WORLDWIDE
ELECTRIC CORPORATION

## INSTRUCTIONS

# MODBUS TCP MODULE

## for use with WSE/WSIQ2

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## Compatibility

This communications module is suitable for use with:

- WSE Compact soft starter
- WSIQ2 Advanced soft starter

**NOTE**
**The Modbus TCP Module is not suitable for use with WSE soft starters using 380/440 VAC control voltage.**

This manual applies to PIM-MT-03.

The part number is printed on a label on the front of the device. For PIM-MT-01, the manual is available from your local supplier.

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

# Contents



# 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.

Failure to follow the information and instructions in this manual will void the warranty.

# Warnings

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

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

**WARNING**

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

# 1 Introduction

## 1.1 Product design

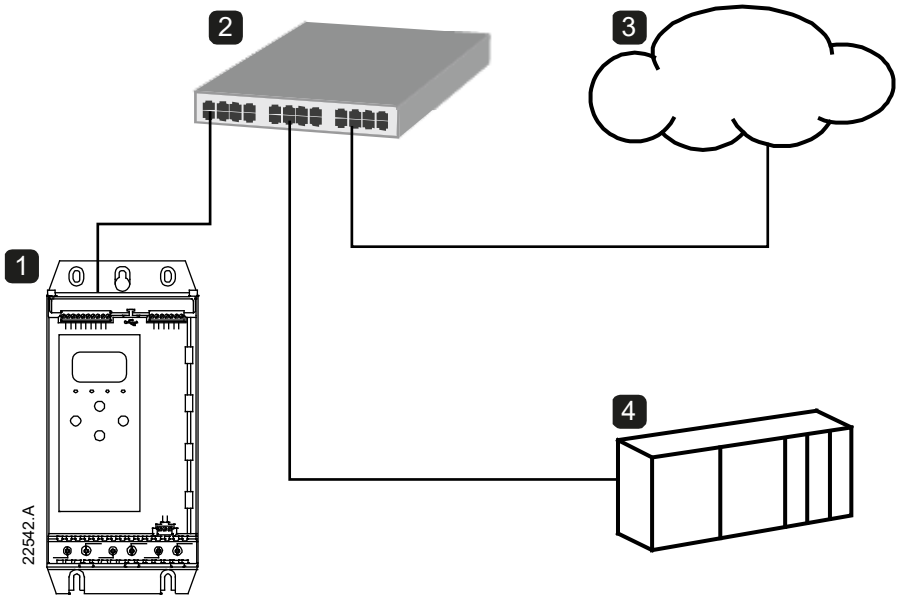
The Modbus TCP Module allows the soft starter to connect to an Ethernet network and be controlled or monitored using an Ethernet communication model.

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.

## 1.2 Communication protocols

The Modbus TCP Module supports the following protocols:

| | |
|---|---|
| Modbus TCP | Industrial ethernet via Modbus TCP |
| MQTT | Message Queue Telemetry Transport |
| OPC UA | Open Platform Communications Unified Architecture |



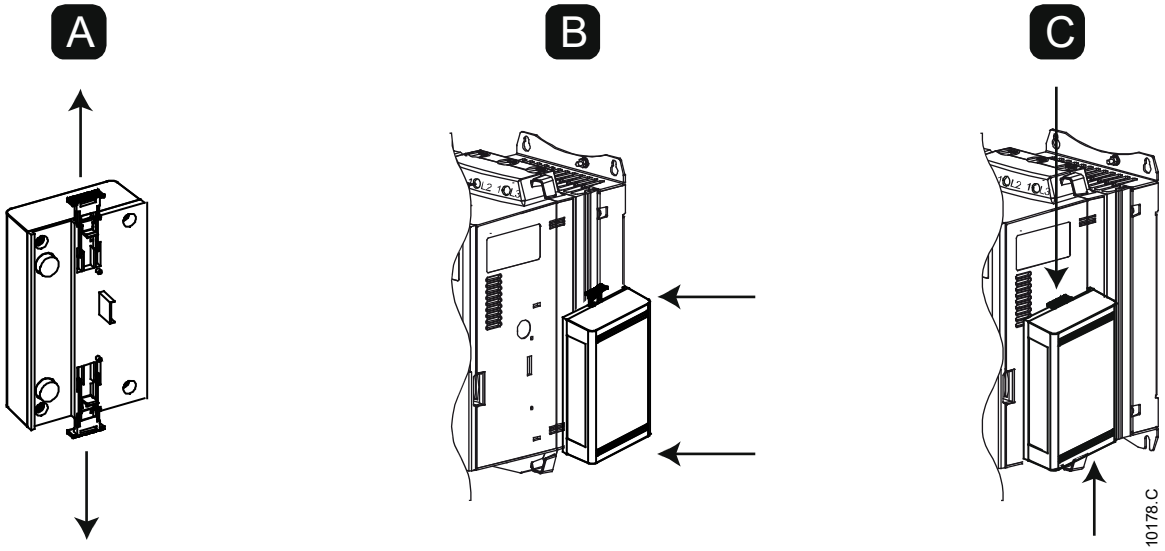

| | |
|---|---|
| **1** | Soft starter |
| **2** | Network switch |
| **3** | IoT connection (MQTT/OPC UA) |
| **4** | Industrial ethernet connection to programmable logic controller |

# 2 Installation

**CAUTION**
Remove mains and control voltage from the soft starter before attaching or removing accessories. Failure to do so may damage the equipment.

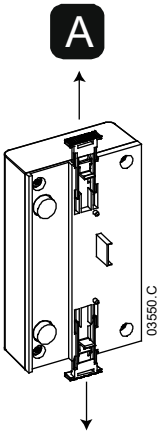
## 2.1 Installation procedure

1. Remove control power and mains supply from the soft starter.
2. Fully pull out the top and bottom retaining clips on the module. [A]
3. Line up the module with the comms port slot. [B]
4. Push in the top and bottom retaining clips to secure the module to the starter. [C]
5. Connect Ethernet Port 1 or Port 2 on the Modbus TCP Module to the network.
6. Apply control power to the soft starter.




To remove the module:

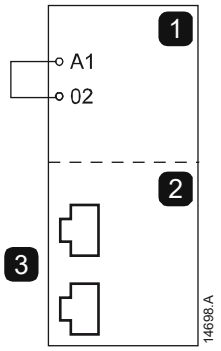
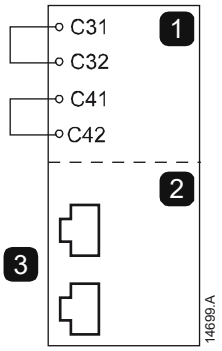
1. Remove control power and mains supply from the soft starter.
2. Disconnect all external wiring from the module.
3. Fully pull out the top and bottom retaining clips on the module. [A]
4. Pull the module away from the soft starter.



## 2.2 Soft starter connection

The device is powered from the soft starter.

**The Modbus TCP Module is not suitable for use with compact soft starters using 380/440 VAC control voltage.**

| Compact soft starter | Advanced soft starter |
|---|---|
|  |  |

| | | | |
|---|---|---|---|
| **1** | Soft starter<br>A1, 02: Stop input | **1** | Soft starter (remote mode)<br>C31, C32: Stop input<br>C41, C42: Reset input |
| **2** | Modbus TCP Module | **2** | Modbus TCP Module |
| **3** | RJ45 Ethernet ports | **3** | RJ45 Ethernet ports |

## 2.3 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°.

## 2.4 Network establishment

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

## 2.5 Addressing

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

- The module is configured with a static IP address as default. A new address can be assigned during configuration, or the device 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.

# 3 Device configuration

**NOTE**

To avoid IP address conflicts and to ensure successful deployment, we recommend that the device is connected directly to a PC or laptop to configure the IP address, before connecting to the network.

**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.

## 3.1 Configuration methods

Ethernet attributes can be configured directly in the device using the on-board web server.

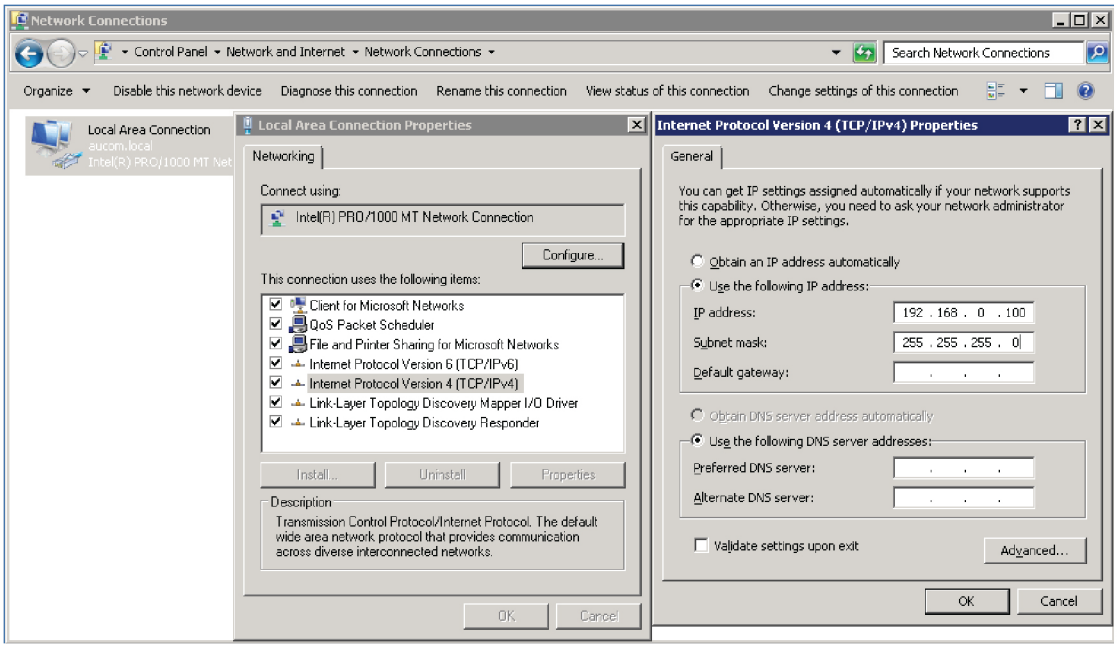
- The module is configured with a static IP address as default. A new address can be assigned during configuration, or the device can be configured to accept a dynamic IP address (via DHCP).
- The web server can configure the IP address and messaging settings for MQTT or OPC UA operation.
- If you cannot connect to the web server, use the Ethernet Device Configuration software to scan the network and identify the device.

## 3.2 On-board web server

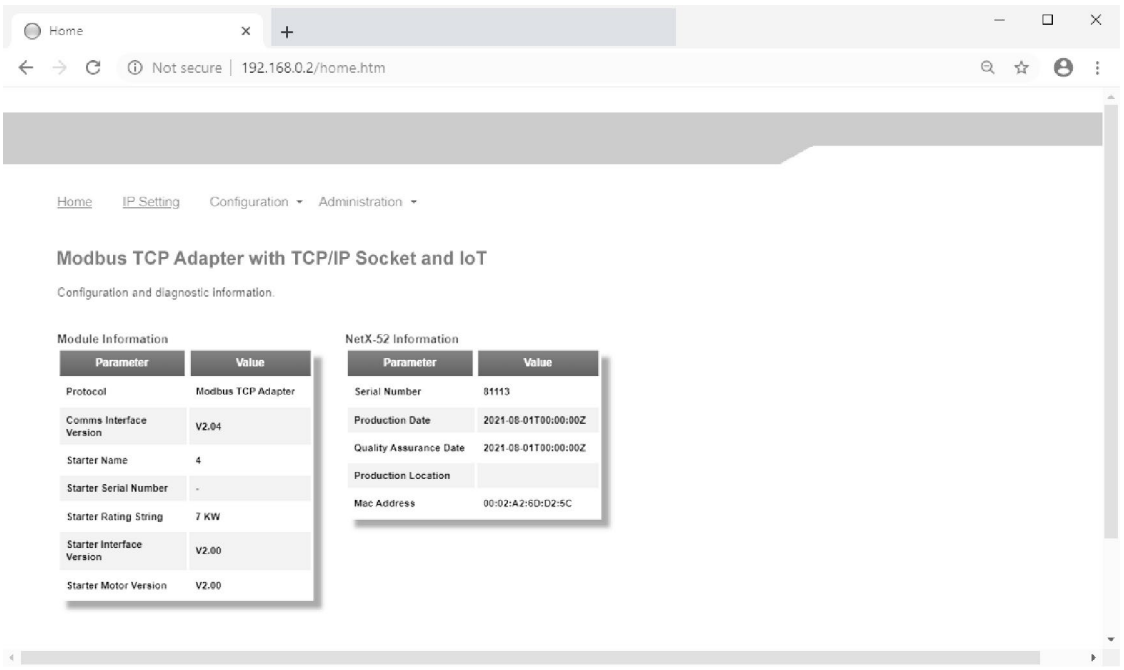
### Connect to the device

To configure settings using the on-board web server, the module must be installed on a soft starter, control power must be available, and the device and computer must be connected to each other or to the same Ethernet network.

The computer must use a fixed IP address (not DHCP) and the same subnet mask as the device. The default address for a new Modbus TCP Module is 192.168.0.1. The default subnet mask is 255.255.255.0.



Once connected, the web server reports basic information about the device and the soft starter.




## Manage users and passwords

The Modbus TCP Module supports multiple users and levels of privilege.

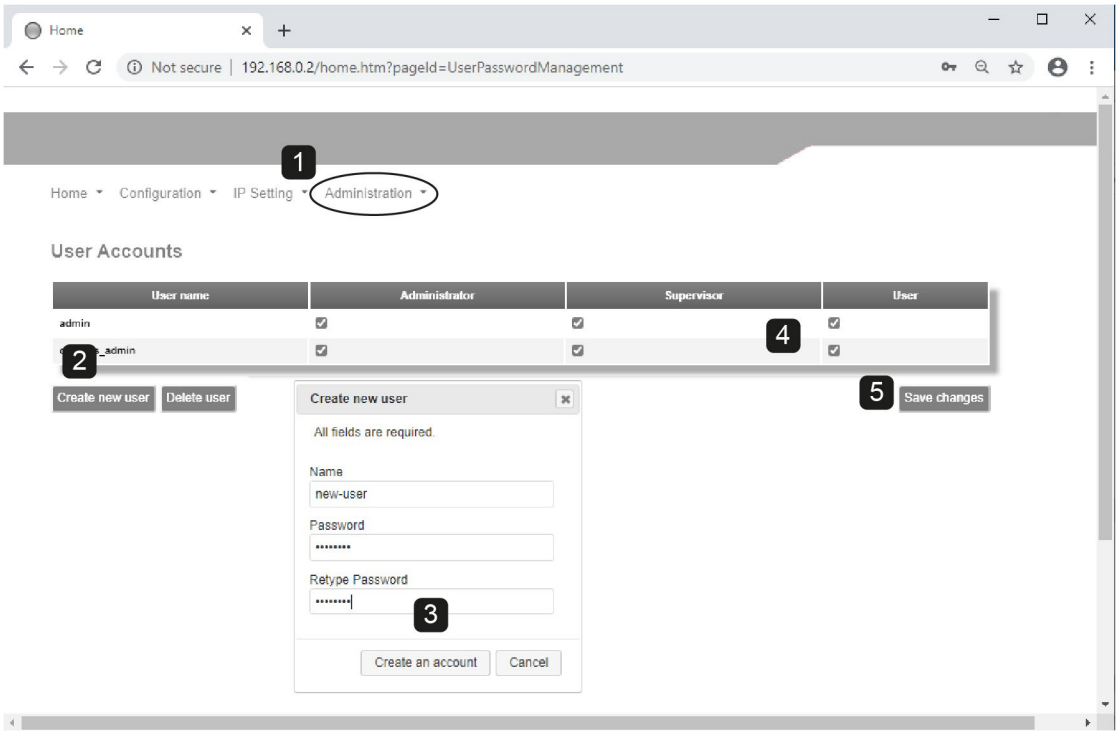
- Users can view the home screen and IP address settings
- Supervisors can view the home screen and IP settings and can change configuration settings
- Administrators can view the home screen, change configuration settings and add or delete users

**NOTE**
For security reasons, we recommend that you define a custom administrator ID and password.

The default username and password are:
username: admin
password: 1978

To add a new user:

1. Connect to the web server then click Administration.
2. Click Create new user.
3. Enter the new username and password then click Create an account.
4. Set privileges (user, supervisor, administrator) as appropriate.
5. Click Save changes.




To delete a user:

1. Connect to the web server then click Administration.
2. Click the required entry in the user list then click Delete user. Click Delete again to confirm the action.

## Configure the IP address

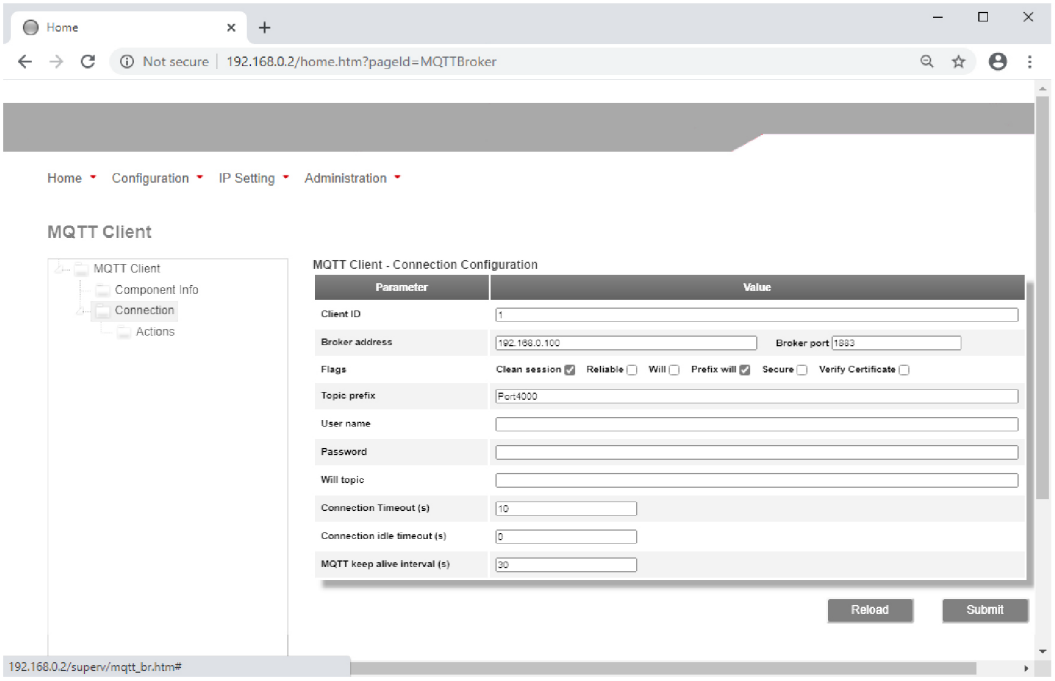
1. Connect to the web server then click IP Setting.
2. Edit the settings as required. To enable DHCP addressing, tick the DHCP checkbox.
3. Click Submit to send the new settings to the device.


## Configure IoT settings

The Modbus TCP Module supports soft starter status monitoring over IoT. The device cannot control or program the soft starter.

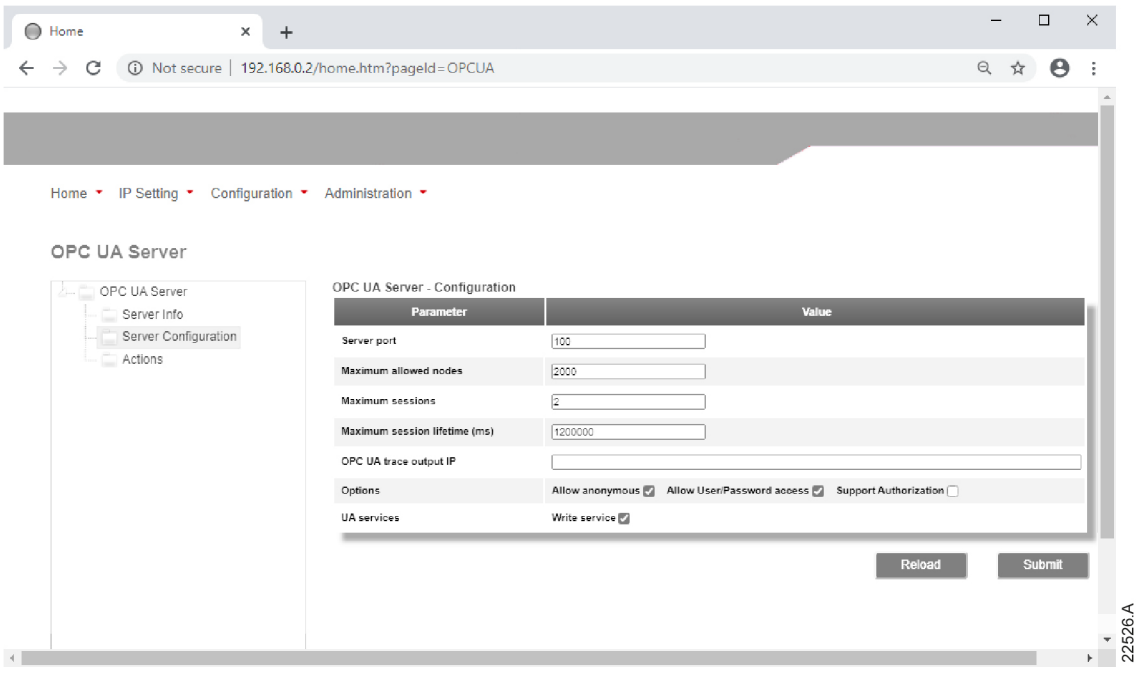
- **Configure MQTT settings**

1. Connect to the web server then click Configuration > MQTT Client.
2. Tick the Enable checkbox to enable MQTT client operation. The MQTT client is enabled by default.
3. Click Connection then configure the settings as required.
4. Use Connection > Actions to select which information the device will publish.
5. Click Submit to save all settings in the device.




- **Configure OPC UA settings**

1. Connect to the web server then click Configuration > OPC UA Server.
2. Tick the Enable checkbox to enable OPC UA client operation. The OPC UA client is enabled by default.
3. Click Server Configuration then configure the settings as required.
4. Use Actions to select the actions for different object instances.
5. Click Submit to save all settings in the device.



## 3.3 Scanning the network

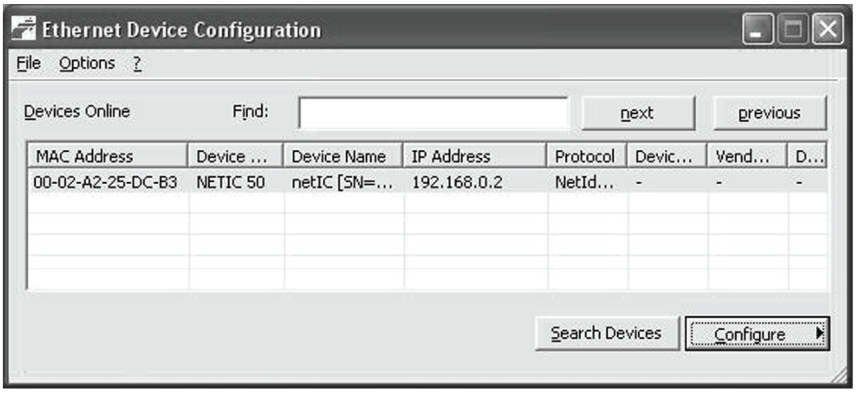
If you cannot connect to the web server, use the Ethernet Device Configuration software to scan the network and identify the device. Changes made via the software cannot be stored permanently in the device and will be lost when control power is cycled.

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.




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

# 4 PLC configuration

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

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

# 5 Operation

The Modbus TCP Module 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.

## 5.1 Device classification

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

## 5.2 Enabling network control

Compact soft starter: For the soft starter to accept fieldbus commands, a link must be fitted across terminals A1-02 on the starter.

Advanced soft starter: Input links are required across the stop and reset inputs if the soft starter is being operated in Remote mode. In Local mode, links are not required.

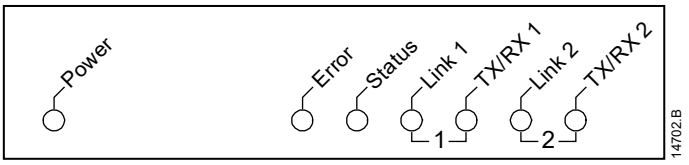
Control via the fieldbus communication network is always enabled in local control mode, and can be enabled or disabled in remote control mode (parameter 6R *Comms in Remote*). See the soft starter user manual for parameter details.

## 5.3 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. The device will not transfer successive duplicate commands to the soft starter.

- If the soft starter is started via fieldbus communications but stopped via the keypad or a remote input, an identical start command cannot be used to restart the starter.
- If the soft starter may also be controlled via the keypad or the remote inputs (as well as via fieldbus communications), a control command should be immediately followed by a status query to confirm the command has been actioned.

## 5.4 Feedback LEDs




| LED name | LED state | Description |
|---|---|---|
| Power | Off | Device is not powered up. |
| | On | Device is receiving power. |
| Error | Off | No error. |
| | Flashing | System error. |
| | On | Communication error. |
| Status | Off | Not ready. |
| | Slow flash | Ready but not configured. |
| | Fast flash | Configured and waiting for communication. |
| | On | Communication has been established. |
| Link x | Off | No network connection. |
| | On | Connected to a network. |
| TX/RX x | Flashing | Establishing connection. |
| | On | Operating normally. |

# 6 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 module unless otherwise stated.

## 6.1 Compatibility

The Modbus TCP Module supports two modes of operation.

- In Standard Mode, the device uses registers defined in the Modbus Protocol Specification.
- In Legacy Mode, the device uses the same registers as The Manufacturer's Modbus Module. Some registers differ from those specified in the Modbus Protocol Specification.

The mode of operation is determined by the values of bit 15 in register 40001.

- Standard Mode: set Bit 15 = 1. Bits 0~7 of register 40001 are used for command.
- Legacy Mode: set Bit 15 = 0. The remaining bits of register 40001 are reserved.

Examples

10000000 00000001 = start the motor (Standard Mode).

10000000 00000000 = stop the motor (Standard Mode).

00000000 xxxxxxxx = use Legacy Mode. The device will ignore the remaining bits in register 40001 and will check the value in register 40002.

## 6.2 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.

The first product parameter is always allocated to register 40009. See the soft starter user manual for a complete parameter list.

The Modbus TCP protocol limits read/write operations to a maximum of 123 registers at one time. The registers must be consecutive. These registers support multiple write (Modbus function code 16). Attempting to write to a single register will return an error code 01 (Illegal function code).

**CAUTION**
Changing the values of the Factory parameters (parameter group 20) may cause unpredictable behaviour in the soft starter. Consult your local supplier before adjusting the Factory parameters.

## 6.3 Standard Mode

### 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:<br>00000000 = Stop<br>00000001 = Start<br>00000010 = Reset<br>00000100 = Quick stop (coast to stop)<br>00001000 = Forced communication trip<br>00010000 = Start using Parameter Set 1<br>00100000 = Start using Parameter Set 2<br>01000000 = Local control<br>10000000 = Remote control |
| | | 8 to 14 | *Reserved* |
| | | 15 | Must = 1 |
| 40002 | *Reserved* | | |
| 40003 | *Reserved* | | |
| 40004 | *Reserved* | | |
| 40005 | *Reserved* | | |
| 40006 | *Reserved* | | |
| 40007 | *Reserved* | | |
| 40008 | *Reserved* | | |
| 40009 | Parameter management (single/multiple read or multiple write) | 0 to 15 | Manage soft starter programmable parameters |

### Status reporting registers (read only)

**NOTE**

For models 0053B and smaller, current reported via communications is 10 times greater than the actual value (displayed on the keypad).

| Register | Description | Bits | Details |
|---|---|---|---|
| 30600 | Product information | 0 to 5 | *Reserved* |
| | | 6 to 8 | Product parameter list version |
| | | 9 to 15 | Product type code:<br>4 = Compact soft starter<br>6 = Advanced soft starter |
| 30601 | Model number | 0 to 7 | *Reserved* |
| | | 8 to 15 | Soft starter model ID |
| 30602 | *Reserved* | | |
| 30603 | *Reserved* | | |

| Register | Description | Bits | Details |
|---|---|---|---|
| 30604 | Starter state | 0 to 4 | 0 = *Reserved*<br>1 = Ready<br>2 = Starting<br>3 = Running<br>4 = Stopping<br>5 = Not ready (restart delay, restart temperature check)<br>6 = Tripped<br>7 = Programming mode<br>8 = Jog forward<br>9 = Jog reverse |
| | | 5 | 1 = Warning |
| | | 6 | 0 = Uninitialised<br>1 = Initialised |
| | | 7 | 0 = Local control<br>1 = Remote control |
| | | 8 | *Reserved* |
| | | 9 | 0 = Negative phase sequence<br>1 = Positive phase sequence |
| | | 10 to 15 | See *Trip codes* on page 17 |
| 30605 | Current | 0 to 13 | Average rms current across all three phases |
| | | 14 to 15 | *Reserved* |
| 30606 | Current | 0 to 9 | Current (% motor FLC) |
| | | 10 to 15 | *Reserved* |
| 30607 | Motor temperature | 0 to 7 | Motor 1 thermal model (%) |
| | | 8 to 15 | Motor 2 thermal model (%) |
| 30608 | Power | 0 to 11 | Power |
| | | 12 to 13 | Power scale<br>0 = Multiply power by 10 to get W<br>1 = Multiply power by 100 to get W<br>2 = Power (kW)<br>3 = Multiply power by 10 to get kW |
| | | 14 to 15 | *Reserved* |
| 30609 | % Power factor | 0 to 7 | 100% = power factor of 1 |
| | | 8 to 15 | *Reserved* |
| 30610 | *Reserved* | | |
| 30611 | Current | 0 to 13 | Phase 1 current (rms) |
| | | 14 to 15 | *Reserved* |
| 30612 | Current | 0 to 13 | Phase 2 current (rms) |
| | | 14 to 15 | *Reserved* |
| 30613 | Current | 0 to 13 | Phase 3 current (rms) |
| | | 14 to 15 | *Reserved* |
| 30614 | *Reserved* | | |
| 30615 | *Reserved* | | |

| Register | Description | Bits | Details |
|---|---|---|---|
| 30616 | *Reserved* | | |
| 30617 | Parameter list version number | 0 to 7 | Parameter list minor revision |
| | | 8 to 15 | Parameter list major version |
| 30618 | Digital input state | 0 to 15 | For all inputs, 0 = open, 1 = closed (shorted)<br>0 = Start<br>1 = Stop<br>2 = Reset<br>3 = Input A<br>4 = Input B<br>5 to 15 = *Reserved* |

## 6.4 Legacy mode

**NOTE**

For models 0053B and smaller, current reported via communications is 10 times greater than the actual value (displayed on the keypad).

| Register | Description | Bits | Details |
|---|---|---|---|
| 40001 | *Reserved* | 0 to 14 | *Reserved* |
| | | 15 | Must be zero |
| 40002 | Command (single write) | 0 to 2 | To send a command to the starter, write the required value:<br>1 = Start<br>2 = Stop<br>3 = Reset<br>4 = Quick stop (coast to stop)<br>5 = Forced communication trip<br>6 = Start using Parameter Set 1<br>7 = Start using Parameter Set 2 |
| | | 3 to 15 | *Reserved* |
| 40003 | Starter state | 0 to 3 | 1 = Ready<br>2 = Starting<br>3 = Running<br>4 = Stopping (including braking)<br>5 = Restart delay (including temperature check)<br>6 = Tripped<br>7 = Programming mode<br>8 = Jog forward<br>9 = Jog reverse |
| | | 4 | 1 = Positive phase sequence (only valid if bit 6 = 1) |
| | | 5 | 1 = Current exceeds FLC |
| | | 6 | 0 = Uninitialised<br>1 = Initialised |
| | | 7 to 15 | *Reserved* |

| Register | Description | Bits | Details |
|---|---|---|---|
| 40004 | Trip code | 0 to 7 | See *Trip codes* on page 17 |
| | | 8 to 15 | *Reserved* |
| 40005 | Motor current | 0 to 7 | Average 3-phase motor current (A) |
| | | 8 to 15 | |
| 40006 | Motor temperature | 0 to 7 | Motor 1 thermal model (%) |
| | | 8 to 15 | |
| 40007 | *Reserved* | | |
| 40008 | *Reserved* | | |
| 40009 ~ 40200 | Parameter management (single/multiple read or multiple write) | 0 to 7 | Manage soft starter programmable parameters |
| | | 8 to 15 | *Reserved* |
| 40600 | Product information | 0 to 5 | Binary protocol version |
| | | 6 to 8 | Parameter list version number |
| | | 9 to 15 | Product type code:<br>4 = Compact soft starter<br>6 = Advanced soft starter |
| 40601 | Model number | 0 to 7 | *Reserved* |
| | | 8 to 15 | Soft starter model ID |
| 40602 | *Reserved* | | |
| 40603 | *Reserved* | | |
| 40604 | Starter state | 0 to 4 | 0 = *Reserved*<br>1 = Ready<br>2 = Starting<br>3 = Running<br>4 = Stopping<br>5 = Not ready (restart delay, restart temperature check)<br>6 = Tripped<br>7 = Programming mode<br>8 = Jog forward<br>9 = Jog reverse |
| | | 5 | 1 = Warning |
| | | 6 | 0 = Uninitialised<br>1 = Initialised |
| | | 7 | Local/Remote<br>0 = Local control<br>1 = Remote control |
| | | 8 | *Reserved* |
| | | 9 | 0 = Negative phase sequence<br>1 = Positive phase sequence |
| | | 10 to 15 | *Reserved* |
| 40605 | Current | 0 to 13 | Average rms current across all three phases |
| | | 14 to 15 | *Reserved* |

| Register | Description | Bits | Details |
|---|---|---|---|
| 40606 | Current | 0 to 9 | Current (% motor FLC) |
| | | 10 to 15 | *Reserved* |
| 40607 | Motor temperature | 0 to 7 | Motor 1 thermal model (%) |
| | | 8 to 15 | *Reserved* |
| 40608 | Power | 0 to 11 | Power |
| | | 12 to 13 | Power scale<br>0 = Multiply power by 10 to get W<br>1 = Multiply power by 100 to get W<br>2 = Power (kW)<br>3 = Multiply power by 10 to get kW |
| | | 14 to 15 | *Reserved* |
| 40609 | % Power factor | 0 to 7 | 100% = power factor of 1 |
| | | 8 to 15 | *Reserved* |
| 40610 | *Reserved* | | |
| 40611 | Current | 0 to 13 | Phase 1 current (rms) |
| | | 14 to 15 | *Reserved* |
| 40612 | Current | 0 to 13 | Phase 2 current (rms) |
| | | 14 to 15 | *Reserved* |
| 40613 | Current | 0 to 13 | Phase 3 current (rms) |
| | | 14 to 15 | *Reserved* |
| 40614 | *Reserved* | | |
| 40615 | *Reserved* | | |
| 40616 | *Reserved* | | |
| 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)<br>0 = Start<br>1 = Stop<br>2 = Reset<br>3 = Input A<br>4 = Input B<br>5 to 15 = *Reserved* |

## 6.5 Trip codes

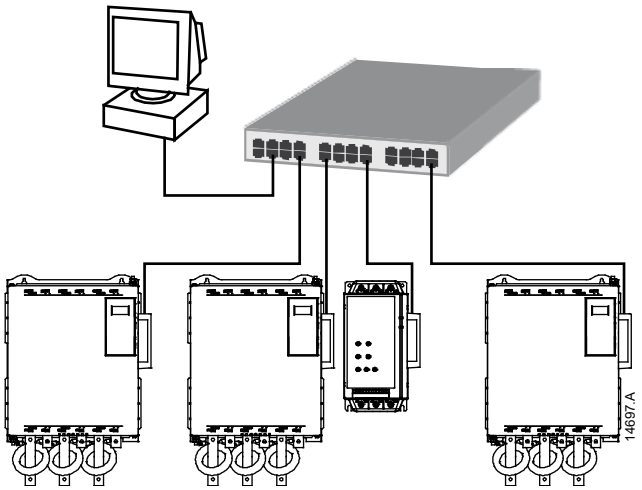
| Trip code | Description |
|---|---|
| 1 | Excess start time |
| 2 | Motor overload |
| 3 | Motor thermistor |
| 4 | Current imbalance |
| 5 | Frequency |
| 6 | Phase sequence |
| 7 | Instantaneous overcurrent |
| 8 | Power loss |
| 9 | Undercurrent |
| 10 | Heatsink overtemperature |
| 11 | Motor connection |
| 12 | Input A trip |
| 13 | FLC too high |
| 14 | Unsupported option (function not available in inside delta) |
| 15 | Starter communication (between device and soft starter) |
| 16 | Network communication (between device and network) |
| 17 | Internal fault |
| 23 | Parameter out of range |
| 26 | L1 phase loss |
| 27 | L2 phase loss |
| 28 | L3 phase loss |
| 29 | L1-T1 shorted |
| 30 | L2-T2 shorted |
| 31 | L3-T3 shorted |
| 32 | Motor 2 overload |
| 33 | Time-overcurrent / Bypass overload |
| 35 | Battery/clock |
| 36 | Thermistor circuit |
| 255 | No trip |

# 7 Network design

The device supports star, line and ring topologies.

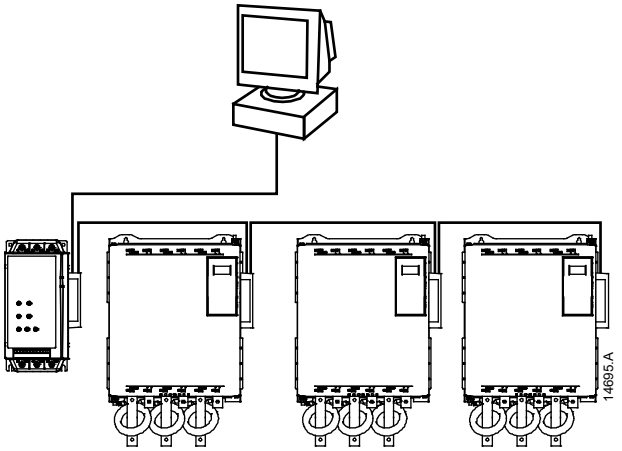
## 7.1 Star topology

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




## 7.2 Line topology

In a line network, the controller connects directly to one port of the first device. The second Ethernet port connects to another device, 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.

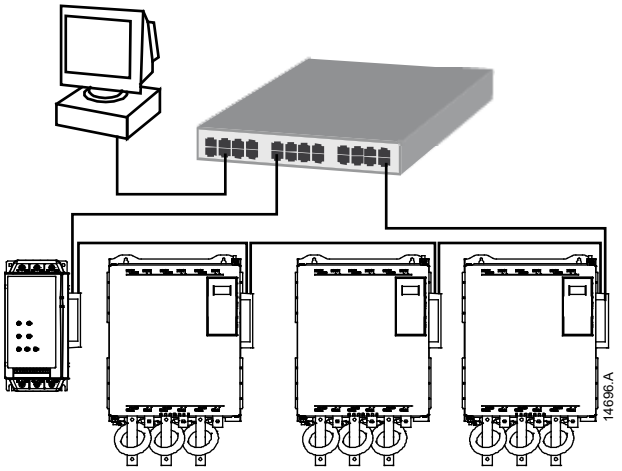
**NOTE**
If the connection between two devices is interrupted, the controller cannot communicate with devices after the interruption point.

**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.

## 7.3 Ring topology

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

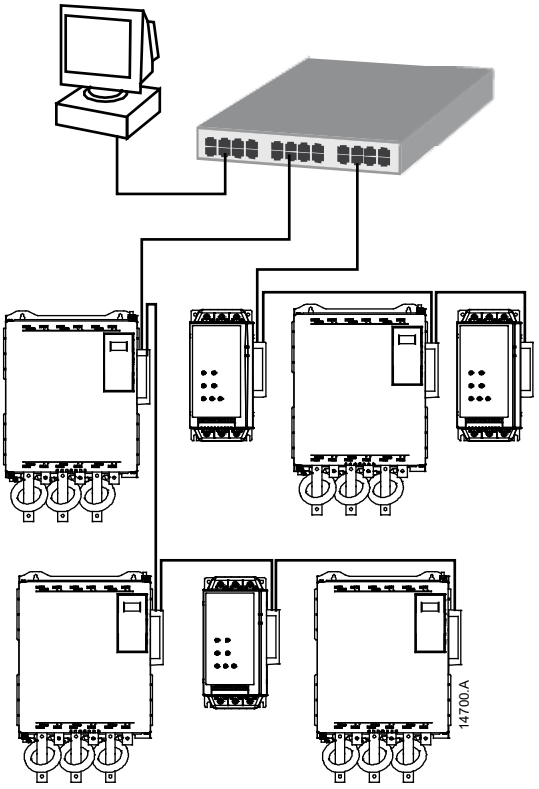
The device supports beacon based ring node configuration.




**NOTE**
The network switch must support loss of line detection.

## 7.4 Combined topologies

A single network can include both star and line components.



# 8 Specifications

- **Enclosure**

Dimensions ..... 40 mm (W) x 166 mm (H) x 90 mm (D)
Weight ..... 250 g
Protection ..... IP20

- **Mounting**

Spring-action plastic mounting clips (x 2)

- **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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