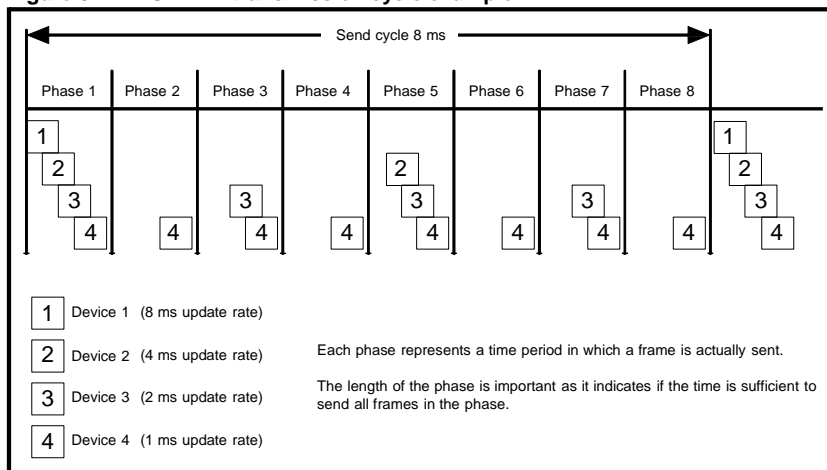
The PROFINET transmission cycle is the time required to update all the devices on the PROFINET network; the length of the PROFINET transmission cycle (send cycle) is determined by the PROFINET device which has the slowest update rate.

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 transmission 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:

$$\text{Number Of Phases} = \text{Send Cycle} / \text{Fastest Update Rate} = 8 \text{ ms} / 1 \text{ ms} = 8$$

6.2.2 Length of phase

The length of each phase is determined by the formula:

$$\text{Length Of Phase} = \text{SendClockFactor} \times 31.25 \mu\text{s} = 32 \times 31.25 \mu\text{s} = 1 \text{ ms}$$

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:

$$\text{Reduction ratio} = \text{Send Cycle Device} / \text{Length Of Phase}$$

In this example,

$$\text{Reduction ratioDevice 1} = 8 \text{ ms} / 1 \text{ ms} = 8$$

$$\text{Reduction ratioDevice 2} = 4 \text{ ms} / 1 \text{ ms} = 4$$

$$\text{Reduction ratioDevice 3} = 2 \text{ ms} / 1 \text{ ms} = 2$$

$$\text{Reduction ratioDevice 4} = 1 \text{ ms} / 1 \text{ ms} = 1$$

The SM-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 Discovery and Configuration Protocol (DCP)

SM-PROFINET supports the discovery and configuration protocol. This protocol (when correctly configured), is used in the event of device replacement to automatically configure the new device. All the necessary configuration is done by the neighboring devices when the new device is detected.

6.3.1 Link Layer Discovery Protocol (LLDP)

LLDP is a manufacturer independent layer 2 protocol, defined in accordance with the IEEE802.1AB standard.

During startup and also at regular intervals, LLDP is used to send and receive device information between neighboring devices. This information includes the device name and port numbers. LLDP messages use a special multicast destination MAC address that 802.1D compliant bridges do not forward, i.e. the LLDP message is only seen by neighboring devices. If all devices in a network support the LLDP protocol then an accurate network topology view can be presented in the diagnostic tool or PLC.

Information received via LLDP is stored locally on every device, in a structure called Management Information Base (MIB). This information can be retrieved using SNMP (Simple Network Management Protocol) messages.

6.3.2 Configuring the network topology for DCP

In order to use the network discovery and configuration protocol, the PLC must be correctly configured and programmed with the physical network topology, the following information is intended as a guide only, for more specific information (in particular for other types of PLC's), then please consult the PLC documentation.

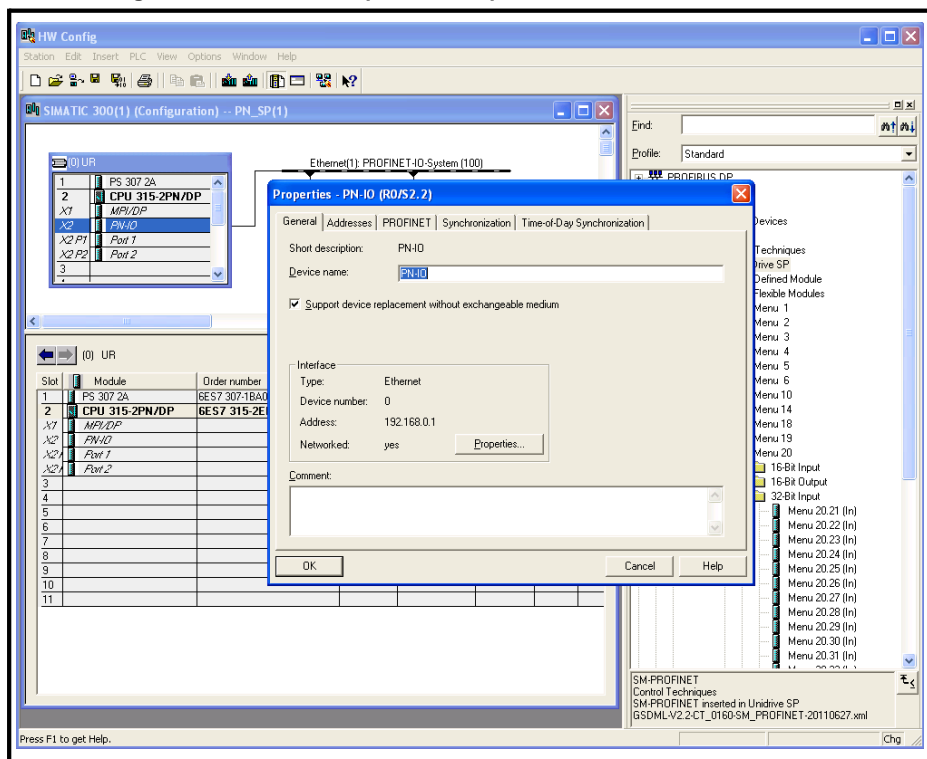
NOTE

Although the Siemens PLC is mentioned in this manual, EPA does not recommend or endorse any particular PLC or controller manufacturer.

The following information relates to the Siemens S7-315 2 PN/DP PLC.

The PLC must be configured to support device replacement, this is an option in the properties of the PROFINET port. In the hardware configuration screen of the SIMATIC STEP7 application, either double click the port, or alternatively select the port, right click it and select 'Object Properties...' as shown in Figure 6-2. Ensure the option 'Support device replacement without exchangeable medium' is selected then click the 'OK' button.

Figure 6-2 PLC device replacement option



The network topology must now be configured. From the hardware configuration screen, select the port, right click it and select 'PROFINET IO Topology...', the topology editor will be displayed, select the 'Graphic view' tab and using 'drag and drop', connect the relevant device ports together to match the physical network wiring. The program must then be compiled and downloaded to the PLC in the normal manner.

Once the PLC has been configured, if a device is replaced then the new device will be automatically configured with the original device's properties, including the device name and IP address.

NOTE

For the discovery protocol to work, the replacement device must not have a device name programmed, i.e. it must be blank or unused. If a device name exists in the module and that name is different to the device name set in the network configuration then the PLC will indicate a configuration error and will not enter data exchange with it.

6.4 Identification and Maintenance (I&M)

Identification and Maintenance (I&M) functions can be used to read and change various information about devices, such as manufacturer, ordering information, serial number, etc. This information can be used to assist the user in tracking the drive's life cycle through commissioning/start-up, parameterization, diagnosis, repair, etc. SM-PROFINET supports I&M0 to I&M4 inclusively; I&M0 is mandatory for all PROFINET devices, I&M1 to I&M4 are optional.

Each I&M function returns specific information about the device and is explained in the following tables.

6.4.1 I&M0

Table 6-1 I&M0 Description

Attribute	Value (Read only)
Manufacturer ID	0x0160
Order ID	SM-PROFINET
Serial number	(Pr 60.35)
Hardware revision	(read from module)
Software revision	(Pr 60.02 and Pr 60.51)
Revision counter	(as read)
Profile ID	(as read)
Profile specific type	(as read)
I&M version	(as read)
I&M supported	(as read)

Manufacturer ID: 2-byte unsigned hexadecimal number assigned by the PROFIBUS business office and specified in the GSDML file.
For EPA this value is 0x0160.

Order ID: 20-byte string to identify the device.
This value is specified in the GSDML file.
For EPA this value is 'SM-PROFINET'.

Serial number: 16-byte string indicating the module serial number.
This value is read from Pr **60.35** of the SM-PROFINET module.

Hardware revision: 2-byte unsigned hexadecimal number indicating the hardware revision of the SM-PROFINET module.
This value is read from Pr **61.40** of the SM-PROFINET module.

Software revision: 4-byte value consisting of a single character 'V' and 3 unsigned 8-bit decimal numbers indicating the software revision of the SM-PROFINET module. This value is taken from Pr 60.02 and Pr 60.51 of the SM-PROFINET module.

Revision counter: 2-byte unsigned decimal number. This value is not changed by SM-PROFINET but can be changed by the network controller.

Profile ID: 2-byte unsigned hexadecimal number indicating the application profile. Devices not following any particular profile use the generic profile value 0xF600.

Profile specific type: 2-byte unsigned hexadecimal number indicating the application profile specific type. This value is not applicable to devices using the generic profile and in these instances this value will be zero.

I&M version: 2 unsigned 8-bit numbers indicating the version of the implemented I&M functions.

I&M supported: 2-byte unsigned number indicating the availability of the implemented I&M functions as shown in Table 6-2.

Table 6-2 Supported I&M bit descriptions

Bit	Value	Description
0		Profile specific I&M
1	0	I&M1 Not supported
	1	I&M1 Supported
2	0	I&M2 Not supported
	1	I&M2 Supported
3	0	I&M3 Not supported
	1	I&M3 Supported
4	0	I&M4 Not supported
	1	I&M4 Supported
5 to 15		Reserved

6.4.2 I&M1

Table 6-3 I&M1 Description

Attribute	Value (Read/Write)
Drive function (32 bytes)	(User defined)
Drive location (22 bytes)	(User defined)

Drive function: 32-byte string indicating the drive function.

Drive location: 22-byte string indicating the drive location.

6.4.3 I&M2

Table 6-4 I&M2 Description

Attribute	Value (Read/Write)
Installation date	(User defined)

Installation date: 16-byte string indicating the installation or commissioning date of the device. The installation date is in the format DD/MM/YYYY.

6.4.4 I&M3

Table 6-5 I&M3 Description

Attribute	Value (Read/Write)
Descriptor (54 bytes)	(User defined)

Descriptor: 54-byte string used to store additional information on the location, function or maintenance status of the device.

6.4.5 I&M4

Table 6-6 I&M4 Description

Attribute	Value (Read/Write)
Signature (54 bytes)	(User defined)

Signature: 54-byte octet string used to allow parameterization tools to store a security code as a reference for a particular parameterization session and audit trail tools to retrieve the code for integrity checks.

NOTE

All unused bytes of the I&M functions will be set to 0x20 (space).

7 Parameter descriptions

7.1 Introduction

This chapter lists the SM-PROFINET Solutions Module parameters and error codes.

7.2 Parameter type coding

Each parameter belongs to one or more type coding categories, these categories are listed in Table 7-1 along with their descriptions.

Table 7-1 Parameter type coding

Bit	1 bit parameter, displays 'On' or 'OFF'
SP	Spare – not used
FI	Filtered parameter, ease of viewing for rapidly changing values.
DE	Destination of an input terminal
Txt	Parameter uses text strings not integer numbers
VM	Variable maximum, the maximum value can vary
DP	Number of decimal places
ND	No default, parameter is not written to when defaults are loaded
RA	Rating dependent parameter
NC	Not copied to/from SMARTCARD
NV	Not visible on the keypad
PT	Protected parameter, cannot be used as a destination
US	User save, parameter saved in EEPROM upon initiating a user save
RW	Read/write parameter (if not set then parameter is read only – RO)
BU	Bit parameters default to 'On', non-bit parameters are unipolar
PS	Power-down save, parameter saved in drive upon a UV trip

7.3 Parameter zero

Parameter zero is used for various operations such as saving parameters, loading default parameters and accessing the SMARTCARD. It is available in all menus and referenced as **xx.00** in the tables which follow.

NOTE

For more information on the use of parameter zero please refer to the relevant drive documentation.

7.4 Single line parameter quick reference look up tables

This section lists the SM-PROFINET Solutions Module internal parameters.

NOTE

The option module menus 60 to 65 are not available on the Commander SK drive.

7.4.1 Menu 60 (Slot configuration)

The slot configuration parameters within menu 60 are mirrored directly to the drive slot configuration menu 15, 16 or 17 depending on which slot the SM-PROFINET module is installed to.

Table 7-2 Slot configuration menu 60

Parameter		Range	Default	Cross reference
60.00	Pr xx.00	0 to 32767	0	Section 7.3 <i>Parameter zero</i> on page 29
60.01	Module ID code	0 to 599	422	Table 7-6 <i>Module ID code</i> on page 33
60.02	Application major firmware version	00.00 to 99.99	N/A	Table 7-7 <i>Application firmware version (major)</i> on page 33
60.06	Module diagnostics	-9999 to 9999	0	Table 7-8 <i>Diagnostics information</i> on page 33
60.07	Network loss enable	0 to 1	1	Table 7-10 <i>SM-PROFINET Network loss enable</i> on page 35
60.10	IP Address W	0 to 255	0	Table 7-11 <i>Base IP address W</i> on page 35
60.11	IP Address X	0 to 255	0	Table 7-12 <i>Base IP address X</i> on page 35
60.12	IP Address Y	0 to 255	0	Table 7-13 <i>Base IP address Y</i> on page 35
60.13	IP Address Z	0 to 255	0	Table 7-14 <i>Base IP address Z</i> on page 35
60.14	Subnet mask W	0 to 255	0	Table 7-15 <i>Subnet mask W</i> on page 36
60.15	Subnet mask X	0 to 255	0	Table 7-16 <i>Subnet mask X</i> on page 36
60.16	Subnet mask Y	0 to 255	0	Table 7-17 <i>Subnet mask Y</i> on page 36
60.17	Subnet mask Z	0 to 255	0	Table 7-18 <i>Subnet mask Z</i> on page 36
60.18	Default gateway W	0 to 255	0	Table 7-19 <i>Default gateway W</i> on page 38
60.19	Default gateway X	0 to 255	0	Table 7-20 <i>Default gateway X</i> on page 38
60.20	Default gateway Y	0 to 255	0	Table 7-21 <i>Default gateway Y</i> on page 38
60.21	Default gateway Z	0 to 255	0	Table 7-22 <i>Default gateway Z</i> on page 38
60.28	Data update rate	0 to 9999	0	Table 7-23 <i>Data update rate</i> on page 39
60.29	Module management	1000 to 1999	0	Table 7-24 <i>Module management</i> on page 39
60.30	Load option defaults	OFF (0) or On (1)	OFF	Table 7-26 <i>Load Solutions Module defaults</i> on page 40
60.32	Re-initialize module	OFF (0) or On (1)	OFF	Table 7-27 <i>Request to reinitialize</i> on page 40
60.35	Serial number	0 to 9999999	N/A	Table 7-28 <i>Serial number</i> on page 41

Parameter		Range	Default	Cross reference
60.44	Module temperature	0 to 255	0	Table 7-29 <i>Module temperature</i> on page 41
60.46	Critical task % free	0 to 100	0	Table 7-30 <i>Critical task % free</i> on page 41
60.47	Worst case critical % free	0 to 100	0	Table 7-31 <i>Worst case critical task % free</i> on page 41
60.48	Flash file system % free	0 to 100	0	Table 7-32 <i>Flash file system % free</i> on page 42
60.49	Solutions Module warning	0 to 255	0	Table 7-33 <i>Solutions Module warning</i> on page 42
60.50	Solutions Module error status	0 to 255	0	Table 7-35 <i>Solutions Module error status</i> on page 42
60.51	Application minor firmware version	0 to 99	N/A	Table 7-37 <i>Minor firmware version (zz)</i> on page 43

7.4.2 Menu 61 (General module setup)

The general module setup parameters within menu 61 provide access to various Solutions Module configuration settings and information.

Table 7-3 General module setup menu 61

Parameter		Range	Default	Cross reference
61.00	Pr xx.00	0 to 32767	0	Section 7.3 <i>Parameter zero</i> on page 29
61.01	Pr 1.00 shortcut	0 to 32767	0	Section 7.6.1 <i>SM-PROFINET Parameter 1.00 shortcut</i> on page 44.
61.07	Option slot indicator	0 to 3	0	Section 7.6.2 <i>SM-PROFINET option slot indicator</i> on page 44.
61.40	Option hardware issue	0 to 255	0	Table 7.6.3 <i>SM-PROFINET option hardware issue</i> on page 44.
61.42	500 ms task % free	0 to 100	0	Section 7.6.4 <i>SM-PROFINET 500 ms task % free</i> on page 44.
61.43	External memory % free	0 to 100	0	Section 7.6.5 <i>SM-PROFINET external memory % free</i> on page 44.
61.44	Internal memory % free	0 to 100	0	Section 7.6.6 <i>SM-PROFINET internal memory % free</i> on page 45.
61.49	Solutions Module error sub-code	0 to 255	0	Section 7.6.7 <i>SM-PROFINET Solutions Module error sub-code</i> on page 45.

7.4.3 Menu 62 (Module MAC address)

Menu 62 parameters indicate the factory programmed option module base MAC address.

Table 7-4 PROFINET module setup menu 62

Parameter		Range	Default	Cross reference
62.00	Pr xx.00	0 to 32767	0	section 7.3 <i>Parameter zero</i> on page 29
62.40	MAC address U	0 to 255	0	section 7.7.1 <i>SM-PROFINET MAC address U</i> on page 45
62.41	MAC address V	0 to 255	13	section 7.7.2 <i>SM-PROFINET MAC address V</i> on page 45
62.42	MAC address W	0 to 255	30	section 7.7.3 <i>SM-PROFINET MAC address W</i> on page 46
62.43	MAC address X	0 to 255	N/A	section 7.7.4 <i>SM-PROFINET MAC address X</i> on page 46
62.44	MAC address Y	0 to 255	N/A	section 7.7.5 <i>SM-PROFINET MAC address Y</i> on page 46
62.45	MAC address Z	0 to 255	N/A	section 7.7.6 <i>SM-PROFINET MAC address Z</i> on page 46

7.4.4 Menu 65 (PROFINET slot settings)

Parameters within menu 65 indicate the configured slot cyclic module ID number.

Each SM-PROFINET cyclic IO module configured in the PLC will have it's unique ID number written to the relevant menu 65 parameter.

Pr **65.01** will indicate the module ID for slot 1, Pr **65.02** for slot 2 etc.

e.g. If Pr **20.21** is configured in slot 1 as an input and Pr **20.22** is configured in slot 2 as an output then Pr **65.01** will indicate the value 20210 and Pr **65.02** will indicate the value 20221.

Table 7-5 PROFINET slot settings menu 65

Parameter		Range	Default	Cross reference
65.00	Pr xx.00	0 to 32767	0	Section 7.3 <i>Parameter zero</i> on page 29.
65.01 to 65.64	Slot 1 module ID to Slot 64 module ID	0 to $2^{32} - 1$	0	Section 7.8.1 <i>SM-PROFINET slot identification number</i> on page 48.

NOTE

The term 'slot' refers to the option module's allocated memory location for the mapped parameter (not the drive option module slot), each slot contains one cyclic parameter value. There are 64 possible slots available and assigned to parameters 1 to 64 in menu 65.

7.5 Full parameter descriptions - slot configuration menu 60

This section provides detailed information on the SM-PROFINET Solutions Module's slot configuration parameters contained in menu 60.

7.5.1 SM-PROFINET ID code

Table 7-6 Module ID code

Pr 60.01	Default	422					
	Range	422					
	Access	ND	PT	US	BU		

This parameter displays the module ID code, this ID code indicates the type of Solutions Module installed; the module ID code for SM-PROFINET is 422.

7.5.2 SM-PROFINET application firmware version (major)

Table 7-7 Application firmware version (major)

Pr 60.02	Default	N/A					
	Range	00.00 to 99.99					
	Access	ND	NC	PT	BU		

Pr 60.02 contains the major revision number of the Solutions Module's firmware version (xx.yy);

The full version of the Solutions Module's firmware can be assembled by combining the major revision (xx.yy) from Pr 60.02 and the minor revision (zz) from Pr 60.51 as follows: xx.yy.zz.

e.g. for application firmware version 01.01.00, Pr 60.02 will display 1.01 and Pr 60.51 will display 0.

7.5.3 SM-PROFINET diagnostics information

Table 7-8 Diagnostics information

Pr 60.06	Default	0					
	Range	-9999 to 9999					
	Access	ND	NC	PT			

This parameter is used to provide status error diagnostics and operating information about the SM-PROFINET module. Table 7-9 lists the possible error codes and their descriptions.

Table 7-9 Diagnostics

Code	Meaning	Description
Running states		
>0	Messages per second	The total number of messages for all active protocols the module is handling per second
0	Ethernet link established	The Solutions Module has completed initialization but no Ethernet frames have been detected
Application		
-25	Starting fieldbus	The fieldbus is starting
-30	Initializing fieldbus	The fieldbus is being initialized
-50	Initializing databases	The module databases are being initialized
-70	Initializing file system	The module file system is being initialized
-99	Application started	The main application has been launched
Bootloader		
-100	Default mode	The bootloader has finished but no application was launched. CMP messages will be handled normally
-101	Launching application	The application is being launched
-110	Loading application	The application image is being copied from the file system into memory
-130	Checking boot mode	The required boot mode is being checked
-148	Verifying file system	The file system is being verified
-149	Formatting file system	The file system is being formatted
-150	Initializing file system	The file system handler is being initialized
-159	Erasing storage flash memory	The storage area of the flash memory is being erased
-160	Erasing flash memory	The entire flash memory is being erased
-180	Initializing memory	The memory manager is being initialized
-199	Bootloader start	The bootloader is starting up
Recovery/Test		
-241	Testing complete	All tests have been successfully completed
-244	Testing DINT/RMINT	The DINT/RMINT mechanism is being tested
-245	Testing digital inputs	The digital inputs are being tested
-246	Testing Ethernet ports	The two Ethernet ports are being tested
-247	Testing drive interface	The drive interface to the module is being tested
-248	Testing thermal trip	The thermal trip mechanism is being tested
-249	Testing RAM	The RAM is being tested
-250	Testing file system	The integrity of the file system is being checked
-299	Recovery application started	The recovery application has been launched

7.5.4 SM-PROFINET Network loss enable

Table 7-10 SM-PROFINET Network loss enable

Pr 60.07	Default	1					
	Range	0 to 1					
	Access	US	RW	BU			

This parameter enables/disables the network loss detection feature.

If Pr 60.07=0, then no trip will occur if the PROFINET IO messages are lost.

If Pr 60.07=1, then a slot error trip will occur if the PROFINET IO messages are lost and the value 65 will be written to Pr 60.50.

The trip can be cleared by resetting the drive and will not occur again unless the PROFINET IO messages are detected again and subsequently lost.

7.5.5 SM-PROFINET base IP address W

Table 7-11 Base IP address W

Pr 60.10	Default	0					
	Range	0 to 255					
	Access	US	RW	BU			

This parameter indicates the most significant byte of the base IP address.

7.5.6 SM-PROFINET base IP address X

Table 7-12 Base IP address X

Pr 60.11	Default	0					
	Range	0 to 255					
	Access	US	RW	BU			

This parameter indicates the second most significant byte of the base IP address.

7.5.7 SM-PROFINET base IP address Y

Table 7-13 Base IP address Y

Pr 60.12	Default	0					
	Range	0 to 255					
	Access	US	RW	BU			

This parameter indicates the third most significant byte of the base IP address.

7.5.8 SM-PROFINET base IP address Z

Table 7-14 Base IP address Z

Pr 60.13	Default	0					
	Range	0 to 255					
	Access	US	RW	BU			

This parameter indicates the least significant byte of the base IP address.

These parameters are normally written to by the PLC during the parameterization phase.

Parameters Pr 60.10 to Pr 60.13 form the Solutions Module's base IP address using the format W.X.Y.Z, the base IP address is the IP address used by the PLC to communicate with the module over TCP/IP for non real time communications.

7.5.9 SM-PROFINET subnet mask W

Table 7-15 Subnet mask W

Pr 60.14	Default	0					
	Range	0 to 255					
	Access	US	RW	BU			

This parameter indicates the most significant byte of the subnet mask.

7.5.10 SM-PROFINET subnet mask X

Table 7-16 Subnet mask X

Pr 60.15	Default	0					
	Range	0 to 255					
	Access	US	RW	BU			

This parameter indicates the second most significant byte of the subnet mask.

7.5.11 SM-PROFINET subnet mask Y

Table 7-17 Subnet mask Y

Pr 60.16	Default	0					
	Range	0 to 255					
	Access	US	RW	BU			

This parameter indicates the third most significant byte of the subnet mask.

7.5.12 SM-PROFINET subnet mask Z

Table 7-18 Subnet mask Z

Pr 60.17	Default	0					
	Range	0 to 255					
	Access	US	RW	BU			

This parameter indicates the least significant byte of the subnet mask.

These parameters are normally written to by the PLC during the parameterization phase.

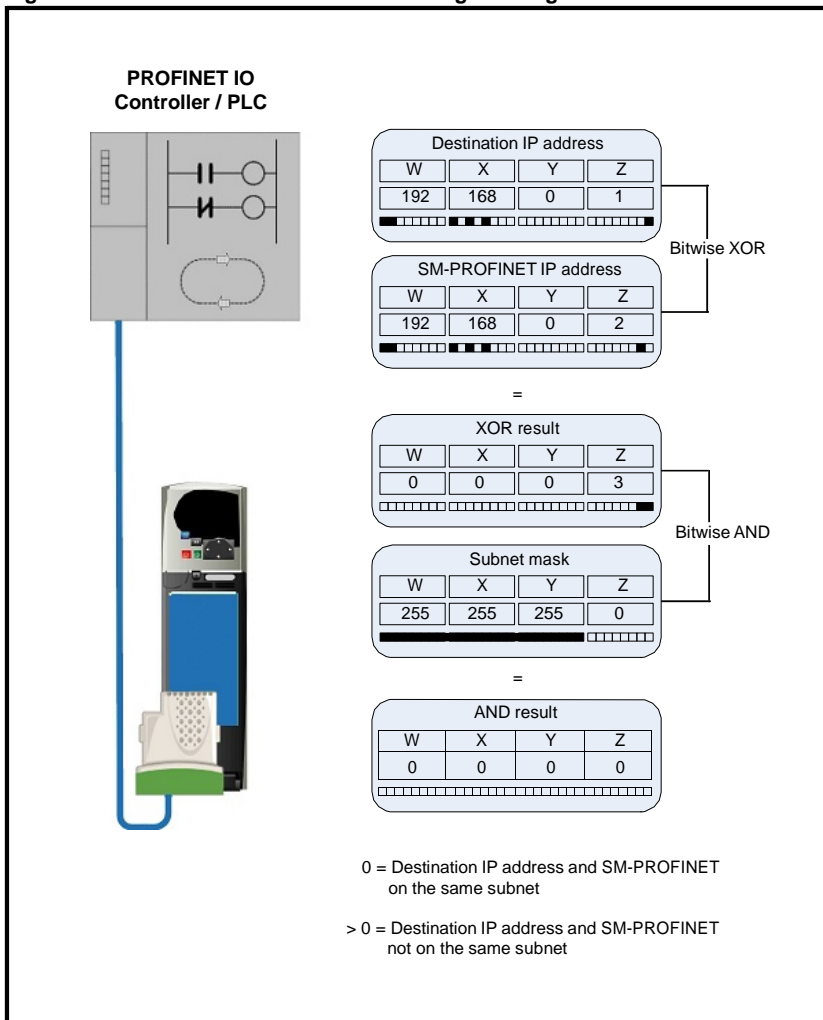
Parameters Pr 60.14 to Pr 60.17 form the Solutions Module's subnet mask using the format W.X.Y.Z.

The subnet mask is used by the SM-PROFINET module to determine if destination addresses are either:

- On the same subnet and can, therefore, be transmitted directly
or
- On a remote network and should, therefore, be transmitted through the default gateway

This is achieved by doing a bitwise XOR of the destination IP address with its own IP address. A bitwise AND is then performed on this result and the subnet mask. A result of zero indicates that the destination IP address is on the same subnet, a non-zero result indicates the destination address is on a remote network. This is illustrated in Figure 7-1 *SM-PROFINET destination message routing* on page 37.

Figure 7-1 SM-PROFINET destination message routing

**NOTE**

The IP address and subnet mask parameters can be saved in the drive, however the PLC may override these values with different values, if they differ from the configured values in the PLC.

7.5.13 SM-PROFINET default gateway W

Table 7-19 Default gateway W

Pr 60.18	Default	0					
	Range	0 to 255					
	Access	US	RW	BU			

This parameter indicates the most significant byte of the default gateway.

7.5.14 SM-PROFINET default gateway X

Table 7-20 Default gateway X

Pr 60.19	Default	0					
	Range	0 to 255					
	Access	US	RW	BU			

This parameter indicates the second most significant byte of the default gateway.

7.5.15 SM-PROFINET default gateway Y

Table 7-21 Default gateway Y

Pr 60.20	Default	0					
	Range	0 to 255					
	Access	US	RW	BU			

This parameter indicates the third most significant byte of the default gateway.

7.5.16 SM-PROFINET default gateway Z

Table 7-22 Default gateway Z

Pr 60.21	Default	0					
	Range	0 to 255					
	Access	US	RW	BU			

This parameter indicates the least significant byte of the default gateway.

These parameters are normally written to by the PLC during the parameterization phase. Parameters Pr 60.18 to Pr 60.21 form the Solutions Module's default gateway address using the format W.X.Y.Z. The default gateway address specifies the IP address of a device that will handle the routing of the messages not on the local subnet.

7.5.17 Data update rate

Table 7-23 Data update rate

Pr 60.28	Default	0				
	Range	0 to 9999				
	Access	ND	NC	PT		

This parameter indicates the number of times the data is updated per second.

Under certain conditions, the specified module update rate may not be achievable, the value displayed in this parameter will be the actual number of times the data is updated per second. Unless the specified module update rate is not achievable, the value displayed should be equal to 1 divided by the specified module update rate (in seconds).

e.g. for an update rate of 2 ms.

Pr 60.28 = 1 / 0.002 = 500

NOTE

This parameter was added in firmware version V01.00.02 and was not available in previous firmware versions.

NOTE

This parameter will display a value of zero if the communication link to the IO controller is broken.

7.5.18 SM-PROFINET module management

Table 7-24 Module management

Pr 60.29	Default	0				
	Range	1000 to 1999				
	Access	US	RW	BU		

This parameter provides low level test and configuration options for the SM-PROFINET module. In general, this parameter does not need to be changed, it is provided mainly for factory testing of the module only.

If any value outside the range of 1000 to 1999 is written to this parameter, then this value will be ignored, and the parameter value will be overwritten with zero. Any change to this parameter will require the module to be reset for the new value to take effect. When the requested function is complete, this parameter will be reset to zero.

NOTE

If a parameter save was requested, then the requested function will be saved and executed on every power cycle until the value is reset to zero and saved.

Table 7-25 Module management functions

Setting	Function	Description
10xx	Launch app xx	Launch the application image file /binaries/imagexx.sys.
1500	Fail safe	Starts the module in TCP/IP mode with all user protocols (Modbus, FTP, etc) disabled except for the HTTP thread which will start with default thread priority.
1501	Wait for CMP	The bootloader will not initialize the file system or launch any application, it will just poll the drive's EIA-485 buffer for any CMP messages.

7.5.19 Load Solutions Module defaults

Table 7-26 Load Solutions Module defaults

Pr 60.30	Default	OFF					
	Range	OFF / ON					
	Access	bit	ND	US	RW		

If set to ON when the module is reset, this parameter will cause the Solutions Module to return to its default factory condition, any previous settings will be lost (including the PROFINET IO device name and IP address); after defaulting the parameters, the module will reset this parameter back to OFF and will then reinitialize.

NOTE

The parameters must then be saved to retain the default values. The PROFINET cyclic communication will be interrupted if the module is reset.

7.5.20 Reinitializing the SM-PROFINET module

Table 7-27 Request to reinitialize

Pr 60.32	Default	OFF					
	Range	OFF / ON					
	Access	bit	ND	US	RW		

Changes to the SM-PROFINET configuration in menu 15, 16 and 17 parameters will not take effect until the SM-PROFINET has been reinitialized.

To reinitialize SM-PROFINET:

- Set Pr 60.32 to On
- When the sequence has been completed, Pr 60.32 will be reset to OFF
- The SM-PROFINET will reinitialize using the updated configuration

NOTE

This sequence does NOT store the SM-PROFINET configuration parameters in the drive or the SM-PROFINET flash memory. This parameter will change back to OFF after the reset is complete and as such the change may not be visible on the display.

7.5.21 Reinitialize all Solutions Modules

To reinitialize all Solutions Modules installed on a drive:

- Set Pr xx.00 to 1070
- Reset the drive

NOTE

This sequence does NOT store the SM-PROFINET configuration parameters in the drive or the SM-PROFINET flash memory. The PROFINET cyclic communication will be interrupted if the module is reset.

7.5.22 Saving parameters in the drive

To avoid loss of the configured settings when the drive is powered down, it is necessary to save the parameters in the drive's memory. To save the drive parameters refer to the relevant drive documentation. The drive will save all the drive parameters (except applications menu 20) but the operation of the SM-PROFINET will not be affected. Any changes made to the SM-PROFINET configuration parameters (mapping etc.) will not take effect until the SM-PROFINET module is reset.

NOTE

On drives with multiple Solutions Module slots, the applications menu 20 may be saved if an SM-Applications module is installed. See the SM-Applications documentation for more information. Although the parameters can be saved in the drive, the PLC may override these values with different values if they differ from the configured values in the PLC when the communication between the PLC and module is started.

7.5.23 SM-PROFINET serial number

Table 7-28 Serial number

Pr 60.35	Default	0					
	Range	0 to 9999999					
	Access	ND	NC	PT			

The serial number is loaded into the SM-PROFINET during manufacture and cannot be changed. It contains the last seven digits of the ten digit serial number on the label.

7.5.24 Module temperature

Table 7-29 Module temperature

Pr 60.44	Default	0					
	Range	0 to 255					
	Access	US	BU				

This parameter shows the Solutions Module temperature reading in degrees °C.

If this parameter reaches the maximum allowed value, then the drive will trip with error code 74 in parameter Pr 60.50. SM-PROFINET has six temperature sensors fitted and each sensor has its own temperature thresholds; Pr 60.44 displays the highest of the six temperatures measured.

7.5.25 Critical task% free

Table 7-30 Critical task % free

Pr 60.46	Default	0					
	Range	0 to 100					
	Access	NC	PT	BU			

7.5.26 Worst case critical task % free

Table 7-31 Worst case critical task % free

Pr 60.47	Default	0					
	Range	0 to 100					
	Access	NC	PT	BU			

Parameters Pr 60.46 and Pr 60.47 indicate how much of the cycle time allocated to the critical task is remaining and available for other module tasks.

7.5.27 Flash file system % free

Table 7-32 Flash file system % free

Pr 60.48	Default	0					
	Range	0 to 100					
	Access	NC	PT	BU			

This parameter indicates the percentage of the unused flash file system.

7.5.28 Solutions Module warning

Table 7-33 Solutions Module warning

Pr 60.49	Default	0					
	Range	0 to 255					
	Access	NC	PT	BU			

This parameter provides an indication of a non-critical warning condition, Table 7-34 shows the bit configuration of the warning value.

Table 7-34 Warning bit configuration (Pr 60.49)

Bit	Warning
0	A Solutions Module feature is issuing a warning
1	Critical task free value is below the warning threshold
2	Failed CMP file access
3	Reserved
4	
5	
6	
7	

7.5.29 Solutions Module error status

Table 7-35 Solutions Module error status

Pr 60.50	Default	0					
	Range	0 to 255					
	Access	NC	PT	BU			

If an error occurs in the SM-PROFINET module, the reason for the error is written into Pr 60.50 and the drive may trip with a slot error. Table 7-36 shows the SM-PROFINET error codes and descriptions.

Table 7-36 SM-PROFINET error codes (Pr 60.50)

Error code	Description
1	No fieldbus mode selected
2	Critical task overrun
3	Invalid feedback source
4	Unknown drive type
5	Unsupported drive type
6	Unknown drive mode
7	Unsupported drive mode
10	Invalid or missing application
62	Database initialization error
63	File system initialization error
64	Error initializing fieldbus stack
65	The PROFINET IO messages have stopped
74	Solutions Module overheated
75	Drive not responding
76	Modbus connection timed out
80	Inter-option communication failure
81	Inter-option communication to slot 1 timeout
82	Inter-option communication to slot 2 timeout
83	Inter-option communication to slot 3 timeout
84	Memory allocation error
85	File system error
86	Configuration file error
98	Solutions Module background task has not completed
99	Software fault

7.5.30 SM-PROFINET firmware version (minor)

Table 7-37 Minor firmware version (zz)

Pr 60.51	Default	N/A				
	Range	0 to 99				
	Access	NC	PT	BU		

Pr **60.51** contains the minor revision number of the application firmware version (zz). The full version of the Solutions Module's application firmware can be assembled by combining the major revision (xx.yy) from Pr **60.02** and the minor revision (zz) from Pr **60.51** as follows: xx.yy.zz.

e.g. for application firmware version 01.01.00, Pr **60.02** will display 1.01 and Pr **60.51** will display 0.

7.6 Full parameter descriptions - general module setup menu 61

This section provides detailed information on the SM-PROFINET general module setup parameters contained in menu 61.

7.6.1 SM-PROFINET Parameter 1.00 shortcut

Table 7-38 Pr 1.00 shortcut

Pr 61.01	Default	0					
	Range	0 to 32767					
	Access	ND	PT	RW	BU		

Some Solutions Modules do not provide access to a parameter zero. This parameter is provided as a shortcut to Pr 1.00.

NOTE

This parameter is essentially the same as parameter zero in any menu (Pr x.00) and is provided for compliance with other real time Ethernet modules (e.g. SM-EtherCAT).

7.6.2 SM-PROFINET option slot indicator

Table 7-39 Option slot indicator

Pr 61.07	Default	0					
	Range	1 to 3					
	Access	BU					

This parameter displays the number of the option slot on the drive in which the SM-PROFINET module is installed.

7.6.3 SM-PROFINET option hardware issue

Table 7-40 Option hardware issue

Pr 61.40	Default	0					
	Range	0 to 255					
	Access	BU					

This parameter displays the SM-PROFINET module hardware issue number.

7.6.4 SM-PROFINET 500 ms task % free

Table 7-41 500 ms task % free

Pr 61.42	Default	0					
	Range	0 to 100					
	Access	BU					

This parameter indicates what percentage of the 500 ms system task is unused and available.

7.6.5 SM-PROFINET external memory % free

Table 7-42 External memory % free

Pr 61.43	Default	0					
	Range	0 to 100					
	Access	BU					

This parameter indicates what percentage of the external memory is unused and available.

7.6.6 SM-PROFINET internal memory % free

Table 7-43 Internal memory % free

Pr 61.44	Default	0				
	Range	0 to 100				
	Access	BU				

This parameter indicates what percentage of the internal memory is unused and available.

Flexible module

To optimize the available parameters, not all drive parameters are available using defined modules; if a parameter is required that is not listed then one of the flexible modules may be used instead.

There are 6 flexible modules available, 3 input (Read) and 3 output (Write); each input or output module can be configured for either an 8, 16 or 32-bit data size and either signed or unsigned.

When the flexible module is initially placed on the network, the 'Properties' dialog window opens and from the 'Parameters' tab the required drive parameter can be configured.

7.6.7 SM-PROFINET Solutions Module error sub-code

Table 7-44 Solutions Module error sub-code

Pr 61.49	Default	0				
	Range	0 to 255				
	Access	ND	NC	PT	BU	

This parameter provides an extra error code to assist in diagnosing the current slot error.

7.7 Full parameter descriptions - Module MAC address menu 62

This section provides detailed information on the PROFINET IO setup parameters contained in menu 62.

7.7.1 SM-PROFINET MAC address U

Table 7-45 SM-PROFINET MAC address U

Pr 62.40	Default	0				
	Range	0 to 255				
	Access					

This parameter indicates the most significant byte of the base MAC address.

7.7.2 SM-PROFINET MAC address V

Table 7-46 SM-PROFINET MAC address V

Pr 62.41	Default	13				
	Range	0 to 255				
	Access					

This parameter indicates the second most significant byte of the base MAC address.

7.7.3 SM-PROFINET MAC address W

Table 7-47 SM-PROFINET MAC address W

Pr 62.42	Default	30				
	Range	0 to 255				
	Access					

This parameter indicates the third most significant byte of the base MAC address.

7.7.4 SM-PROFINET MAC address X

Table 7-48 SM-PROFINET MAC address X

Pr 62.43	Default	N/A				
	Range	0 to 255				
	Access					

This parameter indicates the fourth most significant byte of the base MAC address.

7.7.5 SM-PROFINET MAC address Y

Table 7-49 SM-PROFINET MAC address Y

Pr 62.44	Default	N/A				
	Range	0 to 255				
	Access					

This parameter indicates the fifth most significant byte of the base MAC address.

7.7.6 SM-PROFINET MAC address Z

Table 7-50 SM-PROFINET MAC address Z

Pr 62.45	Default	N/A				
	Range	0 to 255				
	Access					

This parameter indicates the least significant byte of the base MAC address.

The MAC address is a unique number identifying a particular device on a network and takes the form U:V:W:X:Y:Z.

The SM-PROFINET option module has three MAC addresses associated with it, the base MAC address is the address used by the PROFINET controller/PLC to identify a device and to communicate with it over the RT channel; the other two MAC addresses will be sequential and follow directly on from the base MAC address to identify the two switch ports for TCP/IP communication; all three MAC addresses are allocated to the module serial number during manufacture.

The SM-PROFINET base MAC address may be found on the option module rating label (see *Figure 2-1 SM-PROFINET label details* on page 9).

The most significant three bytes of the MAC address are the manufacturer identification number, for EPA these will be 00:0D:1E.

The least significant three bytes can be used to form a unique serial number for the SM-PROFINET module, this serial number is not related to the module serial number given in Pr 60.35.

This section provides detailed information on the PROFINET IO slot identification parameters contained in menu 65.

When configuring the cyclic data, each drive parameter is given a unique module ID number. There are module ID numbers for input parameters and different module ID numbers for output parameters. For parameters which are both inputs and outputs, there is one module ID for input and another module ID for output.

For normal drive parameters (excluding menu 3 and slot feedback parameters), the module ID can be calculated as follows:

Input parameters

Module ID = Menu x 1000 + Parameter x 10 + mode value x 100,000,000

Output parameters

Module ID = Menu x 1000 + Parameter x 10 + 1 + mode value x 100,000,000

The mode value is a number which is based upon the drive modes allowed as shown in Table 7-51.

Table 7-51 Drive mode specific values

Mode Value	Open Loop	Closed Loop	Servo	Regen
0	x	x	x	x
1	x			
2		x		
3	x	x		
4			x	
5	x		x	
6		x	x	
7	x	x	x	
8				x
9	x			x
10		x		x
11	x	x		x
12			x	x
13	x		x	x
14		x	x	x
15	x	x	x	x

For other parameters, Table 7-52 lists the parameter and relevant module ID numbers.

NOTE

The term 'slot' refers to the option module's allocated memory location for the mapped parameter (not the drive option module slot), each slot contains one cyclic parameter value. There are 64 possible slots available and assigned to parameters 1 to 64 in menu 65.

Table 7-52 SM-PROFINET special parameter module ID list

Parameter	Module ID	Description
3.28	10000000	Drive position feedback b47 to b32 (Revolution Counter)
3.29	10000000	Drive position feedback b31 to b16 (Position)
3.30	10000000	Drive position feedback b15 to b0 (Fine Position)
-	10000004	User defined 16-bit read
-	10000005	User defined 32-bit read
-	10000003	User defined 8-bit read
-	10000007	User defined 16-bit write
-	10000008	User defined 32-bit write
-	10000006	User defined 8-bit write
3.02	600003020	Speed feedback
3.27	700003270	Drive encoder speed
3.28	700003280	Drive encoder revolution counter
3.29	700003290	Drive encoder position
3.30	700003300	Drive encoder fine position
MM.03	1000030	Slot speed feedback
MM.04	1000040	Slot revolution counter
MM.05	1000050	Slot position
MM.06	1000060	Slot fine position
MM.04	10000001	Slot position feedback b47 to b32 (Revolution Counter)
MM.05	10000001	Slot position feedback b31 to b16 (Position)
MM.06	10000001	Slot position feedback b15 to b0 (Fine Position)

Each parameter configured in the PLC will have it's unique module ID number written to the relevant parameter in menu 65. Pr **65.01** will indicate the module ID for slot 1, Pr **65.02** for slot 2, etc.

For example, if Pr **20.21** is configured in slot 1 as an input, and Pr **20.22** is configured in slot 2 as an output, then Pr **65.01** will indicate the value 20210 and Pr **65.02** will indicate the value 20221.

7.8.1 SM-PROFINET slot identification number

Table 7-53 Slot identification number

Pr 65.01 to 65.64	Default	0				
	Range	0 to $2^{32}-1$ (0 to 4294967295)				
	Access					

NOTE

Menu 65 parameters are automatically saved in the SM-PROFINET Solutions Module when written.

8 Diagnostics

This chapter provides basic diagnostic information intended to enable resolution of the most common problems encountered when setting up a SM-PROFINET module. It is not unreasonable to say that a high percentage of problems reported by customers, are basic set-up problems which could be rectified by using the basic information in this chapter.

Start by reference to Figure 5-2 *SM-PROFINET setup flowchart* on page 22 and also Figure 8-1 *Diagnostics flowchart* on page 51, to determine the possible cause of a problem. If after following the flowcharts you are still experiencing problems, please contact your supplier or local EPA Drive Centre for support.

8.1 LED diagnostics

SM-PROFINET is equipped with 2 LED's on the front panel to aid the diagnostics procedure. Each LED indicates the state of the associated Ethernet connection and is detailed in Table 8-1 below.

Table 8-1 LED functionality

State	Meaning	Action
OFF	No Ethernet connection detected	Check Ethernet cable is connected correctly and drive is powered up
Steady green	Ethernet connection established	Check for errors in the PROFINET controller/PLC
Flashing green	Ethernet message detected	None

8.2 Solutions Module warning

Parameter Pr **60.49** provides indication of a non-critical warning condition within the Solutions Module. Because more than one warning is possible at any given moment in time, each warning condition is indicated by a particular bit of the value. Table 8-2 shows the possible warning conditions and possible remedial actions.

Table 8-2 SM-PROFINET Warning bit configuration (Pr 60.49)

Bit	Warning	Action
0	A Solutions Module feature is issuing a warning	Check SM-PROFINET configuration parameters
1	Critical task free value is below the warning threshold	Increase available task space by reducing the number of operations within the critical task
2	Failed CMP file access	Check communication settings, if problem persists then replace Solutions Module
3	Reserved	Reserved
4		
5		
6		
7		

8.3 Solutions Module error status

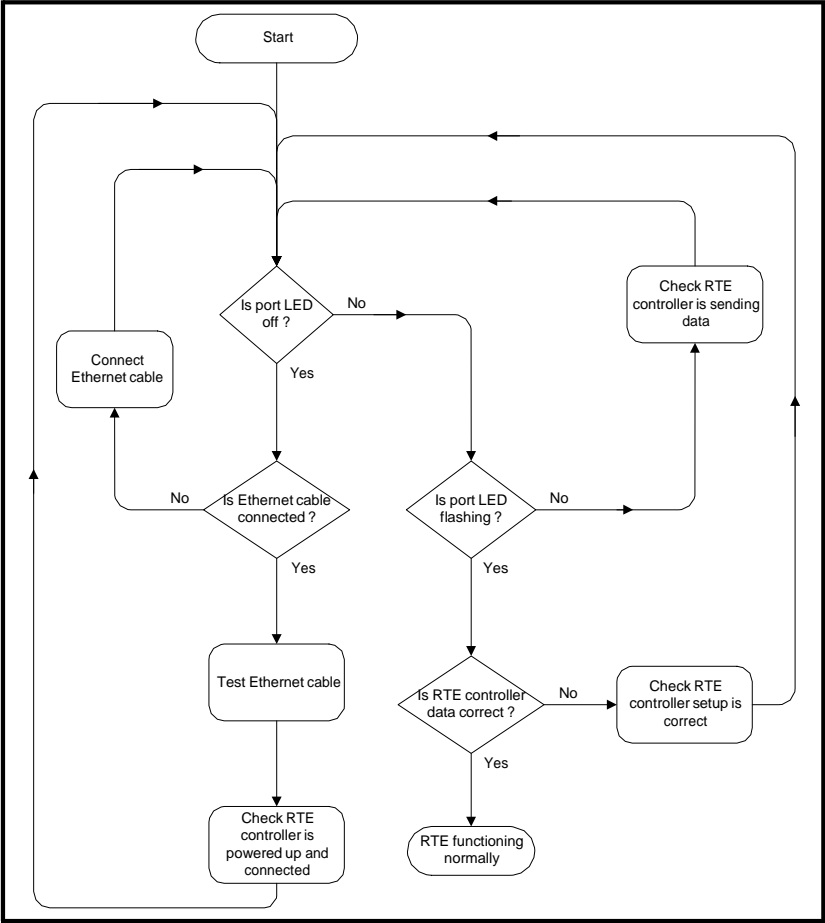
If an error occurs in the SM-PROFINET module, the reason for the error is written into Pr 60.50, and the drive may trip with a slot error. Table 8-3 below shows the SM-PROFINET error codes, descriptions and possible remedial actions.

Table 8-3 SM-PROFINET error codes (Pr 60.50)

Error code	Description	Action
1	No fieldbus mode selected	Select the fieldbus mode and re-initialize the module.
2	Critical task overrun	Reduce the number of operations within the critical task.
3	Invalid feedback source	Select a valid feedback source.
4	Unknown drive type	Fit the Solutions Module to a known drive (see section 3.1 <i>General Installation</i>).
5	Unsupported drive type	
6	Unknown drive mode	The drive operating mode is not known, set a valid drive operating mode.
7	Unsupported drive mode	
10	Invalid or missing application	Replace SM-PROFINET module.
62	Database initialization error	
63	File system initialization error	
64	Fieldbus stack initialization error	
65	The PROFINET IO messages have stopped	Check network connections
74	Solutions Module overheated	Ensure the ambient operating temperature has not been exceeded.
75	Drive not responding	Replace SM-PROFINET module.
76	Modbus connection timed out	Increase Modbus timeout value.
80	Inter-option communication failure	Check source/destination parameter exists; replace SM-PROFINET module.
81	Inter-option communication to slot 1 timeout	
82	Inter-option communication to slot 2 timeout	
83	Inter-option communication to slot 3 timeout	
84	Memory allocation error	Replace SM-PROFINET module
85	File system error	
86	Configuration file error	
98	Solutions Module background task has not completed	Reduce the number of cyclic parameters
99	Software fault	Replace SM-PROFINET module

8.4 Diagnostics flowchart

Figure 8-1 Diagnostics flowchart



8.5 Diagnostics parameters

This section contains the diagnostics parameters relevant in diagnosing setup or network communication problems.

8.5.1 SM-PROFINET ID code

Table 8-4 SM-PROFINET module ID code

Pr 60.01	Default	422					
	Range	422					
	Access	ND	PT	US	BU		

This parameter displays the module ID code, this ID code indicates the type of module installed; the module ID code for SM-PROFINET is 422.

8.5.2 SM-PROFINET firmware version

SM-PROFINET major firmware version (xx.yy)

Table 8-5 SM-PROFINET major firmware version (xx.yy)

Pr 60.02	Default	N/A					
	Range	00.00 to 99.99					
	Access	ND	NC	PT	BU		

Pr 60.02 contains the major revision number of the application firmware version (xx.yy);

Table 8-6 SM-PROFINET minor firmware version (zz)

Pr 60.51	Default	N/A					
	Range	0 to 99					
	Access	NC	PT	BU			

Pr 60.51 contains the minor revision number of the application firmware version (zz); The full version of the Solutions Module's application firmware can be assembled by combining the major revision (xx.yy) from Pr 60.02 and the minor revision (zz) from Pr 60.51 as follows: xx.yy.zz.

e.g. for application firmware version 01.01.00, Pr 60.02 will display 1.01 and Pr 60.51 will display 0.

8.5.3 SM-PROFINET diagnostics information

Table 8-7 SM-PROFINET diagnostics information

Pr 60.06	Default	0					
	Range	-9999 to 9999					
	Access	ND	NC	PT			

This parameter is used to provide status error diagnostics and operating information on the SM-PROFINET module.

Table 8-8 SM-PROFINET diagnostics (Pr 60.06)

Code	Meaning	Description
Running states		
>0	Messages per second	The total number of messages for all active protocols the module is handling per second
0	Ethernet link established	The Ethernet link has been established but no frames are being received or transmitted
Application		
-1	Initialization complete	The option module has initialized correctly but no Ethernet frames have been detected
-25	Starting fieldbus	The fieldbus is starting
-30	Initializing fieldbus	The fieldbus is being initialized
-50	Initializing databases	The module databases are being initialized
-70	Initializing file system	The module file system is being initialized
-99	Application started	The main application has been launched
Bootloader		
-100	Default mode	The bootloader has finished but no application was launched. CMP messages will be handled normally
-101	Launching application	The application is being launched
-110	Loading application	The application image is being copied from the file system into memory
-130	Checking boot mode	The required boot mode is being checked
-148	Verifying file system	The file system is being verified
-149	Formatting file system	The file system is being formatted
-150	Initializing file system	The file system handler is being initialized
-159	Erasing storage flash memory	The storage area of the flash memory is being erased
-160	Erasing flash memory	The entire flash memory is being erased
-180	Initializing memory	The memory manager is being initialized
-199	Bootloader start	The bootloader is starting up
Recovery/Test		
-241	Testing complete	All tests have been successfully completed
-244	Testing DINT/RMINT	The DINT/RMINT mechanism is being tested
-245	Testing digital inputs	The digital inputs are being tested
-246	Testing Ethernet ports	The two Ethernet ports are being tested
-247	Testing drive interface	The drive interface to the module is being tested
-248	Testing thermal trip	The thermal trip mechanism is being tested
-249	Testing RAM	The RAM is being tested
-250	Testing file system	The integrity of the file system is being checked
-299	Recovery application started	The recovery application has been launched

8.5.4 SM-PROFINET data update rate

Table 8-9 SM-PROFINET data update rate

Pr 60.28	Default	0					
	Range	0 to 9999					
	Access	ND	NC	PT			

This parameter indicates the number of times the data is updated per second. Under certain conditions, the specified module update rate may not be achievable, the value displayed in this parameter will be the actual number of times the data is updated per second. Unless the specified module update rate is not achievable, the value displayed should be equal to 1 divided by the specified module update rate (in seconds).

e.g. for an update rate of 2 ms.

Pr 60.28 = $1 / 0.002 = 500$

NOTE

This parameter was added in firmware version V01.00.02.

NOTE

This parameter will display a value of zero if the communication link to the IO controller is broken.

8.5.5 Option module warning

Table 8-10 Option module warning

Pr 60.49	Default	0					
	Range	0 to 255					
	Access	NC	PT	BU			

This parameter provides an indication of a non-critical warning condition.

Table 8-11 shows the bit configuration of the warning value.

Table 8-11 SM-PROFINET warning bit configuration (Pr 60.49)

Bit	Warning
0	An option module feature is issuing a warning
1	Critical task free value is below the warning threshold
2	Failed CMP file access
3	Reserved
4	Reserved
5	Reserved
6	Reserved
7	Reserved

8.5.6 Option module error status

Table 8-12 Option module error status

Pr 60.50	Default	0				
	Range	0 to 255				
	Access	NC	PT	BU		

If an error occurs in the SM-PROFINET module, the reason for the error is written into Pr **60.50** and the drive may trip with a slot error. Table 8-13 shows the SM-PROFINET error codes and descriptions.

8.5.7 SM-PROFINET error codes (Pr 60.50)

Table 8-13 Option module error status

Error code	Description
1	No fieldbus mode selected
2	Critical task overrun
3	Invalid feedback source
4	Unknown drive type
5	Unsupported drive type
6	Unknown drive mode
7	Unsupported drive mode
10	Invalid or missing application
62	Database initialization error
63	File system initialization error
64	Error initializing fieldbus stack
65	The PROFINET IO messages have stopped
74	Option module overheated
75	Drive not responding
76	Modbus connection timed out
80	Inter-option communication failure
81	Inter-option communication to slot 1 timeout
82	Inter-option communication to slot 2 timeout
83	Inter-option communication to slot 3 timeout
84	Memory allocation error
85	File system error
86	Configuration file error
98	Option module background task has not completed
99	Software fault

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.

ASCII (American Standard Code for Information Interchange): A standard character encoding mechanism established by ANSI to provide compatibility between data systems and services.

Asynchronous Transmission: Each character transmitted is individually synchronized using start and stop bits.

ANSI (American National Standards Institute): A voluntary organization that represents the USA in the ISO, and is responsible for defining ASCII. Members include manufacturers, common carriers, and other standards organizations such as the IEEE.

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

Bandwidth: The information-carrying capability of a communications channel or line, expressed in Hertz (Hz), between the highest and lowest frequencies of a band.

Baseband Transmission: Direct transmission method whereby the transmission medium carries only one signal at a time usually for distances under ten miles.

BCC (Block Check Character): A control character added to a block in character oriented protocols used for determining if the block was received in error -- such as CRC and LRC.

BCD (Binary Coded Decimal): A digital system that uses six-bit binary codes to represent decimal digits, providing 64 possible combinations.

Binary: A digital system with two states, 1 and 0.

Bit: A contraction of the phrase binary digit, representing the smallest unit of information and the basic unit in data communications, a bit may have the value of 1 or 0.

Bit Rate: The speed at which binary digits (bits) would be transmitted over a communications path and usually expressed in "bits per second" (bps). Bit rate should not be confused with Baud which defines the rate of signal state changes.

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

CCITT (The Consultative Committee International Telegraph and Telephone): The international advisory committee, established under the United Nations that sets international recommendations which often are accepted as standards.

Channel: A data link which connects two devices allowing them to communicate with each other.

Character: Any letter, number, punctuation mark or other sign contained in a message, including characters for control functions and for special symbols.

Checksum: The sum of a group of data provided with the group, for checking purposes.

Control Character: A non-printing character used to initiate, modify, or stop a control function. LF (line feed) is an example of a control character.

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.

CRC (Cyclic Redundancy Check): An error checking control method in which the block check character (BCC) is the remainder after dividing all the serialized bits in a transmitted block by a prespecified binary number.

Crossover lead: A network cable where the terminal connections at one end of the cable are connected straight through to the other end with the exception of the data pair which are transposed.

(Normally used to connect two network devices together as a separate network.)

CSMA (Carrier Sense Multiple Access): A contention-based LAN access method where Ethernet devices listen prior to transmitting, send a packet of data, then free the line for other devices to transmit. While stations do not transmit until the line is clear, transmission collisions still occur.

CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance): A CSMA protocol using a slotted TDM to minimize a collision reoccurrence. For optimum results, CSMA/CA will work best if the time slot is short as compared to the length of the packet.

CSMA/CD (Carrier Sense Multiple Access with Collision Detection): A LAN access method where all networked devices listen for transmissions before attempting to transmit. If two or more devices begin transmitting at the same time, each stops for a random period of time before attempting to re-transmit.

Cyclic (implicit or polled) data: Data that is transmitted at regular intervals over the network; sometimes referred to as "Implicit data" or "Polled data".

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.

Decentralized: A processing method where intelligence is located at several remote locations of the same processing system.

Deterministic: A system is deterministic when the output can be predicted with certainty. For communication systems, a deterministic system is one where the messages can be reliably delivered at precise time intervals.

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

DHCP (Dynamic Host Configuration Protocol): This is a protocol used to allocate dynamic IP addresses to network devices from a central server.

DNS (Domain Name Server): This is a server that is used to convert a URL such as "www..com" to an IP address such as 129.254.254.106.

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

Duplex: A communication facility providing transmission in either one direction only (half-duplex) or two directions simultaneously (full-duplex).

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

GSDML (General Station Description Markup Language) file: An XML based file that defines the properties of a network device and contains information describing the features available on the device.

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.

Frame: The entire sequence of bits and bytes in a transmitted block.

FTP (File Transfer Protocol): A protocol using the TCP/IP protocols commonly used for transferring files over the Internet.

Full-duplex: See Duplex

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

Half-duplex: See Duplex

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.

IEEE (Institute of Electrical and Electronic Engineers): An international institute that issues its own standards and is a member of ANSI and ISO.

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.

ISO (International Standards Organization): The International, voluntary standards organization, closely aligned with the CCITT perhaps best noted for its OSI model and OSI communications protocol. Membership includes other international organizations issuing standards, with ANSI being the American representative.

Jitter: A tendency toward a lack of synchronization or other impairment caused by the mechanical or electrical changes in communications equipment.

LAN (Local Area Network): The data communications facilities used to provide communications within a limited geographical area, normally up to 6 miles, using the higher data rates normally from 1 Mbps to 1 Gbps. LANs may have bridges or gateways to other networks but are usually confined to a building or cluster of buildings.

Latency: The waiting time, or delay between a device's request message and the response message.

LED: Light Emitting Diode.

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

LSB: Least Significant Bit/Byte.

MAC address: This is a unique address that is assigned to SM-PROFINET 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 controller: The network device which controls the cyclic communication on a network. (See *PLC*).

Network topology: The arrangement of devices and the links connecting the devices on a network.

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-crossover lead: See Patch lead.

Non-cyclic (explicit) data: Data that is requested or sent as required and not on a regular basis. Sometimes referred to as "Explicit data".

Non-deterministic: A non-deterministic system is one where the output can not be predicted with certainty. For communication systems, a non-deterministic system is one where the messages can not be delivered at precise time intervals.

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

OSI Model (Open Systems Interconnection Model): The 7-layer reference model recommended by the ISO to provide a logical structure for network operations protocol.

Parity Bit: An error-checking bit whose binary value (0 or 1) depends on whether the sum of bits with the value 1 in the unit of data being checked is odd or even. If the total number of bits with value 1, including the parity bit (or bits), is even, the unit of data is said to have even parity; if it is odd, it has odd parity.

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.

PDU (Protocol Data Unit): This is the main Modbus message telegram, to which is added the MBAP header to form the complete Modbus telegram.

PLC (Programmable Logic Controller): A digital computer used for automation of electromechanical processes. Sometimes used as a communication specific network controller.

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

Polled data: See Cyclic data.

Protocol: The method of "line discipline" used to control the orderly exchange of information between the stations on a data link or on a data communications network or system.

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.

RT (Real Time): A communication system which can accurately deliver messages to within pre-determined time tolerances.

RTE (Real Time Ethernet): An Ethernet based communication system which can accurately deliver messages to within pre-determined time tolerances.

Scan rate: See Poll rate.

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

SMTP (Simple Mail Transfer Protocol): A protocol used for sending email.

SNTP (Simple Network Time Protocol): A protocol used for synchronising time over a network.

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.

Synchronous Transmission: A constant time interval between characters is used to ensure that all data communications equipment is in step with each other. The opposite of asynchronous transmission, synchronous transmission, does not use start-stop bits surrounding each byte, but relies on the transmitter and receiver to be functioning at a fixed rate of transmission, thereby being a more efficient method of data communication.

TCP (Transmission Control Protocol): This protocol is responsible for ensuring that the data on the network reaches its destination.

TDM (Time Division Multiplexer): A multiplexer designed to apportion its composite link time between its available channels, interleaving data at a higher speed on the main or multiplexed channel. The data signals are then separated to restore the data to the individual input channels.

URL (Uniform Resource Locator): A method used to give a web site a friendly name such as www..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.

XML (Extensible Markup Language): A document definition that is intended to store and transfer data between applications.

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