

Modbus TCP

Communications option
for EMX4e/EMX4i soft starters

User Guide



BENSHAW

Applied Motor Controls

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Product Compatibility

This expansion card is suitable for use with EMX4e and EMX4i soft starters.

Product description	Soft starter name
Basic model	EMX4e
Advanced model	EMX4i

Parameter Management

Parameter lists vary according to the model and version of soft starter.

Refer to the relevant soft starter literature for a complete parameter list.

For the latest manuals and software, please visit our website.

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1 Disclaimer

The examples and diagrams in this manual are included solely for illustrative purposes. The information contained in this manual is subject to change at any time and without prior notice. In no event will responsibility or liability be accepted for direct, indirect or consequential damages resulting from the use or application of this equipment.

2 Warnings



WARNING

For your safety, isolate the soft starter from mains voltage before attaching or removing accessories.



WARNING

Inserting foreign objects or touching the inside of the starter while the expansion port cover is open may endanger personnel, and can damage the starter.

3 Important User Information

Observe all necessary safety precautions when controlling the soft starter remotely. Alert personnel that machinery may start without warning.

It is the installer's responsibility to follow all instructions in this manual and to follow correct electrical practice.

3.1 Product Design

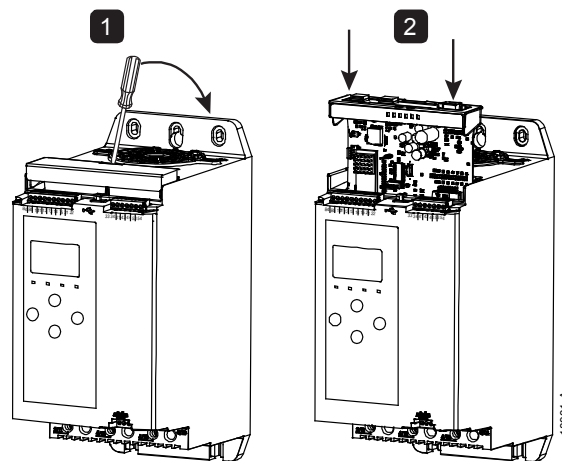
The Modbus TCP Card allows the soft starter to connect to an Ethernet network and be controlled or monitored using an Ethernet communication model.

Familiarity with Ethernet protocols and networks is required to operate the device successfully. For difficulties using this device with third party products, including PLCs, scanners and commissioning tools, contact the relevant supplier.

4 Installation

4.1 Installing the Expansion Card

1. Push a small flat-bladed screwdriver into the slot in the centre of the expansion port cover, and ease the cover away from the starter.
2. Line up the card with the expansion port. Gently push the card along the guide rails until it clicks into the starter.



4.2 Network Connection

Ethernet Ports

The device has two Ethernet ports. If only one connection is required, either port can be used.

Cables

Use Category 5, 5e, 6 or 6e cable to connect to the device.

EMC Precautions

To minimise electromagnetic interference, Ethernet cables should be separated from motor and mains cables by 200 mm.

If the Ethernet cable must cross motor or mains cables, the crossing should be at an angle of 90°.

4.3 Network Establishment

The controller must establish communications directly with each device before the device can participate in the network.

4.4 Addressing

Each device in a network is addressed using a MAC address and an IP address.

- The device can be assigned a static IP address during configuration, or can be configured to accept a dynamic IP address (via DHCP).
- The MAC address is fixed within the device and is printed on a label on the front of the device.

4.5 Enabling Network Control

The soft starter will only accept commands from the Modbus TCP Card if parameter 1A *Command Source* is set to 'Network'.



NOTE

If the reset input is active, the starter will not operate. If a reset switch is not required, use parameter 71 to set the reset input to normally open or fit a link across terminals 10, 11 on the soft starter.

5 Device Configuration



NOTE

The Error LED flashes whenever the device is receiving power but is not connected to a network. The Error LED will flash occasionally during the configuration process.

5.1 Configuration Methods

- Network communication parameters for the card should be set via the soft starter (via the Main Menu or by uploading a configuration file via USB Save & Load). Parameters configured via the starter are stored permanently in the starter.
- If physical access to the starter is not possible, Ethernet attributes can be configured directly in the card using the on-board web server. The default address for a new card is 192.168.0.2. The default subnet mask is 255.255.255.0. The web server will only accept connections from within the same subnet domain. Changes made via the on-board web server are not stored permanently and will be lost when control power is cycled.
- If the subnet domain of the card is different from the controller, or if the IP address has been changed and is no longer known, use the Ethernet Device Configuration Tool to scan the network and identify the device. Changes made via the Ethernet Device Configuration Tool cannot be stored permanently in the device and will be lost when control power is cycled.

5.2 Configure Network Settings via the Starter

Use parameters 12H~12U to configure the network address.

Parameter	Parameter name	Default
12H	<i>Gateway Address</i>	192
12I	<i>Gateway Address 2</i>	168
12J	<i>Gateway Address 3</i>	0
12K	<i>Gateway Address 4</i>	100
12L	<i>IP Address</i>	192
12M	<i>IP Address 2</i>	168
12N	<i>IP Address 3</i>	0
12O	<i>IP Address 4</i>	2
12P	<i>Subnet Mask</i>	255
12Q	<i>Subnet Mask 2</i>	255
12R	<i>Subnet Mask 3</i>	255
12S	<i>Subnet Mask 4</i>	0
12T	<i>DHCP</i>	Disable
12U	<i>Location ID</i>	0

5.3 On-board Web Server

To configure settings using the on-board web server, the card must be installed in a soft starter, control power must be available, and the card and computer must both be connected to the Ethernet network.



NOTE

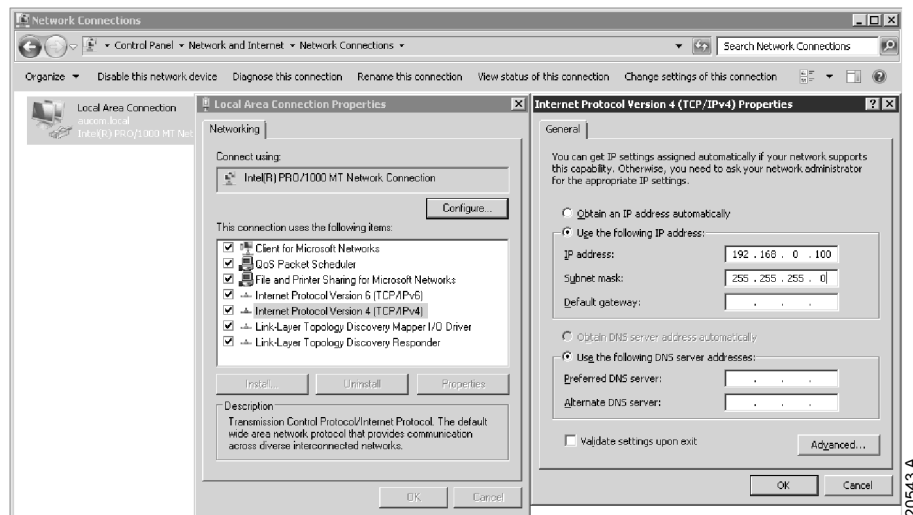
If prompted to enter a username and password:

username: admin

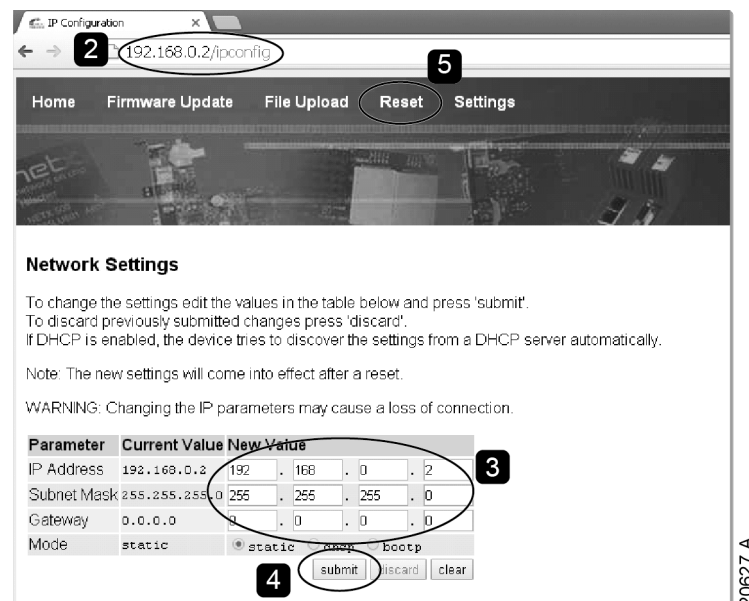
password: admin

To configure the device using the on-board web server:

1. The network adapter settings on the computer must be fixed IP address (not DHCP) and the same subnet as the card. The default subnet mask is 255.255.255.0.



2. Start a browser and enter the device address, followed by /ipconfig. The default address for a new card is 192.168.0.2.



3. Edit the settings as required.
4. Click "Submit" to send the new settings to the device.
5. Click "Reset" then follow the on-screen instructions to activate the settings in the device.

NOTE: Changes made via the on-board web server are not stored permanently and will be lost when control power is cycled.

**NOTE**

If you change the subnet mask, the web server will not be able to communicate with the device after the new settings are saved.

**NOTE**

Changing the IP address via the web server does not change the address settings saved in the soft starter.

5.4 Ethernet Device Configuration Tool

Use the Ethernet Device Configuration Tool to connect to the device if you do not know the IP address, or if the subnet mask of the web server does not match.

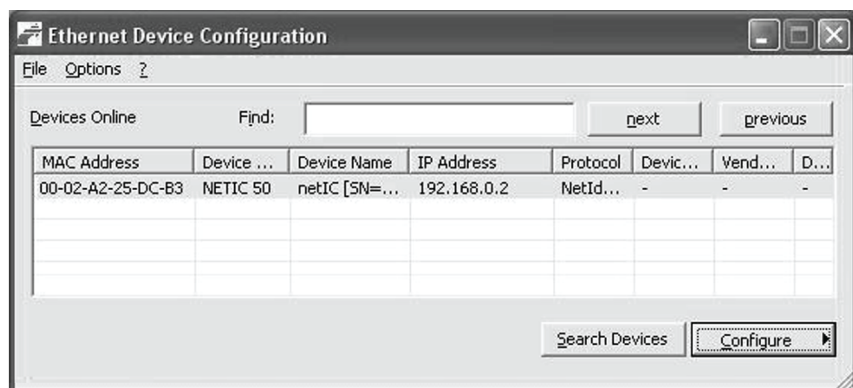
The Ethernet Device Configuration Tool is available from your local supplier.

**NOTE**

If your PC has a firewall enabled, you must add the tool to the list of authorised programs.

To identify the device using the Ethernet Device Configuration Tool:

1. Start the Ethernet Device Configuration Tool.
2. Click on Search Devices. The software will search for connected devices.



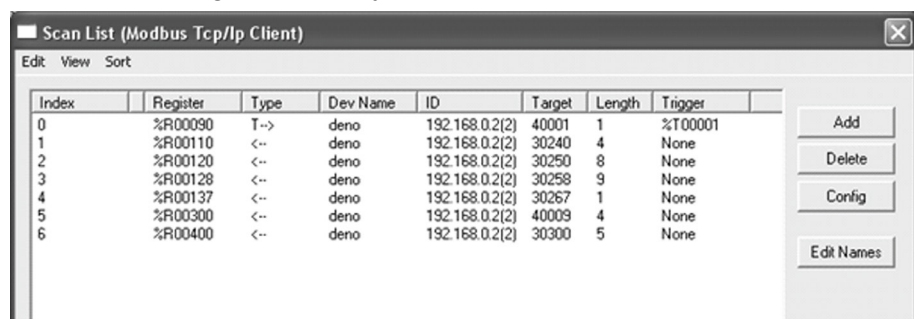
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3. Use the IP address to connect to the device via the web server.

6 PLC Configuration

The PLC must be configured to map registers within the card to addresses within the PLC.

The device must be configured directly in the PLC. No additional files are required.



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7 Operation

The Modbus TCP Card must be controlled by a Modbus client (such as a PLC) which complies with the Modbus Protocol Specification. For successful operation, the client must also support all functions and interfaces described in this document.



NOTE

The available features and parameter details may vary according to the model and software version of the starter. Refer to the soft starter user manual for details of parameters and supported features.

7.1 Device Classification

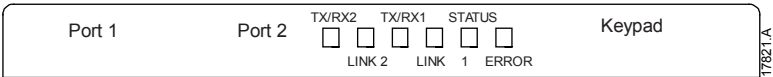
The Modbus TCP Card is a Modbus server and must be managed by a Modbus client over Ethernet.

7.2 Ensuring Safe and Successful Control

Data written to the device will remain in its registers until the data is overwritten or the device is reinitialised.

If the soft starter may be controlled via Command Override (parameter 7A) or may be disabled via the reset input (terminals 10, 11) fieldbus commands should be cleared from the registers. If a command is not cleared, it will be re-sent to the starter once fieldbus control resumes.

7.3 Feedback LEDs



LED name	LED Status	Description
Error	Off	No error.
	Flashing	System error.
	On	Communication error.
Status	Off	Device is not powered up.
	Slow flash	Ready but not configured.
	Fast flash	Communication has been established.
Link x	Off	No network connection.
	On	Connected to a network.
TX/RX x	Flashing	Operating normally.
	Off	No network connection.

8 Modbus Registers



NOTE

The available features and parameter details may vary according to the model and software version of the starter. Refer to the soft starter user manual for details of parameters and supported features.



NOTE

All references to registers mean the registers within the card unless otherwise stated.

8.1 Command and Configuration Registers (Read/Write)

Register	Description	Bits	Details
40001	Command (single write)	0 to 7	To send a command to the starter, write the required value: 00000000 = Stop 00000001 = Start 00000010 = Reset 00000100 = Quick stop (coast to stop) 00001000 = Forced communication trip 00010000 = Start using Parameter Set 1 00100000 = Start using Parameter Set 2 01000000 = <i>Reserved</i> 10000000 = <i>Reserved</i>
		8 to 14	<i>Reserved</i>
		15	Must = 1
40002	<i>Reserved</i>		
40003	<i>Reserved</i>		
40004	<i>Reserved</i>		
40005	<i>Reserved</i>		
40006	<i>Reserved</i>		
40007	<i>Reserved</i>		
40008	<i>Reserved</i>		
40009 ~ 40xxx	Parameter management (single/multiple read or multiple write)	0 to 15	Manage soft starter programmable parameters. See the relevant soft starter literature for a complete parameter list.

8.2 Parameter Management

Parameters can be read from and written to the starter. When writing parameters to the soft starter, every parameter will be updated to match the values in the PLC.



NOTE

While parameters are being written, the starter cannot start/stop the motor.

The Modbus protocol limits read/write operations to a maximum of 123 registers at one time. The registers must be consecutive.

To avoid loss of communications due to an unintentional change of network configuration, write the network address parameter settings before writing start/stop parameter settings.

When writing parameters to the soft starter, we recommend the following procedure:

1. Configure all soft starter parameter values in the PLC as required, including IP address, Gateway Address, Subnet Mask and DHCP configuration.
2. Write the parameter block that includes the network parameter settings from the PLC to the soft starter.
3. Write the other parameter blocks from the PLC to the starter until all parameter values have been written.



NOTE

For reliable operation, the parameter block containing network configuration settings must be written first.

8.3 Status Reporting Registers (Read Only)



NOTE

For models 0064B and smaller (soft starter model ID 1~4), the current reported via communications registers is 10 times greater than the actual value.

Register	Description	Bits	Details
30003	<i>Reserved</i>		
30004	<i>Reserved</i>		
30005	<i>Reserved</i>		
30006	<i>Reserved</i>		
30007	<i>Reserved</i>		
30008	<i>Reserved</i>		
30600	Version	0 to 5	Binary protocol version
		6 to 8	Parameter list major version
		9 to 15	Product type code: 12 = basic model 13 = advanced model
30601	Model number	0 to 7	<i>Reserved</i>
		8 to 15	Soft starter model ID
30602	<i>Reserved</i>		
30603	<i>Reserved</i>		
30604	Starter state	0 to 4	0 = <i>Reserved</i> 1 = Ready 2 = Starting 3 = Running 4 = Stopping 5 = Not ready (restart delay, restart temperature check, run simulation, reset input is open) 6 = Tripped 7 = Programming mode 8 = Jog forward 9 = Jog reverse
		5	1 = Warning
		6	0 = Uninitialised 1 = Initialised

Register	Description	Bits	Details
		7	Command source 0 = Remote Keypad, Digital Input, Clock 1 = Network
		8	<i>Reserved</i>
		9	0 = Negative phase sequence 1 = Positive phase sequence
		10 to 15	<i>Reserved</i>
30605	Current	0 to 13	Average rms current across all three phases
		14 to 15	<i>Reserved</i>
30606	Current	0 to 9	Current (% motor FLC)
		10 to 15	<i>Reserved</i>
30607	Motor temperature	0 to 7	Motor thermal model (%)
		8 to 15	<i>Reserved</i>
30608	Power	0 to 11	Power
		12 to 13	Power scale 0 = Multiply power by 10 to get W 1 = Multiply power by 100 to get W 2 = Power (kW) 3 = Multiply power by 10 to get kW
		14 to 15	<i>Reserved</i>
30609	% Power factor	0 to 7	100% = power factor of 1
		8 to 15	<i>Reserved</i>
30610	Voltage	0 to 13	Average rms voltage across all three phases
		14 to 15	<i>Reserved</i>
30611	Current	0 to 13	Phase 1 current (rms)
		14 to 15	<i>Reserved</i>
30612	Current	0 to 13	Phase 2 current (rms)
		14 to 15	<i>Reserved</i>
30613	Current	0 to 13	Phase 3 current (rms)
		14 to 15	<i>Reserved</i>
30614	Voltage	0 to 13	Phase 1 voltage
		14 to 15	<i>Reserved</i>
30615	Voltage	0 to 13	Phase 2 voltage
		14 to 15	<i>Reserved</i>
30616	Voltage	0 to 13	Phase 3 voltage
		14 to 15	<i>Reserved</i>
30617	Parameter list version number	0 to 7	Parameter list minor revision
		8 to 15	Parameter list major version

Register	Description	Bits	Details
30618	Digital input state	0 to 15	For all inputs, 0 = open, 1 = closed (shorted) 0 = Start/Stop 1 = <i>Reserved</i> 2 = Reset (See note below.) 3 = Input A 4 = Input B 5 to 15 = <i>Reserved</i>
30619	Trip code	0 to 7	See <i>Trip Codes</i> on page 13
		8 to 15	<i>Reserved</i>
30620~ 30631	<i>Reserved</i>		

**NOTE**

The reset input is normally closed by default. If parameter 7I *Reset/Enable Logic* is set to normally open, the reported state will be inverted (0 = closed, 1 = open).

8.4 Legacy Mode

The Modbus TCP Card can also operate in Legacy Mode, which uses the same registers as the clip-on Modbus RTU Module, supplied by The Manufacturer for use with older soft starters. Some registers differ from those specified in the Modbus Protocol Specification.

Initialising Legacy Mode

If the card has been operating in Standard Mode, it must be reset before communicating in Legacy Mode. To initialise the card for Legacy Mode, either:

- cycle control power or
- reset register 40001 to zero (write zero to bits 0~15)

Registers

**NOTE**

For models 0064B and smaller (soft starter model ID 1~4), the current reported via communications registers is 10 times greater than the actual value.

**NOTE**

Legacy Mode reports read-only status information in registers 40003 onwards, to match the register definitions of the clip-on Modbus Module for use with older soft starters. Identical data is also available via registers 30003 onwards.

Register	Description	Bits	Details
40001	<i>Reserved</i>		
40002	Command (single write)	0 to 2	To send a command to the starter, write the required value: 1 = Start 2 = Stop 3 = Reset 4 = Quick stop (coast to stop) 5 = Forced communication trip 6 = Start using Parameter Set 1 7 = Start using Parameter Set 2
		3 to 15	<i>Reserved</i>

Register	Description	Bits	Details
40003	Starter state	0 to 3	1 = Ready 2 = Starting 3 = Running 4 = Stopping (including braking) 5 = Restart delay (including temperature check) 6 = Tripped 7 = Programming mode 8 = Jog forward 9 = Jog reverse
		4	1 = Positive phase sequence (only valid if bit 6 = 1)
		5	1 = Current exceeds FLC
		6	0 = Uninitialised 1 = Initialised
		7 to 15	<i>Reserved</i>
40004	<i>Reserved</i>		
40005	Motor current	0 to 7	Average rms current across all three phases
		8 to 15	<i>Reserved</i>
40006	Motor temperature	0 to 7	Motor thermal model (%)
		8 to 15	<i>Reserved</i>
40007	<i>Reserved</i>		
40008	<i>Reserved</i>		
40009 ~ 40xxx	Parameter management (single/multiple read or multiple write)	0 to 7	Manage soft starter programmable parameters. See the relevant soft starter literature for a complete parameter list.
		8 to 15	<i>Reserved</i>
40600	Version	0 to 5	Binary protocol version
		6 to 8	Parameter list version number
		9 to 15	Product type code: 12 = basic model 13 = advanced model
40601	Model number	0 to 7	<i>Reserved</i>
		8 to 15	Soft starter model ID
40602	<i>Reserved</i>		
40603	<i>Reserved</i>		

Register	Description	Bits	Details
40604	Starter state	0 to 4	0 = <i>Reserved</i> 1 = Ready 2 = Starting 3 = Running 4 = Stopping 5 = Not ready (restart delay, restart temperature check, run simulation, reset input is open) 6 = Tripped 7 = Programming mode 8 = Jog forward 9 = Jog reverse
		5	1 = Warning
		6	0 = Uninitialised 1 = Initialised
		7	Command source 0 = Remote Keypad, Digital Input, Clock 1 = Network
		8	<i>Reserved</i>
		9	0 = Negative phase sequence 1 = Positive phase sequence
		10 to 15	<i>Reserved</i>
40605	Current	0 to 13	Average rms current across all three phases
		14 to 15	<i>Reserved</i>
40606	Current	0 to 9	Current (% motor FLC)
		10 to 15	<i>Reserved</i>
40607	Motor temperature	0 to 7	Motor thermal model (%)
		8 to 15	<i>Reserved</i>
40608	Power	0 to 11	Power
		12 to 13	Power scale 0 = Multiply power by 10 to get W 1 = Multiply power by 100 to get W 2 = Power (kW) 3 = Multiply power by 10 to get kW
		14 to 15	<i>Reserved</i>
40609	% Power factor	0 to 7	100% = power factor of 1
		8 to 15	<i>Reserved</i>
40610	Voltage	0 to 13	Average rms voltage across all three phases
		14 to 15	<i>Reserved</i>
40611	Current	0 to 13	Phase 1 current (rms)
		14 to 15	<i>Reserved</i>
40612	Current	0 to 13	Phase 2 current (rms)
		14 to 15	<i>Reserved</i>

Register	Description	Bits	Details
40613	Current	0 to 13	Phase 3 current (rms)
		14 to 15	<i>Reserved</i>
40614	Voltage	0 to 13	Phase 1 voltage
		14 to 15	<i>Reserved</i>
40615	Voltage	0 to 13	Phase 2 voltage
		14 to 15	<i>Reserved</i>
40616	Voltage	0 to 13	Phase 3 voltage
		14 to 15	<i>Reserved</i>
40617	Parameter list version number	0 to 7	Parameter list minor revision
		8 to 15	Parameter list major version
40618	Digital input state	0 to 15	For all inputs, 0 = open, 1 = closed (shorted) 0 = Start/Stop 1 = <i>Reserved</i> 2 = Reset (See note below.) 3 = Input A 4 = Input B 5 to 15 = <i>Reserved</i>
40619	Trip code	0 to 7	See <i>Trip Codes</i> on page 13
		8 to 15	<i>Reserved</i>
40620~40631	<i>Reserved</i>		

**NOTE**

The reset input is normally closed by default. If parameter 7I *Reset/Enable Logic* is set to normally open, the reported state will be inverted (0 = closed, 1 = open).

8.5 Trip Codes

Trip Code	Description
0	No trip
1	Excess start time
2	Motor overload
3	Motor thermistor
4	Current imbalance
5	Frequency
6	Phase sequence
7	Instantaneous overcurrent
8	Power loss
9	Undercurrent
10	Heatsink overtemperature
11	Motor connection
12	Input A trip
13	FLC too high
14	Unsupported option (function not available in inside delta)
15	Communications card fault
16	Forced network trip

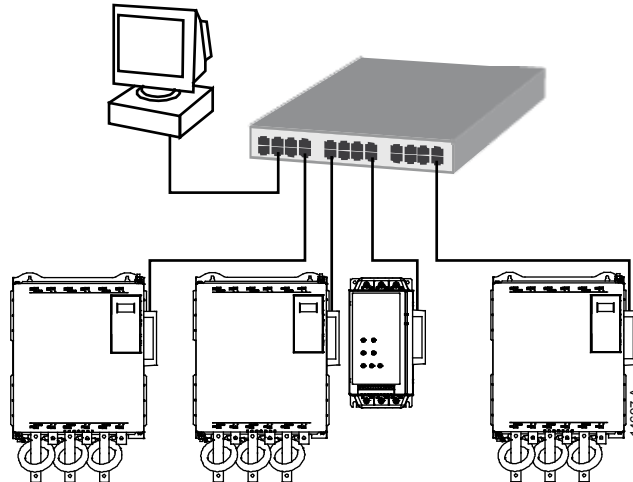
Trip Code	Description
17	Internal fault
18	Overvoltage
19	Undervoltage
23	Parameter out of range
24	Input B trip
26	L1 phase loss
27	L2 phase loss
28	L3 phase loss
29	L1-T1 shorted
30	L2-T2 shorted
31	L3-T3 shorted
33	Time-overcurrent (Bypass overload)
34	SCR overtemperature
35	Battery/clock
36	Thermistor circuit
47	Overpower
48	Underpower
56	Keypad disconnected
57	Zero Speed Detect
58	SCR Itsm
59	Instantaneous overcurrent
60	Rating Capacity
70	Current Read Err L1
71	Current Read Err L2
72	Current Read Err L3
73	Remove Mains Volts (mains voltage connected in run simulation)
74	Motor Connection T1
75	Motor Connection T2
76	Motor Connection T3
77	Firing Fail P1
78	Firing Fail P2
79	Firing Fail P3
80	VZC Fail P1
81	VZC Fail P2
82	VZC Fail P3
83	Low Control Volts
84~96	Internal fault x. Contact your local supplier with the fault code (X).

9 Network Design

The device supports star, line and ring topologies.

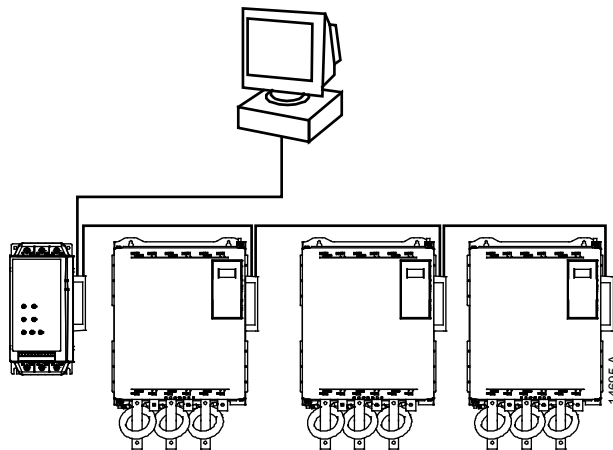
9.1 Star Topology

In a star network, all controllers and devices connect to a central network switch.



9.2 Line Topology

In a line network, the controller connects directly to one port of the first card. The second Ethernet port connects to another card, which in turn connects to another device until all devices are connected.



NOTE

The device has an integrated switch to allow data to pass through in line topology. The device must be receiving control power from the soft starter for the switch to operate.



NOTE

If the connection between two devices is interrupted, the controller cannot communicate with devices after the interruption point.



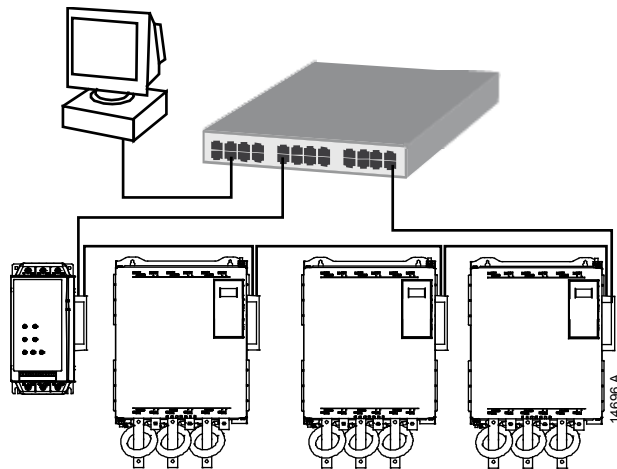
NOTE

Each connection adds a delay to communication with the next device. The maximum number of devices in a line network is 32. Exceeding this number may reduce the reliability of the network.

9.3 Ring Topology

In a ring topology network, the controller connects to the first card, via a network switch. The second Ethernet port of the card connects to another device, which in turn connects to another device until all devices are connected. The final device connects back to the switch.

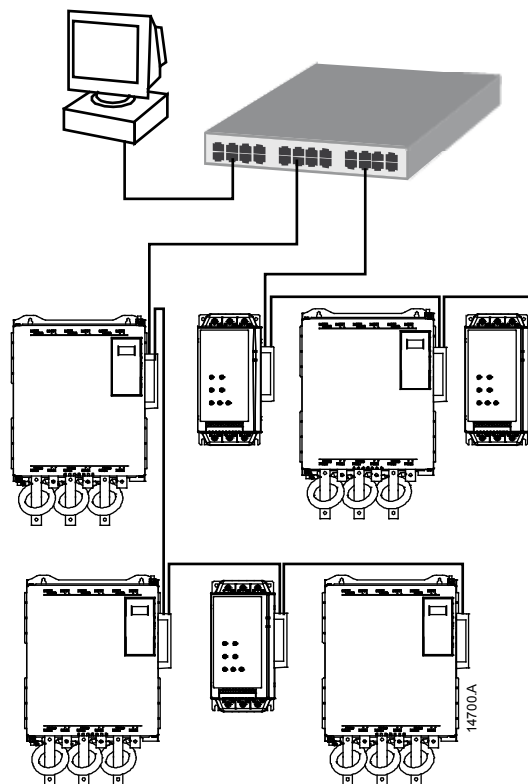
The device supports beacon based ring node configuration.

**NOTE**

The network switch must support loss of line detection.

9.4 Combined Topologies

A single network can include both star and line components.



10 Specifications

Connections

Soft starter 6-way pin assembly
Contacts Gold flash
Network RJ45

Settings

IP address Automatically assigned, configurable
Device name Automatically assigned, configurable

Network

Link speed 10 Mbps, 100 Mbps (auto-detect)
Full duplex
Auto crossover

Power

Consumption (steady state, maximum) 35 mA @ 24 VDC
Reverse polarity protected
Galvanically isolated

Certification

CE EN 60947-4-2



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