EMERSON™

Industrial Automation

User Guide

SM-Ethernet

Solutions Module for:

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

Part Number: 0471-0047-06
Issue: 6

CONTROL TECHNIQUES

www.controltechniques.com

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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Environmental Statement

Control Techniques is committed to minimising the environmental impacts of its manufacturing operations and of its products throughout their life cycle. To this end, we operate an Environmental Management System (EMS) which is certified to the International Standard ISO 14001. Further information on the EMS, our Environment Policy and other relevant information is available on request, or can be found at www.greendrives.com.

The electronic variable speed drives manufactured by Control Techniques 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, while other parts are secured with conventional fasteners. Virtually all parts of the product are suitable for recycling.

Product packaging is of good quality and can be re-used. Large products are packed in wooden crates, while smaller products come in strong cardboard cartons which themselves have a high-recycled fibre content. If not re-used, these containers can be recycled. Polythene, used on the protective film and bags from wrapping product, can be recycled in the same way. Control Techniques' packaging strategy prefers easily recyclable materials of low environmental impact, and regular reviews identify opportunities for improvement.

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 Control Techniques 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 **MM.02** will display 1.01 and Pr **MM.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 Control Techniques products, please approach your usual contact in the first instance. Control Techniques position statement can be viewed at:

http://www.controltechniques.com/REACH

Contents

4

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

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, 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 SECURE DISABLE / 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 SECURE DISABLE / 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.

The SECURE DISABLE / SAFE TORQUE OFF function is only available as standard on the Unidrive SP / Digitax ST.

The SECURE DISABLE function on Unidrive SP and the SAFE TORQUE OFF function on Digitax ST meet the requirements of EN954-1 category 3 for the prevention of unexpected starting of the drive. They 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.**

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.

1.4 Environmental limits

Instructions 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.

For more information on these limits see the relevant drive user guide.

1.5 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.

For instructions in achieving compliance with specific EMC standards, please refer to the relevant drive user guide.

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

98/37/EC: Safety of machinery.

89/336/EEC: Electromagnetic Compatibility.

1.6 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 **0.46** for Unidrive SP, Affinity and Digitax ST, Pr **0.06** in Commander SK and Pr **0.28** in Mentor MP. This affects the thermal protection of the motor.

1.7 Adjusting parameters

Some parameters 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 over Ethernet.

1.8 General safety considerations for remote operation

SM-Ethernet 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.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

2 Introduction

2.1 Features

The SM-Ethernet is a Solutions Module that can be used on the following products to provide Ethernet slave connectivity:
- Unidrive SP
- Commander SK
- Affinity
- Digitax ST
- Mentor MP

With the exception of Commander SK, it is possible to use more than one SM-Ethernet module or a combination of SM-Ethernet and other Solutions Modules to add additional functionality such as extended I/O, gateway functionality, or additional PLC features.

The following list gives an overview of the functionality available within SM-Ethernet.

- Single RJ45 connectivity with support for shielded twisted pair.
- 10/100Mbs Ethernet with auto-negotiation.
- Full and half duplex operation with auto-negotiation.
- Auto crossover detection.
- TCP/IP.
- Modbus TCP/IP.
- EtherNet/IP.
- Embedded web pages for configuration.
- Event driven E-mail generation.
- SyPTPro over Ethernet.
- OPC server over Ethernet.
- CTSoft over Ethernet.
- Static IP configuration or DHCP client.
- SMTP.
- SNTP.
- Firmware updates over Ethernet using web pages.
- User defined web pages.
- Integrated security.
- 4kV impulse isolation.
- Help files integrated into the module.
- Multiple language support.

SM-Ethernet is powered from the host drive's internal power supply and draws 280mA from the supply.

2.1.1 Backup/auxiliary supply

Unidrive SP, Affinity and Digitax ST drives provide a method of powering up the control circuits (and therefore any Solutions Modules installed) if the AC supply is removed, this allows the SM-Ethernet to continue operating when the main AC supply is switched off. For every SM-Ethernet module installed allow for an extra 280mA of supply current to be drawn from the backup supply.

2.2 Solutions Module identification

Figure 2-1 SM-Ethernet
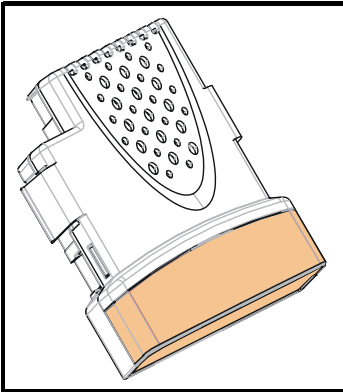
The SM-Ethernet can be identified by:

1. The label located on the underside of the Solutions Module.

Figure 2-2 SM-Ethernet label
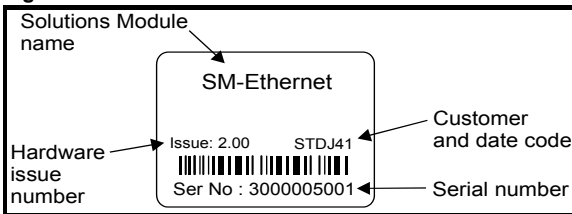
2. The color coding across the front of the Solutions Module. SM-Ethernet being beige.

2.2.1 Date code format

The date code is split into two sections: a letter followed by a number. (see Figure 2-2 *SM-Ethernet label* on page 9)

The letter indicates the year, and the number indicates the week number (within the year) in which the Solutions Module was built.

The letters go in alphabetical order, starting with A in 1990 (B in 1991, C in 1992 etc.).

Example:
A date code of R35 would correspond to week 35 of year 2008.

2.3 Product conformance

SM-Ethernet complies with IEEE 802.3 and meets the isolation requirements of safety standard EN50178.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

2.4 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 2.1 *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 2.1 *Drive menu availability*) and **xx** signifies the parameter number.

Table 2.1 Drive menu availability

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

3   Mechanical installation

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

> ⚠️ **WARNING**
>
> 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 5. 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 Fitting a Solutions Module
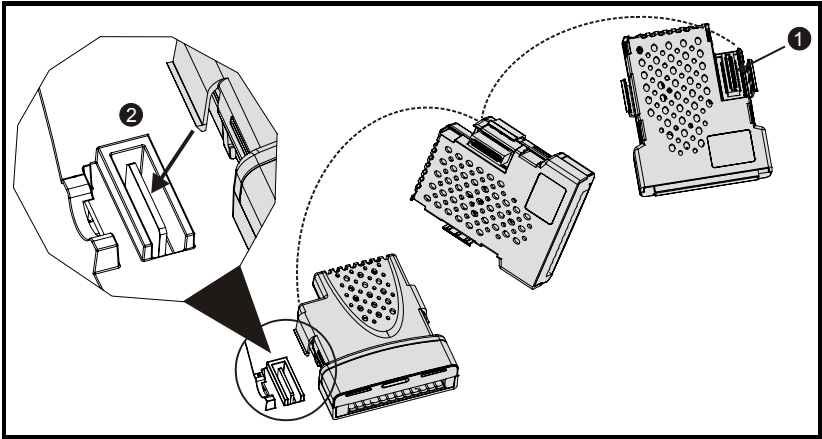
The Solutions Module connector is located on the underside of the module (1). Push this into the Solutions Module slot located on the drive until it clicks into place (2). Note that some drives require a protective tab to be removed from the Solutions Module slot. For further information, refer to the appropriate drive manual.

4 Electrical installation

4.1 SM-Ethernet module information

SM-Ethernet provides a standard RJ45 UTP/STP (*Un-shielded/Shielded Twisted Pair*) connection to a 10Mbs or 100Mbs Ethernet system. In addition to the RJ45 connector a grounding tag is supplied for supplementary bonding. SM-Ethernet provides 4 diagnostic LEDs for status and information purposes.

Figure 4-1 SM-Ethernet terminals
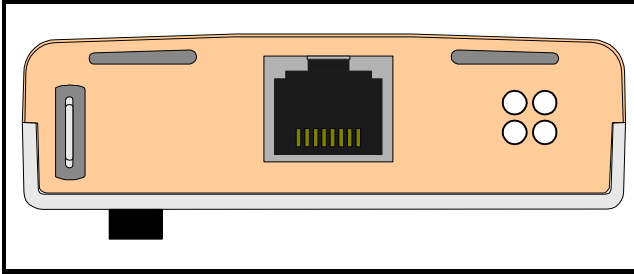
Figure 4-1 shows an overview of the module connections and indicators. The default mode for the RJ45 is crossover.

Figure 4-2 SM-Ethernet Module Layout
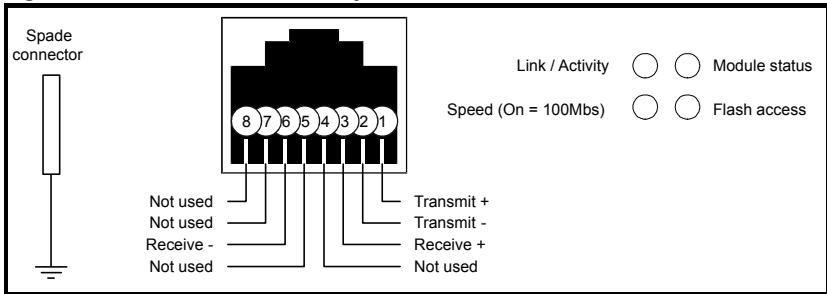
Table 4.1 RJ45 pin out details

RJ45 Terminal	Internal Crossover Disabled (Pr **MM.43**=0)	Internal Crossover Enabled (Pr **MM.43**=1)
1	Transmit +Ve	Receive +Ve
2	Transmit -Ve	Receive -Ve
3	Receive +Ve	Transmit +Ve
4	-	-
5	-	-
6	Receive -Ve	Transmit -Ve
7	-	-
8	-	-

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

4.2 Cabling considerations

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

4.3 Module grounding

SM-Ethernet 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.

4.4 SM-Ethernet cable shield connections

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

4.5 Cable

It is recommended that a minimum specification of CAT5e is installed on new installations, as this gives a good cost/performance ratio. If you are using existing cabling this may limit the maximum data rate depending on the cable ratings. In noisy environments the use of STP or fiber optic cable will offer additional noise immunity.

NOTE Cabling issues are the single biggest cause of network down-time. Ensure cabling is correctly routed, wiring is correct, connectors are correctly installed and any switches or routers used are rated for industrial use. Office grade Ethernet equipment does not generally offer the same degree of noise immunity as equipment intended for industrial use.

4.6 Maximum network length

The main restriction imposed on Ethernet cabling is the length of a single segment of cable as detailed in Table 4.2. If distances greater than this are required it may be possible to extend the network with additional switches or by using a fiber optic converter.

Table 4.2 Ethernet maximum network lengths

Type Of Cable	Data rate (bit/s)	Maximum trunk length (m)
Copper - UTP/STP CAT 5	10M	100
Copper - UTP/STP CAT 5	100M	100
fiber Optic - Multi-mode	10M	2000
fiber Optic - Multi-mode	100M	3000
fiber Optic - Single-mode	10M	no standard
fiber Optic - Single-mode	100M	up to 100000

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

4.7 Minimum node to node cable length

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

4.8 Network topology

4.8.1 Hubs

A hub provides a basic connection between network devices. Each device is connected to one port on the hub. Any data sent by a device is then sent to all ports on the hub.

The use of hubs is not recommended for use within control systems due to the increased possibility of collisions. Collisions can cause delays in data transmission and are best avoided, in severe cases a single node can prevent other nodes on the same hub (or collision domain) from accessing the network.

If using hubs or repeaters you must ensure that the path variability value and propagation equivalent values are checked. This is, however, beyond the scope of this document.

NOTE *Control Techniques* do not recommend the use of un-switched hubs.

4.8.2 Switches

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

NOTE Some switches require a certain time to intitialise (typically 30 to 60 seconds) if SM-Ethernet is reset.

4.8.3 Routers

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

4.8.4 Firewalls

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

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

4.8.5 VPN

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

4.9 Typical network connections

4.9.1 Single PC to SM-Ethernet

To connect a PC to the SM-Ethernet using the default setting of Pr **MM.43** requires a crossover cable. This allows the two devices to communicate without the need to change any settings on SM-Ethernet or the use of a switch or hub.

Figure 4-3   Connecting a single PC to SM-Ethernet using a crossover cable
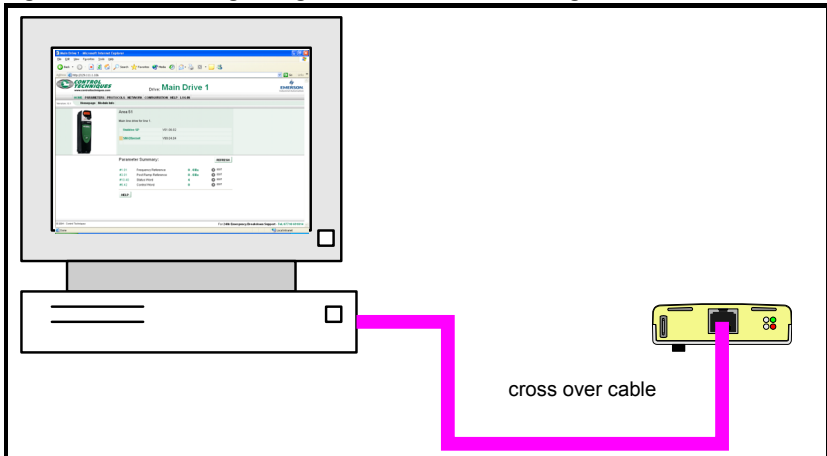
cross over cable

NOTE   When purchasing network cables it is recommended that a different color (*e.g. pink*) is used for crossover cables to allow easy recognition. When connecting as in Figure 4-3, to avoid the need for crossover cables it is possible to change the SM-Ethernet RJ45 port to use a non-crossover cable by setting Pr **MM.43** to 1. This will force SM-Ethernet to detect the type of cable used when it initialises allowing either type to be used. If auto-detect is disabled (Pr **MM.43**=0) a cross-over cable is needed or you need to connect via a switch. For more information see *SM-Ethernet enable auto-crossover detection* on page 95.

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

4.9.2 Single PC to multiple SM-Ethernet using a single switch

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

Figure 4-4 Single PC to multiple SM-Ethernet modules using a switch

Non-crossover cable

Switch

Non-crossover cable
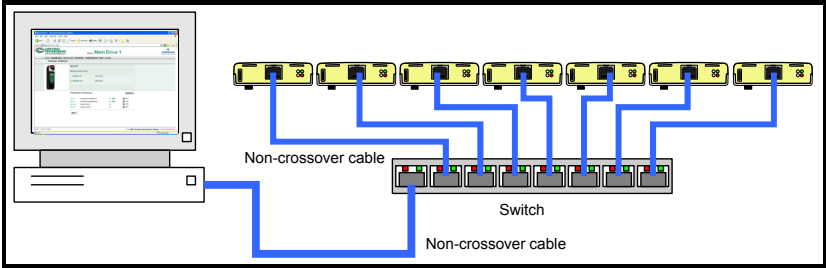
4.9.3 Single PC to multiple SM-Ethernet using more than one switch

When using more than one switch, ensure that the cables connecting the switches are of the correct type. This will normally be a crossover cable, unless the switch supports auto crossover correction or has a switch to convert the socket, if this is the case a non-crossover lead may be used. Please consult the documentation supplied with the switch for more information.

Figure 4-5 Connections with multiple switches

Non-crossover cables

Switch

Non-crossover cable or crossover cable (*check device documentation*)

Non-crossover cables

Switch
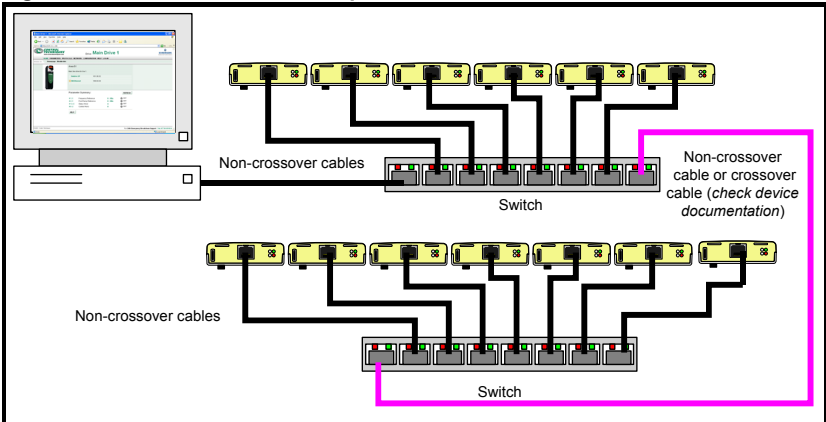
4.9.4 Connection of network subnets

When connecting multiple network subnets a router or firewall should be used to allow effective management of network traffic. A subnet is identified by the change in the network section of the IP address (*see section 5.7.1 The IP address* on page 19 *for more information*). A subnet boundary is usually designated by a router or firewall. The design of larger networks, however, is beyond the scope of this document.

Safety
information

Introduction

Mechanical
installation

Electrical
installation

**Getting
started**

Protocols

Web page
basics

FTP/custom
pages

Applications

Security

Diagnostics

Advanced
features

Quick
reference

Glossary of
terms

Index

5   Getting started

5.1   Minimum software versions required for Ethernet

Table 5.1 below, lists the minimum versions of software required for Ethernet
communication.

Table 5.1 Required software versions for communication over Ethernet

Product	Software Version
Unidrive SP	Version 01.06.00 or later
Commander SK	Version 01.06.00 or later
Digitax ST	Version 01.00.00 or later
Affinity	Version 01.00.00 or later
Mentor MP	Version 01.00.00 or later
SM-Applications	Version 01.04.05 or later
SM-Ethernet	Version 01.02.00 or later
OPC Server	Version 03.01.00 or later
CTScope	Version 01.00.00 or later
SyPTPro	Version 02.01.00 or later
CTSoft	Version 01.05.00 or later

5.2   Network design considerations

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

To avoid bandwidth issues it is recommended that the control network is logically
separate from any other network. Where possible a physically separate network should
be used. If this is not possible, the use of managed network devices should be
considered to prevent unnecessary traffic such as broadcasts reaching the control
network.

NOTE   The use of un-switched hubs is not recommended.

5.3   Addressing

The addressing system used on Ethernet uses two essential numbers for making
connection, these are the IP address and the subnet mask. The address allows a
specific device to be located and the subnet mask defines how many bits represent the
subnet part of the address and how many bits represent the node address (*see section
5.7.1 The IP address* on page 19). Generally devices on different subnets can only
communicate by using a gateway (*typically a router or firewall*).

5.4   Where do IP addresses come from?

Every address on a network must be unique. If you do not connect your network to any
other networks the assignment of IP addresses is not critical (*although using a standard
system is recommended*), as you have full control of the addresses used. The issue of
addressing becomes important when connecting multiple networks together or
connecting to the Internet where there is a strong possibility of duplication of addresses
if a scheme is not followed.

5.5 Addressing etiquette

The following list details some points that should be considered when selecting addresses:

- **Reserve address space:** Ensure you have enough reserve address space on your chosen addressing scheme to allow for future expansion.
- **Uniqueness:** Ensure your addresses are unique, every device on a subnet must have a unique address.
- **Avoid reserved addresses:** For example the address 127.0.0.1 is reserved as the loop back address.
- **Broadcast and system addresses:** The highest and lowest host address on a subnet are reserve addresses.
- **Use a system:** Have a scheme for assigning your addresses, for example typically servers may have a low IP address and routers a high IP address. It is not necessary to allocate consecutive IP addresses so it is possible to reserve ranges for specific uses such as servers, work stations or routers.

5.6 Class types

IP addresses are grouped into ranges called classes, each class has a specific set of addresses and has a typical situation where it is used.

When selecting the class of IP address required, consideration must be given to how many subnets you need, how many hosts are required and if you will need a public (*worldwide*) or a private (*local*) addressing scheme. Table 5.2 shows an overview of how the class types are defined and Table 5.3 shows how each class separates the subnet and host ID.

Table 5.2 Subnets and hosts supported by class type

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

Table 5.3 Address components

Address Class	IP Address	Subnet Component	Host Component
A	w.x.y.z	w	x.y.z
B	w.x.y.z	w.x	y.z
C	w.x.y.z	w.x.y	z

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

5.6.1 Class A addresses

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

5.6.2 Class B addresses

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

5.6.3 Class C addresses

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

5.6.4 Class D & E addresses

These addresses are reserved for multicasting and experimental use.

5.7 Generating the complete address

A complete IP address consists of an IP address and a subnet mask, these two numbers are required to allow communication on Ethernet using TCP/IP.

5.7.1 The IP address

The IP address is made up from four 8 bit decimal numbers (*octets*) and is written as follows:

w.x.y.z   for example192.168.0.1 (*class c*)

5.7.2 The subnet mask

The subnet mask defines what part of the address constitutes the subnet within the IP address and what part of the address constitutes the host address. The subnet mask is bit-wise ANDed with the address to give the subnet to which the host belongs. A typical class C subnet mask would be 255.255.255.0, this may alternatively be written as '/24' as in the example below, showing an IP address of 192.168.0.1 with a subnet mask of 255.255.255.0. This alternative notation indicates the number of bits representing the subnet part of the address, starting from the most significant bit.

Alternative subnet mask notation: *192.168.0.1 /24*

5.7.3 Completing the address

To determine which part of the address constitutes the network address and which part constitutes the node address, the IP address is bit-wise ANDed with the subnet mask. Figure 5-1 shows how the IP address and subnet mask are used to determine the subnet address and the host address.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Figure 5-1 Completing the address
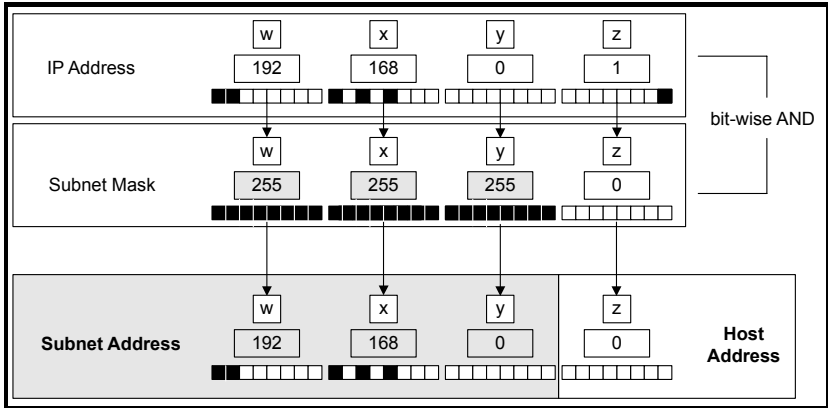
5.8 DHCP considerations

5.8.1 Using fixed IP addressing

Using fixed IP addresses (*manually configured*) on SM-Ethernet means that if a module fails, the IP address can be restored to a replacement module without the need to reconfigure the DHCP server. Using fixed addresses also prevents the DHCP server from changing the address. When using fixed IP addresses, it is vital that the SM-Ethernet IP address is reserved on the DHCP server to prevent duplicate addressing.

NOTE If using manual IP address configuration please note that the IP address subnet mask and the default gateway must also be set manually. For more information on manual configuration see section 7.2.6 *Network* on page 72.

5.8.2 Using DHCP

If DHCP is used it is recommended that the allocated IP address is allocated SM-Ethernet's MAC address, this strategy prevents the IP address changing on the SM-Ethernet. Any leased addresses should be leased permanently to prevent IP address changes.

NOTE If SM-Ethernet is configured to use DHCP and the module requires exchanging, the new SM-Ethernet module will have a different MAC address and hence the DHCP server will issue the new module with a different IP address.

5.9 Basic principles of routing

Routing is required to get TCP/IP packets from one subnet to another. In an IP network nodes from one subnet cannot communicate directly with nodes on a different subnet. To allow nodes to communicate, a router (*or similar device*) is required to allow the two subnets to exchange data. This means that any node wishing to communicate with a node that is not on its own subnet, must know the address of a router that is on its own subnet. This is sometimes called a gateway or default gateway.

5.10   Set-up flow chart

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

```
                          Start

              Connect all drives
              together using
              approved cable /          See Chapter 4
              connectors /
              switches

              Ensure each drive
              Is correctly              See Chapter 4
              grounded

              Ensure segment
              lengths no longer         See Chapter 4
              than maximum
              limits.

              Ensure that there         Note: Redundant
              are no circular           systems require
              loops between             specialist hardware.
              devices/switches

              Ensure the correct
              cable types are           See Chapter 4
              used

              Perform cable         A dedicated
              tests                 Ethernet cable
                                    tester Is
                                    recommended.

              Configure the IP
              address,  subnet          See Chapter 5
              mask and default
              gateway                       Any changes
                                            made will require a
                                            module reset to be
                                            activated.
                                            Pr MM.32 = ON)
              Check data rate.
              (Pr MM.04)                See Chapter 5

              Ensure PC is on
              the same subnet
              or the default            See Chapter 5
              gateway on the
              drive & PC are set
```

```
              PING all drives
              from a command            See Chapter 5
              prompt to test
              connections

              Connect to each
              drive using a web         See Chapter 7
              browser

              Save module
              settings on drive.        See Chapter 5

              Configure
              additional features       See Chapter 7
              using a web
              browser

                          END
```

SM-Ethernet User Guide   **21**
Issue: 6   www.controltechniques.com

5.11 Setting the IP address

The SM-Ethernet IP address is formed by taking the component parts of the address from parameters Pr **MM.10** to Pr **MM.13** and combining them as in Figure 5-2. The address is then used in conjunction with the subnet mask.

Figure 5-2 The IP address

SM-Ethernet IP address	W_{ip}	X_{ip}	Y_{ip}	Z_{ip}
	Pr **MM.10**	Pr **MM.11**	Pr **MM.12**	Pr **MM.13**
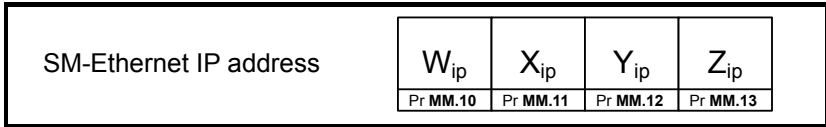
NOTE   When DHCP is enabled (*see section 5.15 DHCP (Dynamic Host Configuration Protocol) on page 25*) the whole IP address is acquired from the DHCP server and written to the parameters in the drive during start-up. This could take several minutes depending on server availability and network status.

5.11.1 SM-Ethernet IP address W_{ip}

SM-Ethernet IP address W_{ip}		
	Default	192
Pr **MM.10**	Range	0 to 255
	Access	RW

This is the most significant octet of SM-Ethernet's IP address. When using DHCP this will be updated from the DHCP server.

5.11.2 SM-Ethernet IP address X_{ip}

SM-Ethernet IP address X_{ip}		
	Default	168
Pr **MM.11**	Range	0 to 255
	Access	RW

This is the second most significant octet of SM-Ethernet's IP address. When using DHCP this will be updated from the DHCP server.

5.11.3 SM-Ethernet IP address Y_{ip}

SM-Ethernet IP address Y_{ip}		
	Default	1
Pr **MM.12**	Range	0 to 255
	Access	RW

This is the third most significant octet of SM-Ethernet's IP address. When using DHCP this will be updated from the DHCP server.

5.11.4 SM-Ethernet IP address Z_{ip}

SM-Ethernet IP address Z_{ip}		
	Default	100
Pr **MM.13**	Range	0 to 255
	Access	RW

This is the least significant octet of SM-Ethernet's IP address. When using DHCP this will be updated from the DHCP server.

5.12 Setting the subnet mask

The SM-Ethernet subnet mask is formed by taking the component parts of the subnet mask from parameters Pr **MM.14** to Pr **MM.17** and combining them as in Figure 5-3. The subnet mask is then used in conjunction with the IP address.

Figure 5-3   The subnet mask

SM-Ethernet subnet mask	W_{subnet}	X_{subnet}	Y_{subnet}	Z_{subnet}
	Pr **MM.14**	Pr **MM.15**	Pr **MM.16**	Pr **MM.17**

NOTE When DHCP is enabled the whole subnet mask address is acquired from the DHCP server and written to the parameters in the drive during start-up. This could take several minutes depending on server availability and network status.

5.12.1 SM-Ethernet IP subnet mask W_{subnet}

SM-Ethernet IP subnet mask W_{subnet}		
	Default	255
Pr **MM.14**	Range	0 to 255
	Access	RW

This is the most significant octet of SM-Ethernet's IP subnet mask. When using DHCP this will be updated from the DHCP server.

5.12.2 SM-Ethernet IP subnet mask X_{subnet}

SM-Ethernet IP address X_{subnet}		
	Default	255
Pr **MM.15**	Range	0 to 255
	Access	RW

This is the second most significant octet of SM-Ethernet's IP subnet mask. When using DHCP this will be updated from the DHCP server.

5.12.3 SM-Ethernet IP subnet mask Y_{subnet}

SM-Ethernet IP subnet mask Y_{subnet}		
	Default	255
Pr **MM.16**	Range	0 to 255
	Access	RW

This is the third most significant octet of SM-Ethernet's IP subnet mask. When using DHCP this will be updated from the DHCP server.

5.12.4 SM-Ethernet IP subnet mask Z_{subnet}

SM-Ethernet IP subnet mask Z_{subnet}		
	Default	0
Pr **MM.17**	Range	0 to 255
	Access	RW

This is the least significant octet of SM-Ethernet's IP subnet mask. When using DHCP this will be updated from the DHCP server.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

5.13 Setting the default gateway

The SM-Ethernet's default gateway is formed by taking the component parts of the default gateway from parameters Pr **MM.18** to Pr **MM.21** and combining them as in Figure 5-4. The default gateway is then used in conjunction with the IP address and subnet mask to locate hosts on different subnets.

Figure 5-4   The default gateway

SM-Ethernet subnet mask	$W_{gateway}$	$X_{gateway}$	$Y_{gateway}$	$Z_{gateway}$
	Pr **MM.18**	Pr **MM.19**	Pr **MM.20**	Pr **MM.21**

The default gateway is a routing device that allows a host to reach other devices that are not on the same subnet. The default gateway must be on the same subnet as the host that is trying to use it.

> **NOTE**   When DHCP is enabled the whole default gateway address is acquired from the DHCP server and written to the parameters in the drive during start-up. This could take several minutes depending on server availability.

> **NOTE**   When communication is performed through a gateway, the devices on both sides of the gateway must be configured to see their side of the gateway for communications to be established.

5.13.1 SM-Ethernet IP default gateway $W_{gateway}$

SM-Ethernet IP default gateway $W_{gateway}$		
Pr **MM.18**	Default	192
	Range	0 to 255
	Access	RW

This is the most significant octet of SM-Ethernet's default gateway address. When using DHCP this will be updated from the DHCP server.

5.13.2 SM-Ethernet IP default gateway $X_{gateway}$

SM-Ethernet IP default gateway $X_{gateway}$		
Pr **MM.19**	Default	168
	Range	0 to 255
	Access	RW

This is the second most significant octet of SM-Ethernet's default gateway address. When using DHCP this will be updated from the DHCP server.

5.13.3 SM-Ethernet IP default gateway $Y_{gateway}$

SM-Ethernet IP default gateway $Y_{gateway}$		
Pr **MM.20**	Default	1
	Range	0 to 255
	Access	RW

This is the third most significant octet of SM-Ethernet's default gateway address. When using DHCP this will be updated from the DHCP server.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

5.13.4 SM-Ethernet IP default gateway Z$_{gateway}$

SM-Ethernet IP default gateway Z$_{gateway}$		
	Default	254
Pr **MM.21**	Range	0 to 255
	Access	RW

This is the least significant octet of SM-Ethernet's default gateway address. When using DHCP this will be updated from the DHCP server.

5.14   SM-Ethernet baud rate

SM-Ethernet baud rate		
	Default	0
Pr **MM.04**	Range	0 to 2
	Access	RW

SM-Ethernet can be set to automatically detect the baud rate or be fixed at either 10Mbs or 100Mbs. Pr **MM.44** will indicate the data rate that is being used by the SM-Ethernet.

Table 5.4 SM-Ethernet baud rate

Pr MM.04	baud rate
0	Auto detect
1	10Mbs
2	100Mbs

NOTE   This parameter should normally be left in the auto detect state.

5.15   DHCP (Dynamic Host Configuration Protocol)

5.15.1 DHCP enable

DHCP enable		
	Default	0
Pr **MM.05**	Ranges	0 to 1
	Access	RW

This parameter determines if the module gets it's network configuration (*IP address, subnet mask, etc.*) from the host drive parameters or from a DHCP server on the network. The DHCP server can be configured to give the module the next free address or an address based on the MAC address of SM-Ethernet.

Table 5.5 DHCP options

Pr MM.05	DHCP enable
0	Use local configuration
1	Use DHCP server

A DHCP server will typically provide SM-Ethernet with an IP address, subnet mask, default gateway and DNS information.

5.15.2 DHCP server configuration

When using DHCP it is possible that every time SM-Ethernet re-initialises it will receive a new IP address. This will make it difficult to keep track of what IP address is allocated to a particular module and when using a Modbus IP master this would also require re-configuration.

Control Techniques recommend that the leased IP address for SM-Ethernet is allocated to SM-Ethernet's MAC address. This will prevent SM-Ethernet's IP address changing when it re-initialises or when the DHCP server renews the SM-Ethernet's lease.

5.16 SM-Ethernet operating status

SM-Ethernet operating status		
Pr **MM.06**	Default	N/A
	Range	-95 to 9999
	Access	RO

This parameter gives an approximation of the number of packets per second processed on SM-Ethernet, a value of zero indicates that SM-Ethernet is initialised and ready to communicate.

If this parameter is a negative value this indicates that the module is initialising or there is a fault. If this value is still negative after 3 minutes see section 11.5.1 *SM-Ethernet diagnostic information* on page 97.

5.17 Re-initialising SM-Ethernet

Re-initialising SM-Ethernet		
Pr **MM.32**	Default	OFF
	Range	OFF / ON
	Access	RW

Changes to the SM-Ethernet configuration will not take effect until the SM-Ethernet has been re-initialised.

To re-initialise SM-Ethernet:

1. Set Pr **MM.32** to ON.
2. Before the reset takes place Pr **MM.32** will be reset to OFF.
3. The SM-Ethernet will re-initialise using the updated configuration.

NOTE This sequence does NOT store the SM-Ethernet configuration parameters in the host drive or the SM-Ethernet FLASH memory. Pr **MM.32** will revert to OFF immediately and may not be visible on the display.

5.18 Re-initialise all Solutions Modules

To re-initialise all Solutions Modules installed on a drive:

1. Set Pr **MM.00** to 1070. (See note regarding Commander SK).
2. Press the red RESET button on the drive.

NOTE This sequence does NOT store the SM-Ethernet configuration parameters in the drive or the SM-Ethernet FLASH memory. The 1070 reset will not work in the SM-Ethernet module if Pr **MM.37** is set to ON, although it will work for any other modules.

NOTE On Commander SK drives, Pr **00.00** is not available, a different menu number must be used, e.g. Pr **01.00**.

5.19 Saving parameters to the drive

To avoid loss of the configured settings when the drive is powered down it is necessary to write 1000 to Pr **MM.00** and then press the reset button to perform a drive save.

To store drive parameters:

- Set Pr **MM.00** to 1000. (See notes).
- Press the red RESET button.

The drive will store all parameters (except Menu 20), but the operation of the SM-Ethernet will not be affected. Changes made to the SM-Ethernet configuration parameters will not take effect until the SM-Ethernet is re-initialised.

| NOTE | Menu 20 may be saved in memory (not Commander SK) if an SM-Applications is installed. See the *SM-APPLICATIONS/SM-APPLICATIONS LITE User Guide* documentation for more information. If the host drive is running on a low voltage supply only or has a UU trip active the value 1001 must be used instead of 1000. |

| NOTE | On Commander SK drives, Pr **00.00** is not available, a different menu number must be used, e.g. Pr **01.00**. |

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

6 Protocols

SM-Ethernet supports a wide range of protocols for communicating over Ethernet, each protocol has a specific use and it is important to understand how to use each protocol before designing a system.

6.1 PC/PLC considerations

If the subnet of the host PC/PLC is different to the subnet of SM-Ethernet, then both SM-Ethernet and the PC/PLC must be configured with the address of a gateway that allows communication between the two devices.

6.2 Modbus TCP/IP

Modbus TCP/IP is one of the most widely supported industrial Ethernet based protocols offering the functionality and simplicity of the Modbus protocol, with the flexibility of Ethernet. Table 6.1 shows the supported Modbus function codes.

The SM-Ethernet implementation of Modbus TCP/IP follows the specification provided by the Modbus organisation. Modbus TCP/IP uses the standard Protocol Data Unit (PDU) but without the CRC bytes and encapsulates it within a Modbus TCP/IP Application Data Unit (ADU) for transmission. This means that the Modbus PDU is the same for both standard and Ethernet based transmission.

Table 6.1 Supported Modbus function codes

Code	Description
3	Read multiple 16 bit registers.
6	Write single 16 bit register.
16	Write multiple 16 bit registers.
23	Read and write multiple 16 bit registers.

Modbus TCP/IP port

The port number used for Modbus TCP/IP may be reconfigured to a different port number using Pr **62.04** as detailed in Table 6.2 *SM-Ethernet Modbus TCP/IP configuration* .

Table 6.2 SM-Ethernet Modbus TCP/IP configuration

SM-Ethernet Modbus TCP/IP configuration		
	Default	502
Pr **62.04**	Range	0 to 65535
	Access	RW

A timer is available under the MODBUS IP configuration section of the web pages to allow loss of MODBUS communications to be managed (see Chapter 12 *Advanced features* on page 101 for more Modbus I/P options).

> **NOTE** Unidrive SP versions prior to V01.06.00 with SM-Ethernet versions after V01.01.00 are not capable of supporting CMP Port-ID 0. This will prevent communications to the drive, ensure the latest drive and SM-Ethernet firmware are used.

> **NOTE** The SM-Ethernet module must request control of the EIA-485 (RS-485) buffer to enable reliable communication in this mode. This is done by setting Pr **MM.37** to ON.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

6.3   Web pages (HTTP)

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

In addition to the standard web pages it is possible to generate custom pages for displaying drive parameters for diagnostic or basic HMI (human machine interface) style displays. For more information on custom web pages please refer to Chapter 8 *FTP/ custom pages* on page 73.

To view web pages on SM-Ethernet one of the following web browsers should be used:

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

The standard web pages provide access to the following features:

- Parameters.
- Protocol configuration.
- Network configuration.
- General configuration.
- Help pages providing guidance on use.
- System file updates for SM-Ethernet.
- Language support.

For details of the web pages please see Chapter 7 *Web page basics* on page 66.

6.4   FTP

FTP will allow custom web page changes on SM-Ethernet. If an appropriate network infrastructure exists it will be possible to perform these updates remotely.

SM-Ethernet has a basic file system that will allow the user to upload files. The following facilities are supported:

- Web page languages
- Custom web pages

See Chapter 8 *FTP/custom pages* on page 73 for more details.

6.5   SMTP (email)

SM-Ethernet provides a method for sending Emails based on events. Up to 3 Email messages may be configured to transmit on a pre-defined condition. For more information on SMTP see section 12.1 *Email configuration* on page 101.

6.6   SNTP (clock synchronisation)

SNTP allows synchronisation of SM-Ethernet's real-time clock with the time on a server. This time information can be written to parameters or can be used to trigger events specified in the 'Scheduled Events'. For more information on SNTP and scheduled events see section 12.2 *Scheduled events* on page 102.

6.7 EtherNet/IP

SM-Ethernet (v01.03.00 and later) supports the EtherNet/IP protocol and conforms to the EtherNet/IP adaptation of the Common Industrial Protocol (CIP) Specification. This is the same upper-layer protocol and object model as used in DeviceNet.

The SM-Ethernet module will operate as a slave device and the following functionality is supported.

- Variable length input assembly object (instance 100).
- Variable length output assembly object (instance 101).
- Maximum assembly object size of 160 bytes (40 parameters).
- Explicit (non-cyclic) access to parameters.
- A.C. and D.C. Drive Profiles.
- Management of consistent data transfer between SM-Ethernet and SM-Applications modules.
- Configuration via the web page interface.

6.7.1 Performance

The performance of EtherNet/IP will depend on several factors, including the data rate, EtherNet/IP thread priority and network traffic. If the EtherNet/IP thread is allocated a high priority and the network traffic is dominated by EtherNet/IP then the following performance should be achieved.

- Turn around time for polled (implicit) data of 2ms.
- Turn around time for non-cyclic (explicit) data of 5ms.

NOTE Access to SM-Applications using the inter-option communication channel will extend these times.

NOTE These network performance timings are not guaranteed and will vary depending on the network configuration.

NOTE The performance values stated above will also be slower on Commander SK due to the hardware differences of the Commander SK.

6.7.2 Configuration

The EtherNet/IP configuration can be accessed from the top-level **PROTOCOLS** menu of the web page interface. From this page, the following general configuration settings can be viewed or changed.

- Connection status (view only).
- Advanced EDS file - *disabled* or *enabled*.
- Requested packet interval (RPI) timeout trip - *disabled* or *enabled.*
- Read consistency - *disabled* or *enabled*.
- Write consistency - *disabled* or *enabled.*

The cyclic (implicit) data parameter mapping configuration can also be changed from this page. For more information on cyclic data parameter mappings see section 6.7.10*Configuring SM-Ethernet cyclic parameters* on page 33.

NOTE The user must be logged in as an "Administrator" or "Super user" to change the configuration settings.

6.7.3 Connection Status

This indicates if a cyclic (implicit) connection has been made and whether cyclic data transfer is in progress. If no cyclic connection has been made then the status will indicate "Awaiting Connection", if a cyclic connection has been made then the status will indicate "Connected".

6.7.4 Advanced EDS File

If the advanced EDS file is disabled, then the identity object will only contain the product code and revision number, if the advanced EDS file is enabled, then the information in the identity object will also contain details of other option modules installed in the other option slots and an appropriate EDS file containing a comprehensive parameter list will be required by the PLC.

Control Techniques does not currently provide advanced EDS files, but suitable generic files are usually available from the PLC supplier.

For more information on the identity object see section 6.7.23 *Identity object* on page 47.

6.7.5 Requested Packet Interval (RPI) timeout trip

This timeout is defined by the EtherNet/IP protocol and is configured in the PLC master. If enabled, then SM-Ethernet will monitor the data traffic and if data is not received within the specified time, it will force a drive trip (SL1.Er, SL2.Er or SL3.Er, depending on which slot the solutions module is installed to, for Unidrive SP/Affinity/Digitax ST/ Mentor MP or SL.Er for Commander SK) and a trip code in Pr **MM.50** of 50. This indicates that SM-Ethernet has detected that the cyclic data communication has been interrupted.

| NOTE | The trip will only occur if the drive experiences a loss of network traffic for the specified duration, i.e. if data was being received but was then interrupted. The trip will not occur if no network traffic has been detected. |

6.7.6 Read consistency (data skew)

Under normal conditions, cyclic data is sampled at the EtherNet/IP task tick rate and transmitted at the Requested Packet Interval (RPI). However, if another option module was in the process of modifying the mapped parameters while these parameters were being sampled, then the data transmitted across the network may not be consistent across the entire assembly object. If read consistency is enabled (and a trigger parameter specified) then data will only be sampled when the trigger parameter contains a non-zero value. This trigger parameter will then be set to zero after the data has been sampled.

It is therefore possible, by controlling the trigger parameters, that an SM-Applications module can ensure that the values in the cyclic data parameters are not sampled until all values are updated.

Whether consistency is enabled or not, data will always be consistent for an individual parameter, i.e. all 4 bytes of a 32 bit value will be consistent.

| NOTE | The trigger parameter is a parameter that is used by SM-Ethernet to allow cyclic parameters to be sampled and is configured from the **EtherNet/IP** sub-menu of the **PROTO-COLS** menu. This parameter value will be set to zero when either the SM-Ethernet module or the drive is reset. |

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

6.7.7 Write consistency (data skew)

Under normal conditions, cyclic data is written whenever a value in the assembly object changes. However, if another option module was in the process of reading the mapped parameters while these parameters were being written, then the data obtained will not be consistent. If write consistency is enabled (and a trigger parameter specified) then data will only be written when the trigger parameter contains a value of zero. This trigger parameter will then be set to one after the data has been written.

It is therefore possible, by controlling the trigger parameters, that an SM-Applications module can ensure that the values sampled are consistent.

Whether consistency is enabled or not, data will always be consistent for an individual parameter, i.e. all 4 bytes of a 32 bit value will be consistent.

NOTE The trigger parameter is a parameter that is used by SM-Ethernet to allow cyclic parameters to be written and is configured from the **EtherNet/IP** sub-menu of the **PROTOCOLS** menu. This parameter value will be set to zero when either the SM-Ethernet module or the drive is reset.

Example

In this example, Pr **20.01** is set as the "read trigger" parameter and Pr **20.02** set as the "write trigger" parameter in the SM-Ethernet module, the PLC master is configured to add the values of Pr **20.11**, Pr **20.12** and Pr **20.13,** and write the result to Pr **20.21**, the SM-Applications module is configured to increment the values of Pr **20.11**, Pr **20.12** and Pr **20.13** by 1 each time the background task is executed.

With read and write consistency enabled, SM-Ethernet will sample the cyclic data parameters when the value of Pr **20.01** is not zero and write the cyclic data when the value of Pr **20.02** is zero.

The DPL code in the SM-Application module may be written as follows:

```
Initial{
// Initialise variable
   newvalue=0
} //Initial

Background{
top:
   if #20.02=1 then
       newvalue=#20.11        // Store #20.11 value
       #20.11=newvalue+1      // Increment #20.11 by 1
       newvalue=#20.12        // Store #20.12 value
       #20.12=newvalue+1      // Increment #20.12 by 1
       newvalue=#20.13        // Store #20.13 value
       #20.13=newvalue+1      // Increment #20.13 by 1
       #20.01=1               // Enable sampling
       #20.02=0               // Enable PLC writes
   endif
goto top: // main background loop
} //Background
```

6.7.8 Non-cyclic (explicit) data transfer

Non-cyclic or explicit messaging is used to read and write parameters non-cyclically by means of assembly objects. All of the AC Drives profile attributes can be accessed using explicit messaging. For more information on the AC Drives profile see section 6.7.26 *AC/DC Drive object* on page 60.

The *Control Techniques* object (class 100 or 0x64) provides access to all drive parameters using the following format.

Class code:	*100 (0x64)*	
Instance:	*Menu*	
Attribute:	*Parameter*	
Read code:	*14 (0x0E)*	*Get_Attribute_Single*
Write code:	*16 (0x10)*	*Set_Attribute_Single*

NOTE An instance value of 0 is not a valid value in this context, therefore an instance value of 200 (0xC8) should be used to access menu 0 parameters. For more information on the *Control Techniques* object see section 6.7.27 *Control Techniques object* on page 64.

6.7.9 Cyclic (implicit or polled) data transfer

Cyclic data is a method of data transfer that must be set-up during network configuration, but is transmitted automatically once configuration is complete.

EtherNet/IP transfers cyclic data using assembly objects, "cyclic data" is also sometimes referred to as "polled data" or "implicit data". The terms "input" and "output" refer to data from the perspective of the PLC, an "output" assembly object is used to transfer cyclic data from the PLC to SM-Ethernet, conversely, an "input" assembly object transfers data from SM-Ethernet to the PLC.

NOTE Some PLCs provide the option of transmitting a configuration assembly object. The SM-Ethernet module does not use a configuration object, if one is required by the PLC configuration tool, then instance 1 should be specified with a length of 0 bytes.

NOTE The web pages are used to configure the parameter information that is transmitted within the assembly objects. For more information on configuring the mapping parameters see section 6.7.10 *Configuring SM-Ethernet cyclic parameters* on page 33.

6.7.10 Configuring SM-Ethernet cyclic parameters

In order to use cyclic data over EtherNet/IP, SM-Ethernet must be configured to map the required parameter data to the assembly object. Object 100 (0x64) is used for reading parameters and object 101 (0x65) is used for writing parameters. To change the mapping configuration, open the web page "EtherNet/IP" from the **PROTOCOLS** menu, and select the appropriate assembly object, from here the required parameters may be mapped to the selected assembly object. Figure 6-1 on page 34, shows a sample web page configuration screen for mapping parameters.

The first requirement is to set the number of bytes to be allocated (mapping size), this can range from 4 to 160 bytes in increments of 4. Each drive parameter requires 4 bytes of data, this means that the minimum number of parameters that can be allocated is 1 and the maximum is 40.

NOTE The SM-Ethernet parameter mapping configuration screen refers to bytes of data, the PLC configuration tool may refer to words of data, a data word consists of 2 bytes or 16 bits of data. A double word (32 bits or 4 bytes) is used for each drive parameter.

Figure 6-1 SM-Ethernet parameter mapping configuration

Parameter mapping table.
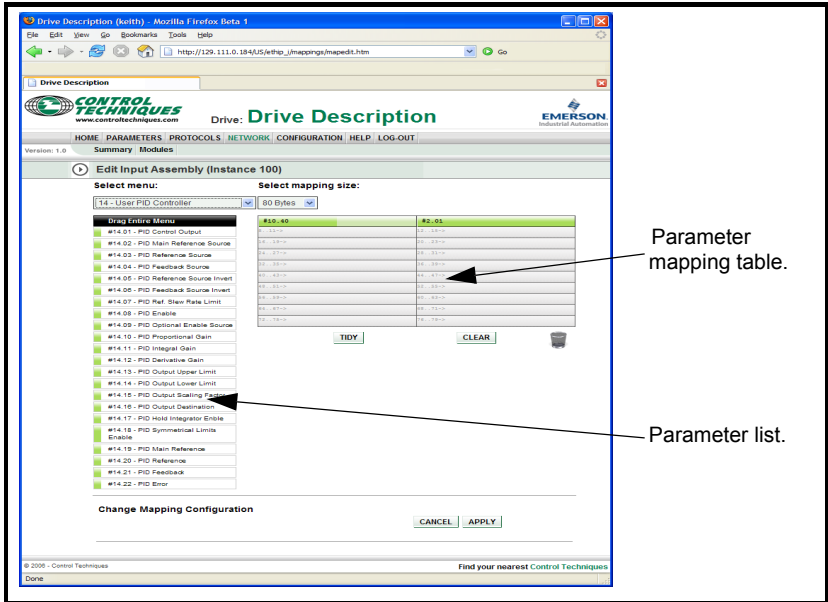
Parameter list.

A single parameter may be selected by "dragging" it from the parameter list on the left side of the page to the parameter mapping table on the right side of the page or, alternatively, "double-clicking" on it will append it to the end of the list in the table.

A range of parameters may be selected by "double-clicking" on the 'Parameter mapping table' at the position required to be allocated up to, the table will be automatically filled up to this position. If no parameter has been previously allocated, the first parameter in the parameter list will be used.

The "TIDY" button can be used to remove any un-allocated spaces in the parameter mapping table by moving allocated parameters up.

To remove all allocated mappings in the table, the "CLEAR" button can be pressed.

To accept the changes made, click on the "APPLY" button. To cancel the changes and revert back to the previous configuration, click on the "CANCEL" button.

NOTE   If the web pages are not displayed as shown or do not function correctly then the browser settings may need to be checked to allow the Java script controls to function correctly.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

6.7.11 Configuring the PLC

Due to the many different makes of PLCs available, the information in this section may not be relevant to all types of PLCs. The information supplied in this section relates to the "ControlLogix" family of controllers supplied by "Allen Bradley".

NOTE Although the Allen Bradley PLCs are mentioned in this document, this does not represent an endorsement of any particular PLC type or PLC manufacturer.

When configuring the PLC for cyclic communication with SM-Ethernet, the length of each parameter data word and the number of parameters must be specified correctly, Figure 6-2, shows the PLC configuration for 40 input parameters and 40 output parameters, as each parameter consists of 32 bits (4 bytes), the length of each data word should be set to 32 bits (DINT - double integer word).

The length of each data word (*Comm Format in the PLC configuration in Figure 6-2*) must normally be configured when the Ethernet module is created within the PLC and can not be changed. If a different length is required then a new Ethernet module must be created.

In order to communicate with the SM-Ethernet, the PLC must have the SM-Ethernet IP address set correctly as illustrated in Figure 6-2.

Figure 6-2 PLC configuration

Number of data words (parameters).

Length of each data word.

SM-Ethernet IP address.
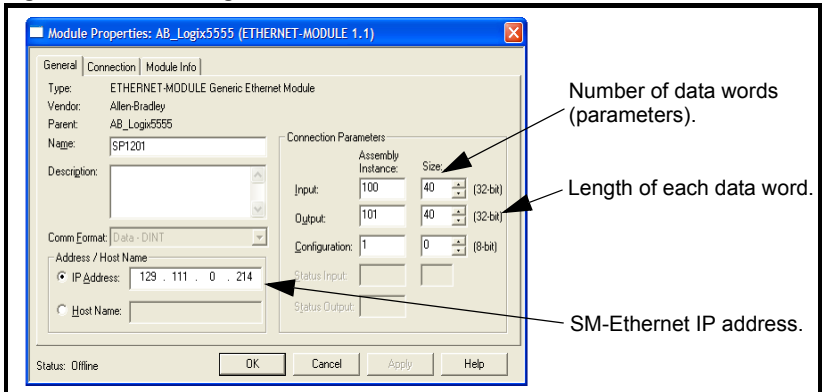
6.7.12 Assembly objects

An assembly object is an object which contains a group of attributes to control or monitor the drive operation. These attributes can be members of EtherNet/IP objects or drive parameters. SM-Ethernet supports a series of standard assembly objects (see section 6.7.13 *Supported drive assembly objects* on page 36) and two *Control Techniques* objects to access the drive parameters.

Table 6.3 Control Techniques assembly objects

Number	Type	Length (bytes)	Default Length (bytes)	Default Mappings	
				Bytes 0 to 3	Bytes 4 to 7
0x64 (100_{10})	Input	4 to 160	8	Pr **10.40**	Pr **2.01**
0x65 (101_{10})	Output	4 to 160	8	Pr **6.42**	Pr **1.21**

6.7.13 Supported drive assembly objects

The EtherNet/IP protocol includes a series of pre-defined assembly objects to control and monitor the drive operation. Table 6.4 *Pre-defined drive assembly objects* on page 36 lists these assembly objects and their functions.

NOTE Conformance with the pre-defined assembly objects specification can only be guaranteed if the speed reference configuration of the drive has not been changed from the default settings. For information on setting default values, refer to the appropriate drive user guide.

Table 6.4 Pre-defined drive assembly objects

Object	Type	Object name
0x14 (20_{10})	Output	Basic speed control output.
0x15 (21_{10})	Output	Extended speed control output.
0x16 (22_{10})	Output	Speed and torque control output.
0x17 (23_{10})	Output	Extended speed and torque control output.
0x46 (70_{10})	Input	Basic speed feedback.
0x47 (71_{10})	Input	Extended speed feedback.
0x48 (72_{10})	Input	Basic speed and torque feedback.
0x49 (73_{10})	Input	Extended speed and torque feedback.

6.7.14 Basic speed control

Output assembly object 0x14 (20_{10})

The PLC or scanner must be configured for 4 output bytes (or 2 output words) if this assembly object is to be used.

Table 6.5 Basic speed control

Data word	Function
Word 0	Basic control word.
Word 1	Speed reference (*SpeedRef*).

Basic control word

The basic control word consists of 2 bytes (16 bits), with only 2 bits of the low byte being used as shown below.

b15	b14	b13	b12	b11	b10	b9	b8

b7	b6	b5	b4	b3	b2	b1	b0
					FaultRst		RunFwd

The individual bit functions are described as follows:

Name	Control Word	Description
RunFwd	b0	Set this bit to command the drive to run in the forward direction.
FaultRst	b2	A 0 to 1 transition will reset the drive if the drive was in a trip state.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

NOTE For the drive to run at the speed specified in Word 1, Pr **6.43** must be *ON* and bit 0, bit 7 and bit 8 of the drive control word (Pr **6.42**) must all be set to 1 and the external hardware enable signal must be present.

The individual bit functions for the drive control word are shown in Table 6.6 below.

Table 6.6 Drive control word bit functions

Bit	Function	**Equivalent parameter**
0	Drive enable.	Pr **6.15**
1	Run forward.	Pr **6.30**
2	Jog forward.	Pr **6.31**
3	Run reverse.	Pr **6.32**
4	Forward/reverse.	Pr **6.33**
5	Run.	Pr **6.34**
6	Not stop.	Pr **6.39**
7	Auto/manual.	N/A
8	Analog/preset reference.	Pr **1.42**
9	Jog reverse.	Pr **6.37**
10	Reserved.	N/A
11	Reserved.	N/A
12	Trip drive.	N/A
13	Reserved.	Pr **10.33**
14	Keypad watchdog.	N/A

Speed reference (*SpeedRef*)

The speed reference word utilises 2 bytes (16 bits) as shown below.

b15	**b14**	**b13**	**b12**	**b11**	**b10**	**b9**	**b8**
SpeedRef (high byte)							

b7	**b6**	**b5**	**b4**	**b3**	**b2**	**b1**	**b0**
SpeedRef (low byte)							

For more information on the setting of the speed reference see section 6.7.26 *AC/DC Drive object* on page 60.

6.7.15 Extended speed control

Output assembly object 0x15 (21_{10})

The PLC or scanner must be configured for 4 output bytes (or 2 output words) if this assembly object is to be used.

Table 6.7 Extended speed control

Data word	**Function**
Word 0	Extended control word.
Word 1	Speed reference (*SpeedRef*).

Extended control word

The extended control word consists of 2 bytes (16 bits), with only the low byte used as shown.

b15	b14	b13	b12	b11	b10	b9	b8

b7	b6	b5	b4	b3	b2	b1	b0
	NetRef	NetCtrl			FaultRst	RunRev	RunFwd

The individual bit functions are described as follows:

Name	Control Word	Description
RunFwd	b0	Set this bit to command the drive to run in the forward direction.
RunRev	b1	Set this bit to command the drive to run in the reverse direction.
FaultRst	b2	A 0 to 1 transition will reset the drive if the drive was in a trip state.
NetCtrl	b5	Used in conjunction with Pr **6.43** to enable the drive control word bits b0-b6 and bit 9 (Pr **6.42**).
NetRef	b6	Set this bit to command the drive to use the remote speed reference value specified in Word 1.

NOTE For the drive to run at the speed specified in Word 1, Pr **6.43** must be *ON* and bit 0, bit 7 and bit 8 of the drive control word (Pr **6.42**) must all be set to 1 and the external hardware enable signal must be present.

NOTE For information on the drive control word see Table 6.6 *Drive control word bit functions* on page 37.

Speed reference (*SpeedRef*)

The speed reference word utilises 2 bytes (16 bits) as shown below.

b15	b14	b13	b12	b11	b10	b9	b8
SpeedRef (high byte)							

b7	b6	b5	b4	b3	b2	b1	b0
SpeedRef (low byte)							

For more information on the setting of the speed reference see section 6.7.26 *AC/DC Drive object* on page 60.

6.7.16 Basic speed and torque control

Output assembly object 0x16 (22$_{10}$)

The PLC or scanner must be configured for 6 output bytes (or 3 output words) if this assembly object is to be used.

Table 6.8 Basic speed and torque control

Data Word	Function
Word 0	Basic control word.
Word 1	Speed reference (*SpeedRef*).
Word 2	Torque reference (*TorqueRef*).

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Basic control word

The basic control word consists of 2 bytes (16 bits), with only 2 bits of the low byte being used as shown below.

b15	b14	b13	b12	b11	b10	b9	b8

b7	b6	b5	b4	b3	b2	b1	b0
					FaultRst		RunFwd

The individual bit functions are described as follows:

Name	Control Word	Description
RunFwd	b0	Set this bit to command the drive to run in the forward direction.
FaultRst	b2	A 0 to 1 transition will reset the drive if the drive was in a trip state.

NOTE For the drive to run at the speed specified in Word 1, Pr **6.43** must be *ON* and bit 0, bit 7 and bit 8 of the drive control word (Pr **6.42**) must all be set to 1.

NOTE For information on the drive control word see Table 6.6 *Drive control word bit functions* on page 37.

Speed reference (*SpeedRef*)

The speed reference word utilises 2 bytes (16 bits) as shown below.

b15	b14	b13	b12	b11	b10	b9	b8
SpeedRef (high byte)							

b7	b6	b5	b4	b3	b2	b1	b0
SpeedRef (low byte)							

For more information on the setting of the speed reference see section 6.7.26 *AC/DC Drive object* on page 60.

Torque reference (*TorqueRef*)

The torque reference word utilises 2 bytes (16 bits) as shown below.

b15	b14	b13	b12	b11	b10	b9	b8
TorqueRef (high byte)							

b7	b6	b5	b4	b3	b2	b1	b0
TorqueRef (low byte)							

For more information on the setting of the torque reference see section 6.7.26 *AC/DC Drive object* on page 60.

6.7.17 Extended speed and torque control

Output assembly object 0x17 (23₁₀)

The PLC or scanner must be configured for 6 output bytes (or 3 output words) if this assembly object is to be used.

Table 6.9 Extended speed and torque control

Data word	Function
Word 0	Extended control word.
Word 1	Speed reference (*SpeedRef*).
Word 2	Torque reference (*TorqueRef*).

Extended control word

The extended control word consists of 2 bytes (16 bits), with only 5 bits of the low byte used as shown below.

b15	b14	b13	b12	b11	b10	b9	b8

b7	b6	b5	b4	b3	b2	b1	b0
	NetRef	NetCtrl			FaultRst	RunRev	RunFwd

The individual bit functions are described as follows:

Name	Control Word	Description
RunFwd	b0	Set this bit to command the drive to run in the forward direction.
RunRev	b1	Set this bit to command the drive to run in the reverse direction.
FaultRst	b2	A 0 to 1 transition will reset the drive if the drive was in a trip state.
NetCtrl	b5	Used in conjunction with Pr **6.43** to enable the drive control word bits b0-b6 and bit 9 (Pr **6.42**).
NetRef	b6	Set this bit to command the drive to use the remote speed reference value specified in Word 1.

NOTE For the drive to run at the speed specified in Word 1, Pr **6.43** must be *ON* and bit 0, bit 7 and bit 8 of the drive control word (Pr **6.42**) must all be set to 1 and the external hardware enable signal must be present.

NOTE For information on the drive control word see Table 6.6 *Drive control word bit functions* on page 37.

Speed reference (*SpeedRef*)

The speed reference word utilises 2 bytes (16 bits) as shown below.

b15	b14	b13	b12	b11	b10	b9	b8
SpeedRef (high byte)							

b7	b6	b5	b4	b3	b2	b1	b0
SpeedRef (low byte)							

For more information on the setting of the speed reference see section 6.7.26 *AC/DC Drive object* on page 60.

Torque reference (*TorqueRef*)

The torque reference word utilises 2 bytes (16 bits) as shown below.

b15	b14	b13	b12	b11	b10	b9	b8
TorqueRef (high byte)							

b7	b6	b5	b4	b3	b2	b1	b0
TorqueRef (low byte)							

For more information on the setting of the torque reference see section 6.7.26 *AC/DC Drive object* on page 60.

6.7.18 Basic speed feedback

Input assembly object 0x46 (70_{10})

The PLC or scanner must be configured for 4 input bytes (or 2 input words) if this assembly object is to be used.

Table 6.10 Basic speed feedback

Data word	Function
Word 0	Basic status word.
Word 1	Speed feedback (*SpeedActual*).

Basic status word

The basic status word consists of 2 bytes (16 bits), with only 2 bits of the low byte used as shown below.

b15	b14	b13	b12	b11	b10	b9	b8

b7	b6	b5	b4	b3	b2	b1	b0
					Running1 (Fwd)		Faulted

The individual bit functions are described as follows:

Bit	Name	Description
b0	Faulted	Indicates whether the drive is OK or tripped (0=OK, 1=Tripped).
b2	Running1 (Fwd)	Indicates if the drive is running in the forward direction (0=False, 1=True).

Speed feedback (*SpeedActual*)

The speed feedback word utilises 2 bytes (16 bits) as shown below.

b15	b14	b13	b12	b11	b10	b9	b8
SpeedActual (high byte)							

b7	b6	b5	b4	b3	b2	b1	b0
SpeedActual (low byte)							

For more information on the speed feedback see section 6.7.26 *AC/DC Drive object* on page 60.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

6.7.19 Extended speed feedback

Input assembly object 0x47 (71_{10})

The PLC or scanner must be configured for 4 input bytes (or 2 input words) if this assembly object is to be used.

Table 6.11 Extended speed feedback

Data word	Function
Word 0	Extended status word.
Word 1	Speed feedback (*SpeedActual*).

Extended status word

The extended status word consists of 2 bytes (16 bits), with the bits having functions as shown below.

b15	b14	b13	b12	b11	b10	b9	b8
DriveState							

b7	b6	b5	b4	b3	b2	b1	b0
At Reference	RefFrom Net	CtrlFrom Net	Ready	Running2 (Rev)	Running1 (Fwd)	Warning	Faulted

The DriveState byte returns a code to indicate the operating state of the drive as shown in Table 6.12 below.

Table 6.12 DriveState codes

Code	b15 - b8	State	Description
1	00000001	Startup	This state is skipped over on CT drives.
2	00000010	Not_Ready	Inhibit.
3	00000011	Ready	Ready.
4	00000100	Enabled	Run or Stop (Stop is only enabled by default in Servo mode).
5	00000101	Stopping	Deceleration or Injection.
6	00000110	Fault_Stop	AC_UU (this will only occur if Mains Loss is enabled).
7	00000111	Faulted	Tripped.
0	00000000	Vendor Specific	All other DriveType states, e.g. Scan, Orienting, Regen Active, etc.

The individual bits of the low byte of the extended status word are described in Table

6.13 *Extended status word (low byte)* on page 43.

Table 6.13 Extended status word (low byte)

Name	Bit	Description
Faulted	b0	Indicates whether the drive is OK or tripped. 0=OK (Pr **10.01**=1). 1=Tripped (Pr **10.01**=0).
Warning	b1	Indicates if one of the drive alarms is active.
Running1 (Fwd)	b2	Indicates if the drive is running in the forward direction. 0=False, 1=True.
Running2 (Rev)	b3	Indicates if the drive is running in the reverse direction. 0=False, 1=True.
Ready	b4	The 'Ready' bit is set depending on which state the drive is in. Ready = True. Enabled = True. Stopping = True. All others = False.
CtrlFromNet	b5	Indicates if the drive is being controlled from the 'Drive Control Word'. 0=False, 1=True.
RefFromNet	b6	Indicates if the speed reference is derived from Pr **1.21.** 0=False (Pr **1.50**<>1 OR Pr **1.49**<>3). 1=True (Pr **1.50**=1 AND Pr **1.49**=3).
AtReference	b7	Indicates if the drive speed has reached the set reference. 0=False (Pr **10.06**=0). 1=True (Pr **10.06**=1).

Speed feedback (*SpeedActual*)

The speed feedback word utilises 2 bytes (16 bits) as shown below.

b15	b14	b13	b12	b11	b10	b9	b8
SpeedActuall(high byte)							

b7	b6	b5	b4	b3	b2	b1	b0
SpeedActual (low byte)							

For more information on the speed feedback see section 6.7.26 *AC/DC Drive object* on page 60.

6.7.20 Basic speed and torque feedback

Input assembly object 0x48 (72$_{10}$)

The PLC or scanner must be configured for 6 input bytes (or 3 input words) if this assembly object is to be used.

Table 6.14 Basic speed and torque feedback

Data word	**Function**
Word 0	Basic status word
Word 1	Speed feedback (*SpeedActual*).
Word 2	Torque feedback (*TorqueActual*).

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Basic status word

The basic status word consists of 2 bytes (16 bits), with only the low byte used as shown below.

b15	b14	b13	b12	b11	b10	b9	b8

b7	b6	b5	b4	b3	b2	b1	b0
					Running1 (Fwd)		Faulted

The individual bit functions are described as follows:

Bit	Name	Description
b0	Faulted	Indicates whether the drive is OK or tripped (0=OK, 1=Tripped).
b2	Running1 (Fwd)	Indicates if the drive is running in the forward direction (0=False, 1=True).

Speed feedback (*SpeedActual*)

The speed feedback word utilises 2 bytes (16 bits) as shown below.

b15	b14	b13	b12	b11	b10	b9	b8
SpeedActual (high byte)							

b7	b6	b5	b4	b3	b2	b1	b0
SpeedActual (low byte)							

For more information on the speed feedback see section 6.7.26 *AC/DC Drive object* on page 60.

Torque feedback (*TorqueActual*)

The torque feedback word utilises 2 bytes (16 bits) as shown below.

b15	b14	b13	b12	b11	b10	b9	b8
TorqueActual (high byte)							

b7	b6	b5	b4	b3	b2	b1	b0
TorqueActual (low byte)							

For more information on the torque feedback see section 6.7.26 *AC/DC Drive object* on page 60.

6.7.21 Extended speed and torque feedback

Input assembly object 0x49 (73_{10})

The PLC or scanner must be configured for 6 input bytes (or 3 input words) if this assembly object is to be used.

Table 6.15 Basic speed and torque feedback

Data word	Function
Word 0	Extended status word.
Word 1	Speed feedback (*SpeedActual*).
Word 2	Torque feedback (*TorqueActual*).

Extended status word

The extended status word consists of 2 bytes (16 bits), with the bits having functions as shown below.

b15	b14	b13	b12	b11	b10	b9	b8
DriveState							

b7	b6	b5	b4	b3	b2	b1	b0
At Reference	RefFrom Net	CtrlFrom Net	Ready	Running2 (Rev)	Running1 (Fwd)	Warning	Faulted

The DriveState byte returns a code to indicate the operating state of the drive as shown in Table 6.16.

Table 6.16 DriveState codes

Code	b15 - b8	State	Description
1	00000001	Startup	This state is skipped over on CT drives.
2	00000010	Not_Ready	Inhibit.
3	00000011	Ready	Ready.
4	00000100	Enabled	Run or Stop (Stop is only enabled by default in Servo mode).
5	00000101	Stopping	Deceleration or Injection.
6	00000110	Fault_Stop	AC_UU (this will only occur if Mains Loss is enabled).
7	00000111	Faulted	Tripped.
0	00000000	Vendor Specific	All other DriveType states, e.g. Scan, Orienting, Regen Active, etc.

The individual bits of the low byte of the extended status word are described in Table 6.17 *Extended status word (low byte)* on page 46.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Table 6.17 Extended status word (low byte)

Name	Bit	Description
Faulted	b0	Indicates whether the drive is OK or tripped. 0=OK (Pr **10.01**=1). 1=Tripped (Pr **10.01**=0).
Warning	b1	Indicates if one of the drive alarms is active.
Running1 (Fwd)	b2	Indicates if the drive is running in the forward direction. 0=False, 1=True.
Running2 (Rev)	b3	Indicates if the drive is running in the reverse direction. 0=False, 1=True.
Ready	b4	The 'Ready' bit is set depending on which state the drive is in. Ready = True. Enabled = True. Stopping = True. All others = False.
CtrlFromNet	b5	Indicates if the drive is being controlled from the 'Drive Control Word'. 0=False, 1=True.
RefFromNet	b6	Indicates if the speed reference is derived from Pr **1.21.** 0=False (Pr **1.50**<>1 OR Pr **1.49**<>3). 1=True (Pr **1.50**=1 AND Pr **1.49**=3).
AtReference	b7	Indicates if the drive speed has reached the set reference. 0=False (Pr **10.06**=0). 1=True (Pr **10.06**=1).

Speed feedback (*SpeedActual*)

The speed feedback word utilises 2 bytes (16 bits) as shown below.

b15	b14	b13	b12	b11	b10	b9	b8
SpeedActuall(high byte)							

b7	b6	b5	b4	b3	b2	b1	b0
SpeedActual (low byte)							

For more information on the speed feedback see section 6.7.26 *AC/DC Drive object* on page 60.

Torque feedback (*TorqueActual*)

The torque feedback word utilises 2 bytes (16 bits) as shown below.

b15	b14	b13	b12	b11	b10	b9	b8
TorqueActual (high byte)							

b7	b6	b5	b4	b3	b2	b1	b0
TorqueActual (low byte)							

For more information on the torque feedback see section 6.7.26 *AC/DC Drive object* on page 60

6.7.22 Object Model

The Object Model has the following object classes present.

Table 6.18 Supported Objects

Object Class	Class Code	No. of Instances	Effect
Identity	0x01 (1_{10})	1	Provides device information (See Table 6.19 on page 47)
Motor Data	0x28 (40_{10})	2	Defines the motor data (For AC motors, see Table 6.25 on page 52) (For DC motors, see Table 6.27 on page 53)
Control Supervisor	0x29 (41_{10})	1	Provides drive control and monitoring information (See Table 6.28 on page 56)
AC/DC Drive	0x2A (42_{10})	1	Provides information on the drive running state (See Table 6.32 on page 60)
Control Techniques Group	0x64 (100_{10})	45	Provides an interface to drive parameters (See Table 6.34 on page 64)
TCP/IP Interface	0xF5 (245_{10})	1	Provides the mechanism to configure the TCP/IP interface (See Section 6.7.28)
Ethernet Link	0xF6 (246_{10})	1	Maintains link specific counters and status information (See Section 6.7.29)

6.7.23 Identity object

Class: 0x01 (1_{10})

The identity object provides identification of and general information about the device.

Table 6.19 Identity object

Attribute	Access	Name	Data Type
1	Get	VendorID	UINT
2	Get	DeviceType	UINT
3	Get	ProductCode	UINT
4	Get	Revision	USINT
6	Get	SerialNumber	UDINT
7	Get	ProductName	SHORT_STRING

Vendor ID

Name:	VendorID		
Class	0x01	Default	0x101 (257_{10})
Instance	0x01	Data Type	UINT
Attribute	0x01	Access	Get

Returns the vendor ID code 0x101 (257_{10}) for *Control Techniques*.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/Custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Device type

Name:	DeviceType		
Class	0x01	**Default**	0x02
Instance	0x01	**Data Type**	UINT
Attribute	0x02	**Access**	Get

Returns the device type code. The following codes are used:

Device Type code	Drive type
0x02	AC Drive
0x13	DC Drive

Product code

Name:	ProductCode		
Class	0x01	**Default**	See below
Instance	0x01	**Data Type**	UINT
Attribute	0x03	**Access**	Get

Returns a 16 bit value to identify the drive type, major revision number and drive mode and also links a node to the installed EDS files. If a basic EDS file is used then the product code is calculated as shown in Table 6.20 *Basic product code* below.

Table 6.20 Basic product code

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Product			Major Revision				Mode			0					

Product (b15 to b13)

The product code is defined as follows:

Product Code	Description	
	AC Drive (Type: 0x02)	**DC Drive (Type: 0x13)**
1	Unidrive SP	Mentor MP
2	Commander SK	*Reserved*
4	GP20	*Reserved*
5	Digitax ST	*Reserved*
6	Affinity	*Reserved*

Major Revision (b12 to b9)
The major revision returned will be calculated from the formula:

> **#11.29** * 3.

Where **#11.29** is the value of Pr **11.29** before the decimal point.

e.g. For a value of "1.09" in Pr **11.29**, the major revision returned is 3.

Mode (b8 to b6)

The mode value is defined as follows:

Mode	Description	
	AC Drive (Type: 0x02)	**DC Drive (Type: 0x13)**
0	Commander SE	Reserved
1	Open Loop	Reserved
2	Closed Loop Vector	Mentor MP
3	Servo	Reserved
4	Regen	Reserved

Bits **b5** to **b0** are not used and will be set to 0.

If an advanced EDS file is used then the product code is calculated as shown in Table 6.21 *Advanced product code* below.

Table 6.21 Advanced product code

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Product			Major Revision + Slot				Mode			Slot X			Slot Y		

Product (b15 to b13)
(See Table 6.20 *Basic product code* on page 48).

Major Revision + Slot (b12 to b9)
The value contains the major revision number of the drive firmware and the slot that the SM-Ethernet module is installed in.

The value returned will be calculated from the formula:

#11.29 * 3 + (*Slot* -1)

Where **#11.29** is the value of Pr **11.29** before the decimal point and *Slot* is the slot number that the SM-Ethernet module is installed in.

e.g. For a value of "1.09" in Pr **11.29** and the SM-Ethernet module installed in slot 3, the value returned will be 5.

Mode (b8 to b6)
(See Table 6.20 *Basic product code* on page 48).

Slot X (b5 to b3)
This indicates the option module family type installed in the lowest numbered slot, excluding the slot where this SM-Ethernet is installed.

Slot X = Pr **MM.01**/100. *(Any fractional part of result ignored)*

Slot Y (b2 to b0)
This indicates the option module family type installed in the highest numbered slot, excluding the slot where this SM-Ethernet is installed.

Slot Y = Pr **MM.01**/100. *(Any fractional part of result ignored)*

For the option module ID codes see Table 6.22 *Option modules ID codes* on page 50).

NOTE   The advanced EDS file mode is not supported on Commander SK.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Table 6.22 Option modules ID codes

b5 - b3 (Slot X) b2 - b0 (Slot Y)	Value	Module Family	Module ID	Module
001	1	Feedback	101	SM-Resolver.
001	1	Feedback	102	SM-Universal Encoder Plus.
001	1	Feedback	104	SM-Encoder Plus.
001	1	Feedback	104	SM-Encoder Output Plus.
010	2	I/O	201	SM-I/O Plus
010	2	I/O	203	SM-I/O Timer
010	2	I/O	204	SM-I/O PELV
010	2	I/O	205	SM-I/O 24V
010	2	I/O	206	SM-I/O 120V
010	2	I/O	207	SM-I/O Lite
010	2	I/O	208	SM-I/O 32
011	3	Applications	301	SM-Applications
011	3	Applications	302	SM-Applications Lite
011	3	Applications	303	SM-EZMotion
011	3	Applications	304	SM-Applications Plus
011	3	Applications	305	SM-Applications Lite V2
100	4	Fieldbus	401	SM-LON
100	4	Fieldbus	403	SM-PROFIBUS DP
100	4	Fieldbus	404	SM-Interbus
100	4	Fieldbus	406	SM-CAN
100	4	Fieldbus	407	SM-DeviceNet
100	4	Fieldbus	408	SM-CANopen
100	4	Fieldbus	409	SM-Sercos
100	4	Fieldbus	410	SM-Ethernet
100	4	Fieldbus	421	SM-EtherCAT
101	5	Position	501	SM-SLM

Revision

Name:	Revision		
Class	0x01	Default	N/A
Instance	0x01	Data Type	ARRAY of USINT
Attribute	0x04	Access	Get

Returns 2 bytes to indicate the minor and sub-version revision numbers.

If a basic generic EDS file is used then only the minor revision in the upper byte is returned as shown in Table 6.23 *Basic revision* on page 51.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Table 6.23 Basic revision

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Minor Revision								0	127_{10} (All bits set to 1)						

The minor revision returned will be calculated from the formula:

#11.29 Mod 100 + 1.

Where "**#11.29** Mod 100" refers to the fractional value of Pr **11.29**, (the value after the decimal point).

e.g. For a value of "1.09" in Pr **11.29**, the minor revision returned is 10.

Bits **b0** to **b6** are used to inform the configuration tool that the advanced EDS file is not enabled and each bit will be set to 1.

If an advanced EDS file is used then the revision number is calculated as shown below.

Table 6.24 Advanced revision

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Sub-version								0	Minor Revision						

Minor revision

The minor revision returned will be calculated from the formula:

#11.29 Mod 100 + 1.

Where "**#11.29** Mod 100" refers to the fractional value of Pr **11.29**, (the value after the decimal point).

e.g. For a value of "1.09" in Pr **11.29**, the minor revision returned is 10.

Sub-version

The sub-version returned will be calculated from the formula:

#11.34 + 1.

e.g. For a value of "1" in Pr **11.34**, the sub-version returned is 2.

Serial Number

Name:	SerialNumber		
Class	0x01	Default	N/A
Instance	0x01	Data Type	UDINT
Attribute	0x06	Access	Get

Returns the least 3 significant bytes of the SM-Ethernet MAC address. The MAC address is set during production, and cannot be changed. This value is also displayed in Pr **MM.35**.

NOTE   This can be used to find the complete MAC address of the module by combining the numbers with 00:0D:1E:xx.xx.xx. Where xx.xx.xx. is a value in Pr **MM.35** converted to base 16 (HEX). e.g. If Pr **MM.35** contains the value of 1193046, this would give the complete MAC address of 00 0D 1E 12 34 56.

Product Name

Name:	ProductName		
Class	0x01	Default	SM-Ethernet
Instance	0x01	Data Type	SHORT_STRING
Attribute	0x07	Access	Get

Returns 12 bytes (ASCII) to indicate the product name as a short string. The first byte specifies the number of following bytes that constitute the product name. The SM-Ethernet returns the string "SM-Ethernet".

6.7.24 Motor data object

Class: 0x28 (40_{10})

There are 2 instances of the Motor data object. Instance 1 will represent menu 5 motor information (motor map 1) and instance 2 will represent menu 21 motor information (motor map 2). The instance being used by the other dependant objects will be determined by Pr **21.15**, to use the second motor map objects (instance 2), Pr **21.15** should be set to *ON*. Pr **21.15** is polled in the background task, so the user should be aware that during motor map changeover, the RPM speed reference may not be accurate. The available attributes and associated functions for the AC motor data object are shown in Table 6.25 *AC Motor data object attributes* below, the available attributes and associated functions for the DC motor data object are shown in Table 6.27 *DC Motor data object attributes* on page 53.

Table 6.25 AC Motor data object attributes

AC Motor Instance Attributes			Drive Parameter	
Attribute ID	Name	Access	Instance 1	Instance 2
0x03 (3_{10})	MotorType (*)	Get/Set	Pr **64.13**	Pr **64.14**
0x06 (6_{10})	RatedCurrent	Get/Set	Pr **5.07** (scaled to 100mA units)	Pr **21.07** (scaled to 100mA units)
0x07 (7_{10})	RatedVoltage	Get/Set	Pr **5.09**	Pr **21.09**
0x09 (9_{10})	RatedFreq	Get/Set	Pr **5.06** (scaled to Hz)	Pr **21.06** (scaled to Hz)
0x0F (15_{10})	BaseSpeed	Get/Set	Pr **5.08** (scaled to rpm units)	Pr **21.08** (scaled to rpm units)
0x64 (100_{10})	Motor2Select	Get Set	Pr **21.15** Pr **11.45**	Pr **21.15** Pr **11.45**

(* The MotorType attribute has no effect on drive operation, it is only used to provide information to the user as shown in Table 6.26 *Supported motor types* below).

NOTE In Open loop mode, only attributes 6 and 7 will be supported.

Table 6.26 Supported motor types

Value	Motor Type	
	AC	DC
2	Reserved	FC DC motor
6	Wound rotor induction motor	Reserved
7	Squirrel cage induction motor (default)	Reserved
9	Sinusoidal PM BL motor	Reserved
10	Trapezoidal PM BL motor	Reserved

Table 6.27 DC Motor data object attributes

DC Motor Instance Attributes			Drive Parameter	
Attribute ID	Name	Access	Instance 1	Instance 2
0x03 (3_{10})	MotorType (*)	Get/Set	Pr **64.13**	Pr **64.14**
0x06 (6_{10})	RatedCurrent	Get/Set	Pr **5.07** (scaled to 100mA units)	Pr **21.07** (scaled to 100mA units)
0x07 (7_{10})	RatedVoltage	Get/Set	Pr **5.09**	Pr **21.09**
0x0F (15_{10})	BaseSpeed	Get/Set	Pr **5.08** (scaled to rpm units)	Pr **21.08** (scaled to rpm units)
0x10 (16_{10})	RatedFieldCur	Get/Set	Pr **5.70** (scaled to 100mA units)	Pr **21.24** (scaled to 100mA units)
0x11 (17_{10})	MinFieldCur	Get Set	Pr **5.70** * Pr **5.69** / 100 Pr **5.69** = MinFieldCur * 100 / Pr **5.70** (scaled to 100mA units) Pr **5.69** will be written with the appropriate instance value, depending on which motor map is selected.	Pr **21.24** * Pr **5.69** / 100 Pr **5.69** = MinFieldCur * 100 / Pr **21.24** (scaled to 100mA units) Pr **5.69** will be written with the appropriate instance value, depending on which motor map is selected.
0x12 (18_{10})	RatedFieldVolt	Get/Set	Pr **5.73**	Pr **21.23**
0x64 (100_{10})	Motor2Select	Get Set	Pr **21.15** Pr **11.45**	Pr **21.15** Pr **11.45**

(* The MotorType attribute has no effect on drive operation, it is only used to provide information to the user as shown in Table 6.26 *Supported motor types* on page 52).

Motor type

Name:	MotorType1		
Class	0x28	**Default**	7
Instance	0x01	**Data Type**	USINT
Attribute	0x03	**Access**	Get/Set

Returns or sets the motor type to be used by the drive for instance 1.

Name:	MotorType2		
Class	0x28	**Default**	7
Instance	0x02	**Data Type**	USINT
Attribute	0x03	**Access**	Get/Set

Returns or sets the motor type to be used by the drive for instance 2.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Rated current

Name:	RatedCurrent1		
Class	0x28	Default	Pr **5.07** / 10
Instance	0x01	Data Type	USINT
Attribute	0x06	Access	Get/Set

Returns or sets the rated motor current in Amps for instance 1. This attribute is linked to Pr **5.07**.

Set Pr **5.07** = RatedCurrent1 * 10.

Get RatedCurrent1 = Pr **5.07** / 10.

Name:	RatedCurrent2		
Class	0x28	Default	Pr **21.07** / 10
Instance	0x02	Data Type	USINT
Attribute	0x06	Access	Get/Set

Returns or sets the rated motor current in Amps for instance 2. This attribute is linked to Pr **21.07**.

Set Pr **21.07** = RatedCurrent2 * 10.

Get RatedCurrent2 = Pr **21.07** / 10.

Rated voltage

Name:	RatedVoltage1		
Class	0x28	Default	Pr **5.09**
Instance	0x01	Data Type	USINT
Attribute	0x07	Access	Get/Set

Returns or sets the rated motor voltage in Volts for instance 1. This attribute is linked to Pr **5.09**.

Name:	RatedVoltage2		
Class	0x28	Default	Pr **21.09**
Instance	0x02	Data Type	USINT
Attribute	0x07	Access	Get/Set

Returns or sets the rated motor voltage in Volts for instance 2. This attribute is linked to Pr **21.09**.

Rated frequency

Name:	RatedFreq1		
Class	0x28	Default	Pr **5.06** / 10
Instance	0x01	Data Type	USINT
Attribute	0x09	Access	Get/Set

Returns or sets the rated motor frequency in Hertz for instance 1. This attribute is linked to Pr **5.06**.

Set   Pr **5.06** = RatedFreq1 * 10.

Get   RatedFreq1 = Pr **5.06** / 10.

Name:	RatedFreq2		
Class	0x28	Default	Pr **21.06** / 10
Instance	0x02	Data Type	USINT
Attribute	0x09	Access	Get/Set

Returns or sets the rated motor frequency in Hertz for instance 2. This attribute is linked to Pr **21.06**.

Set   Pr **21.06** =RatedFreq2 * 10.

Get   RatedFreq2 = Pr **21.06** / 10.

Base speed

Name:	BaseSpeed1		
Class	0x28	Default	Pr **5.08**
Instance	0x01	Data Type	USINT
Attribute	0x0F	Access	Get/Set

Returns or sets the base speed of the motor in RPM for instance 1. This attribute is linked to Pr **5.08**.

Name:	BaseSpeed2		
Class	0x28	Default	Pr **21.08**
Instance	0x02	Data Type	USINT
Attribute	0x0F	Access	Get/Set

Returns or sets the base speed of the motor in RPM for instance 2. This attribute is linked to Pr **21.08**.

Motor2Select

Name:	Motor2Select		
Class	0x28	Default	
Instance	0x01	Data Type	USINT
Attribute	0x64	Access	Get/Set

Selects between Motor Map 1 and Motor Map 2. This attribute is linked to Pr **11.45**. When this bit is set to 1, Motor Map 2 will be active.

NOTE   Any change in this attribute will be implemented when the drive is disabled.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

6.7.25 Control Supervisor object

Class: 0x29 (41_{10})

The Control Supervisor object provides access to various attributes which control or monitor the drive running state. The available attributes and their associated functions are shown in Table 6.28 below.

Table 6.28 Control Supervisor object attributes

Attribute ID	Name	Access	Parameter dependence	
0x03 (3_{10})	RunFwd	Get/Set	Pr **6.42 b1**	
0x04 (4_{10})	RunRev	Get/Set	Pr **6.42 b3**	
0x05 (5_{10})	NetCtrl	Get/Set	Pr **6.42 b7**	
0x06 (6_{10})	State	Get	(See Table 6.29 on page 57)	
0x07 (7_{10})	RunningFwd	Get	1	Pr **10.14**=0 AND Pr **10.02**=1
			0	Pr **10.14**=1 OR Pr **10.02**=0
0x08 (8_{10})	RunningRev	Get	1	Pr **10.14**=1 AND Pr **10.02**=1
			0	Pr **10.14**=0 OR Pr **10.02**=0
0x09 (9_{10})	Ready	Get	(See Table 6.30 on page 58)	
0x0A (10_{10})	Faulted	Get	Inverse of Pr **10.01**	
0x0B (11_{10})	Warning	Get	Pr 10.19	
0x0C (12_{10})	FaultRst	Get/Set	Dummy parameter, sets Pr **10.38** to 100 on a 0 to 1 transition	
0x0D (13_{10})	FaultCode	Get	(See Table 6.31 on page 59)	
0x0F (15_{10})	CtrlFormNet	Get	1	Pr **6.42 b7**=1 AND Pr **6.43**=1
			0	Pr **6.42 b7**=0 OR Pr **6.43**=0
0x66 (102_{10})	DriveEnable	Get/Set	Pr **6.42 b0**	

RunFwd

Name:	RunFwd		
Class	0x29	**Default**	N/A
Instance	0x01	**Data Type**	USINT
Attribute	0x03	**Access**	Get/Set

Set to 1 to run the drive in the forward direction.

Get/Set Pr **6.42** (bit 1).

RunRev

Name:	RunRev		
Class	0x29	**Default**	N/A
Instance	0x01	**Data Type**	USINT
Attribute	0x04	**Access**	Get/Set

Set to 1 to run the drive in the reverse direction.

Get/SetPr **6.42** (bit 3).

NetCtrl

Name:	NetCtrl		
Class	0x29	**Default**	N/A
Instance	0x01	**Data Type**	USINT
Attribute	0x05	**Access**	Get/Set

Switches between terminal and fieldbus control.

Get/SetPr **6.42** (bit 7)

0 = Terminal control.

1 = Fieldbus control.

State

Name:	State		
Class	0x29	**Default**	N/A
Instance	0x01	**Data Type**	USINT
Attribute	0x06	**Access**	Get

This returns a code to indicate the current running state of the drive as shown in Table 6.29 below.

Table 6.29 Control Supervisor state attribute

Code	State	Description
1	Startup	This state is skipped over on CT drives
2	Not_Ready	Inhibit
3	Ready	Ready
4	Enabled	Run or Stop (Stop is only enabled by default in Servo mode)
5	Stopping	Decelerating or DC injection braking
6	Fault_Stop	ACUU (AC Under Voltage) - this will only occur if mains loss is enabled
7	Faulted	Tripped
0	Vendor Specific	All other DriveType states, e.g. Scan, Orienting, Regen Active, etc.

RunningFwd

Name:	RunningFwd		
Class	0x29	**Default**	N/A
Instance	0x01	**Data Type**	USINT
Attribute	0x07	**Access**	Get

Indicates that the drive is running in the forward direction.

This attribute will be set to 1 when Pr **10.14** = 0 and Pr **10.02** = 1.

RunningRev

Name:	RunningRev		
Class	0x29	**Default**	N/A
Instance	0x01	**Data Type**	USINT
Attribute	0x08	**Access**	Get

Indicates that the drive is running in the reverse direction.

This attribute will be set to 1 when Pr **10.14**=1 and Pr **10.02**=1.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Ready

Name:	Ready		
Class	0x29	Default	N/A
Instance	0x01	Data Type	USINT
Attribute	0x09	Access	Get

The Ready attribute will be set in accordance with the state as shown in Table 6.30 below.

Table 6.30 Control Supervisor Ready attribute

Code	State	Ready state
3	Ready	True
4	Enabled	True
5	Stopping	True
All others		False

Faulted

Name:	Faulted		
Class	0x29	Default	N/A
Instance	0x01	Data Type	USINT
Attribute	0x0A	Access	Get

Indicates that the drive is tripped, i.e. not OK (inverse of Pr **10.01**).

Get 1 = Pr **10.01** = 0.

Get 0 = Pr **10.01** = 1.

Warning

Name:	Warning		
Class	0x29	Default	N/A
Instance	0x01	Data Type	USINT
Attribute	0x0B	Access	Get

Indicates that one of the drive alarms is active.

Get Pr **10.19.**

FaultRst

Name:	FaultRst		
Class	0x29	Default	N/A
Instance	0x01	Data Type	USINT
Attribute	0x0C	Access	Get/Set

Resets the drive from a tripped condition.

Sets Pr **10.38** to 100 on a 0 to 1 transition.

FaultCode

Name:	FaultCode		
Class	0x29	Default	N/A
Instance	0x01	Data Type	USINT
Attribute	0x0D	Access	Get

The fault code attribute will return the ODVA fault code as follows:

If the drive is not OK, the drive fault code is obtained from Pr **10.20**, if the drive fault code is listed in Table 6.31, then SM-Ethernet will return the ODVA fault code as shown in Table 6.31 below.

If the drive fault code is not listed in Table 6.31 then SM-Ethernet will return the ODVA code as follows:

ODVA Fault Code = 0x1000 + drive fault code.

Table 6.31 Control Supervisor fault code attribute

Drive Fault Code	ODVA Fault Code	Drive Fault Code	ODVA Fault Code
1	0x3220	20	0x2310
2	0x3210	21	0x4300
3	0x2300	26	0x5112
4	0x7112	32	0x3130
6	0x9000		

CtrlFromNet

Name:	CtrlFromNet		
Class	0x29	Default	N/A
Instance	0x01	Data Type	USINT
Attribute	0x0F	Access	Get

Indicates whether the drive is operating under fieldbus or terminal control.

This attribute will be set to 1 if Pr **6.42** (bit 7) = 1 and Pr **6.43** = 1 (fieldbus).

DriveEnable

Name:	DriveEnable		
Class	0x29	Default	N/A
Instance	0x01	Data Type	USINT
Attribute	0x66	Access	Get/Set

Enables the drive. This puts the drive into the "Ready" state, allowing the **RunFwd** and **RunRev** attributes to control the drive. **RunFwd** and **RunRev** will have no effect if **DriveEnable** is not set to 1.

Get/Set   Pr **6.42** bit 0.

NOTE   The external hardware enable signal must also be present before the drive will enter the Ready state.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

6.7.26 AC/DC Drive object

Class: 0x2A (42$_{10}$)

The AC/DC Drive object provides information on the drive running state and supports the following attributes:

Table 6.32 AC/DC Drive object attributes

Attribute ID	Name	Access	Parameter dependence	
0x03 (3$_{10}$)	AtReference	Get	Pr 10.06	
0x04 (4$_{10}$)	NetRef	Get/Set	Pr 6.42 (bit 8)	
0x06 (6$_{10}$)	DriveMode	Get/Set	(See Table 6.33 on page 61)	
0x07 (7$_{10}$)	SpeedActual	Get	Closed Loop	Pr 3.02
			Open Loop	Pr 5.04
0x08 (8$_{10}$)	SpeedRef	Get/Set	Closed Loop	Pr 1.21 (scaled to 0 decimal places)
		Get	Open Loop	Pr 1.21 * 60 / *NofPP* (scaled to 0 decimal places)
		Set	Open Loop	Pr 1.21 = SpeedRef * *NofPP* / 60 (scaled to 0 decimal places)
0x0B (11$_{10}$)	TorqueActual	Get	Pr 4.20 (scaled to 1 decimal place)	
0x0C (12$_{10}$)	TorqueRef	Get/Set	Pr **4.08** (scaled to 1 decimal place)	
0x1D (29$_{10}$)	RefFromNet	Get	1	Pr **1.49**=3 AND Pr **1.50**=1
			0	Pr **1.49**<>3 OR Pr **1.50**<>1

NOTE *NofPP* = Number of Pole Pairs.

NOTE NetRef can only be changed between local and remote when the drive is in speed control mode. If a change is requested when in torque mode then an error code will be returned.

AtReference

Name:	AtReference		
Class	0x2A	**Default**	N/A
Instance	0x01	**Data Type**	USINT
Attribute	0x03	**Access**	Get

Indicates that the drive is running at the requested speed.

> Get Pr **10.06**
>> 0 = Drive not running at requested speed.
>> 1 = Drive running at requested speed.

NetRef

Name:	NetRef		
Class	0x2A	**Default**	N/A
Instance	0x01	**Data Type**	USINT
Attribute	0x04	**Access**	Get/Set

Selects the source of the speed reference.

> Get/SetPr **6.42** bit 8
>> 0 = analog speed reference.
>> 1 = digital speed reference.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

NOTE The NetRef can only be changed between local and remote when the drive is configured in speed control mode. If a change is requested when in torque mode then a 'Device State Conflict' error code 0x10 will be returned.

DriveMode

Name:	DriveMode		
Class	0x2A	Default	N/A
Instance	0x01	Data Type	USINT
Attribute	0x06	Access	Get/Set

DriveMode does not allow the operating mode of the drive to be changed. Pr **4.11** will be written to as shown in Table 6.33 below, provided that the drive is already in the correct operating mode.

Table 6.33 AC/DC Drive object DriveMode attribute

Access	Value	Mode (Pr 4.11)	Current drive mode (Pr 11.31)
Get	1	Open Loop Speed (0)	Open loop (1)
	2	Closed Loop Speed (0)	Closed loop vector (2)
	2	Closed Loop Speed (0)	Servo (3)
	2	Closed Loop Speed (0)	Mentor MP
	3	Torque Control (1)	Open loop (1)
	3	Torque Control (1)	Closed loop vector (2)
	3	Torque Control (1)	Servo (3)
	3	Torque Control (1)	Mentor MP
	0	Don't care	Regen (4)
	0	User defined Torque control with speed override (2) OR Coiler/uncoiler mode (3) OR Speed control with torque feed-forward (4)	Don't care
Set	0	Invalid Attribute Value (0x09)	Don't care
	1	Open Loop Speed (0)	Open loop (1)
	1	Device State Conflict (0x10)	Closed loop vector (2) OR Servo (3) OR Regen (4) OR Mentor MP
	2	Closed Loop Speed (0)	Closed loop vector (2) OR Servo (3) OR Mentor MP
	2	Device State Conflict (0x10)	Open loop (1) OR Regen (4)
	3	Torque Control (1)	Open loop (1) OR Closed loop vector (2) OR Servo (3) OR Mentor MP
	3	Device State Conflict (0x10)	Regen (4)

NOTE Pr **11.31** will never be changed by setting the DriveMode attribute. An error (0x10) will be generated if the requested DriveMode value does not correspond to the current DriveType operating mode.

SpeedActual

Name:	SpeedActual		
Class	0x2A	Default	N/A
Instance	0x01	Data Type	USINT
Attribute	0x07	Access	Get

Returns the actual speed of the motor in RPM. The source of the motor speed depends on the operating mode of the drive.

Get   Pr **5.04** (Open Loop).

Get   Pr **3.02** (Closed Loop or Servo).

SpeedRef

Name:	SpeedRef		
Class	0x2A	Default	N/A
Instance	0x01	Data Type	USINT
Attribute	0x08	Access	Get/Set

Sets or returns the speed reference in RPM.

Closed loop, Servo

Get/Set SpeedRef = Pr **1.21** (Scaled to 0 decimal places).

Open loop

Get   SpeedRef = (Pr **1.21** * 60) / Pole Pairs (Scaled to 0 decimal places).

Set   Pr **1.21** = (SpeedRef * Pole Pairs) / 60 (Scaled to 0 decimal places).

TorqueActual

Name:	TorqueActual		
Class	0x2A	Default	N/A
Instance	0x01	Data Type	USINT
Attribute	0x0B	Access	Get

Returns the actual load on the motor as a percentage of the rated motor load. This attribute has 1 decimal place precision, a value of 1000 represents 100.0% load.

Get   Pr **4.20**.

TorqueRef

Name:			
Class	0x2A	Default	N/A
Instance	0x01	Data Type	USINT
Attribute	0x0C	Access	Get/Set

Sets the load (torque) reference as % of rated motor load (torque). This attribute has 1 decimal place precision, so a value of 1000 represents 100.0% load.

Set Pr **4.08** = TorqueRef / 10.

Get TorqueRef = Pr **4.08** * 10.

RefFromNet

Name:	RefFromNet		
Class	0x2A	Default	
Instance	0x01	Data Type	USINT
Attribute	0x1D	Access	Get

Indicates the source of the speed reference.

TRUE if Pr **1.49** = 3 and Pr **1.50** = 1.

FALSE otherwise.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

6.7.27 Control Techniques object

Class: 0x64 (100_{10})

The Control Techniques object provides access to all drive parameters. For example, parameter Pr **4.20** would be accessed as Class 100, Instance 4, Attribute 20.

Table 6.34 Control Techniques object

| Instance	Menu	Name
0x01 (1_{10})	1	Frequency / speed reference.
0x02 (2_{10})	2	Ramps control.
0x03 (3_{10})	3	Speed control.
0x04 (4_{10})	4	Current control.
0x05 (5_{10})	5	Motor control.
0x06 (6_{10})	6	Sequencing.
0x07 (7_{10})	7	Analog I/O.
0x08 (8_{10})	8	Digital I/O.
0x09 (9_{10})	9	Logic.
0x0A (10_{10})	10	Drive status.
0x0B (11_{10})	11	Drive set-up.
0x0C (12_{10})	12	Programmable thresholds.
0x0D (13_{10})	13	Position control.
0x0E (14_{10})	14	Process PID loop.
0x0F (15_{10})	15	Slot 1 configuration.
0x10 (16_{10})	16	Slot 2 configuration.
0x11 (17_{10})	17	Slot 3 configuration.
0x12 (18_{10})	18	User application menu 1.
0x13 (19_{10})	19	User application menu 2.
0x14 (20_{10})	20	User application menu 3.
0x15 (21_{10})	21	Second motor map.
0x16 (22_{10})	22	Additional menu 0 setup
0x17 (23_{10})	23	Header selections
0x3C (60_{10})	60	Fieldbus virtual parameter menu.
0x3D (61_{10})	61	General module virtual parameter menu.
0x3E (62_{10})	62	DNS server virtual parameter menu.
0x3F (63_{10})	63	Modbus TCP/IP virtual parameter menu.
0x40 (64_{10})	64	EtherNet/IP virtual parameter menu.
0x46 (70_{10}) - 0x57 (87_{10})	70 - 87	Menus of option module (if installed) in the lowest numbered slot.
0x64 (100_{10}) - 0x7F (127_{10})	100 - 127	Menus of option module (if installed) in slot 1.
0x82 (130_{10}) - 0x9D (157_{10})	130 - 157	Menus of option module (if installed) in slot 2.
0xA0 (160_{10}) - 0xBB (187_{10})	160 - 187	Menus of option module (if installed) in slot 3.
0xC8 (200_{10})	0	Menu 0.

6.7.28 TCP/IP Interface object

Class: 0xF5 (245$_{10}$)

The TCP/IP Interface object provides the mechanism to configure the SM-Ethernet TCP/IP network interface. Examples of configurable items include the device IP address, network mask and gateway address.

NOTE This object is normally configured by the PLC software.

6.7.29 Ethernet Link object

Class: 0xF6 (246$_{10}$)

The Ethernet Link object maintains link-specific counters and status information for the Ethernet 802.3 communication interface.

NOTE This object is normally configured by the PLC software.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

7 Web page basics

7.1 Connecting to SM-Ethernet

If you are using DHCP, all settings on the SM-Ethernet module will be configured by the network DHCP server, you can confirm this is working by checking the IP address has been correctly configured in parameters Pr **MM.10** to Pr **MM.13**. In order to communicate, the PC must be on the same subnet as the drive or you must have a gateway specified for the host PC and the SM-Ethernet module.

NOTE If you are not using DHCP you will need to manually configure the address, subnet mask and default gateway (*if you are connecting from a different subnet*) see section 5.11 *Setting the IP address* on page 22.

7.1.1 Making a connection

To connect to SM-Ethernet, enter the address of the SM-Ethernet module (*see section 5.11 Setting the IP address* on page 22) into the browser window as follows:

http://192.168.1.100 (*this is the default address*)

Replacing the address (*192.168.1.100*) with the address of the SM-Ethernet module you wish to communicate with.

NOTE The default IP address when not using DHCP is 192.168.1.100. In order to communicate with this address your PC will need to be on the same subnet or have a gateway capable of reaching this address, additionally SM-Ethernet will also require a gateway configured to communicate with the PC in this case.

7.2 Web page menu structure

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

Figure 7-1 Web page structure
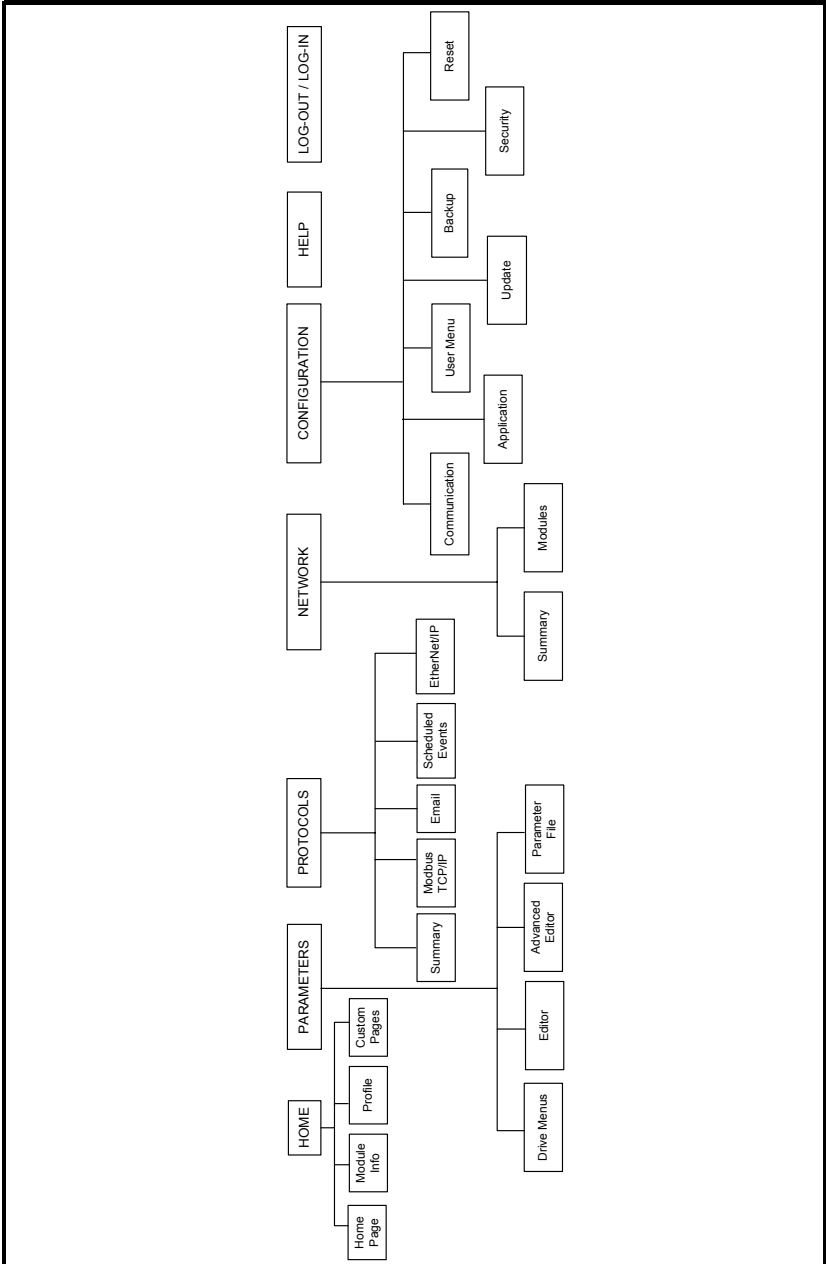
Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

7.2.1 The home page

Figure 7-2 shows the initial home page when connected to SM-Ethernet.

Figure 7-2 The home page
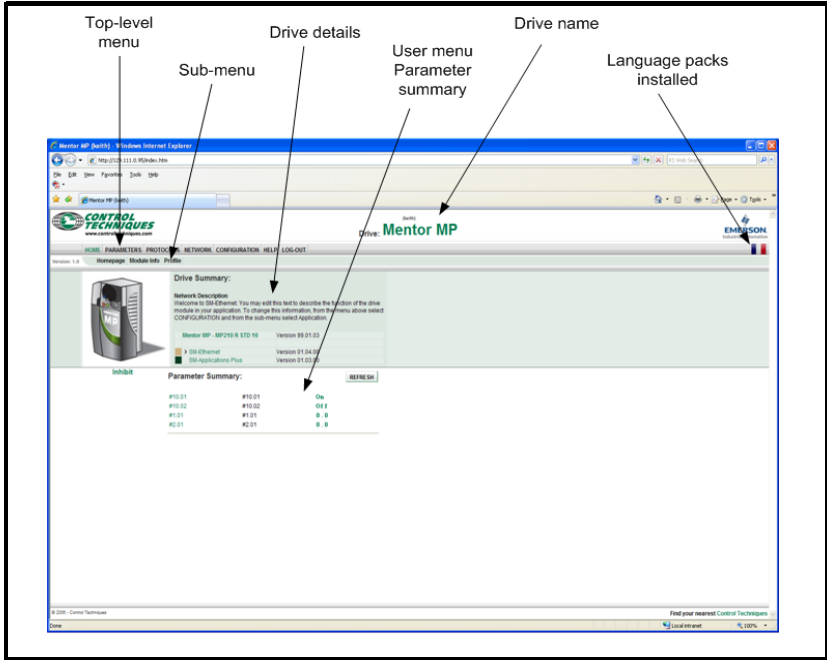
The home page contains the following main areas:

- **Top-level menu** - this is the menu that is used to navigate to the menus on SM-Ethernet. Click on the items to make a selection.

- **Sub-menu** - the sub-menu sub divides the top-level menu in to more sub-sections. Click on the items to make a selection.

- **Drive details** - contains more details about the SM-Ethernet usage and settings. The section also details any Solutions Modules installed to the drive and their firmware versions.

- **User menu parameter summary** - details the parameters that the user has previously defined to appear in this menu.

- **Drive name** - this is the name allocated to SM-Ethernet during set-up.

- **Language packs installed** - this area of the screen will indicate whether any languages (other than English) are installed in the module. Click on the image to select that language display or alternatively the language can be changed from within the user profile menu.

7.2.2   Logging in
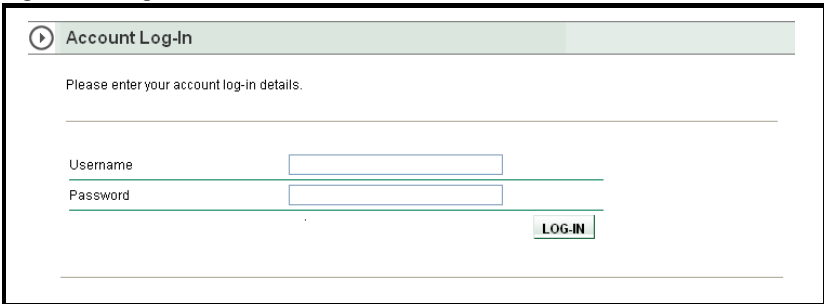
Before you can view any additional screens you must login to SM-Ethernet. The default *username* is **root** and the default *password* is **ut72**. The **root** *username* cannot be changed, but the password should be changed to prevent unauthorized access to SM-Ethernet. This account is not appropriate for day to day use, and an Administrator account should be created as soon as is practically possible. The password for the **root** account should be noted in a secure place as this password is not reset when the module is defaulted.

Figure 7-3 shows the login screen, after entering the details click the "LOG-IN" button to login. If you lose your passwords you will need to contact your supplier or local drive centre for instructions on how to change the password. The inactivity logout is configurable per account, although it cannot be set to 'Disabled' for Super User and Administrator accounts.

NOTE   Passwords are case sensitive and must be at least 6 characters in length and limited to a maximum of 15 characters. For security reasons passwords should be recorded in a secure location known only to the account user.

NOTE   The root account password cannot be reset back to the default (**ut72**) as this would be less than the minimum length allowed for a password.

Figure 7-3 Log-in

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

Depending on which page is active, after a period of inactivity you may be automatically logged out. This can be configured from the **Profile** sub-menu of the **HOME** page to one of the following options:

- Default (10 minutes)
- 5 minutes
- 15 minutes
- 30 minutes
- 60 minutes
- Disabled ('Read Only' and 'General User' accounts only)

7.2.3 Home

Homepage - Displays information about the drive and user configured parameters.

Module Info - Shows technical information about SM-Ethernet. This information includes the MAC address, SM-Ethernet firmware version, the power-up time, file system availability and other parameters.

Profile - Allows users to change passwords, languages and session timeout lengths.

Custom pages - Only present if custom pages have been defined.

7.2.4 Parameters

Drive Menus - Displays a list of the menus within the host drive.

Editor - Shows the parameter editor interface.

The "operators" and "source" options supported by the "Advanced Editor" can also be used in the "Update Value" box to modify the selected parameter.

Advanced Editor - Allows direct parameter access by means of a command line instruction, in a similar way to the immediate window in SyPTPro.

The syntax of the command instruction is as follows:

> {#[int]mm.pp} {[operator][-][source]}

NOTE For clarity, spaces may be inserted between command arguments as required.

The terminology is described in Table 7.1 *Advanced editor command line syntax* .

Table 7.1 Advanced editor command line syntax

Command	Description	Example	Result
Destination parameter (required)			
#mm.pp	Represents the destination menu and parameter.	**#20.21**	Returns the value of Pr **20.21**.
Integer function (optional)			
int	Forces parameter data type to be treated as an integer.	# **int** 1.21 = 50	Pr **1.21** displays the value "5.0".
Operator (required)			
=	Use source value directly (optional).	#20.21 **=** 123	Writes the value "123" to Pr **20.21.**
++	Increment destination value by 1. *Note: Cannot be used with the "-" function.*	#20.21 **++**	Increments the value of Pr **20.21** value by 1.
--	Decrement destination value by 1. *Note: Cannot be used with the "-" function.*	#20.21 **--**	Decrements the value of Pr **20.21** value by 1.
+=	Increment destination value by source value.	#1.21 **+=** #20.21	Increments the value of Pr **1.21** by the value of Pr **20.21**.
-=	Decrement destination value by source value.	#1.21 **-=** #20.21	Decrements the value of Pr **1.21** by the value of Pr **20.21**.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Table 7.1 Advanced editor command line syntax

Command	Description	Example	Result
^=	Exclusive OR destination value with source value.	#20.20 **^=** #20.21	Exclusively ORs the value of Pr **20.20** with the value of Pr **20.21** and writes the result to Pr **20.20**.
&=	AND destination value with source value.	#20.20 **&=** #20.21	ANDs the value of Pr **20.20** with the value of Pr **20.21** and writes the result to Pr 20.20.
|=	OR destination value with source value.	#20.20 **|=** #20.21	ORs the value of Pr **20.20** with the value of Pr **20.21** and writes the result to Pr **20.20**.
Negate function (optional)			
-	Negates the source value *Note: Cannot be used without the source parameter specified.* *Note: Cannot be used with the "++" or "--" operators.*	#20.20 = **-** #20.21	Writes Pr **20.20** with a value equal, but of opposite polarity, to the value of Pr **20.21**.
Source parameter (required unless "++" or "--" operators used)			
#mm.pp	Represents the source menu and parameter.	#20.20 = **#20.21**	Writes the value of Pr **20.21** into Pr **20.20**
n *or* 0xn	Represents a number to be used for the source value. *Note: Can be specified in decimal or hexadecimal.*	#20.20 = **1500** *or* #20.20 = **0x05DC**	Writes the value "1500" into Pr **20.20**

Parameter File - Allows a CTSoft parameter file to be downloaded from the host drive for setting up parameters.

7.2.5   Protocols

Summary - Displays and allows editing of the protocol thread priority levels.

Modbus TCP/IP - Displays and allows editing of the TCP/IP settings for Modbus TCP/IP.

Email - Allows setting up of event triggered e-mails and configuration of the mail server settings.

Scheduled Events - Configure events to trigger at certain times or on certain event conditions, also configures the time source server.

EtherNet/IP - Displays and allows editing of the EtherNet/IP settings and parameter mappings.

7.2.6 Network

Summary - Allows SM-Ethernet to scan the local subnet for other SM-Ethernet modules.

Modules - The network scan option scans for any module that is within broadcast range. This is not limited by subnets, but by gateways and proxy servers. It can be on the same subnet, or a different subnet, as long as it is not behind a gateway that does not forward broadcast messages. The web pages will only show the first 250 modules found. The modules web page can also be used to configure the IP address settings of other modules on the network, other modules do not have to have valid IP settings to be found. This means that when manually configuring IP addresses, only one module needs to be configured through parameters, the others can all be left with the default settings and configured through the web page of the module that has a valid IP address.

| NOTE | The Ethernet discovery protocol is not compatible across versions. Modules running firmware version V01.00.00 may not locate modules running version V01.01.00 and above and visa-versa.

7.2.7 Configuration

Communications - Displays and allows changes to the Ethernet and TCP/IP settings. The Ethernet settings which can be changed here are baud rate, duplex mode and crossover compensation. (The only possible change in the TCP/IP section is the option to enable or disable the DHCP server).

Application - Allows the displayed information on the Homepage to be viewed or changed. This includes the drive name, network name, drive function and contact details.

User Menu - Allows configuration of the user menu (*as shown on the home page under Parameter Summary*) to be changed.

Update - Allows system files, language files and backup files to be uploaded to the SM-Ethernet module.

Backup - Allows data from the module to be downloaded for backup and security reasons. This file can include the application configuration, module parameter values and module security settings. This file can be uploaded to any SM-Ethernet module (*Decrypt module security settings* not selected) or only to the SM-Ethernet module that was used to create the backup file (*Decrypt module security settings* selected) using the **Update** menu option.

Security - Provides user accounts and password management facilities along with a facility to configure the connection filters.

Reset - Allows the module to be reset.

7.2.8 Help

These pages provide a basic level of help on the features of the SM-Ethernet module.

7.2.9 Log-Out

This option logs the current user out of the web pages.

Safety
information

Introduction

Mechanical
installation

Electrical
installation

Getting
started

Protocols

Web page
basics

**FTP/custom
pages**

Applications

Security

Diagnostics

Advanced
features

Quick
reference

Glossary of
terms

Index

8 FTP/custom pages

8.1 Introduction

SM-Ethernet gives you the facility to generate customised web pages (*similar to HMI screens*) that can be viewed using a web browser. Figure 8-1 shows one of the supplied custom web pages that can be used as a starting point for your own pages.

Figure 8-1 Custom web page
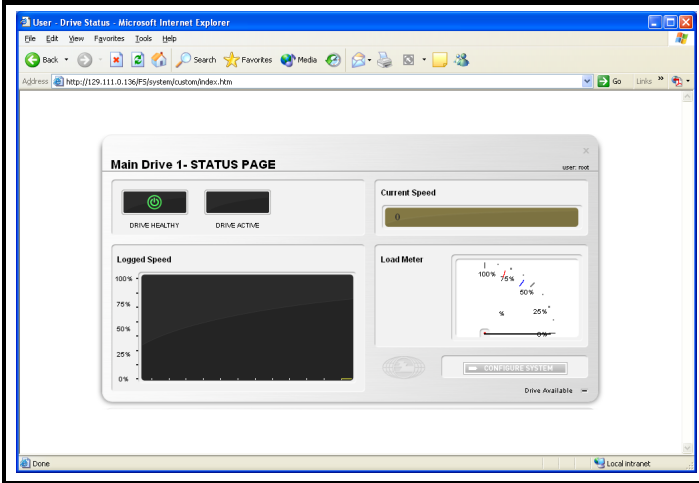
| NOTE | To avoid potential problems *Control Techniques* recommend that custom web page design is performed only by suitably experienced personnel. Support on this subject will be limited to interfacing to the drive only. General web design techniques will not be supported. |

8.2 Managing files

In order to upload to SM-Ethernet and download from SM-Ethernet custom web pages on the drive you must connect to the drive using an FTP program. Most popular FTP programs should be suitable for this purpose.

8.3 Connections using FTP

These instructions are generic and should be suitable for most FTP programs.

- Open the FTP program.
- Set the host to the IP address of the drive you wish to communicate with.
- Set the port to 21.
- Bypass any proxy server.
- Set server type to ftp.
- Enter the *user name* and *password* for an Administrative account. See section 10.4 *Account management* on page 86.
- Select active mode.
- Set the default remote directory to */system/*.
- Connect to SM-Ethernet.

8.4 Custom files

After connecting to SM-Ethernet you should see a listing of the file structure.
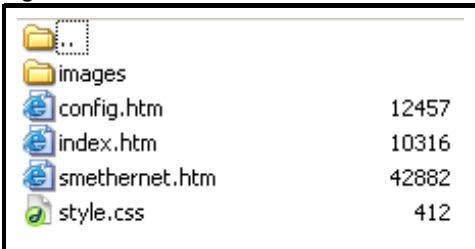
Figure 8-2 Directory structure

Figure 8-2 shows an example of the directory structure on SM-Ethernet, the files required to generate custom pages are contained within the *custom* directory.

Figure 8-3 Custom files

Figure 8-3 shows the files for the custom pages that are installed by default on SM-Ethernet, however index.htm is the only required file, and if this exists the custom pages will appear in the sub-menu when logged in. The files are defined as follows.

- **smethernet.htm** - contains the Javascript for connecting to the drive parameters and should not be changed.
- **index.htm** - contains examples of how to use the Javascript to display pages on a web page for monitoring of values.
- **config.htm** - contains examples of how to use Javascript to write to parameters in the drive.
- **style.css** - contains the cascading style sheet definitions for the web pages.
- **images** - contains the images for the custom pages, these may be added to if required.

NOTE If these files are not present then please contact your supplier or local drive centre as the custom pages will need to be uploaded into the SM-Ethernet module using the FTP connection.

8.5   Generating your own pages

Before starting to modify the pages on SM-Ethernet it is recommended that the current files are backed up onto your PC. This will enable you to restore the files to a known working state. The procedure for modifying the pages is as follows:

- Copy the directory structure to your local hard disk.
- Edit the *index.htm* and *config.htm* to your requirements.
- Add any additional web pages following the structure of *index.htm* and *config.htm*.
- Insert any additional images in the *images* directory.
- Upload the files to the drive and test them.

NOTE   To test the web pages on the module you will need to log-in to the web pages then select *custom pages* from the *home page* option. You can access the pages directly as *http://WWW.XXX.YYY.ZZZ/FS/system/custom/index.htm* (*where WWW.XXX.YYY.ZZZ is the target SM-Ethernet module's IP address*). You must still be logged in to view these pages (some user accounts can be configured to be permanently logged in see section 10.6 *Security levels* on page 87).

8.6   Understanding custom pages

The custom pages are controlled exclusively by the Javascript contained in the library file *smethernet.htm*, this contains the code required to communicate with parameters in the SM-Ethernet and the host drive. The *index.htm* and *config.htm* contain a link to *smethernet.htm* as a reference for the Javascripts required for displaying state, updating values and for producing some of the on-screen objects such as sliders and switches.

From within *index.htm* and *config.htm* there are entries that use the features of *smethernet.htm* for displaying and updating values. These are contained within *<script>* and *</script>* tags as shown below:

```
<script>
new Light("light1", "10.1", {imageOn:"images/healthy_on.gif",
imageOff:"images/illum_off.gif"});
</script>
```

This process is transparent to the end user and the only browser support required is Javascript.

The final stage of the process is the method that SM-Ethernet uses to communicate to the drive. The Javascript in *smethernet.htm* requests a URL from the drive in the format:

```
http://129.111.0.136/US/20.21=5/dynamic/writeparval.xml
```

This is decoded as write the value 5 to Pr **20.21** and return the result of this request in an XML web page on SM-Ethernet with address 129.111.0.136.

SM-Ethernet then decodes the information in the address and returns an XML stream containing the results of the operation, as detailed below, indicating the success of the operation.

```
<status value="0" text="OK" />
```

Reading of parameters is performed in a similar way but uses the URL as follows:

```
http://129.111.0.136/US/1.21/dynamic/readparval.xml
```

This is decoded as a single read of Pr **1.21** from the SM-Ethernet module with the address 129.111.0.136. For multiple parameters each parameter is separated by the underscore character as follows:

```
http://129.111.0.136/US/1.21_1.24/dynamic/readparval.xml
```

The response to the URL request above would be:

```
<parameters>
<parameter name="1.21" value="55" dp="1" text="5.5Hz" />
<parameter name="1.24" value="0" dp="1" text="0.0Hz" />
</parameters>
```
showing the values read from each parameter along with the number of decimal places for the parameter.

NOTE   To read or write the parameters you must be logged in with appropriate security access.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

9 Applications

SM-Ethernet provides an alternative to the EIA-485 (RS-485) connections provided on the front of the drive. By using SM-Ethernet it is possible to communicate to the drive using the following range of *Control Techniques* products.

- CTSoft.
- CTScope
- SyPTPro.
- SyPTLite.
- OPC server.

This means that any applications that are familiar to the engineer can now be used over Ethernet as if the user were connected locally.

⚠ **CAUTION**	Some parameters 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 over Ethernet.

9.1 Minimum software versions required for Ethernet

Table 9.1 below, lists the products used in this chapter and their minimum versions of software required for Ethernet communication.

Table 9.1 Required software versions for communication over Ethernet

Product	Software Version
Unidrive SP	Version 01.06.00 or later
Commander SK	Version 01.06.00 or later
Digitax ST	Version 01.00.00 or later
Affinity	Version 01.00.00 or later
Mentor MP	Version 01.00.00 or later
SM-Applications	Version 01.04.05 or later
SM-Ethernet	Version 01.02.00 or later
OPC Server	Version 03.01.00 or later
CTScope	Version 01.00.00 or later
SyPTPro	Version 02.01.00 or later
CTSoft	Version 01.05.00 or later

9.2 CTSoft

9.2.1 Installing CTSoft

To install CTSoft follow the instructions provided with the software. To use CTSoft with Ethernet will require a version of CTSoft that has support for Ethernet and the associated API or communication server. Please contact the supplier of the drive for more information.

9.2.2 Basic configuration of CTSoft

After installing CTSoft double click on the program icon. The window shown in Figure 9-1 on page 78 will be displayed. Ensure the drive is connected to the Ethernet network and the PC is on the same subnet (or the drive and PC have suitable gateway addresses configured).

Figure 9-1 CTSoft start-up
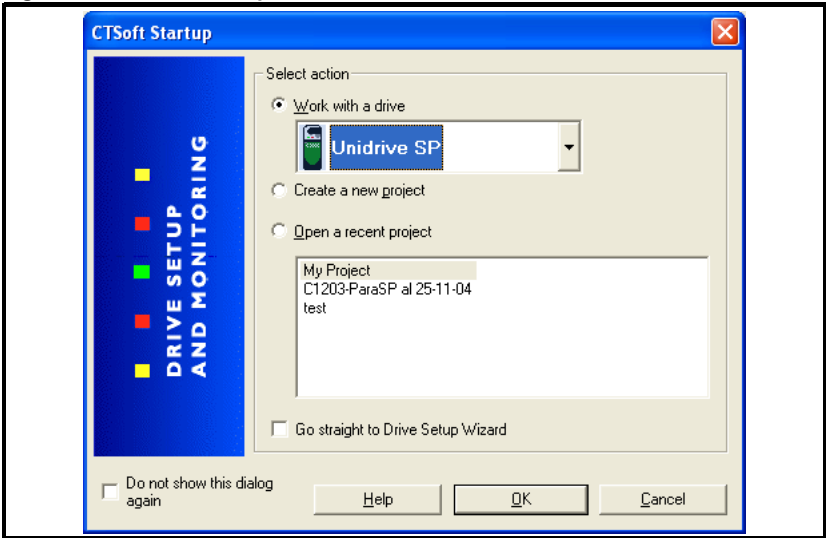
Select the "Work with a drive" option and select the correct drive type followed by clicking on the "OK" button.

From the navigation panel (Explorer) double click on the drive properties from the list as shown in Figure 9-2 *Drive properties* on page 78.

Figure 9-2 Drive properties

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index
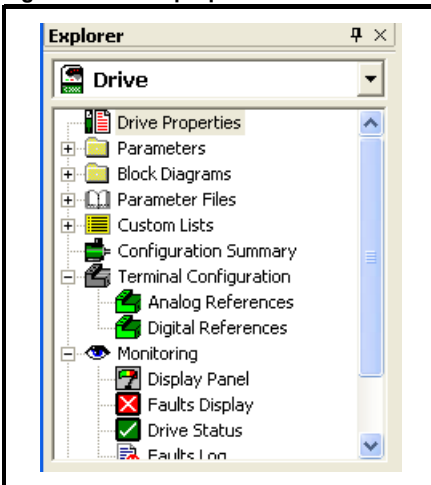
Figure 9-3   Drive properties settings
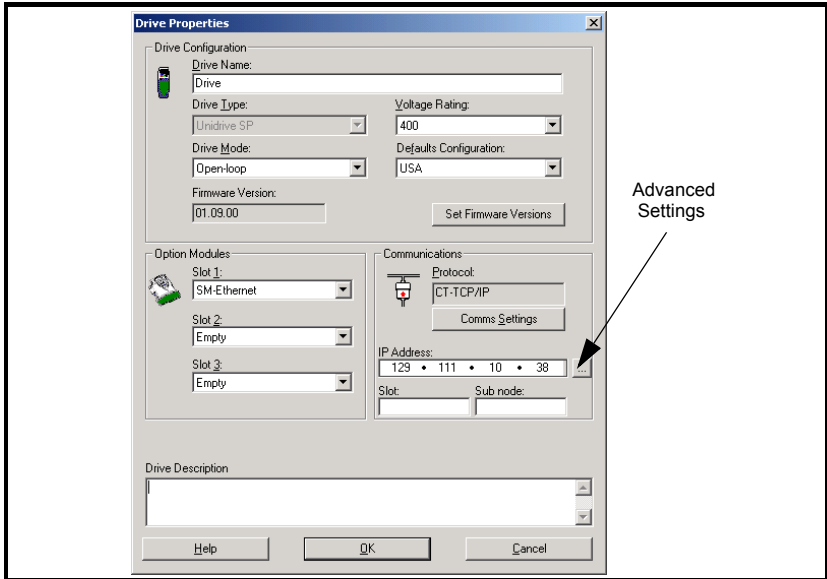
From the drive properties menu shown in Figure 9-3 click on the "Comms Settings" button and select "CT-TCP/IP" from the protocol drop down box, then click on "advanced" and change the "TCP/IP Extra Timeout" to 2000. Click "OK" and "OK" again to return to the screen shown in Figure 9-3.

Figure 9-3 shows the settings required to specify the IP address of the SM-Ethernet module that the software will directly connect to. The IP address is always required.

To connect to a single drive via Ethernet all that is required is the IP address. The Slot and Sub node fields should be left blank.

To communicate through the host drive via the SM-Ethernet module to a second drive on a CTNet network, the "Slot" and "Sub node" values must be entered.

The "Slot" is the slot number of the host drive which contains the SM-Applications module used to route the CTNet messages onto the CTNet network. The "Sub node" is the CTNet node address of the drive to be communicated with.

For example, if the host drive has a SM-Ethernet installed in Slot 3 and a SM-Applications installed in Slot 2, to communicate to a drive with a CTNet node address of 5, a "slot" number of 2 and a "Sub node" of 5 should be entered.

9.2.3   Advanced settings

These are accessed using the button (as shown in Figure 9-3). The Port number will affect all communications and should not usually be changed, any changes to this Port must be matched on the SM-Ethernet module. The Unit ID should normally be blank, if not this informs the software that a third party gateway is in use and communications via SM-Ethernet will not be possible (for a gateway example see Knowledge Base Article COMMS024).

SM-Ethernet User Guide   **79**
Issue: 6   www.controltechniques.com

Figure 9-4 Advanced TCP settings
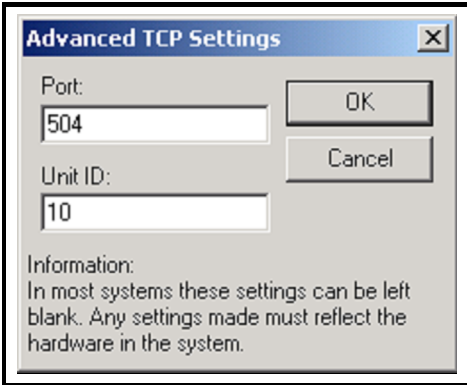
Finally click "OK" to finish the configuration process. Follow the instructions provided with CTSoft to use the product.

The only configuration possible using CTSoft over SM-Ethernet is a single SM-Ethernet module on a solitary network drive at the same time.

NOTE Support for the SM-Ethernet was included in CTSoft Version 01.05.00 and above. Support for using SM-Ethernet as a gateway to CTNet was included in CTSoft Version 01.06.01 and above.

NOTE For communication to be established, the serial priority parameter Pr **MM.37** must be set to ON in SM-Ethernet.

9.3 CTScope

9.3.1 Installing CTScope

To install CTScope, follow the instructions provided with the software.

9.3.2 CTScope configuration

All the appropriate configuration settings are displayed on the main screen for communication over TCP/IP with CTScope.

NOTE For communication to be established, the serial priority parameter Pr **MM.37** must be set to ON in SM-Ethernet.

9.4 SyPTPro

9.4.1 Installing SyPTPro

To install SyPTPro follow the instructions provided with the software. To use SyPTPro with Ethernet will require a version of SyPTPro that has support for Ethernet. Table 9.1 below lists the minimum software version required for communication over Ethernet for the *Control Techniques* products used in this section.

9.4.2   SyPTPro configuration

There are a number of possible configurations for using SyPTPro over Ethernet.

1. A single SM-Ethernet module on a solitary network drive.
2. A first drive hosting a single SM-Ethernet module with a single SM-Applications networked to a second CTNet enabled drive or Beckhoff bus coupler.
3. A first drive hosting two SM-Ethernet modules networked to a second CTNet drive hosting a single SM-Ethernet module.

Figure 9-5 illustrates these three configurations.

Figure 9-5   SyPTPro over Ethernet routing options
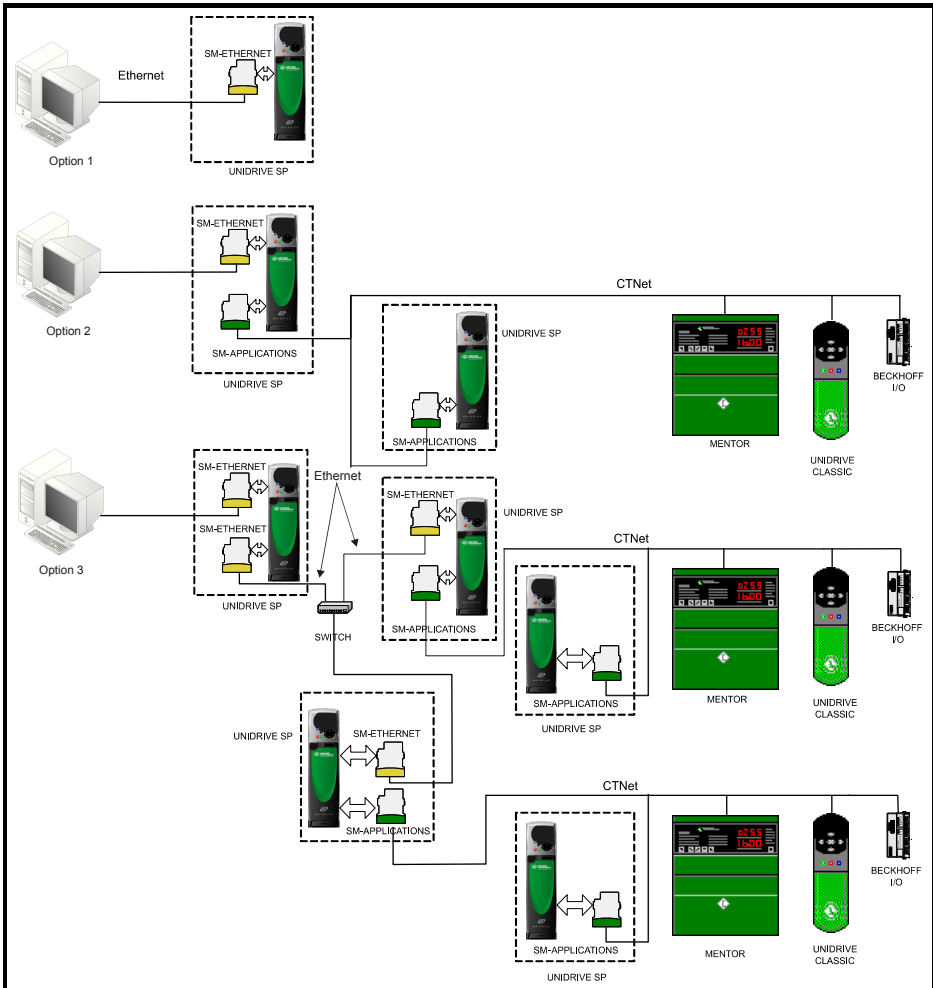
For each configuration the following steps must be taken:

1. After installing SyPTPro double click on the program icon. The window shown in Figure 9-6, below, will be displayed. If the current protocol is not set to "CT-TCP/IP

SM-Ethernet User Guide
81
Issue: 6   www.controltechniques.com

(Ethernet)", then click the "Change" button and a window similar to Figure 9-7, below, will be displayed, select the "CT-TCP/IP" protocol and click "OK".

2. Select the "Go online and detect drives" option and click "OK", the communication settings window will be displayed as shown in Figure 9-8 on page 83.

3. From the communication settings window, select the "Automatically scan local network" option. (SyPTPro can be instructed to search for all nodes on the local network, specific nodes grouped together on a particular network or additional networks (Ethernet or CTNet) via specified IP address(es), these addresses are added by selecting the "Connect to/through specific nodes" option and clicking on the "Add" button. Each IP address and port number (if necessary) may now be added, click on "OK" to accept the changes and return to the PC communication settings window).

4. When all network options are configured as required, click on "OK" and SyPTPro will browse the network to find all drives resident on it (depending on the configured network settings).
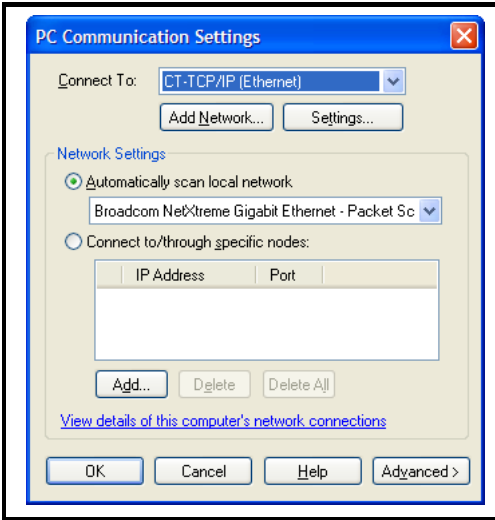
Figure 9-6 SyPTPro startup
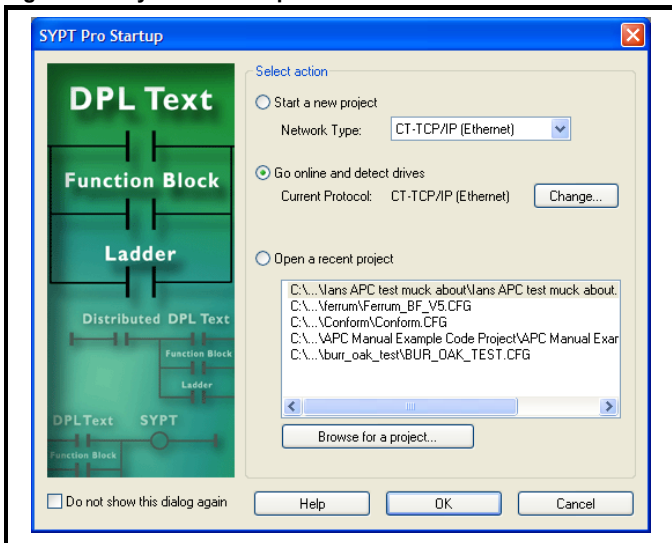

Figure 9-7 Drive communication settings
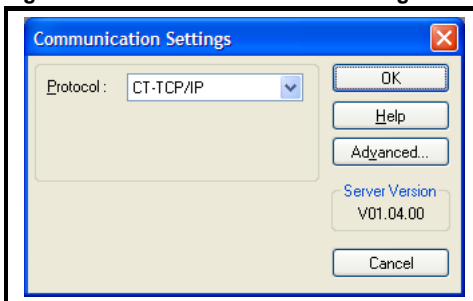
NOTE For communication to be established, the serial priority parameter Pr **MM.37** must be set to ON in SM-Ethernet.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Figure 9-8 PC Communication settings

5.   A graphical representation of the network is displayed. Figure 9-9, below, shows the third configuration type. A first drive hosting two SM-Ethernet modules networked to a second CTNet drive hosting a single SM-Ethernet module.

Figure 9-9 Hardware architecture
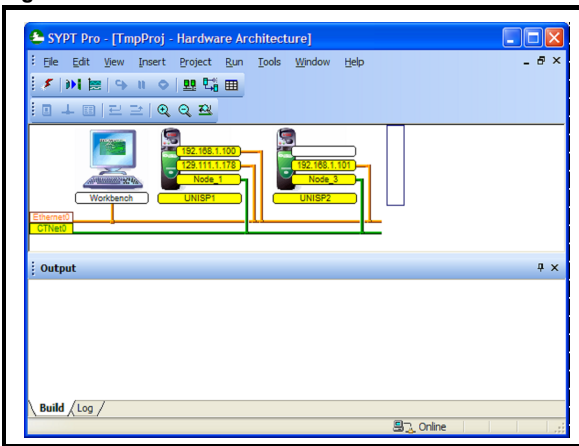
| NOTE | For a system with multiple networks Pr **MM.38** can be used to define the group in which the module is found, this is reflected in SyPTPro by the network number, for example if a module is set to group 2 it will appear on network Ethernet2 in SyPTPro. Pr **MM.38** must match the network number that the module is connected to in SyPTPro otherwise the node may not be detected. |

9.5 SyPTLite

SYPTLite is currently only supported if launched from SyPTPro.

9.6 OPC server

The *Control Techniques* OPC server can be used to provide communication between an OPC client (which supports the OPC data access specification) and any suitable *Control Techniques* drive. The OPC client configures the OPC server on which drive parameters to read and the cyclic rate at which they will be read. The OPC server will notify the client if any of the configured parameter values change, the OPC client then requests the updated value from the OPC server.

The *Control Techniques* OPC server version 03.01.00 and above support the TCP/IP protocol used over Ethernet.

NOTE For further information please contact the supplier of the drive.

Safety
information

Introduction

Mechanical
installation

Electrical
installation

Getting
started

Protocols

Web page
basics

FTP/custom
pages

Applications

Security

Diagnostics

Advanced
features

Quick
reference

Glossary of
terms

Index

10   Security

10.1   Introduction

On open networked systems it is important that security is considered. Security covers aspects such as access to devices using passwords, network infrastructure, company procedures and backup procedures.

The physical system security should be enforced with acceptable user policies and appropriate employee guidelines.

10.2   General site security issues

10.2.1   Connecting your computer

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

10.2.2   Virus considerations

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

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

10.2.3   Firewall issues

When a high level of security is required between the automation network and the business network a firewall should be used. This helps prevent unwanted traffic passing between the networks and can be used to restrict access to certain machines or users.

NOTE   Some managed switches provide control methods for network traffic, however a firewall offers significantly more features. Configuration of a switch or firewall is beyond the scope of this document.

10.3   Default restrictions

By default, access to the drive over Ethernet is set to read/write access. By default, all services are available. This can be changed using Pr **MM.36** (please see section 12.4.7 *SM-Ethernet disable full access* on page 106 for more information).

10.3.1   Disable Full Access

The global write enable Pr **MM.36** is set to 0 by default. This will allow parameters to be changed within the drive. To prevent changes to drive parameters over Ethernet, Pr **MM.36** should be set to a 1. This will prevent changes via Modbus IP, EtherNet/IP and the web pages.

10.4   Account management

A user account system is provided to allow an administrator to give access rights to different classes of user. The system provides accounts for administrator and user account types. The default username **root** and password **ut72** should be used to gain initial access to the module. Once logged on, additional accounts should be added as required, with key members of the engineering staff having supervisor access. It is recommended that a policy is put into place to ensure that passwords are recorded elsewhere.

There is a limit on the number of active user accounts allowed, this limit is fixed at 10 and includes logged-in users and any communication accounts in use (e.g. FTP, EtherNet/IP, etc.).

The maximum number of active logged-in user accounts is 5.

NOTE   A good company policy on passwords can help prevent problems occurring due to lost passwords.

10.5   Adding new accounts

In order to add a new account you will need to follow the instructions below:

1. Log on to the web pages using the *root* or an *administrator* account.

2. Choose the top level **CONFIGURATION** menu then the **Security** menu.

3. Select "Add/Modify/Remove user accounts".

4. Click on "New".

5. Enter the details as requested in the menu.

6. Click "Apply" to finish.

NOTE   Following changes to the *root* account password SM-Ethernet should be reset using the reset function on the web pages.

10.5.1 Administrator accounts

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

10.5.2 Other user accounts

Other user accounts should be used for engineers that need to make changes to the system occasionally, different account types are available depending on the facilities and features required. For more information see section 10.6 *Security levels* on page 87.

10.6 Security levels

Security levels are provided to allow different types of users to be given different access rights to the drive and module parameters. Table 10.1 shows the access rights for specific user types.

Table 10.1 Security levels

	View Home Page	View Help Pages	View Parameters	View Status Pages	View Config Overviews	Edit Parameters	Edit Configuration	View Security Setttings	Edit Security Settings	Enable Features	Upload Firmware	Disable session timeout
Open Access	Yes	No	No	No	No	No	No	No	No	No	No	N/A
Read Only	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	Yes
General User	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes
Super User	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Administrator	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

10.6.1 Limiting access

SM-Ethernet will prevent a single user logging in more than once. A maximum of 5 simultaneous web based connections are possible. It is always possible for an administrator to log in.

10.6.2 Protocol authentication

Certain protocols and services will require a user to authenticate using a password and a username. This protection is detailed in the relevant protocol section of the user guide.

10.6.3 Connection filtering

It is possible to configure SM-Ethernet to only accept connections from trusted IP, network or MAC addresses. This is a very secure method of preventing unauthorized access to the drive.

A list of trusted hosts is stored in the module and only addresses on this list are able to communicate with SM-Ethernet.

NOTE   Be careful when enabling connection filtering as it is possible to lose the ability to communicate with SM-Ethernet. If this situation occurs it is possible to disable connection filtering by setting Pr **MM.39** to 0.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

11   Diagnostics

This section of the manual provides basic diagnostic information intended to enable resolution of the most common problems encountered when setting up an SM-Ethernet module on an Ethernet network.

A high percentage of problems reported are basic setup problems that can be avoided by using the following pages. Start by using the *Diagnostic flow chart* on page 89 to determine the possible cause of a problem. If after following the flow chart you are still experiencing problems please contact your supplier or local drive supplier for support.

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

11.1   LED diagnostics

The SM-Ethernet module is equipped with 4 LEDs on the front panel to aid in the diagnostics procedure. The functions of these LEDs are described in Table 11.1 *LED functionality* below.
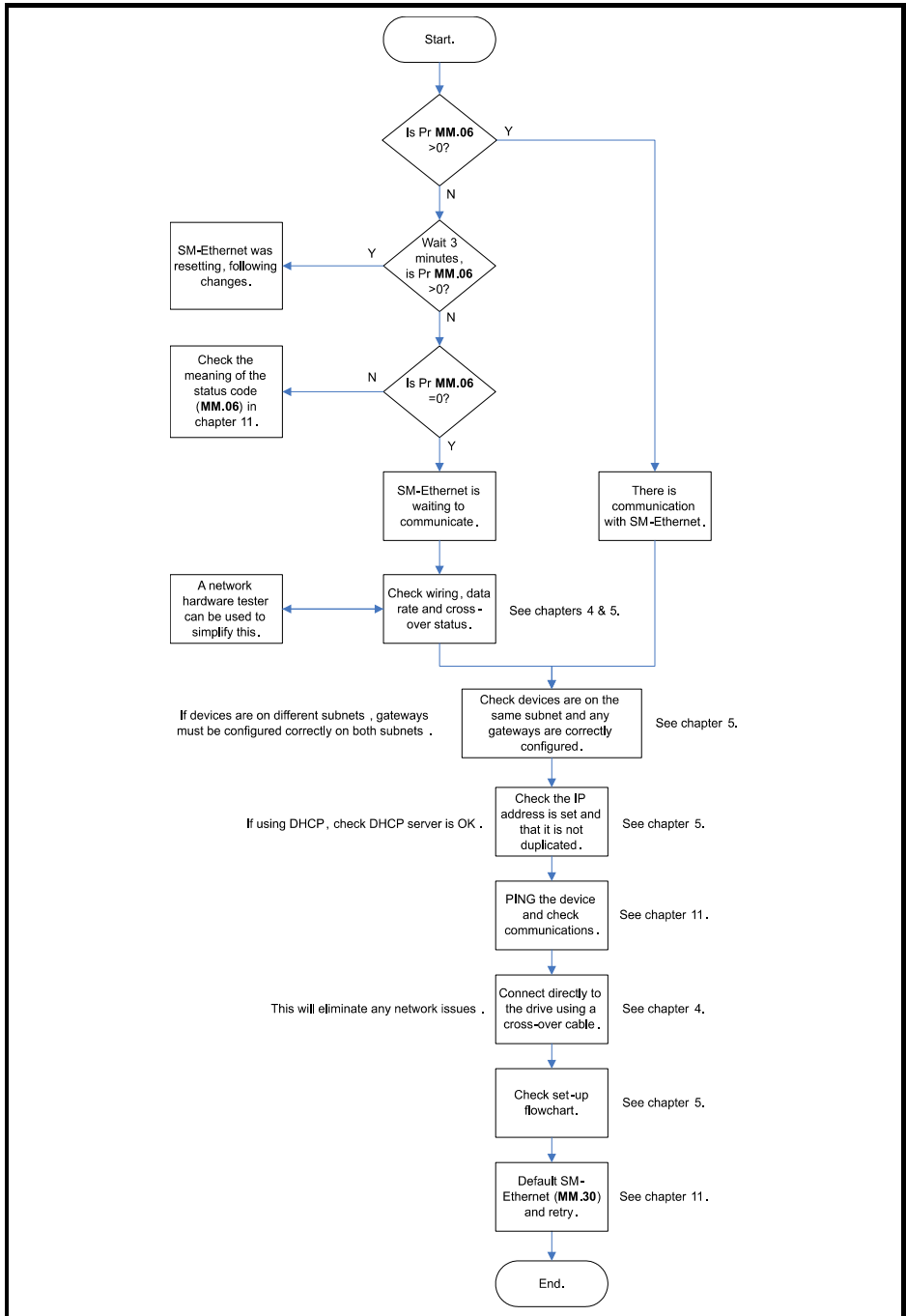
Table 11.1 LED functionality

LED Name	LED State	Description
Link / Activity	Off	Ethernet connection not detected.
	Steady green	Ethernet connection detected.
	Flashing green	Ethernet communication detected.
Speed	Off	10Mb/s data rate.
	On	100Mb/s data rate.
Module status	Flashing green (slow)	Running RAM bootloader image.
	Flashing green (fast)	Initialising main image.
	Steady green	Running.
	Flashing green and red	Warning (slot or configuration error).
	Steady red	Major fault.
Flash access	Steady green	Reading from flash memory.
	Steady red	Writing to flash memory.

Figure 11-1 SM-Ethernet connections and LED indicator layout

11.2   Diagnostic flow chart

Start.

Is Pr **MM.06** >0?

Y — There is communication with SM-Ethernet.

N

Wait 3 minutes, is Pr **MM.06** >0?

Y — SM-Ethernet was resetting, following changes.

N

Is Pr **MM.06** =0?

N — Check the meaning of the status code (**MM.06**) in chapter 11.

Y

SM-Ethernet is waiting to communicate.

Check wiring, data rate and cross-over status. — See chapters 4 & 5.

A network hardware tester can be used to simplify this.

Check devices are on the same subnet and any gateways are correctly configured. — See chapter 5.

If devices are on different subnets, gateways must be configured correctly on both subnets.

Check the IP address is set and that it is not duplicated. — See chapter 5.

If using DHCP, check DHCP server is OK.

PING the device and check communications. — See chapter 11.

Connect directly to the drive using a cross-over cable. — See chapter 4.

This will eliminate any network issues.

Check set-up flowchart. — See chapter 5.

Default SM-Ethernet (**MM.30**) and retry. — See chapter 11.

End.

Safety information
Introduction
Mechanical installation
Electrical installation
Getting started
Protocols
Web page basics
FTP/custom pages
Applications
Security
Diagnostics
Advanced features
Quick reference
Glossary of terms
Index

11.3 Module identification parameters

The basic SM-Ethernet configuration parameters can be accessed through the slot menu in the drive, Pr **MM.xx** where **MM** is the menu for SM-Ethernet in the host drive.

11.3.1 SM-Ethernet module ID code

SM-Ethernet - module ID code		
Pr **MM.01**	Default	410 (SM-Ethernet)
	Range	-
	Access	RO

The module ID code indicates the type of module installed into the slot corresponding to menu **MM**. This is useful for checking the module installed is of the correct type, especially when used with DPL code. The ID code for SM-Ethernet is 410.

11.3.2 SM-Ethernet firmware version

SM-Ethernet firmware - major version (xx.yy)		
Pr **MM.02**	Default	N/A
	Range	00.00 to 99.99
	Access	RO

SM-Ethernet firmware - minor version (zz)		
Pr **MM.51**	Default	N/A
	Range	0 to 99
	Access	RO

Unidrive SP (Sizes 1 to 6) / Unidrive SPM / Mentor MP
The software version of the Solutions Modules can be identified by looking at Pr **15.02** or Pr **16.02** or Pr **17.02** and Pr **15.51** or Pr **16.51** or Pr **17.51**.

Menu 15,16 or 17 is Solutions Module slot dependent with menu 17 being the lowest position nearest the control terminal connections.

The software version takes the form of xx.yy.zz, where Pr **15.02** or Pr **16.02** or Pr **17.02** displays xx.yy and Pr **15.51** or Pr **16.51** or Pr **17.51** displays zz (e.g. for software version 01.01.00 on a module in the middle Solutions Module slot, Pr **16.02** will display 1.01 and Pr **16.51** will display 0).

Unidrive SP (Size 0) / Digitax ST / Unidrive ES / Affinity
The software version of the Solutions Modules can be identified by looking at Pr **15.02** or Pr **16.02** and Pr **15.51** or Pr **16.51**.

Menu 15 or 16 is Solutions Module slot dependent with menu 15 (Unidrive SP size 0 and Digitax ST) or menu 16 (Unidrive ES and Affinity) being the position nearest the control terminal connections.

The software version takes the form of xx.yy.zz, where Pr **15.02** or Pr **16.02** displays xx.yy and Pr **15.51** or Pr **16.51** displays zz (e.g. for software version 01.01.00 on a module in the middle Solutions Module slot (Unidrive ES and Affinity) or for Unidrive SP size 0 and Digitax ST, the Solutions Module slot nearest the incoming supply terminals), Pr **16.02** will display 1.01 and Pr **16.51** will display 0).

Commander SK (Sizes B to D and 2 to 6)
The software version of the Solutions Module can be identified by looking at Pr **15.02** and Pr **15.51**. The software version takes the form of xx.yy.zz, where Pr **15.02** displays xx.yy and Pr **15.51** displays zz (e.g. for software version 01.01.00 Pr **15.02** will display 1.01 and Pr **15.51** will display 0).

11.3.3 SM-Ethernet user allocated address

SM-Ethernet - user allocated address		
Pr **MM.03**	**Default**	0
	Range	0 to 65535
	Access	RW

This is used as a way to identify the node on the network independently of the IP address. This is not the IP address. This allows SM-Ethernet to be identified without knowing the IP address and is used in conjunction with Pr **MM.38** (see section 12.4.9 *SM-Ethernet user allocated group* on page 107).

11.4 Network configuration parameters

11.4.1 SM-Ethernet data rate

SM-Ethernet - data rate		
Pr **MM.04**	**Default**	0
	Range	0 to 2
	Access	RW

The SM-Ethernet will automatically detect the network data rate when set to 0. When using auto-detect, information about the negotiated setting will be stored in Pr **MM.44**.

Table 11.2 SM-Ethernet baud rates

Pr **MM.04**	bit/s
0	Auto-detect
1	10Mbs
2	100Mbs

11.4.2 SM-Ethernet DHCP enable

SM-Ethernet - DHCP enable		
Pr **MM.05**	**Default**	0 (disabled)
	Ranges	0 to 1
	Access	RW

If set to a 0 the module will use static IP addressing and get it's address, subnet mask and default gateway from parameters Pr **MM.10** to Pr **MM.13**, Pr **MM.14** to Pr **MM.17** and Pr **MM.18** to Pr **MM.21** respectively. When set to 1 the module will obtain this information from a DHCP server on the network.

NOTE It is recommended that the MAC address of the SM-Ethernet module is used to allocate the IP address when DHCP is enabled.

11.4.3 SM-Ethernet IP address W_{ip}

SM-Ethernet - IP address W_{ip}		
Pr **MM.10**	**Default**	192
	Range	0-255
	Access	RW

This is the most significant octet of the module's IP address. When using DHCP this will be updated from the DHCP server. The IP address is in the format W.X.Y.Z.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

If DHCP is disabled, (**MM.05**=0), then this parameter should be saved (**xx.00**=1000 or **xx.00**=1001 if using a DC supply to power the drive) and activated by resetting the SM-Ethernet module (**MM.32**=ON).

11.4.4 SM-Ethernet IP address X_{ip}

SM-Ethernet - IP address X_{ip}		
	Default	168
Pr **MM.11**	**Range**	0-255
	Access	RW

This is the second most significant octet of the module's IP address. When using DHCP this will be updated from the DHCP server. The IP address is in the format W.X.Y.Z.

If DHCP is disabled, (**MM.05**=0), then this parameter should be saved (**xx.00**=1000 or **xx.00**=1001 if using a DC supply to power the drive) and activated by resetting the SM-Ethernet module (**MM.32**=ON).

11.4.5 SM-Ethernet IP address Y_{ip}

SM-Ethernet - IP address Y_{ip}		
	Default	1
Pr **MM.12**	**Range**	0-255
	Access	RW

This is the third most significant octet of the module's IP address. When using DHCP this will be updated from the DHCP server. The IP address is in the format W.X.Y.Z.

If DHCP is disabled, (**MM.05**=0), then this parameter should be saved (**xx.00**=1000 or **xx.00**=1001 if using a DC supply to power the drive) and activated by resetting the SM-Ethernet module (**MM.32**=ON).

11.4.6 SM-Ethernet IP address Z_{ip}

SM-Ethernet - IP address Z_{ip}		
	Default	100
Pr **MM.13**	**Range**	0-255
	Access	RW

This is the least significant octet of the module's IP address. When using DHCP this will be updated from the DHCP server. The IP address is in the format W.X.Y.Z.

If DHCP is disabled, (**MM.05**=0), then this parameter should be saved (**xx.00**=1000 or **xx.00**=1001 if using a DC supply to power the drive) and activated by resetting the SM-Ethernet module (**MM.32**=ON).

11.4.7 SM-Ethernet IP subnet mask W_{subnet}

SM-Ethernet - IP subnet mask W_{subnet}		
	Default	255
Pr **MM.14**	**Range**	0-255
	Access	RW

This is the most significant octet of the module's IP subnet mask. When using DHCP this will be updated from the DHCP server. The IP subnet mask is in the format W.X.Y.Z.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

If DHCP is disabled, (**MM.05**=0), then this parameter should be saved (**xx.00**=1000 or **xx.00**=1001 if using a DC supply to power the drive) and activated by resetting the SM-Ethernet module (**MM.32**=ON).

11.4.8 SM-Ethernet IP subnet mask X$_{subnet}$

SM-Ethernet - IP address X$_{subnet}$		
Pr **MM.15**	**Default**	255
	Range	0-255
	Access	RW

This is the second most significant octet of the module's IP subnet mask. When using DHCP this will be updated from the DHCP server. The IP subnet mask is in the format W.X.Y.Z.

If DHCP is disabled, (**MM.05**=0), then this parameter should be saved (**xx.00**=1000 or **xx.00**=1001 if using a DC supply to power the drive) and activated by resetting the SM-Ethernet module (**MM.32**=ON).

11.4.9 SM-Ethernet IP subnet mask Y$_{subnet}$

SM-Ethernet IP subnet mask Y$_{subnet}$		
Pr **MM.16**	**Default**	255
	Range	0-255
	Access	RW

This is the third most significant octet of the module's IP subnet mask. When using DHCP this will be updated from the DHCP server. The IP subnet mask is in the format W.X.Y.Z.

If DHCP is disabled, (**MM.05**=0), then this parameter should be saved (**xx.00**=1000 or **xx.00**=1001 if using a DC supply to power the drive) and activated by resetting the SM-Ethernet module (**MM.32**=ON).

11.4.10 SM-Ethernet IP subnet mask Z$_{subnet}$

SM-Ethernet - IP subnet mask Z$_{subnet}$		
Pr **MM.17**	**Default**	0
	Range	0-255
	Access	RW

This is the least significant octet of the module's IP subnet mask. When using DHCP this will be updated from the DHCP server. The IP subnet mask is in the format W.X.Y.Z.

If DHCP is disabled, (**MM.05**=0), then this parameter should be saved (**xx.00**=1000 or **xx.00**=1001 if using a DC supply to power the drive) and activated by resetting the SM-Ethernet module (**MM.32**=ON).

11.4.11 SM-Ethernet IP default gateway W$_{gateway}$

SM-Ethernet IP - default gateway W$_{gateway}$		
Pr **MM.18**	**Default**	192
	Range	0-255
	Access	RW

This is the most significant octet of the module's IP default gateway address. When using DHCP this will be updated from the DHCP server. The default gateway address is in the format W.X.Y.Z.

If DHCP is disabled, (**MM.05**=0), then this parameter should be saved (**xx.00**=1000 or **xx.00**=1001 if using a DC supply to power the drive) and activated by resetting the SM-Ethernet module (**MM.32**=ON).

11.4.12 SM-Ethernet IP default gateway X$_{gateway}$

SM-Ethernet IP - default gateway X$_{gateway}$		
	Default	168
Pr **MM.19**	**Range**	0-255
	Access	RW

This is the second most significant octet of the module's IP default gateway address. When using DHCP this will be updated from the DHCP server. The default gateway address is in the format W.X.Y.Z.

If DHCP is disabled, (**MM.05**=0), then this parameter should be saved (**xx.00**=1000 or **xx.00**=1001 if using a DC supply to power the drive) and activated by resetting the SM-Ethernet module (**MM.32**=ON).

11.4.13 SM-Ethernet IP default gateway Y$_{gateway}$

SM-Ethernet IP - default gateway Y$_{gateway}$		
	Default	1
Pr **MM.20**	**Range**	0-255
	Access	RW

This is the third most significant octet of the module's IP default gateway address. When using DHCP this will be updated from the DHCP server. The IP subnet mask is in the format W.X.Y.Z.

If DHCP is disabled, (**MM.05**=0), then this parameter should be saved (**xx.00**=1000 or **xx.00**=1001 if using a DC supply to power the drive) and activated by resetting the SM-Ethernet module (**MM.32**=ON).

11.4.14 SM-Ethernet IP default gateway Z$_{gateway}$

SM-Ethernet IP - default gateway Z$_{gateway}$		
	Default	254
Pr **MM.21**	**Range**	0-255
	Access	RW

This is the least significant octet of the module's IP default gateway address. When using DHCP this will be updated from the DHCP server. The default gateway address is in the format W,X,Y,Z.

If DHCP is disabled, (**MM.05**=0), then this parameter should be saved (**xx.00**=1000 or **xx.00**=1001 if using a DC supply to power the drive) and activated by resetting the SM-Ethernet module (**MM.32**=ON).

11.4.15 SM-Ethernet Duplex mode

SM-Ethernet Duplex mode		
	Default	0 (auto-detect)
Pr **MM.42**	**Range**	0 to 2
	Access	RW

This parameter determines how the duplex mode is set on SM-Ethernet. When set to 0 the module will auto-negotiate the duplex mode.

Table 11.3 Duplex mode

Pr MM.42	bit/s
0	Auto-detect.
1	full duplex.
2	half duplex.

If this parameter value is changed, then a module save should be performed
(**xx.00**=1000 or **xx.00**=1001 if using a DC supply to power the drive) followed by
resetting the SM-Ethernet module (**MM.32=**ON) to activate the change.

11.4.16 SM-Ethernet enable auto-crossover detection

SM-Ethernet - Enable crossover detection		
	Default	0 (disabled)
Pr **MM.43**	**Range**	0 to 1
	Access	RW

This parameter is used to determine if the module should use auto-crossover detection
or use a standard (*patch*) cable. If it is set to 0 you either need a cross-over cable or you
need to connect via a switch.

Table 11.4 Crossover detection

Pr MM.43	Crossover detection
0	Disabled.
1	Enabled.

If this parameter value is changed, then a module save should be performed
(**xx.00**=1000 **xx.00**=1001 if using a DC supply to power the drive) followed by
resetting the SM-Ethernet module (**MM.32=**ON) to activate the change.

11.4.17 SM-Ethernet actual baud rate

SM-Ethernet Actual baud rate		
	Default	0
Pr **MM.44**	**Range**	0 to 2
	Access	R

Displays the baud rate at which SM-Ethernet is operating.

Table 11.5 Actual baud rate

Pr MM.44	Actual baud rate
0	Baud rate not set.
1	10Mbs.
2	100Mbs.

11.4.18 SM-Ethernet actual duplex mode

SM-Ethernet Actual duplex mode		
	Default	0
Pr **MM.45**	**Range**	0 to 2
	Access	R

Displays the duplex mode that SM-Ethernet is currently using.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Table 11.6 Actual duplex mode

Pr MM.45	Actual duplex mode
0	Duplex mode not set.
1	Full duplex mode.
2	Half duplex mode.

11.4.19 SM-Ethernet MAC address U_{MAC}

SM-Ethernet MAC address U_{MAC}		
	Default	00 (Control Techniques)
Pr **61.01**	Range	0 to 255
	Access	R

The most significant byte of the MAC address. The MAC address is a unique value specific to only a single SM-Ethernet module and takes the form U:V:W:X:Y:Z. The MAC address may be found on the product label on the outside of SM-Ethernet. This part of the MAC address will always be set to 00 as the first 3 bytes of the MAC address defines the manufacturer (Control Techniques).

11.4.20 SM-Ethernet MAC address V_{MAC}

SM-Ethernet MAC address V_{MAC}		
	Default	0D (Control Techniques)
Pr **61.02**	Range	0 to 255
	Access	R

The second most significant byte of the MAC address. The MAC address is a unique value specific to only a single SM-Ethernet module and takes the form U:V:W:X:Y:Z. The MAC address may be found on the product label on the outside of SM-Ethernet. This part of the MAC address will always be set to 0D as the first 3 bytes of the MAC address defines the manufacturer (Control Techniques).

11.4.21 SM-Ethernet MAC address W_{MAC}

SM-Ethernet MAC address U_{MAC}		
	Default	1E (Control Techniques)
Pr **61.03**	Range	0 to 255
	Access	R

The third most significant byte of the MAC address. The MAC address is a unique value specific to only a single SM-Ethernet module and takes the form U:V:W:X:Y:Z. The MAC address may be found on the product label on the outside of SM-Ethernet. This part of the MAC address will always be set to 1E as the first 3 bytes of the MAC address defines the manufacturer (Control Techniques).

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/Custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

11.4.22 SM-Ethernet MAC address X_{MAC}

SM-Ethernet MAC address X_{MAC}		
Pr **61.04**	Default	-
	Range	0 to 255
	Access	R

The fourth most significant byte of the MAC address. The MAC address is a unique value specific to only a single SM-Ethernet module and takes the form U:V:W:X:Y:Z. The MAC address may be found on the product label on the outside of SM-Ethernet. The last 3 bytes form a unique serial number for a specific SM-Ethernet.

11.4.23 SM-Ethernet MAC address Y_{MAC}

SM-Ethernet MAC address Y_{MAC}		
Pr **61.05**	Default	-
	Range	0 to 255
	Access	R

The fifth most significant byte of the MAC address. The MAC address is a unique value specific to only a single SM-Ethernet module and takes the form U:V:W:X:Y:Z. The MAC address may be found on the product label on the outside of SM-Ethernet. The last 3 bytes form a unique serial number for a specific SM-Ethernet.

11.4.24 SM-Ethernet MAC address Z_{MAC}

SM-Ethernet MAC address Z_{MAC}		
Pr **61.06**	Default	-
	Range	0 to 255
	Access	R

The least significant byte of the MAC address. The MAC address is a unique value specific to only a single SM-Ethernet module and takes the form U:V:W:X:Y:Z. The MAC address may be found on the product label on the outside of SM-Ethernet. The last 3 bytes form a unique serial number for a specific SM-Ethernet.

11.5 Diagnostic parameters

11.5.1 SM-Ethernet diagnostic information

SM-Ethernet - diagnostic information		
Pr **MM.06**	Default	N/A
	Range	-99 to 9999
	Access	RO

The diagnostic information for the SM-Ethernet can be viewed in the diagnostic information parameter (Pr **MM.06**). When the SM-Ethernet is communicating successfully over Ethernet, Pr **MM.06** will give an indication of the number of frames that are being processed per second. For a list of operating status codes see Table 11.7 *SM-Ethernet operating status codes* on page 98.

Table 11.7 SM-Ethernet operating status codes

Pr MM.06	Status	Description
Running states		
>0	Network ok	Indicates the number of frames the SM-Ethernet has transmitted and received per second.
0	Link established	A link has been established but no frames are being transmitted or received.
-1	Initialisation complete	The Solutions Module has initialised correctly but no network communication is taking place on Ethernet.
Initialisation states		
-2	Protocols	The user protocols such as the web server, discovery, modbus, etc. are being initialised.
-4	Ethernet	DHCP (if used) has configured the module address. The security and application settings are being loaded from the file system.
-6	File	Configuration files are being handled.
-8	Drive	The drive interface is being initialised.
-10	Storage	The file system and memory manager are being initialised.
Boot loader states		
-14	Launch	The application image was successfully extracted and about to be executed.
-15	Firmware ok	Firmware is tested and is valid and about to be extracted to RAM.
-16	FLASH ok	FLASH programming with new firmware finished.
-17	Program FLASH	Downloaded firmware being written to FLASH.
-18	Download	New firmware is being downloaded from the FTP server.
-19	Ethernet interface	The Ethernet interface is being initialised.
-20	Start	Boot loader RAM image has started.
Functional test states		
-81	Functional test complete	The functional test has completed successfully.
-85	Functional test fail	The module cannot communicate successfully with it's link partner (e.g. connected PC).
-86	Drive functional test fail	The module cannot communicate successfully with the host drive.
-87	Thermal functional test fail	The thermal monitoring circuit on the SM-Ethernet module is not working correctly.
-88	RAM test fail	The SDRAM memory is not working correctly.
-89	FLASH test fail	The FLASH memory is not working correctly.
Error Codes		
-92	Major hardware fault	The Solutions Module hardware is not working correctly. Remove and then re-apply power to the drive. If the problem persists the module should be replaced.
-93	Invalid Configuration	The module's parameters have been incorrectly configured which is preventing the module from continuing with it's initialisation. Check the module's configuration.
-94	Major software fault	The Solutions Module has encountered an unexpected error. Remove and then re-apply power to the drive. If the problem persists the module should be replaced.
-95	Initialisation Failed	The Solutions Module has encountered an unexpected error. Remove and then re-apply power to the drive. If the problem persists the module should be replaced.

If the SM-Ethernet module does not initialise correctly when the drive is powered up, remove the power from the module, wait for the drive under-voltage ('UU') trip to disappear and re-apply the power, if the problem persists then the SM-Ethernet module should be changed.

11.5.2 SM-Ethernet non-critical warning

SM-Ethernet Solutions Module error status		
Pr **MM.49**	Default	0
	Range	0 to 255
	Access	R

This parameter provides an indication for the user that a non-critical warning condition has been encountered. Bit 0 is set if any Solutions Module warning is active. Bits 1 through 7 can be mapped to specific warnings within the module, (this is not currently possible as there are insufficient warning types to make it necessary).

11.5.3 SM-Ethernet error status

SM-Ethernet Solutions Module error status		
Pr **MM.50**	Default	0
	Range	0 to 255
	Access	R

If an error occurs the reason for the error is written to this parameter and the drive may produce a slot error. A value of 0 indicates that the module has not detected an error. For a list of SM-Ethernet error codes see Table 11.8 *SM-Ethernet error codes* on page 100.

NOTE   This parameter is reset to 0 if SM-Ethernet is reset.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Table 11.8 SM-Ethernet error codes

Pr MM.50	Error Description
50	EtherNet/IP Requested Packet Interval (RPI) timeout.
51	EtherNet/IP stack has run out of memory.
52	EtherNet/IP socket error.
53	Maximum EtherNet/IP sessions reached.
54	Maximum EtherNet/IP connections reached.
55	EtherNet/IP request limit reached.
61	Invalid configuration parameters.
62	Error initialising drive database.
63	Error initialising file system.
65	Invalid read consistency parameter.
66	Invalid write consistency parameter.
70	No valid menu data available for the module from the drive.
74	The Solutions Module has overheated.
75	The drive is not responding.
76	The Modbus connection has 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.
87	Language file error.
90	Drive not supported.
91	Drive mode not supported.
96	EtherNet/IP error.
97	Missed event task.
98	The Solutions Module background task has not been completed.
99	Software fault.

12 Advanced features

12.1 Email configuration

SM-Ethernet provides the facilities for sending email alerts. These emails are configured based on a trigger condition contained within a parameter.

12.1.1 Requirements

In order to send emails you will need the following:

- A mail server that accepts SMTP connections without a password.
- An email address for SM-Ethernet.
- The IP address of the mail server.

NOTE
It is recommended that the address used is part of the standard corporate address structure (i.e. *SMEthernet1@mycompany.com)*, contact your system administrator for advice on obtaining an email address. SM-Ethernet will not receive email, and facilities should be put in place to prevent mail going to this account residing on the server.

12.1.2 Setup

To setup email on SM-Ethernet you must first be logged in with appropriate permissions. From the **PROTOCOLS** menu select **Email** then select the **Modify Configuration** option on the menu. Enter the IP address of the mail server and the port number required (normally 25) click on "APPLY" to save the settings. You can now add up to 3 configurable email messages.

12.1.3 Email triggers

Under the individual email configuration screens you can configure the individual message setup for the email. The trigger requires one parameter to trigger the event and one parameter to re-arm the trigger. The parameter may be the same parameter or a different parameter depending on the application. For both trigger and re-arm you must specify the condition that must be true to generate the event.

The re-arm inhibit should be used to limit the number of mails that could be sent. This is important as SM-Ethernet has the potential to generate a high volume of email, if the trigger and re-arm conditions are continuously met. Setting this parameter will prevent messages from the same source being re-sent until the inhibit time has expired.

To complete the process you need to enter an appropriate email source name, a destination email address, the title of the email, any text you wish to send and then select if you wish to include a parameter file in the email. Sending a parameter file in the email is useful for determining the nature of any problems as a snapshot of the drive at the time of trigger is produced.
If all settings are correct, then the email may be enabled in the 'Options' section of the configuration page.
A test email may also be generated to test the server settings.

NOTE
Some email servers and clients may convert the '.par' file to '.dat' if this occurs you should contact your systems administrator for assistance.

NOTE
If the 'From' field of an email is left blank the email will automatically be sent from the modules drive name. The drive name can be specified in the application details of the module, which is accessed from the **Application** menu.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

12.2   Scheduled events

It is possible to configure the SM-Ethernet module to trigger certain events at certain times. The following examples show what can be achieved:

- The SM-Ethernet module could be configured to send an email once every month. Note that an event cannot send an email directly but it can change the value of a parameter. The email handler can then be configured to monitor the same parameter and to transmit when the value changes.
- Once every 200ms the SM-Ethernet module could trigger an "*Event"* task in an SM-Applications module, causing it to sample data.
- A number of SM-Ethernet modules could write the current date and time to drive parameters once every second, within 50ms of each other. Thus providing each drive with a timestamp for scheduling coordinated (not synchronised) motion.

NOTE   Care must be taken to prevent a large amount of emails from being transmitted too quickly, otherwise the Ethernet network or server may be compromised.

NOTE   As the module has no back-up for the real-time clock it will need synchronising with an external clock every time the module is reset (except if the module has requested control of the serial communications buffer, where the reset is inhibited). In order for the clock to maintain accuracy it is important that re-synchronisation is carried out regularly. This synchronisation signal can come from a few different sources, but the module can only be configured to use a single method at any one time.

12.2.1 Requirements

In order to schedule events based upon the time you will need a SNTP server IP address that does not require a login or a SNTP server that is broadcasting the time on the same network as the SM-Ethernet module.

12.2.2 SNTP Setup

To setup SNTP on SM-Ethernet you must first be logged in with appropriate permissions. From the **PROTOCOLS** menu select **Scheduled Events** then select the "Modify Configuration" option. You must now choose which type of SNTP source you wish to use.

SNTP Broadcast
The module can be set to receive a SNTP timestamp from a server at regular time intervals. This mechanism involves very little network traffic or configuration on the module, but does not take into account network transmission delays.

SNTP Requests
The module can request the time from a specified time server at regular intervals, each node would need to request the time individually when required. This mechanism is potentially more accurate than the broadcast mechanism but does require each node to be configured individually and produces more network traffic than a broadcast.

If the source type is set to *request* you must specify the server IP address and the time interval between requests.

If the SNTP source is enabled and a time duration is selected for the *Update Warning Delay*, then, if SM-Ethernet does not receive a time update from the specified server within the selected time, a value of 3 is written to Pr **MM.49** (non-critical warning).

12.2.3 Events

A total of 10 events can be configured on each SM-Ethernet module. Each event has the following:

- Summary - Each event can be given a descriptive name and independently enabled and disabled. To delete an event, tick the "Remove" option and then "APPLY". The "Missed Event Trip" option can be used to cause a trip if more than one event is missed.
- Time of first event - This section is used to specify when the event will first occur. When entering "Hour", "Minute", "Second" and "Millisecond" data, no information of a higher resolution can be omitted. e.g. If you wish the first event to occur at 30 minutes past the next hour, then the values "--:30:00:00" must be entered (the "Second" and "Millisecond" information must be included).
- Event condition - This section has two options, the first option will trigger the event if the set conditions are met, the second option will trigger the event if the specified parameter contains a non-zero value.
- Event action - This section is used to specify what action is to be taken on the event being triggered.
- Recurrence rule - This section is used to specify when the event will re-occur following the start condition being met. The minimum recurrence interval is 100ms.

12.3 Updating and backup

12.3.1 Updating SM-Ethernet firmware

The SM-Ethernet module firmware and associated files can be updated using the internal web pages from the **CONFIGURATION** menu then select the **Update** menu. Browse for the file (*.pkg) then click "UPLOAD". Firmware uploads can take a few minutes and the status of the update will be shown on screen.

| NOTE | Do not reset or power down the drive when uploading firmware as this may result in data loss or corruption of the system file. |

12.3.2 Updating SM-Ethernet language files

The SM-Ethernet module supports multiple languages, the language files are supplied as .pkg files (e.g. english.pkg) and can be updated (or added) using the internal web pages in the same way that the firmware is updated.

| NOTE | Do not reset or power down the drive when uploading the language file as this may result in data loss or corruption of the system file. |

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

12.3.3 Backup

To backup parameters in the drive using the internal web pages use the **CONFIGURATION** menu and select the **Backup** submenu. Select the options you require from the following:

- *Application configuration data* - contains information such as drive name and the information from the *Current Application Configuration* pages.

- *Saved module parameter values* - All the internal menus, Pr **60.xx**, Pr **61.xx**, Pr **62.xx** and Pr **MM.xx.**

- *Module specific security settings* - All the usernames, passwords and security related functions. If you do not select the decrypt option below these values may only be used on the module they came from.

- *Decrypted module security settings* - Ticking this box allows the security settings above to be restored to any module. This option is only available to Adminstrative users.

Click on the "SUBMIT" button and choose a filename and location to save the file.

NOTE It is recommended that before and after any changes are made a sequentially named backup is made. This means that at any point it is possible to restore the module to a previous state. In the event of data corruption or module failure the data can then be restored.

12.4   Advanced parameters

The parameters listed in this section are for advanced use only. You should only adjust the following parameters if you have a thorough understanding of SM-Ethernet and the application.

12.4.1 SM-Ethernet module management

SM-Ethernet - module management		
Pr **MM.29**	Default	0
	Range	1000 to 1999
	Access	RO

Setting this parameter to 1500 and re-initialising the module activates the protocol "fail safe" mode. All user protocols (modbus, FTP etc.) are disabled except for the web interface, which will start with default thread priority.

NOTE This does not reset passwords.

12.4.2 SM-Ethernet load defaults (reset memory)

SM-Ethernet - load option defaults		
Pr **MM.30**	Default	OFF
	Range	OFF/ON
	Access	RW

When set to *ON* and the SM-Ethernet module is reset (Pr **MM.32** set to *ON*), the module will change it's parameter values stored in the module's local memory to default values. Any user changes or user web pages in the module will be lost. During this operation communications will be stopped. This parameter will automatically revert to *OFF* following the operation. Pr **MM.32** must be set to *ON* to activate the change (see section 5.17 *Re-initialising SM-Ethernet* on page 26).

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

| NOTE | The use of this parameter will lose any configuration in the module. Unless you have made a backup copy of the module's configuration you will lose all settings. All passwords and users are deleted, the root password remains unchanged. |

12.4.3 SM-Ethernet save option parameters (backup)

SM-Ethernet - save option parameters		
	Default	OFF
Pr **MM.31**	Range	OFF/ON
	Access	RW

This will save the module's current configuration in it's local memory. During this operation communications will be stopped. This will save menu 60 (*Pr MM.xx*), menu 61, web page customisations, email settings, etc. This parameter should only be used to transfer a SM-Ethernet module to a different drive or when you wish to save any internal parameters directly (i.e. Pr **61.10**). In order to save these parameters in the drive's memory a drive save must be performed. This is required as SM-Ethernet will take it's operating parameters directly from the slot memory on the host drive at startup.

| NOTE | To save the parameters in the drive, a value of 1000 should be entered in Pr **xx.00** followed by a drive reset (press the reset button, or toggle the reset input, or write the value 100 to Pr **10.38**). |

* If the drive is in the under-voltage trip state or is fed from a low voltage backup supply, the value 1001 should be used and not 1000.

12.4.4 SM-Ethernet re-initialise

SM-Ethernet re-initialise		
	Default	OFF
Pr **MM.32**	Range	OFF/ON
	Access	RW

This will force the module to re-initialise and start up with the values contained in the slot menu of the host drive (**MM.xx**). This parameter will automatically reset to *OFF* after completion. During this operation communications will be stopped.

| NOTE | The transition of **MM.32** from *OFF* to *ON* may not be visible on the drive display due to the update rate of the display. |

| NOTE | Writing 1070 to menu Pr **MM.00** (to re-initialise all option modules) may not re-initialise the SM-Ethernet module. The handling of 1070 within SM-Ethernet is dependent on the state of Pr **MM.37**. See section 12.4.8 *SM-Ethernet reduce serial interface priority* on page 107 for further information. |

12.4.5 SM-Ethernet restore parameters

SM-Ethernet - restore parameters		
Pr **MM.33**	Default	OFF
	Range	OFF/ON
	Access	RW

This will change the operating parameters for the module by copying the configuration from the backup copy in the SM-Ethernet module. During this operation communications will be stopped. The restored parameters will include menu 60 (*Pr MM.xx*), menu 61, web page customisations, email settings, etc. This will not save the current operating menu of the drive (*Pr MM.xx*), a drive save must be performed to achieve this.

12.4.6 SM-Ethernet serial number

SM-Ethernet - serial number		
Pr **MM.35**	Default	N/A
	Range	0 to 9999
	Access	R

The serial number is programmed into the module at the time of manufacture and consists of the least significant 3 bytes of the MAC address in decimal format.

NOTE This can be used to find the complete MAC address of the module by combining the numbers with 00:0D:1E:xx.xx.xx. Where xx.xx.xx. is a value in Pr **MM.35** converted to base 16 (HEX). e.g. If Pr **MM.35** contains the value of 1193046, this would give the complete MAC address of 00 0D 1E 12 34 56.

12.4.7 SM-Ethernet disable full access

SM-Ethernet - disable full access		
Pr **MM.36**	Default	OFF (enabled)
	Range	OFF/ON
	Access	RW

This parameter will restrict a remote user's access to the drive. Pr **MM.36** = *ON* ensures that write access to the drive is disabled. Pr **MM.36** = *OFF* allows full access to the drive parameters. With this parameter enabled access to the following is not allowed.

- Modbus TCP/IP write.
- EtherNet/IP write.
- FTP upload.
- Web page write access to SM-Ethernet.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

12.4.8 SM-Ethernet reduce serial interface priority

SM-Ethernet reduce serial interface priority		
Pr **MM.37**	**Default**	OFF
	Range	OFF/ON
	Access	RW

NOTE It is not possible for the drive and SM-Ethernet module to support all of the available serial communication protocols simultaneously. This parameter, when set, allows SM-Ethernet to request the highest priority (not relevant for Commander SK).

When on:

The SM-Ethernet module will request highest priority (it's actual state is shown in Pr **6.50**) and the following restrictions will be applied:

- The drive's serial interface will only be able to handle messages of 32 bytes or less. This will restrict the use of the software tools CTSoft, CTScope, OPC server, SyPTPro and SyPTLite when communicating via the RJ45 serial interface connector.
- An LCD keypad mounted directly to the drive will not work.
- A remote LCD keypad will work when connected to the RJ45 serial communications port.
- A Solutions Module reset using Pr **MM.00** = 1070 may not work.

When off:

- Access to drive parameters and SM-Application parameters will still be allowed.
- This will restrict the use of the software tools CTSoft, CTScope, OPC server, SyPTPro and SyPTLite over Ethernet as SM-Ethernet will not be able to route messages using inter-option communications.

NOTE When routing through SM-Ethernet to CTNet, this parameter must be set to *ON*. Failure to set this parameter *ON* will result in communication loss or unstable communications.

NOTE For a system with multiple modules installed, the priority should be set for the module that is receiving the incoming request.

NOTE Only one option module can have priority of the serial communications buffer at any time, priority access will be given to the first module requesting it.

12.4.9 SM-Ethernet user allocated group

SM-Ethernet - User allocated group		
Pr **MM.38**	**Default**	0
	Range	0 to 65535
	Access	RW

This parameter can be used to provide logical groups for *Control Techniques* drives. This will allow grouping independently of the IP settings. This is used in conjunction with parameter Pr **MM.03** (see section 12.4.10 *SM-Ethernet user allocated address* on page 108).

12.4.10 SM-Ethernet user allocated address

SM-Ethernet - user allocated address		
Pr **MM.03**	**Default**	0
	Range	0 to 65535
	Access	RW

This is used as a way to identify the node on the network independently of the IP address.

12.4.11 SM-Ethernet connection filtering

SM-Ethernet - Connection filtering		
Pr **MM.39**	**Default**	0 (disabled)
	Range	0 or 1
	Access	RW

When set to a 1 the connection filter list will be enabled. If you make a mistake configuring the connection filtering and cannot connect to the module, setting this parameter to 0 will allow communication to be restored.

12.5 Modbus TCP/IP (CT implementation)

Modbus TCP/IP is one of the most widely supported Industrial Ethernet based protocols offering the functionality and simplicity of the Modbus protocol, combined with the flexibility of Ethernet. The SM-Ethernet implementation of Modbus TCP/IP uses a subset of the standard protocol provided by the Modbus organisation.

Modbus TCP/IP is an application layer protocol for communication between automation devices utilising an Ethernet network connection. It is a client-server protocol where the client sends a request and waits for the server to respond.

NOTE The default port for Modbus TCP/IP communication is 502, but this may be reconfigured using Pr **63.01** on SM-Ethernet.

12.5.1 Data structure

Communication between devices is based upon Application Data Units (ADUs) as shown in Figure 12-1. The ADU consists of two parts, the Modbus Application Protocol (MBAP) (Table 12.1) and the Protocol Data Units (see Table 12.2). Modbus TCP/IP extends the standard PDU to include an IP specific 7-byte header called the Modbus Application Protocol (MBAP).

Figure 12-1 ADU
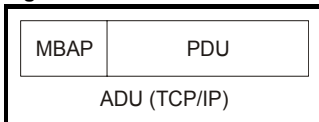
NOTE It is important that when you implement the Modbus TCP ADU as shown in Figure 12-1, you include the MBAP as well as the PDU.

NOTE The rest of this section does not repeat the MBAP header for each function code for reasons of clarity.

Safety
information

Introduction

Mechanical
installation

Electrical
installation

Getting
started

Protocols

Web page
basics

FTP/custom
pages

Applications

Security

Diagnostics

**Advanced
features**

Quick
reference

Glossary of
terms

Index

12.5.2 Data access

Data access using Modbus TCP/IP takes the form of a request for data by the master, followed by a response from the slave indicating either success (response), or failure (exception response) as shown in Figure 12-2. If no response is received this indicates that the message has not been received or the node is unable to reply.

Figure 12-2 Modbus TCP/IP- request, response, exception
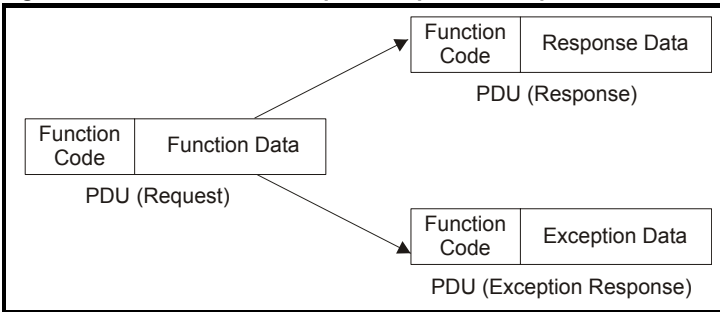
MBAP and PDU message structure

The following tables document the structure of the MBAP and PDU, specifically the functions of each data byte within the overall message structure.

Table 12.1 MBAP

Byte	Description
0	Transaction identifier MSB.
1	Transaction identifier LSB.
2	Protocol identifier MSB.
3	Protocol identifier LSB.
4	Length MSB.
5	Length LSB.
6	Unit identifier.

Table 12.2 PDU

PDU	Consists of
Request	Function code, 1 byte Function data, > 1 byte
Response	Function code, 1 byte Response data, > 1 byte
Exception Response	Error code, 1 byte Exception code, 1 byte

| NOTE | If accessing one of the SM-Applications parameters (menus 7x, 8x or 9x) on a drive with more than one SM-Applications module installed, the message will be routed to the SM-Applications module installed in the lowest slot number, if this is undesireable then the direct access parameters (menus 10x, 11x, 12x, etc) should be used.

SM-Ethernet User Guide
Issue: 6   www.controltechniques.com

109

12.6 Supported Modbus function codes

Table 12.3 below, details the supported Modbus function codes on SM-Ethernet. All function codes write to 16 bit registers only, to write to a 32 bit destination see section 12.6.1 *Extended data types* on page 110.

Table 12.3 Supported function codes

Code		Description
Decimal	Hex.	
3	0x03	Read multiple 16 bit registers.
6	0x06	Write single 16 bit register.
16	0x10	Write multiple 16 bit registers.
23	0x17	Read and write multiple 16 bit registers.

NOTE *Control Techniques* register numbers are referenced from 0 to 65535 rather than the traditional 1 to 65536. This is because the *Control Techniques* implementation of Modbus in the receiving node adds 1 to the register number effectively preventing access to parameter Pr **00.00** within the drive.

12.6.1 Extended data types

Standard Modbus registers are 16 bits in size and reference a single drive parameter (Pr **xx.xx**). To support 32 bit data types (both integer and floating point) the Modbus multiple read and write services are used to transfer a contiguous array of 16 bit registers. *Control Techniques* products typically contain a mix of 16 bit and 32 bit registers. To permit the client to select the appropriate 16 bit or 32 bit access the top two bits of the register address are used to select the required data type as shown in Figure 12-3.

Figure 12-3 Modbus register data type selection
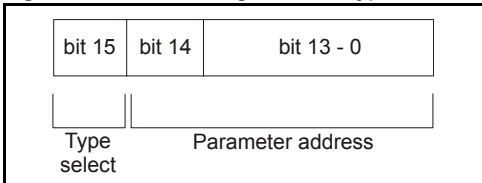
The extended data types are defined such that the type '00' allows for backwards compatibility.

Table 12.4 Data type field

Type field bits 15-14	Selected data type	Comments
00	INT16	Backward compatible.
01	INT32	None.
10	Float 32**	IEEE794 standard not supported on all servers.
11	Reserved	None.

**Not currently supported.

NOTE *Control Techniques* drive parameters currently do not support *Float32*. To overcome this INT32 should be used to represent 32 bit values. If a 32 bit data type is selected then the server uses two consecutive 16 bit Modbus registers in 'big endian' format (MSB transmitted first). For details of the data types within each product please consult the documentation for that product or contact your supplier.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

12.6.2 FC03-Read multiple registers

This function code allows a contiguous array of registers to be read. The server (drive) imposes an upper limit on the number of registers that may be read and If this is exceeded the server will issue an exception code 2.

Table 12.5 Client request message

Byte	Description
0	Server destination node address, 0 is broadcast.
1	Function code 0x03.
2	Start register address MSB.
3	Start register address LSB.
4	Number of 16 bit registers MSB.
5	Number of 16 bit registers LSB.

Table 12.6 Server (drive) response message

Byte	Description
0	Server source node address.
1	Function code 0x03.
2	Length of register data (bytes).
3	Register data 0 MSB.
4	Register data 0 LSB.
5	*Register data 1 MSB.*
6	*Register data 1 LSB.*

| NOTE | For each byte in the PDU message, the MSB is transmitted first, followed by the LSB. |

| NOTE | If only one 16 bit register of a 32 bit register address is read the server returns the least significant word. |

| NOTE | For multiple registers, the register data will be returned in ascending order, beginning with the start register address. |

| NOTE | The Modbus CRC bytes are not required when using TCP/IP due to the ethernet frame providing the error checking. |

12.6.3 FC06-Write single register

Writes a value to a single 16 bit register. The normal response is an echo of the request after the register contents have been successfully written. The register address can correspond to a 32 bit parameter but only the least significant 16 bits of data will be returned.

Table 12.7 Client request message

Byte	Description
0	Server destination node address, 0 is broadcast.
1	Function code 0x06.
2	Register address MSB.
3	Register address LSB.
4	Register data MSB.
5	Register data LSB.

Table 12.8 Server (drive) response message

Byte	Description
0	Server source node address.
1	Function code 0x06.
2	Register address MSB.
3	Register address LSB.
4	Register data MSB.
5	Register data LSB.

| NOTE | To write 32 bits of data to a 32 bit register address, the extended data type must be used (see section 12.6.1 *Extended data types* on page 110). |

| NOTE | For each byte in the PDU message, the MSB is transmitted first, followed by the LSB. |

| NOTE | The Modbus CRC bytes are not required when using TCP/IP due to the ethernet frame providing the error checking. |

12.6.4 FC16-Write multiple registers

Writes a contiguous array of registers. The server imposes an upper limit on the number of registers that can be written. If this is exceeded the server will discard the request and the client will time out.

Table 12.9 Client request message

Byte	Description
0	Server destination node address, 0 is broadcast.
1	Function code 0x10.
2	Start register address MSB.
3	Start register address LSB.
4	Number of 16 bit registers MSB.
5	Number of 16 bit registers LSB.
6	Length of register data to write (bytes).
7	Register data 0 MSB.
8	Register data 0 LSB.
9	*Register data 1 MSB.*
10	*Register data 1 LSB.*

Table 12.10 Server (drive) response message

Byte	Description
0	Server source node address.
1	Function code 0x10.
2	Start register address MSB.
3	Start register address LSB.
4	Number of 16 bit registers written MSB.
5	Number of 16 bit registers written LSB.

NOTE For each byte in the PDU message, the MSB is transmitted first, followed by the LSB.

NOTE For multiple registers, the register data is transmitted in ascending order, beginning with the start register address.

NOTE The Modbus CRC bytes are not required when using TCP/IP due to the ethernet frame providing the error checking.

12.6.5 FC23-Read and write multiple registers

Reads and writes two contiguous arrays of registers. The server imposes an upper limit on the number of registers that can be written. If this is exceeded the server will discard the request and the client will time out.

Table 12.11 Client request message

Byte	Description
0	Server destination node address, 0 is broadcast.
1	Function code 0x17.
2	Start register address to read MSB.
3	Start register address to read LSB.
4	Number of 16 bit registers to read MSB.
5	Number of 16 bit registers to read LSB.
6	Start register address to write MSB.
7	Start register address to write LSB.
8	Number of 16 bit registers to write MSB.
9	Number of 16 bit registers to write LSB.
10	Length of register data to write (bytes).
11	Register data 0 MSB.
12	Register data 0 LSB.
13	*Register data 1 MSB.*
14	*Register data 1 LSB.*

Table 12.12 Server (drive) response message

Byte	Description
0	Server source node address.
1	Function code 0x17.
2	Length of register data in read (bytes).
3	Register data 0 MSB.
4	Register data 0 LSB.
5	*Register data 1 MSB.*
6	*Register data 1 LSB.*

NOTE For each byte in the PDU message, the MSB is transmitted first, followed by the LSB.

NOTE For both the request and response message, the register data is transmitted in ascending order, beginning with the start register address.

NOTE The Modbus CRC bytes are not required when using TCP/IP due to the ethernet frame providing the error checking.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

12.7   Modbus exception codes

Modbus exceptions are a response that indicates a failed operation by the client. This is signalled by the addition of 0x80 in the function code of the response. The specific error can be identified by the next byte which contains the error code ID, corresponding to the table below.

Table 12.13 Exception error codes

ID Code	Name	Description
0x01	FUNCTION_NOT_SUPPORTED	The received function code is not supported on the server, i.e. not FC3, FC6, FC16 or FC23.
0x02	TOO_MANY_REGISTERS	The parameter reference and/or the transfer length are/is invalid.
0x04	SERVER_FAILURE	This error is generated when a response to a routed message is found to be corrupt. CRC error occurred.
0x06	SERVER_BUSY	This can occur if the module is trying to route a message but it cannot get control of the drive's communications buffer.
0x0B	GATEWAY_PROBLEM_NO_RESPONSE	This occurs if there is no response to a routed message.

13 Quick reference

13.1 Complete parameter reference

The table below lists all the SM-Ethernet set-up parameters that are required to configure the module.

Table 13.1 SM-Ethernet parameter reference

Parameter	Default	Cross reference	Description
Pr **MM.01**	410	Section 11.3.1 on page 90	Module ID code.
Pr **MM.02**	-	Section 11.3.2 on page 90	Option software version.
Pr **MM.03**	0	Section 11.3.3 on page 91	User allocated address.
Pr **MM.04**	0	Section 11.4.1 on page 91	Ethernet data rate.
Pr **MM.05**	0	Section 11.4.2 on page 91	DHCP enable.
Pr **MM.06**	0	Section 11.5.1 on page 97	Ethernet module diagnostic information.
Pr **MM.10**	192	Section 5.11 on page 22	IP address W_{ip}.
Pr **MM.11**	168		IP address X_{ip}.
Pr **MM.12**	1		IP address Y_{ip}.
Pr **MM.13**	100		IP address Z_{ip}.
Pr **MM.14**	255	Section 5.12 on page 23	Subnet mask W_{subnet}.
Pr **MM.15**	255		Subnet mask X_{subnet}.
Pr **MM.16**	255		Subnet mask Y_{subnet}.
Pr **MM.17**	0		Subnet mask Z_{subnet}
Pr **MM.18**	192	Section 5.13 on page 24	Default gateway $W_{gateway}$.
Pr **MM.19**	168		Default gateway $X_{gateway}$.
Pr **MM.20**	1		Default gateway $Y_{gateway}$.
Pr **MM.21**	254		Default gateway $Z_{gateway}$.
Pr **MM.29**	0	Section 12.4.1 on page 104	Module management.
Pr **MM.30**	OFF	Section 12.4.2 on page 104	Load option defaults.
Pr **MM.31**	OFF	Section 12.4.3 on page 105	Save option parameters.
Pr **MM.32**	OFF	Section 12.4.4 on page 105	Request to re-initialise.
Pr **MM.33**	OFF	Section 12.4.5 on page 106	Restore parameters.
Pr **MM.35**	0	Section 12.4.6 on page 106	Serial number (partial MAC address).
Pr **MM.36**	OFF	Section 12.4.7 on page 106	Disable full access.
Pr **MM.37**	OFF	Section 12.4.8 on page 107	Reduce SP serial interface priority.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Table 13.1 SM-Ethernet parameter reference

Parameter	Default	Cross reference	Description
Pr **MM.38**	0	Section 12.4.9 on page 107	User allocated group.
Pr **MM.39**	0	Section 12.4.11 on page 108	Connection filtering.
Pr **MM.42**	0	Section 11.4.15 on page 94	Duplex mode.
Pr **MM.43**	0	Section 11.4.16 on page 95	Crossover detection.
Pr **MM.44**	-	Section 11.4.17 on page 95	Actual baud rate.
Pr **MM.45**	-	Section 11.4.18 on page 95	Actual duplex mode.
Pr **MM.49**	0	Section 11.5.2 on page 99	Non-critical warning condition.
Pr **MM.50**	0	Section 11.5.3 on page 99	Solutions Module error status.
Pr **MM.51**	-	Section 11.3.2 on page 90	Solutions Module software sub-version.

Table 13.2 SM-Ethernet virtual parameter reference

Parameter	Default	Description
Menu 60		
Pr **60.00**	0	Parameter zero.
Pr **60.01**	410	Module ID code.
Pr **60.02**	-	Option software version.
Pr **60.03**	0	User allocated address.
Pr **60.04**	0	Ethernet data rate.
Pr **60.05**	0	DHCP enable.
Pr **60.06**	0	Ethernet module diagnostic information.
Pr **60.10**	192	IP address $W_{ip.}$
Pr **60.11**	168	IP address $X_{ip.}$
Pr **60.12**	1	IP address $Y_{ip.}$
Pr **60.13**	100	IP address $Z_{ip.}$
Pr **60.14**	255	Subnet mask $W_{subnet.}$
Pr **60.15**	255	Subnet mask $X_{subnet.}$
Pr **60.16**	255	Subnet mask $Y_{subnet.}$
Pr **60.17**	0	Subnet mask $Z_{subnet.}$
Pr **60.18**	192	Default gateway $W_{gateway.}$
Pr **60.19**	168	Default gateway $X_{gateway.}$
Pr **60.20**	1	Default gateway $Y_{gateway.}$
Pr **60.21**	254	Default gateway $Z_{gateway.}$
Pr **60.29**	0	Module management.
Pr **60.30**	OFF	Load option defaults.
Pr **60.31**	OFF	Save option parameters.
Pr **60.32**	OFF	Request to re-initialise.
Pr **60.33**	OFF	Restore parameters.
Pr **60.35**	0	Serial number (partial MAC address).

Table 13.2 SM-Ethernet virtual parameter reference

Parameter	Default	Description
Pr **60.36**	OFF	Disable full access.
Pr **60.37**	OFF	Reduce SP serial interface priority.
Pr **60.38**	0	User allocated group.
Pr **60.39**	0	Connection filtering.
Pr **60.42**	0	Duplex mode.
Pr **60.43**	0	Crossover detection.
Pr **60.44**	-	Actual baud rate.
Pr **60.45**	-	Actual duplex mode.
Pr **60.49**	0	Non-critical warning condition.
Pr **60.50**	0	Solutions Module error status.
Pr **60.51**	-	Solutions Module software sub-version.
		Menu 61
Pr **61.00**	0	Parameter zero.
Pr **61.01**	-	MAC address U_{MAC}.
Pr **61.02**	-	MAC address V_{MAC}.
Pr **61.03**	-	MAC address W_{MAC}.
Pr **61.04**	-	MAC address X_{MAC}.
Pr **61.05**	-	MAC address Y_{MAC}.
Pr **61.06**	-	MAC address Z_{MAC}.
Pr **61.07**	-	Slot indicator.
Pr **61.10**	4 (High)	Modbus thread priority.
Pr **61.11**	3 (Medium)	FTP thread priority.
Pr **61.12**	3 (Medium)	SMTP thread priority.
Pr **61.13**	3 (Medium)	HTTP thread priority.
Pr **61.14**	4 (High)	Event thread priority.
Pr **61.15**	4 (High)	EtherNet/IP thread priority.
Pr **61.20**	5000	Modbus thread tick time (µs).
Pr **61.21**	2000	EtherNet/IP thread tick time (µs).
Pr **61.30**	2000	Discovery and identification process silent period (ms).
Pr **61.31**	30000	Discovery and identification process maximum search time (ms).
Pr **61.32**	30000	Discovery and identification process search retention time (ms).
Pr **61.33**	250	IP communications timeout (ms).
Pr **61.34**	500	IP routing timeout (ms).
Pr **61.50**	-	Bootloader software version.
Pr **61.51**	-	Bootloader software sub-version.
		Menu 62
Pr **62.00**	0	Parameter zero.
Pr **62.01**	0	Primary DNS server W_{DNS1}.
Pr **62.02**	0	Primary DNS server X_{DNS1}.
Pr **62.03**	0	Primary DNS server Y_{DNS1}.
Pr **62.04**	0	Primary DNS server Z_{DNS1}.
Pr **62.05**	0	Secondary DNS server W_{DNS2}.
Pr **62.06**	0	Secondary DNS server X_{DNS2}.
Pr **62.07**	0	Secondary DNS server Y_{DNS2}.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Table 13.2 SM-Ethernet virtual parameter reference

Parameter	Default	Description
Pr **62.08**	0	Secondary DNS server Z_{DNS2}.
Pr **62.09**	0	Tertiary DNS server W_{DNS3}.
Pr **62.10**	0	Tertiary DNS server X_{DNS3}.
Pr **62.11**	0	Tertiary DNS server Y_{DNS3}.
Pr **62.12**	0	Tertiary DNS server Z_{DNS3}.
		Menu 63
Pr **63.00**	0	Parameter zero.
Pr **63.01**	502	Listening Modbus TCP/IP port.
Pr **63.02**	10	Maximum number of concurrent Modbus connections.
Pr **63.03**	5	Maximum number of priority Modbus connections.
Pr **63.04**	2	Maximum number of priority connections per client.
Pr **63.05**	OFF	Modbus timeout enable.
Pr **63.06**	1000	Modbus timeout time (ms).
Pr **63.10**	0	1st Priority connection.
Pr **63.11**	0	2nd Priority connection.
Pr **63.12**	0	3rd Priority connection.
Pr **63.13**	0	4th Priority connection.
Pr **63.14**	0	5th Priority connection.
Pr **63.15**	0	6th Priority connection.
Pr **63.16**	0	7th Priority connection.
Pr **63.17**	0	8th Priority connection.
Pr **63.18**	0	9th Priority connection.
Pr **63.19**	0	10th Priority connection.
Pr **63.20**	0	11th Priority connection.
Pr **63.21**	0	12th Priority connection.
Pr **63.22**	0	13th Priority connection.
Pr **63.23**	0	14th Priority connection.
Pr **63.24**	0	15th Priority connection.
Pr **63.25**	0	16th Priority connection.
Pr **63.26**	0	17th Priority connection.
Pr **63.27**	0	18th Priority connection.
Pr **63.28**	0	19th Priority connection.
Pr **63.29**	0	20th Priority connection.
		Menu 64
Pr **64.00**	0	Parameter zero.
Pr **64.01**	1	Parameter alignment.
Pr **64.02**	ON	Endianism.
Pr **64.03**	OFF	Read consistency.
Pr **64.04**	0	Read consistency trigger parameter.
Pr **64.05**	OFF	Write consistency.
Pr **64.06**	0	Write consistency trigger parameter.

Table 13.2 SM-Ethernet virtual parameter reference

Parameter	Default	Description
Pr **64.10**	-	Connection status
Pr **64.11**	ON	RPI timeout trip enable.
Pr **64.12**	OFF	Advanced EDS file enable.
Pr **64.13**	7	Motor 1 type.
Pr **64.14**	7	Motor 2 type.
Pr **64.15**	8	Primary input assembly object size (bytes).
Pr **64.16**	8	Primary output assembly object size (bytes).
Pr **64.20**	0	Input mapping parameter 1.
Pr **64.21**	0	Input mapping parameter 2.
Pr **64.22**	0	Input mapping parameter 3.
Pr **64.23**	0	Input mapping parameter 4.
Pr **64.24**	0	Input mapping parameter 5.
Pr **64.25**	0	Input mapping parameter 6.
Pr **64.26**	0	Input mapping parameter 7.
Pr **64.27**	0	Input mapping parameter 8.
Pr **64.28**	0	Input mapping parameter 9.
Pr **64.29**	0	Input mapping parameter 10.
Pr **64.30**	0	Input mapping parameter 11.
Pr **64.31**	0	Input mapping parameter 12.
Pr **64.32**	0	Input mapping parameter 13.
Pr **64.33**	0	Input mapping parameter 14.
Pr **64.34**	0	Input mapping parameter 15.
Pr **64.35**	0	Input mapping parameter 16.
Pr **64.36**	0	Input mapping parameter 17.
Pr **64.37**	0	Input mapping parameter 18.
Pr **64.38**	0	Input mapping parameter 19.
Pr **64.39**	0	Input mapping parameter 20.
Pr **64.40**	0	Input mapping parameter 21.
Pr **64.41**	0	Input mapping parameter 22.
Pr **64.42**	0	Input mapping parameter 23.
Pr **64.43**	0	Input mapping parameter 24.
Pr **64.44**	0	Input mapping parameter 25.
Pr **64.45**	0	Input mapping parameter 26.
Pr **64.46**	0	Input mapping parameter 27.
Pr **64.47**	0	Input mapping parameter 28.
Pr **64.48**	0	Input mapping parameter 29.
Pr **64.49**	0	Input mapping parameter 30.
Pr **64.50**	0	Input mapping parameter 31.
Pr **64.51**	0	Input mapping parameter 32.
Pr **64.52**	0	Input mapping parameter 33.
Pr **64.53**	0	Input mapping parameter 34.
Pr **64.54**	0	Input mapping parameter 35.
Pr **64.55**	0	Input mapping parameter 36.
Pr **64.56**	0	Input mapping parameter 37.
Pr **64.57**	0	Input mapping parameter 38.

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Table 13.2 SM-Ethernet virtual parameter reference

Parameter	Default	Description
Pr **64.58**	0	Input mapping parameter 39.
Pr **64.59**	0	Input mapping parameter 40.
Pr **64.60**	0	Output mapping parameter 1.
Pr **64.61**	0	Output mapping parameter 2.
Pr **64.62**	0	Output mapping parameter 3.
Pr **64.63**	0	Output mapping parameter 4.
Pr **64.64**	0	Output mapping parameter 5.
Pr **64.65**	0	Output mapping parameter 6.
Pr **64.66**	0	Output mapping parameter 7.
Pr **64.67**	0	Output mapping parameter 8.
Pr **64.68**	0	Output mapping parameter 9.
Pr **64.69**	0	Output mapping parameter 10.
Pr **64.70**	0	Output mapping parameter 11.
Pr **64.71**	0	Output mapping parameter 12.
Pr **64.72**	0	Output mapping parameter 13.
Pr **64.73**	0	Output mapping parameter 14.
Pr **64.74**	0	Output mapping parameter 15.
Pr **64.75**	0	Output mapping parameter 16.
Pr **64.76**	0	Output mapping parameter 17.
Pr **64.77**	0	Output mapping parameter 18.
Pr **64.78**	0	Output mapping parameter 19.
Pr **64.79**	0	Output mapping parameter 20.
Pr **64.80**	0	Output mapping parameter 21.
Pr **64.81**	0	Output mapping parameter 22.
Pr **64.82**	0	Output mapping parameter 23.
Pr **64.83**	0	Output mapping parameter 24.
Pr **64.84**	0	Output mapping parameter 25.
Pr **64.85**	0	Output mapping parameter 26.
Pr **64.86**	0	Output mapping parameter 27.
Pr **64.87**	0	Output mapping parameter 28.
Pr **64.88**	0	Output mapping parameter 29.
Pr **64.89**	0	Output mapping parameter 30.
Pr **64.90**	0	Output mapping parameter 31.
Pr **64.91**	0	Output mapping parameter 32.
Pr **64.92**	0	Output mapping parameter 33.
Pr **64.93**	0	Output mapping parameter 34.
Pr **64.94**	0	Output mapping parameter 35.
Pr **64.95**	0	Output mapping parameter 36.
Pr **64.96**	0	Output mapping parameter 37.
Pr **64.97**	0	Output mapping parameter 38.
Pr **64.98**	0	Output mapping parameter 39.
Pr **64.99**	0	Output mapping parameter 40.

NOTE   The parameters in Table 13.2 are configured internally by the web pages and should not be altered via parameter access directly.

14   Glossary of terms

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

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.

Assembly object: A software component within the SM-Ethernet which allows access to the parameters within the drive or which allows control and monitoring of the drive by using the EtherNet/IP protocol.

Attribute: A sub-division of a *Class* which uniquely identifies a specific command. e.g. The *VendorID* is an attribute of the *Identity object* class. Used in conjunction with the *Class* and *Instance* properties.

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

ADU: Application Data Unit. The complete Modbus message frame (ADU) consists of the Modbus Application Protocol (MBAP) and Protocol Data Unit (PDU).

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

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

Class: A collection of properties which allow the control or monitoring of a device. Used in conjunction with the *Instance* and *Attribute* properties.

Consistency: A method of ensuring that the data transferred over the network is transmitted as a single entity, thus preventing data skew when multiple bytes are transmitted.

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.

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.

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.

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

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

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

DHCP: Dynamic Host Configuration Protocol. This is a method of allocating IP settings of a node from a central server.

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

EDS File: Electronic Data Sheet file. A file which specifies the EtherNet/IP device functionality.

Ethernet address: *See MAC address.*

EtherNet/IP: An industrial application layer protocol for communicating to devices over Ethernet. The EtherNet/IP protocol communicates to the drive using assembly objects.

Exception codes: An error response from Modbus.

Explicit data: *See Non-cyclic data.*

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

FTP: File Transfer Protocol. Used for transferring files.

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

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.*

Instance: A collection of properties (**Attributes**) that are contained within a *Class*. Used in conjunction with the *Class* and *Attribute* properties.

IP: Internet Protocol, this is the protocol used to transmit bytes across an IP network.

IP address: An address that identifies a node uniquely on a subnet or network.

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

LED: Light Emmiting 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-Ethernet 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.

MBAP: Modbus application protocol. This is a 7 byte header added to the main Modbus telegram (PDU) which contains IP specific identifiers.

Modbus IP: A protocol that allows Modbus to be sent over TCP/IP. The modbus protocol allows manipulation of the parameters within the host drive and SM-Ethernet.

MSB: Most Significant Bit/Byte.

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".

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

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

PC: Personal Computer.

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: Programming Logic Controller.

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

Polled data: *See Cyclic data*.

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

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

Scan rate: See *Poll rate*.

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

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

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

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.

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

URL: Uniform Resource Locator. A method used to give a web site a friendly name such as *www.controltechniques.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 transfer data.

Index

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

Safety information

Introduction

Mechanical installation

Electrical installation

Getting started

Protocols

Web page basics

FTP/custom pages

Applications

Security

Diagnostics

Advanced features

Quick reference

Glossary of terms

Index

128

Safety information
Introduction
Mechanical installation
Electrical installation
Getting started
Protocols
Web page basics
FTP/custom pages
Applications
Security
Diagnostics
Advanced features
Quick reference
Glossary of terms
Index