



Installation Guide

VLT[®] BACnet/IP MCA 125

VLT[®] HVAC Drive FC 102



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1 Introduction

1.1 Purpose of the Manual

This installation guide provides information for the quick installation of a VLT® BACnet/IP MCA 125 option in a VLT® frequency converter.

The installation guide is intended for use by qualified personnel. Users are assumed to be familiar with:

- VLT® frequency converter.
- BACnet/IP technology.
- BMS controller that is used as a master in the system.

Read the instructions before installation and ensure that the instructions for safe installation are observed.

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BACnet® is a registered trademark of ASHRAE.

1.2 Additional Resources

Resources available for the frequency converters and optional equipment:

- The relevant frequency converter operating instructions provide the necessary information for getting the frequency converter up and running.
- The relevant frequency converter design guide provides detailed information about capabilities and functionality to design motor control systems.
- The relevant frequency converter programming guide provides greater detail on working with parameters and many application examples.
- The *VLT® BACnet/IP MCA 125 Installation Guide* provides information about installing the BACnet/IP and troubleshooting.
- The *VLT® BACnet/IP MCA 125 Programming Guide* provides information about configuring the system, controlling the frequency converter, parameter access, programming, troubleshooting, and some typical application examples.

Supplementary publications and manuals are available from Danfoss. See vlt-drives.danfoss.com/Support/Technical-Documentation/ for listings.

1.3 Product Overview

1.3.1 Intended Use

This installation guide relates to BACnet/IP interface.

Ordering number:

- 134B1586 (conformal coated).

The BACnet/IP interface is designed to communicate with any system complying with the BACnet over Ethernet or BACnet/IP standard. BACnet/IP provides users with the network protocols to deploy standard Ethernet technology for manufacturing and building automation applications while enabling Internet and enterprise connectivity.

VLT® BACnet/IP MCA 125 is intended for use with:

- VLT® HVAC Drive FC 102

1.3.2 Items Supplied

When the fieldbus option is not factory-mounted, the following items are supplied:

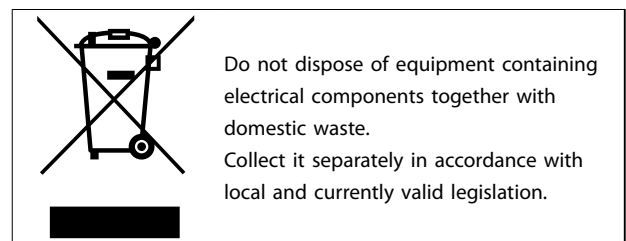
- Fieldbus option
- LCP cradle
- Front covers (in various sizes)
- Stickers
- Accessories bag
- Strain relief (only for A1 and A2 enclosures)
- Installation guide

1.4 Approvals and Certifications



More approvals and certifications are available. For more information, contact a local Danfoss partner.

1.5 Disposal



1.6 Symbols, Abbreviations, and Conventions

Abbreviation	Definition
BMS	Building management system
CIP™	Common industrial protocol
DHCP	Dynamic host configuration protocol
EMC	Electromagnetic compatibility
IP	Internet protocol
LCP	Local control panel
LED	Light emitting diode
MAR	Major recoverable fail
MAU	Major unrecoverable fail
PC	Personal computer
PLC	Programmable logic controller
TCP	Transmission control protocol

Table 1.1 Symbols and Abbreviations

Conventions

- Numbered lists indicate procedures.
- Bullet lists indicate other information and description of illustrations.
- Italicized text indicates the following:
 - Cross-reference.
 - Link.
 - Parameter name.
 - Parameter option.
 - Parameter group name.
- All dimensions are in metric values (imperial values in brackets).
- An asterisk (*) indicates the default setting of a parameter.

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2 Safety

2.1 Safety Symbols

The following symbols are used in this guide:

⚠ WARNING

Indicates a potentially hazardous situation that could result in death or serious injury.

⚠ CAUTION

Indicates a potentially hazardous situation that could result in minor or moderate injury. It can also be used to alert against unsafe practices.

NOTICE

Indicates important information, including situations that can result in damage to equipment or property.

2.2 Qualified Personnel

Correct and reliable transport, storage, installation, operation, and maintenance are required for the trouble-free and safe operation of the frequency converter. Only qualified personnel are allowed to install or operate this equipment.

Qualified personnel are defined as trained staff, who are authorized to install, commission, and maintain equipment, systems, and circuits in accordance with pertinent laws and regulations. Also, the qualified personnel must be familiar with the instructions and safety measures described in this installation guide.

2.3 Safety Precautions

⚠ WARNING

HIGH VOLTAGE

Frequency converters contain high voltage when connected to AC mains input, DC supply, or load sharing. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury.

- Only qualified personnel must perform installation, start-up, and maintenance.

⚠ WARNING

UNINTENDED START

When the frequency converter is connected to AC mains, DC supply, or load sharing, the motor may start at any time. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage. The motor can start with an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up Software, or after a cleared fault condition.

To prevent unintended motor start:

- Press [Off/Reset] on the LCP before programming parameters.
- Disconnect the frequency converter from the mains.
- Completely wire and assemble the frequency converter, motor, and any driven equipment before connecting the frequency converter to AC mains, DC supply, or load sharing.

⚠ WARNING

DISCHARGE TIME

The frequency converter contains DC-link capacitors, which can remain charged even when the frequency converter is not powered. High voltage can be present even when the warning LED indicator lights are off. Failure to wait the specified time after power has been removed before performing service or repair work can result in death or serious injury.

- Stop the motor.
- Disconnect AC mains and remote DC-link supplies, including battery back-ups, UPS, and DC-link connections to other frequency converters.
- Disconnect or lock PM motor.
- Wait for the capacitors to discharge fully. The minimum waiting time is specified in the *chapter Safety* in the *operating instructions* supplied with the frequency converter.
- Before performing any service or repair work, use an appropriate voltage measuring device to make sure that the capacitors are fully discharged.

⚠ WARNING**LEAKAGE CURRENT HAZARD**

Leakage currents exceed 3.5 mA. Failure to ground the frequency converter properly can result in death or serious injury.

- Ensure the correct grounding of the equipment by a certified electrical installer.

⚠ WARNING**EQUIPMENT HAZARD**

Contact with rotating shafts and electrical equipment can result in death or serious injury.

- Ensure that only trained and qualified personnel perform installation, start-up, and maintenance.
- Ensure that electrical work conforms to national and local electrical codes.
- Follow the procedures in this guide.

⚠ CAUTION**INTERNAL FAILURE HAZARD**

An internal failure in the frequency converter can result in serious injury when the frequency converter is not properly closed.

- Ensure that all safety covers are in place and securely fastened before applying power.

3 Installation

3

3.1 Safety Instructions

See *chapter 2 Safety* for general safety instructions.

3.2 EMC-compliant Installation

To obtain an EMC-compliant installation, follow the instructions provided in the relevant frequency converter *operating instructions* and *design guide*. Refer to the BACnet/IP master manual from the BMS supplier for further installation guidelines.

3.3 Grounding

- Ensure that all stations connected to the fieldbus network are connected to the same ground potential. When there are long distances between the stations in a fieldbus network, connect the individual station to the same ground potential. Install equalizing cables between the system components.
- Establish a grounding connection with low HF impedance, for example by mounting the frequency converter on a conductive backplate.
- Keep the ground wire connections as short as possible.
- Electrical contact between the cable screen and the frequency converter enclosure or ground is not allowed in Ethernet installations. The RJ45 connector of the Ethernet interface provides an electrical path for the burst transient to ground.
- To reduce burst transient, use high-strand wire.

3.4 Cable Routing

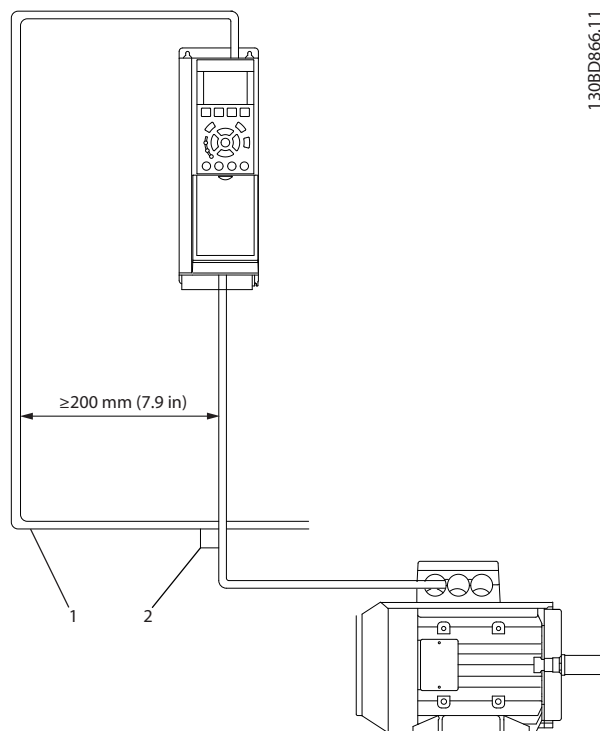
NOTICE

EMC INTERFERENCE

Use shielded cables for motor and control wiring, and separate cables for fieldbus communication, motor wiring, and brake resistor. Failure to isolate fieldbus communication, motor, and brake resistor cables can result in unintended behavior or reduced performance. Minimum 200 mm (7.9 in) clearance between power, motor, and control cables is required. For power sizes above 315 kW (450 hp), increase the minimum distance to 500 mm (20 in).

NOTICE

When the fieldbus cable crosses a motor cable or a brake resistor cable, ensure that the cables cross at an angle of 90°.



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1	Ethernet cable
2	90° crossing

Illustration 3.1 Cable Routing

3.5 Topology

3.5.1 Topology Types

The BACnet/IP MCA 125 option features a built-in Ethernet switch with 2 Ethernet RJ45 connectors. Where the enclosure protection rating is higher than IP2x, the frequency converter may be equipped with two M12 connectors instead.

The module enables the connection of several BACnet/IP options in a line topology as an alternative to a traditional star topology.

The 2 ports are equal. If only 1 connector is used, either port can be used.

3.5.1.1 Star Topology

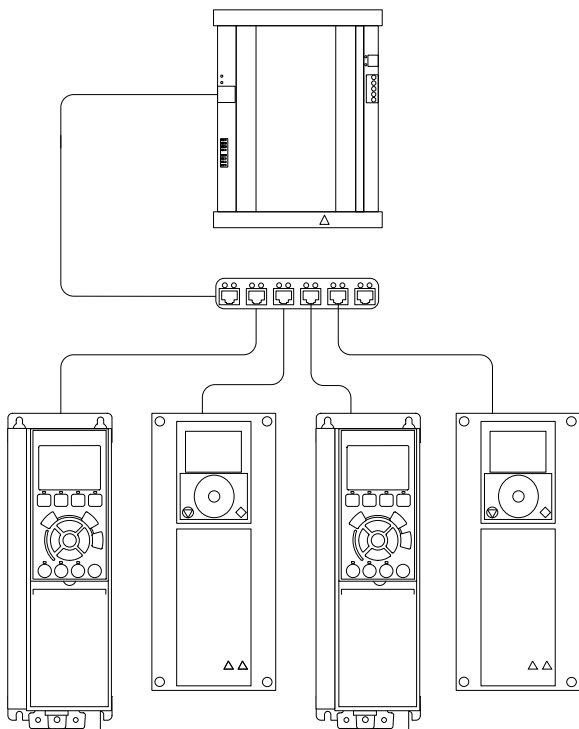


Illustration 3.2 Star Topology

3.5.1.2 Line Topology

In many installations, line topology enables simpler cabling and the use of smaller or fewer Ethernet switches. The BACnet/IP interface supports line topology with its 2 ports and built-in Ethernet switch.

When line topology is used, take precautions to avoid timeout in the BMS when more than 8 frequency converters are installed in series. Each frequency converter in the network adds a small delay to the communication due to the built-in Ethernet switch. When the update time is too short, the delay can lead to a timeout in the BMS.

Set the update time as shown in Table 3.1. The numbers given are typical values and can vary from installation to installation.

Numbers of frequency converters connected in series	Minimum update time [ms]
<8	2
8–16	4
16–32	8
>32	Large jitter can occur.

Table 3.1 Minimum Update Time

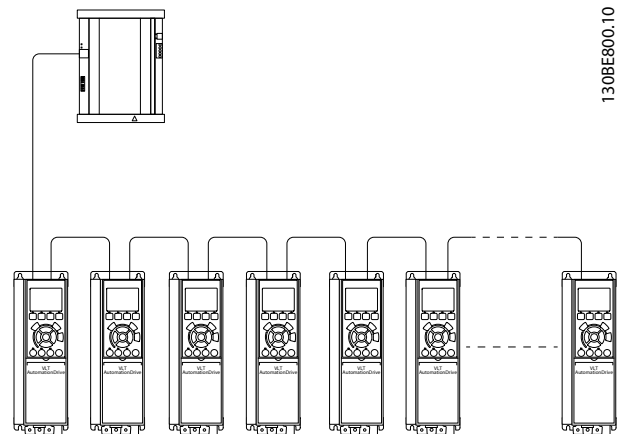


Illustration 3.3 Line Topology

NOTICE

In line topology, activate the built-in switch by powering all frequency converters, either by mains or a 24 V DC option card.

NOTICE

Installing frequency converters of different power sizes in line topology may result in unwanted power-off behavior when using control word timeout (parameter 8-02 Control Word Source to parameter 8-06 Reset Control Word Timeout). Mount the frequency converters with the longest discharge time first in the line topology. In normal operation, the frequency converters with bigger power sizes have a longer discharge time.

3.5.1.3 Ring/Redundant Topology

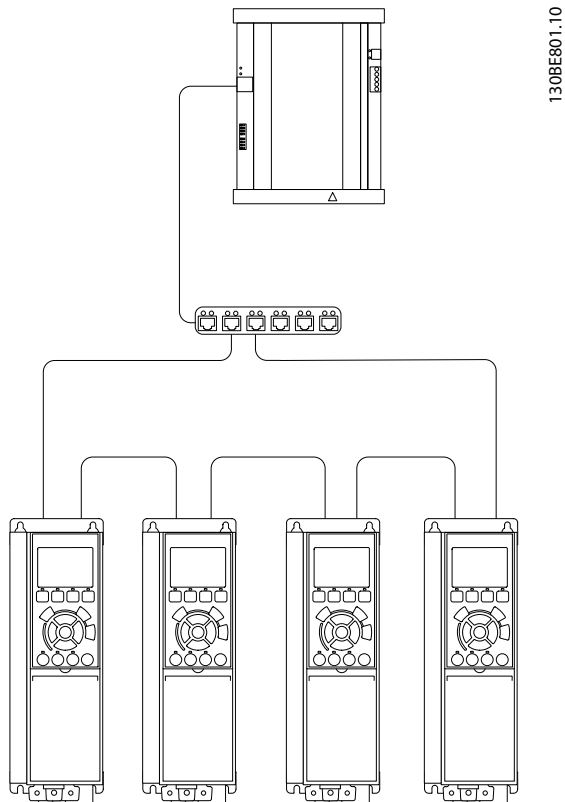


Illustration 3.4 Ring/Redundant Topology

Ring topology can increase the availability of an Ethernet network.

For ring topology:

- Install a special switch (redundancy manager) between the BMS controller and the frequency converters.
- Configure the redundancy manager switch to clearly define the ports that connect to the ring.

When the ring is closed, the main redundancy manager tests the ring for detects. If the redundancy manager detects a fault in the ring, it reconfigures the ring into 2 lines instead. The transition time from ring topology into 2 lines can vary from 200 ms up to several seconds depending on the components installed in the ring. Set the timing of the BMS controller to ensure that the transition time does not lead to a timeout fault.

NOTICE

For ring/redundant topology, ensure that the redundancy manager switch supports the detection of loss of line topology. The switch inside the BACnet/IP interface does not support this detection, as the redundancy manager has to perform this task.

3.5.1.4 Recommended Design Rules

- Pay special attention to active network components when designing an Ethernet network.
- For line topology, a small delay is added with each additional switch in the line. For more information, see *Table 3.1*.
- Do not connect more than 32 frequency converters in series. To prevent unstable or faulty communication, set the timing, if this limit is exceeded.

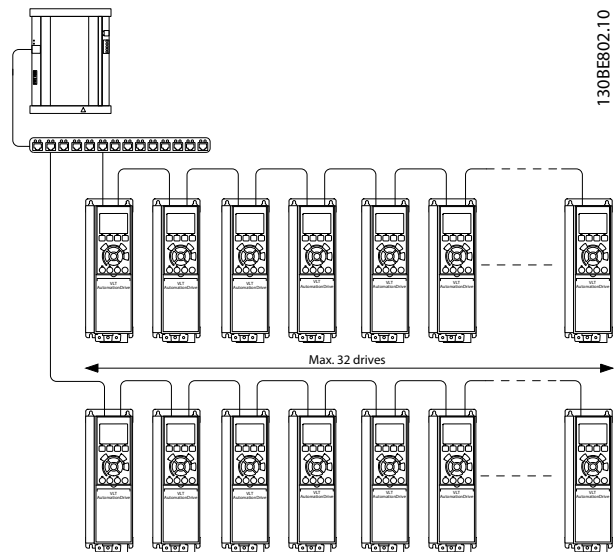


Illustration 3.5 Recommended Design Rules

3.6 Mounting

1. Check whether the fieldbus option is already mounted in the frequency converter. If the option is already mounted, go to step 6.
2. Remove the LCP or blind cover from the frequency converter.
3. Use a screwdriver to remove the front cover and the LCP cradle.
4. Mount the fieldbus option with the Ethernet port facing upwards for top cable entry (see *Illustration 3.7*), or with the Ethernet port facing downwards for bottom cable entry (see *Illustration 3.8*).
5. Remove the knockout plate from the new LCP cradle.
6. Mount the new LCP cradle.

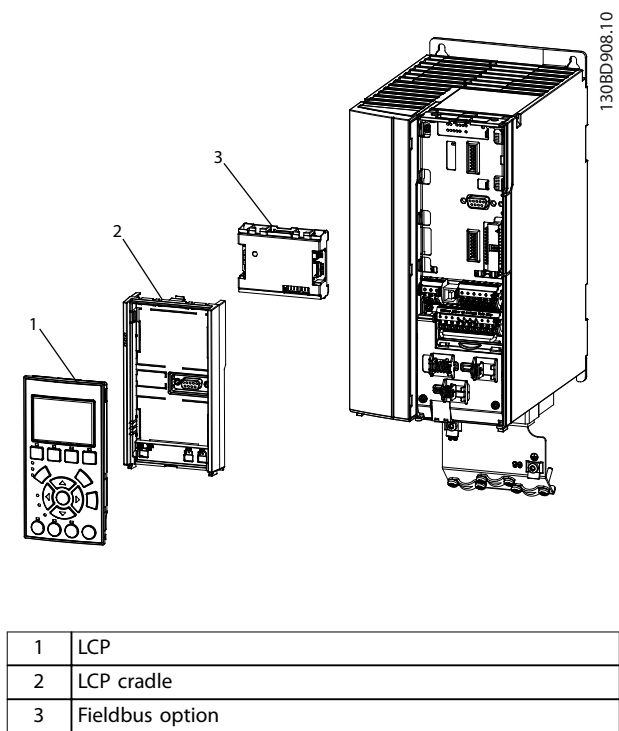


Illustration 3.6 Exploded View

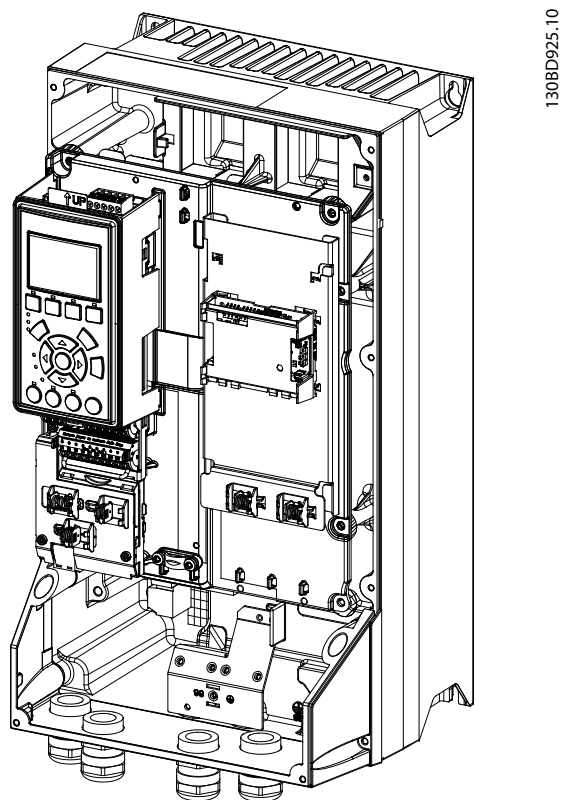


Illustration 3.8 Option Mounted with the Ethernet Port Facing Downward (A4–A5, B, C, D, E, F Enclosures)

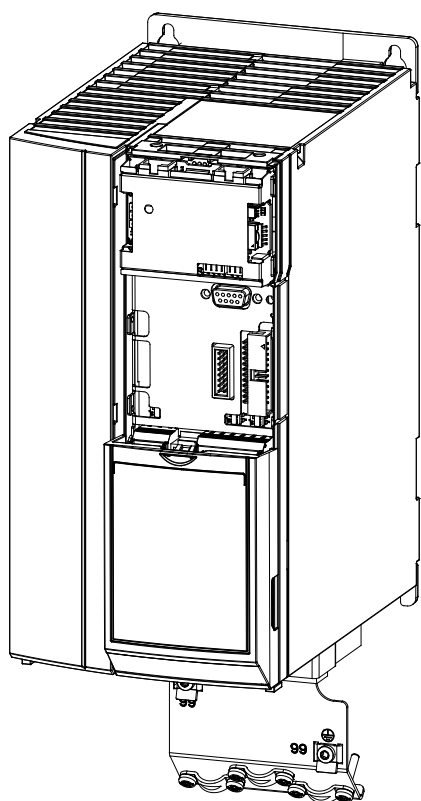
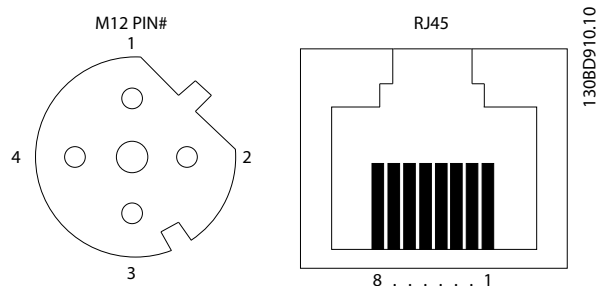


Illustration 3.7 Option Mounted with the Ethernet Port Facing Upward (A1–A3 Enclosures)



Signal	M12 PIN #	RJ45
RX +	1	1
TX +	2	3
RX -	3	2
TX -	4	4

Illustration 3.9 Ethernet Connectors

3.7 Electrical Installation

3.7.1 Cabling Requirements

- Select cables suitable for Ethernet data transmission. Normally, CAT5e and CAT6 cables are recommended for industrial applications.
- Both types are available as unshielded twisted pair and shielded twisted pair. Shielded cables are recommended for use in industrial environments and with frequency converters.
- A maximum cable length of 100 m (328 ft) is allowed between the switches.
- Use optical fibers for gapping longer distances and providing galvanic isolation.

3.7.2 Wiring Procedures

Wiring procedure for enclosure types A1–A3

1. Mount the pre-configured cable wires with the connectors on the fieldbus option. For A1 and A2 enclosures, mount the supplied strain relief on top of the frequency converter with 2 screws, as shown in *Illustration 3.10*. For cable specifications, refer to *chapter 3.7.1 Cabling Requirements*.
2. Position the cable between the spring loaded metal clamps to establish mechanical fixation and electrical contact between the cable and ground.

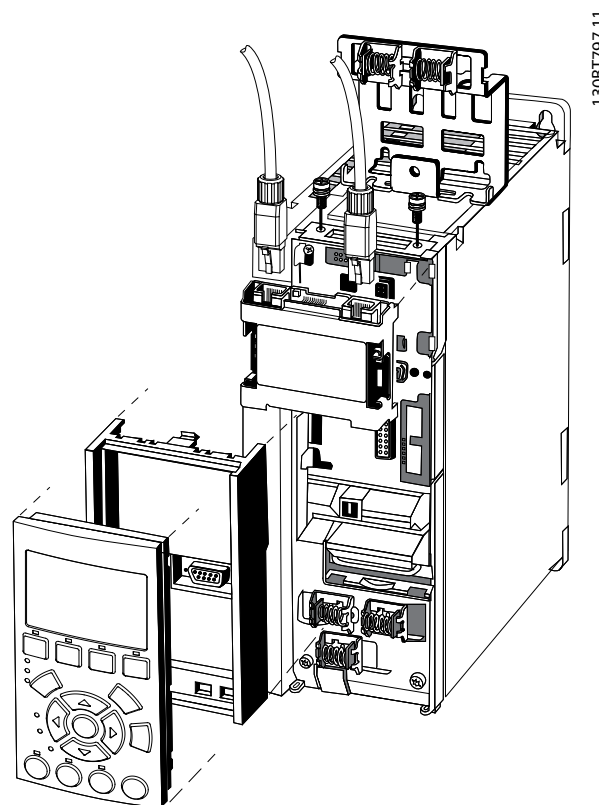
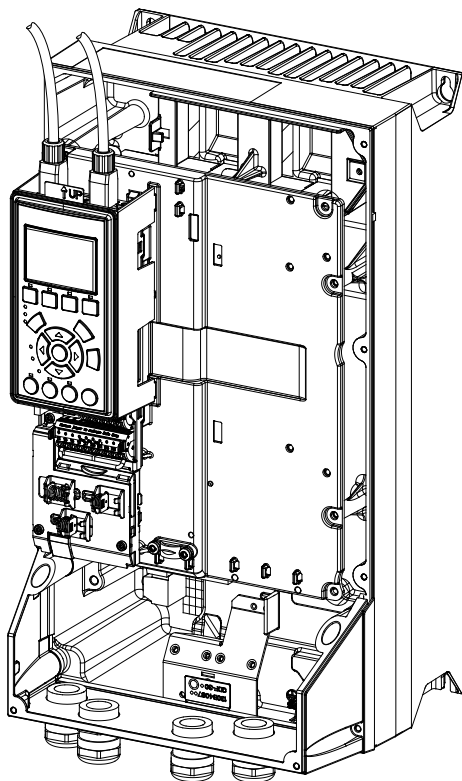


Illustration 3.10 Wiring for Enclosure Types A1–A3

Wiring procedure for enclosure types A4–A5, B1–B4, and C1–C4

1. Push the cable through the cable glands.
2. Mount the pre-configured cable wires with the connectors on the fieldbus option. For cable specifications, refer to *chapter 3.7.1 Cabling Requirements*.
3. Fix the cable to the metal base plate using the springs, see *Illustration 3.11*.
4. Tighten the cable glands securely.

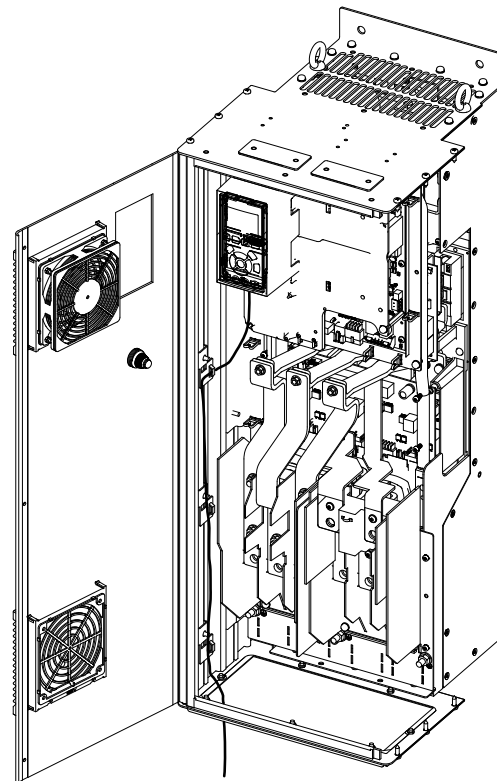


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Illustration 3.11 Wiring for Enclosure Types A4–A5, B1–B4, and C1–C4

Wiring procedure for enclosure types D, E, and F

1. Mount the pre-configured cable wires with the connectors on the fieldbus option. For cable specifications, refer to *chapter 3.7.1 Cabling Requirements*.
2. Fix the cable to the metal base plate using the springs, see *Illustration 3.12*.
3. Tie down the cable and route it with other control wires inside the unit, see *Illustration 3.12*.



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Illustration 3.12 Wiring for Enclosure Types D, E, and F

NOTICE

Do not strip the Ethernet cable. Do not ground it via the strain relief plate. Ground the shielded Ethernet cables through the RJ45 connector on the BACnet/IP interface.

3.8 Reassembling the Cover

1. Mount the new front cover and the LCP.
2. Attach the sticker with the correct product name to the front cover.

3.9 Applying Power

Follow the instructions in the frequency converter *Operating Instructions* to commission the frequency converter. The frequency converter automatically detects the BACnet/IP interface. A new parameter group (Group 8-7) appears.

3.10 Checking Network Cabling

NOTICE

After installing the BACnet/IP interface, be aware of the following parameter settings:

3

- *Parameter 8-01 Control Site: [2] Control word only or [0] Digital and control word*
- *Parameter 8-02 Control Word Source: [3] Option A.*
- *Parameter 8-03 Control Timeout Time.*
- *Parameter 8-70 BACnet Device Instance.*
- *Parameter 12-71 BACnet Datalink.*

If BACnet/IP is used the following parameters must be set correctly:

- *Parameter 12-00 IP Address Assignment.*
- *Parameter 12-01 IP Address (if parameter 12-00 IP Address Assignment is set to [0] MANUAL).*
- *Parameter 12-02 Subnet Mask (if parameter 12-00 IP Address Assignment is set to [0] MANUAL).*

4 Troubleshooting

4.1 Warnings and Alarms

NOTICE

Refer to the relevant frequency converter *Operating Instructions* for an overview of warning and alarm types, and for the full list of warnings and alarms.

Alarm word and warning word are shown in the display in Hex format. When there is more than 1 warning or alarm, the sum of all warnings or alarms is shown. Warning word and alarm word are shown in *parameter 16-90 Alarm Word* to *parameter 16-95 Ext. Status Word 2*.

4.2 Troubleshooting

4.2.1 LED Status

The BACnet/IP interface has 3 bicolored LEDs that allow fast and detailed diagnosis. Each LED is linked to its unique part of the BACnet/IP interface, see *Table 4.1*.

LED label	Description
MS	Module status. Reflects the activity on the BACnet/IP stack.
NS1	Network status 1. Reflects the activity on Ethernet port 1.
NS2	Network status 2. Reflects the activity on Ethernet port 2.

Table 4.1 LED Label






State	LED		Description
Power up	Red/ green: 	Solid red/green	The device is powering up.
Running	Green: 	Flashing green	No IP address is configured.
	Green: 	Solid green	The link is OK and the IP address is configured.
	Red: 	Flashing red	Fault: <ul style="list-style-type: none"> IP address conflict Device ID error
	Red: 	Solid red	Alarm

Table 4.2 MS: Module Status

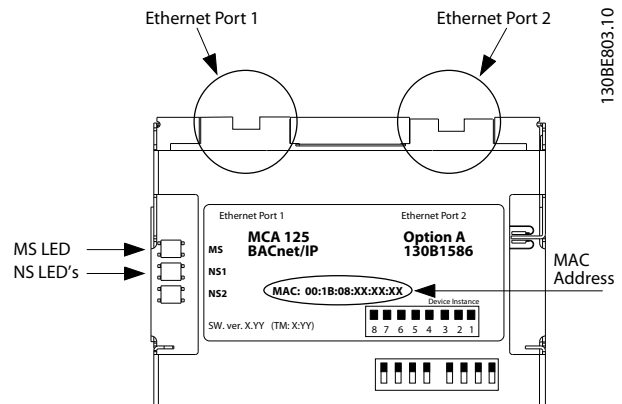


Illustration 4.1 Overview of BACnet/IP Interface





State	LED		Description
Power up	Red/ green: 	Solid red/green	The device is powering up (after MS LED).
Running	Green: 	Flashing green	No IP address is configured.
	Green: 	Solid green	The link is active and the IP address is configured.
	Red: 	Solid red	The IP address assigned to the device is already in use.
	Off	Off	There is no link or the link has been removed after valid IP address has been entered.

Table 4.3 NS1+NS2: Network Status (1 per Port)

4.2.2 No Communication with the Frequency Converter

Check: Link status

The status of the Ethernet link can be directly identified using the LEDs, when no BACnet connection is established.

Use *parameter 12-10 Link Status* to verify presence of the link.

Use *parameter 12-11 Link Duration* to verify that the link is steadily present.

The parameter shows the duration of the present link, and is preset to 00:00:00:00 when the link is broken.

Check: Cabling

In rare cases of cabling misconfiguration, the option may show the presence of a link but no communication is running. Exchange the cable if in doubt.

Check: IP address

Verify that the option has a valid IP address (refer to *parameter 12-01 IP Address*). When the option has identified a duplicate IP Address, NS LEDs are steady red. When the option is set up for BOOTP or DHCP, verify that a BOOTP or DHCP Server is connected in *parameter 12-04 DHCP Server*. If no server is connected, the parameter shows: 000.000.000.000.

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