User Guide

SI-BACnet IP

Part Number: 0478-0739-02 Issue 2

Compliance Information

Manufacturer: Nidec Control Techniques Limited ("we", "our")
Registered office: The Gro, Newtown, Powys, SY16 3BE United Kingdom
Registered in: England and Wales, company registration number 01236886
Manufacturer's EU Authorised Representative: Nidec Netherlands B.V., Kubus 155, 3364 DG Sliedrecht, the Netherlands, registered at the Dutch Trade Register under number 33213151; Tel. +31 (0)184 420 555, info.nl@mail.nidec.com

Original instructions

With reference to the UK Supply of Machinery (Safety) Regulations 2008 and the EU Machinery Directive 2006/42/EC, the English version of this Manual constitutes the original instructions. Manuals published in other languages are translations of the original instructions and the English language version of this Manual prevails over any other language version in the event of inconsistency.

Documentation and user software tools

Manuals, datasheets and software that we make available to users of our products can be downloaded from: **http://www.controltechniques.com/support.**
Manuals may be accompanied by an Errata list. This will be located alongside the manuals if applicable.

Warranty and liability

The contents of this Manual are presented for information purposes only, and while every effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. All sales are governed by our terms and conditions, which are available on request. We reserve the right to modify or improve the designs, specifications or performance of our products at any time without notice. For full details of the warranty terms applicable to the product, contact the supplier of the product.

In no event and under no circumstances shall we be liable for damages and failures due to misuse, abuse, improper installation, or abnormal conditions of temperature, dust, or corrosion, or failures due to operation outside the published ratings for the product, nor shall we be liable for consequential and incidental damages of any kind.

Environmental management

We operate an Environmental Management System which complies with the requirements of ISO 14001:2015. Further information on our Environmental Statement can be found at: **http://www.controltechniques.com/environment**.

Restriction and control of hazardous substances

The products covered by this Manual comply with the following legislation and regulations on the restriction and control of hazardous substances:

UK Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
UK REACH etc. (Amendment etc.) (EU Exit) Regulations 2020, European Union REACH Regulation EC 1907/2006
EU restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) - Directive 2011/65/EU
EC Regulation 1907/2006 on the Registration, Evaluation, authorisation, and restriction of Chemicals (REACH)
Chinese Administrative Measures for Restriction of Hazardous Substances in Electrical and Electronic Products 2016/07/01
U.S. Environmental Protection Agency ("EPA") regulations under the Toxic Substances Control Act ("TSCA")
MEPC 68/21 / Add.1, Annex 17, Resolution MEPC.269(68) 2015 Guidelines for the development of the inventory of hazardous materials

The products covered by this Manual do not contain asbestos.

Further information on REACH and RoHS can be found at: **http://www.controltechniques.com/environment**.

Conflict minerals

With reference to the Conflict Minerals (Compliance) (Northern Ireland) (EU Exit) Regulations 2020, the U.S. Dodd-Frank Wall Street Reform and Consumer Protection Act and Regulation (EU) 2017/821 of the European Parliament and of the European Council:

We have implemented due diligence measures for responsible sourcing, we conduct conflict minerals surveys of relevant suppliers, we continually review due diligence information received from suppliers against company expectations and our review process includes corrective action management. We are not required to file an annual conflict minerals disclosure. Nidec Control Techniques Limited is not an issuer as defined by the U.S. SEC.

Disposal and recycling (WEEE)

When electronic products reach the end of their useful life, they must not be disposed of along with domestic waste but should be recycled by a specialist recycler of electronic equipment. Control Techniques products are designed to be easily dismantled into their major component parts for efficient recycling. The majority of materials used in the product are suitable for recycling.

Product packaging is of good quality and can be re-used. Large products are packed in wooden crates. Smaller products are packaged in strong cardboard cartons which have a high recycled fibre content. Cartons can be re-used and recycled. Polythene, used in protective film and bags for wrapping the product, can be recycled. When preparing to recycle or dispose of any product or packaging, please observe local legislation and best practice.

CONTROL TECHNIQUES

Contents

1 Safety information

1.1 Warnings, cautions and notes

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

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 Important safety information. Hazards. Competence of designers and installers

This guide applies to products which control electric motors either directly (drives) or indirectly (controllers, option modules and other auxiliary equipment and accessories). In all cases the hazards associated with powerful electrical drives are present, and all safety information relating to drives and associated equipment must be observed.

Specific warnings are given at the relevant places in this guide.

Drives and controllers are intended as components for professional incorporation into complete systems. If installed incorrectly they may present a safety hazard. The drive uses high voltages and currents, carries a high level of stored electrical energy, and is used to control equipment which can cause injury. Close attention is required to the electrical installation and the system design to avoid hazards either in normal operation or in the event of equipment malfunction. System design, installation, commissioning/start-up and maintenance must be carried out by personnel who have the necessary training and competence. They must read this safety information and this guide carefully.

1.3 Responsibility

It is the responsibility of the installer to ensure that the equipment is installed correctly with regard to all instructions given in this guide. They must give due consideration to the safety of the complete system, so as to avoid the risk of injury both in normal operation and in the event of a fault or of reasonably foreseeable misuse.

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation of the equipment.

1.4 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 ground (earth) connections.

This guide contains instructions for achieving compliance with specific EMC standards.

All machinery to be supplied within the European Union in which this product is used must comply with the following directives:

2006/42/EC Safety of machinery.

2014/30/EU: Electromagnetic Compatibility.

1.5 Electrical hazards

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. Hazardous voltage may be present in any of the following locations:

- AC and DC supply cables and connections
- Output cables and connections
- Many internal parts of the drive, and external option units

Unless otherwise indicated, control terminals are single insulated and must not be touched.

The supply must be disconnected by an approved electrical isolation device before gaining access to the electrical connections.

The STOP and Safe Torque Off functions of the drive do not isolate dangerous voltages from the output of the drive or from any external option unit.

The drive must be installed in accordance with the instructions given in this guide. Failure to observe the instructions could result in a fire hazard.

1.6 Stored electrical charge

The drive contains capacitors that remain charged to a potentially lethal voltage after the AC supply has been disconnected. If the drive has been energized, the AC supply must be isolated at least ten minutes before work may continue.

1.7 Mechanical hazards

Careful consideration must be given to the functions of the drive or controller which might result in a hazard, either through their intended behaviour 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.

With the sole exception of the Safe Torque Off function, none of the drive functions must be used to ensure safety of personnel, i.e. they must not be used for safety-related functions.

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

The design of safety-related control systems must only be done by personnel with the required training and experience. The Safe Torque Off function will only ensure the safety of a machine if it is correctly incorporated into a complete safety system. The system must be subject to a risk assessment to confirm that the residual risk of an unsafe event is at an acceptable level for the application.

1.8 Access to equipment

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

1.9 Environmental limits

Instructions in this guide regarding transport, storage, installation and use of the equipment must be complied with, including the specified environmental limits. This includes temperature, humidity, contamination, shock and vibration. Drives must not be subjected to excessive physical force.

1.10 Hazardous environments

The equipment must not be installed in a hazardous environment (i.e. a potentially explosive environment).

1.11 Motor

The safety of the motor under variable speed conditions must be ensured.

To avoid the risk of physical injury, do not exceed the maximum specified speed of the motor.

Low speeds may cause the motor to overheat because the cooling fan becomes less effective, causing a fire hazard. 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 must not be relied upon. It is essential that the correct value is entered in the Motor Rated Current parameter.

1.12 Mechanical brake control

Any brake control functions are provided to allow well co-ordinated operation of an external brake with the drive. While both hardware and software are designed to high standards of quality and robustness, they are not intended for use as safety functions, i.e. where a fault or failure would result in a risk of injury. In any application where the incorrect operation of the brake release mechanism could result in injury, independent protection devices of proven integrity must also be incorporated.

1.13 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.

1.14 Electromagnetic compatibility (EMC)

Installation instructions for a range of EMC environments are provided in the relevant Power Installation Guide. If the installation is poorly designed or other equipment does not comply with suitable standards for EMC, the product might cause or suffer from disturbance due to electromagnetic interaction with other equipment. It is the responsibility of the installer to ensure that the equipment or system into which the product is incorporated complies with the relevant EMC legislation in the place of use.

2 Introduction

2.1 What is BACnet?

BACnet is a communication protocol for building automation and control networks. It is intended to provide interoperability among different vendors' equipment.

2.2 SI-BACnet IP

The following standards and profiles are supported by the SI-BACnet IP option module:

- BACnet Specification Standard 135-2016
- BACnet communication protocol version 1 revision 19 over an Ethernet (IP) network
- BACnet Application Specific Controller (B-ASC) Profile.

The SI-BACnet IP option module acts as a data server on the BACnet network only.

2.3 Supported drives

The SI-BACnet IP option module supports the following drives:

- HVAC drive H300
- Pump drive F600
- Commander C200
- Commander C300
- Commander C300 PM

NOTE

If fitted to any other drive, the SI-BACnet IP module will regard it as an HVAC H300 drive.

Table 2-1 shows the supported BACnet objects.

Table 2-1 BACnet/IP Protocol Supported Drives and Objects

Object Name	H300			F600			C200		C300		C300 PM
	OL	RFC-A	RFC-S	OL	RFC-A	RFC-S	OL	RFC-A	OL	RFC-A	PM
AI-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AI-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AO-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AO-2	✓	✓	✓	✓	✓	✓	x	x	x	x	x
AV-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-4	✓	✓	✓	✓	✓	✓	x	x	x	x	x
AV-5	✓	✓	✓	✓	✓	✓	x	x	x	x	x
AV-6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-7	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-9	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-11	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-12	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-13	✓	x	x	✓	x	x	✓	✓	✓	✓	✓
AV-14	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-15	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-16	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Object Name	H300			F600			C200		C300		C300 PM
	OL	RFC-A	RFC-S	OL	RFC-A	RFC-S	OL	RFC-A	OL	RFC-A	PM
AV-17	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-18	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-19	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-20	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-21	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-22	✓	✓	✓	✓	✓	✓	x	x	x	x	x
AV-23	✓	✓	✓	✓	✓	✓	x	x	x	x	x
AV-24	✓	✓	✓	✓	✓	✓	x	x	x	x	x
AV-25	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-26	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-27	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-28	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-29	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-30	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-31	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-32	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-33	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AV-34	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BI-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BI-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BI-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BI-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BI-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BI-6	✓	✓	✓	✓	✓	✓	x	x	x	x	x
BI-7	✓	✓	✓	✓	✓	✓	x	x	✓	✓	✓
BO-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BO-2	✓	✓	✓	✓	✓	✓	x	x	x	x	x
BO-3	✓	✓	✓	✓	✓	✓	x	x	x	x	x
BO-4	✓	✓	✓	✓	✓	✓	x	x	x	x	x
BO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BO-6	✓	✓	✓	✓	✓	✓	x	x	x	x	x
BV-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BV-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BV-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BV-4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BV-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BV-6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Device	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MSV-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NP-1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NP-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

NOTES

AI = ANALOG_INPUT
AO = ANALOG_OUTPUT
AV = ANALOG_VALUE
BI = BINARY_INPUT
BO = BINARY_OUTPUT
BV = BINARY_VALUE
MSV = MULTI_STATE_VALUE
NP = NETWORK_PORT

Table 2-2 BACnet objects to drive parameter mapping

Object		Default Source/Destination Mapped Parameter											
		H300			C200		C300		C300 PM		F600		
ID	Name / Mapping	OL	RFC-A	RFC-S	OL	RFC-A	OL	RFC-A	OL	RFC-A	OL	RFC-A	RFC-S
AI-1	Analog Input 1 (07.001)	01.036	01.036	01.036	01.036	01.036	01.036	01.036	01.036	01.036	29.034	29.034	29.034
AI-2	Analog Input 2 (07.002)	01.037	01.037	01.037	01.037	01.037	01.037	01.037	01.037	01.037	01.036	01.036	01.036
AO-1	Analog Output 1 (07.019[1])	05.001	03.002	03.002	02.001	02.001	02.001	02.001	02.001	02.001	05.001	03.002	03.001
AO-2	Analog Output 2 (07.022[1])	04.002	04.002	04.002	N/A	N/A	N/A	N/A	N/A	N/A	04.002	04.002	04.002
AV-1	Analog Value 1 (01.021) Speed Ref	01.021	01.021	01.021	01.021	01.021	01.021	01.021	01.021	01.021	01.021	01.021	01.021
AV-2	Analog Value 2 (14.025) PID1 Dig Ref	14.025	14.025	14.025	14.025	14.025	14.025	14.025	14.025	14.025	14.025	14.025	14.025
AV-3	Analog Value 3 (14.026) PID1 Dig Fback	14.026	14.026	14.026	14.026	14.026	14.026	14.026	14.026	14.026	14.026	14.026	14.026
AV-4	Analog Value 4 (14.055) PID2 Dig Ref	14.055	14.055	14.055	N/A	N/A	N/A	N/A	N/A	N/A	14.055	14.055	14.055
AV-5	Analog Value 5 (14.056) PID2 Dig Fback	14.056	14.056	14.056	N/A	N/A	N/A	N/A	N/A	N/A	14.056	14.056	14.056
AV-6	Analog Value 6 (01.006) Max Speed Ref	01.006	01.006	01.006	01.006	01.006	01.006	01.006	01.006	01.006	01.006	01.006	01.006
AV-7	Analog Value 7 (10.038) User Trip Param	10.038	10.038	10.038	10.038	10.038	10.038	10.038	10.038	10.038	10.038	10.038	10.038
AV-8	Analog Value 8 (06.021) Filtr Change(dt)	06.021	06.021	06.021	06.021	06.021	06.021	06.021	06.021	06.021	06.021	06.021	06.021
AV-9	Analog Value 9 (04.001) Output Current	04.001	04.001	04.001	04.001	04.001	04.001	04.001	04.001	04.001	04.001	04.001	04.001
AV-10	Analog Value 10 (05.001) Output Frequency	05.001	05.001	05.001	05.001	05.001	05.001	05.001	05.001	05.001	05.001	05.001	05.001
AV-11	Analog Value 11 (05.003) Output Power	05.003	05.003	05.003	05.003	05.003	05.003	05.003	05.003	05.003	05.003	05.003	05.003
AV-12	Analog Value 12 (04.020) Output Torque	04.020	04.020	04.020	04.020	04.020	04.020	04.020	04.020	04.020	04.020	04.020	04.020
AV-13	Analog Value 13 (05.004) Output Speed	05.004	N/A	N/A	05.004	05.004	05.004	05.004	05.004	05.004	05.004	N/A	N/A
AV-14	Analog Value 14 (10.040) Drive Status Wd	10.040	10.040	10.040	10.040	10.040	10.040	10.040	10.040	10.040	10.040	10.040	10.040
AV-15	Analog Value 15 (10.020) Last Trip	10.020	10.020	10.020	10.020	10.020	10.020	10.020	10.020	10.020	10.020	10.020	10.020
AV-16	Analog Value 16 (06.023) Nxt Filtr Ch Time	06.023	06.023	06.023	06.023	06.023	06.023	06.023	06.023	06.023	06.023	06.023	06.023
AV-17	Analog Value 17 (6.025) Energy Meter(MWh)	06.025	06.025	06.025	06.025	06.025	06.025	06.025	06.025	06.025	06.025	06.025	06.025
AV-18	Analog Value 18 (6.026) Energy Meter(kWh)	06.026	06.026	06.026	06.026	06.026	06.026	06.026	06.026	06.026	06.026	06.026	06.026
AV-19	Analog Value 19 (14.020) PID1 Ref	14.020	14.020	14.020	14.020	14.020	14.020	14.020	14.020	14.020	14.020	14.020	14.020
AV-20	Analog Value 20 (14.021) PID1 Fback	14.021	14.021	14.021	14.021	14.021	14.021	14.021	14.021	14.021	14.021	14.021	14.021
AV-21	Analog Value 21 (14.001) PID1 Output	14.001	14.001	14.001	14.001	14.001	14.001	14.001	14.001	14.001	14.001	14.001	14.001

Object		Default Source/Destination Mapped Parameter											
		H300			C200		C300		C300 PM		F600		
ID	Name / Mapping	OL	RFC-A	RFC-S	OL	RFC-A	OL	RFC-A	OL	RFC-A	OL	RFC-A	RFC-S
AV-22	Analog Value 22 (14.050) PID2 Ref	14.050	14.050	14.050	N/A	N/A	N/A	N/A	N/A	N/A	14.050	14.050	14.050
AV-23	Analog Value 23 (14.051) PID2 Fback	14.051	14.051	14.051	N/A	N/A	N/A	N/A	N/A	N/A	14.051	14.051	14.051
AV-24	Analog Value 24 (14.031) PID2 Output	14.031	14.031	14.031	N/A	N/A	N/A	N/A	N/A	N/A	14.031	14.031	14.031
AV-25	Analog Value 25 (S.04.001) User Configurable Param 1	S.04.001	S.04.001	S.04.001	S.04.001	S.04.001	S.04.001	S.04.001	S.04.001	S.04.001	S.04.001	S.04.001	S.04.001
AV-26	Analog Value 26 (S.04.002) User Configurable Param 2	S.04.002	S.04.002	S.04.002	S.04.002	S.04.002	S.04.002	S.04.002	S.04.002	S.04.002	S.04.002	S.04.002	S.04.002
AV-27	Analog Value 27 (S.04.003) User Configurable Param 3	S.04.003	S.04.003	S.04.003	S.04.003	S.04.003	S.04.003	S.04.003	S.04.003	S.04.003	S.04.003	S.04.003	S.04.003
AV-28	Analog Value 28 (S.04.004) User Configurable Param 4	S.04.004	S.04.004	S.04.004	S.04.004	S.04.004	S.04.004	S.04.004	S.04.004	S.04.004	S.04.004	S.04.004	S.04.004
AV-29	Analog Value 29 (S.04.005) User Configurable Param 5	S.04.005	S.04.005	S.04.005	S.04.005	S.04.005	S.04.005	S.04.005	S.04.005	S.04.005	S.04.005	S.04.005	S.04.005
AV-30	Analog Value 30 (S.04.006) User Configurable Param 6	S.04.006	S.04.006	S.04.006	S.04.006	S.04.006	S.04.006	S.04.006	S.04.006	S.04.006	S.04.006	S.04.006	S.04.006
AV-31	Analog Value 31 (S.04.007) User Configurable Param 7	S.04.007	S.04.007	S.04.007	S.04.007	S.04.007	S.04.007	S.04.007	S.04.007	S.04.007	S.04.007	S.04.007	S.04.007
AV-32	Analog Value 32 (S.04.008) User Configurable Param 8	S.04.008	S.04.008	S.04.008	S.04.008	S.04.008	S.04.008	S.04.008	S.04.008	S.04.008	S.04.008	S.04.008	S.04.008
AV-33	Analog Value 33 (S.04.009) User Configurable Param 9	S.04.009	S.04.009	S.04.009	S.04.009	S.04.009	S.04.009	S.04.009	S.04.009	S.04.009	S.04.009	S.04.009	S.04.009
AV-34	Analog Value 34 (S.04.010) User Configurable Param 10	S.04.010	S.04.010	S.04.010	S.04.010	S.04.010	S.04.010	S.04.010	S.04.010	S.04.010	S.04.010	S.04.010	S.04.010
BI-1	Binary Input 1 Digital I/O 1 State	08.001	08.001	08.001	08.001	08.001	08.001	08.001	08.001	08.001	08.001	08.001	08.001
BI-2	Binary Input 2 Digital I/O 2 State	08.002	08.002	08.002	08.002	08.002	08.002	08.002	08.002	08.002	08.002	08.002	08.002
BI-3	Binary Input 3 Digital I/O 3 State	08.003	08.003	08.003	08.003	08.003	08.003	08.003	08.003	08.003	08.003	08.003	08.003
BI-4	Binary Input 4 Drive Binary IP4	08.004	08.004	08.004	08.004	08.004	08.004	08.004	08.004	08.004	08.004	08.004	08.004
BI-5	Binary Input 5 Drive Binary IP5	08.005	08.005	08.005	08.005	08.005	08.005	08.005	08.005	08.005	08.005	08.005	08.005
BI-6	Binary Input 6 Drive Binary IP6	08.006	08.006	08.006	N/A	N/A	N/A	N/A	N/A	N/A	08.006	08.006	08.006
BI-7	Binary Input 7 STO IP 1	08.009	08.009	08.009	N/A	N/A	08.039	08.039	08.039	08.039	08.009	08.009	08.009
BO-1	Binary Output 1 (08.021) Drive Binary OP1	08.001	08.001	08.001	08.001	08.001	08.001	08.001	08.001	08.001	08.001	08.001	08.001
BO-2	Binary Output 2 (08.022) Drive Binary OP2	08.002	08.002	08.002	N/A	N/A	N/A	N/A	N/A	N/A	08.002	08.002	08.002
BO-3	Binary Output 3 (08.023) Drive Binary OP3	08.003	08.003	08.003	N/A	N/A	N/A	N/A	N/A	N/A	08.003	08.003	08.003
BO-4	Binary Output 4 Drive Binary OP4 24V	08.008	08.008	08.008	N/A	N/A	N/A	N/A	N/A	N/A	08.008	08.008	08.008

Object		Default Source/Destination Mapped Parameter											
		H300			C200		C300		C300 PM		F600		
ID	Name / Mapping	OL	RFC-A	RFC-S	OL	RFC-A	OL	RFC-A	OL	RFC-A	OL	RFC-A	RFC-S
BO-5	Binary Output 5 Drive Binary RI1	08.007	08.007	08.007	08.008	08.008	08.008	08.008	08.008	08.008	08.007	08.007	08.007
BO-6	Binary Output 6 Drive Binary RI2	08.045	08.045	08.045	N/A	N/A	N/A	N/A	N/A	N/A	08.045	08.045	08.045
BV-1	Binary Value 1 Reset Energy Metr	06.024	06.024	06.024	06.024	06.024	06.024	06.024	06.024	06.024	06.024	06.024	06.024
BV-2	Binary Value 2 Filtr Change Rqd	06.022	06.022	06.022	06.022	06.022	06.022	06.022	06.022	06.022	06.022	06.022	06.022
BV-3	Binary Value 3 Drive Run Fwrd	06.030	06.030	06.030	06.030	06.030	06.030	06.030	06.030	06.030	06.034	06.034	06.034
BV-4	Binary Value 4 Drive Healthy	10.001	10.001	10.001	10.001	10.001	10.001	10.001	10.001	10.001	10.001	10.001	10.001
BV-5	Binary Value 5 Drive Warning	10.019	10.019	10.019	10.019	10.019	10.019	10.019	10.019	10.019	10.019	10.019	10.019
BV-6	Binary Value 6 Drive Reset	10.033	10.033	10.033	10.033	10.033	10.033	10.033	10.033	10.033	10.033	10.033	10.033

[1] - Pointer parameter (value specifies the parameter to be used as the source or destination parameter).

2.4 Features

The following list gives an overview of the functionality available:

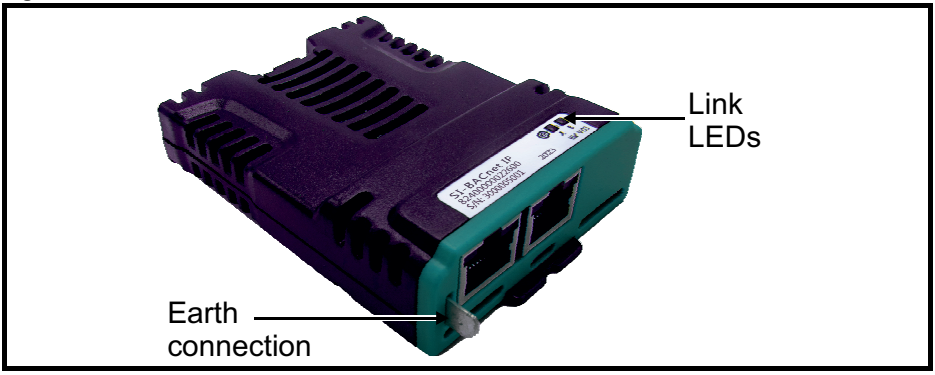
- Dual RJ45 connectivity with support for shielded twisted pair.
- 100 Mbs Ethernet.
- Full and half duplex operation.
- Auto crossover detection.
- Modbus TCP/IP.
- BACnet IP.
- Unidrive M Connect over Ethernet.
- Machine Control Studio over Ethernet.
- Static IP configuration.

2.5 Backup/auxiliary supply

Some drives provide a method of powering up the control circuits (and therefore any option module installed) if the AC supply is removed, this allows BACnet IP communication to continue operating when the main AC supply is switched off.

2.6 Option module identification

Figure 2-1 SI-BACnet IP



The BACnet IP can be identified by:
1. The label located on the topside of the option module.

2. The colour coding across the front of the option module. SI-BACnet IP being Water Blue.

Figure 2-2 SI-BACnet IP label

2.6.1 Date code format

The date code is four numbers. The first two numbers indicate the year and the remaining numbers indicate the week of the year in which the module was built.

Example:

A date code of 2405 would correspond to week 5 of year 2024.

2.7 Conventions used in this guide

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

In the case of an option module, the option module set-up parameters in menu 0 will appear in drive menu 15, 16 or 17 depending on which slot the module is installed in.

The setting of the Option Slot Identifiers (Pr **11.056**) may change the slot numbering from those described above.

NOTE For Commander C200 / C300 drives, the option module set-up parameters will appear in menu 15, and the Option Slot Identifier (Pr **11.056**) is not available

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

- Pr **S.mm.ppp** - Where **S** signifies the option module slot number and **mm.ppp** signifies the menu and parameter number respectively.
  If the option module slot number is not specified then the parameter reference will be a drive parameter.
- Pr **MM.ppp** - Where **MM** signifies the menu allocated to the option module setup menu and **ppp** signifies the parameter number within the set-up menu.
- Pr **mm.000** - Signifies parameter number 000 in any drive menu.

2.8 Firmware Statement

This product is supplied with the latest firmware version. When retro-fitting to an existing system, all firmware versions should be verified to confirm the same functionality as products of the same type already present. This also applies to products returned from a Nidec Industrial Automation's Service Centre or Repair Centre. If there is any doubt please contact the supplier of the product.

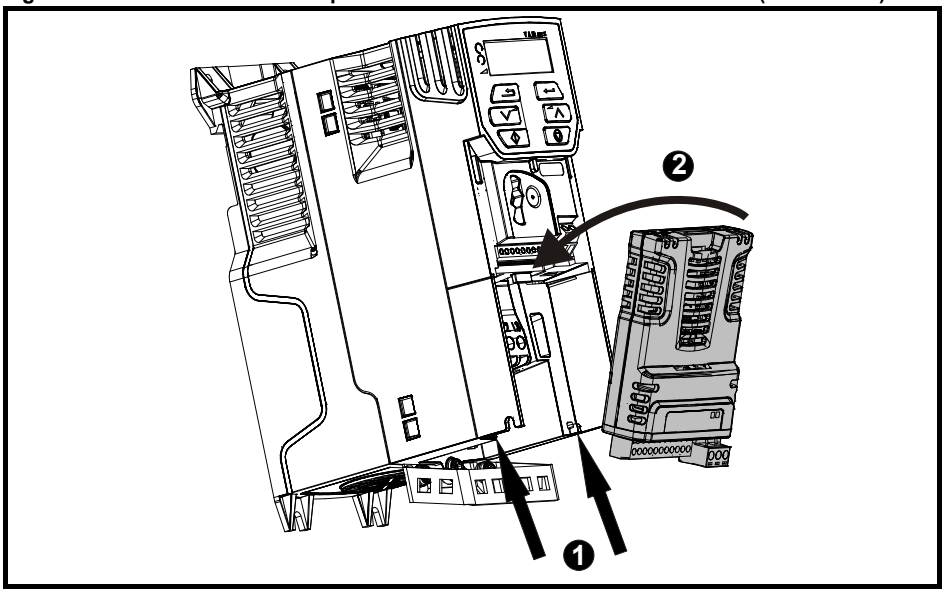
The firmware version of the product can be identified by looking at Pr **MM.002** where **MM** is the relevant menu number for the module slot being used.

3 Mechanical installation

WARNING

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

Figure 3-1 Installation of an SI option module on Commander C200 / C300 (sizes 2 to 4)

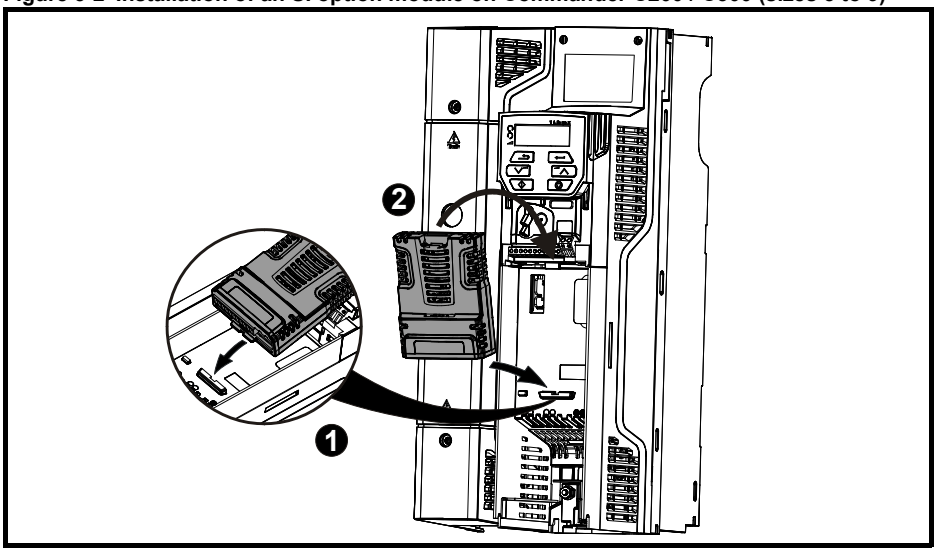


- With the option module tilted slightly backwards, align and locate the two holes in the rear of the option module onto the two tabs (1) on the drive.
- Place the option module onto the drive as shown in (2) until the module clicks into place. The terminal cover on the drive holds the option module in place, so this must be put back on.

NOTE Option modules can only be installed on drives that have the option module slot functionality.

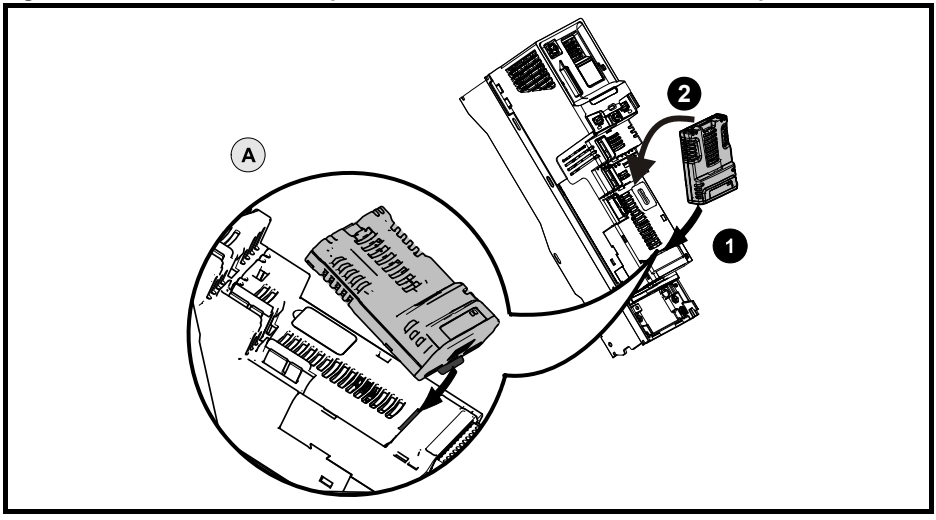
NOTE Figure 3-1 above is for illustration only, the actual option module may be different to the one shown.

Figure 3-2 Installation of an SI option module on Commander C200 / C300 (sizes 5 to 9)



- Place the option module onto the drive as shown in (2) until the module clicks into place. The terminal cover on the drive holds the option module in place, so this must be put back on.

Figure 3-3 Installation of an SI option module on HVAC Drive H300 or Pump Drive F600



- Move the option module in direction shown (1/2).
- Align and insert the option module tab in to the slot provided, this is highlighted in the detailed view (A).
- Press down on the option module until it clicks into place.

NOTE Option module slots must be used in the following order: Slot 3 (lower), Slot 2 (middle) and then Slot 1(upper).

4 Electrical installation

4.1 SI-BACnet IP module information

SI-BACnet IP provides two standard RJ45 UTP/STP (*Un-shielded/Shielded Twisted Pair*) connections to a 100 Mbs Ethernet system. In addition to the RJ45 connectors, a grounding tag is supplied for supplementary bonding. SI-BACnet IP provides 2 diagnostic LEDs for status and information purposes located on the module topside.

Figure 4-1 SI-BACnet IP

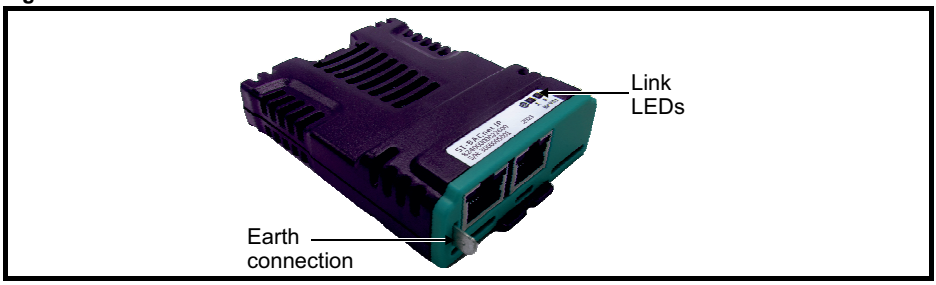
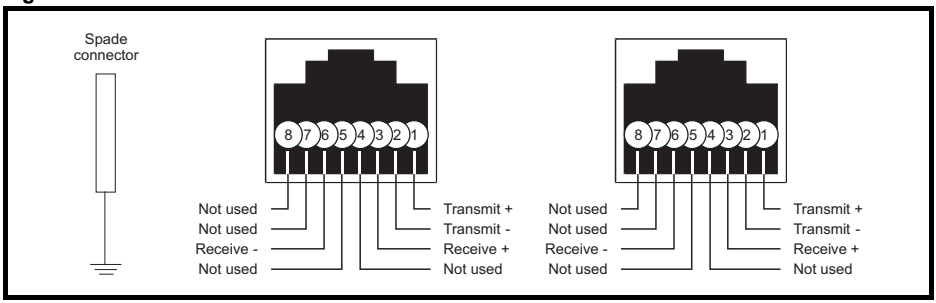


Figure 4-1 shows an overview of the module connections and indicators.

Figure 4-2 Ethernet connections



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.

Any isolated signal circuit has the capability to become live through accidental contact with other conductors; as such they should always be double-insulated from live parts. The routing of network and signal wires should be done so as to avoid close proximity to mains voltage cabling.

4.3 Module grounding

SI-BACnet IP 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 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 fibre 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 4-1. 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 4-1 Ethernet maximum network lengths

Type Of Cable	Data rate (bit/s)	Maximum trunk length (m)
Copper - UTP/STP CAT 5	100 M	100
Fibre Optic - Multi-mode		3000
Fibre Optic - Single-mode		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 Network topology

The SI-BACnet IP option module supports multiple network topologies this allows the user to design a robust network using the topology that works best for the chosen design.

Star topology:

- Enables individual devices to be swapped out
- Minimise message transmission delays

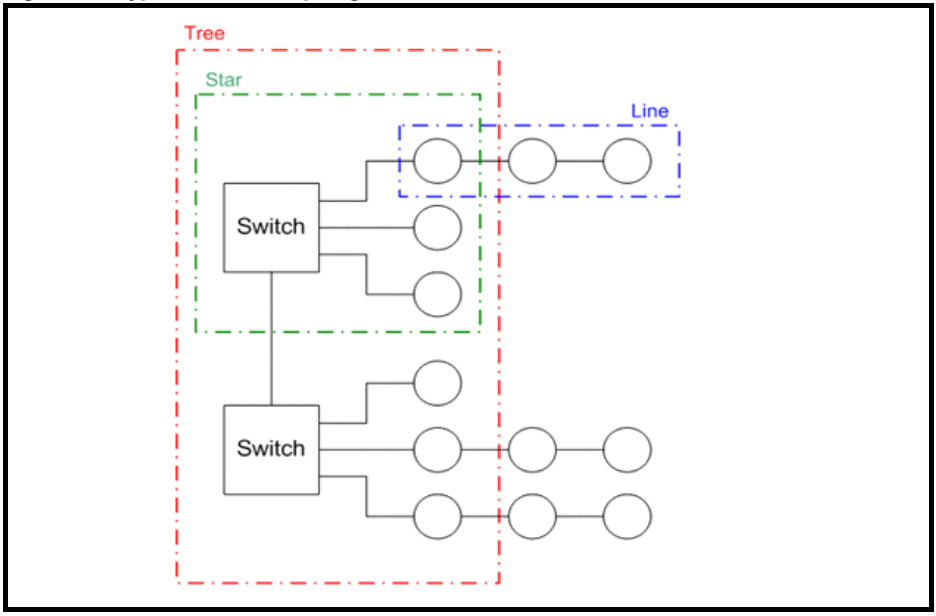
Line topology (daisy chain):

- Simple wiring
- Lowest cost

Tree topology:

- Maximises bandwidth - contains messages within appropriate segments
- Products can be connected in functional groups, e.g. to enable one section of a machine to be turned off

Figure 4-3 Typical network topologies



5 Getting started

5.1 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 supported.

5.2 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 5.6.1 The IP address* on page 23). Generally devices on different subnets can only communicate by using a gateway (*typically a router or firewall*).

5.3 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.

5.4 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 reserved 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.

5.5 Class types

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

When selecting the class of IP address required, consideration must be given to how many subnets you need, how many hosts are required and if you will need a public (*worldwide*) or a private (*local*) addressing scheme. Table 5-1 shows an overview of how the class types are defined and Table 5-2 shows how each class separates the subnet and host ID.

Table 5-1 Subnets and hosts supported by class type

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

Table 5-2 Address components

Address Class	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.

5.5.1 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.

5.5.2 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.

5.5.3 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.

5.5.4 Class D & E addresses

These addresses are reserved for multicasting and experimental use.

5.6 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.

5.6.1 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*)

5.6.2 The subnet mask

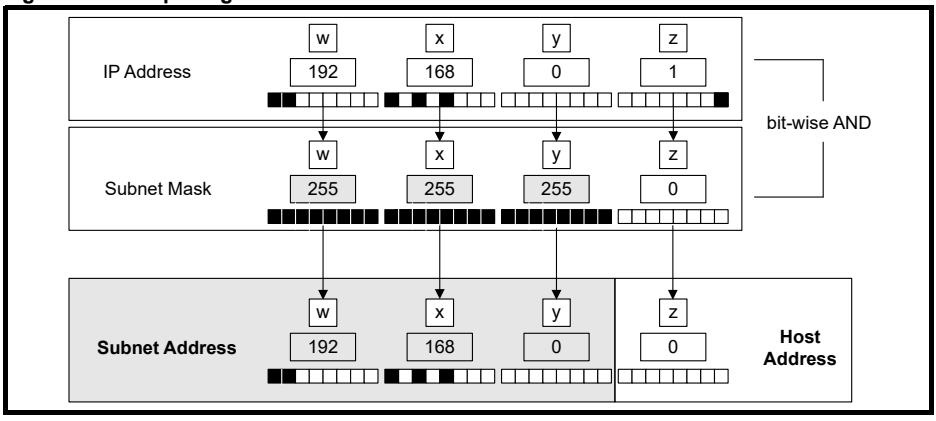
The subnet mask defines what part of the address constitutes the subnet within the IP address and what part of the address constitutes the host address. The subnet mask is bit-wise ANDed with the address to give the subnet to which the host belongs. A typical class C subnet mask would be 255.255.255.0, 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*

5.6.3 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.

Figure 5-1 Completing the address



5.7 Static IP addressing

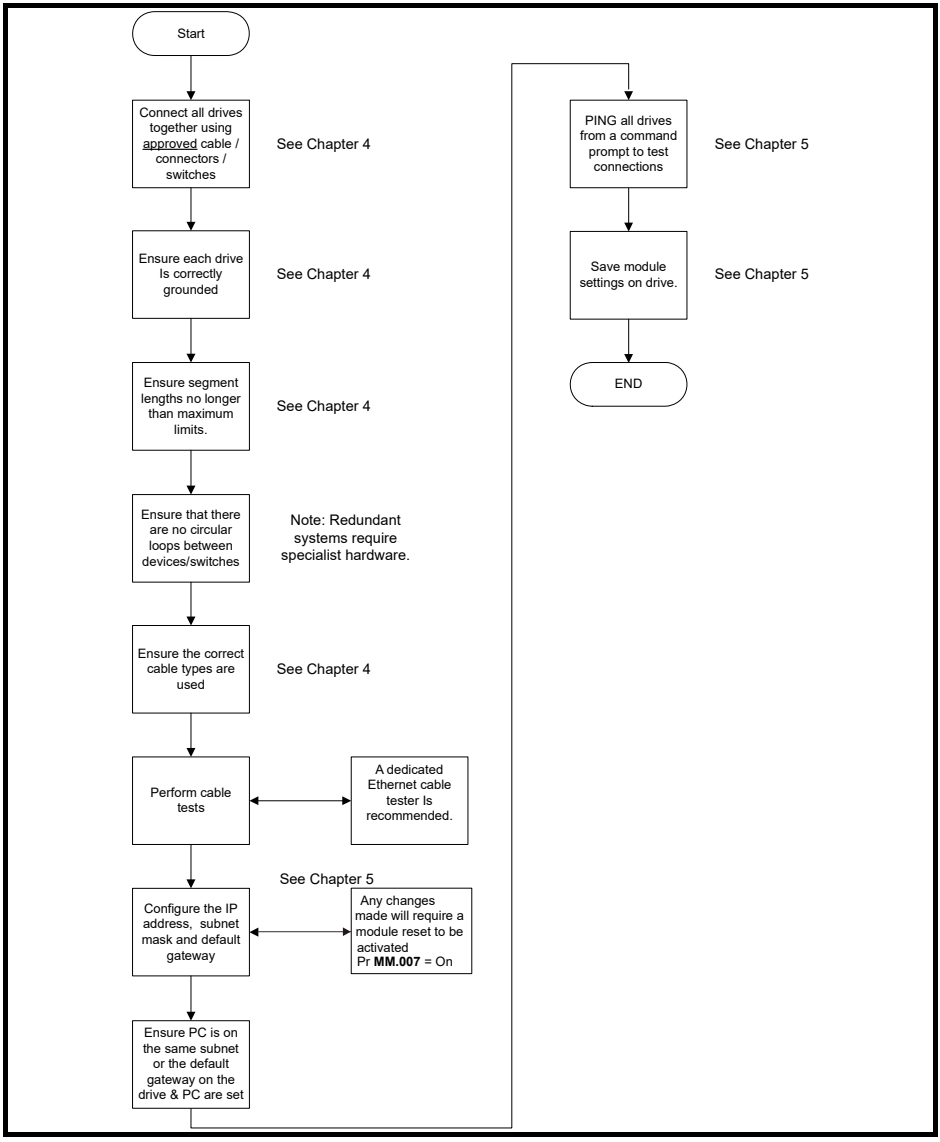
Using fixed IP addresses (*manually configured*) means that if a module fails, the IP address can be restored to a replacement module without the need to reconfigure the DHCP server. Using fixed addresses also prevents the DHCP server from changing the address. When using fixed IP addresses, it is vital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

5.8 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.

5.9 Set-up flow chart



5.10 Single line parameter descriptions

Table 5-3 lists the coding used for the parameter type in the subsequent parameter description tables.

Table 5-3 Parameter type coding

RW	Read / Write	RO	Read-only	Bit	Bit parameter	Txt	Text string	Date	Date parameter	Time	Time parameter
Chr	Character parameter	Bin	Binary parameter	IP	IP address	Mac	MAC address	Ver	Version number	SMP	Slot, menu, parameter
Num	Number parameter	DE	Destination	ND	No default value	RA	Rating dependent	NC	Non-copyable	PT	Protected
FI	Filtered	US	User save	PS	Power-down save	BU	Bit default or Unipolar	MPN	Menu, parameter		

5.10.1 Internal menus

The SI-BACnet IP module provides parameters for configuration and information, these parameters are grouped into menus as shown in Table 5-4

Table 5-4 SI-BACnet IP internal menus

Menu	Name	Description
S.00	Module Setup	Provides module information such as firmware version, serial number and status
S.02	Ethernet Configuration	Configures and provides information on the Ethernet network
S.03	BACnet IP Configuration	Configures and provides information on the BACnet network
S.04	BACnet IP User Params	Provides ten user configurable parameters for analog values
S.15	Modbus TCP/IP Setup	Configures and provides information on the Modbus Protocol

NOTE The SI-BACnet IP module must be reset (Pr **S.00.007** = On) for any parameter changes to become active

5.10.2 Menu 0 - Module Setup (MM.ppp)

Table 5-5 Menu 0 parameters

Parameter		Range	Default	Access	Size (Bits)
S.00.000	Parameter mm.000	0 to 65535		RW	16
S.00.001	Module ID	0 to 65535		RO	16
S.00.002	Software Version	00.00.00.00 to 99.99.99.99		RO	32
S.00.003	Hardware Version	0.00 to 655.35		RO	16
S.00.004	Serial Number LS	0 to 99999999		RO	32
S.00.005	Serial Number MS	0 to 99999999		RO	32
S.00.006	Status	-2 (Bootldr - Update), -1 (Bootldr - Idle), 0 (Initialising), 1 (OK), 2 (Config), 3 (Error)		RO	8
S.00.007	Reset	0 (Off) to 1 (On)	0 (Off)	RW	1
S.00.008	Default	0 (Off) to 1 (On)	0 (Off)	RW	1
S.00.009	Active Alarm Bits	0000000000000000 to 1111111111111111	0000000000000000	RO	16
S.00.010	Active IP Address	128.0.0.0 to 127.255.255.255		RO	32
S.00.011	Date Code	0 to 9999		RO	16
S.00.012	Capability Mask	0000000000000000 to 1111111111111111		RO	16
S.00.013	Operation Mode	0 (NORMAL), 1 (LIMITED-IN), 2 (LIMITED), 3 (LIMITED-OUT)		RO	8
S.00.030	Slot Indicator	0 to 8		RO	8
S.00.031	Slot Menu Number	0 to 255		RO	8

The Module Setup menu (menu 0) is also displayed in the drive menu 15, 16 or 17 depending on which slot the option module is installed to and the setting of the Option Slot Identifiers parameter (**11.056**). See section 2.7 *Conventions used in this guide* for more information.

Table 5-6 *Menu 0 slot availability* details the drive models and their available slots and associated drive menus for use with both the SI-BACnet IP option module.

Table 5-6 Menu 0 slot availability

Drive model	Module	Slot number	Drive menu (MM)
Commander C200 / C300 / C300 PM	SI-BACnet IP	1	15
		2	N/A
		3	N/A
HVAC Drive H300	SI-BACnet IP	1	15
		2	16
		3	17
Pump Drive F600	SI-BACnet IP	1	15
		2	16
		3	17

5.10.3 Menu 2 - Ethernet Configuration

Table 5-7 Menu 2 parameters

Parameter		Range	Default	Access	Size (Bits)
S.02.000	Parameter **mm.000**	0 to 65535		RW	16
S.02.003	Network Status	0 (Initialising), 1 (Links Down), 2 (DHCP In Progress), 3 (No Address), 4 (Ready), 5 (Active), 6 (IP Addr Conflict)		RO	8
S.02.004	Network Message Count	0 to 65535 msg/s		RO	16
S.02.005	DHCP Enable	0 (Off) to 1 (On)	0 (Off)	RW	1
S.02.006	IP Address	0.0.0.0 to 255.255.255.255	192.168.1.100	RW	32
S.02.007	Subnet Mask	0.0.0.0 to 255.255.255.255	255.255.255.0	RW	32
S.02.008	Default Gateway	0.0.0.0 to 255.255.255.255	192.168.1.254	RW	32
S.02.009	Primary DNS	0.0.0.0 to 255.255.255.255	0.0.0.0	RW	32
S.02.010	Secondary DNS	0.0.0.0 to 255.255.255.255	0.0.0.0	RW	32
S.02.011	MAC Address	000000000000 to FFFFFFFFFFFF		RO	64
S.02.024	Ethernet MTU	158 to 1500 bytes	1500 bytes	RW	16

5.10.4 Menu 3 - BACnet IP Setup

Table 5-8 Menu 3 parameters

Parameter		Range	Default	Access	Size (Bits)
S.03.000	Parameter **mm.000**	0 to 65535		RW	16
S.03.004	BACnet IP Configuration Error	0 (No Error), 1 (Param Config), 2 (Comms Error)		RO	8
S.03.005	BACnet Device ID	0 to 4194302	1	RW	32
S.03.006	BACnet Device Name String 1-4	-2147483648 to 2147483647	1397304642	RW	32
S.03.007	BACnet Device Name String 5-8	-2147483648 to 2147483647	1094938213	RW	32
S.03.008	BACnet Device Name String 9-12	-2147483648 to 2147483647	1948272976	RW	32
S.03.009	BACnet Device Name String 13-16	-2147483648 to 2147483647	0	RW	32
S.03.010	BACnet IP UDP Port	47808 to 65535	47808	RW	16
S.03.011	Enable Password Protection	0 (Off) or 1 (On)	1 (On)	RW	1
S.03.012	Set Reinit Password	1001 to 9999	1234	RW	16
S.03.013	Set DCC Password	1001 to 9999	1234	RW	16
S.03.014	BACnet Database Revision	0 to 4294967295	0	RO	32

5.10.5 Menu 4 - BACnet IP User Params

Table 5-9 Menu 4 parameters

Parameter		Range	Default	Access	Size (Bits)
S.04.000	Parameter **mm.000**	0 to 65535		RW	16
S.04.001 **to** **S.04.010**	User Param 1 to User Param 10	0 (00.000) to 65535 (65.535)	0 (00.000)	RW	16

5.10.6 Menu 15 - Modbus

Table 5-10 Menu 15 parameters

Parameter		Range	Default	Access	Size (Bits)
S.15.000	Parameter **mm.000**	0 to 65535		RW	16
S.15.001	Enable	0 (Off) to 1 (On)	1 (On)	RW	1
S.15.002	Reset	0 (Off) to 1 (On)	0 (Off)	RW	1
S.15.003	Default	0 (Off) to 1 (On)	0 (Off)	RW	1
S.15.004	Modbus Config Error	0 (No error), 1 (Port in use), 2 (Timeout event), 3 (Num Connections)		RO	8
S.15.005	Modbus Listening Port	0 to 65535	502	RW	16
S.15.006	Maximum Connections	0 to 10	2	RW	8
S.15.007	Maximum Priority Connections	0 to 5	0	RW	8
S.15.008	Max Connections Per Client	1 to 10	2	RW	8
S.15.009	Modbus Timeout	1 to 10000 ms	100 ms	RW	16
S.15.010	Modbus Timeout Action	0 (Trip) to 1 (No action)	1 (No action)	RW	8
S.15.011	Modbus Timeout Event Dest	0 (This slot), 1 (Slot 1), 2 (Slot 2), 3 (Slot 3), 4 (Slot 4)	0 (This slot)	RW	8
S.15.012	Modbus Timeout Event Type	0 (No event), 1 (Trigger Event), 2 (Trigger Event 1), 3 (Trigger Event 2), 4 (Trigger Event 3), 5 (Trigger Event 4)	0 (No event)	RW	8
S.15.013	Modbus Register Addressing Mode	0 (Standard) to 1 (Modified)	0 (Standard)	RW	8
S.15.020	Priority Connection 1	0.0.0.0 to 255.255.255.255	0.0.0.0	RW	32
S.15.021	Priority Connection 2	0.0.0.0 to 255.255.255.255	0.0.0.0	RW	32
S.15.022	Priority Connection 3	0.0.0.0 to 255.255.255.255	0.0.0.0	RW	32
S.15.023	Priority Connection 4	0.0.0.0 to 255.255.255.255	0.0.0.0	RW	32
S.15.024	Priority Connection 5	0.0.0.0 to 255.255.255.255	0.0.0.0	RW	32

6 Parameters

The Ethernet interface holds two parameter databases; the Ethernet interface internal parameter database and the host drive's parameter database.

The Ethernet interface internal parameters can be accessed from the drive's keypad, a user program in a MCi200/MCi210 option module, PC Tools applications software or a module in another slot of the drive. The notation **S.mm.ppp** is used to access these parameters where **S** is the slot number, **mm** is the menu number and **ppp** is the parameter number. For example, to access Pr **02.004** of a MCi210 installed in slot 2 of a drive from a module in slot 3, it will be accessed using Pr **2.02.004.**

The Ethernet interface will also hold a copy of the host drive's database. At power up, if the stored drive database is different to that of the drive, the Ethernet interface will upload the drive's database and overwrite the stored database. If the two databases match, the drive's database will not be uploaded.

A module that is powered up for the first time will not contain a drive database and therefore will perform a drive database upload.

6.1 Full parameter descriptions

6.1.1 Menu 0 - Module setup

S.00.001	**Module ID**		
Minimum	0	Maximum	65535
Default	None	Units	None
Type	16 Bit Volatile	Update Rate	Power-up write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

The SI-BACnet IP module ID is 439 and is written on power up.

S.00.002	**Software Version**		
Minimum	0 (00.00.00.00)	Maximum	99999999 (99.99.99.99)
Default	None	Units	None
Type	32 Bit Volatile	Update Rate	Written on module initialisation
Display Format	Version Number	Decimal Places	0
Coding	RO, ND, NC, PT		

Module firmware version in **ww.xx.yy.zz** format.

S.00.003	**Hardware Version**		
Minimum	00.00	Maximum	655.35
Default	None	Units	None
Type	16 Bit Volatile	Update Rate	Written on module initialisation
Display Format	Standard	Decimal Places	2
Coding	RO, ND, NC, PT		

The hardware version of the option module is in the format of **xx.yy.**

S.00.004	Serial Number LS		
Minimum	0	Maximum	99999999
Default	None	Units	None
Type	32 Bit Volatile	Update Rate	Power-up write
Display Format	Lead Zero Pad	Decimal Places	0
Coding	RO, ND, NC, PT		

The module serial number is available as a pair of 32-bit values where *Serial Number LS* (**S.00.004**) provides the least significant 8 decimal digits, and *Serial Number MS* (**S.00.005**) provides the most significant 8 decimal digits. The reconstructed serial number is ((**S.00.005** x 100000000) + **S.00.004**). For example serial number "0001234567898765" would be stored as **S.00.005** = 12345 and **S.00.004** = 67898765.

The serial number format for drives and option modules manufactured after June 2022 changed from a 10-digit number to a 10-character number, the first 2 digits represent the ASCII equivalent letter denoting the manufacturing location.

For more information, please refer to the Technical Notification T220701.

The following example shows the actual product serial number (represented as a 10-character string, as shown on the product labels), and the equivalent 11-digit serial number displayed on the drive keypad (or via comms):

Actual Serial Number	Pr S.00.004 (LSW)	Pr S.00.005 (MSW)	Serial Number Displayed
M240108050	40108050	772	77240108050

S.00.005	Serial Number MS		
Minimum	0	Maximum	99999999
Default	None	Units	None
Type	32 Bit Volatile	Update Rate	Power-up write
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT		

See *Serial Number LS* (**S.00.004**)

S.00.006	Status		
Minimum	-2 (Bootldr - Update)	Maximum	3 (Error)
Default	None	Units	None
Type	8 Bit Volatile	Update Rate	Background
Display Format	Text	Decimal Places	0
Coding	RO, Txt, ND, NC, PT		

This parameter displays the current status of the module. All possible values are shown in the following table.

Value	Text	Description
-2	Bootldr - Update	The bootloader is performing a flash update.
-1	Bootldr - Idle	The bootloader is idle.
0	Initialising	Module is currently initialising.
1	OK	Module has initialised and has found no errors.
2	Config	A configuration error has been detected.
3	Error	An error has occurred preventing the module from running correctly.

S.00.007	Reset		
Minimum	0 (Off)	Maximum	1 (On)
Default	0 (Off)	Units	None
Type	1 Bit Volatile	Update Rate	Read every 200 ms, Written to 0 on module initialisation.
Display Format	Bit	Decimal Places	0
Coding	RW, NC		

When set, the option module performs a warm reset. When the reset has been executed and the option module is performing it's initialisation routines this parameter will be cleared to zero.

NOTE The drive, and any other modules installed to the drive, will not be affected by the reset.

S.00.008	Default		
Minimum	0 (Off)	Maximum	1 (On)
Default	0 (Off)	Units	None
Type	1 Bit Volatile	Update Rate	Read every 200 ms, Written to 0 on module initialisation.
Display Format	Bit	Decimal Places	0
Coding	RW, NC		

If set to "On" when the module is reset, this parameter will cause the module to return to it's "Out of box configuration" and any settings changed will be returned to their default values. Following the default sequence, the module will set the parameter to "Off" and the module will reset.

Take care using this parameter as any configuration information will be irretrievably lost!

S.00.009	Active Alarm Bits		
Minimum	0 (0000000000000000)	Maximum	65535 (1111111111111111)
Default	0 (0000000000000000)	Units	None
Type	16 Bit Volatile	Update Rate	Background
Display Format	Binary	Decimal Places	0
Coding	RO, NC, BU		

The following table shows the possible alarm conditions and their associated bit position.

Bit	Alarm
0	User Program
1	eCMP
2	Modbus
3	Ethernet/IP (not supported on SI-BACnet IP)
4	Reserved
5	Filesystem
6	Too Hot

S.00.010	Active IP Address		
Minimum	-2147483648 (128.0.0.0)	Maximum	2147483647 (127.255.255.255)
Default	0 (0.0.0.0)	Units	None
Type	32 Bit Volatile	Update Rate	Power-up or reset
Display Format	IP address	Decimal Places	0
Coding	RO, ND, NC, PT		

The module's active IP address.

S.00.011	Date Code		
Minimum	0	Maximum	9999
Default	None	Units	None
Type	16 Bit Volatile	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RW, ND, NC, PT		

The date code is a 4-digit number in the form *yyww*, where *yy* and *ww* represent the year and week number of the manufacturing date of the module.
For example, a value of 2401 would indicate the module was manufactured during week 1 of the year 2024.

S.00.012	Capability Mask		
Minimum	0 (000000000000000)	Maximum	32767 (111111111111111)
Default	None	Units	None
Type	16 Bit Volatile	Update Rate	Power-up or reset
Display Format	Binary	Decimal Places	0
Coding	RO, ND, NC, PT		

This is a read only value that shows the protocol capability status of the module; each bit represents a particular protocol, a value of 1 indicates the protocol is not available, a value of 0 indicates the protocol is available.
This parameter value is determined during manufacture and for SI-BACnet IP modules should always be 0 (000000000000000).
Currently only bit 0 is assigned (Profinet), all other bits are reserved.

NOTE Although this parameter is available, the SI-BACnet IP module does not support Profinet or any other real-time protocol, so is not applicable to the SI-BACnet IP module.

S.00.013	Operation Mode		
Minimum	0 (NORMAL)	Maximum	3 (LIMITED-OUT)
Default	None	Units	None
Type	8 Bit Volatile	Update Rate	Background
Display Format	Standard	Decimal Places	0
Coding	RO, Txt, ND, NC, PT		

This is a read only value that shows the operation mode of the module in accordance with the following table.

Value	Text	Description
0	NORMAL	Incoming cyclic data is written to the drive parameters
1	LIMITED-IN	The option module is transitioning from NORMAL to LIMITED mode
2	LIMITED	Incoming cyclic data is not written to the drive parameters
3	LIMITED-OUT	The option module is transitioning fro LIMITED to NORMAL mode

NOTE

This parameter only relates to cyclic protocols, as BACnet is not a cyclic protocol, this parameter is not applicable to SI-BACnet IP.

S.00.030	Slot Indicator		
Minimum	0	Maximum	8
Default	None	Units	None
Type	8 Bit Volatile	Update Rate	Initialisation
Display Format	Standard	Decimal Places	0
Coding	BU, RO, ND, NC, PT		

This is a read only value that shows the slot number in which the module is fitted.

S.00.031	Menu Number		
Minimum	0	Maximum	255
Default	None	Units	None
Type	8 Bit Volatile	Update Rate	Initialisation
Display Format	Standard	Decimal Places	0
Coding	BU, RO, ND, NC, PT		

This is a read only value that shows the drive menu number in which the module setup menu is mirrored.

6.1.2 Menu 2 - Ethernet configuration

S.02.003	Network Status		
Minimum	0 (Initialising)	Maximum	6 (IP Addr Conflict)
Default	None	Units	None
Type	8 Bit Volatile	Update Rate	Written every second
Display Format	Text	Decimal Places	0
Coding	RO, Txt, ND, NC, PT, BU		

Value	Text	Description
0	Initialising	The network interface is being initialised
1	Links Down	No link connection has been detected on either of the Ethernet ports
2	DHCP In Progress	The module is attempting to obtain the IP address, subnet mask, default gateway and DNS server addresses from a DHCP server
3	No Address	The module does not have an IP address - either the user has not provided one manually or one could not be allocated via DHCP
4	Ready	The network interface has been successfully configured but no data is being received or transmitted
5	Active	The network interface is receiving or transmitting data
6	IP Addr Conflict	Duplicate IP address detected on network

This parameter indicates the status of the network that the module is connected to.

S.02.004	Network Message Count		
Minimum	0	Maximum	65535
Default	None	Units	Messages/s
Type	16 Bit Volatile	Update Rate	Written every second
Display Format	Standard	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

This parameter displays the number of frames that the module is transmitting and/or receiving every second.

The maximum recommended Ethernet message rate per second is 8000, if this value is exceeded, or network issues are encountered, it is recommended the user should consider optimising the network design by using gateways and segregation.

S.02.005	DHCP Enable		
Minimum	0 (Off)	Maximum	1 (On)
Default	0 (Off)	Units	None
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

Controls whether or not the module will attempt to use a Dynamic Host Configuration Protocol (DHCP) server to obtain the IP address, subnet mask, default gateway and DNS servers.

When DHCP is enabled, the following parameters will become read-only immediately following a module reset:

- IP Address (**S.02.006**)
- Subnet Mask (**S.02.007**)
- Default Gateway (**S.02.008**)
- Primary DNS (**S.02.009**)
- Secondary DNS (**S.02.010**)

S.02.006	**IP Address**		
Minimum	0 (0.0.0.0)	Maximum	4294967295 (255.255.255.255)
Default	3232235876 (192.168.1.100)	Units	None
Type	32 Bit User Save	Update Rate	DHCP enabled: write on event; DHCP disabled: read on reset
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

Controls and displays the IP address of the module.

If DHCP is enabled this parameter becomes read-only, and until an IP address is allocated to the module will display 0.0.0.0. If no DHCP server replies to the DHCP request within approximately 1 minute, then the Ethernet interface will automatically assign a link-local IP address in the range 169.254.0.0 to 169.254.255.255

If DHCP is disabled the module will initialise, on reset or power cycle, with the IP address stored for the parameter.

S.02.007	**Subnet Mask**		
Minimum	0 (0.0.0.0)	Maximum	4294967295 (255.255.255.255)
Default	4294967040 (255.255.255.0)	Units	None
Type	32 Bit User Save	Update Rate	DHCP enabled: write on event; DHCP disabled: read on reset
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

Controls and displays the subnet mask of the module.

If DHCP is enabled this parameter becomes read-only, and until a subnet mask is allocated to the module will display 0.0.0.0.

If DHCP is disabled the module will initialise, on reset or power cycle, with the subnet mask stored for the parameter.

S.02.008	Default Gateway		
Minimum	0 (0.0.0.0)	Maximum	4294967295 (255.255.255.255)
Default	3232236030 (192.168.1.254)	Units	None
Type	32 Bit User Save	Update Rate	DHCP enabled: write on event; DHCP disabled: read on reset
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

Controls and displays the default gateway of the module.

If DHCP is enabled this parameter becomes read-only, and until a default gateway is allocated to the module will display 0.0.0.0.

If DHCP is disabled the module will initialise, on reset or power cycle, with the default gateway stored for the parameter.

S.02.009	Primary DNS		
Minimum	0 (0.0.0.0)	Maximum	4294967295 (255.255.255.255)
Default	0 (0.0.0.0)	Units	None
Type	32 Bit User Save	Update Rate	DHCP enabled: write on event; DHCP disabled: read on reset
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

The module can use this IP address when it wishes to resolve the IP address for a domain name. This parameter performs the same function as *Secondary DNS* (**S.02.010**), however the address specified in this parameter will be tried first. Only when this address is unsuccessful will the secondary DNS address be tried.

If DHCP is enabled this parameter becomes read-only, and until a primary DNS address is allocated to the module will display 0.0.0.0.

If DHCP is disabled the module will initialise, on reset or power cycle, with the primary DNS address stored for the parameter.

S.02.010	Secondary DNS		
Minimum	0 (0.0.0.0)	Maximum	4294967295 (255.255.255.255)
Default	0 (0.0.0.0)	Units	None
Type	32 Bit User Save	Update Rate	DHCP enabled: write on event; DHCP disabled: read on reset
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

The module can use this IP address when it wishes to resolve the IP address for a domain name. This parameter performs the same function as *Primary DNS* (**S.02.009**), however the address specified in this parameter will be tried only when the primary DNS address is unsuccessful.

If DHCP is enabled this parameter becomes read-only, and until a secondary DNS address is allocated to the module will display 0.0.0.0.

If DHCP is disabled the module will initialise, on reset or power cycle, with the secondary DNS address stored for the parameter.

S.02.011	MAC Address		
Minimum	0 (000000000000)	Maximum	281474976710655 (FFFFFFFFFFFF)
Default	None	Units	None
Type	64 bit volatile	Update Rate	Power-up write
Display Format	MAC Address	Decimal Places	0
Coding	RO, ND, NC, PT, BU		

The 48-bit MAC address of the module.

S.02.024	Ethernet MTU		
Minimum	158	Maximum	1500
Default	1500	Units	Bytes
Type	16 Bit User Save	Update Rate	Read on module reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

6.1.3 Menu 3 - BACnet IP Setup

This menu is used to configure the BACnet interface.

S.03.004	BACnet IP Configuration Error		
Minimum	0 (No Error)	Maximum	2 (Comms Error)
Default	None	Units	None
Type	8 Bit Volatile	Update Rate	Background
Display Format	Text	Decimal Places	0
Coding	RO, Txt, BU, PT, NC, ND		

This parameter will indicate any BACnet IP configuration errors in accordance with the following table.

Value	Text	Description
0	No Error	No Error
1	Param Config	One or more configured parameters for BACnet objects are invalid. This error may be seen if the source or destination parameter is either the incorrect data size, or does not exist in the drive, or the value is set to 0.
2	Comms Error	BACnet IP socket creation failed

S.03.005	BACnet Device ID		
Minimum	0	Maximum	4194302
Default	1	Units	None
Type	32 Bit User Save	Update Rate	Module reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter specifies the BACnet Device Identifier to uniquely identify the BACnet device over the network.

S.03.006	BACnet Device Name String 1-4		
Minimum	-2147483648	Maximum	2147483647
Default	1397304642	Units	None
Type	32 Bit User Save	Update Rate	Module reset
Display Format	String	Decimal Places	0
Coding	RW, PT		

This parameter specifies the first four characters of a string which can be used to identify the SI-BACnet IP module in the Device Name BACnet object.

S.03.007	BACnet Device Name String 5-8		
Minimum	-2147483648	Maximum	2147483647
Default	1094938213	Units	None
Type	32 Bit User Save	Update Rate	Module reset
Display Format	String	Decimal Places	0
Coding	RW, PT		

This parameter specifies the second set of four characters of a string which can be used to identify the SI-BACnet IP module in the Device Name BACnet object.

S.03.008	BACnet Device Name String 9-12		
Minimum	-2147483648	Maximum	2147483647
Default	1948272976	Units	None
Type	32 Bit User Save	Update Rate	Module reset
Display Format	String	Decimal Places	0
Coding	RW, PT		

This parameter specifies the third set of four characters of a string which can be used to identify the SI-BACnet IP module in the Device Name BACnet object.

S.03.009	BACnet Device Name String 13-16		
Minimum	-2147483648	Maximum	2147483647
Default	0	Units	None
Type	32 Bit User Save	Update Rate	Module reset
Display Format	String	Decimal Places	0
Coding	RW, PT		

This parameter specifies the last four characters of a string which can be used to identify the SI-BACnet IP module in the Device Name BACnet object.

The parameter value is converted to a four-byte hexadecimal value, where each byte represents the equivalent ASCII character in the device name.

For example, the default values are:

Description	Parameter	Decimal Value	Hex (0x)	Characters
Device name 1-4	**S.03.006**	1397304642	53492D42	SI-B
Device name 5-8	**S.03.007**	1094938213	41436E65	ACne
Device name 9-12	**S.03.008**	1948272976	74204950	t IP
Device name 13-16	**S.03.009**	0	00000000	

The complete Device Name is therefore "SI-BACnet IP".
The Connect commissioning software tool automatically displays the characters, not the numerical values.

S.03.010	BACnet IP UDP Port		
Minimum	47808	Maximum	65535
Default	47808	Units	None
Type	16 Bit User Save	Update Rate	Module reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter specifies the BACnet IP port number to be used for BACnet services.

S.03.011	Enable Password Protection		
Minimum	0 (Off)	Maximum	1 (On)
Default	1 (On)	Units	None
Type	1 Bit User Save	Update Rate	Module reset
Display Format	Bit	Decimal Places	0
Coding	RW, BU		

This parameter enables the password protection for the Reinitialise Device and Device Communication Control features. The passwords are set in Pr **S.03.012** and **S.03.013** respectively.

S.03.012	Set Reinit Password		
Minimum	1001	Maximum	9999
Default	1234	Units	None
Type	16 Bit User Save	Update Rate	Module reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter sets the Reinitialise Device password.

S.03.013	Set DCC Password		
Minimum	1001	Maximum	9999
Default	1234	Units	None
Type	16 Bit User Save	Update Rate	Module reset
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter sets the Device Communication Control password.

S.03.014	BACnet Database Revision		
Minimum	0	Maximum	4294967295
Default	0	Units	None
Type	32 Bit Volatile	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RO, BU, PT		

This parameter increments whenever there is a change in the Device Identifier or Device Name property of the BACnet Device object. This parameter will be set to 0 if the SI-BACnet IP module is defaulted.

6.1.4 Menu 4 - BACnet IP User Menu Parameters

This menu contains 10 parameters which can be used to configure the BACnet Analog Values 25 to 34.

S.04.001 to S.04.010	**User Param 1 to User Param 10**		
Minimum	00.000	Maximum	65.535
Default	00.000	Units	None
Type	16 Bit User Save	Update Rate	Module reset
Display Format	MenuParam	Decimal Places	3
Coding	RW, BU, PT		

The BACnet Analog Values 25 thru 34 can be used as destinations for the user configurable parameters in menu 4, the required source parameter is specified in the relevant User Menu parameter in menu 4, this source parameter value will then be available in the associated BACnet Analog Value number object.

For example, to copy the value of the source parameter Pr **20.021** (*Application Menu 3*) to the BACnet Analog Value 26, the source parameter number (20.021) should be entered in Pr **S.04.002**.

i.e. **S.04.002** (*User Menu 2*) = 20.021

The value of the source parameter (20.021) will then be available in the Analog Value 26 object.

6.1.5 Menu 15 – Modbus

S.15.001	Enable		
Minimum	0 (Off)	Maximum	1 (On)
Default	1 (On)	Units	None
Type	1 Bit User Save	Update Rate	Background read
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter is used to enable or disable Modbus master and slave functionality.

S.15.002	Reset		
Minimum	0 (Off)	Maximum	1 (On)
Default	0 (Off)	Units	None
Type	1 Bit Volatile	Update Rate	Background read; written to 0 on initialisation
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

This parameter is used to perform a warm reset of the Modbus protocol interface. When set and the protocol has reset, the parameter will be reset to zero (Off).

S.15.003	Default		
Minimum	0 (Off)	Maximum	1 (On)
Default	0 (Off)	Units	None
Type	1 Bit Volatile	Update Rate	On module reset, protocol interface reset or protocol enable
Display Format	Standard	Decimal Places	0
Coding	RW, NC		

This parameter allows the Modbus protocol to be defaulted to factory settings. This includes all of the protocol features, configuration, mappings and stored objects.

S.15.004	Modbus Config Error		
Minimum	0 (No error)	Maximum	3 (Num Connections)
Default	None	Units	None
Type	8 Bit Volatile	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RO, Txt, NC, ND, PT, BU		

Value	Text	Description
0	No error	No error
1	Port in use	Specified port is currently in use by another protocol
2	Timeout event	Timeout trigger event location is not valid
3	Num Connections	The Max priority connection is greater than the max connections

This parameter will indicate any Modbus configuration errors.

S.15.005	Modbus Listening Port		
Minimum	0	Maximum	65535
Default	502	Units	None
Type	16 Bit User Save	Update Rate	5 ms
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter can be changed from its default port of 502, however it is the user's responsibility to ensure that a valid port is set.

S.15.006	Maximum Connections		
Minimum	0	Maximum	10
Default	2	Units	None
Type	8 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter permits the user to specify the total number of connections that one or more clients can open with the module at any one time.

S.15.007	Maximum Priority Connections		
Minimum	0	Maximum	5
Default	0	Units	None
Type	8 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter defines how many of the maximum connections specified in *Maximum Connections* (**S.15.006**) can be configured as a priority connection. A connection is accepted into the priority connections pool if the client's IP address matches one of the values stored in parameters *Priority Connection 1* (**S.15.020**), *Priority Connection 2* (**S.15.021**), *Priority Connection 3* (**S.15.022***)* or *Priority Connection 4* (**S.15.023**).

The priority connections are permanent and, once made will only be deleted at the request of the client or due to a communications error.

Any connections not in the priority connections pool are kept in the non-priority connections pool. If a client attempts to establish a priority connection and all available non-priority connections are in use, the non-priority connection that has not been used for the longest will be closed to make way for the new priority connection.

S.15.008	Max Connections Per Client		
Minimum	1	Maximum	10
Default	2	Units	None
Type	8 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter defines the maximum number of priority connections that any one client can establish with the SI-BACnet IP module. This check is only performed on the connections in the priority connections pool.

S.15.009	Modbus Timeout		
Minimum	1	Maximum	10000
Default	100	Units	ms
Type	16 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, BU		

This parameter defines the time period in which the Modbus server must receive a message before any specified action (as defined in *Modbus Timeout Action* (**S.15.010**)) is performed. When the timeout occurs, bit 2 in the module's alarm parameter (*Active Alarm Bits* (**S.00.009**)) will be set and the specified action will be performed.

The timeout is enabled when the server receives its first message.

NOTE It is good system design to allow for some message loss by setting the timeout duration to be greater than the transmit period by a factor of 2 or more.

S.15.010	Modbus Timeout Action		
Minimum	0 (Trip)	Maximum	1 (No action)
Default	1 (No action)	Units	None
Type	8 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, Txt, BU		

Value	Text	Description
0	Trip	Trip drive and raise error
1	No action	No action

Defines the action when no message is received within the time period specified in *Modbus Timeout (***S.15.009)**.

NOTE If a trip is enabled, this will be triggered by the PC Tools software (Unidrive M Connect, etc.), upon scanning the network, or other Modbus masters (HMIs, PLCs etc.), using acyclic read/write commands.

S.15.011	Modbus Timeout Event Dest		
Minimum	0 (This slot)	Maximum	4 (Slot 4)
Default	0 (This slot)	Units	None
Type	8 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, Txt, BU		

Value	Text	Description
0	This slot	Trigger event in this slot
1	Slot 1	Trigger event in slot 1
2	Slot 2	Trigger event in slot 2
3	Slot 3	Trigger event in slot 3
4	Slot 4	Trigger event in slot 4

Defines the destination slot to trigger the event (defined by *Modbus Timeout Event Type* (**S.15.012**)) when a timeout occurs.

NOTE This feature is not yet implemented.

S.15.012	Modbus Timeout Event Type		
Minimum	0 (No event)	Maximum	5 (Trigger Event 4)
Default	0 (No event)	Units	None
Type	8 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, Txt, BU		

Value	Text	Description
0	No event	No event
1	Trigger Event	Trigger module Event
2	Trigger Event 1	Trigger module Event 1
3	Trigger Event 2	Trigger module Event 2
4	Trigger Event 3	Trigger module Event 3
5	Trigger Event 4	Trigger module Event 4

Defines the event to trigger when a timeout occurs. *Modbus Timeout Event Destination* (**S.15.011**) must specify an appropriate consumer (slot option) of the event.

NOTE This feature is not yet implemented.

S.15.013	Modbus Register Addressing Mode		
Minimum	0 (Standard)	Maximum	1 (Modified)
Default	0 (Standard)	Units	None
Type	8 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	Standard	Decimal Places	0
Coding	RW, Txt, BU		

Value	Text	Description
0	Standard	(mm x 100) + ppp - mm<=162 and ppp<=99
1	Modified	(mm x 256) + ppp - mm<=63 and ppp<=255

Specifies the Modbus register addressing mode.

The standard addressing mode allows menus up to 162 and parameters up to 99 to be accessed, for any parameter above 99, the modified addressing mode bust be used, however, this mode limits the highest accessible menu number to 63.

S.15.020	Priority Connection 1		
Minimum	0 (0.0.0.0)	Maximum	4294967295 (255.255.255.255)
Default	0 (0.0.0.0)	Units	None
Type	32 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

This parameter specifies an IP address for priority connection 1.

S.15.021	Priority Connection 2		
Minimum	0 (0.0.0.0)	Maximum	4294967295 (255.255.255.255)
Default	0 (0.0.0.0)	Units	None
Type	32 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

This parameter specifies an IP address for priority connection 2.

S.15.022	Priority Connection 3		
Minimum	0 (0.0.0.0)	Maximum	4294967295 (255.255.255.255)
Default	0 (0.0.0.0)	Units	None
Type	32 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

This parameter specifies an IP address for priority connection 3.

S.15.023	Priority Connection 4		
Minimum	0 (0.0.0.0)	Maximum	4294967295 (255.255.255.255)
Default	0 (0.0.0.0)	Units	None
Type	32 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

This parameter specifies an IP address for priority connection 4.

S.15.024	Priority Connection 5		
Minimum	0 (0.0.0.0)	Maximum	4294967295 (255.255.255.255)
Default	0 (0.0.0.0)	Units	None
Type	32 Bit User Save	Update Rate	Module reset, Modbus interface reset or Modbus interface enable
Display Format	IP Address	Decimal Places	0
Coding	RW, BU		

This parameter specifies an IP address for priority connection 5.

NOTE The Priority Connection parameters 20 through 24 must be filled in ascending order starting from the Priority Connection 1 (**S.15.020**) through Priority Connection 5 (**S.15.024**). If a higher numbered Priority Connection is specified without the lower ones being filled, then it will be ignored.

7 Key features and Protocols

This section details the key features and protocols supported by the SI-BACnet IP option module.

7.1 PC/PLC considerations

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

7.2 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 7-1 shows the supported Modbus function codes.

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 (RTU) and Ethernet based transmission.

Table 7-1 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.

7.2.1 Modbus TCP/IP port

The port number used for Modbus TCP/IP may be reconfigured to a different port number using Pr **S.15.005** see *Modbus Listening Port* (**S.15.005**) on page 92 for more information. A timer is available to allow a loss of Modbus communication to be managed (see *Modbus Timeout* (**S.15.009**) for more information).

7.2.2 Data structure

Communication between devices is based upon Modbus Application Data Units (ADUs), the ADU consists of 2 parts, the Modbus Application Protocol (MBAP) header and the Modbus Protocol Data Unit (PDU).

Figure 7-1 Modbus Data Structure

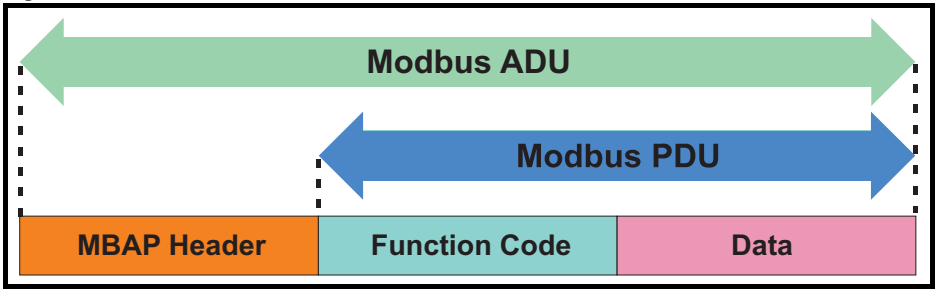


Table 7-2 MBAP Header

Field	Length (Bytes)	Description
Transaction Identifier	2	Uniquely identifies the transaction (0 to 65535)
Protocol Identifier	2	Identifies the protocol (0 = Modbus)
Length	2	Number of following bytes in the message
Unit Identifier	1	Uniquely identifies the destination node (0 to 255)

The unit identifier within the MBAP header is used to identify whether the destination node is the host drive or an option module (not available on the onboard Ethernet interface with firmware versions prior to V01.02.01.10).

Table 7-3 MBAP Unit Identifier

Unit Identifier	Destination
0 or 255	Drive
1	Slot 1
2	Slot 2
3	Slot 3
4	Slot 4 (onboard Ethernet)
254	Self

7.2.3 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 success or failure. If no response is received this indicates that the message has not been received or the message is invalid or the node is unable to reply.

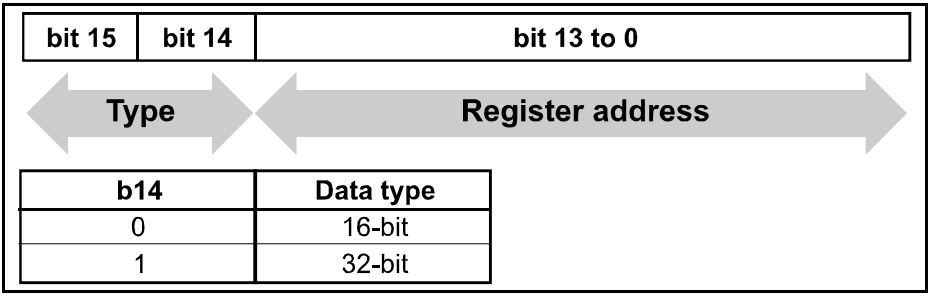
Each drive or option module parameter is internally mapped to a single 16-bit Modbus register, all Modbus function codes access 16-bit registers only. To access a 32-bit parameter, two contiguous Modbus registers must be specified in the request and the 32-bit data access scheme must be used.

7.2.4 32-bit data access

Standard Modbus registers are 16 bits in size and reference a single drive/option module parameter. To access a 32-bit data value the multiple read/write services must be used to transfer a contiguous array of 16-bit registers. To instruct the client to select either 16-bit or 32-bit access bit 14 of the register address is used.

NOTE Bit b15 of the register address is reserved for future use.

Figure 7-2 Data type selection



b14	Data type
0	16-bit
1	32-bit

If 32-bit data type is selected then this effectively adds 16384 (0x4000) to the start register address.

e.g. For drive parameter Pr **01.021** in standard addressing mode, the start register value is 16384 + 120 = 16504 (0x4078)

7.2.5 Supported Modbus function codes

The following table details the supported Modbus function codes.

Table 7-4 Supported Modbus function codes

Function Code		Description
Decimal	Hex (0x)	
3	03	Read multiple 16-bit registers
6	06	Write single 16-bit register
16	10	Write multiple 16-bit registers
23	17	Read and write multiple 16-bit registers

7.2.6 Register addressing

The Modbus register address is 16 bits in size, of which the upper two bits are used for data type selection leaving 14 bits to represent the parameter address, taking into account the slave increments the address value by 1, this results in a theoretical maximum parameter address of 163.84 (limited to 162.99 in software) when the default standard addressing mode (see *Modbus Register Addressing Mode* (**S.15.013**)) is used.

To access a parameter number above 99 then the modified addressing mode must be used (see *Modbus Register Addressing Mode* (**S.15.013**)), this will allow access to parameter numbers up to 255 but also limit the maximum menu number to 63.

NOTE A reset is not required to activate the change, the addressing mode is effectively made active immediately on changing.

The Modbus slave device increments the register address by 1 before processing the command, this effectively prevents access to parameter Pr **00.000** in the drive or option module.

The table below shows how the start register address is calculated for both addressing modes.

Table 7-5 Start register addressing

CT Parameter	Addressing mode	Protocol register			
s.mm.ppp	Standard	mm * 100 + ppp - 1			
	Modified	mm * 256 + ppp - 1			
Examples					
		16-bit		**32-bit**	
		Decimal	**Hex (0x)**	**Decimal**	**Hex (0x)**
0.01.021	Standard	120	00 78	16504	40 78
	Modified	276	01 14	16660	41 14
0.01.000	Standard	99	00 63	16483	40 63
	Modified	255	00 FF	16639	40 FF
3.70.001	Standard	7000	1B 58	23384	5B 58
	Modified	N/A	N/A	N/A	N/A
0.03.161	Standard	N/A	N/A	N/A	N/A
	Modified	928	03 A0	17312	43 A0

Drive parameters (starting at Pr **00.001**) are mapped to equivalent Modbus registers beginning at register 40001, so when accessing the drive parameters from an HMI or PLC using Modbus registers, the equivalent Modbus register will be the Protocol register + 1.

7.2.7 FC03 – Read multiple registers

This function code allows a contiguous array of registers to be read. The Modbus TCP frame is limited to a maximum length of 255 bytes, this includes the TCP/IP header, this imposes a limit on the number of drive parameters that can be accessed in a single transaction. The maximum number of registers that can be read is 120, this allows up to 120 16-bit parameters or 60 32-bit parameters to be read in a single transaction. If this is exceeded the server will issue an exception response code 2.

Master request data

Byte	Description
7	Function code 0x03
8	Start register address (MSB)
9	Start register address (LSB)
10	Number of 16-bit registers (MSB)
11	Number of 16-bit registers (LSB)

Slave response data

Byte	Description
7	Function code 0x03
8	Length of data in read block (Bytes)
9	Register data (MSB)
10	Register data (LSB)

The normal response includes the function code, number of data bytes in the read block followed by the register data (unless an exception occurs).

If 32-bit parameter addressing is used, then for each parameter read:

- Two 16-bit registers must be used in the request
- The register data in the response will contain 4 bytes of data

Example
To read drive parameters **0.20.021** to **0.20.023** (transaction ID = 42) with 32-bit data access and standard addressing:

Master request data

Byte	Hex value	Description
0-1	00 2A	Transaction ID (42)
2-3	00 00	Protocol ID (0=TCP/IP)
4-5	00 06	Length (Bytes=6)
6	FF	Unit identifier (FF= Drive)
7	03	Function code (3)
8-9	47 E4	Start register (20.20)
10-11	00 06	Number of registers (6)

Slave response data

Byte	Hex value	Description
0-1	00 2A	Transaction ID (42)
2-3	00 00	Protocol ID (0=TCP/IP)
4-5	00 0F	Length (Bytes=15)
6	FF	Unit identifier (FF= Drive)
7	03	Function code (3)
8	0C	Data length (Bytes=12)
9-12	?	Pr **0.20.021** data
13-16	?	Pr **0.20.022** data
17-20	?	Pr **0.20.023** data

7.2.8 FC06 – Write single register

This function code writes a single 16-bit value to a register. The normal response is an echo of the request (unless an exception occurs) returned after the parameter has been written.

The register address can be a 32-bit parameter address but only the lower 16 bits of the value will be written.

Master request data

Byte	Description
7	Function code 0x06
8	Start register address (MSB)
9	Start register address (LSB)
10	Register data (MSB)
11	Register data (LSB)

Slave response data

Byte	Description
7	Function code 0x06
8	Start register address (MSB)
9	Start register address (LSB)
10	Register data (MSB)
11	Register data (LSB)

Example
To write the value 12345 to drive parameter **0.20.001** (transaction ID = 42) using standard addressing:

Master request data

Byte	Hex value	Description
0-1	00 2A	Transaction ID (42)
2-3	00 00	Protocol ID (0=TCP/IP)
4-5	00 06	Length (Bytes=6)
6	FF	Unit identifier (FF= Drive)
7	06	Function code (06)
8-9	07 D0	Start register (**20.000)**
10-11	30 39	Register data (12345)

Slave response data

Byte	Hex value	Description
0-1	00 2A	Transaction ID (42)
2-3	00 00	Protocol ID (0=TCP/IP)
4-5	00 06	Length (Bytes=6)
6	FF	Unit identifier (FF= Drive)
7	06	Function code (6)
8-9	07 D0	Start register (**20.000**)
10-11	30 39	Register data (12345)

7.2.9 FC16 – Write multiple registers

This function code allows a contiguous series of registers to be written. The Modbus TCP frame is limited to a maximum length of 255 bytes, this includes the TCP/IP header, this imposes a limit on the number of drive parameters that can be accessed in a single transaction. The maximum number of registers that can be written is 120, this allows up to 120 16-bit parameters or 60 32-bit parameters to be read in a single transaction. If this is exceeded the server will issue an exception response code 2.The normal response includes the function code, start register address and number of 16-bit registers written (unless an exception occurs), returned after the parameters have been written.

If 32-bit parameter addressing is used, then for each parameter written:

- Two 16-bit registers must be used in the request
- Four bytes must be specified in the request
- The number of registers written in the response will be twice the number of parameters written

Master request data

Byte	Description
7	Function code 0x10
8	Start register address (MSB)
9	Start register address (LSB)
10	Number of 16-bit registers (MSB)
11	Number of 16-bit registers (LSB)
12	Length of register data to write (Bytes)
13	Register data (MSB)
14	Register data (LSB)

Slave response data

Byte	Description
7	Function code 0x10
8	Start register address (MSB)
9	Start register address (LSB)
10	Number of 16-bit registers written (MSB)
11	Number of 16-bit registers written (LSB)

Example
To write the value 12345 to drive parameters **0.20.021** through **0.20.023** (Transaction ID=42) using standard 32-bit addressing:

Master request data

Byte	Hex value	Description
0-1	00 2A	Transaction ID (42)
2-3	00 00	Protocol ID (0=TCP/IP)
4-5	00 13	Length (Bytes=19)
6	FF	Unit identifier (FF= Drive)
7	10	Function code (16)
8-9	47 E4	Start register (**20.020**)
10-11	00 06	Number of registers (6)
12	0C	Register data length (Bytes)
13-16	00 00 30 39	Register data 0
17-20	00 00 30 39	Register data 1
21-24	00 00 30 39	Register data 2

Slave response data

Byte	Hex value	Description
0-1	00 2A	Transaction ID (42)
2-3	00 00	Protocol ID (0=TCP/IP)
4-5	00 06	Length (Bytes=6)
6	FF	Unit identifier (FF= Drive)
7	10	Function code (16)
8-9	47 E4	Start register (**20.020**)
10-11	00 06	Registers written (6)

7.2.10 FC23 – Read/Write multiple registers

This function code allows a contiguous series of registers to be written and another contiguous series of registers to be read. The Modbus TCP frame is limited to a maximum length of 255 bytes, this includes the TCP/IP header, this imposes a limit on the number of drive parameters that can be accessed in a single transaction. The maximum number of registers that can be read is 120 and similarly the maximum number of registers that can be written is 120, this allows up to 120 16-bit parameters or 60 32-bit parameters to be read and / or written in a single transaction. If this is exceeded the server will issue an exception response code 2.

Master request data

Byte	Description
7	Function code 0x17
8	Start read register address (MSB)
9	Start read register address (LSB)
10	Number of registers to read (MSB)
11	Number of registers to read (LSB)
12	Start write register address (MSB)
13	Start write register address (LSB)
14	Number of registers to write (MSB)
15	Number of registers to write (LSB)
16	Length of register data to write (Bytes)
17	Register data 0 (MSB)
18	Register data 0 (LSB)

Slave response data

Byte	Description
7	Function code 0x17
8	Length of data in read block (Bytes)
9	Register data (MSB)
10	Register data (LSB)

The normal response includes the function code, number of data bytes in the read block followed by the register data (unless an exception occurs).

If 32-bit parameter addressing is used:

- For each parameter read or written, two 16-bit registers must be used in the request
- For each parameter written, four bytes must be specified in the request
- For each parameter read, four bytes of data will be used in the response

Example

To write the value 12345 to drive parameters **0.20.021** through **0.20.023** and read the values of parameters **0.20.024** through **0.20.026** (Transaction ID=42) using standard addressing:

Master request data

Byte	Hex value	Description
0-1	00 2A	Transaction ID (42)
2-3	00 00	Protocol ID (0=TCP/IP)
4-5	00 17	Length (Bytes=6)
6	FF	Unit identifier (FF= Drive)
7	17	Function code (23)
8-9	47 E7	Start read register (**20.023**)
10-11	00 06	Number of read registers (6)
12-13	47 E4	Start write register (**20.020**)
14-15	00 06	Number of write registers (6)
16	0C	Length of register data to write (Bytes=12)
17-20	00 00 30 39	Register data 0 (12345)
21-24	00 00 30 39	Register data 1 (12345)
25-28	00 00 30 39	Register data 2 (12345)

Slave response data

Byte	Hex value	Description
0-1	00 2A	Transaction ID (42)
2-3	00 00	Protocol ID (0=TCP/IP)
4-5	00 0F	Length (Bytes=15)
6	FF	Unit identifier (FF= Drive)
7	17	Function code (23)
8	0C	Length of data (Bytes=12)
9-12	?? ?? ?? ??	Register data 0 (Pr **20.024**)
13-16	?? ?? ?? ??	Register data 1 (Pr **20.025**)
17-20	?? ?? ?? ??	Register data 2 (Pr **20.026**)

7.2.11 Modbus Exception Response Message

If the master request is rejected then an exception response message will be returned.

Exception Response Message

Byte	Hex value	Description
0-1	?? ??	Transaction ID (defined by Modbus Master)
2-3	00 00	Protocol ID
4-5	00 03	Number of data bytes to follow
6	??	Unit identifier
7	??	Function code (request FC with bit b7 set to 1)
8	??	Exception code 01 = Function code not supported 02 = Invalid register address

The master request function code will be returned but with bit b7 set (e.g. function code 0x03 will be returned as 0x83)

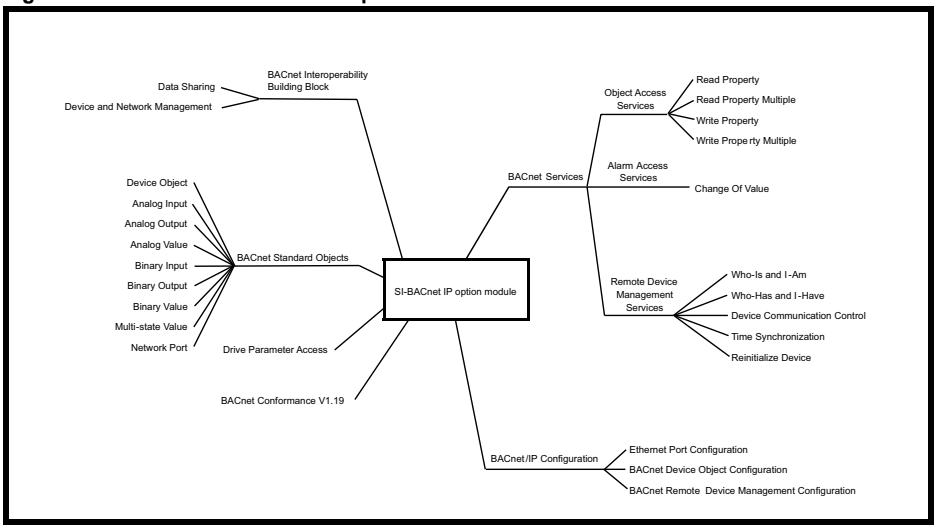
7.3 BACnet

BACnet (**B**uilding **A**utomation **C**ontrol **Net**work) is a communication protocol for building automation and control networks. It is intended to provide interoperability among different vendors' equipment.

This section details the BACnet objects and services supported by SI-BACnet IP.

Figure 7-3 shows the SI-BACnet IP option module feature map.

Figure 7-3 SI-BACnet IP feature map



7.3.1 BACnet supported objects and services

SI-BACnet IP supports the following BACnet services and objects:

- Data Sharing BIBB
  - Read Property (Object Access Service)
  - Read Property Multiple (Object Access Service)
  - Write Property (Object Access Service)
  - Write Property Multiple (Object Access Service)
  - Change Of Value
- Device and Network Management BIBB
  - Who-Is (Remote Device Management Service) - Execute
  - I-Am (Remote Device Management Service) - Initiate
  - Who-Has (Remote Device Management Service) -Execute
  - I-Have (Remote Device Management Service) - Initiate
  - Device Communication Control (Remote Device Management Service)
  - Time Synchronization (Remote Device Management Service)
  - Reinitialize Device (Remote Device Management Service)
- Standard Objects
  - Device Object
  - Analog Input
  - Analog Output
  - Analog Value
  - Binary Input
  - Binary Output
  - Binary Value
  - Multi-state Value
  - Network Port

Object properties can be either Read Only, Writable, or Commandable.

Read Only - Properties can only be read, not written to.

Writable - Properties can be read and immediately written to.

Commandable - Properties can be read or written to, when written to the command must include the priority value in the range 1 to 16, with 1 being the highest priority and 16 being the lowest; the drive parameter is set to the value written at the highest priority level. The value of the 'Relinquish_Default' property becomes the 'Present_Value' when no priority is provided.

7.3.2 BACnet Interoperability Building Blocks (BIBBs)

BACnet Interoperability Building Blocks (BIBBs) are a collection of one or more BACnet Services. These services are described in terms of a BACnet node device. There are two types of nodes defined in the BACnet protocol:

- "A" node or 'Client' device which uses the data from the network.
- "B" node or 'Server' device which provides data to the network.

The SI-BACnet IP option module will be the data provider on the network, thus acts as a "Server" or "B" node device to the 'Client' or 'A' node device.

7.3.3 Data Sharing (Object Access Services)

This BIBB prescribes the SI-BACnet IP option module capabilities required to perform the data sharing functions on the BACnet network.

ReadProperty-B (DS-RP-B)

BACnet Service	Initiate	Execute	SI-BACnet IP Function
ReadProperty	No	Yes	Provides a single value of data to the client

This is a confirmed service request used by a BACnet client to read the value of one BACnet device property in the SI-BACnet option module.

Request: The request frame contains the Object Identifier, Property, and data Array Index (optional).

The SI-BACnet IP supports the following data types:

- NULL
- Character String
- Object Identifier
- Enumerated
- Date
- Time
- Bit String
- Octet String
- Unsigned Integer
- Boolean
- Real
- Array

If the property identified to read is of the Array data type, then the 'Property Array Index' parameter is required. If this array index parameter is excluded, then the entire array shall be referenced by the SI-BACnet IP option module.

Response: Successful result includes Request frame content and the property value.

Failed result indicates the reason for failure specified by 'Error Type' (Error Class & Error Code).

Scenarios	Error Class	Error Code
Requested object does not exist	OBJECT	UNKNOWN_OBJECT
Requested property does not exist	PROPERTY	UNKNOWN_PROPERTY
An array index is provided but the property is not an array	PROPERTY	PROPERTY_IS_NOT_AN_ARRAY
An array index is provided that is outside the range existing in the property	PROPERTY	INVALID_ARRAY_INDEX
The property is not accessible using this service	PROPERTY	READ_ACCESS_DENIED

ReadPropertyMultiple-B (DS-RPM-B)

BACnet Service	Initiate	Execute	SI-BACnet IP Function
ReadPropertyMultiple	No	Yes	Provides multiple values of data at a time to the client

This is a confirmed service request used by a BACnet client to read the value of one or more BACnet device properties of one or more objects in the SI-BACnet option module.

Request: The request frame contains the list of Read Access Specifications which is made up of two components, the Object Identifier and the List of Property References.

The List of Property References shall contain:

- Specific property of the object identifier.
- Property identifier 'ALL' means all the defined properties (excluding 'Property_List') of the object are to be accessed including proprietary property.
- Property identifier 'REQUIRED' means that only those standard properties (excluding 'Property_List') having a conformance code of 'R' or 'W' shall be returned.
- Property identifier 'OPTIONAL' means only those standard properties present in the object identifier which has conformance code 'O' shall be returned.

Response: The read access result contains 'Object Identifier' with 'List of Results'.

The 'List_Of_Results' attribute consists of:

- Property Identifier.
- Array Index if identified property is of type Array.
- Property values.
- Property access error.

Access error indicates the reason for failure specified by 'Error Type' (Error Class & Error Code).

Scenarios	Error Class	Error Code
Requested object does not exist	OBJECT	UNKNOWN_OBJECT
Requested property does not exist	PROPERTY	UNKNOWN_PROPERTY
An array index is provided but the property is not an array	PROPERTY	PROPERTY_IS_NOT_AN_ARRAY
An array index is provided that is outside the range existing in the property	PROPERTY	INVALID_ARRAY_INDEX
The property is not accessible using this service	PROPERTY	READ_ACCESS_DENIED

WriteProperty-B (DS-WP-B)

BACnet Service	Initiate	Execute	SI-BACnet IP Function
WriteProperty	No	Yes	Allows a single value to be changed by the client

This is a confirmed service request used by a BACnet client to modify the value of a single specified property of a BACnet device in the SI-BACnet option module.

The SI-BACnet IP option module has restricted write access to the 'Present_Value' property of certain objects. In such cases, an attempt to modify a restricted property shall result in the return of an error of the 'Error Class' PROPERTY and the 'Error Code' WRITE_ACCESS_DENIED.

NOTE These restricted properties may be altered using the 'Connect' commissioning software.

Request: The request frame contains 'Object Identifier', 'Property Identifier', 'Property Array Index', 'Property Value' and 'Priority' (Optional).

Supported Datatype:

- Real
- Enumerated
- Character String
- Object Identifier

Priority shall be in the range 1-16, which indicates the priority assigned to this write operation (with 1 being the highest priority and 16 being the lowest priority).

If an attempt is made to write to a Commandable property without specifying the priority, a default priority of 16 (the lowest priority) shall be assumed.

Priority 6 is reserved, if an attempt is made to write to a property using priority 6, the 'Write Access Denied' error will be returned and the command will be ignored

If an attempt is made to write to a property that is not Commandable with a specified priority, the priority shall be ignored.

Response: 'Simple ACK' in response indicates the service request succeed. Failed result indicates the reason for failure specified by 'Error Type' (Error Class & Error Code).

Scenarios	Error Class	Error Code
Requested object does not exist	OBJECT	UNKNOWN_OBJECT
Requested property does not exist	PROPERTY	UNKNOWN_PROPERTY
An array index is provided but the property is not an array	PROPERTY	PROPERTY_IS_NOT_AN_ARRAY
An array index is provided that is outside the range existing in the property	PROPERTY	INVALID_ARRAY_INDEX
The specified property is currently not writable by the requestor. (e.g. Read Only)	PROPERTY	WRITE_ACCESS_DENIED
The datatype of the value provided is incorrect for the specified property	PROPERTY	INVALID_DATATYPE
The value provided is outside the range of values that the property can accept	PROPERTY	VALUE_OUT_OF_RANGE

WritePropertyMultiple-B (DS-WPM-B)

BACnet Service	Initiate	Execute	SI-BACnet IP Function
WritePropertyMultiple	No	Yes	Allows multiple values of data to be changed at a time by the client

This is a confirmed service request used by a BACnet client to modify the value of one or more specified properties of a BACnet object present in the SI-BACnet IP option module.

The SI-BACnet IP option module's object properties shall be modified by the WritePropertyMultiple service in the order specified in the 'List of Write Access Specifications' parameter, and execution of the service shall continue until all the specified properties have been written to, or a property is encountered that for some reason cannot be modified as requested.

The SI-BACnet IP option module has restricted write access to the 'Present_Value' property of certain objects. In such cases, an attempt to modify a restricted property shall result in the return of an error of the 'Error Class' PROPERTY and the 'Error Code' WRITE_ACCESS_DENIED.

Note: These restricted properties may be altered using the 'Connect' commissioning software.

Request: The request frame contains 'List of Write Access Specifications'. This specification consists of 'Object Identifier' and the 'List of Properties', each of which consist of 'Property Identifier', 'Property Array Index'(Optional), 'Property Value' and 'Priority' (Optional).

Supported Datatype:

- Real
- Enumerated
- Character String
- Object Identifier

Priority shall be in the range 1-16, which indicates the priority assigned to this write operation (with 1 being the highest priority and 16 being the lowest priority).

If an attempt is made to write to a Commandable property without specifying the priority, a default priority of 16 (the lowest priority) shall be assumed.

Priority 6 is reserved, if an attempt is made to write to a property using priority 6, the 'Write Access Denied' error will be returned and the command will be ignored

If an attempt is made to write to a property that is not Commandable with a specified priority, the priority shall be ignored.

Response: 'Simple ACK' in response indicates the service request succeed.
Failed result indicates the reason for failure specified by 'Error Type' (Error Class & Error Code) and 'First Failed Write Attempt' parameter. This parameter shall convey the 'Object Identifier', 'Property Identifier', and 'Property Array Index' of the first failed element in the 'List of Write Access Specification' for which the write attempt failed.

Scenarios	Error Class	Error Code
Requested object does not exist	OBJECT	UNKNOWN_OBJECT
Requested property does not exist	PROPERTY	UNKNOWN_PROPERTY
An array index is provided but the property is not an array	PROPERTY	PROPERTY_IS_NOT_AN_ARRAY
An array index is provided that is outside the range existing in the property	PROPERTY	INVALID_ARRAY_INDEX
The specified property is currently not writable by the requestor. (e.g. Read Only)	PROPERTY	WRITE_ACCESS_DENIED
The datatype of the value provided is incorrect for the specified property	PROPERTY	INVALID_DATATYPE
The value provided is outside the range of values that the property can accept	PROPERTY	VALUE_OUT_OF_RANGE

7.3.4 Data Sharing (Alarm Access Services)

These BACnet services provide the mechanism to monitor BACnet properties in the SI-BACnet IP option module and inform a subscribed BACnet client of a change in value of any of the monitored properties.

A BACnet client must initially subscribe to the SI-BACnet IP option module with the object properties of interest, the SI-BACnet IP option module will then monitor these properties, and if any of the values change, will notify the subscribed client with the new value(s).

Change Of Value-B (DS-COV-B)
SI-BACnet IP supports a minimum of 5 concurrent subscriptions with indefinite lifetimes.

The following BACnet services are supported:

BACnet Service	Initiate	Execute	SI-BACnet IP Function
SubscribeCOV	No	Yes	Subscribes the client for COV notifications
ConfirmedCOVNotification	Yes	No	Returns the COV values (receipt expected)
UnconfirmedCOVNotification	Yes	No	Returns the COV values (no receipt expected)

SubscribeCOV
The 'SubscribeCOV' service is used by a 'COV-client' to subscribe for the receipt of notifications of changes that may occur to the properties of a particular object.

The subscription establishes a connection between the change of value detection and reporting mechanism within the 'COV-server' device and a process within the 'COV-client' device.

Notifications of changes are issued by the 'COV-server' device when changes occur after the subscription has been established.

ConfirmedCOVNotification and UnconfirmedCOVNotification

The 'ConfirmedCOVNotification' and 'UnconfirmedCOVNotification' services are used by the 'COV-server' device to convey the change notifications.

The 'COV-Client' sends the request frame for 'SubscribeCOV' to the 'COV-Server' (SI-BACnet IP option module).

Request: The request frame consists of 'Subscriber Process Identifier', 'Monitored Object Identifier', 'Issue Confirmed Notifications' and 'Lifetime' attributes.

		Request Frame Attribute	Data Type	Description
Subscribe COV Request with indefinite lifetime	Cancellation Request	Subscriber Process Identifier	Unsigned32	It is a numeric 'handle' meaningful to the subscriber. This handle shall be used to identify the process within the 'COV-client' that should receive the notification
		Monitored Object Identifier	BACnetObjectIdentifier	Shall convey the identifier of the object within the receiving device for which a subscription is desired
		Issue Confirmed Notifications	BOOLEAN	This parameter conveys whether the 'COV-server' device (SI-BACnet IP option module) shall issue the 'ConfirmedCOVNotification' (TRUE) or 'UnconfirmedCOVNotification' (FALSE) when change occur. If this parameter is present, it means that 'subscription' or 're-subscription' is to occur, and that the lifetime shall be refreshed to its initial state
		Lifetime	Unsigned	A value of zero shall indicate an indefinite lifetime

Response: Successful result indicates that the requested service has succeeded. Failed result indicates the reason for failure specified by 'Error Type' (Error Class & Error Code).

Scenarios	Error Class	Error Code
Requested object does not exist	OBJECT	UNKNOWN_OBJECT
Requested object does not support COV-notifications	OBJECT	OPTIONAL_FUCNTIONALITY_NOT_SUPPORTED
The number of subscribed clients has been exceeded	SERVICES	NO_SPACE_TO_ADD_LIST_ELEMENT

The SI-BACnet IP option module standard objects that support standardised COV reporting use different criteria for determining that a 'change of value' has occurred, these are summarised in the following table.

Object Type	Criteria	Properties Reported
Analog Input	If 'Present_Value' changes by 'COV_Increment'	Present_Value
Analog Output		
Analog Value		

7.3.5 Device and Network Management

This BIBB prescribes the SI-BACnet IP option module capabilities required to perform the device and network management functions on the BACnet network.

The following BACnet services are supported:

Dynamic Device Binding-B (DM-DDB-B)
The SI-BACnet IP option module will provide information about its device attributes and respond to requests to identify itself.

BACnet Service	Initiate	Execute	SI-BACnet IP Function
Who-Is	No	Yes	Replies using the I-Am service request
I-Am	Yes	No	Reply to Who-Is service request

Who-Is
This is an unconfirmed service. The 'Who-Is' service may be used to determine the 'Device' object identifier and network addresses of all devices on the network, or to determine the network address of a specific device whose 'Device' object identifier is known, but whose address is not.

Request: The request frame contains device instance range 'Low' and 'High' limit (Optional).

The Device Instance Range 'Low' and 'High' limit parameter range is 0 - 4194302.

Devices whose 'Object_Identifier' instance number falls within the range greater than or equal to 'Device Instance Range Low Limit' and less than or equal to 'Device Instance Range High Limit' shall be qualified to respond.

The value of the 'Device Instance Range Low Limit' shall be less than or equal to the value of the 'Device Instance Range High Limit.

If the 'Device Instance Range Low Limit' and 'Device Instance Range High Limit' parameters are omitted, then all devices that receive this message are qualified to respond with an I-Am service request.

Response: If the SI-BACnet IP option module 'Object_Identifier' value is within the device instance range, then the SI-BACnet IP option module responds with the 'I-Am' message.

The response frame consist of 'I-Am' Device Identifier, Max APDU Length Accepted, Segmentation Supported and Vendor Identifier.

If the SI-BACnet IP option module 'Object_Identifier' value is not within the device instance range, then the SI-BACnet IP option module will not respond.

I-Am
The 'I-Am' service is also an unconfirmed service. The 'I-Am' service is used to respond to 'Who-Is' service requests. However, the 'I-Am' service request may be issued at any time. It does not need to be preceded by the receipt of a 'Who-Is' service request.

The SI-BACnet IP option module broadcasts an 'I-Am' service request when it powers up.

Dynamic Object Binding-B (DM-DOB-B)
The SI-BACnet IP option module will provide address information about its objects upon request.

BACnet Service	Initiate	Execute	SI-BACnet IP Function
Who-Has	No	Yes	Replies using the I-Have service request
I-Have	Yes	No	Reply to Who-Has service request

Who-Has
The 'Who-Has' service is an unconfirmed service. The 'Who-Has' service is used by a sending BACnet-user to identify the 'Device' object identifiers and network addresses of other BACnet devices whose local databases contain an object with a given 'Object_Name' or a given 'Object_Identifier'.

The SI-BACnet IP option module responds to the 'Who-Has' service request with the 'I-Have' service. The 'I-Have' service request may be issued at any time and does not need to be preceded by the receipt of a 'Who-Has' service request.

Request: The request frame contains 'Object Identifier' or 'Object Name' and device instance range 'Low' and 'High' limit (Optional).

If the 'Object Identifier' parameter is omitted, then the 'Object Name' parameter shall be present and vice versa.

The Device Instance Range 'Low' and 'High' limit parameter range is 0 - 4194302.

Devices whose 'Object_Identifier' instance number falls within the range greater than or equal to 'Device Instance Range Low Limit' and less than or equal to 'Device Instance Range High Limit' shall be qualified to respond.

The value of the 'Device Instance Range Low Limit' shall be less than or equal to the value of the 'Device Instance Range High Limit.

If the 'Device Instance Range Low Limit' and 'Device Instance Range High Limit' parameters are omitted, then all devices that receive this message are qualified to respond with an 'I-Have' service request.

Response: If the SI-BACnet IP option module 'Object_Identifier' value is within the device instance range, and the 'Object Identifier' or 'Object Name' is present in the SI-BACnet IP option module, then the SI-BACnet IP option module will respond with the 'I-Have' message.

The response frame consists of 'Device Identifier', 'Object Identifier' and 'Object Name'.

If the 'I-Have' is being transmitted in response to a previously received 'Who-Has', then the 'I-Have' shall be transmitted in such a manner that the BACnet-user that sent the 'Who-Has' will receive the resulting 'I-Have'. Since the request is unconfirmed, no further action is required.

I-Have
The 'I-Have' service is also an unconfirmed service. The 'I-Have' service is used to respond to 'Who-Has' service requests. However, the 'I-Have' service request may be issued at any time. It does not need to be preceded by the receipt of a 'Who-Has' service request.

DeviceCommunicationControl-B (DM-DCC-B)
The SI-BACnet IP option module will respond to communication control exercised by a 'Client' or 'A' device.

BACnet Service	Initiate	Execute	SI-BACnet IP Function
DeviceCommunicationControl	No	Yes	Indefinite duration control supported

DeviceCommunicationControl
The Device Communication Control service request is used by a BACnet Client device to instruct a SI-BACnet IP option module to stop responding to all APDUs (except 'DeviceCommunicationControl' or 'ReinitializeDevice') on the communication network for an indefinite duration of time.

A password may be required from the client BACnet-user prior to executing the service.

The SI-BACnet IP option module supports the time duration 'indefinite', meaning communication must be re-enabled by a 'DeviceCommunicationControl' or 'ReinitializeDevice' service only and not by time.

Request: The request frame contains 'Time Duration' (Optional), 'Enable/Disable' and 'Password'(Optional).

If the 'Time Duration' parameter is not present, then the time duration shall be considered indefinite. The 'Time Duration' parameter shall be ignored, and the time considered to be indefinite if the 'Enable/Disable' parameter has a value of ENABLE.

The SI-BACnet IP option module supports the enumeration values 'ENABLE' and 'DISABLE' for the 'Enable/Disable' parameter.

The Password parameter shall be 4-digit value and configured using the 'Connect' commissioning software.

Response: 'Simple ACK' in response indicates the service request succeed.

Failed result indicates the reason for failure specified by 'Error Type' Type' (Error Class & Error Code).

Scenarios	Error Class	Error Code
The password is invalid or absent when one is required	SECURITY	PASSWORD_FAILURE

TimeSynchronization-B (DM-TS-B)
The SI-BACnet IP option module will interpret time synchronisation messages from the 'Client' or 'A' device.

BACnet Service	Initiate	Execute	SI-BACnet IP Function
TimeSynchronization	No	Yes	Establishes time synchronisation with the client

TimeSynchronization
This is an unconfirmed service used by a requesting BACnet-user to notify an SI-BACnet IP option module of the correct current time. This service may be broadcast, multicast, or addressed to a single recipient. Its purpose is to notify recipients of the correct current time so that option module may synchronise their internal clocks with one another.

Request: The request frame contains current date and time. The SI-BACnet IP option module, upon receiving a 'TimeSynchronization' service request, will update its local representation of time with the received value.

Response: No response expected. New data and time values will be reflected in the 'Local_Time' and 'Local_Date' properties of the Device object.

NOTE Time synchronisation is only available on drives with a Real-Time Clock, and Pr **0.06.019** (*Date/Time Selector*) is set to 'Local Keypad' or 'Remote Keypad'. If either of these is not true then, upon receiving a Time Synchronisation command, SI-BACnet IP will not return the current time information in the response, and the Local_Date and Local_Time properties will not be included in the Device object properties.

ReinitializeDevice-B (DM-RD-B)
The SI-BACnet IP option module will perform the reinitialization request from the 'Client' or 'A' device.

BACnet Service	Initiate	Execute	SI-BACnet IP Function
ReinitializeDevice	No	Yes	Perform reinitialization request

ReinitializeDevice
The SI-BACnet IP option module supports the password field, and also the 'WARMSTART' and 'COLDSTART' service option.

The 'ReinitializeDevice' service is used by a client BACnet-user to instruct an SI-BACnet IP option module to reboot itself (cold start), reset itself to some predefined initial state (warm start), or to activate network port object changes. Resetting or rebooting a device is primarily initiated by a human operator for diagnostic purposes.

The SI-BACnet IP option module supports the 'ReinitializeDevice' service with restart options COLDSTART and WARMSTART.

COLDSTART shall mean to reboot the option module and start over, retaining all data and programs that would normally be retained during a brief power outage.

WARMSTART shall means soft reset to the option module. The BACnet stack shall reinitialise to power initialisation state.

Request: The request frame contains 'Reinitialized State of Device' and 'Password' (Optional).

The 'Time Duration' parameter shall be ignored, and the time considered to be indefinite if the 'Enable/Disable' parameter has a value of ENABLE.

The SI-BACnet IP option module supports the enumeration value 'ENABLE' and 'DISABLE' for the 'Enable/Disable' parameter.

The Password parameter shall be 4-digit value and configured using the 'Connect' commissioning software.

Response: 'Simple ACK' in response indicates the service request succeeded.

Failed result indicates the reason for failure specified by 'Error Type' (Error Class & Error Code).

Scenarios	Error Class	Error Code
The password is invalid or absent when one is required	SECURITY	PASSWORD_FAILURE
Unsupported State is given	SERVICES	Optional Functionality Is Not Supported

7.3.6 BACnet Standard Objects

The SI-BACnet IP option module supports the following standard BACnet object types and their corresponding number of instances (depending on drive type and operating mode):

- Device Object (1)
- Analog Input Object (2)
- Analog Output Object (2)
- Analog Value Object (34)
- Binary Input Object (7)
- Binary Output Object (6)
- Binary Value Object (6)
- Multi-state Value Object (1)
- Network Port Object (2)

7.3.6.1 Device Object

BACnet's Device Object represents the features of the SI-BACnet IP option module. Only one instance of the Device Object is supported.

SI-BACnet IP supports the following Device Object properties:

- Object_Identifier (Mandatory)
- Object_Name (Mandatory)
- Object_Type (Mandatory)
- System_Status (Mandatory)
- Vendor_Name (Mandatory)
- Vendor_Identifier (Mandatory)
- Model_Name (Mandatory)
- Firmware_Version (Mandatory)
- Application_Software_Version (Mandatory)
- Protocol_Version (Mandatory)
- Protocol_Revision (Mandatory)
- Protocol_Services_Supported (Mandatory)
- Protocol_Object_Types_Supported (Mandatory)
- Object_List (Mandatory)
- Max_APDU_Length_Accepted (Mandatory)
- Segmentation_Supported (Mandatory)
- Local_Time (Optional)
- Local_Date (Optional)
- APDU_Timeout (Mandatory)
- Number_Of_APDU_Retries (Mandatory)
- Device_Address_Binding (Mandatory)
- Database_Revision (Mandatory)
- Property_List (Mandatory)
- Active_COV_Subscriptions (Optional)

Object_Identifier

Description	Provides the BACnet device identification information.		
Data Type	BACnetObjectIdentifier	Conformance Code	Mandatory
Minimum	0	Maximum	4194302
Default	1	Access	RW

Object_Name

Description	Represents the unique name of the BACnet device object.		
Data Type	CharacterString	Conformance Code	Mandatory
Minimum	1 Character	Maximum	16 Characters
Default	SI-BACnet IP	Access	RW

Object_Type

Description	Indicates the object's membership with BACnet object type class. 0 (Analog Input), 1 (Analog Output), 2 (Analog Value), 3 (Binary Input), 4 (Binary Output), 5 (Binary Value), 8 (Device), 19 (Multi-state Value), 56 (Network Port)		
Data Type	BACnetObjectIdentifier	Conformance Code	Mandatory
Minimum	0 (Analog Input)	Maximum	56 (Network Port)
Default	8 (Device)	Access	RO

System_Status

Description	Indicates the current physical and logical status of the SI-BACnet IP option module. 0 (Operational), 1 (Operational-Read-Only), 2 (Download-Required), 3 (Download-In-Progress), 4 (Non-operational), 5 (Backup-In-Progress)		
Data Type	BACnetDeviceStatus	Conformance Code	Mandatory
Minimum	0 (Operational)	Maximum	5 (Backup-In-Progress)
Default	0 (Operational)	Access	RO

NOTE SI-BACnet IP supports Operational (0) status only.

Vendor_Name

Description	**Indicates the BACnet device manufacturer**		
Data Type	CharacterString	Conformance Code	Mandatory
Minimum	N/A	Maximum	N/A
Default	Control Techniques Ltd.	Access	RO

Vendor_Identifier

Description	Indicates the BACnet device manufacturer identification code assigned by ASHRAE		
Data Type	Unsigned16	Conformance Code	Mandatory
Minimum	N/A	Maximum	N/A
Default	220	Access	RO

Model_Name

Description	Indicates the unique character string assigned by the vendor to represent the SI-BACnet IP option module.		
Data Type	CharacterString	Conformance Code	Mandatory
Minimum	N/A	Maximum	N/A
Default	SI-BACnet IP	Access	RO

Firmware_Revision

Description	Indicates the firmware version of the SI-BACnet IP option module (ww.xx.yy).		
Data Type	CharacterString	Conformance Code	Mandatory
Minimum	N/A	Maximum	N/A
Default	None	Access	RO

Application_Software_Version

Description	Indicates the version of the application software installed.		
Data Type	CharacterString	Conformance Code	Mandatory
Minimum	N/A	Maximum	N/A
Default	None	Access	RO

Protocol_Version

Description	Indicates the version of the BACnet protocol supported by the SI-BACnet IP option module.		
Data Type	Unsigned	Conformance Code	Mandatory
Minimum	N/A	Maximum	N/A
Default	1	Access	RO

Protocol_Revision

Description	Indicates the minor revision level of the BACnet standard implemented in the SI-BACnet IP option module.		
Data Type	Unsigned	Conformance Code	Mandatory
Minimum	N/A	Maximum	N/A
Default	19	Access	RO

Protocol_Services_Supported

Description	A binary representation of the standard protocol services supported by the SI-BACnet IP option module.		
Data Type	BACnetServicesSupported	Conformance Code	Mandatory
Minimum	N/A	Maximum	N/A
Default	See following table	Access	RO

Device Object - Protocol Services Supported by SI-BACnet IP

Service	Bit Position
Subscribe COV	5
Read Property	12
Read Property Multiple	14
Write Property	15
Write Property Multiple	16
Device Communication Protocol	17
Reinitialize Device	20
Time Synchronization	32
Who-Has	33
Who-Is	34

Protocol_Object_Types_Supported

Description	A binary representation of the standard object types supported by the SI-BACnet IP option module		
Data Type	BACnetObjectTypesSupported	Conformance Code	Mandatory
Minimum	N/A	Maximum	N/A
Default	See following table	Access	RO

Service	Bit Position
Analog Input	0
Analog Output	1
Analog Value	2
Binary Input	3
Binary Output	4
Binary Value	5
Device	8
Multi-state Value	19
Network Port	56

Object_List

Description	This property is a BACnetARRAY of BACnetObjectIdentifier for each object within the SI-BACnet IP option module accessible using the BACnet services.		
Data Type	BACnetARRAY[N] of BACnetObjectIdentifier	Conformance Code	Mandatory
Minimum	N/A	Maximum	N/A
Default	See following table	Access	RO

Device Object - Object List

Object	Instances
Device	1
Analog Input	2
Analog Output	2
Analog Value	34
Binary Input	7
Binary Output	6
Binary Value	6
Multi-state Value	1
Network Port	2

NOTE The Object List is based on the drive type, derivative and mode.

Max_APDU_Length_Accepted

Description	This property indicates the maximum number of octets that may be contained in the application layer protocol data unit.		
Data Type	Unsigned	Conformance Code	Mandatory
Minimum	N/A	Maximum	N/A
Default	1476	Access	RO

Segmentation_Supported

Description	This property indicates whether the SI-BACnet IP option module supports segmentation of messages. 0 (Both), 1 (Transmit), 2 (Receive), 3 (None).		
Data Type	BACnetSegmentation	Conformance Code	Mandatory
Minimum	0 (Both)	Maximum	3 (None)
Default	3 (None)	Access	RO

Local_Time

Description	This property indicates the current system time (hh:mm:ss) from the SI-BACnet IP option module.		
Data Type	Time	Conformance Code	Optional
Minimum	N/A	Maximum	N/A
Default	00:00:00	Access	RO

NOTE Time synchronisation is only available on drives with a Real-Time Clock, and Pr **0.06.019** (*Date/Time Selector*) is set to 'Local Keypad' or 'Remote Keypad'. If either of these is not true then, upon receiving a Time Synchronisation command, SI-BACnet IP will not return the current time information in the response.

Local_Date

Description	This property indicates the current system date (dd/mm/yyyy) from the SI-BACnet IP option module.		
Data Type	Date	Conformance Code	Optional
Minimum	N/A	Maximum	N/A
Default	01/01/12	Access	RO

NOTE Time synchronisation is only available on drives with a Real-Time Clock, and Pr **0.06.019** (*Date/Time Selector*) is set to 'Local Keypad' or 'Remote Keypad'. If either of these is not true then, upon receiving a Time Synchronisation command, SI-BACnet IP will not return the current time information in the response.

APDU_Timeout

Description	This property indicates the amount of time in milliseconds (ms) between retransmissions of an APDU requiring acknowledgement when no acknowledgement has been received.		
Data Type	Unsigned	Conformance Code	Mandatory
Minimum	N/A	Maximum	N/A
Default	10,000	Access	RO

Number_Of_APDU_Retries

Description	This property indicates the maximum number of times that an APDU message shall be retransmitted.		
Data Type	Unsigned	Conformance Code	Mandatory
Minimum	N/A	Maximum	N/A
Default	3	Access	RO

Device_Address_Binding

Description	This property consists of a list of a BACnet 'Object Identifier' of a 'Device' object and a BACnet device address. Entries in this list identify the actual device addresses when accessed via a BACnet service request.		
Data Type	BACnetLIST of BACnetAddressBinding	Conformance Code	Mandatory
Minimum	N/A	Maximum	N/A
Default	NULL	Access	RO

Database_Revision

Description	This property indicates the logical revision number for the SI-BACnet IP option module database.		
Data Type	Unsigned	Conformance Code	Mandatory
Minimum	0	Maximum	4294967295
Default	0	Access	RO

Property_List

Description	This property consists of a list of 'Device' object properties supported by the SI-BACnet IP option module. 'Object_Name', 'Object_Type', 'Object_Identifier' and 'Property_List' properties are excluded from the list.		
Data Type	BACnetARRAY[N] of BACnetPropertyIdentifier	Conformance Code	Mandatory
Minimum	N/A	Maximum	N/A
Default	See following table	Access	RO

Device Object - Property List

Object	Number
APDU_Timeout	11
Application Software Version	12
Device_Address_Binding	30
Firmware_Revision	44
Local_Date	56
Local_Time	57
Max_APDU_Length_Accepted	62
Model_Name	70
Number_Of_APDU_Retries	73
Object_List	76
Protocol_Object_Types_Supported	96

Object	Number
Protocol_Services_Supported	97
Protocol_Version	98
Segmentation_Supported	107
System_Status	112
Vendor_Identifier	120
Vendor_Name	121
Protocol_Revision	139
Active_COV_Subscriptions	152
Database_Revision	155

Active_COV_Subscriptions

Description	This property provides a network-visible indication of the COV subscriptions currently active. This property is applicable because COV subscription service is supported by the SI-BACnet IP option module.		
Data Type	BACnetLIST of BACnetCOVMultipleSubscription	Conformance Code	Optional
Minimum	0	Maximum	20
Default	NULL	Access	RO

7.3.6.2 Analog Input

The following table shows the Analog Input object properties supported by SI-BACnet IP:

Table 7-6 Analog Input object properties

Service Request No:	Property Name	Description
1	Object_Identifier	Represents a number which uniquely identifies the object.
2	Object_Name	Represents a string of printable characters which specify a unique name for the object.
3	Object_Type	Indicates the object's membership with the BACnet object type class.
4	Present_Value	Shows the current value of the Analog Input.
5	Status_Flag	Shows the health of the Analog Input object. Consists of four Boolean values: 'IN_ALARM', 'FAULT', 'OVERRIDDEN', 'OUT_OF_SERVICE'.
6	Event_State	Determines whether the object has an active event state or not. Drive Trip: 'Fault' Drive Healthy: 'Normal' The SI-BACnet IP option module supports event reporting on trip.
7	Out_Of_Service	Indicates whether the physical input the object represents is in service or not.
8	Units	Indicates the measurement unit of the object.
9	Property_List	Consists of a list of properties supported by the SI-BACnet IP option module for the Analog Input object. 'Object_Name', 'Object_Type', 'Object_Identifier' and 'Property_List' properties are excluded from the list.
10	Reliability	Indicates the reliability of the object. Drive Trip: 'Unreliable Other' Drive Healthy: 'No Fault Detected'
11	COV_Increment (Writable)	REAL property type used to generate the COV notification. If 'Present_Value' changes by the value specified in 'COV_Increment', then 'COV_Notification' is generated.

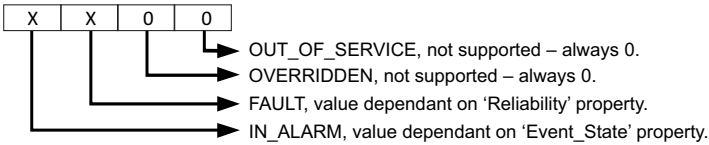
Two instances of the 'Analog Input' object are supported, the following table shows the default configurations.

Table 7-7 Analog Input object default configuration

Service Request No:	Property Name	Analog Input 1	Analog Input 2
1	Object_Identifier	ANALOG_INPUT:1	ANALOG_INPUT:2
2	Object_Name	#AI_01 Drive Analog IP1	#AI_02 Drive Analog IP2
3	Object_Type	0 (ANALOG_INPUT)	0 (ANALOG_INPUT)
4	Present_Value	[Analog Input 1 (Pr **07.001**)] Value: (%) based on AnalogReference 1 (Pr **01.036**) Range: -100 to 100	[Analog Input 2 (Pr **07.002**)] Value: (%) based on Analog Reference 2 (Pr **01.037**) Range: -100 to 100
5	Status_Flag	0000	0000
6	Event_State	0 (Normal)	0 (Normal
7	Out_Of_Service	False	False
8	Units	98 (%)	98 (%)
9	Property_List	36 (Event_State), 81 (Out_Of_Service), 85 (Present_Value), 111 (Status_Flag), 117 (Units), 22 (COV_Increment), 103 (Reliability)	36 (Event_State), 81 (Out_Of_Service), 85 (Present_Value), 111 (Status_Flag), 117 (Units), 22 (COV_Increment), 103 (Reliability)
10	Reliability	0 (No_Fault_Detected)	0 (No_Fault_Detected)
11	COV_Increment (Writable)	0	0

All properties are read only, except 'COV_Increment' (Writable).

Status_Flag: 4-digit binary value (Read Only) decoded as follows:



7.3.6.3 Analog Output

The following table shows the Analog Output object properties supported by SI-BACnet IP:

Table 7-8 Analog Output object properties

Service Request No:	Property Name	Description
1	Object_Identifier	Represents a number which uniquely identifies the object.
2	Object_Name	Represents a string of printable characters which specify a unique name for the object.
3	Object_Type	Indicates the object's membership with the BACnet object type class.
4	Present_Value (Writable/Commandable)	Shows the current value of the Analog Output.
5	Status_Flag	Shows the health of the Analog Output object. Consists of four Boolean values: 'IN_ALARM', 'FAULT', 'OVERRIDDEN', 'OUT_OF_SERVICE'.

Service Request No:	Property Name	Description
6	Event_State	Determines whether the object has an active event state or not. The SI-BACnet IP option module does not support event reporting for analog outputs, therefore this property will always be 0 (Normal).
7	Out_Of_Service	Indicates whether the physical point the object represents is in service or not. This property will be set when 'Present_Value' is decoupled from the physical point.
8	Units	Indicates the measurement unit of the object.
9	Property_List	Consists of a list of properties supported by the SI-BACnet IP option module for the Analog Output object. 'Object_Name', 'Object_Type', 'Object_Identifier' and 'Property_List' properties are excluded from the list.
10	Priority_Array	This property is an array of prioritised values.
11	Relinquish_Default (Writable)	This property is the default value used for the 'Present_Value' property when all command priority values in the 'Priority_Array' property have a NULL value.
12	COV_Increment (Writable)	REAL property type used to generate the COV notification. If 'Present_Value' changes by the value specified in the 'COV_Increment' property, then 'COV_Notification' is generated.
13	Current_Command_Priority	This property indicates the currently active priority.

Two instances of the 'Analog Output' object are supported, the following table shows the default configurations.

Table 7-9 Analog Output object default configuration

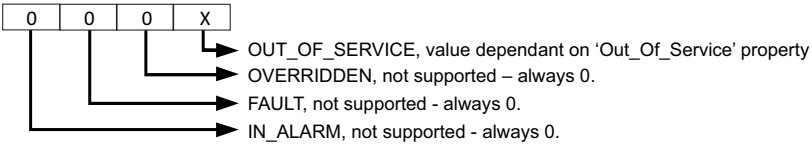
Service Request No:	Property Name	Analog Output 1	Analog Output 2
1	Object_Identifier	ANALOG_OUTPUT:1	ANALOG_OUTPUT:2
2	Object_Name	#AO_01 Drive Analog OP1	#AO_02 Drive Analog OP2
3	Object_Type	1 (ANALOG_OUTPUT)	1 (ANALOG_OUTPUT)
4	Present_Value (Writable/Commandable)	Value: (%) based on Analog Output 1 Source (Pr **07.019**) Range: -100 to 100	Value: (%) based on Analog Output 2 Source (Pr **07.022**) Range: -100 to 100
5	Status_Flag	0001	0001
6	Event_State	0 (Normal)	0 (Normal)
7	Out_Of_Service	True: Pr **07.019**≠18.011 to 18.025 False: Pr **07.019**=18.011 to 18.025	True: Pr **07.022**≠18.011 to 18.025 False: Pr **07.022**=18.011 to 18.025
8	Units	98 (%)	98 (%)
9	Property_Array	NULL Range: 0 to 100, NULL	NULL Range: 0 to 100, NULL
10	Relinquish_Default (Writable)	0 Range: 0 to 100	0 Range: 0 to 100
11	Property_List	36 (Event_State), 81 (Out_Of_Service), 85 (Present_Value), 87 (Priority_Array), 104 (Relinquish_Default), 111 (Status_Flag), 117 (Units), 431 (Current_Command_Priority), 22 (COV_Increment)	36 (Event_State), 81 (Out_Of_Service), 85 (Present_Value), 87 (Priority_Array), 104 (Relinquish_Default), 111 (Status_Flag), 117 (Units), 431 (Current_Command_Priority), 22 (COV_Increment)

Service Request No:	Property Name	Analog Output 1	Analog Output 2
12	Current_Command_Priority	NULL: 'Present_Value'= 'Relinquish_Default' Range: NULL, 1 to 16	NULL: 'Present_Value'= 'Relinquish_Default' Range: NULL, 1 to 16
13	COV_Increment (Writable)	0	0

All properties are read only, except 'Relinquish_Default' and ‘COV_Increment’ (Writable).

‘Present_Value' is a Commandable property.

Status_Flag: 4-digit binary value (Read Only) decoded as follows:



These Analog Outputs are used to display an analog value from one of the drive's application menu 18 (parameters 11 thru 25) as configured by the relevant source parameter (Pr **07.019** or **07.022**).

'Out of Service' - By default this property will be True, disabling the BACnet Analog Output; to enable the BACnet Analog Output, the relevant drive source parameter (Pr **07.019** or **07.022**) must be configured for one of the drive parameters 11 thru 25 in menu 18 and the BACnet interface must then be reset to activate the change, this will then set the 'Out Of Service' property to 'False' and the BACnet Analog Output will then display the value in the relevant configured source parameter (Pr **07.019** or **07.022**) as a percentage scaled to the source parameter range (signed 16-bit).

This will give a range of -100 % to +100 % for a value in Pr **18.011** of -32767 to 32767.

NOTE A parameter save must be performed if the changes are to be saved.

Example

To read the drive's Speed Feedback (Pr **03.002**) in Analog Output 1

- Set **07.019** (*Analog Output 1 Source*) = 18.011
- Set **12.008** (*Variable Select 1 Source 1*) = 03.002
- Set **12.011** (*Variable Select 1 Destination*) = 18.011
- Reset the drive
- Reset the BACnet interface
- The ‘Present_Value’ will be the same percentage of Pr **03.002** scaled for Pr **18.011**.

7.3.6.4 Analog Value

SI-BACnet IP supports 34 instances of Analog Value objects, based on drive type and mode.

These are organised in five groups as shown in the following table:

Table 7-10 Analog Value object instances

Service Request No:	Instance	Group Name
1 to 5	AnalogValue1 to AnalogValue5	Commandable
6 to 8	AnalogValue6 to AnalogValue8	Writable
9 to 11	AnalogValue9 to AnalogValue11	LatchOnTrip
12 to 24	AnalogValue12 to AnalogValue24	ReadOnly
25 to 34	AnalogValue25 to AnalogValue34	UserSelectable

Analog Value object - Commandable

The Analog Value object Commandable group properties are shown in the following table.

Table 7-11 Analog Value object properties (Commandable group)

Service Request No:	Property Name	Description
1	Object_Identifier	Represents a number which uniquely identifies the object.
2	Object_Name	Represents a string of printable characters which specify a unique name for the object.
3	Object_Type	Indicates the object's membership with the BACnet object type class.
4	Present_Value (Writable/Commandable)	Shows the current value of the Analog Value.
5	Status_Flag	Shows the health of the Analog Value object. Consists of four Boolean values: 'IN_ALARM', 'FAULT', 'OVERRIDDEN', 'OUT_OF_SERVICE'.
6	Event_State	Determines whether the object has an active event state or not. The SI-BACnet IP option module does not support event reporting for Analog Value commandable objects, therefore this property will always be 0 (Normal).
7	Out_Of_Service	Indicates whether the physical point the object represents is in service or not. The SI-BACnet IP option module does not support the 'Out_Of_Service' property for commandable Analog Value objects.
8	Units	Indicates the measurement unit of the object.
9	Priority_Array	This property is an array of prioritised values. Range: 0 to 100.
10	Relinquish_Default (Writable)	This property is the default value used for the 'Present_Value' property when all command priority values in the 'Priority_Array' property have a NULL value. Range: 0 to 100.
11	COV_Increment (Writable)	REAL property type used to generate the COV notification. If 'Present_Value' changes by the value specified in the 'COV_Increment' property, then 'COV_Notification' is generated.
12	Property_List	Consists of a list of properties supported by the SI-BACnet IP option module for the Analog Value object. 'Object_Name', 'Object_Type', 'Object_Identifier' and 'Property_List' properties are excluded from the list.
13	Current_Command_Priority	This property indicates the currently active priority.

SI-BACnet IP supports 5 instances of Commandable Analog Value objects.

The default Analog Value object Commandable group configuration is shown in the following table:

Table 7-12 Analog Value object default configuration (Commandable group)

Service Request No:	Property Name	Analog Value Commandable
1	Object_Identifier	See Table 7-13 *Analog Value instance default (Commandable)*
2	Object_Name	See Table 7-13 *Analog Value instance default (Commandable)*
3	Object_Type	2 (ANALOG_VALUE)
4	Present_Value (Writable, Commandable)	See Table 7-13 *Analog Value instance default (Commandable)*
5	Status_Flag	0000
6	Event_State	0 (Normal)
7	Out_Of_Service	0 (False)
8	Units	See Table 7-13 *Analog Value instance default (Commandable)*
9	Priority_Array	NULL
10	Relinquish_Default (writable)	0
11	Property_List	36 (Event_State), 81 (Out_Of_Service), 85 (Present_Value), 87 (Priority_Array), 104 (Relinquish_Default), 111 (Status_Flag), 117 (Units), 431 (Current_Command_Priority), 22 (COV_Increment)
12	Current_Command_Priority	NULL: 'Present_Value'='Relinquish_Default' Range: NULL, 1 to 16
13	COV_Increment (Writable)	0

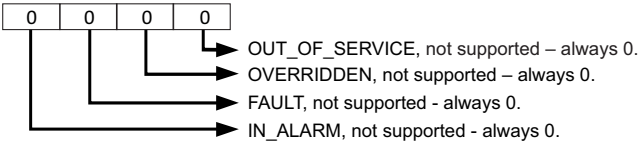
Table 7-13 Analog Value instance default (Commandable)

Instance	Object_Identifier	Object_Name	Menu Param Mapped	Units
AnalogValue1	ANALOG_VALUE:1	#AV_01 Speed Ref	Pr **01.021** (-550 to 550)	Hertz
AnalogValue2	ANALOG_VALUE:2	#AV_02 PID1 Dig Ref	Pr **14.025** (-100 to 100)	Percent
AnalogValue3	ANALOG_VALUE:3	#AV_03 PID1 Dig Fback	Pr **14.026** (-100 to 100)	Percent
AnalogValue4	ANALOG_VALUE:4	#AV_04 PID2 Dig Ref	Pr **14.055** (-100 to 100)	Percent
AnalogValue5	ANALOG_VALUE:5	#AV_05 PID2 Dig Fback	Pr **14.056** (-100 to 100)	Percent

NOTE The parameter value ranges shown in Table 7-13 above, are for the H300 drive in open-loop mode, and may be different according to the host drive type and operating mode.

All properties are read only, except 'Relinquish_Default' (Writable), 'Present_Value' (Writable or Commandable) and 'COV_Increment' (Writable).

Status_Flag: 4-digit binary value (Read Only) decoded as follows:



Analog Value object - Writable

The Analog Value object Writable group properties are shown in the following table:

Table 7-14 Analog Value object properties (Writable group)

Service Request No:	Property Name	Description
1	Object_Identifier	Represents a number which uniquely identifies the object.
2	Object_Name	Represents a string of printable characters which specify a unique name for the object.
3	Object_Type	Indicates the object's membership with the BACnet object type class.
4	Present_Value (Writable)	Shows the current value of the Analog Value.
5	Status_Flag	Shows the health of the Analog Value object. Consists of four Boolean values: 'IN_ALARM', 'FAULT', 'OVERRIDDEN', 'OUT_OF_SERVICE'.
6	Event_State	Determines whether the object has an active event state or not. The SI-BACnet IP option module does not support event reporting for Analog Value writable objects, therefore this property will always be 0 (Normal).
7	Out_Of_Service	Indicates whether the physical point the object represents is in service or not. The SI-BACnet IP option module does not support the 'Out_Of_Service' property for writable Analog Value objects.
8	Units	Indicates the measurement unit of the object.
9	COV_Increment (Writable)	REAL property type used to generate the COV notification. If 'Present_Value' changes by the value specified in the 'COV_Increment' property, then 'COV_Notification' is generated.
10	Property_List	Consists of a list of properties supported by the SI-BACnet IP option module for the Analog Value object. 'Object_Name', 'Object_Type', 'Object_Identifier' and 'Property_List' properties are excluded from the list.

SI-BACnet IP supports 3 instances of Writable Analog Value objects.

The default Analog Value object Writable group configuration is shown in the following table:

Table 7-15 Analog Value object default configuration (Writable group)

Service Request No:	Property Name	Analog Value Writable
1	Object_Identifier	See Table 7-16 *Analog Value instance default (Writable)*
2	Object_Name	See Table 7-16 *Analog Value instance default (Writable)*
3	Object_Type	2 (ANALOG_VALUE)
4	Present_Value (Writable)	See Table 7-16 *Analog Value instance default (Writable)*
5	Status_Flag	0000
6	Event_State	0 (Normal)

Service Request No:	Property Name	Analog Value Writable
7	Out_Of_Service	0 (False)
8	Units	See Table 7-16 *Analog Value instance default (Writable)*
9	Property_List	36 (Event_State), 81 (Out_Of_Service), 85 (Present_Value), 111 (Status_Flag), 117 (Units), 22 (COV_Increment)
10	COV_Increment (Writable)	0

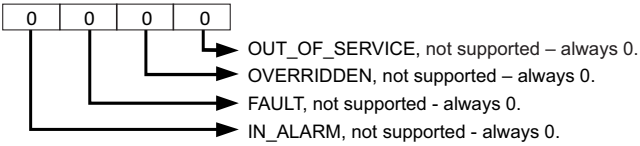
Table 7-16 Analog Value instance default (Writable)

Instance	Object_Identifier	Object_Name	Menu Param Mapped	Units
AnalogValue6	ANALOG_VALUE:6	#AV_06 Max Speed Ref	Pr **01.006** (0 to 550) Default: 50.0	Hertz
AnalogValue7	ANALOG_VALUE:7	#AV_07 User Trip Param	Pr **10.038** (0 to 255) Default: 0	None
AnalogValue8	ANALOG_VALUE:8	#AV_08 Filtr Change(dt)	Pr **06.021** (0 to 30k) Default: 0	Hours

NOTE The parameter value ranges shown in Table 7-16 above, are for the H300 drive in open-loop mode, and may be different according to the host drive type and operating mode.

All properties are read only, except 'Present_Value' and 'COV_Increment' (Writable).

Status_Flag: 4-digit binary value (Read Only) decoded as follows:



Analog Value Object - LatchOnTrip

The Analog Value object LatchOnTrip group properties are shown in the following table:

Table 7-17 Analog Value object properties (LatchOnTrip group)

Service Request No:	Property Name	Description
1	Object_Identifier	Represents a number which uniquely identifies the object.
2	Object_Name	Represents a string of printable characters which specify a unique name for the object.
3	Object_Type	Indicates the object's membership with the BACnet object type class.
4	Present_Value	Shows the current value of the Analog Value.
5	Status_Flag	Shows the health of the Analog Value object. Consists of four Boolean values: 'IN_ALARM', 'FAULT', 'OVERRIDDEN', 'OUT_OF_SERVICE'.
6	Event_State	Determines whether the object has an active event state or not. The SI-BACnet IP option module supports event reporting for Analog Value Latch_On_Trip. Drive Trip: 'Fault' Drive Healthy: 'Normal'.
7	Out_Of_Service	Indicates whether the physical point the object represents is in service or not. The SI-BACnet IP option module does not support the 'Out_Of_Service' property for Analog Value Latch_On_Trip objects, therefore this property will always be 0 (False).
8	Units	Indicates the measurement unit of the object.
9	COV_Increment (Writable)	REAL property type used to generate the COV notification. If 'Present_Value' changes by the value specified in the 'COV_Increment' property, then 'COV_Notification' is generated.
10	Property_List	Consists of a list of properties supported by the SI-BACnet IP option module for the Analog Value object. 'Object_Name', 'Object_Type', 'Object_Identifier' and 'Property_List' properties are excluded from the list.
11	Reliability	Indicates the reliability of the object. Drive Trip: 'Unreliable Other' Drive Healthy: 'No Fault Detected'

SI-BACnet IP supports 3 instances of Latch_On_Trip Analog Value objects.

The default Analog Value object Latch_On_Trip group configuration is shown in the following table:

Table 7-18 Analog Value object default configuration (LatchOnTrip group)

Service Request No:	Property Name	Analog Value Writable
1	Object_Identifier	See Table 7-19 *Analog Value instance default (LatchOnTrip)*
2	Object_Name	See Table 7-19 *Analog Value instance default (LatchOnTrip)*
3	Object_Type	2 (ANALOG_VALUE)
4	Present_Value	See Table 7-19 *Analog Value instance default (LatchOnTrip)*
5	Status_Flag	0000
6	Event_State	0 (Normal)
7	Out_Of_Service	0 (False)
8	Units	See Table 7-19 *Analog Value instance default (LatchOnTrip)*

Service Request No:	Property Name	Analog Value Writable
9	Property_List	36 (Event_State), 81 (Out_Of_Service), 85 (Present_Value), 111 (Status_Flag), 117 (Units), 22 (COV_Increment) 103 (Reliability)
10	Reliability	0 (No Fault Detected)
11	COV_Increment (Writable)	0

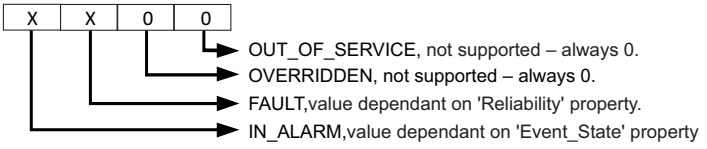
Table 7-19 Analog Value instance default (LatchOnTrip)

Instance	Object_Identifier	Object_Name	Menu Param Mapped	Units
AnalogValue9	ANALOG_VALUE:9	#AV_09 Output Current	Pr **04.001** (0 to 99999.999)	Amperes
AnalogValue10	ANALOG_VALUE:10	#AV_10 Output Frequency	Pr **05.001** (-550 to 550)	Hertz
AnalogValue11	ANALOG_VALUE:11	#AV_11 Output Power	Pr **05.003** (-99999.999 to 99999.999)	Kilowatts

NOTE The parameter value ranges shown in Table 7-19 above, are for the H300 drive in open-loop mode, and may be different according to the host drive type and operating mode.

All properties are read only except 'COV_Increment' (Writable).

Status_Flag: 4-digit binary value (Read Only) decoded as follows:



Analog Value object - ReadOnly

The Analog Value object ReadOnly group properties are shown in the following table:

Table 7-20 Analog Value object properties (ReadOnly group)

Service Request No:	Property Name	Description
1	Object_Identifier	Represents a number which uniquely identifies the object.
2	Object_Name	Represents a string of printable characters which specify a unique name for the object.
3	Object_Type	Indicates the object's membership with the BACnet object type class.
4	Present_Value	Shows the current value of the Analog Value.
5	Status_Flag	Shows the health of the Analog Value object. Consists of four Boolean values: 'IN_ALARM', 'FAULT', 'OVERRIDDEN', 'OUT_OF_SERVICE'.
6	Event_State	Determines whether the object has an active event state or not. The SI-BACnet IP option module does not support event reporting for Analog Value read only objects, therefore this property will always be 0 (Normal).

Service Request No:	Property Name	Description
7	Out_Of_Service	Indicates whether the physical point the object represents is in service or not. The SI-BACnet IP option module does not support the 'Out_Of_Service' property for Analog Value read only objects, therefore this property will always be 0 (False).
8	Units	Indicates the measurement unit of the object.
9	COV_Increment (Writable)	REAL property type used to generate the COV notification. If 'Present_Value' changes by the value specified in the 'COV_Increment' property, then 'COV_Notification' is generated.
10	Property_List	Consists of a list of properties supported by the SI-BACnet IP option module for the Analog Value object. 'Object_Name', 'Object_Type', 'Object_Identifier' and 'Property_List' properties are excluded from the list.

SI-BACnet IP supports 13 instances of Read Only Analog Value objects based on drive type and mode.

The default Analog Value object Read Only group configuration is shown in the following table:

Table 7-21 Analog Value object default configuration (ReadOnly group)

Service Request No:	Property Name	Analog Value Writable
1	Object_Identifier	See Table 7-22 *Analog Value instance default (ReadOnly)*
2	Object_Name	See Table 7-22 *Analog Value instance default (ReadOnly)*
3	Object_Type	2 (ANALOG_VALUE)
4	Present_Value	See Table 7-22 *Analog Value instance default (ReadOnly)*
5	Status_Flag	0000
6	Event_State	0 (Normal)
7	Out_Of_Service	0 (False)
8	Units	See Table 7-22 *Analog Value instance default (ReadOnly)*
9	Property_List	36 (Event_State), 81 (Out_Of_Service), 85 (Present_Value), 111 (Status_Flag), 117 (Units), 22 (COV_Increment)
10	COV_Increment (Writable)	0

Table 7-22 Analog Value instance default (ReadOnly)

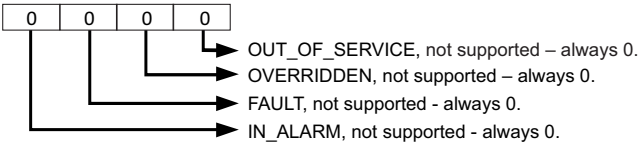
Instance	Object_Identifier	Object_Name	Menu Param Mapped	Units
AnalogValue12	ANALOG_VALUE:12	#AV_12 Output Torque	Pr **04.020** (0 to 99999.999)	Percent
AnalogValue13	ANALOG_VALUE:13	#AV_13 Output Speed	Pr **05.004** (-180000 to 180000)	RPM
AnalogValue14	ANALOG_VALUE:14	#AV_14 Drive Status Wd	Pr **10.040** (0 to 32767)	None
AnalogValue15	ANALOG_VALUE:15	#AV_15 Last Trip	Pr **10.020**	None
AnalogValue16	ANALOG_VALUE:16	#AV_16 Nxt Filtr Ch Time	Pr **06.023**	Hours
AnalogValue17	ANALOG_VALUE:17	#AV_17 Enrgy Meter(MWh)	Pr **06.025**	Megawatt Hours

Instance	Object_Identifier	Object_Name	Menu Param Mapped	Units
AnalogValue18	ANALOG_VALUE:18	#AV_18 Enrgy Meter(kWh)	Pr **06.026**	Kilowatt Hours
AnalogValue19	ANALOG_VALUE:19	#AV_19 PID1 Ref	Pr **14.020**	Percent
AnalogValue20	ANALOG_VALUE:20	#AV_20 PID1 Fback	Pr **14.021**	Percent
AnalogValue21	ANALOG_VALUE:21	#AV_21 PID1 Output	Pr **14.001**	Percent
AnalogValue22	ANALOG_VALUE:22	#AV_22 PID2 Ref	Pr **14.050**	Percent
AnalogValue23	ANALOG_VALUE:23	#AV_23 PID2 Fback	Pr **14.051**	Percent
AnalogValue24	ANALOG_VALUE:24	#AV_24 PID2 Output	Pr **14.031**	Percent

NOTE The parameter value ranges shown in Table 7-22 above, are for the H300 drive in open-loop mode, and may be different according to the host drive type and operating mode.

All properties are read only except 'COV_Increment' (Writable).

Status_Flag: 4-digit binary value (Read Only) decoded as follows:



Analog Value Object - UserSelectable

The Analog Value object UserSelectable group properties are shown in the following table:

Table 7-23 Analog Value object properties (UserSelectable group)

Service Request No:	Property Name	Description
1	Object_Identifier	Represents a number which uniquely identifies the object.
2	Object_Name	Represents a string of printable characters which specify a unique name for the object.
3	Object_Type	Indicates the object's membership with the BACnet object type class.
4	Present_Value	Shows the current value of the Analog Value. If the Reliability property indicates 'Unreliable Others' then Present_Value will not be active and will return 'Read Access Denied' error.
5	Status_Flag	Shows the health of the Analog Value object. Consists of four Boolean values: 'IN_ALARM', 'FAULT', 'OVERRIDDEN', 'OUT_OF_SERVICE'.
6	Event_State	Determines whether the object has an active event state or not. The SI-BACnet IP option module supports event reporting for Analog Value UserSelectable objects. Event_State=Fault: Invalid parameter configuration Event_State=Normal: Valid parameter configuration
7	Out_Of_Service	Indicates whether the physical point the object represents is in service or not. The SI-BACnet IP option module does not support the 'Out_Of_Service' property for UserSelectable Analog Value objects, therefore this property will always be 0 (False).
8	Units	Indicates the measurement unit of the object.
9	COV_Increment (Writable)	REAL property type used to generate the COV notification. If 'Present_Value' changes by the value specified in the 'COV_Increment' property, then 'COV_Notification' is generated.

Service Request No:	Property Name	Description
10	Property_List	Consists of a list of properties supported by the SI-BACnet IP option module for the Analog Value object. 'Object_Name', 'Object_Type', 'Object_Identifier' and 'Property_List' properties are excluded from the list.
11	Reliability	Indicates the reliability of the object. Reliability=Unreliable Others: Invalid parameter configuration Reliability=No Fault Detected: Valid parameter configuration

SI-BACnet IP supports 10 instances of UserSelectable Analog Value objects.

The default Analog Value object UserSelectable group configuration is shown in the following table:

Table 7-24 Analog Value object default configuration (UserSelectable group)

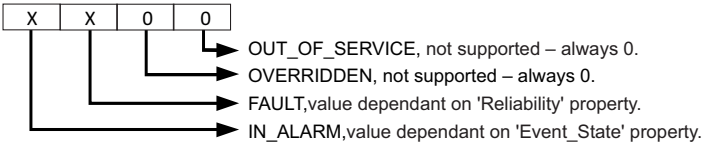
Service Request No:	Property Name	Analog Value Writable
1	Object_Identifier	See Table 7-25 *Analog Value instance default (UserSelectable)*
2	Object_Name	See Table 7-25 *Analog Value instance default (UserSelectable)*
3	Object_Type	2 (ANALOG_VALUE)
4	Present_Value (Writable)	See Table 7-25 *Analog Value instance default (UserSelectable)*
5	Status_Flag	0000
6	Event_State	0 (Normal)
7	Out_Of_Service	0 (False)
8	Units	See Table 7-25 *Analog Value instance default (UserSelectable)*
9	Property_List	36 (Event_State), 81 (Out_Of_Service), 85 (Present_Value), 111 (Status_Flag), 117 (Units), 22 (COV_Increment), 103 (Reliability)
10	COV_Increment (Writable)	0
11	Reliability	0 (No Fault Detected)

Table 7-25 Analog Value instance default (UserSelectable)

Instance	Object_Identifier	Object_Name	Menu Param Mapped
AnalogValue25	ANALOG_VALUE:25	#AV_25 User Configurable Param 1	Pr **S.04.001**
AnalogValue26	ANALOG_VALUE:26	#AV_26 User Configurable Param 2	Pr **S.04.002**
AnalogValue27	ANALOG_VALUE:27	#AV_27 User Configurable Param 3	Pr **S.04.003**
AnalogValue28	ANALOG_VALUE:28	#AV_28 User Configurable Param 4	Pr **S.04.004**
AnalogValue29	ANALOG_VALUE:29	#AV_29 User Configurable Param 5	Pr **S.04.005**
AnalogValue30	ANALOG_VALUE:30	#AV_30 User Configurable Param 6	Pr **S.04.006**
AnalogValue31	ANALOG_VALUE:31	#AV_31 User Configurable Param 7	Pr **S.04.007**
AnalogValue32	ANALOG_VALUE:32	#AV_32 User Configurable Param 8	Pr **S.04.008**
AnalogValue33	ANALOG_VALUE:33	#AV_33 User Configurable Param 9	Pr **S.04.009**
AnalogValue34	ANALOG_VALUE:34	#AV_34 User Configurable Param 10	Pr **S.04.010**

All properties are user selectable except for 'Present_Value' and 'COV_Increment' which are writable.

Status_Flag: 4-digit binary value (Read Only) decoded as follows:



7.3.6.5 Binary Input

SI-BACnet IP supports two Binary Input object type groups, Normal and Bi-directional based on drive type and mode.

Table 7-26 Binary Input object instances

Service Request No:	Instance	Group Name
1 to 3	BinaryInput1 to BinaryInput3	Bi-directional
4 to 7	BinaryInput4 to BinaryInput7	Normal

The following table shows the Bi-directional group Binary Input object properties supported:

Table 7-27 Binary Input object (Bi-directional) properties

Service Request No:	Property Name	Description
1	Object_Identifier	Represents a number which uniquely identifies the object.
2	Object_Name	Represents a string of printable characters which specify a unique name for the object.
3	Object_Type	Indicates the object's membership with the BACnet object type class.
4	Present_Value (Writable)[1]	Shows the current value of the Binary Input.
5	Status_Flag	Shows the health of the Binary Input object. Consists of four Boolean values: 'IN_ALARM', 'FAULT', 'OVERRIDDEN', 'OUT_OF_SERVICE'.
6	Event_State	Determines whether the object has an active event state or not. The SI-BACnet IP option module does not support event reporting for Binary Input objects, therefore this property will always be 0 (Normal).
7	Out_Of_Service	Indicates whether the physical input the object represents is in service or not. This property will be set to 1 (True) when the bi-directional line is selected as an output, otherwise it will be 0 (False).
8	Polarity	This property indicates the relationship between the physical state of the input and the logical state represented by the 'Present_Value' property.
9	Property_List	Consists of a list of properties supported by the SI-BACnet IP option module for the Binary Input object. 'Object_Name', 'Object_Type', 'Object_Identifier' and 'Property_List' properties are excluded from the list.

Three instances of the 'Binary Input' Bi-directional object are supported, the following table shows the default configurations.

Table 7-28 Binary Input object (Bi-directional) default configuration

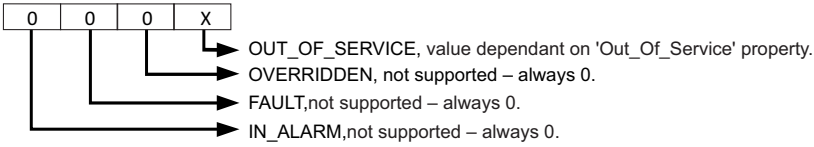
Service Request No:	Property Name	Binary Input 1	Binary Input 2	Binary Input 3
1	Object_Identifier	BINARY_INPUT:1	BINARY_INPUT:2	BINARY_INPUT:3
2	Object_Name	#BI_01 Drive Binary IP1	#BI_02 Drive Binary IP2	#BI_03 Drive Binary IP3
3	Object_Type	3 (BINARY_INPUT)	3 (BINARY_INPUT)	3 (BINARY_INPUT)
4	Present_Value[1]	Digital I/O 1 State (Pr **08.001**)	Digital I/O 2 State (Pr **08.002**)	Digital I/O 3 State (Pr **08.003**)
5	Status_Flag	0000	0000	0000
6	Event_State	0 (Normal)	0 (Normal)	0 (Normal)
7	Out_Of_Service	True: Pr **08.031** = On (Output) False: Pr **08.031** = Off (Input)	True: Pr **08.032** = On (Output) False: Pr **08.032** = Off (Input)	True: Pr **08.033** = On (Output) False: Pr **08.033** = Off (Input)
8	Polarity	0 (Normal)	0 (Normal)	0 (Normal)
9	Property_List	85 (Present_Value), 111 (Status_Flag), 36 (Event_State), 81 (Out_Of_Service), 84 (Polarity)	85 (Present_Value), 111 (Status_Flag), 36 (Event_State), 81 (Out_Of_Service), 84 (Polarity)	85 (Present_Value), 111 (Status_Flag), 36 (Event_State), 81 (Out_Of_Service), 84 (Polarity)

Properties are Read_Only except for 'Present_Value' which is conditionally writable.
Present_Value: User-configurable.

- Binary Input 1: Pr **08.021** (*Dig. I/O 1 Source/Destination*)
- Binary Input 2: Pr **08.022** (*Dig. I/O 2 Source/Destination*)
- Binary Input 3: Pr **08.023** (*Dig. I/O 3 Source/Destination*)

[1] Value is writable when the 'Out_Of_Service' property is set to 1 (True).

Status_Flag: 4-digit binary value (Read Only) decoded as follows:



'Out of Service' - By default, because the drive's digital input/output 1 is configured as an output, this property will be True, disabling the BACnet Binary Input 1; to enable the BACnet Binary Input 1, the digital I/O mode must be configured as Input (Off), this is achieved by setting Pr **08.031** (*Digital I/O 01 Output Select*) to Off, the BACnet interface must then be reset to activate the change, this will then set the 'Out_Of_Service' property to 'False' and the BACnet Binary Input 1 will then show the state of the drive's Digital Input terminal (Pr **08.001**).

The drive's Digital Inputs are not controllable directly via the BACnet Binary Input object's 'Present_Value' property, they are controlled by the mapped source parameter.

Table 7-29 Binary Input object (Normal) properties

Service Request No:	Property Name	Description
1	Object_Identifier	Represents a number which uniquely identifies the object.
2	Object_Name	Represents a string of printable characters which specify a unique name for the object.
3	Object_Type	Indicates the object's membership with the BACnet object type class.
4	Present_Value	Shows the current value of the Binary Input.

Service Request No:	Property Name	Description
5	Status_Flag	Shows the health of the Binary Input object. Consists of four Boolean values: 'IN_ALARM', 'FAULT', 'OVERRIDDEN', 'OUT_OF_SERVICE'.
6	Event_State	Determines whether the object has an active event state or not. The SI-BACnet IP option module does not support event reporting for Binary Input objects, therefore this property will always be 0 (Normal).
7	Out_Of_Service	Indicates whether the physical input the object represents is in service or not. The SI-BACnet IP option module does not support the 'Out_Of_Service' property for Binary Input objects, therefore this property will always be 0 (False).
8	Polarity	This property indicates the relationship between the physical state of the input and the logical state represented by the 'Present_Value' property.
9	Property_List	Consists of a list of properties supported by the SI-BACnet IP option module for the Binary Input object. 'Object_Name', 'Object_Type', 'Object_Identifier' and 'Property_List' properties are excluded from the list.

Four instances of the 'Binary Input' Normal object are supported, the following table shows the default configurations.

Table 7-30 Binary Input object (Normal) default configuration

Service Request No:	Property Name	Analog Value Writable
1	Object_Identifier	Refer to Table 7-31 *Binary Input instance default (Normal)*
2	Object_Name	Refer to Table 7-31 *Binary Input instance default (Normal)*
3	Object_Type	3 (BINARY_INPUT)
4	Present_Value	Refer to Table 7-31 *Binary Input instance default (Normal)*
5	Status_Flag	0000
6	Event_State	0 (Normal)
7	Out_Of_Service	False
8	Polarity	0 (Normal)
9	Property_List	85 (Present_Value), 111 (Status_Flag), 36 (Event_State), 81 (Out_Of_Service), 84 (Polarity)

Table 7-31 Binary Input instance default (Normal)

Instance	Object_Identifier	Object_Name	Present Value
BinaryInput4	BINARY_INPUT:4	#BI_04 Drive Binary IP4	Pr **08.004**
BinaryInput5	BINARY_INPUT:5	#BI_05 Drive Binary IP5	Pr **08.005**
BinaryInput6	BINARY_INPUT:6	#BI_06 Drive Binary IP6	Pr **08.006**
BinaryInput7	BINARY_INPUT:7	#BI_07 Drive Binary IP7	Pr **08.009**

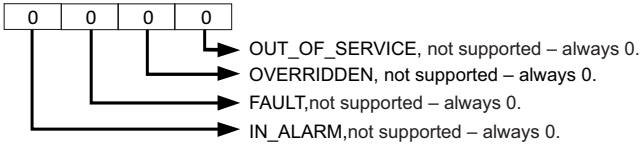
All properties are read only.

Present_Value: User-configurable

- Binary Input 4: Pr **08.024** (*Digital Input 04 Destination*)

- Binary Input 5: Pr **08.025** (*Digital Input 05 Destination*)
- Binary Input 6: Pr **08.026** (*Digital Input 06 Destination*)

Status_Flag: 4-digit binary value (Read Only) decoded as follows:



7.3.6.6 Binary Output

SI-BACnet IP supports two Binary Output object type groups, Bi-directional and Commandable based on drive type and mode.

Table 7-32 Binary Output object instances

Service Request No:	Instance	Group Name
1 to 3	BinaryOutput1 to BinaryOutput3	Bi-directional
4 to 6	BinaryOutput4 to BinaryOutput6	Commandable

The following table shows the Bi-directional group Binary Output object properties supported:

Table 7-33 Binary Output object (Bi-directional) properties

Service Request No:	Property Name	Description
1	Object_Identifier	Represents a number which uniquely identifies the object.
2	Object_Name	Represents a string of printable characters which specify a unique name for the object.
3	Object_Type	Indicates the object's membership with the BACnet object type class.
4	Present_Value (Writable/Commandable)	Shows the current value of the Binary Output
5	Status_Flag	Shows the health of the Binary Output object. Consists of four Boolean values: 'IN_ALARM', 'FAULT', 'OVERRIDDEN', 'OUT_OF_SERVICE'.
6	Event_State	Determines whether the object has an active event state or not. The SI-BACnet IP option module does not support event reporting for Binary Output objects, therefore this property will always be 0 (Normal).
7	Out_Of_Service	Indicates whether the physical input the object represents is in service or not. This property will be set to 1 (True) when the bi-directional line is selected as an input, otherwise it will be 0 (False).
8	Polarity	This property indicates the relationship between the physical state of the output and the logical state represented by the 'Present_Value' property.
9	Property_List	Consists of a list of properties supported by the SI-BACnet IP option Module for the Binary Output object. 'Object_Name', 'Object_Type', 'Object_Identifier' and 'Property_List' properties are excluded from the list.
10	Priority_Array	This property is an array of prioritised values. Range: 0 to 1.
11	Relinquish_Default (Writable)	This property is the default value used for the 'Present_Value' property when all command priority values in the 'Priority_Array' property have a NULL value. Range: 0 to 1.

Service Request No:	Property Name	Description
12	Current_Command_Priority	This property indicates the currently active priority.

Three instances of the 'Binary Output' Bi-directional object are supported, the following table shows the default configurations.

Table 7-34 Binary Output object (Bi-directional) default configuration

Service Request No:	Property Name	Binary Output 1	Binary Output 2	Binary Output 3
1	Object_Identifier	BINARY_OUTPUT:1	BINARY_OUTPUT:2	BINARY_OUTPUT:3
2	Object_Name	#BO_01 Drive Binary OP1	#BO_02 Drive Binary OP2	#BO_03 Drive Binary OP3
3	Object_Type	4 (BINARY_OUTPUT)		
4	Present_Value (Writable, Commandable)	Pr **08.001**	Pr **08.002**	Pr **08.003**
5	Status_Flag	0000		
6	Event_State	0 (Normal)		
7	Out_Of_Service	True: Pr **08.031** = Off (Input) False: Pr **08.031** = On (Output)	True: Pr **08.032** = Off (Input) False: Pr **08.032** = On (Output)	True: Pr **08.033** = Off (Input) False: Pr **08.033** = On (Output)
8	Polarity	0 (Normal)		
9	Property_List	85 (Present_Value), 111 (Status_Flag), 36 (Event_State), 81 (Out_Of_Service), 84 (Polarity), 87 (Priority_Array), 104 (Relinquish_Default), 431 (Current_Command_Priority)		
10	Priority_Array	NULL		
11	Relinquish_Default (Writable)	0		
12	Current_Command_Priority	NULL: 'Present_Value' = 'Relinquish_Default' Range: NULL, 1 to 16		

Properties are Read_Only except for 'Relinquish_Default' which is writable, and 'Present_Value' which is both writable and commandable.

Present_Value: User-configurable

- Binary Output 1: Pr **08.021** (*Dig. I/O 1 Source/Destination*)
- Binary Output 2: Pr **08.022** (*Dig. I/O 2 Source/Destination*)
- Binary Output 3: Pr **08.023** (*Dig. I/O 3 Source/Destination*)

Priority_Array: Property value varies between 0 and 1.

Relinquish_Default: Property value varies between 0 and 1.

Status_Flag: 4-digit binary value (Read Only) decoded as follows:

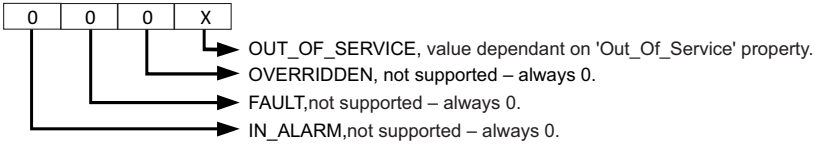


Table 7-35 Binary Output object (Commandable) properties

Service Request No:	Property Name	Description
1	Object_Identifier	Represents a number which uniquely identifies the object.
2	Object_Name	Represents a string of printable characters which specify a unique name for the object.
3	Object_Type	Indicates the object's membership with the BACnet object type class.
4	Present_Value (Writable/Commandable)	Shows the current value of the Binary Output.
5	Status_Flag	Shows the health of the Binary Output object. Consists of four Boolean values: 'IN_ALARM', 'FAULT', 'OVERRIDDEN', 'OUT_OF_SERVICE'.
6	Event_State	Determines whether the object has an active event state or not. The SI-BACnet IP option module does not support event reporting for Binary Output objects, therefore this property will always be 0 (Normal).
7	Out_Of_Service	Indicates whether the physical output the object represents is in service or not. The SI-BACnet IP option module does not support the 'Out_Of_Service' property for Binary Output objects, therefore this property will always be 0 (False).
8	Polarity	This property indicates the relationship between the physical state of the output and the logical state represented by the 'Present_Value' property.
9	Property_List	Consists of a list of properties supported by the SI-BACnet IP option Module for the Binary Output object. 'Object_Name', 'Object_Type', 'Object_Identifier' and 'Property_List' properties are excluded from the list.
10	Priority_Array	This property is an array of prioritised values. Range: 0 to 1.
11	Relinquish_Default (Writable)	This property is the default value used for the 'Present_Value' property when all command priority values in the 'Priority_Array' property have a NULL value. Range: Active to Inactive.
12	Current_Command_Priority	This property indicates the currently active priority.

Three instances of the 'Binary Output' Commandable object are supported, the following table shows the default configurations.

Table 7-36 Binary Output object (Commandable) default configuration

Service Request No:	Property Name	Binary Output 4	Binary Output 5	Binary Output 6
1	Object_Identifier	BINARY_OUTPUT:4	BINARY_OUTPUT:5	BINARY_OUTPUT:6
2	Object_Name	#BO_04 Drive Binary OP4	#BO_05 Drive Binary RI1	#BO_06 Drive Binary RI2
3	Object_Type	4 (BINARY_OUTPUT)		
4	Present_Value (Writable, Commandable)	Pr **08.008**	Pr **08.007**	Pr **08.045**
5	Status_Flag	0000		
6	Event_State	0 (Normal)		
7	Out_Of_Service		0 (False)	
8	Polarity	0 (Normal)		

Service Request No:	Property Name	Binary Output 4	Binary Output 5	Binary Output 6
9	Property_List	85 (Present_Value), 111 (Status_Flag), 36 (Event_State), 81 (Out_Of_Service), 84 (Polarity), 87 (Priority_Array), 104 (Relinquish_Default), 431 (Current_Command_Priority)		
10	Priority_Array	NULL		
11	Relinquish_Default (Writable)	0		
12	Current_Command_ Priority	NULL: 'Present_Value' = 'Relinquish_Default' Range: NULL, 1 to 16		

Properties are Read_Only except for 'Relinquish_Default' which is writable, and 'Present_Value' which is both writable and commandable.

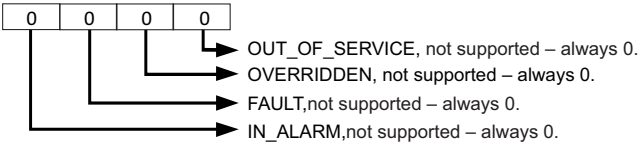
Present_Value: User-configurable

- Binary Output 4: Pr **08.028** (*24V Supply Output Source*)
- Binary Output 5: Pr **08.027** (*Relay Output Source*)
- Binary Output 6: Pr **08.065** (*Relay 2 Source*)

Priority_Array: Property value varies between 0 and 1.

Relinquish_Default: Property value varies between 0 and 1.

Status_Flag: 4-digit binary value (Read Only) decoded as follows:



7.3.6.7 Binary Value

SI-BACnet IP supports 6 instances of Binary Value objects, based on drive type and mode.

The Binary Value object properties are shown in the following table:

Table 7-37 Binary Value object properties

Service Request No:	Property Name	Description
1	Object_Identifier	Represents a number which uniquely identifies the object.
2	Object_Name	Represents a string of printable characters which specify a unique name for the object.
3	Object_Type	Indicates the object's membership with the BACnet object type class.
4	Present_Value	Shows the current value of the Binary Value.
5	Status_Flag	Shows the health of the Binary Value object. Consists of four Boolean values: 'IN_ALARM', 'FAULT', 'OVERRIDDEN', 'OUT_OF_SERVICE'.

Service Request No:	Property Name	Description
6	Event_State	Determines whether the object has an active event state or not. The SI-BACnet IP option module does not support event reporting for Binary Value objects, therefore this property will always be 0 (Normal).
7	Out_Of_Service	Indicates whether the physical point the object represents is in service or not. The SI-BACnet IP option module does not support the 'Out_Of_Service' property for Binary Value objects, therefore this property will always be 0 (False).
8	Property_List	Consists of a list of properties supported by the SI-BACnet IP option module for the Binary Value object. 'Object_Name', 'Object_Type', 'Object_Identifier' and 'Property_List' properties are excluded from the list.
9	Priority_Array	This property is an array of prioritised values. Range: 0 to 1.
10	Relinquish_Default	This property is the default value used for the 'Present_Value' property when all command priority values in the 'Priority_Array' property have a NULL value. Range: Active to Inactive.
11	Current_Command_Priority	This property indicates the currently active priority.

SI-BACnet IP supports 6 instances of Binary Value objects.

The default Binary Value object configuration is shown in the following table:

7.3.6.8 Binary Value object default configuration

Table 7-38 Binary Value object default configuration

Service Request No:	Property Name	Binary Value
1	Object_Identifier	See Table 7-39 *Binary Value object instance default*
2	Object_Name	See Table 7-39 *Binary Value object instance default*
3	Object_Type	5 (BINARY_VALUE)
4	Present_Value (Writable, Commandable)	See Table 7-39 *Binary Value object instance default*
5	Status_Flag	0000
6	Event_State	0 (Normal)
7	Out_Of_Service	0 (False)
8	Polarity	0 (Normal)
9	Property_List	85 (Present_Value), 111 (Status_Flag), 36 (Event_State), 81 (Out_Of_Service), 87 (Priority_Array), 104 (Relinquish_Default), 431 (Current_Command_Priority)
10	Priority_Array	NULL
11	Relinquish_Default (Writable)	0
12	Current_Command_Priority	NULL: 'Present_Value'='Relinquish_Default' Range: NULL, 1 to 16

Table 7-39 Binary Value object instance default

Instance	Object_Identifier	Object_Name	Menu Param Mapped
BinaryValue1	BINARY_VALUE:1	#BV_01 Reset Energy Metr	Pr **06.024**
BinaryValue2	BINARY_VALUE:2	#BV_02 Filtr Change Rqd	Pr **06.022**
BinaryValue3	BINARY_VALUE:3	#BV_03 Drive Run Fwrd	Pr **06.030**
BinaryValue4	BINARY_VALUE:4	#BV_04 Drive Healthy	Pr **10.001**
BinaryValue5	BINARY_VALUE:5	#BV_05 Drive Warning	Pr **10.019**
BinaryValue6	BINARY_VALUE:6	#BV_06 Drive Reset	Pr **10.033**

All properties are read only, except 'Relinquish_Default' (Writable) and 'Present_Value' (Writable or Commandable).

Priority_Array: Applicable only to BinaryValue3, writable and values are 0 or 1.

Relinquish_Default: Applicable only to BinaryValue3, writable and values are 0 or 1.

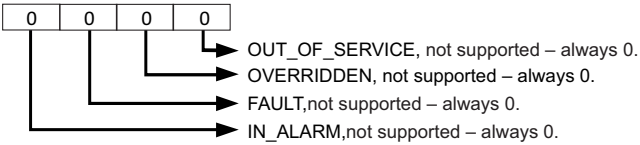
Current_Command_Priority: Applicable only to BinaryValue3, writable and values are 0 or 1.

Present_Value: The 'Present_Value' property has different access functions depending on the instance number as shown in the following table:

Table 7-40 Binary Value object instance Present_Value access

Instance	Access	Range
BinaryValue1	Writable	0 to 1
BinaryValue2	Writable	0 to 0
BinaryValue3	Commandable	0 to 1
BinaryValue4	Read Only	0 to 1
BinaryValue5	Read Only	0 to 1
BinaryValue6	Writable	1 to 1

Status_Flag: 4-digit binary value (Read Only) decoded as follows



7.3.6.9 Multi-state Value

SI-BACnet IP supports one instance of the Multi-state Value object type.

The following table shows the object properties supported:

Table 7-41 Multi-state Value object properties

Service Request No:	Property Name	Description
1	Object_Identifier	Represents a number which uniquely identifies the object.
2	Object_Name	Represents a string of printable characters which specify a unique name for the object.
3	Object_Type	Indicates the object's membership with the BACnet object type class.
4	Present_Value	Shows the logical state of the Multi-state Value object.

Service Request No:	Property Name	Description
5	Status_Flag	Shows the health of the Multi-state Value object. Consists of four Boolean values: 'IN_ALARM', 'FAULT', 'OVERRIDDEN', 'OUT_OF_SERVICE'.
6	Event_State	Determines whether the object has an active event state or not. The SI-BACnet IP option module does not support event reporting for the Multi-state Value object, therefore this property will always be 0 (Normal).
7	Out_Of_Service	Indicates whether the physical input the object represents is in service or not. The SI-BACnet IP option module does not support the 'Out_Of_Service' property for the Multi-state Value object, therefore this property will always be 0 (False).
8	Number_Of_States	This property indicates the number of states that the 'Present_Value' property may have. This property will always contain a non-zero value.
9	Property_List	Consists of a list of properties supported by the SI-BACnet IP option Module for the Multi-state Value object. 'Object_Name', 'Object_Type', 'Object_Identifier' and 'Property_List' properties are excluded from the list.

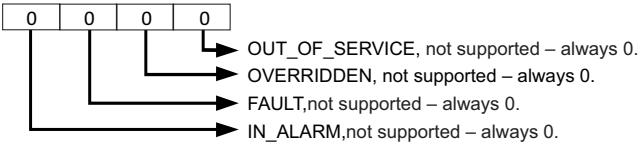
The following table shows the default configuration.

Table 7-42 Multi-state Value object default configuration

Service Request No:	Property Name	Multi-state Value
1	Object_Identifier	MULTI_STATE_VALUE:1
2	Object_Name	#MSV_01 Drive Status
3	Object_Type	19 (MULTI_STATE_VALUE)
4	Present_Value	Drive Status (Pr **10.101**)
5	Status_Flag	0000
6	Event_State	0 (Normal)
7	Out_Of_Service	0 (False)
8	Number_Of_States	Based on drive derivative
9	Property_List	85 (Present_Value), 111 (Status_Flag), 36 (Event_State), 81 (Out_Of_Service), 74 (Number_Of_States)

All properties are Read_Only.

Status_Flag: 4-digit binary value (Read Only) decoded as follows:



Present_Value:

Value	Text
0	Inhibit
1	Ready
2	Stop
3	Scan
4	Run
5	Supply Loss
6	Deceleration
7	Dc Injection
8	Position
9	Trip
10	Active
11	Off
12	Hand
13	Auto
14	Heat
15	Under Voltage
16	Phasing

7.3.6.10 Network Port

SI-BACnet IP supports two instances of the Network Port object type.

The following table shows the object properties supported:

Table 7-43 Network Port object properties

Service Request No:	Property Name	Description
1	Object_Identifier	Represents a number which uniquely identifies the object.
2	Object_Name	Represents a string of printable characters which specify a unique name for the object.
3	Object_Type	Indicates the object's membership with the BACnet object type class.
4	Status_Flag	Shows the health of the Network Port object. Consists of four Boolean values: 'IN_ALARM', 'FAULT', 'OVERRIDDEN', 'OUT_OF_SERVICE'.
5	Reliability	This property provides indication of whether the network port object, network port and network connected to the port are reliable. Possible values are: 0 (No Fault Detected), 1 (No Sensor), 2 (Over Range), 3: (Under Range), 4 (Open Loop), 5 (Shorted Loop), 6 (No Output)
6	Out_Of_Service	Indicates whether the Network Port object is in service or not.
7	Network_Type	This property indicates the type of Network Port object.
8	Protocol_Level	This property indicates whether the network port object represents a physical network interface.
9	Network_Number	This property represents the BACnet network number associated with the BACnet network.
10	Network_Number_Quality	This property represents the current quality of the Network_Number property.

Service Request No:	Property Name	Description
11	Changes_Pending	This property indicates whether the configuration settings in the Network Port object map to the current configuration settings. Possible values are True or False.
12	APDU_Length	This property indicates the maximum number of octets contained in a single APDU frame on this port.
13	Link_Speed	This property represents the network communication rate (bits per second).
14	BACnet_IP_Mode	This property indicates the BACnet/IP mode of the network port. This property will always have the value 0 (NORMAL).
15	BACnet_IP_UDP_Port	This property indicates the UDP port number of the network port.
16	IP_Address	This property indicates the IP address of the network port in hexadecimal format. The value of this property shall be conveyed with the most significant octet first.
17	MAC_Address	This property contains the BACnet MAC address used on the network in hexadecimal format. The value of this property shall be conveyed with the most significant octet first.
18	IP_Default_Gateway	This property indicates the IP address of the default gateway for the network in hexadecimal format. This property shall be conveyed with the most significant octet first.
19	IP_DNS_Server	This property indicates the DNS server used by the network port for internet host name resolution in hexadecimal format. This property shall be conveyed with the most significant octet first.
20	IP_Subnet_Mask	This property indicates the subnet mask for the network in hexadecimal format. This property shall be conveyed with the most significant octet first.
21	Property_List	This property consists of list of properties that are supported by the SI-BACnet IP option module for the 'Network port' object. 'Object_Name', 'Object_Type', 'Object_Identifier' and 'Property_List' properties are excluded from the list.

The following table shows the default configuration.

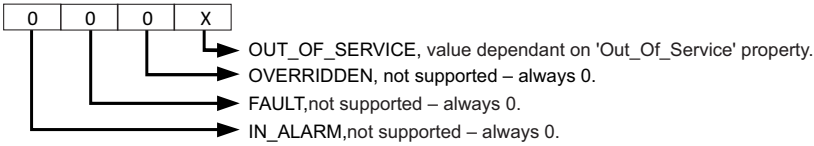
Table 7-44 Network Port object default configuration

Service Request No:	Property Name	Network Port 1	Network Port 2
1	Object_Identifier	NETWORK_PORT:1	NETWORK_PORT:2
2	Object_Name	#NP_01	#NP_02
3	Object_Type	56 (NETWORK_PORT)	56 (NETWORK_PORT)
4	Status_Flag	0000	0000
5	Reliability	0 (No_Fault_Detected)	0 (No_Fault_Detected)
6	Out_Of_Service	0 (False)	0 (False)
7	Network_Type	5 (IPv4)	5 (IPv4)
8	Protocol_Level	2 (BACnet_Application)	2 (BACnet_Application)
9	Network_Number	1	1
10	Network_Number_Quality	3 (Configured)	3 (Configured)
11	Changes_Pending	False	False
12	APDU_Length	1476	1476
13	Link_Speed	0	0
14	BACnet_IP_Mode	0 (Normal)	0 (Normal)
15	BACnet_IP_UDP_Port	47808	47808

Service Request No:	Property Name	Network Port 1	Network Port 2
16	IP_Address	IP Address (Pr **S.02.006**)	IP Address (Pr **S.02.006**)
17	MAC_Address	MAC Address (see below)	MAC Address (see below)
18	IP_Default_Gateway	Default Gateway (Pr **S.02.008**)	Default Gateway (Pr **S.02.008**)
19	IP_DNS_Server	Primary DNS (Pr **S.02.009**)	Primary DNS (Pr **S.02.009**)
20	IP_Subnet_Mask	Subnet Mask (Pr **S.02.007**)	Subnet Mask (Pr **S.02.007**)
21	Property_List	81 (Out_Of_Service), 103 (Reliability), 111 (Status_Flag), 399 (APDU_Length), 416 (Changes_Pending), 420 (Link_Speed), 425 (Network_Number), 426 (Network_Number_Quality), 427 (Network_Type), 482 (Protocol_Level), 400 (IP_Address), 401 (IP_Default_Gateway), 406 (IP_DNS_Server), 408 (BACnet_IP_Mode), 411 (BACnet_IP_Subnet_Mask), 412 (BACnet_UDP_Port), 423 (MAC_Address)	81 (Out_Of_Service), 103 (Reliability), 111 (Status_Flag), 399 (APDU_Length), 416 (Changes_Pending), 420 (Link_Speed), 425 (Network_Number), 426 (Network_Number_Quality), 427 (Network_Type), 482 (Protocol_Level), 400 (IP_Address), 401 (IP_Default_Gateway), 406 (IP_DNS_Server), 408 (BACnet_IP_Mode), 411 (BACnet_IP_Subnet_Mask), 412 (BACnet_UDP_Port), 423 (MAC_Address)

Properties are Read_Only.

Status_Flag: 4-digit binary value (Read Only) decoded as follows:



MAC_Address: This property returns the configured device IP address (**S.02.006**) followed by the BACnet port number (47808).

Example:

For IP address 192.168.0.203 this will return the MAC_Address as follows:

Byte	Value	Description
0	192	Device IP address byte 0 - (192)
1	168	Device IP address byte 1 - (168)
2	0	Device IP address byte 2 - (0)
3	203	Device IP address byte 3 - (203)
4	186	BACnet port number MSB - (47808 Rsh 8 = 186)
5	192	BACnet port number LSB - (47808 XOR 47616 = 192)

8 PC Tools Applications

The Ethernet interface supports the following commissioning and programming software applications:

- Connect (V02.20.01 or later)
- Machine Control Studio
- CTScope

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.

8.1 Connect

Connect is the configuration tool for commissioning, optimising and monitoring the drive or system performance.

Features include:

- Fast task based commissioning and easy maintenance of the Unidrive M family is simplified via familiar Windows interface
- Intuitive graphical tools enhance and simplify user experience
- For experienced users, dynamic drive logic diagrams and enhanced searchable listings are present
- Drive and motor performance can be optimised with minimal specialised drive knowledge
- Tool is scalable to match application requirements
- Supports the import of Unidrive SP parameter files and allows full drive cloning (i.e. parameter sets and application program)
- Multiple simultaneous comms channels for a more complete overview of the system
- Drive discovery gives the ability to find drives on a network automatically without the user having to specify their addresses

For more information on using Connect please refer to the online help supplied.

8.2 Machine Control Studio

Machine Control Studio is a CoDeSys based development environment designed for use with the onboard user program of Unidrive M and the MCi200/MCi210 Machine Controller modules.

Programs can be written in one or more of the supported languages - structured text, function block, SFC (sequential function chart), ladder or instruction list - and downloaded to the onboard programming area on the Unidrive M. The run-time operation of the program can be monitored and the user can interact with the program by setting new values for program variables and drive parameters.

For more information on using Machine Control Studio please refer to the online help supplied.

8.3 CTScope

CTScope is a software application which provides commonly used oscilloscope features to monitor drive parameters.

Features include:

- Four channels
- Triggers
  - Start/Stop at absolute time
  - Start/Stop on value (rising/falling edge)
- Channels can capture parameter values from different nodes
- Scaling & offset per channel
- Cursors to aid measurement
- Zoom facility
- Scroll/Panning facility
- Save/load scope configurations with or without data
- Print facility

8.3.1 Configuration

All the appropriate configuration settings are displayed on the main screen. (CT-TCP/IP must be selected in the Communication Settings).

9 Security

9.1 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.

9.2 General site security issues

9.2.1 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.

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

9.2.3 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 Diagnostics

This section of the manual provides basic diagnostic information intended to enable resolution of the most common problems encountered when setting up the Ethernet interface 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 109 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.

10.1 LED diagnostics

Each Ethernet connection has an associated LED to aid diagnostics, the SI-BACnet IP option module has two LEDs mounted on the topside of the module (Figure 2-1 *SI-BACnet IP* on page 13).

The connection status for the first port (nearest the grounding tab) is indicated by LED “A”, and the second port is indicated by LED “B”.

The function of these LEDs are described inTable 10-1 *LED functionality* below.

Table 10-1 LED functionality

LED State	Description
Off	Ethernet connection not detected.
Steady green	Ethernet connection detected but no data.
Flashing green	Ethernet communication detected and data flow.

10.2 Drive trip display codes

If the Ethernet interface detects an error during operation, it will force a trip on the drive. However, the trip string displayed on the drive will only indicate which slot initiated the trip, if the SI-BACnet IP option module generated the trip then the slot number will be the slot number the SI-BACnet IP option module is fitted to. The exact reason for the trip will be indicated in the drive trip code parameters (Pr **0.10.020** and Pr **0.10.070**).

Table 10-2 *Drive trip indications* on page 105 shows the possible trips that will be displayed on the drive when a problem is detected or the Ethernet interface initiates a trip.

Table 10-2 Drive trip indications

Trip	Description
SlotX HF	The drive has detected that an Ethernet interface is present but is unable to communicate with it due to a hardware fault.
SlotX Error	User trip generated by the Ethernet interface
SlotX Not Fitted	This trip will occur if a drive slot was previously configured with an option module but on power up, no option module was detected.
SlotX Different	This trip will occur if a drive slot was previously configured with an option module but on power up, a different option module was detected. Replacing the option module with another one of the same ID number will not initiate this trip. The trip will also occur if an option module is installed to a previously unused slot.

10.3 Ethernet sub trip codes

Table 10-3 below shows the possible Ethernet sub trip codes displayed in Pr **0.10.070** and their relevant text strings.

It must be noted that not all error codes will be seen in the SI-BACnet IP module as the relevant communication protocol is not supported, they are documented here for completeness.

Table 10-3 Ethernet error codes

Value Pr 0.10.070	Sub trip string	Description
100	Link Loss	Network link has been lost
101	E/IP Timeout	An Ethernet/IP RPI timeout trip has occurred
102	E/IP Read Param	Invalid read consistency parameter, is parameter read only?
103	E/IP Write Param	Invalid write consistency parameter, is parameter read only?
104	E/IP Fault	An unexpected Ethernet/IP error has occurred
105	Modbus Timeout	The Modbus connection has timed out
106	Cyclic Timeout	Cyclic Rx link timeout
107	Cyclic RX Late	Cyclic Rx data was received late
108	INIT Switch	Ethernet switch initialisation error
109	INIT PTP	IEEE1588 (Precision Time Protocol) initialisation error
110	INIT Cyclic	Cyclic data initialisation error
111	INIT Modbus	Modbus TCP initialisation error
112	INIT SMTP	Email (SMTP) initialisation error
113	INIT Ethernet/IP	Ethernet/IP initialisation error
114	INIT TCP/IP	TCP/IP initialisation error
115	Ethernet Failure	Ethernet controller initialisation error

Value Pr 0.10.070	Sub trip string	Description
116	E/IP PLC IDLE	Ethernet/IP PLC Idle
117	Sync Task ORun	Synchronous task overrun
118	INIT Param Chann	Parameter channel Initialisation error
119	Link Overload	Too many links to be handled in the same cycle
120	Mcast Over Limit	Too many multicast addresses being used
121	Init Profinet	Profinet initialisation error
122	Profinet Start	Profinet start error
123	Profinet Plug	Profinet failed to load the slots
124	IM Invalid	Invalid IM data. Default device
125	Profinet Timeout	Profinet cyclic timeout error
126	Capability Error	The selected capability is not available
127	*Reserved 127*	*Reserved*
128	*Reserved 128*	*Reserved*
129	*Reserved 129*	*Reserved*
130	Drive Sync loss	Synchronisation failure
200	Software Fault	Software Fault
201	BG Overrun	Background task overrun
202	Firmware Invalid	Invalid firmware for hardware version
203	Drive Unknown	Unknown drive type
204	DriveUnsupported	Unsupported drive type
205	Mode Unknown	Unknown drive mode
206	Mode Unsupported	Unsupported drive mode
207	FLASH Error	Corrupted Non-volatile FLASH
208	Database Init	Database initialisation error
209	File System Init	File system initialisation error
210	Mem Allocation	Memory allocation error
211	Filesystem Error	File system error
212	Config Save	Configuration file save error
213	Over Temperature	Overheated
214	Drive Timeout	The drive has not responded within watchdog period
215	eCMP Comms Error	eCMP communication failure
216	TO eCMP Slot1	eCMP communication to slot 1 timeout
217	TO eCMP Slot2	eCMP communication to slot 2 timeout

Value Pr 0.10.070	Sub trip string	Description
218	TO eCMP Slot3	eCMP communication to slot 3 timeout
219	TO eCMP Slot4	eCMP communication to slot 4 timeout
220	I/O Overload	Digital output current demand too high
221	Factory Settings	Missing factory settings
222	Functional Test	Functional test failure
223	Config Restore	Configuration file restore error
224	Self Test Error	Power on self test error
225	Runtime Config	Runtime configuration error
226	Processor except	Processor exception
227	Task Starvation	System task starvation
228	EEPROM Error	EEPROM Initialisation error

10.4 Ethernet sub trip codes

If the Ethernet interface detects an alarm condition during operation, it will set the appropriate bit in *Active Alarm Bits* **MM.009**. Table 10-4 *Ethernet alarm bits* on page 107 shows the possible conditions.

Table 10-4 Ethernet alarm bits

Bit (Pr MM.009)	Alarm	Description
0	User Program	The user program has generated an alarm
1	eCMP	An eCMP alarm has been generated
2	Modbus	A Modbus alarm has been generated
3	Ethernet/IP	An Ethernet/IP alarm has been generated
4	PROFINET	A Profinet alarm has been generated
5	File System	File system full alarm has been generated
6	Too Hot	Temperature too high alarm has been generated
7	DCP Signalling	A DCP Signalling alarm has been generated

10.5 Ethernet hardware fault trip codes

If the Ethernet interface detects an internal hardware error, it will force a SlotX.HF (code 250) trip on the drive with an appropriate sub trip string. Table 10-5 shows the possible error codes and sub trip strings.

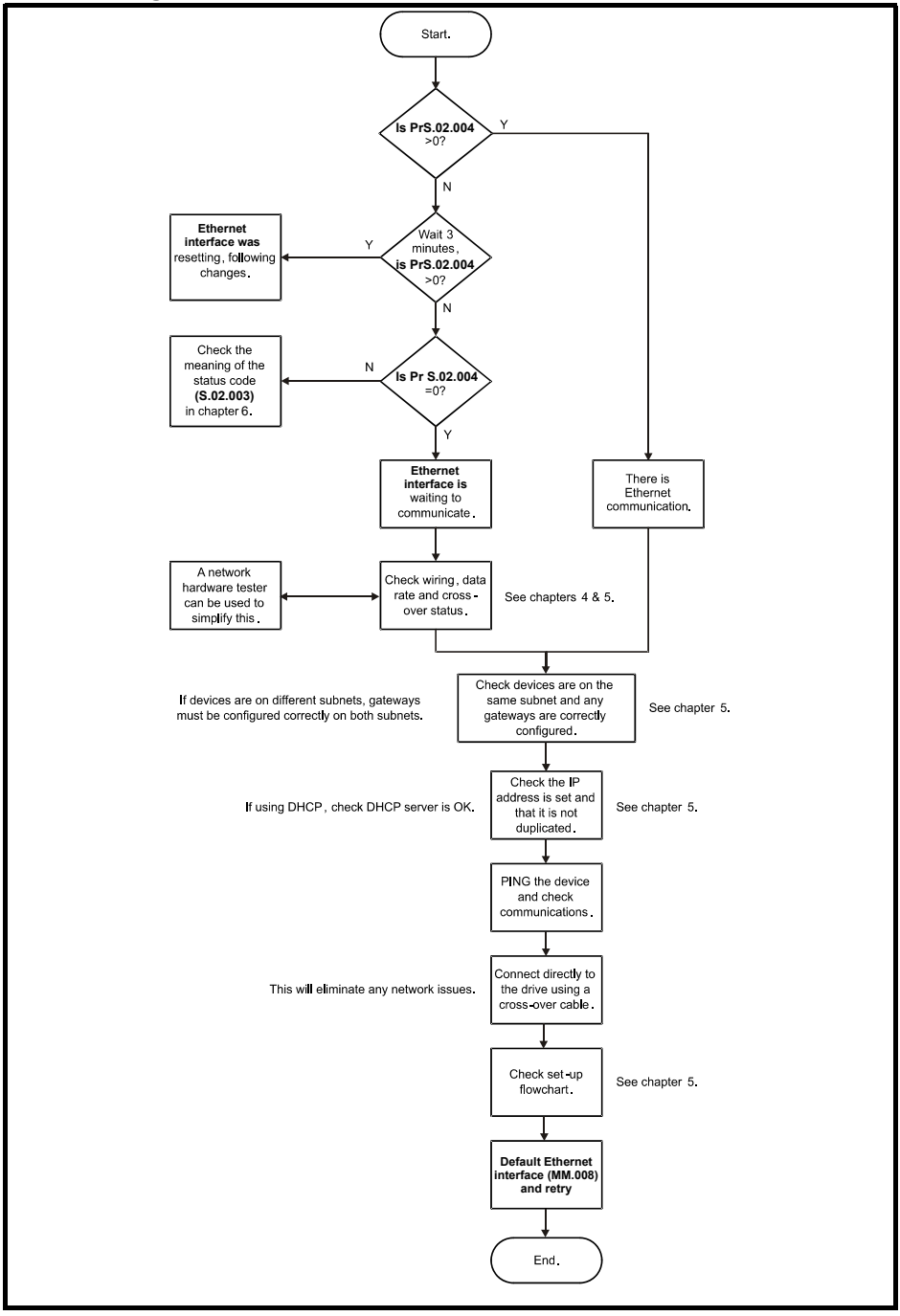
Table 10-5 Ethernet hardware fault trip codes

Value Pr 0.10.070	Reason
1	The module category cannot be identified
2	All the required customisable menu table information has not been supplied or the tables supplied are corrupt
3	There is insufficient memory available to allocate the comms buffers for this module
4	The module has not indicated that it is running correctly during drive power-up
5	The module has been removed after power-up or it has ceased to indicate to the drive processor that it is still active
6	The module has not indicated that it has stopped accessing drive parameters during a drive mode change
7	The module has failed to acknowledge that a request has been made to reset the drive processor
8	The drive failed to read correctly the menu table from the module during drive power-up
9	The drive failed to upload menu tables from the module and timed-out (5s)
10	Menu table CRC invalid

Recommended actions:
Ensure the option module is installed correctly.

- Replace the option module.
- Replace the drive.

10.6 Diagnostic flow chart



11 Glossary of terms

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

ADU: Application Data Unit. The complete Modbus message frame (ADU) consists of the Modbus Application Protocol (MBAP) and Protocol Data Unit (PDU).

Assembly object: A software component within the Ethernet interface 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.

BACnet: Communication protocol for building automation and control networks.

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 the Ethernet interface at the time of manufacture. No other device will have this address. The address is used to make connections to the interface 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 option modules.

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: Programmable Logic Controller.

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

Polled data: *See **Cyclic data**.*

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.

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

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.

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.

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