

Installation Guide

Modbus TCP Module

VLT® Compact Starter MCD 200 and VLT® Soft Starter MCD 500



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1 Safety

1.1 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. Responsibility or liability is never accepted for direct, indirect, or consequential damage resulting from the use or application of this equipment.

1.2 Warnings

W A R N I N G

SHOCK HAZARD

Attaching or removing accessories while the soft starter is connected to mains voltage may cause personal injury.

- Before attaching or removing accessories, isolate the soft starter from mains voltage.

W A R N I N G

RISK OF PERSONAL INJURY AND EQUIPMENT DAMAGE

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

- Do not insert foreign objects in the soft starter with the port cover open.
- Do not touch the inside of the soft starter with the port cover open.

2 Introduction

2.1 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 arising from using this device with 3rd-party products, including PLCs, scanners, and commissioning tools, contact the relevant supplier.

2.2 Compatibility

The Modbus TCP Module is compatible with the following Danfoss soft starters:

- MCD 200: 24 V AC/V DC and 110/240 V AC control voltage.
- MCD 500: All models.

NOTICE

The Modbus TCP Module is not suitable for use with MCD 200 soft starters using 380/440 V AC control voltage.

2.3 Product Versions

The Modbus TCP Module is available in 2 different versions. The part number is printed on the label on the side of the module.

- 175G9904 MCD Modbus TCP Module
 - Monitor and control the soft starter over a Modbus TCP connection.
- 175G9914 MCD Modbus TCP Module
 - Monitor and control the soft starter over a Modbus TCP connection.
 - Monitor and control the soft starter over a TCP connection using VLT® Motion Control Tool MCT 10, refer to the VLT® Motion Control Tool MCT 10 Operating Guide.

The register addresses for status reporting differ for 175G9904 and 175G9914.

This installation guide is suitable for use with 175G9914. For the manual for 175G9904, contact the local supplier.

2.4 Network Connection

Table 1: Supported Protocols

Protocols	
Modbus TCP	Industrial Ethernet via Modbus TCP
TCP	Transmission control protocol to connect to port 4000 of a PC
MQTT	Message queue telemetry transport
OPC UA	Open platform communications unified architecture

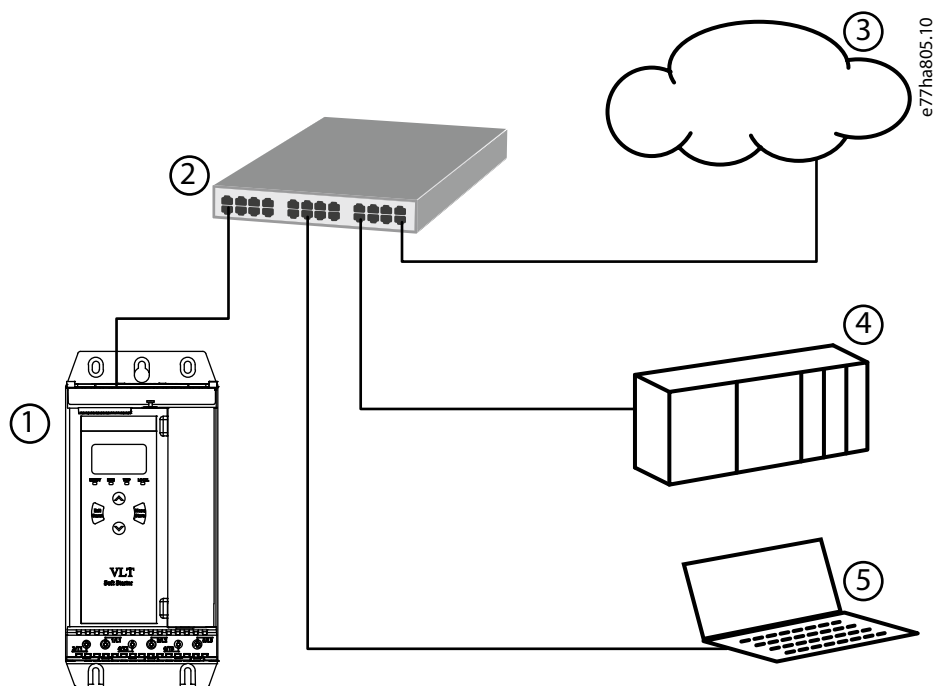


Illustration 1: Overview of Network Connections

1	Soft starter	4	Industrial Ethernet connection to programmable logic controller
2	Network switch	5	TCP connection to VLT® Motion Control Tool MCT 10. Refer to the VLT® Motion Control Tool MCT 10 Operating Guide for connection details.
3	IoT connection (MQTT/OPC UA)		

3 Installation

3.1 Installing the Communication Module

⚠ CAUTION ⚠

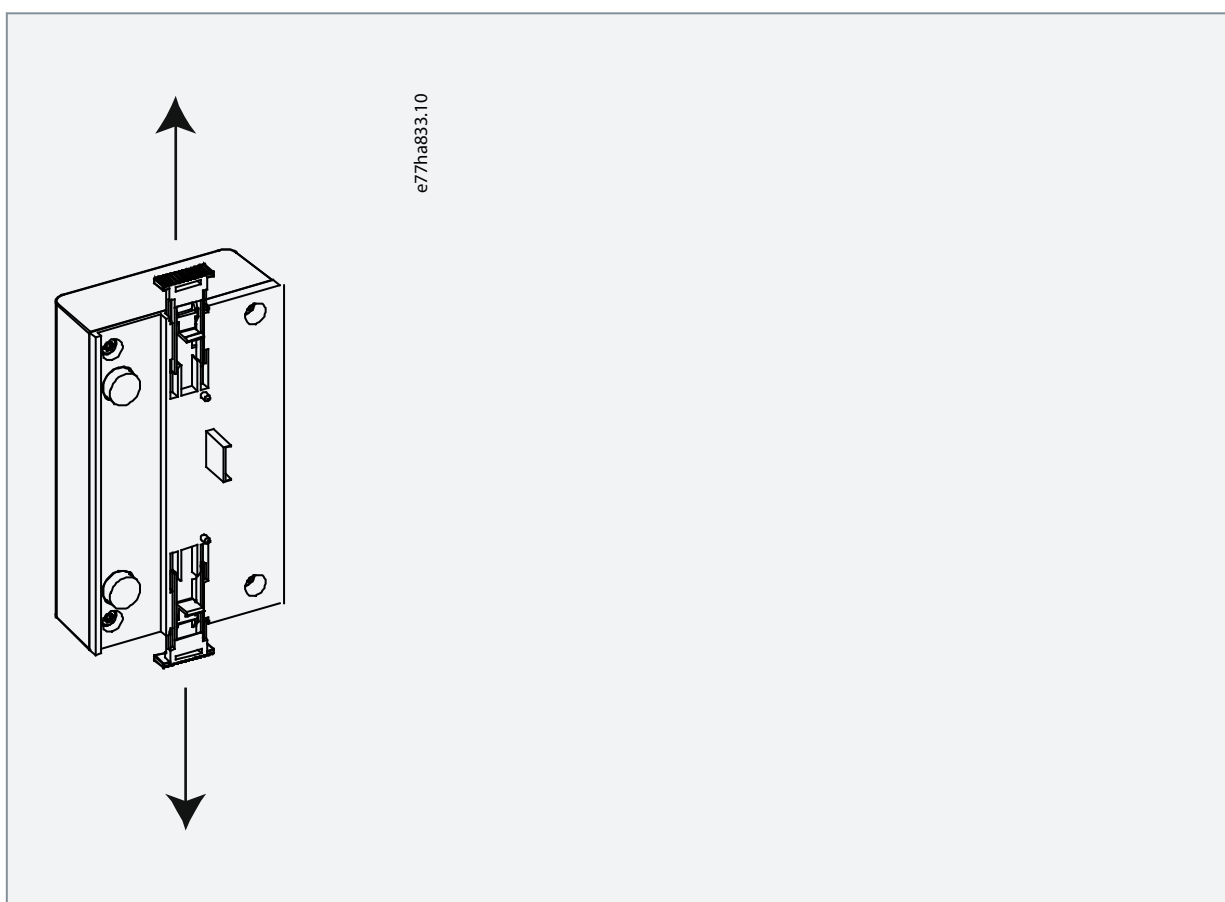
EQUIPMENT DAMAGE

If mains and control voltage are applied when installing or removing options/accessories, it may damage the equipment.

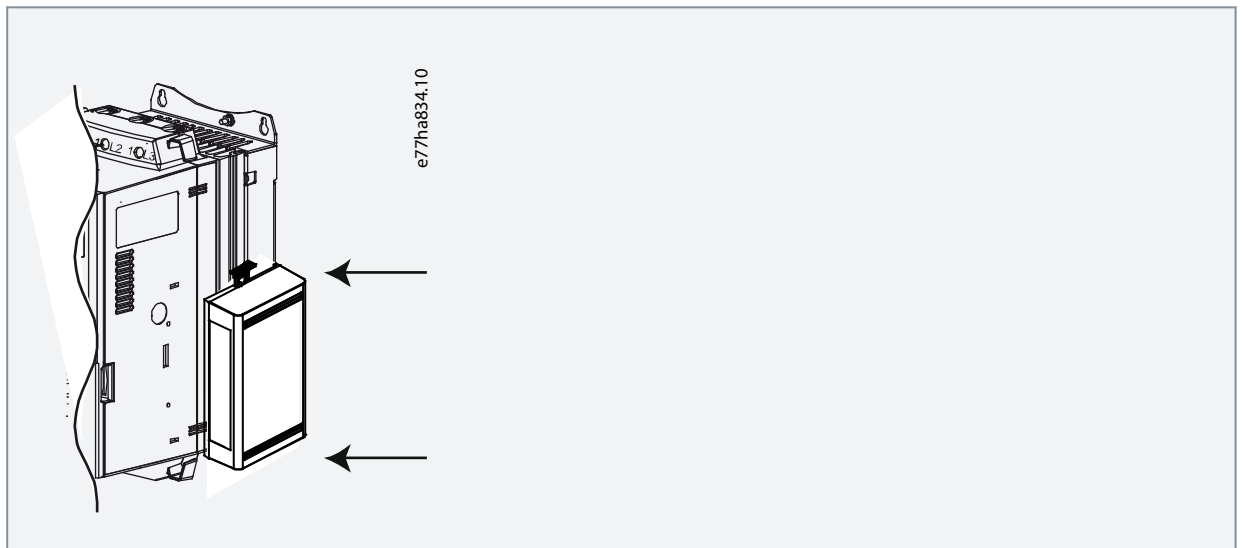
- Remove mains and control voltage from the soft starter before installing or removing options/accessories.

Procedure

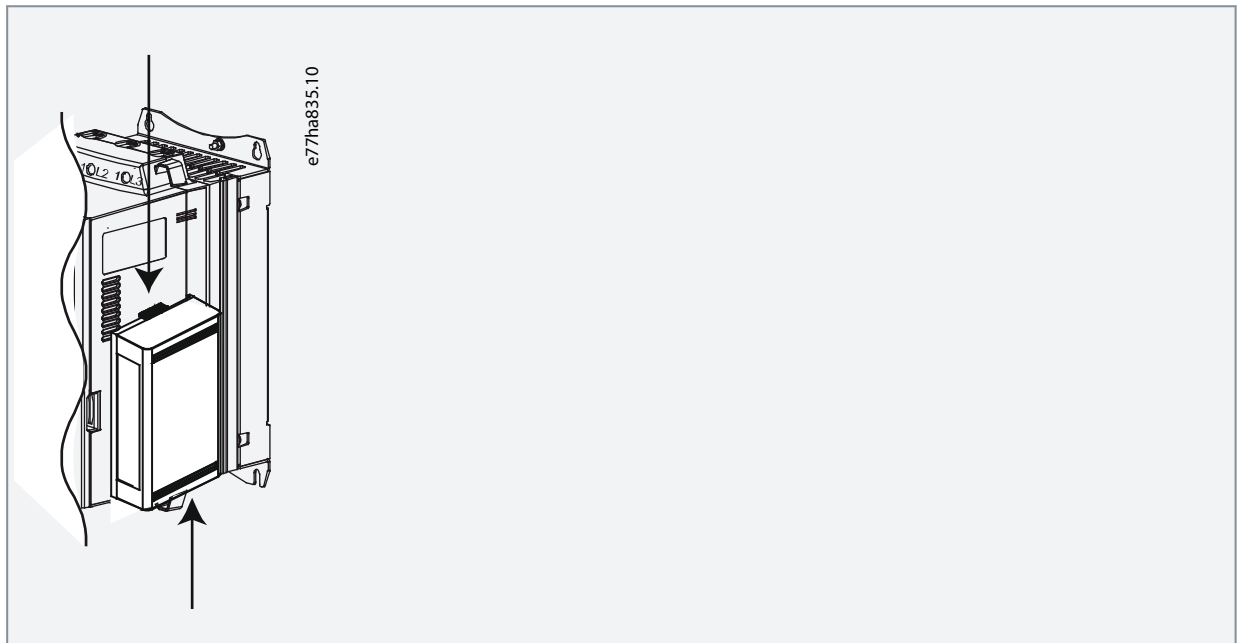
1. Remove control power and mains supply from the soft starter.
2. Fully pull the top and bottom retaining clips on the module.



3. Line up the module with the comms port slot.



4. Push in the top and bottom retaining clips to secure the module to the soft starter.



5. Connect Ethernet Port 1 or Port 2 on the Modbus TCP Module to the network.
6. Apply control power to the soft starter.

4 Connection

4.1 Soft Starter Connection

The Modbus TCP Module is powered from the soft starter.

NOTICE

The Modbus TCP Module is not suitable for use with MCD 200 soft starters using 380/440 V AC control voltage.

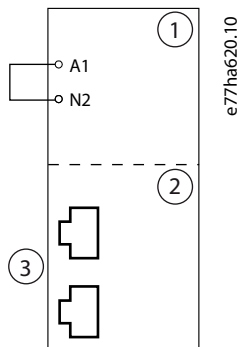


Illustration 2: Connecting MCD 200

1	Soft starter A1, N2: Stop input	3	RJ45 Ethernet ports
2	Modbus TCP Module		

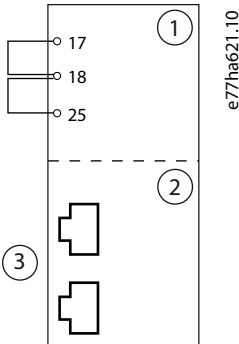


Illustration 3: Connecting MCD 500

1	Soft starter (remote mode) 17, 18: Stop input 25, 18: Reset input	3	RJ45 Ethernet ports
2	Modbus TCP Module		

4.2 Network Connection

4.2.1 Ethernet Ports

The device has 2 Ethernet ports. If only 1 connection is required, either port can be used.

4.2.2 Cables

When connecting to the device, make sure that the cables are of 1 of the following categories:

- Category 5
- Category 5e
- Category 6
- Category 6e

4.2.3 EMC Precautions

To minimize electromagnetic interference, Ethernet cables should be separated from motor and mains cables by 200 mm (7.9 in). 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.

5 Device Configuration

5.1 Before Configuring the Device

NOTICE

To avoid IP address conflicts and to ensure successful deployment, connect the device directly to a PC or laptop to configure the IP address, before connecting to the network.

NOTICE

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.

5.2 Configuration Methods

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

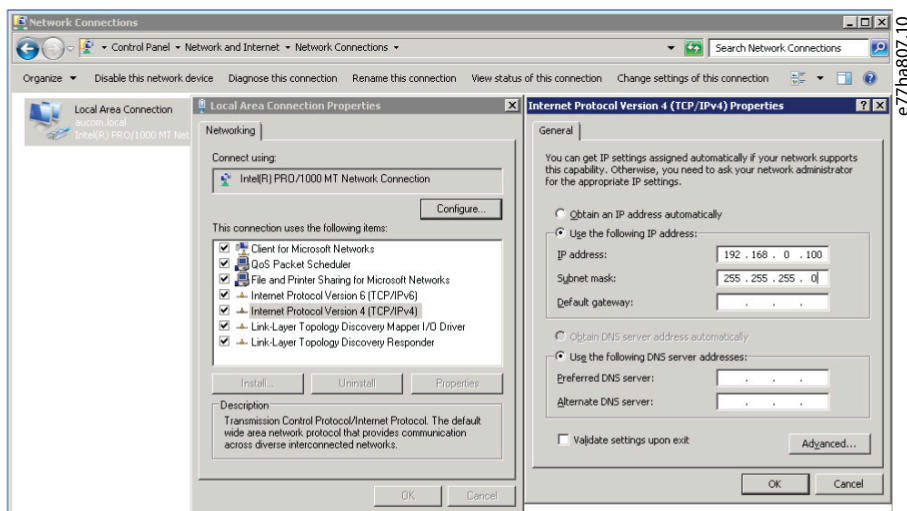
- The module is configured with a static IP address as default. A new address can be assigned during configuration, or the device can be configured to accept a dynamic IP address (via DHCP).
- The web server can configure the IP address and messaging settings for MQTT or OPC UA operation.
- If it is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

5.3 On-board Web Server

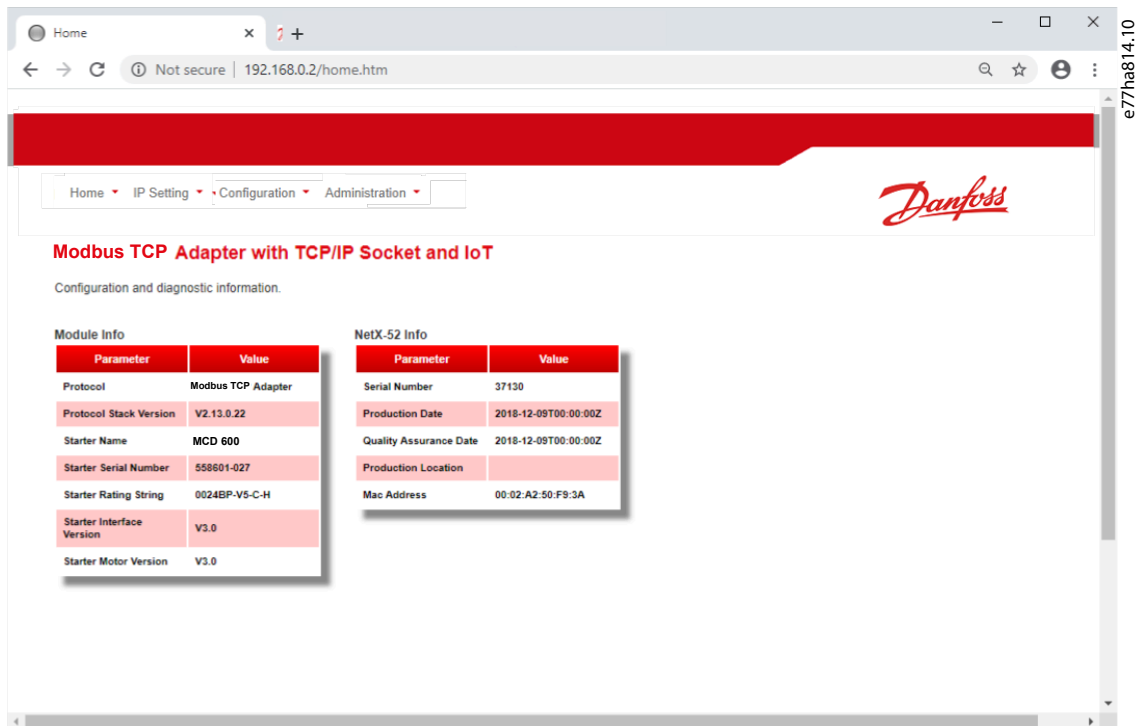
5.3.1 Connect to the Device

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

The computer must use a fixed IP address (not DHCP) and the same subnet mask as the device. The default IP address for a new Modbus TCP Module is 192.168.1.2. The default subnet mask is 255.255.255.0.



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



5.3.2 Manage Users and Passwords

NOTICE

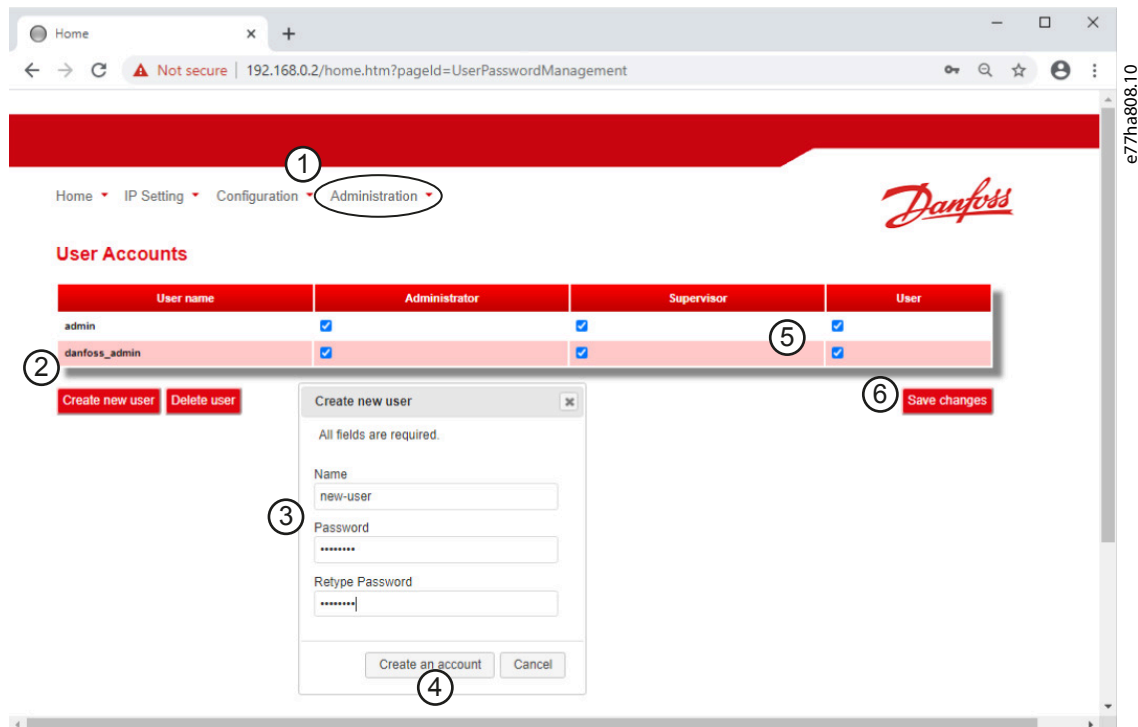
For security reasons, define a custom administrator ID and password. The default username and password are:

- Username: danfoss
- Password: danfoss

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

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

5.3.2.1 Adding a User



Procedure

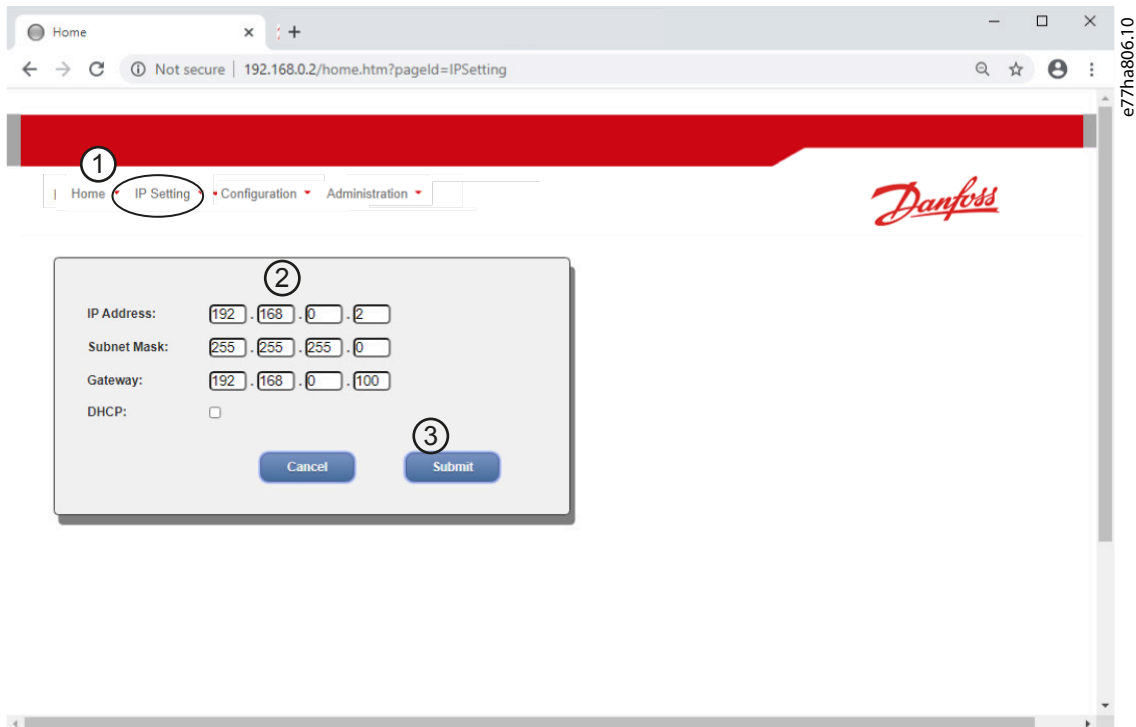
1. Connect to the web server and click *Administration*.
2. Click *Create new user*.
3. Enter the new username and password.
4. Click *Create an account*.
5. Set privileges (user, supervisor, administrator) as appropriate.
6. Click *Save changes*.

5.3.2.2 Deleting a User

Procedure

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

5.3.3 Configuring the IP Address



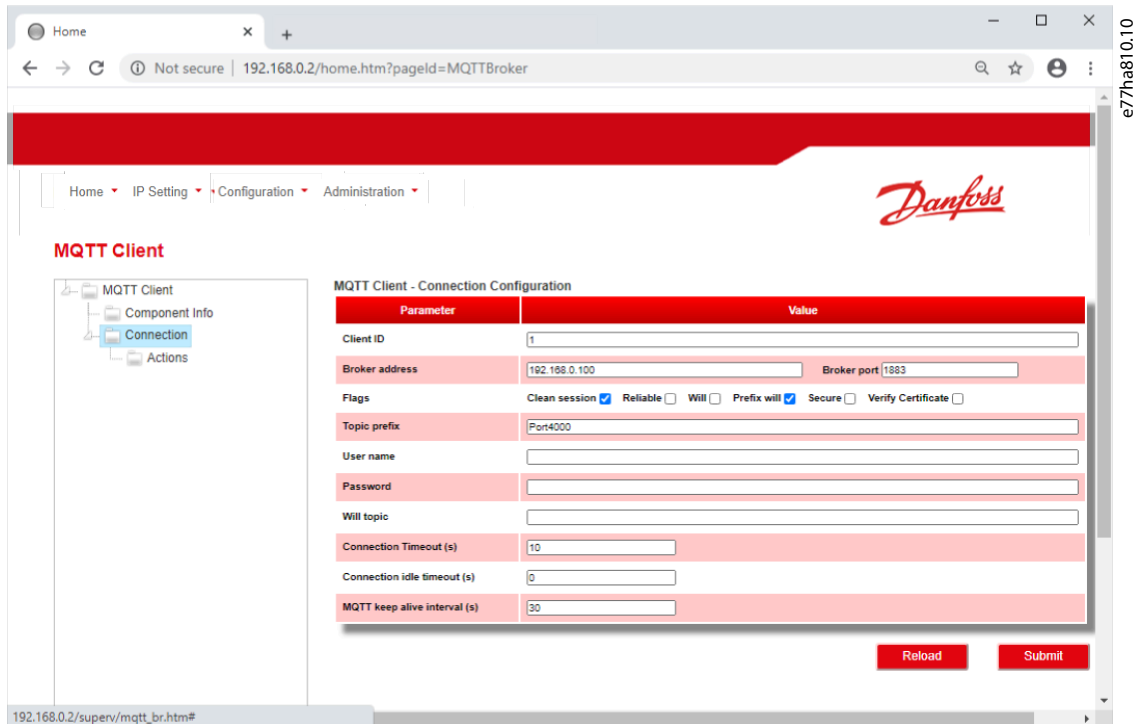
Procedure

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

5.3.4 Configure IoT Settings

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

5.3.4.1 Configuring MQTT Settings



MQTT Client - Connection Configuration

Parameter	Value
Client ID	1
Broker address	192.168.0.100
Broker port	1883
Flags	Clean session <input checked="" type="checkbox"/> Reliable <input type="checkbox"/> Will <input type="checkbox"/> Prefix will <input checked="" type="checkbox"/> Secure <input type="checkbox"/> Verify Certificate <input type="checkbox"/>
Topic prefix	Port4000
User name	
Password	
Will topic	
Connection Timeout (s)	10
Connection idle timeout (s)	0
MQTT keep alive interval (s)	30

Reload Submit

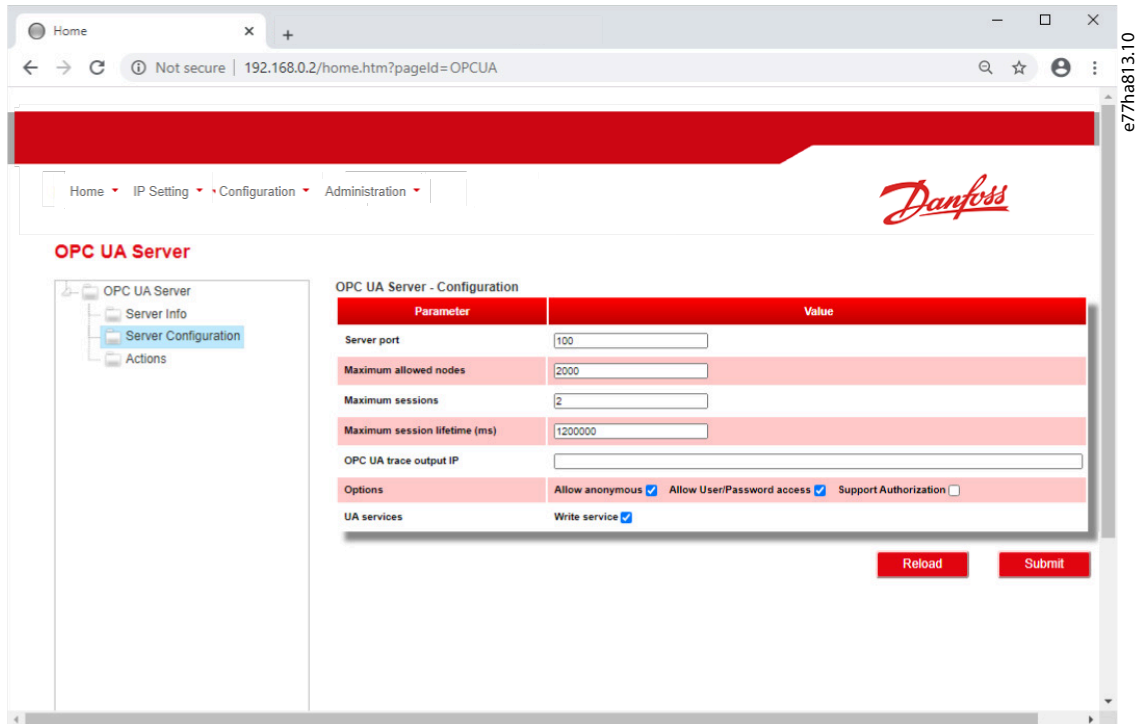
Procedure

1. Connect to the web server and click *Configuration*.
2. Select *MQTT Client*.
3. Tick the *Enable* checkbox to enable MQTT client operation.

The MQTT client is enabled by default.

4. Click *Connection* and configure the settings as required.
5. Click *Connections*⇒*Actions* to select which information the device should publish.
6. Click *Submit* to save all settings in the device.

5.3.4.2 Configuring OPC UA Settings



Procedure

1. Connect to the web server and click *Configuration*.
2. Select *OPC UA Server*.
3. Tick the *Enable* checkbox to enable OPC UA client operation.

The OPC UA client is enabled by default.

4. Click *Server Configuration* and configure the settings as required.
5. Select *Actions* to select the actions for different object instances.
6. Click *Submit* to save all settings in the device.

5.4 Scanning the Network

If there is no connection to the web server and the soft starter cannot be accessed physically, 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 the control power is cycled.

Download the Ethernet Device Configuration Tool from www.danfoss.com under the sections *Service and Support/Downloads*.

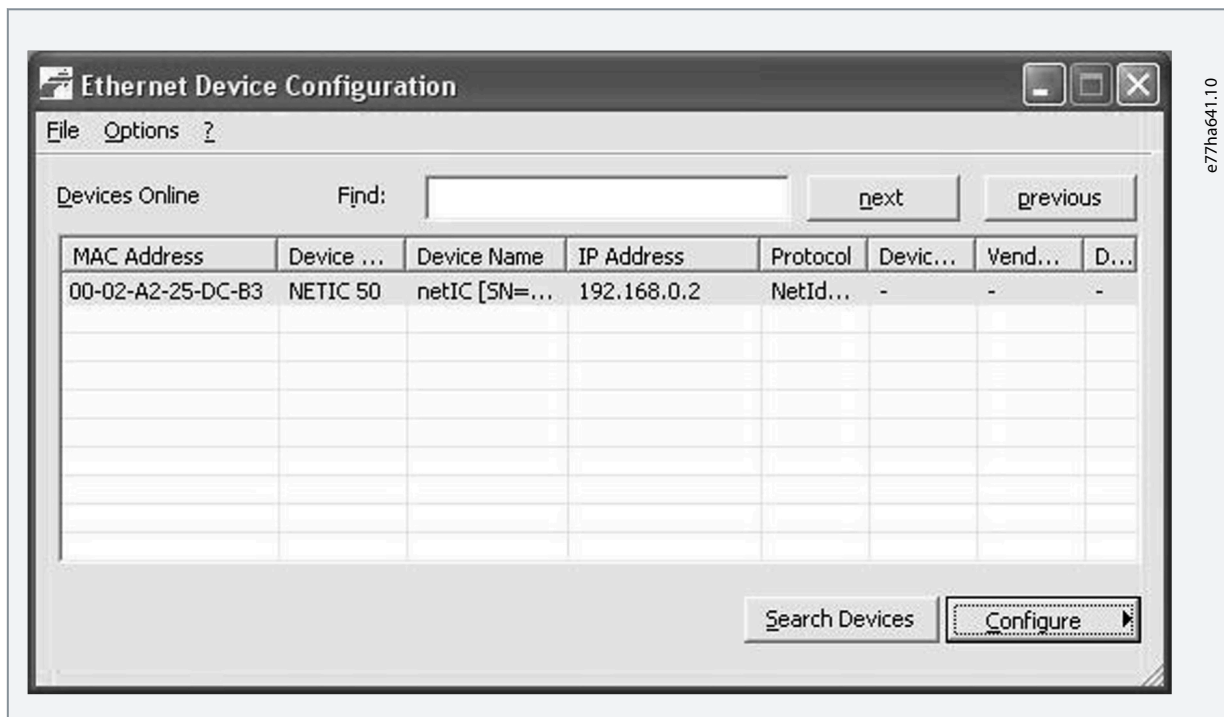
NOTICE

If the PC has a firewall enabled, add the tool to the list of authorized programs.

5.4.1 Identifying the Device with Ethernet Device Configuration Tool

Procedure

1. Start the Ethernet Device Configuration Tool.
2. Click *Search Devices*.



➔ The software searches for connected devices.

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

6 Operation

6.1 Requirements for Successful 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 manual.

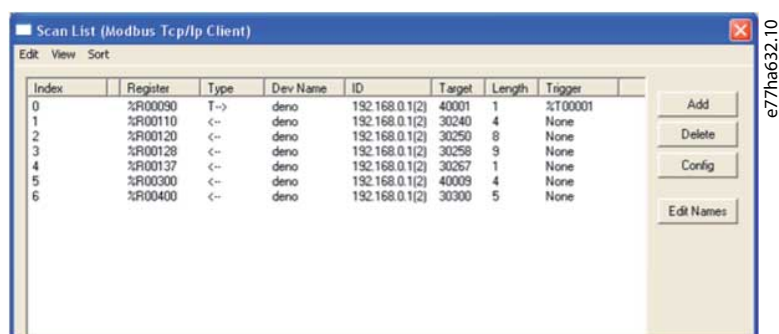
6.2 Device Classification

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

6.3 Configuration Requirements for PLC

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

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



Index	Register	Type	Dev Name	ID	Target	Length	Trigger
0	%R00090	T->	deno	192.168.0.1(2)	40001	1	%T00001
1	%R00110	<-	deno	192.168.0.1(2)	30240	4	None
2	%R00120	<-	deno	192.168.0.1(2)	30250	8	None
3	%R00128	<-	deno	192.168.0.1(2)	30258	9	None
4	%R00137	<-	deno	192.168.0.1(2)	30267	1	None
5	%R00300	<-	deno	192.168.0.1(2)	40009	4	None
6	%R00400	<-	deno	192.168.0.1(2)	30300	5	None

6.4 Enabling Network Control

MCD 200

For the soft starter to accept the fieldbus commands, a link must be fitted across terminals A1–N2 on the soft starter.

MCD 500

Input links are required across terminals 17 and 25–18 if the soft starter is being operated in auto-on mode. In hand-on 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 3-2 Comms in Remote*). See the VLT® Soft Starter MCD 500 Operating Guide for parameter details.

6.5 Ensuring Safe and Successful Control

Data written to the device remains in its registers until the data is overwritten or the device is reinitialized. The Modbus TCP Module will not transfer successive duplicate commands to the soft starter.

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

6.6 Feedback LEDs

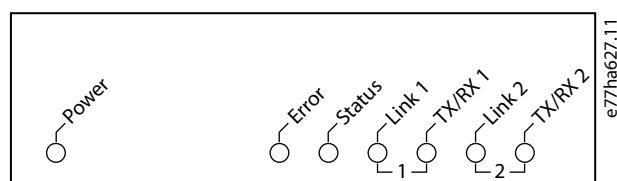


Table 2: LED Descriptions

LED name	LED state	Description
Power	Off	The device is not powered up.
	On	The 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.

7 Modbus Registers

7.1 Important Information

NOTICE

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

NOTICE

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

7.2 Compatibility

The Modbus TCP Module supports 2 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 Modbus RTU Module supplied by Danfoss. 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 ignores the remaining bits in register 40001 and checks the value in register 40002.

7.3 Parameter Management

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

The 1st product parameter is always allocated to register 40009. See the soft starter operating guide 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).

NOTICE

Changing the values of the Factory parameters (*Parameter group 20-**) may cause unpredictable behavior in the soft starter. Consult the local supplier before adjusting the Factory parameters.

7.3.1 Writing Parameters to the Soft Starter

NOTICE

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

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 soft starter until all parameter values have been written.

7.4 Standard Mode

7.4.1 Command and Configuration Registers (Read/Write)

Table 3: Details of Command and Configuration Registers

Register	Description	Bits	Details
40001	Command (single write)	0–7	To send a command to the soft 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 = Reserved 10000000 = Reserved
		8–14	Reserved
		15	Must = 1
40002	Reserved		
40003	Reserved		
40004	Reserved		
40005	Reserved		
40006	Reserved		
40007	Reserved		
40008	Reserved		
40009–40xxx	Parameter management (single/multiple read or multiple write)	0–15	Manage soft starter programmable parameters.

7.4.2 Status Reporting Registers (Read Only)

NOTICE

For models MCD5-0053B and smaller, the current reported via communications registers is 10 times greater than the actual value.

Table 4: Description of Read Registers

Register	Description	Bits	Details
30003	Reserved		
30004	Reserved		
30005	Reserved		
30006	Reserved		
30007	Reserved		
30008	Reserved		

Register	Description	Bits	Details
30600	Product information	0–5	Binary protocol version
		6–8	Parameter list major version
		9–15	Product type code: 4 = MCD 200 7 = MCD 500
30601	Model number	0–7	Reserved
		8–15	Soft starter model ID
30602	Reserved		
30603	Reserved		
30604	Starter state	0–4	0 = Reserved 1 = Ready 2 = Starting 3 = Running 4 = Stopping 5 = Not ready (restart delay, restart temperature check) 6 = Tripped 7 = Programming mode 8 = Jog forward 9 = Jog reverse
		5	1 = Warning
		6	0 = Uninitialized 1 = Initialized
		7	0 = Hand on 1 = Auto on
		8	Reserved
		9	0 = Negative phase sequence 1 = Positive phase sequence
		10–15	See the <i>chapter Trip Codes</i>
30605	Current	0–13	Average rms current across all 3 phases
		14–15	Reserved
30606	Current	0–9	Current (% motor FLC)
		10–15	Reserved
30607	Motor temperature	0–7	Motor thermal model (%)
		8–15	Reserved
30608	Power	0–11	Power
		12–13	Power scale 0 = Multiply power by 10 to get W

Register	Description	Bits	Details
			1 = Multiply power by 100 to get W 2 = Power (kW) 3 = Multiply power by 10 to get kW
		14–15	Reserved
30609	% Power factor	0–7	100% = power factor of 1
		8–15	Reserved
30610	Reserved		
30611	Current	0–13	Phase 1 current (rms)
		14–15	Reserved
30612	Current	0–13	Phase 2 current (rms)
		14–15	Reserved
30613	Current	0–13	Phase 3 current (rms)
		14–15	Reserved
30614	Reserved		
30615	Reserved		
30616	Reserved		
30617	Parameter list version number	0–7	Parameter list minor revision
		8–15	Parameter list major version
30618	Digital input state	0–15	For all inputs, 0 = open, 1 = closed (shorted) 0 = Start/Stop 1 = Reserved 2 = Reset 3 = Input A 4 = Input B 5–15 = Reserved

NOTICE

The reset input is normally closed by default. If *parameter 7-9 Reset/Enable Logic* is set to normally open, the reported state is inverted (0 = closed, 1 = open).

7.5 Legacy Mode

NOTICE

For models MCD5-0053B and smaller, current reported via communications is 10 times greater than the actual value (shown on the LCP).

7.5.1 Registers

Table 5: Description of Registers in Legacy Mode

Register	Description	Bits	Details
40001	Reserved	0–14	Reserved
		15	Must be 0
40002	Command (single write)	0–2	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
		3–15	Reserved
40003	Soft starter state	0–3	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 = Uninitialized 1 = Initialized
		7–15	Reserved
40004	Trip code	0–7	See the chapter <i>Trip Codes</i>
		8–15	Reserved
40005	Motor current	0–7	Average 3-phase motor current (A)
		8–15	Reserved
40006	Motor temperature	0–7	Motor thermal model (%)
		8–15	Reserved
40007	Reserved		
40008	Reserved		
40009–40200	Parameter management (single or multiple read/ write)	0–7	Manage soft starter programmable parameters
		8–15	Reserved
40600	Product information	0–5	Binary protocol version

Register	Description	Bits	Details
		6–8	Parameter list version number
		9–15	Product type code: 4 = MCD 200 7 = MCD 500
40601	Model number	0–7	Reserved
		8–15	Soft starter model ID
40602	Reserved		
40603	Reserved		
40604	Starter state	0–4	0 = Reserved 1 = Ready 2 = Starting 3 = Running 4 = Stopping 5 = Not ready (restart delay, restart temperature check) 6 = Tripped 7 = Programming mode 8 = Jog forward 9 = Jog reverse
		5	1 = Warning
		6	0 = Uninitialized 1 = Initialized
		7	Local/Remote 0 = Hand on 1 = Auto on
		8	Reserved
		9	0 = Negative phase sequence 1 = Positive phase sequence
		10–15	Reserved
40605	Current	0–13	Average rms current across all 3 phases
		14–15	Reserved
40606	Current	0–9	Current (% motor FLC)
		10–15	Reserved
40607	Motor temperature	0–7	Motor thermal model (%)
		8–15	Reserved
40608	Power	0–11	Power
		12–13	Power scale 0 = Multiply power by 10 to get W

Register	Description	Bits	Details
			1 = Multiply power by 100 to get W 2 = Power (kW) 3 = Multiply power by 10 to get kW
		14–15	Reserved
40609	% Power factor	0–7	100% = power factor of 1
		8–15	Reserved
40610	Reserved		
40611	Current	0–13	Phase 1 current (rms)
		14–15	Reserved
40612	Current	0–13	Phase 2 current (rms)
		14–15	Reserved
40613	Current	0–13	Phase 3 current (rms)
		14–15	Reserved
40614	Reserved		
40615	Reserved		
40616	Reserved		
40617	Parameter list version number	0–7	Parameter list minor revision
		8–15	Parameter list major version
40618	Digital input state	0–15	For all inputs, 0 = open, 1 = closed (shorted) 0 = Start 1 = Stop 2 = Reset 3 = Input A 4–15 = Reserved

7.6 Trip Codes

Code	Description	MCD 201	MCD 202	MCD 500
0	No trip	x	x	x
1	Excess start time		x	x
2	Motor overload		x	x
3	Motor thermistor		x	x
4	Current imbalance		x	x
5	Frequency	x	x	x
6	Phase sequence		x	x
7	Instantaneous overcurrent			x

Code	Description	MCD 201	MCD 202	MCD 500
8	Power loss	x	x	x
9	Undercurrent			x
10	Heat sink overtemperature			x
11	Motor connection			x
12	Input A trip			x
13	FLC too high			x
14	Unsupported option (function not available in inside delta)			x
15	Starter communication (between device and soft starter)	x	x	x
16	Network communication (between device and soft starter)	x	x	x
17	Internal fault			x
23	Parameter out of range			x
25	Bypass fail (bypass contactor)			x
26	L1 phase loss			x
27	L2 phase loss			x
28	L3 phase loss			x
29	L1-T1 shorted			x
30	L2-T2 shorted			x
31	L3-T3 shorted			x
33	Time-overcurrent (bypass overload)		x	x
35	Battery/clock			x
36	Thermistor circuit			x

8 Network Design

8.1 Star Topology

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

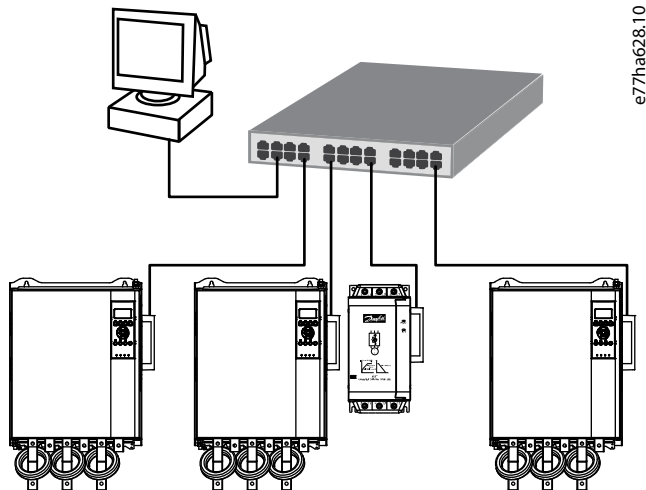


Illustration 4: Example of Star Topology

8.2 Line Topology

In a line network, the controller connects directly to 1 port of the 1st card. The 2nd Ethernet port connects to another module, which in turn connects to another device until all devices are connected.

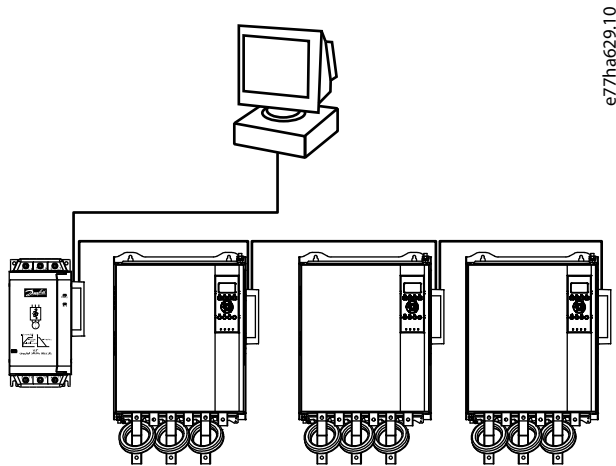


Illustration 5: Example of Line Topology

NOTICE

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.

NOTICE

If the connection between 2 devices is interrupted, the controller cannot communicate with devices after the interruption point.

N O T I C E

Each connection adds a delay to the 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.

8.3 Ring Topology

In a ring topology network, the controller connects to the 1st module via a network switch. The 2nd 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.

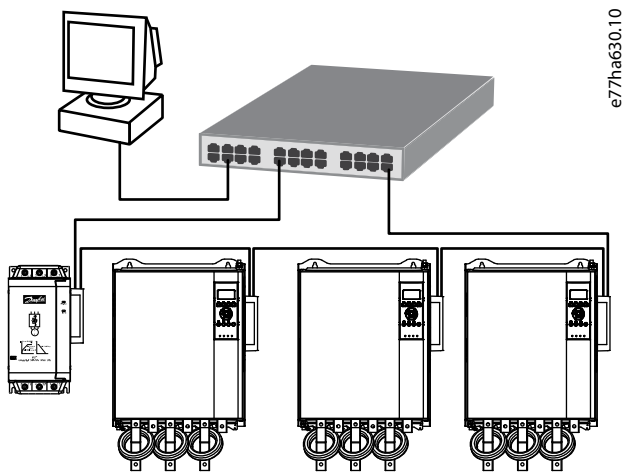


Illustration 6: Example of Ring Topology

N O T I C E

The network switch must support loss of line detection.

8.4 Combined Topologies

A single network can include both star and line components.

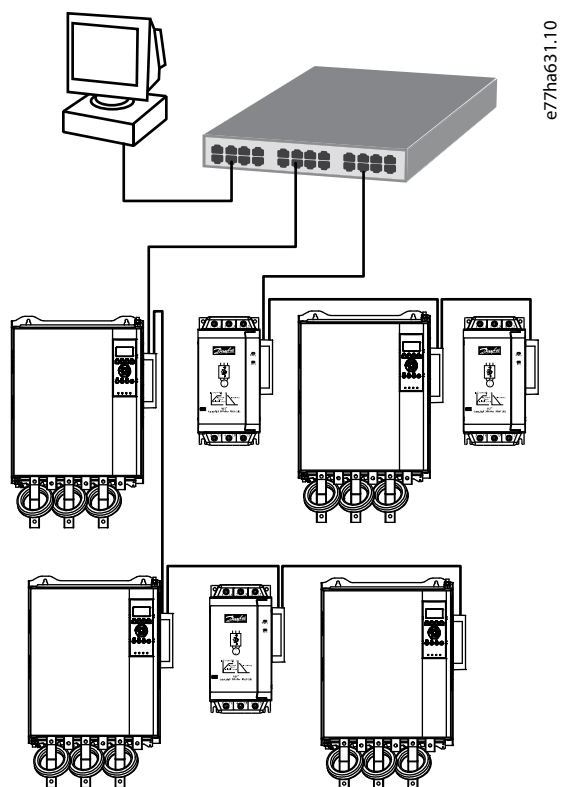


Illustration 7: Example of Combined Topologies

9 Specifications

9.1 Enclosure

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

9.2 Mounting

Spring-action plastic mounting clips (x2)

9.3 Connections

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

9.4 Settings

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

9.5 Network

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

9.6 Power

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

9.7 Certification

RCM	IEC 60947-4-2
CE	EN 60947-4-2

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* 1 7 5 R 1 1 8 9 *



* M 0 0 3 9 4 0 1 *