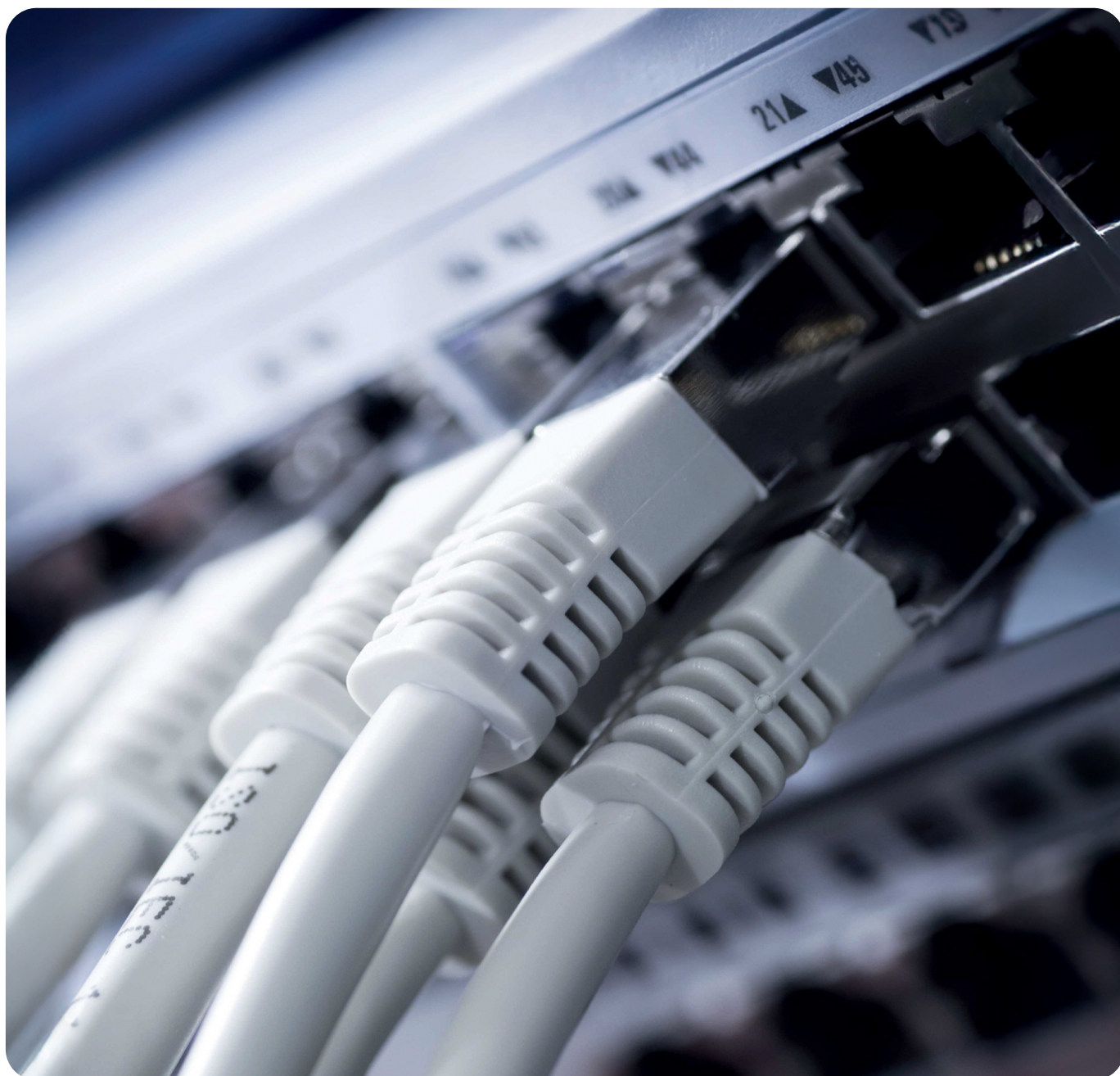




VLT® BACnet/IP MCA 125

VLT® HVAC Drive FC 102, VLT® AQUA Drive FC 202



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1 Introduction

1.1 Purpose of the Installation Guide

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

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

- VLT® drives.
- 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.

1.2 Trademarks

VLT® is a registered trademark for Danfoss A/S.

BACnet™ is a registered trademark of the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).

1.3 Additional Resources

Resources available for the drives and for optional equipment:

- The operating guide of the relevant drive provides the necessary information for getting the drive up and running.
- The design guide of the relevant drive provides detailed information about capabilities and functionality to design motor control systems.
- The programming guide of the relevant drive provides greater details on working with parameters.
- The [VLT® Ethernet Fieldbuses MCA 12X Installation Guide](#) provides information about installing and troubleshooting the BACnet/IP interface.
- The [VLT® BACnet/IP MCA 125 Programming Guide](#) provides information about configuring the system, programming, and troubleshooting.
- The [VLT® Motion Control Tool MCT 10 Operating Guide](#) provides information for installation and use of the software on a PC.

Supplementary publications and guides are available from Danfoss. See www.danfoss.com for listings.

1.4 Product Overview

1.4.1 Intended Use

This installation guide relates to the BACnet/IP interface.

Code 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.
- VLT® AQUA Drive FC 202.

1.4.2 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
- Accessory bags
- Strain relief (only for A1 and A2 enclosures)
- Installation guide.

1.5 Approvals and Certifications



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

1.6 Disposal



Do not dispose of equipment containing electrical components together with domestic waste.
Collect it separately in accordance with local and currently valid legislation.

2 Safety

2.1 Safety Symbols

The following symbols are used in Danfoss documentation and products.

 DANGER
Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

 WARNING
Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

 CAUTION
Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE
Indicates information considered important, but not hazard-related (for example, messages relating to property damage).

	ISO warning symbol for general warnings
	ISO warning symbol for hot surfaces and burn hazard
	ISO warning symbol for high voltage and electric shock
	Symbol for indicating the required discharge time of the capacitors in the product.
	ISO action symbol for referring to the instructions

2.2 Qualified Personnel

To allow trouble-free and safe operation of the unit, only qualified personnel with proven skills are allowed to transport, store, assemble, install, program, commission, maintain, and decommission this equipment.

Persons with proven skills:

- Are qualified electrical engineers, or persons who have received training from qualified electrical engineers and are suitably experienced to operate devices, systems, plants, and machinery in accordance with pertinent laws and regulations.
- Are familiar with the basic regulations concerning health and safety/accident prevention.
- Have read and understood the safety guidelines given in all manuals provided with the unit, especially the instructions given in the operating guide.
- Have a good knowledge of the generic and specialist standards applicable to the specific application.
- Are cleared by the asset owner to have access to the work zone according to the security level in the zone.

2.3 Safety Precautions

WARNING

LACK OF SAFETY AWARENESS

This guide provides important information on preventing injury and damage to the equipment or the system. Ignoring this information can lead to death, serious injury, or severe damage to the equipment.

- Make sure to fully understand the dangers and safety measures present in the application.
- Before performing any electrical work on the drive, lock out and tag out all power sources to the drive.

WARNING



HAZARDOUS VOLTAGE

Drives contain hazardous voltage when connected to the AC mains or connected on the DC terminals. 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 drive is connected to AC mains, DC supply, or load sharing, the motor may start at any time. The motor may start by activation of 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. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage.

- Disconnect the drive from the mains.
- Press [Off/Reset] on the LCP before programming parameters.
- Ensure that the drive is fully wired and assembled when it is connected to AC mains, DC supply, or load sharing.

WARNING



DISCHARGE TIME

The drive contains DC-link capacitors, which can remain charged even when the drive is not powered. High voltage can be present even when the warning indicator lights are off.

Failure to wait the specified time after power has been removed before performing service or repair work could result in death or serious injury.

- Stop the motor.
- Disconnect AC mains, permanent magnet type motors, and remote DC-link supplies, including battery backups, UPS, and DC-link connections to other drives.
- Wait for the capacitors to discharge fully before performing any service or repair work. The discharge time is specified on the drive product label.
- Use a measuring device to make sure that there is no voltage before opening the drive or performing any work on the cables.

 WARNING

ELECTRICAL SHOCK HAZARD - HIGH LEAKAGE CURRENT

Leakage currents exceed 3.5 mA. Failure to connect the system properly to protective earth may result in death or serious injury.

- Ensure reinforced protective earthing conductor according to IEC 60364-5-54 cl. 543.7 or according to local safety regulations for high touch current equipment. The reinforced protective earthing of the converter can be done with:
- PE conductor with a cross-section of at least 10 mm² Cu or 16 mm² Al.
- PE conductor completely enclosed within an enclosure or otherwise protected throughout its length against mechanical damage.

 WARNING

INTERNAL FAILURE HAZARD

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

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

3 Installation

3.1 Safety Instructions

See [2.3 Safety Precautions](#) for general safety instructions.

3.2 EMC-compliant Installation

To obtain an EMC-compliant installation, follow the instructions provided in the product-relevant operating guide 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 distances between the stations in a fieldbus network are long, 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 drive on a conductive mounting plate.
- Keep the ground wire connections as short as possible.
- To establish electrical contact between the cable shield and the drive enclosure, use metal grommets or the clamps provided on the equipment.
- Use high-strand wire to reduce burst transient.

3.4 Cable Routing

For more information on cabling, refer to the product-specific design guide and installation guide included in the shipment.

NOTICE

EMC INTERFERENCE

Failure to isolate fieldbus communication, motor, and brake resistor cables can result in unintended behavior or reduced performance.

- Use shielded cables for motor and control wiring, and separate cables for fieldbus communication, motor wiring, and brake resistor.
- A minimum of 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

CABLE ROUTING

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

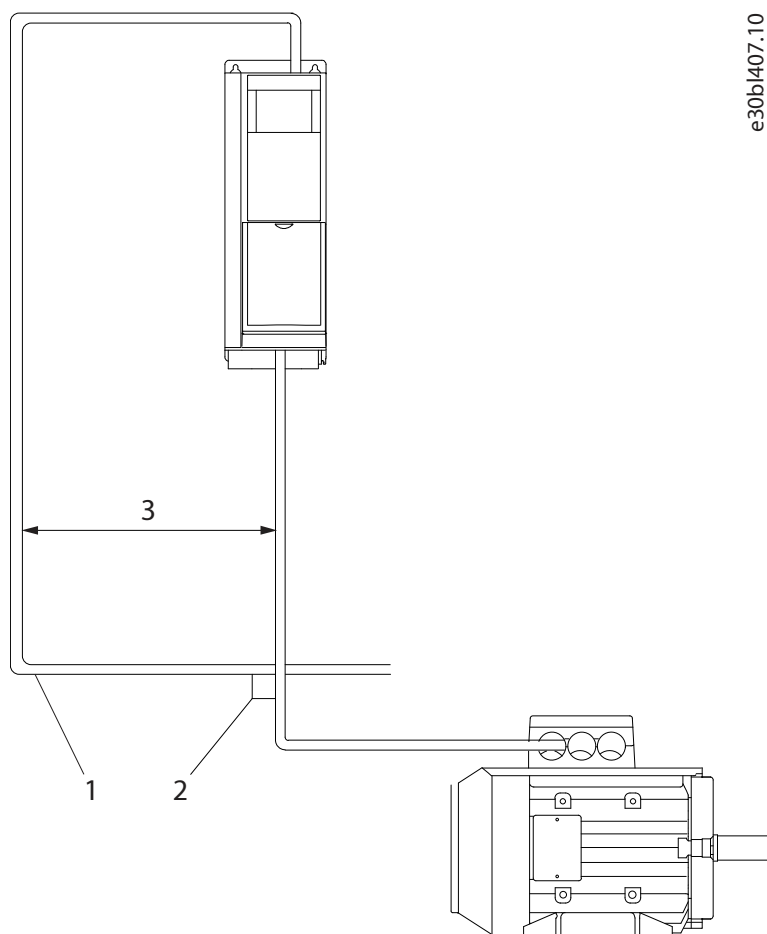


Figure 1: Cable Routing

1	Fieldbus cable	2	90° intersection
3	≥ 200 mm (7.9 in) (≥ 500 mm (20 in) for power sizes >315 kW (450 hp))		

3.5 Topology

3.5.1 Overview of Topology

The VLT® BACnet/IP MCA 125 module features a built-in Ethernet switch with 2 Ethernet RJ45 connectors. Where the enclosure protection rating is higher than IP2x, the drive may be equipped with 2 M12 connectors instead. The fieldbus 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.

3.5.2 Star Topology

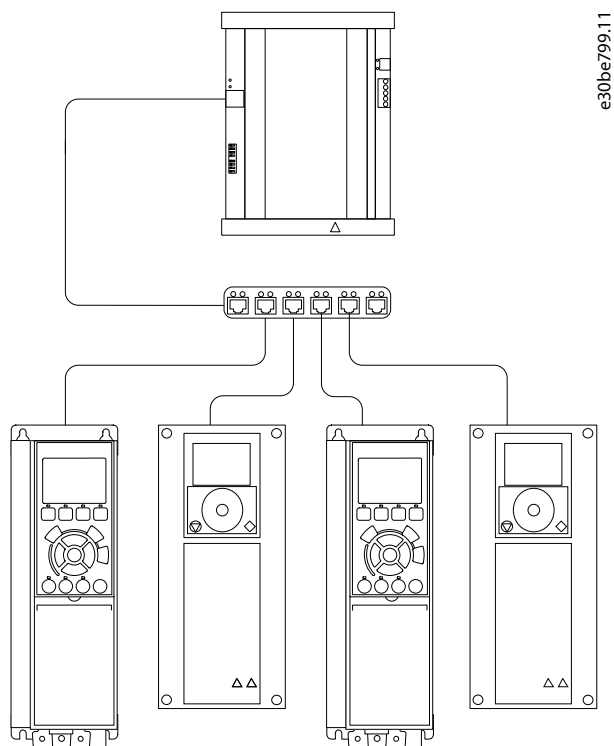


Figure 2: Star Topology

3.5.3 Line Topology

In many applications, 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 a built-in Ethernet switch.

When line topology is used, take precautions to avoid timeout in the BMS when more than 8 drives are installed in series. Each drive 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 1](#). The numbers given are typical values and can vary from installation to installation.

Table 1: Minimum Update Time

Number of drives connected in series	Minimum update time [ms]
<8	2
8–16	4
16–32	8
>32	Large jitter can occur



NOTE: In line topology, activate the built-in switch by powering all drives, either by mains or a 24 V AC option card.

NOTICE

UNWANTED POWER-OFF

Installing drives of different power sizes in line topology pose a risk of unwanted power-off behavior when using control word timeout (in parameters **8-02 Control Word Source** to **8-06 Control Word Timeout**).

- Mount the drive with the longest discharge time first in the line topology. In normal operation, the drives with bigger power sizes have a longer discharge time.

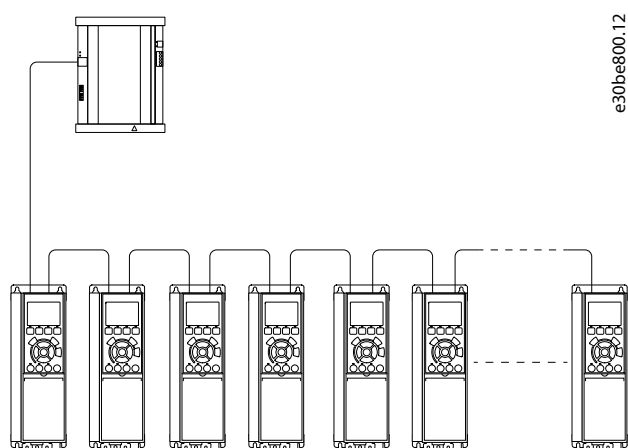


Figure 3: Line Topology

3.5.4 Ring/Redundant Line Topology

Ring topology can increase the availability of an Ethernet network.

For ring topology:

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

When the ring is closed, the redundancy manager tests the ring for defects. 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.



NOTE: 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.

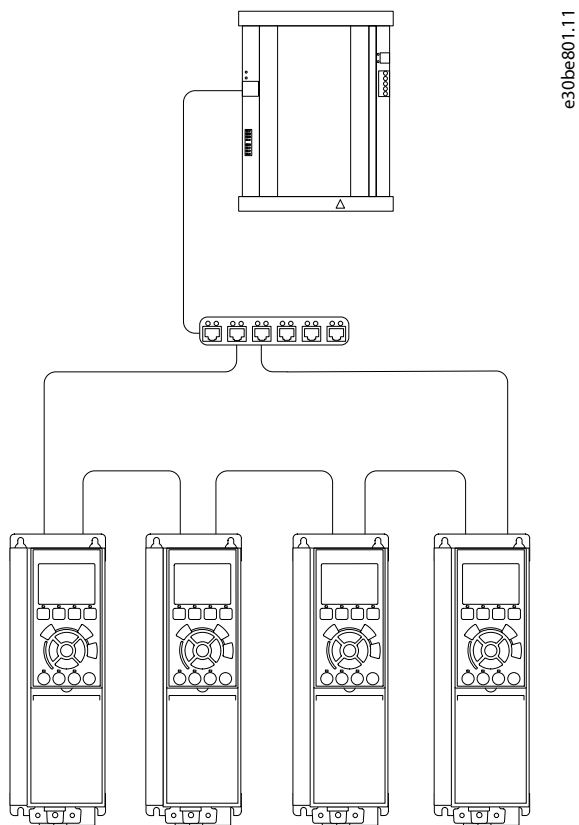


Figure 4: Ring/Redundant Line Topology

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. See [Table 1](#) for more information.
- Do not connect more than 32 drives in a series. Exceeding this limit can result in unstable or faulty communication.

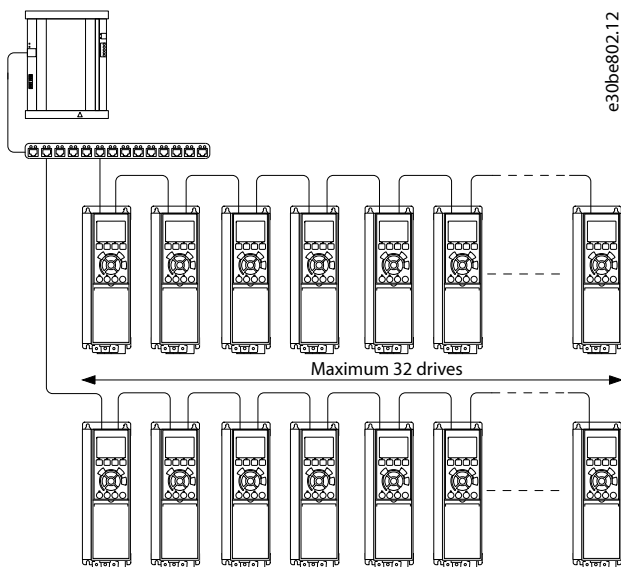


Figure 5: Recommended Design Rules

3.6 Mounting the Fieldbus Option

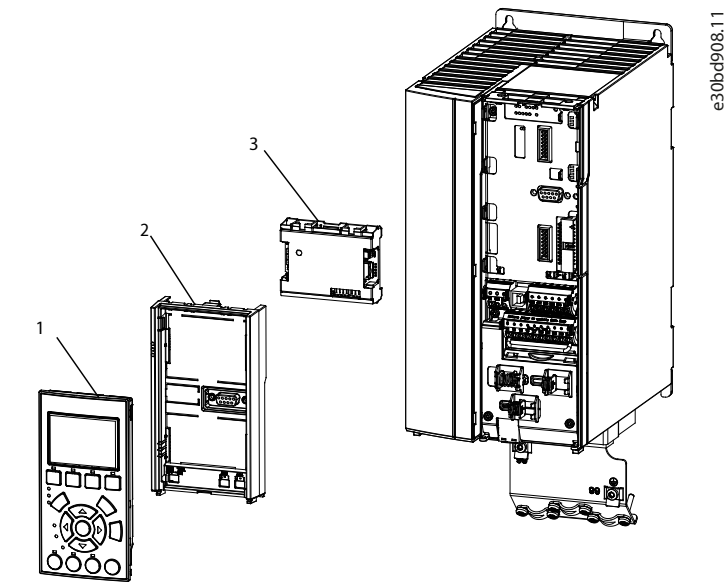


Figure 6: Exploded View of Drive and Fieldbus Option

1	LCP	2	LCP cradle
3	Fieldbus option		

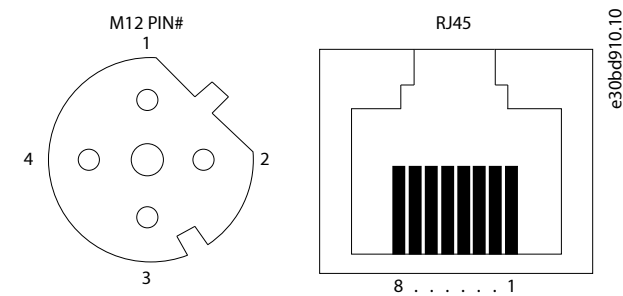
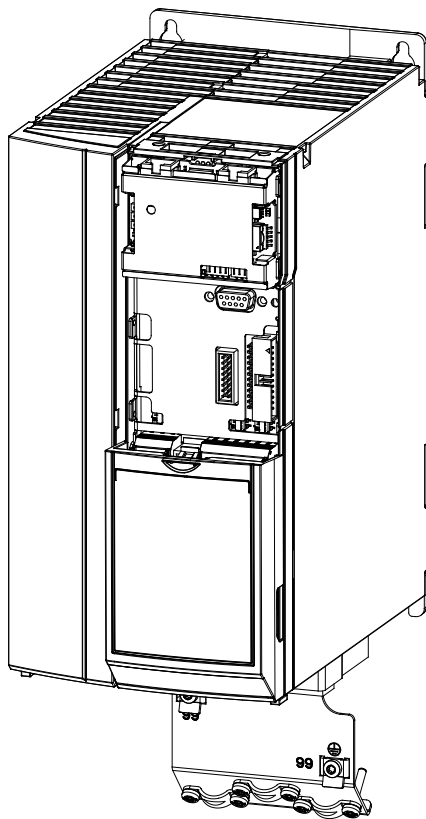


Figure 7: Ethernet Connectors

Table 2: Connector Signals

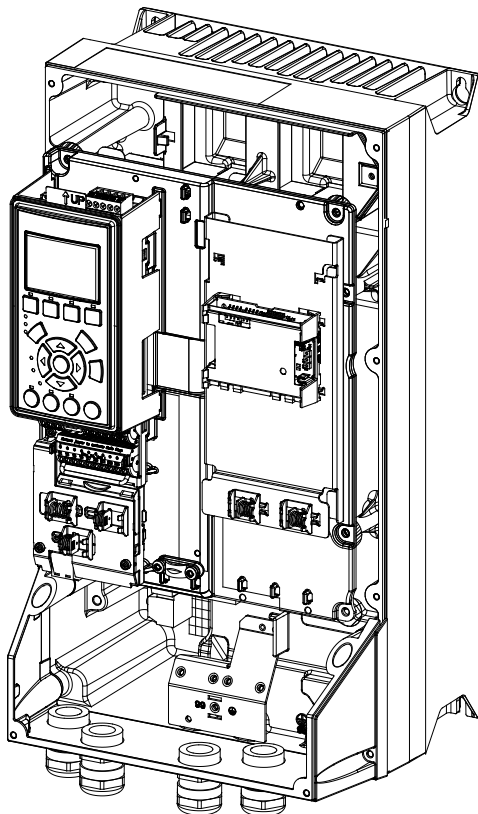
Signal	M12 PIN#	RJ45
RX +	1	1
TX +	2	3
RX -	3	2
TX -	4	4

1. Check whether the fieldbus option is already mounted in the drive. If the option is already mounted, go to step 6.
2. Remove the LCP or blind cover from the drive.
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.



30bd909.11

Figure 8: Option Mounted with the Ethernet Port Facing Upwards (A1–A3 Enclosures)



e30bd925.11

Figure 9: Option Mounted with the Ethernet Port Facing Downwards (A4, A5, B, C, D, E, and F Enclosures)

5. Remove the knockout plate from the new LCP cradle.

6. Mount the new LCP cradle.

3.7 Electrical Installation

3.7.1 Cabling Requirements

- Select cables suitable for Ethernet data transmission. Normally, CAT5e and CAT6e 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 drives.
- A maximum cable length of 100 m (328 ft) is allowed between the switches.
- Use optical fibers for gapping longer distances and for providing galvanic isolation.

3.7.2 Wiring - Enclosure Sizes A1–A3

1. Mount the preconfigured cable wires with the connectors on the fieldbus option.

For A1 and A2 enclosures, mount the supplied strain relief on top of the drive with 2 screws, as shown in [Figure 10](#). For cable specifications, refer to [3.7.1 Cabling Requirements](#).

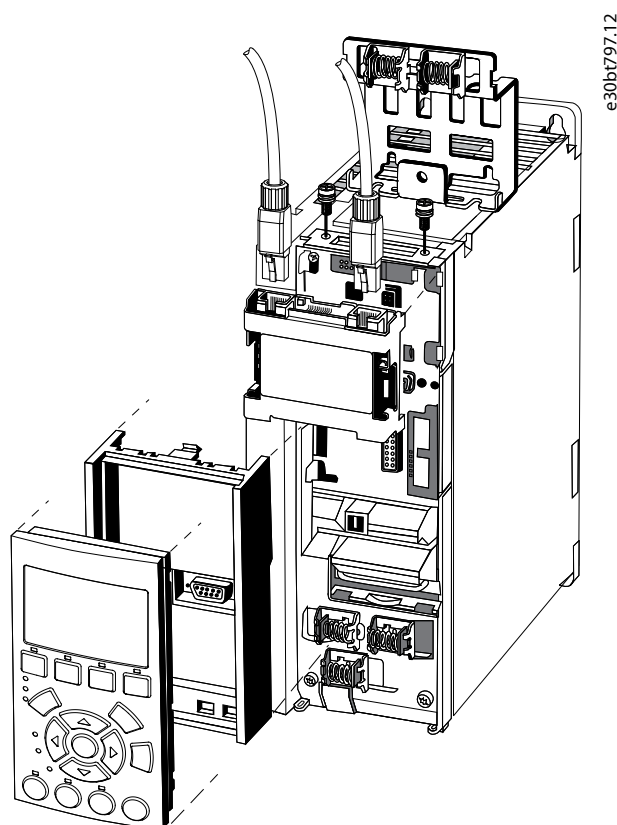


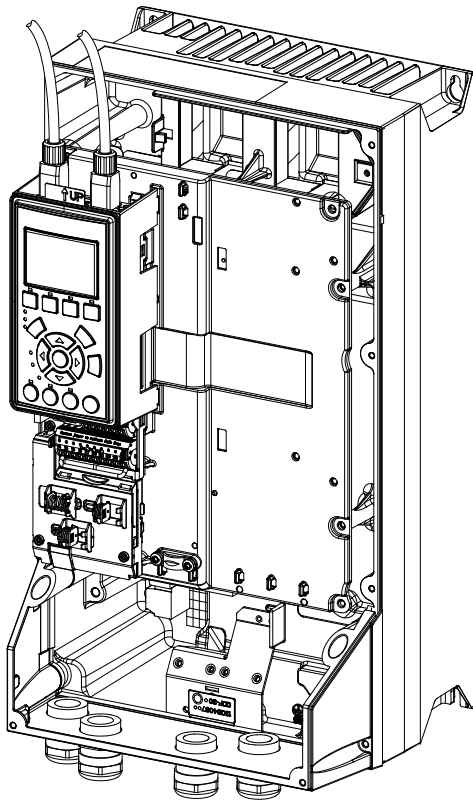
Figure 10: Wiring of Enclosures A1–A3

2. Position the cable shield between the spring-loaded metal clamps to establish mechanical fixation and electrical contact between cable and ground.

3.7.3 Wiring - Enclosure Sizes A4, A5, B1–B4, and C1–C4

1. Put the cable through the cable glands.

2. Mount the preconfigured cable wires with the connectors on the fieldbus option. For cable specifications, refer to [3.7.1 Cabling Requirements](#).
3. Fix the cable shield to the metal base plate using the springs.



e30bd972.11

Figure 11: Wiring of Enclosure Sizes A4, A5, B1–B4, and C1–C4

4. Tighten the cable glands securely.

3.7.4 Wiring - Enclosure Sizes D, E, and F



NOTE: 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 EtherNet/IP interface.

1. Mount the preconfigured cable wires with the connectors on the fieldbus option. For cable specifications, refer to [3.7.1 Cabling Requirements](#).
2. Fix the cable to the metal base plate using the springs.

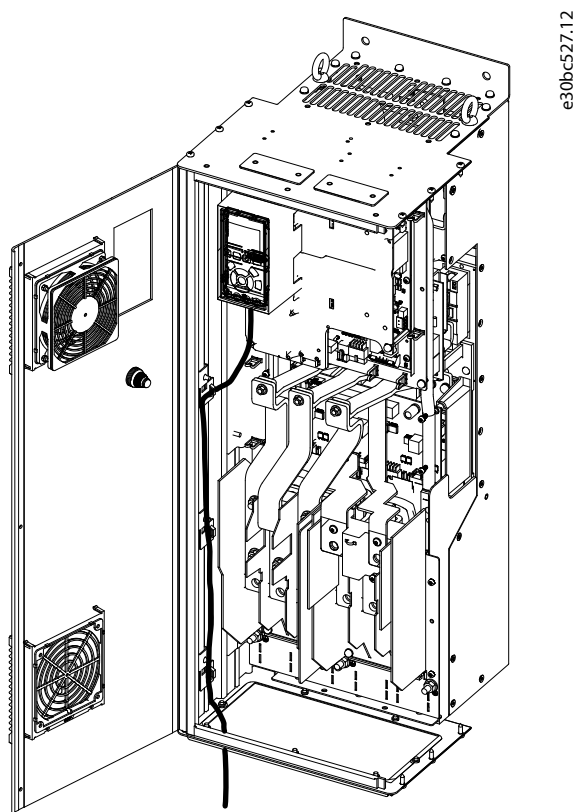


Figure 12: Wiring of Enclosure Sizes D, E, and F

3. Tie down the cable and route it with other control wires inside the unit as shown in [Figure 12](#).

3.8 Reassembling the Cover

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

3.9 Applying Power

Follow the instructions in the drive-specific operating guide to commission the drive. The drive automatically detects the BACnet/IP interface. Parameter group **8-7* BACnet** appears.

3.10 Important Parameter Settings



NOTE: After installing the VLT® BACnet/IP MCA 125, be aware of the following parameter settings:

- 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 **12-72 BACnet Datalink**.

If MCA 125 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



NOTE: Refer to the drive-specific operating guide for an overview of warning and alarm types, and for the full list of warnings and alarms.

Alarm words and warning words are shown in the display in hex format. When there is more than 1 warning or alarm, the sum of all warnings and alarms is shown. Warning words and alarm words are shown in parameter **16-90 Alarm Word** to parameter **16-99 Ext. Status Word 3**.

4.2 LED Status

The VLT® BACnet/IP MCA 125 has 3 bicolored LEDs that allow a fast and detailed diagnosis. Each LED is linked to its unique part of the interface, see [Table 3](#).

Table 3: LED Label

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

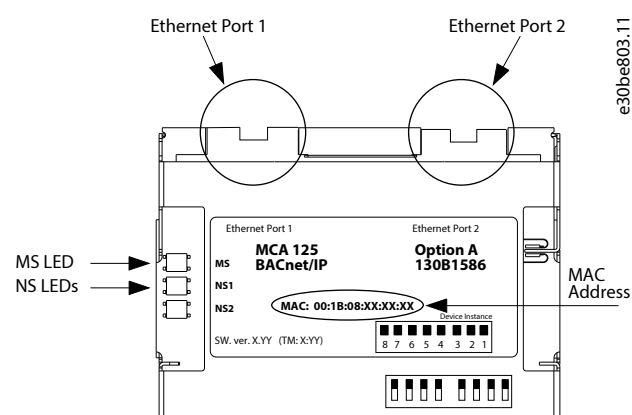


Figure 13: Overview of the VLT® BACnet/IP MCA 125 Option Module



NOTE: In VLT® Motion Control Tool MCT 10, when the drive is scanned via EthernetTSC, right-clicking the drive and selecting *Start Winking* causes the MS/NS LEDs to flash yellow (50% duty cycle at 1 Hz).



NOTE: When link speed for port 1 or port 2 is 10 Mbps, the NS1 and NS2 LEDs go steady yellow.

Table 4: MS: Module Status

State	LED		Description
Power up	Red/green: 	Solid red/green	The device is powering up.
Running	Yellow: 	Solid yellow	No IP address is configured.
	Red: 	Flashing red	Fault: - IP address conflict - Device ID error
	Red: 	Solid red	Alarm

Table 5: NS1 + NS2: Network Status (1 per Port)

State	LED		Description
Power up	Red/green: 	Solid red/green	The device is powering up (after MS LED).
Running	Green: 	Solid green	The link is active.
	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 a valid IP address has been entered.

4.3 No Communication with the Drive

If there is no communication with the drive, proceed with the following checks:

Check the link status

The status of the Ethernet link can be directly identified using the LEDs when no BACnet connection is established. Verify presence of the link in parameter **12-10 Link Status**.

Verify that the link is steadily present in parameter **12-11 Link Duration**. The parameter shows the duration of the present link and is preset to 00:00:00:00 when the link is broken.

Check the cabling

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

Check the IP address

Verify that the option has a valid IP address in parameter **12-01 IP Address**. If the option has identified a duplicate IP address, the NS LEDs are solid red. If 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.

5 Appendix

5.1 Abbreviations

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

5.2 Conventions

- Numbered lists indicate procedures.
- Bulleted and dashed lists indicate listings of other information where the order of the information is not relevant.
- Bolded text indicates important information and section headings.
- Italicized text indicates the following:
 - Cross-reference.
 - Link.
 - Footnote.
 - Alarms/warnings
- Bolded and italicized text indicates the following:
 - Parameter name.
 - Parameter option.
 - Parameter group name.
- All dimensions in drawings are in metric values (imperial values in brackets).
- An asterisk (*) indicates the default setting of a parameter.



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