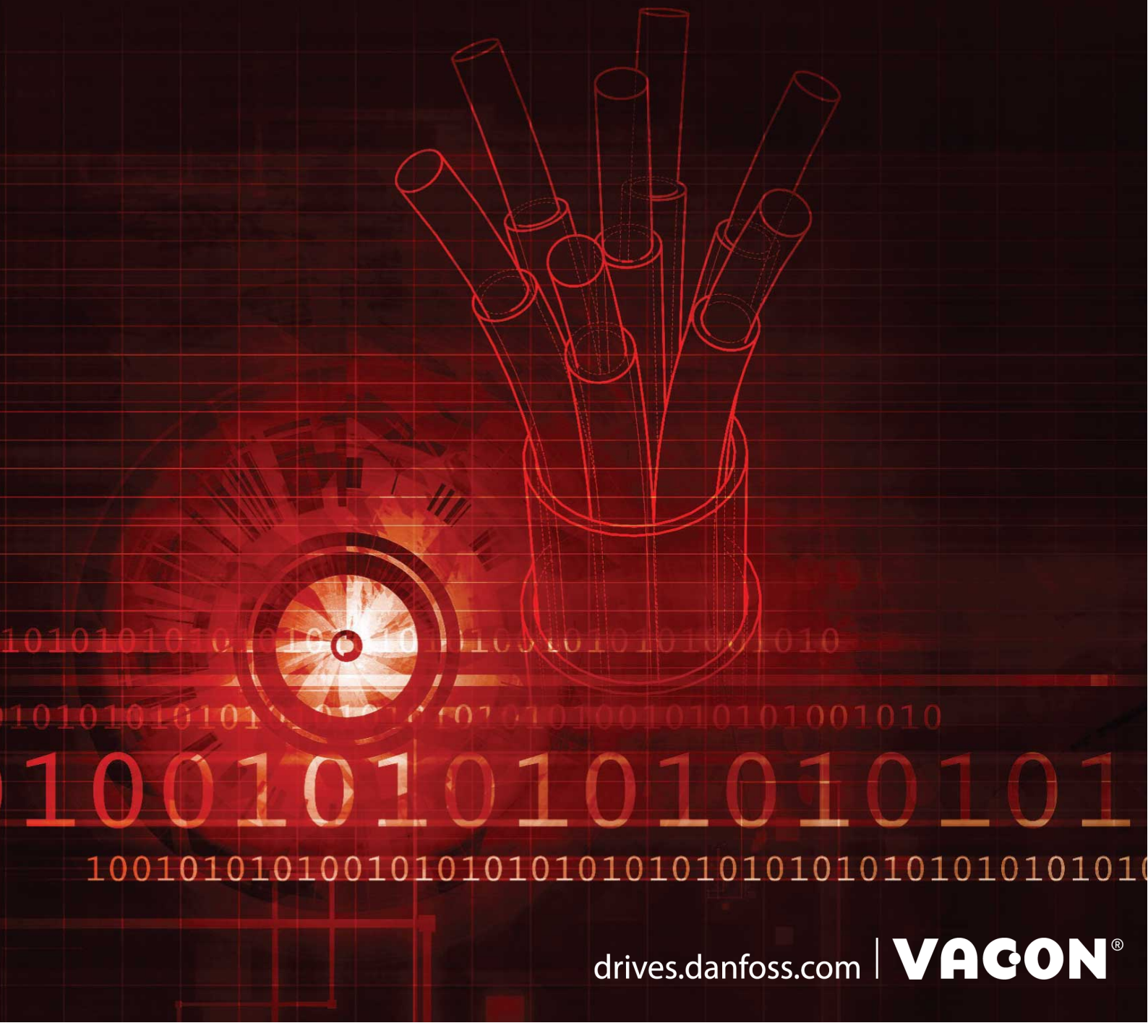
ENGINEERING TOMORROW

Installation Guide

VACON® Ethernet Option Boards

OPTEA, OPTE9, OPTCI, OPTCP, OPTCQ and OPTEC



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Contents

1 Introduction

1.1 Purpose of this Installation Guide

This manual provides information for safe installation and commissioning of:

- Ethernet-based option boards including:
  - OPTEA
  - OPTE9
  - OPTCI
  - OPTCP
  - OPTCQ
  - OPTEC

The Installation Guide is intended for use by qualified personnel only. Personnel must be familiar with the VACON® drive series.

Read and follow this Installation Guide before installation, and ensure that instructions for safe installation are observed. Always keep these instructions available with the drive.

1.2 Additional Resources

Resources available for the drive and optional equipment are:

- VACON® option board User Guides provide information on protocol-specific settings and instructions for setting up the connection.
- The Operating Guide of the AC drive provides the necessary information to get the drive up and running.
- The Application Guide of the AC drive provides more details on working with parameters and many application examples.

Supplementary publications and manuals are available from drives.danfoss.com/knowledge-center/technical-documentation/.

For US and Canadian markets:

NOTE! Download the English and French product manuals with applicable safety, warning and caution information from https://www.danfoss.com/en/service-and-support/.
REMARQUE Vous pouvez télécharger les versions anglaise et française des manuels produit contenant l'ensemble des informations de sécurité, avertissements et mises en garde applicables sur le site https://www.danfoss.com/en/service-and-support/.

1.3 Manual Version

This manual is regularly reviewed and updated. All suggestions for improvement are welcome.

The original language of this manual is English.

Table 1: Manual and Software Version

Edition	Remarks
DPD01643A	First version of the manual. Information moved from VACON® option board manuals.

1.4 Product Overview

1.4.1 Ethernet-based Option Boards

The following table lists the Ethernet-based option boards compatible with VACON® AC drives.

Table 2: Ethernet-based Option Boards

Option board code	Option board	Compatible with AC drive	The correct slots[1]	Specific information
OPTEA	Advanced Dual Port Ethernet board	VACON® NXP, NXS VACON® 100 INDUSTRIAL, 100X, 100 FLOW	D, E	See 4.4 The OPTEA and OPTE9 Option Boards.

Option board code	Option board	Compatible with AC drive	The correct slots[1]	Specific information
				• PROFINET I/O, PROFIsafe • EtherNet/IP • Modbus TCP/UDP • Emulation of OPTCI, OPTCP, OPTCQ
OPTE9	Dual Port Ethernet board	VACON® NXP, NXS VACON® 100 INDUSTRIAL, 100X, 100 FLOW VACON® 20, 20X, 20CP	D, E	See 4.4 The OPTEA and OPTE9 Option Boards. • PROFINET I/O • EtherNet/IP • Modbus TCP/UDP
OPTEC	EtherCAT option board	VACON® NXP VACON® 100 INDUSTRIAL, 100X, 100 FLOW, 100 HVAC VACON® 20, 20X, 20CP	D, E	See 4.5 The OPTEC Option Board.
OPTCI	Modbus TCP option board	VACON® NXP, NXS	D, E	See 4.6 The OPTCI, OPTCP, and OPTCQ Option Boards.
OPTCP	PROFINET I/O option board	VACON® NXP, NXS	D, E	See 4.6 The OPTCI, OPTCP, and OPTCQ Option Boards.
OPTCQ	EtherNet/IP option board	VACON® NXP, NXS	D, E	See 4.6 The OPTCI, OPTCP, and OPTCQ Option Boards.

[1] For option board installation in VACON® 20, a separate option board mounting kit is necessary.

1.4.2 VACON® 100 Family Internal Ethernet Fieldbus Protocols

VACON® 100 INDUSTRIAL, 100 X, and 100 FLOW AC drives support internally the Ethernet fieldbuses listed in the following table. Because they have one Ethernet port, they can be connected to networks with star topology. For detailed installation instructions for the internal fieldbuses, see the Installation Manual of the AC drive in use.

Table 3: VACON® 100 INDUSTRIAL, 100 X, and 100 FLOW Internal Fieldbuses

Fieldbus	Specific information
Modbus TCP/UDP	
BACnet/IP	
PROFINET I/O	Requires +FBIE license
EtherNet/IP	Requires +FBIE license

2 Safety

2.1 Safety Symbols

The following symbols are used in this manual:

⚠ 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).

2.2 Safety Instructions

A safety guide is included in the product delivery. Read the safety instructions carefully before starting to work in any way with the system or its components.

The warnings and cautions in the safety guide give important information on how to prevent injury and damage to the equipment or the system. Read the warnings and cautions carefully and obey their instructions.

⚠ WARNING ⚠

SHOCK HAZARD FROM CONTROL TERMINALS

The control terminals can have a dangerous voltage also when the drive is disconnected from mains. A contact with this voltage can lead to injury.

- Make sure that there is no voltage in the control terminals before touching the control terminals.

⚠ CAUTION ⚠

DAMAGE TO OPTION BOARDS

Do not install, remove, or replace option boards on the drive when the power is on. Doing this can cause damage to the boards.

- Switch off the AC drive before installing, removing, or replacing option boards on the drive.

NOTICE

OPTION BOARD COMPATIBILITY

Installing an incompatible option board can damage the AC drive.

- Make sure that the option board being installed is compatible with the drive.

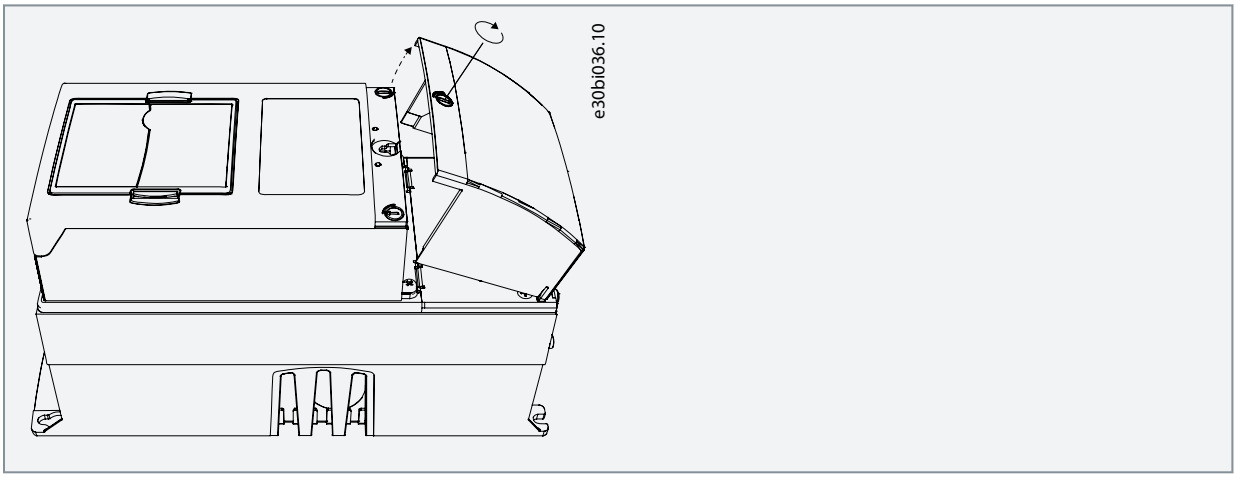
3 Installing

3.1 Installing Option Board in VACON® NXP and NXS

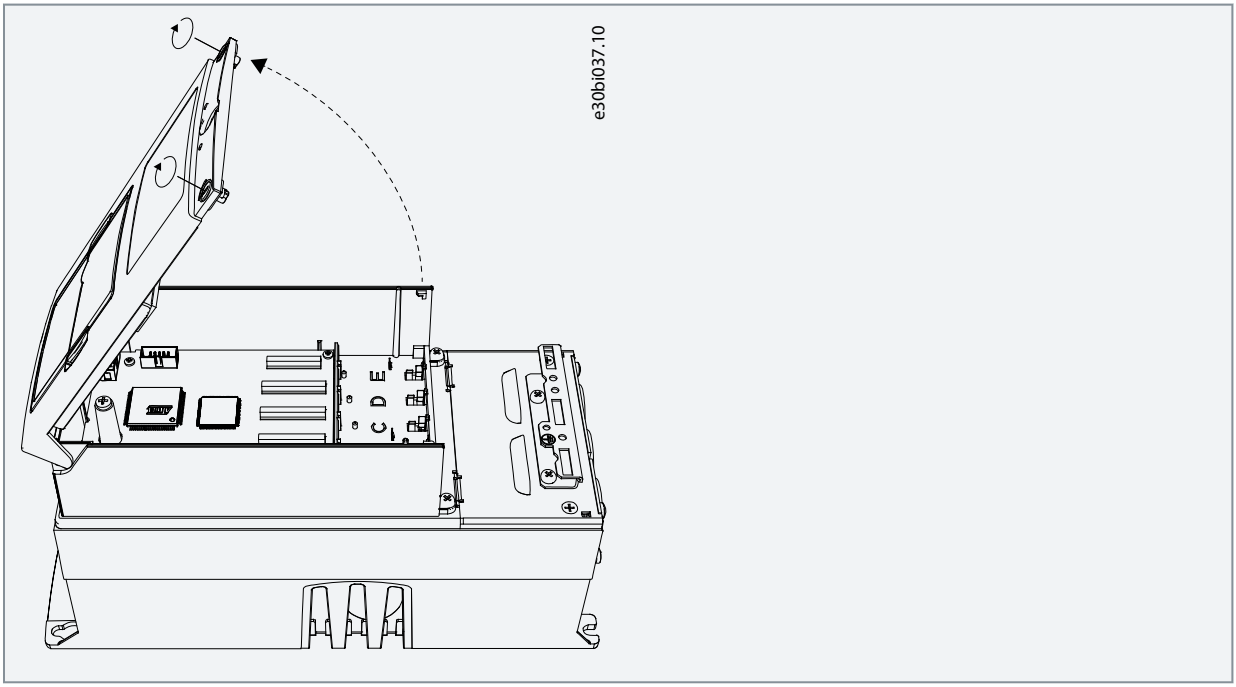
This topic gives instructions for installing the option boards in VACON® NXP and NXS, FR4–FR9.

Procedure

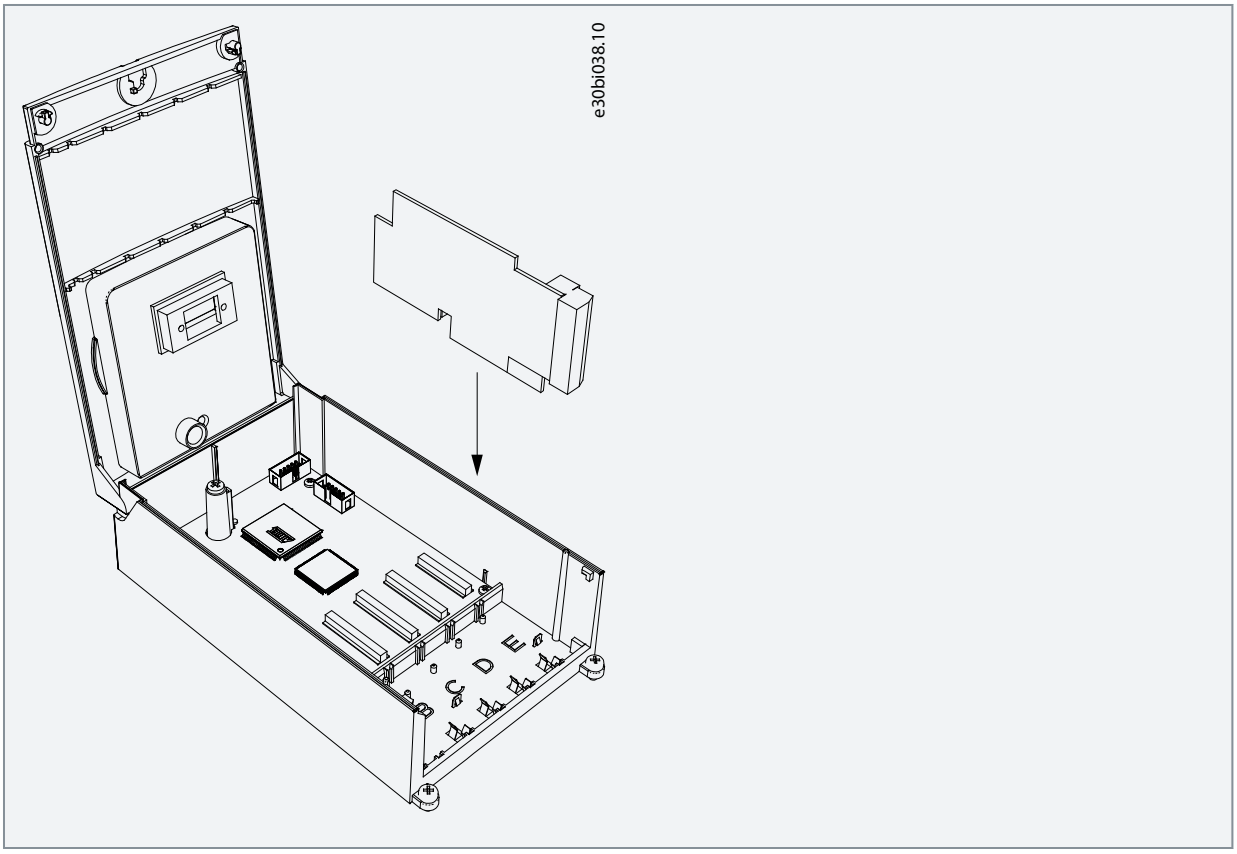
1. In FR5–FR9, open the cover of the AC drive.
2. In FR4, remove the cable cover.



3. Open the cover of the control unit.



4. Install the option board into the slot E or D on the control board of the AC drive. Make sure that the grounding plate fits tightly in the clamp.



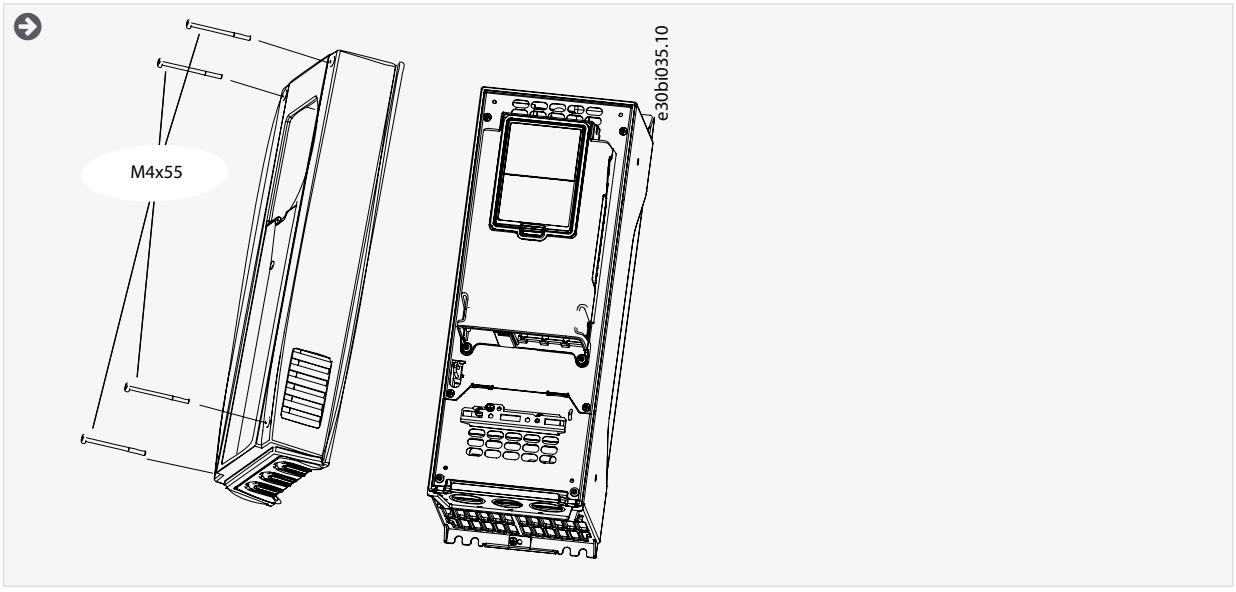
5. In IP21, cut free the opening on the cover of the AC drive for the fieldbus cable.
6. Install the cables.
7. Close the cover of the control unit and attach the cable cover.

3.2 Installing Option Board in VACON® 100 INDUSTRIAL and FLOW

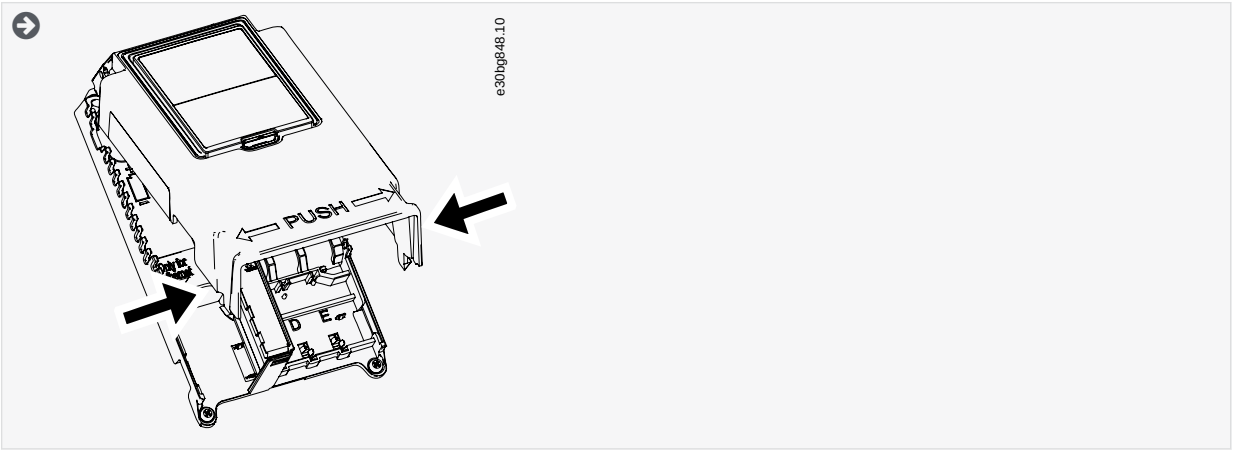
This topic gives instructions for installing the option boards in VACON® 100 INDUSTRIAL and FLOW, MR4–MR12.

Procedure

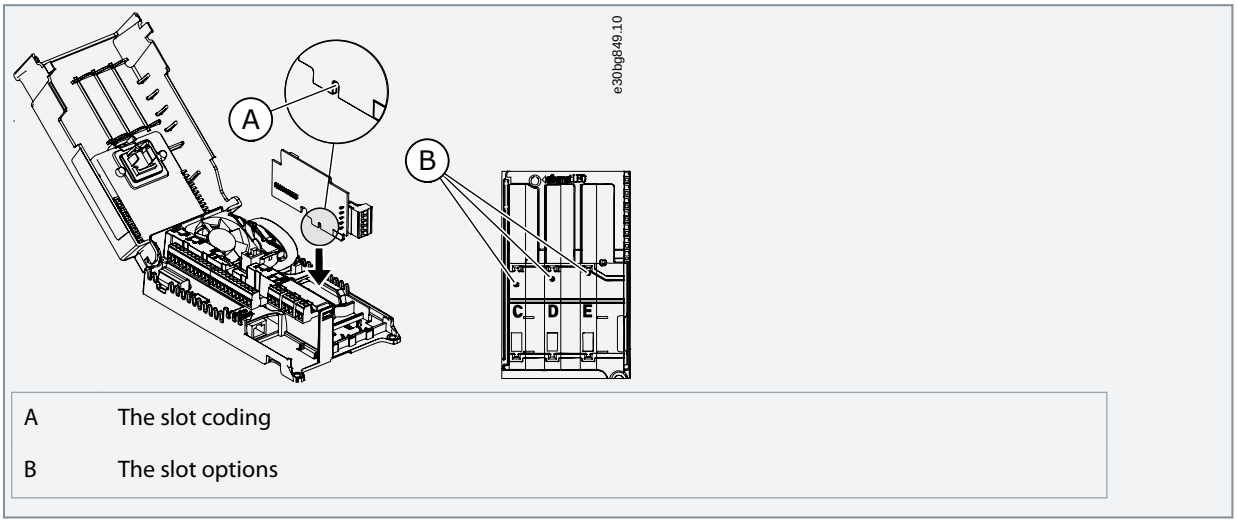
1. Open the cover of the AC drive.



2. To get access to the option board slots, open the cover of the control unit.



3. Install the option board into the slot D or E. Installation of option board into an incorrect slot has been physically prevented. Do not use force.



A	The slot coding
B	The slot options

4. Close the cover of the control unit.
5. In IP21, cut free the opening on the cover of the AC drive for the fieldbus cable.
   In IP54, cut a hole in a grommet and move the cable through it.

Make the connection tight. In internal fieldbus, make the opening on the left side. When installing into the slot D or E, make the opening on the right side.

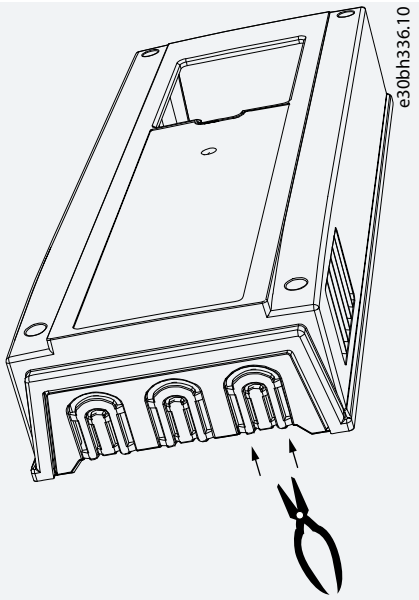


Illustration 1: IP21

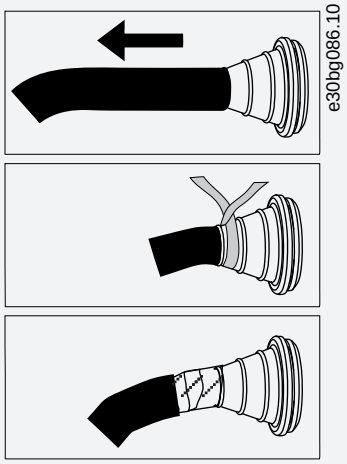
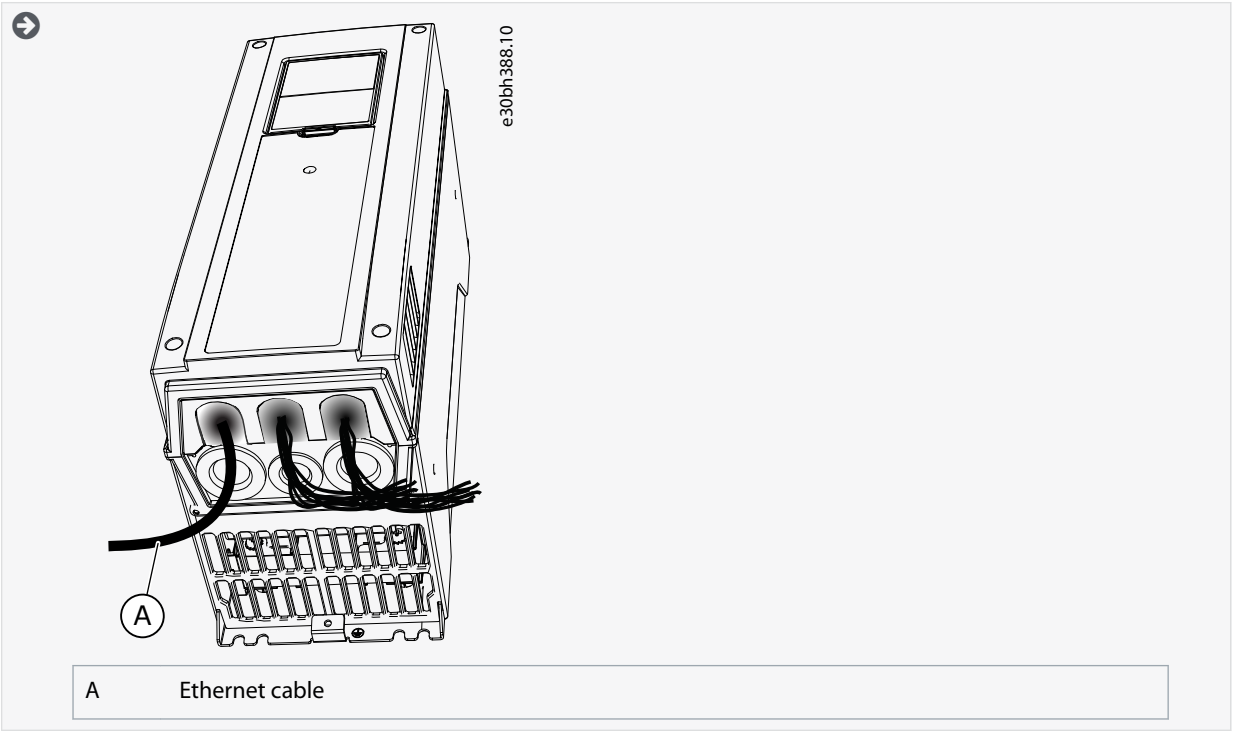


Illustration 2: IP55

6. Install the fieldbus and other cables. See more information in section "Cabling".
7. Close the cover of the AC drive.
8. Pull the fieldbus cable to the side. Move the fieldbus cables away from the mains cable and the motor cable.



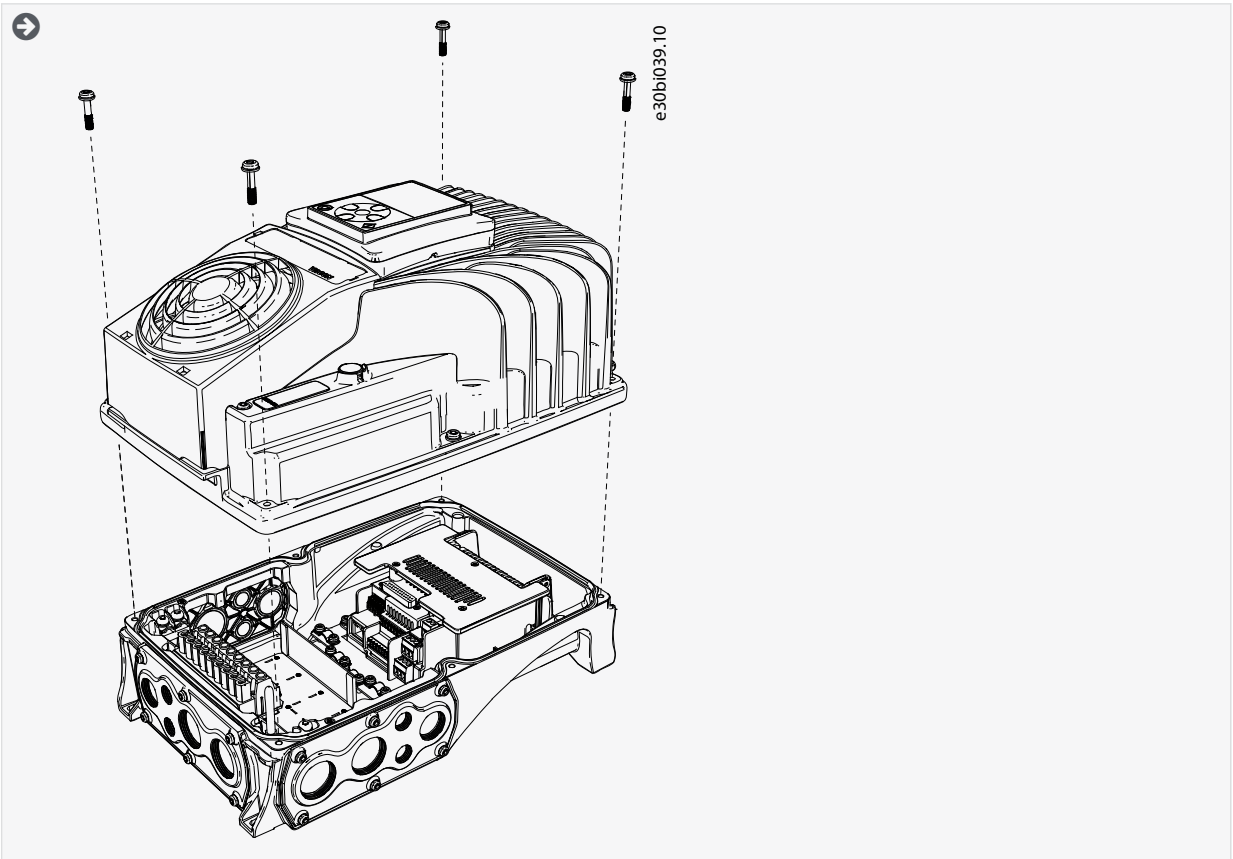
A	Ethernet cable

3.3 Installing Option Board in VACON® 100 X

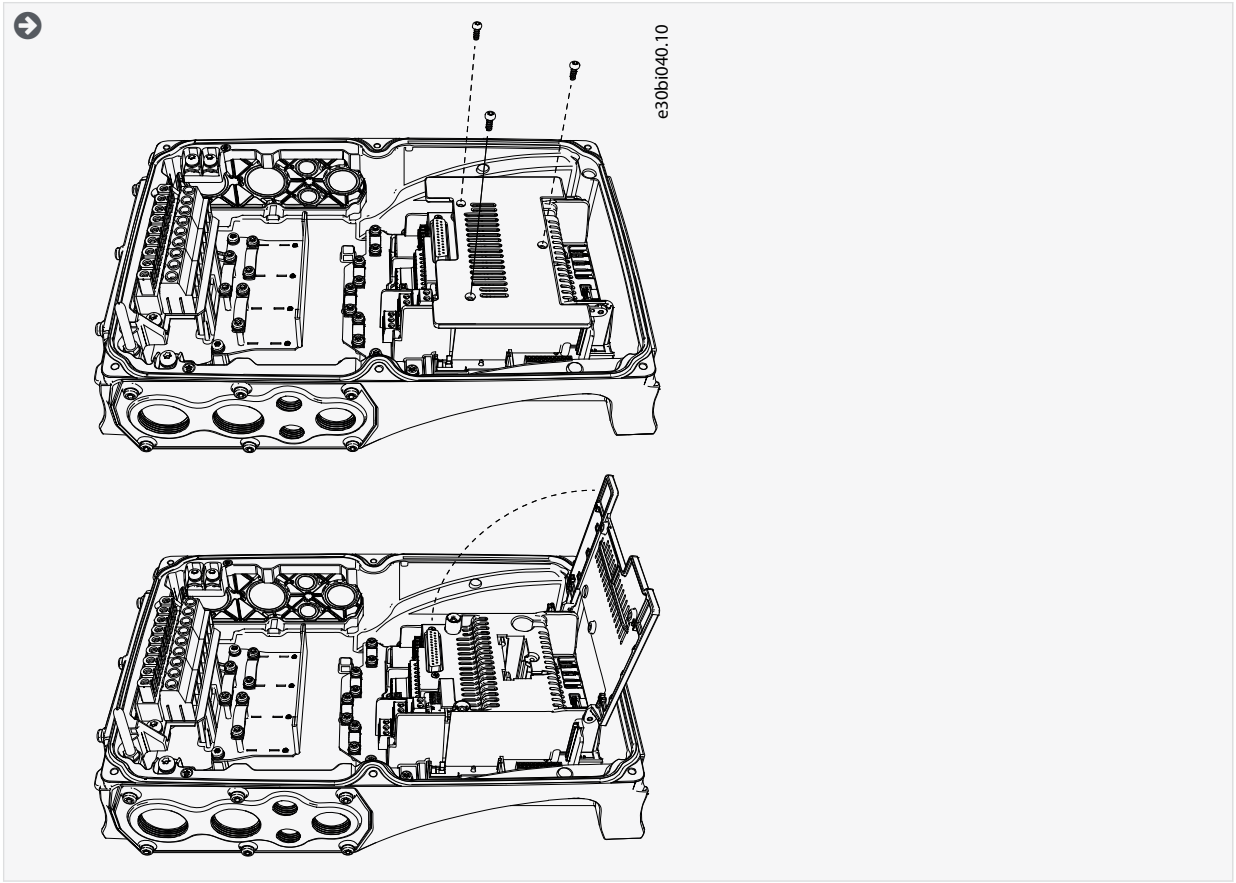
This topic gives instructions for installing the option boards in VACON® 100 X, MM4–MM6.

Procedure

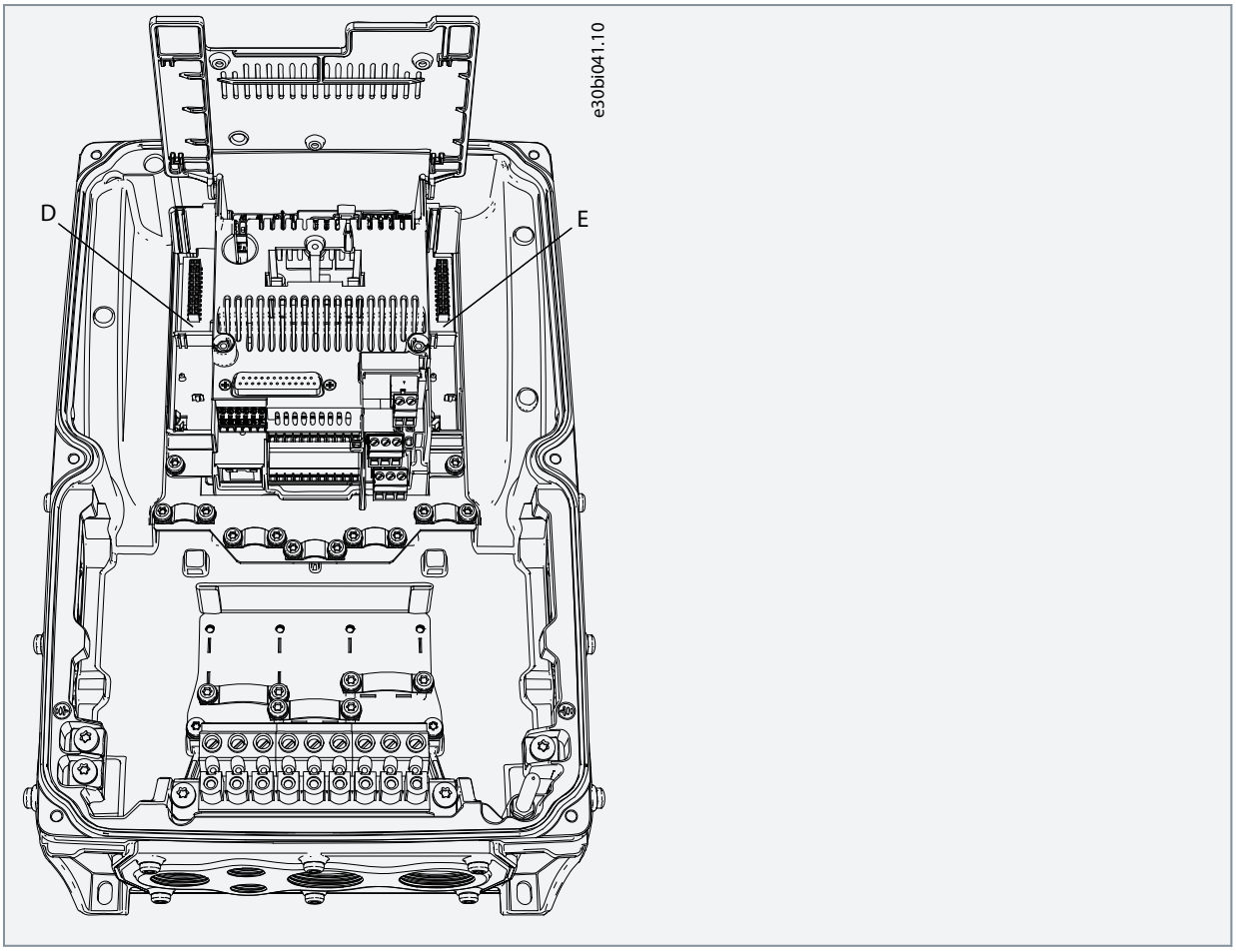
1. Open the cover of the AC drive.



2. To get access to the option board slots, remove the screws and open the cover of the control unit.

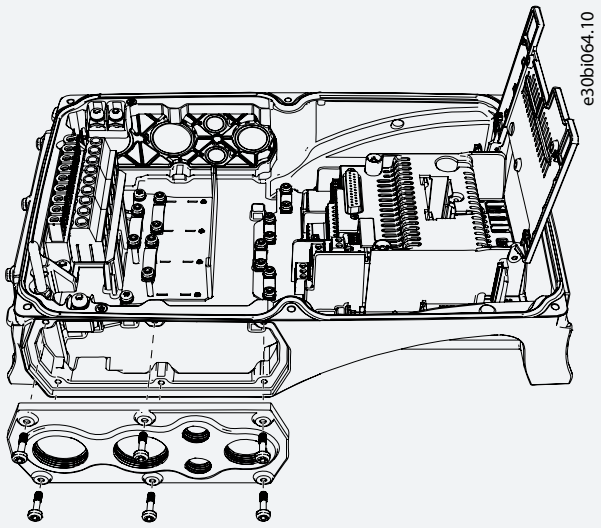


3. Install the option board into the slot D or E.



4. Close the option board cover.
5. Remove the cable entry plate. If the option board is installed in the slot D, use the cable entry plate on the right side. If the option board is installed in the slot E, use the cable entry plate on the left side.

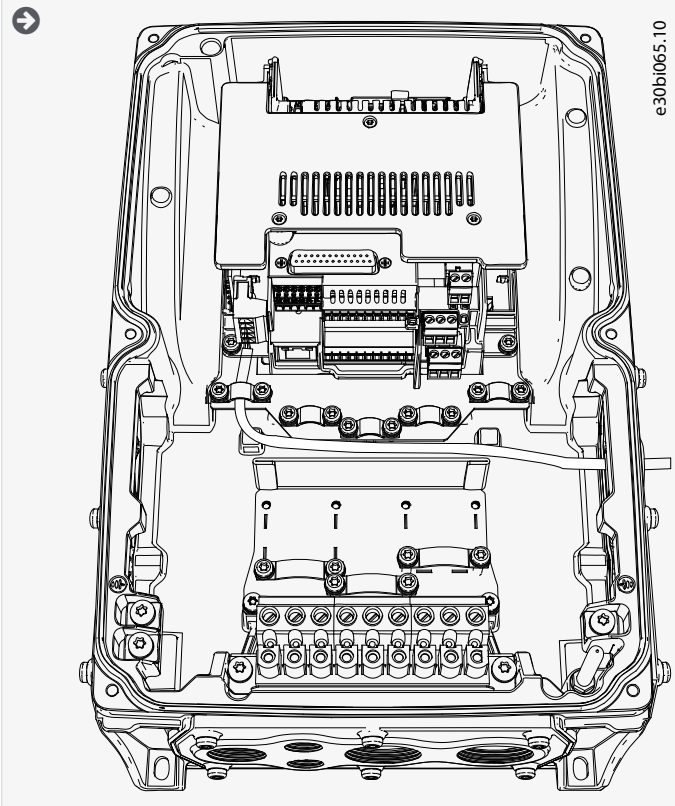
NOTE! The cable entry plate at the bottom of the drive is used only for mains and motor cables.



6. Open the necessary holes in the cable entry plate. Do not open the other holes. See the VACON® 100 X Installation Manual for the dimensions of the holes.
7. Attach a cable gland on the hole in the cable entry plate. Pull the fieldbus cable through the hole.

NOTE! The fieldbus cable must go through the correct cable entry plate to avoid going near the motor cable.

Avoid small bend radius in the fieldbus cables. If the option board is installed in the slot D, use the cable entry plate on the right side. If the option board is installed in the slot E, use the cable entry plate on the left side.



8. Put back the cable entry plate.

9. Close the cover of the AC drive.

3.4 Installing Option Board in VACON® 20

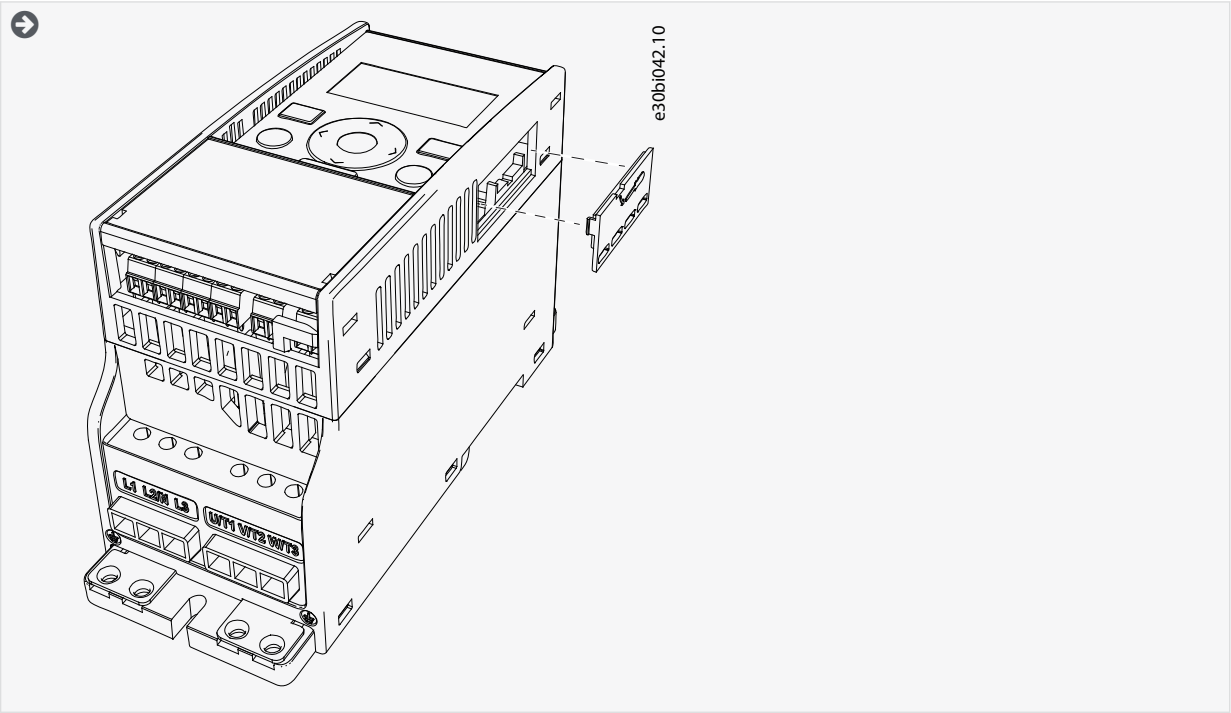
3.4.1 Installing Option Board in VACON® 20, MI1–MI3

This topic gives instructions for installing the option boards in VACON® 20, MI1–MI3.

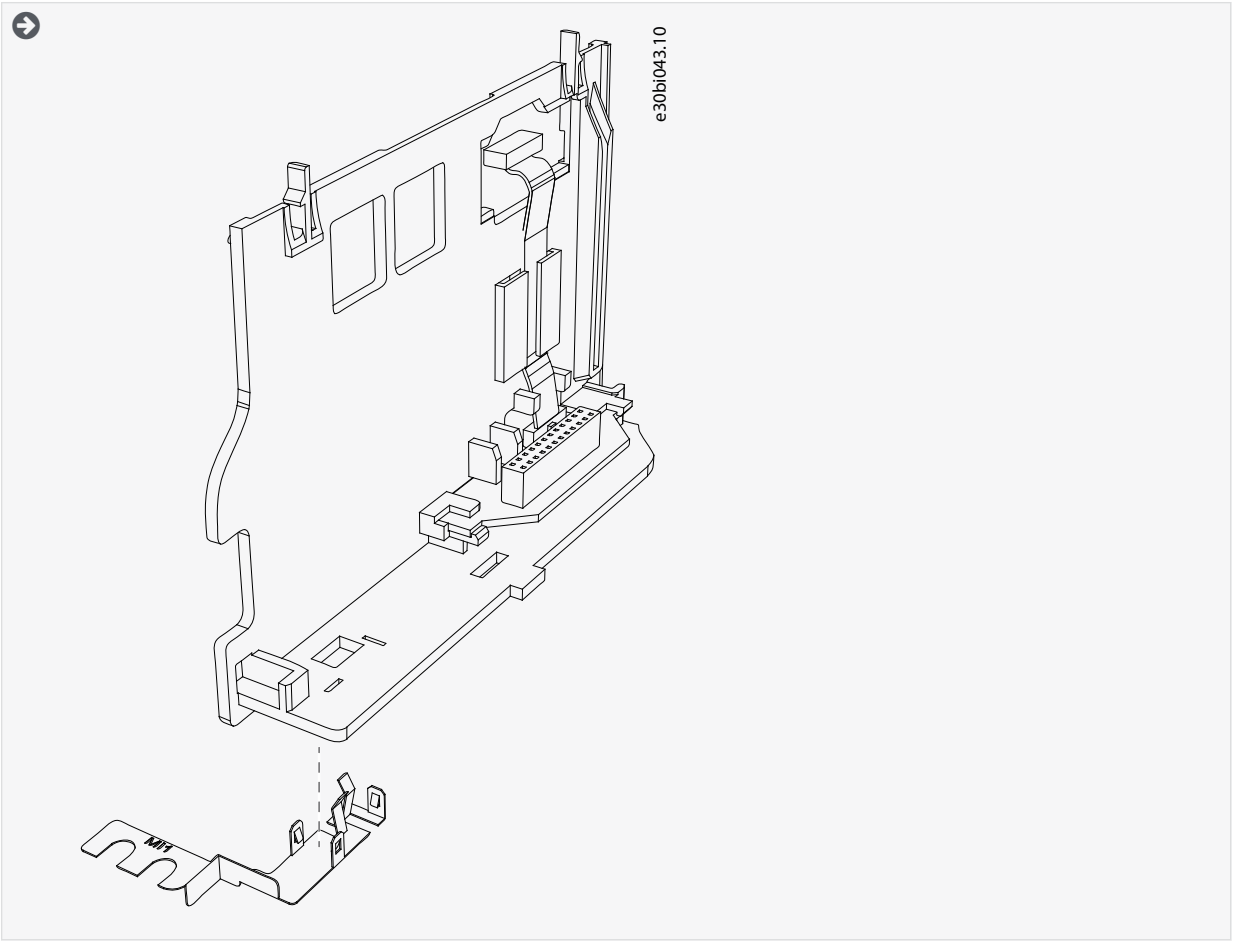
For option board installation, a separate option board mounting kit is required.

Procedure

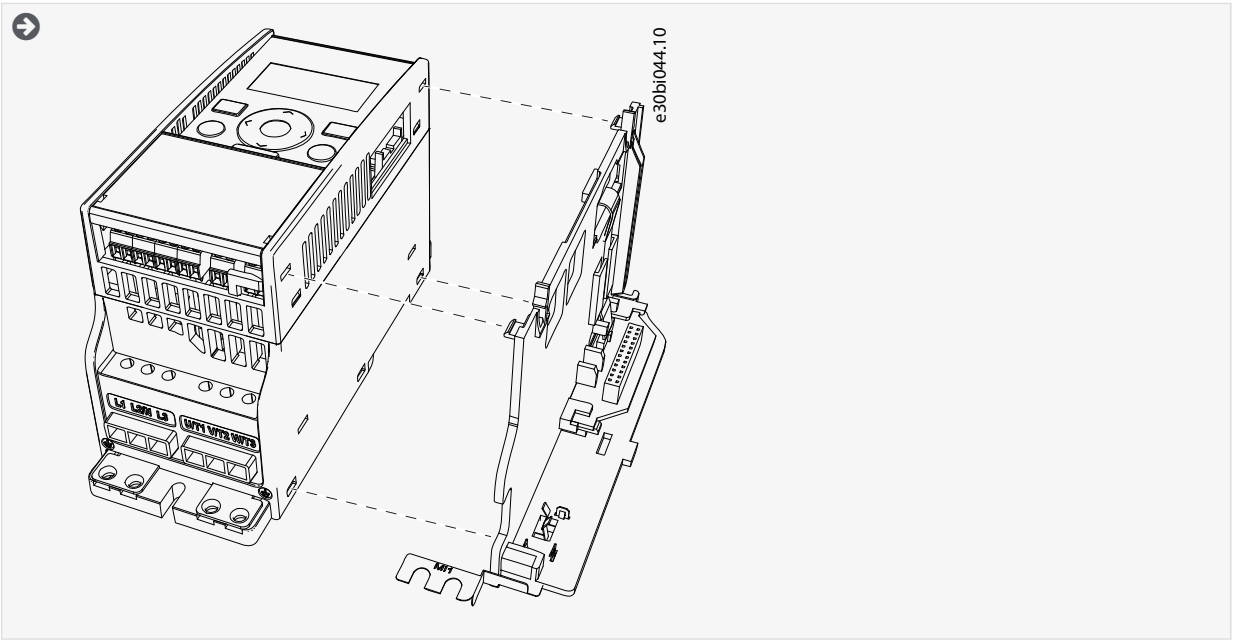
1. Remove the cable connector lid from the AC drive.



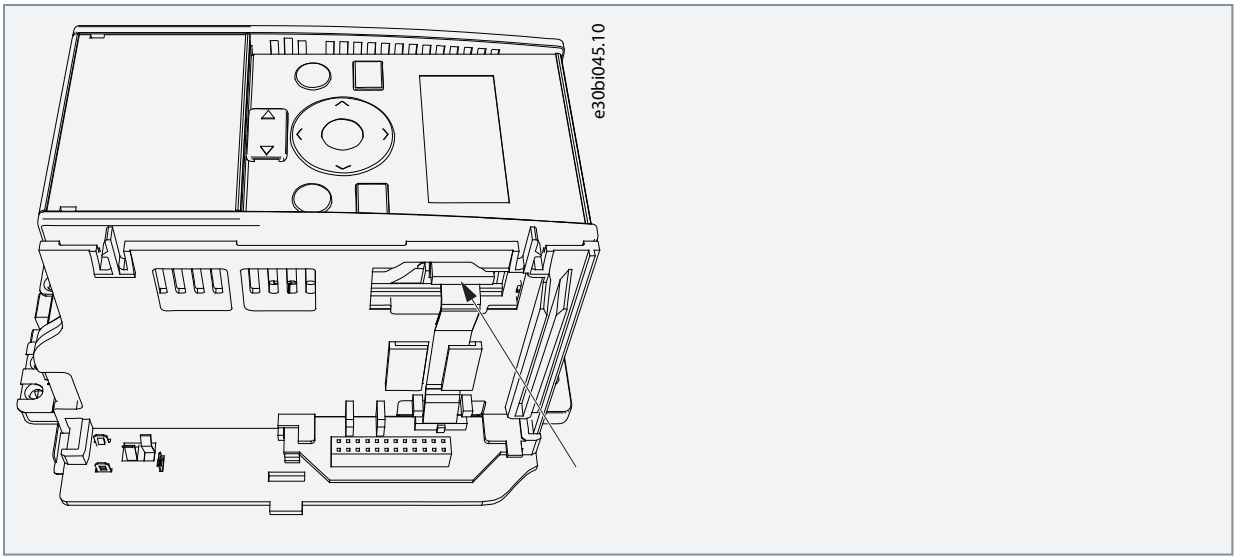
2. Select a correct grounding plate and attach it to the option board mounting frame. The grounding plate is marked with the supported enclosure size.



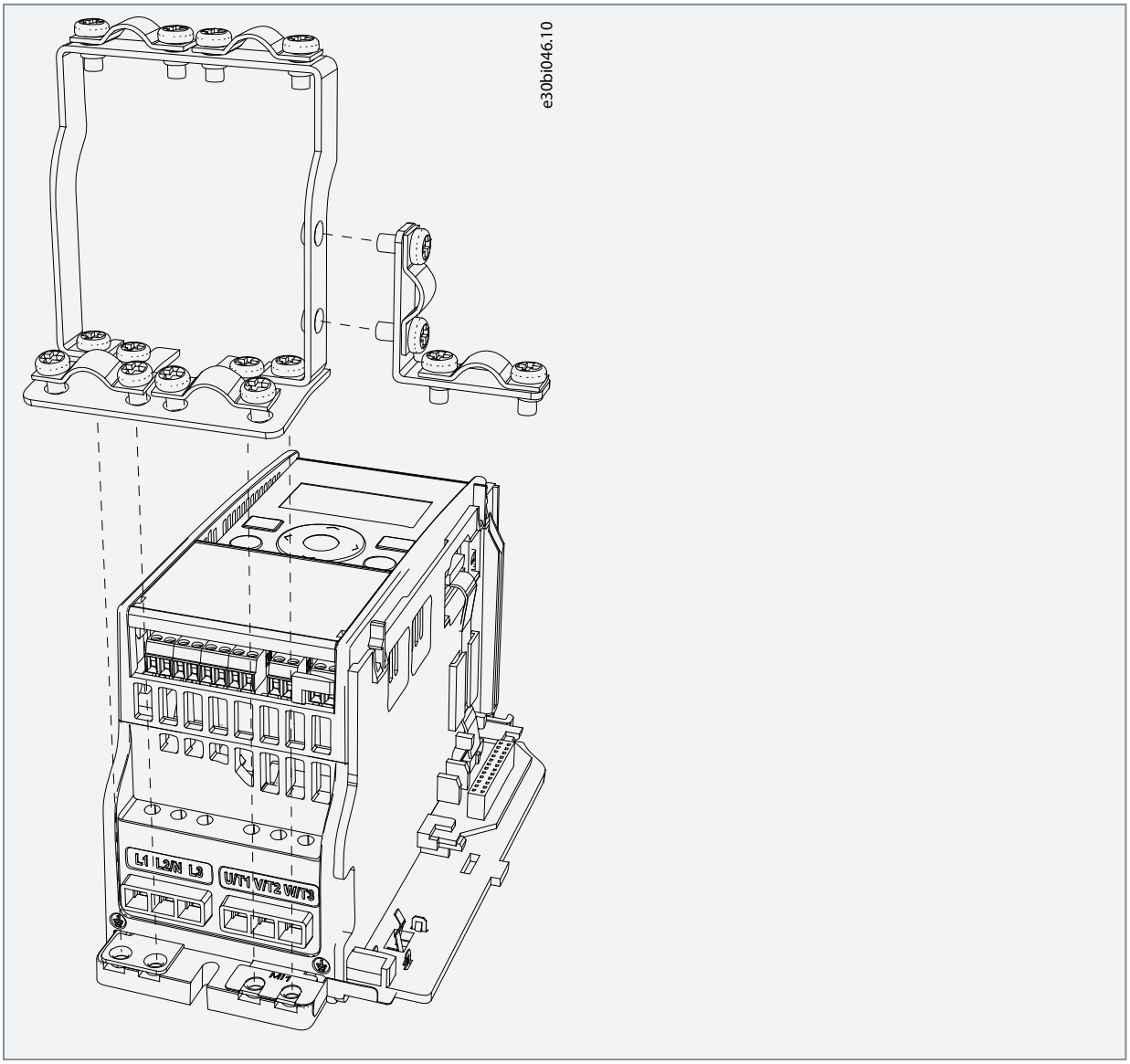
3. Attach the option board mounting frame to the AC drive.



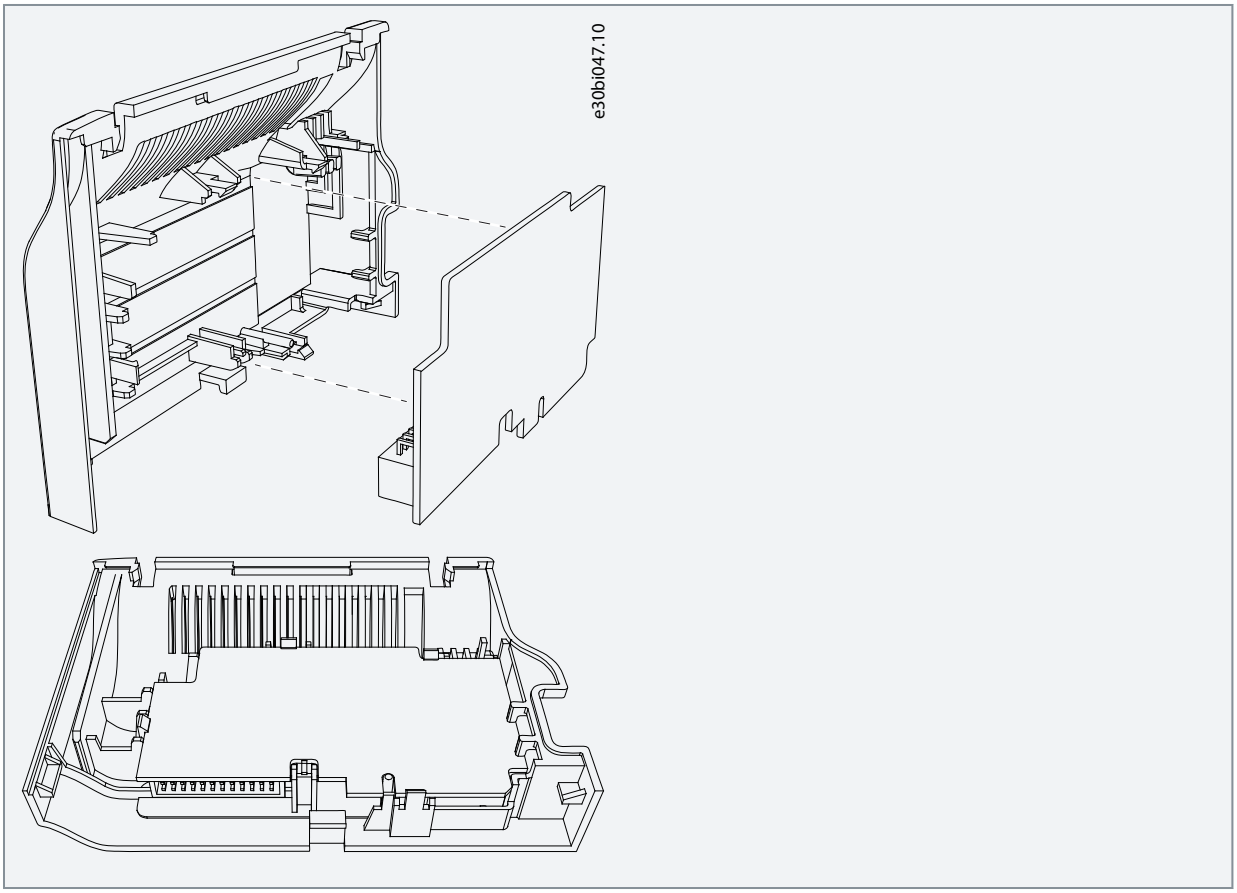
4. Connect the flat cable from the option board mounting frame to the AC drive.



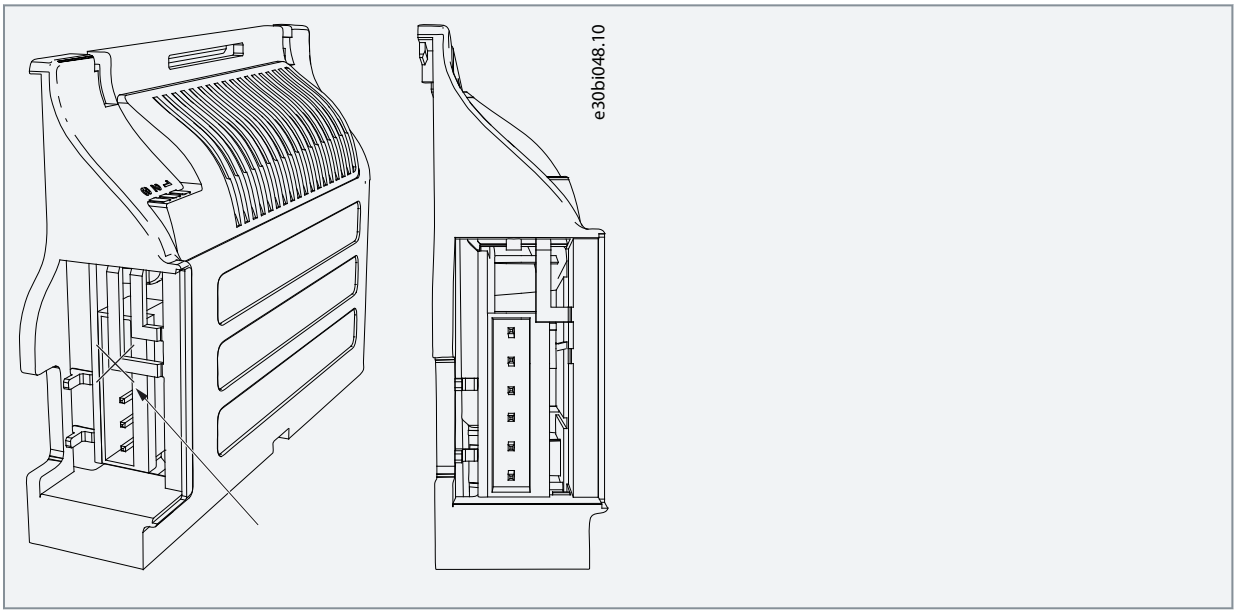
5. If a strain relief is necessary for the cable, attach it.



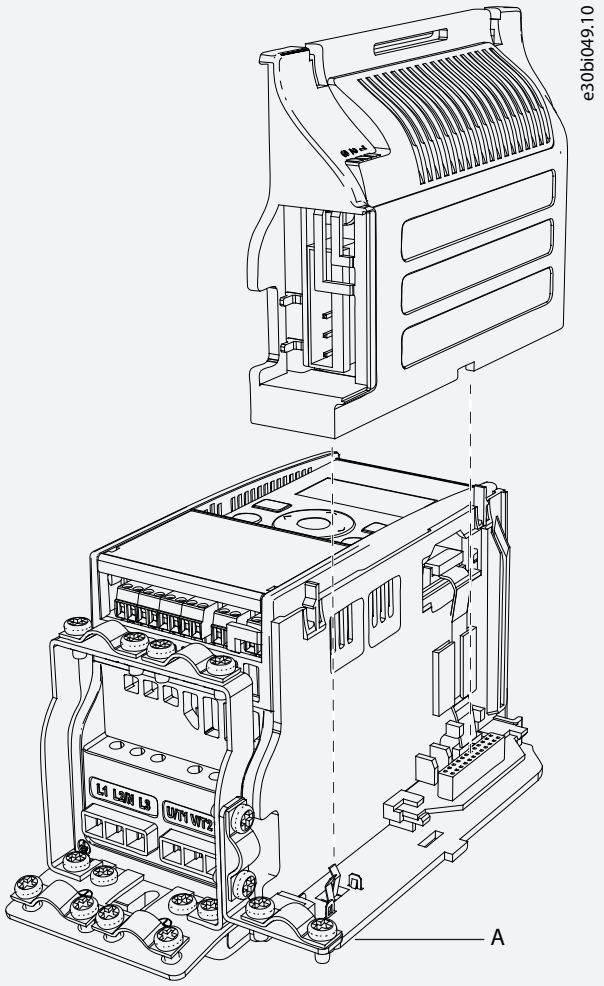
6. Install the option board to the option board holder. Make sure that the option board is securely fastened.



7. Cut free a sufficiently wide opening for the option board connector.



8. Attach the option board cover to the drive. If strain relief is necessary, attach the strain relief cable clamp with screws.



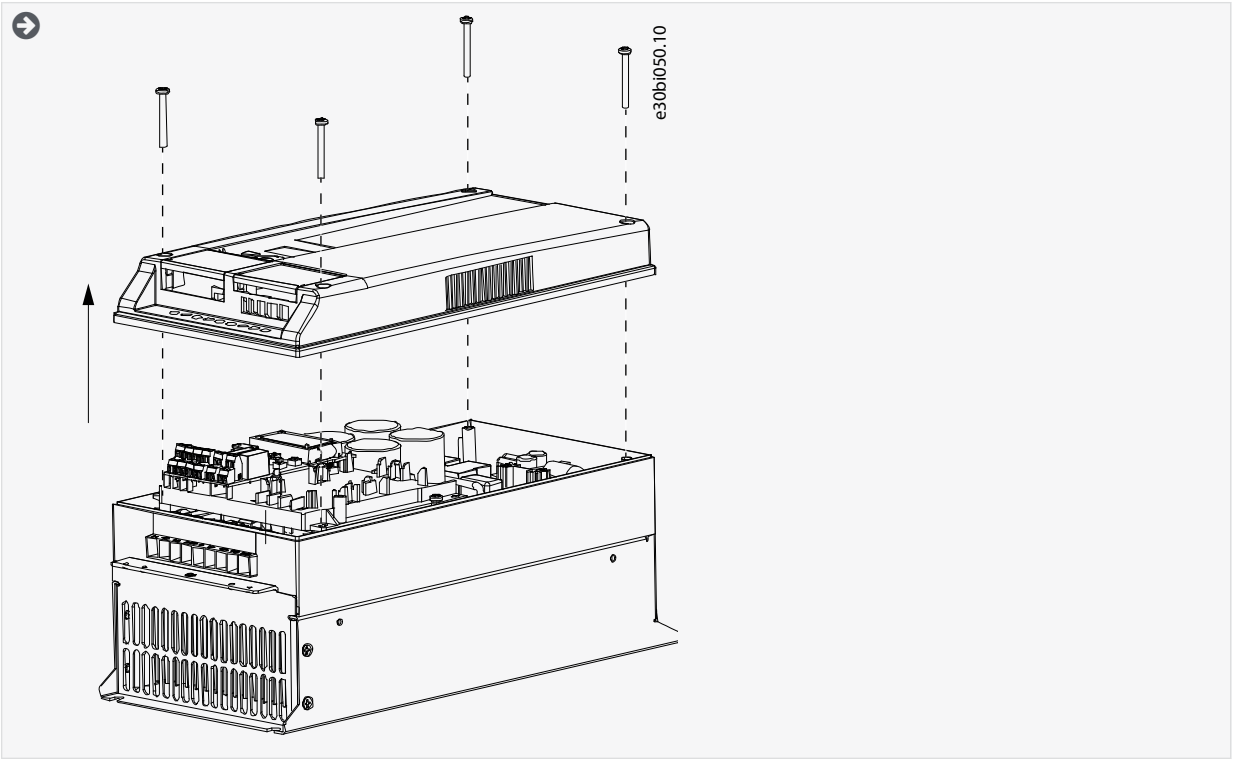
A	The strain relief cable clamp

3.4.2 Installing Option Board in VACON® 20, MI4–MI5

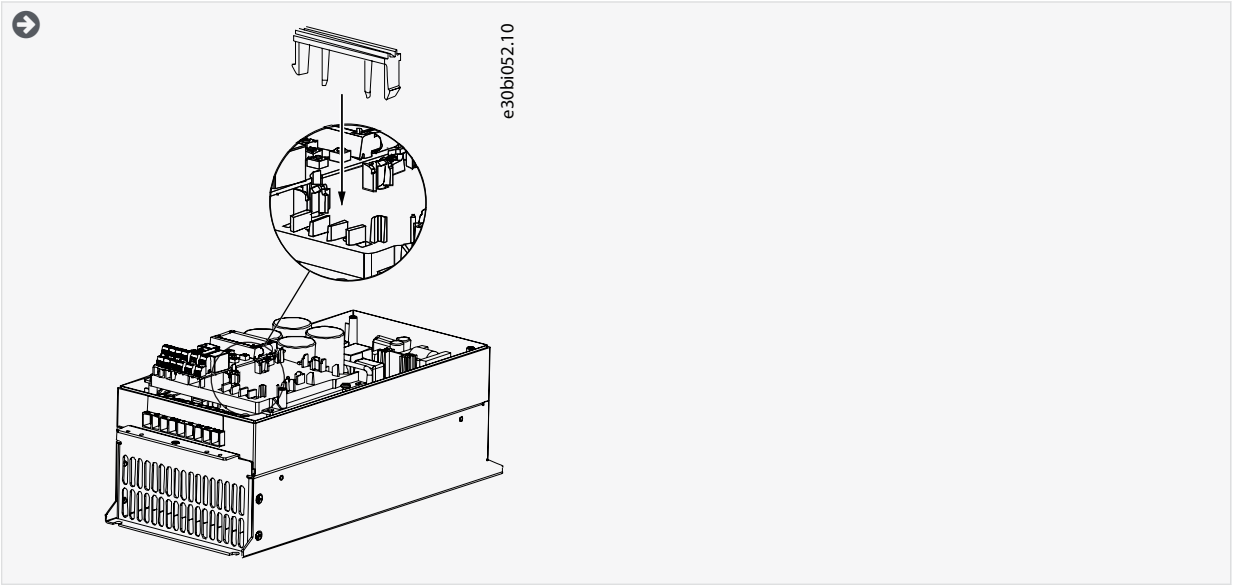
This topic gives instructions for installing the option boards in VACON® 20, MI4–MI5.

Procedure

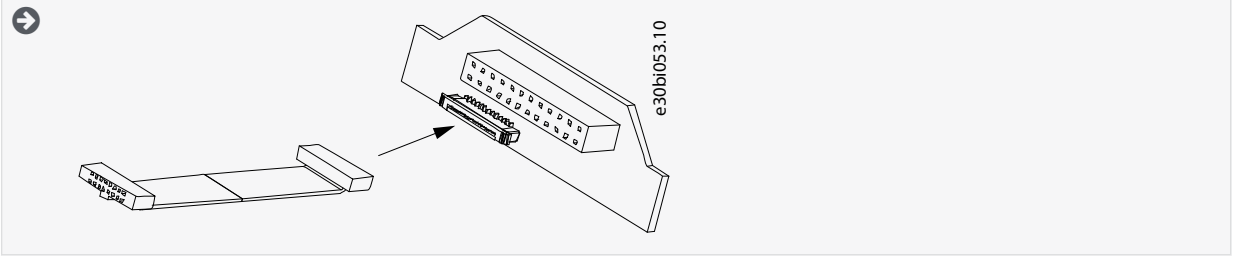
1. In MI4, open the cover of the AC drive. In MI5, open the cover of the AC drive and release the fan connector.



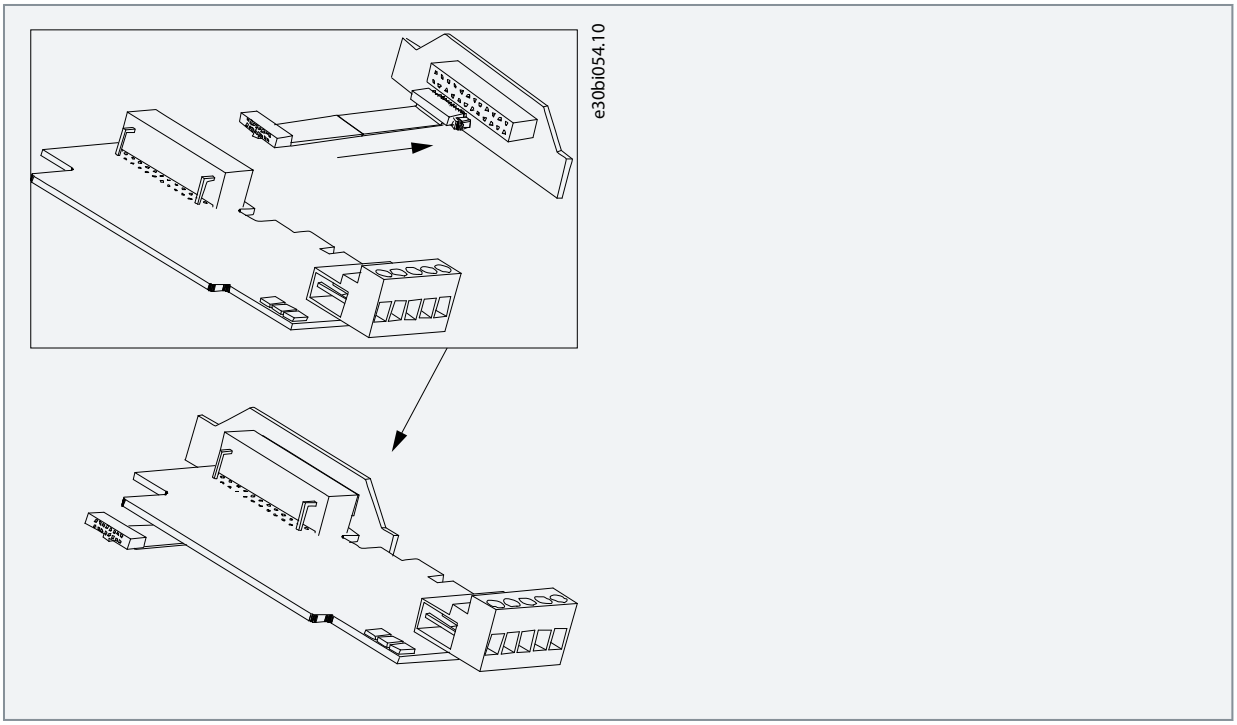
2. Attach the option board support.



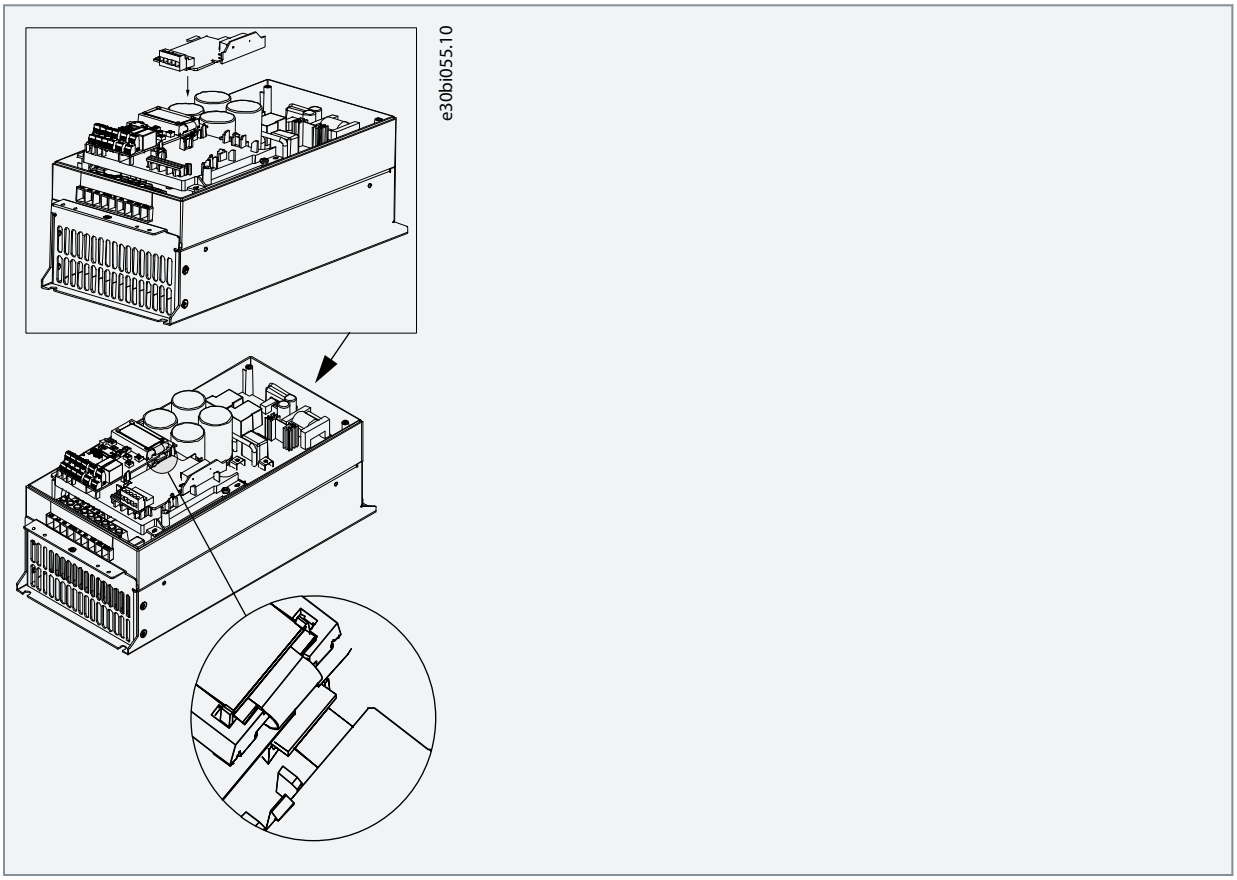
3. Connect the flex cable to the connector PCB.



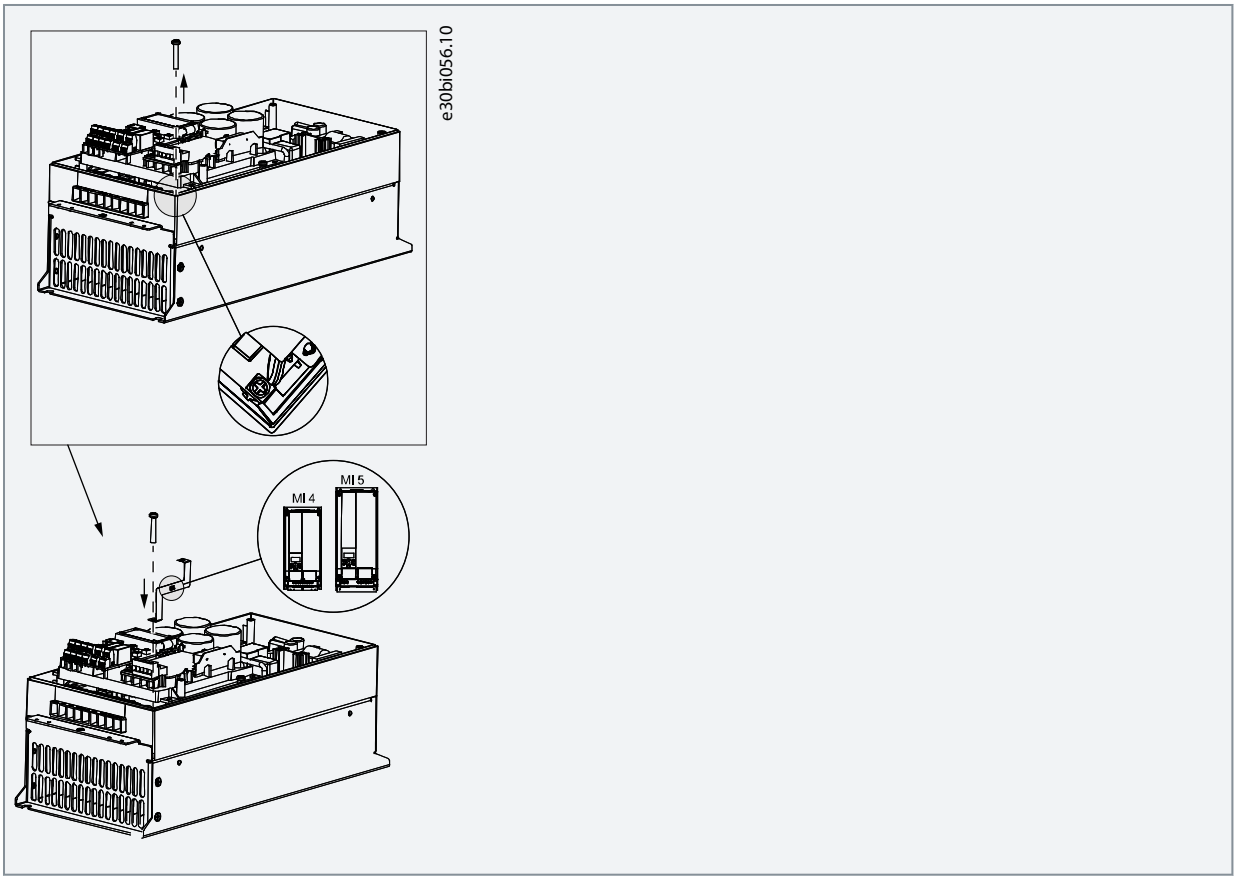
4. Attach the option board to the connector PCB.



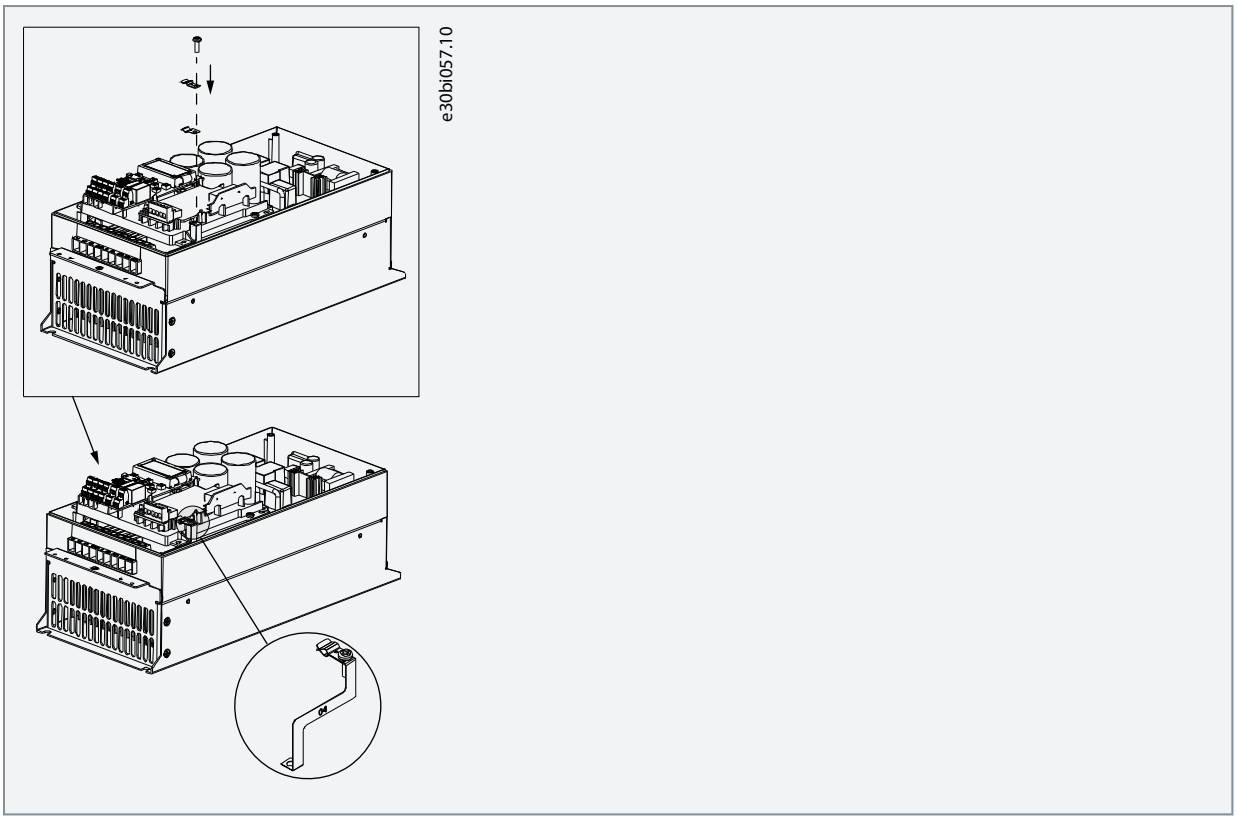
5. Attach the option board assembly to the AC drive and connect the flex cable.



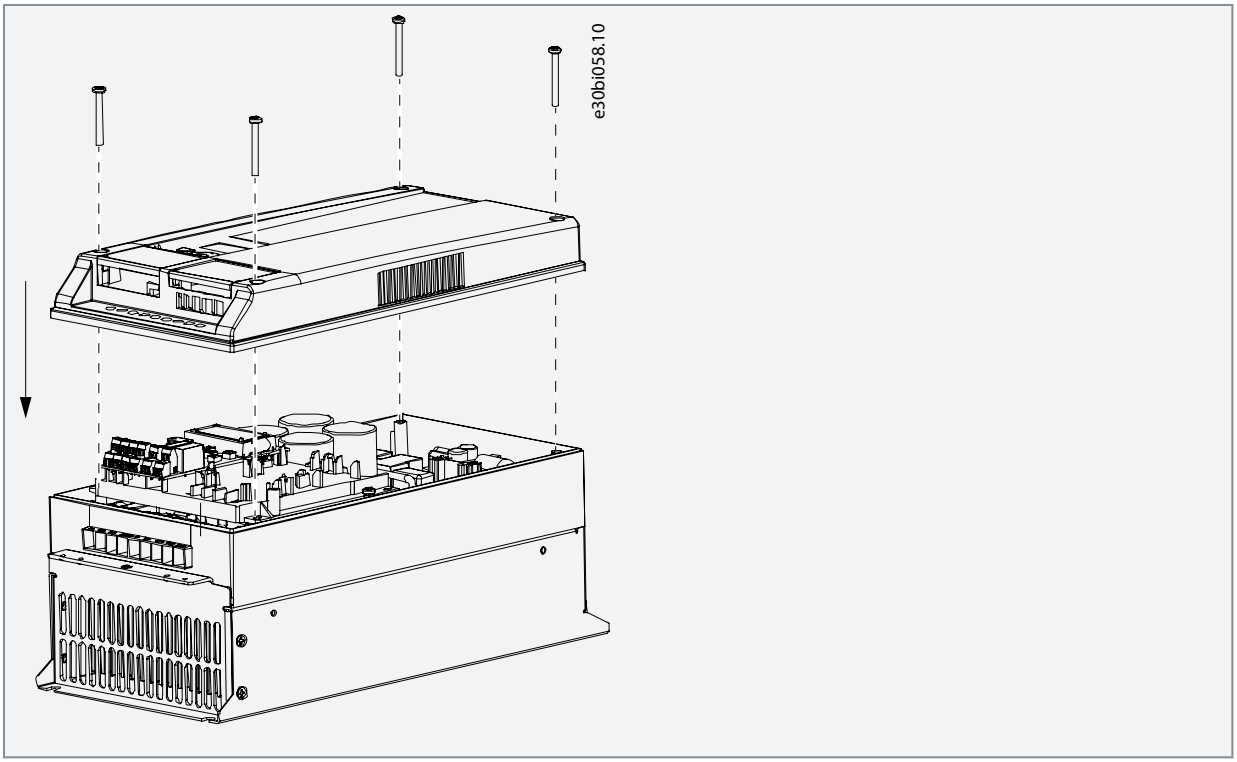
6. Attach a correct grounding plate to the AC drive. The grounding plate is marked with the supported enclosure size.



7. Put a clamp on top of the grounding plate on both sides of the option board.



8. In MI4, close the cover of the drive. In MI5, attach the fan connector and close the cover of the AC drive.

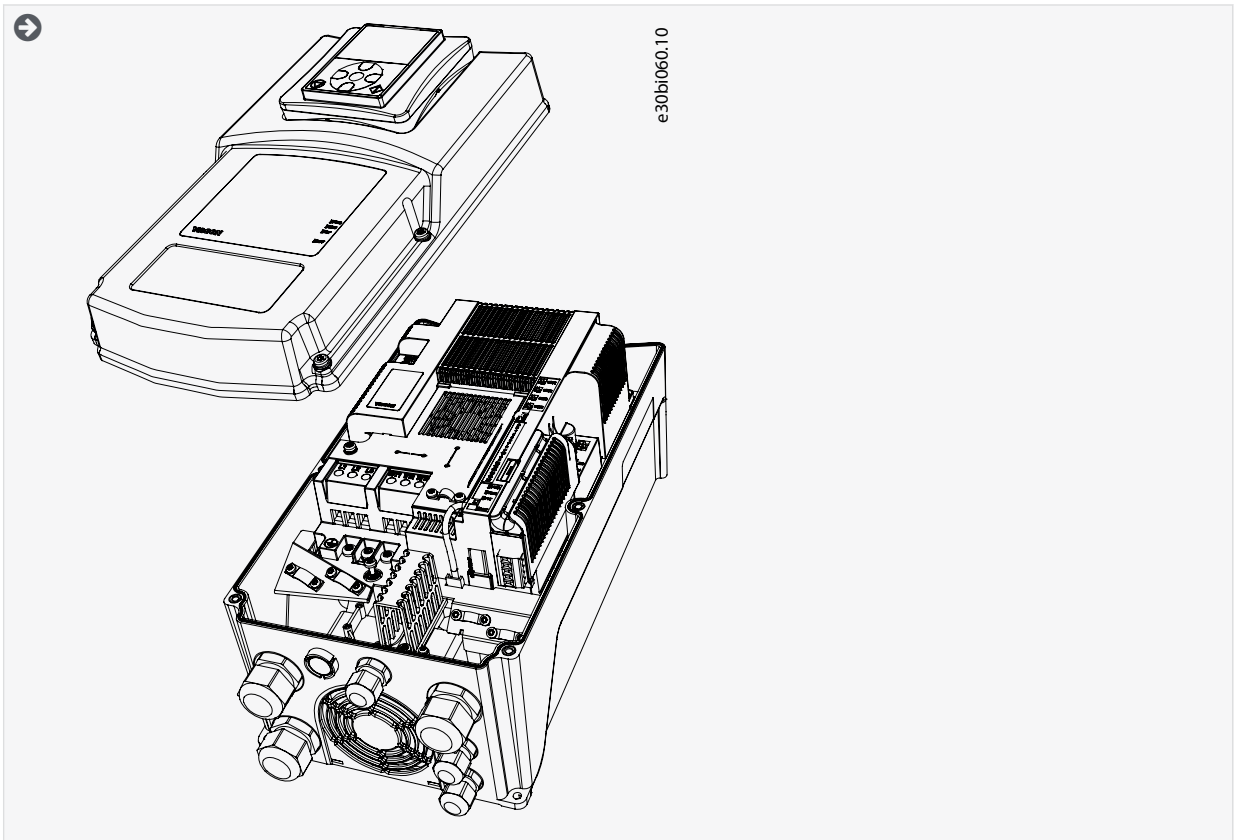


3.5 Installing Option Board in VACON® 20 X and 20 CP

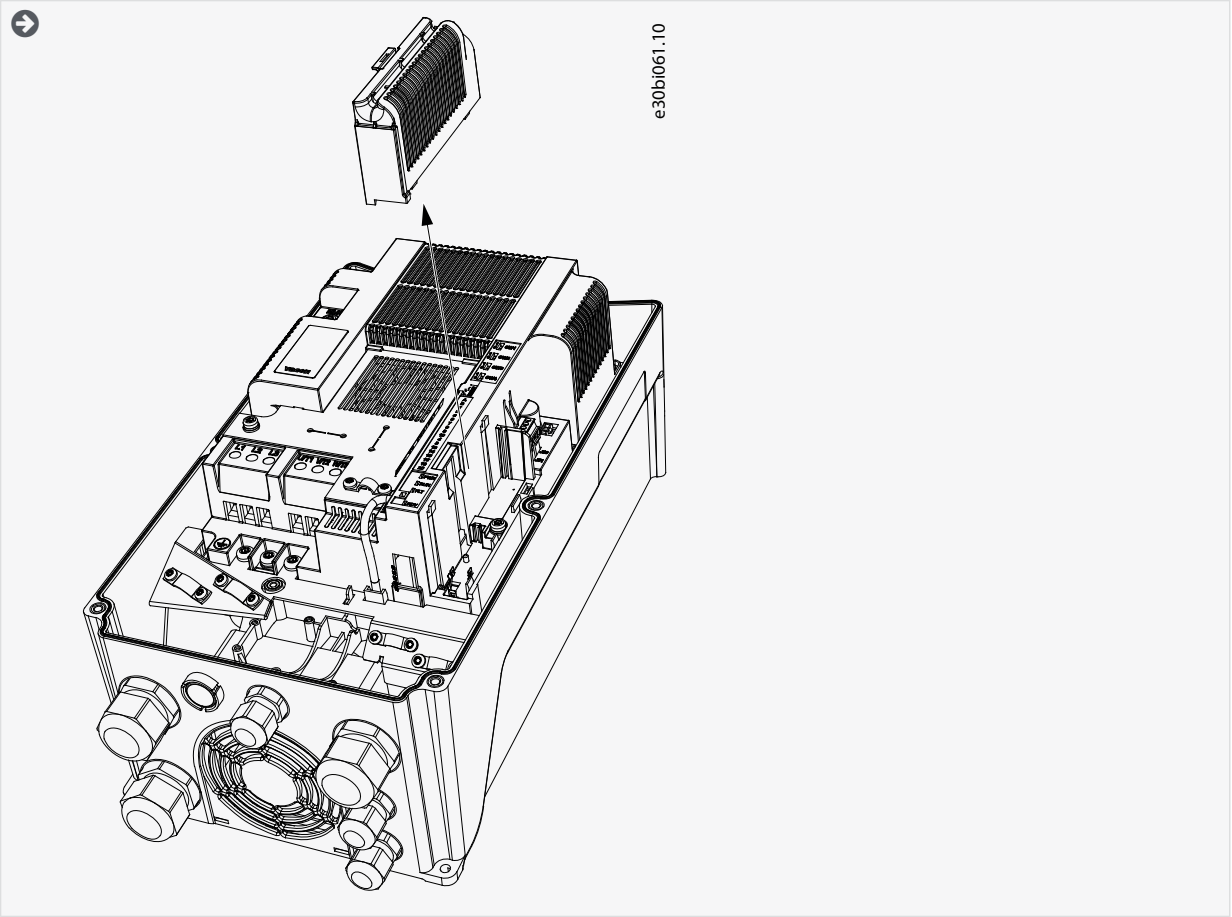
This topic gives instructions for installing the option boards in VACON® 20 X and 20 CP, MU2–MU3, MS2–MS3.

Procedure

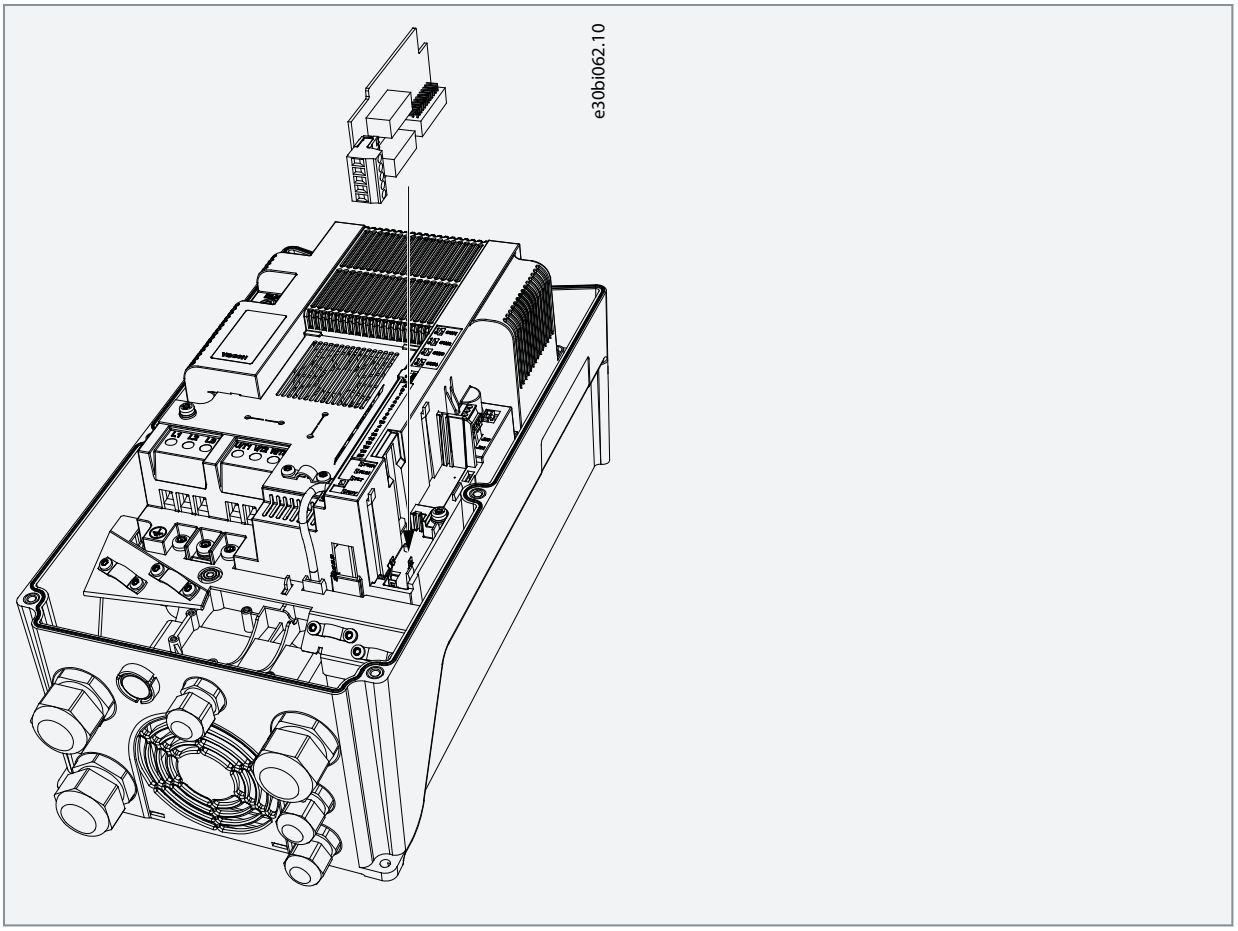
1. In VACON® 20 X, open the cover of the AC drive.



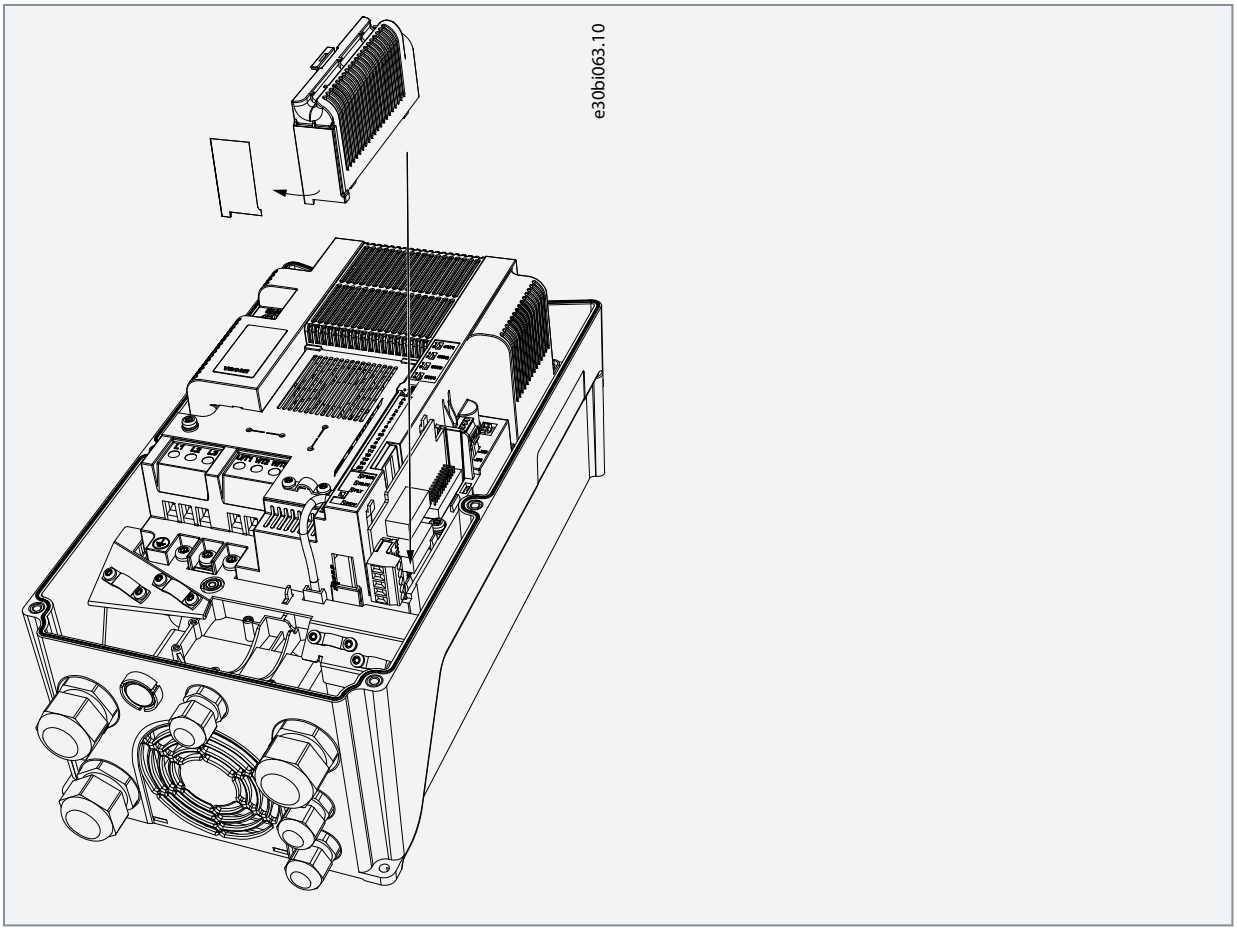
2. Remove the option board cover.



3. Install the option board into the slot.



4. To make an opening for the option board connector, remove the plastic plate at the end of the option board cover. Attach the option board cover to the AC drive.



5. Close the cover of the AC drive.

4 Cabling

4.1 General Cabling Instructions for Fieldbus

To keep the response time and the number of incorrect dispatches to minimum, use only standard industrial components in the network and avoid complex structures. The requirements for commercial cabling components are specified in section 8-8 in the ANSI/TIA/EIA-568-B series standards. Using commercial components can decrease system performance. The use of such products or components can cause unsatisfactory performance in industrial control applications.

4.1.1 Cable Routing

It is important that fieldbus cables are routed separately from motor cables. The recommended minimum distance is 300 mm. Do not let fieldbus cables and motor cables cross each other. If it is not possible, the fieldbus cables must cross other cables at an angle of 90°.

Shielded fieldbus and control cables can be routed in parallel. To have further shielding, install a grounded metal conduit around the fieldbus and control cable run.

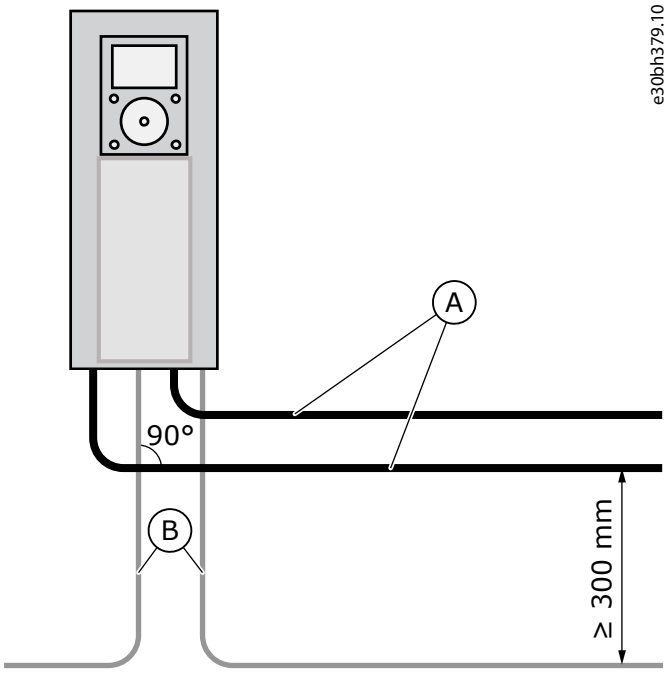


Illustration 3: Routing the Motor and Fieldbus Cables

A	Motor cables
B	Fieldbus cables

Use cables with right length. If there is extra cable, put it in a noise free location. Multiple rounds of cable and a large circumstance area make an antenna (see Illustration 4). Noise connects to fieldbus cable and can cause communication problems.

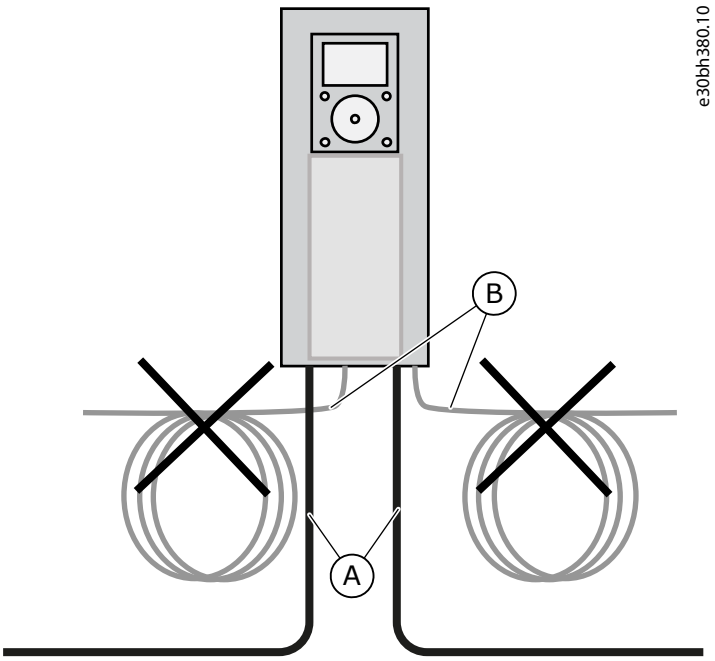


Illustration 4: Installation that Makes an Antenna

A	Motor cables
B	Fieldbus cables

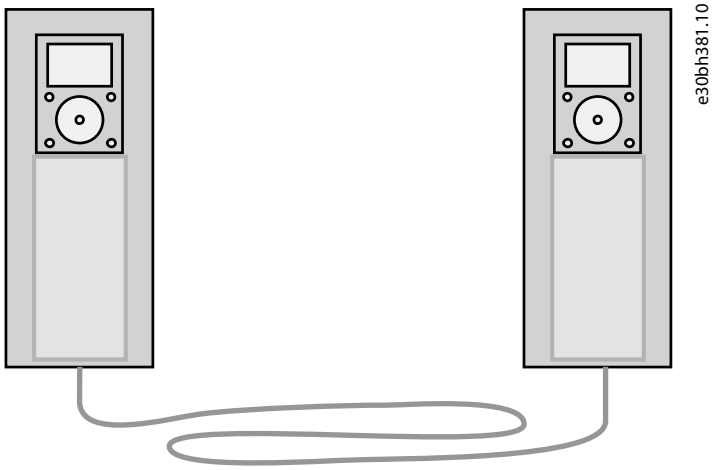


Illustration 5: Example of Good Routing of Extra Fieldbus Cable

N O T I C E

To prevent shield fracture, do not bend the cable too much or run the cable back and forth on the same path too tightly.

4.1.2 Strain Relief

If there is a possibility of tensile load on the cable, install it with a strain relief. When it is possible, the strain relief of the fieldbus cables should not be done at the shield connection to ground. This may reduce the effectiveness of the bonding. The tensile load and vibration can also damage the shield.

4.2 General Cabling Instructions for Ethernet

Use only shielded cables of category CAT5e or CAT6.

Table 4: The Recommended Cable Shielding

Recommendation order	Cable
1	Shielded and Foiled Twisted Pair (S/FTP) CAT5e or CAT6
2	Shielded Twisted Pair (STP) CAT5e or CAT6
3	Foiled Twisted Pair (FTP) CAT5e or CAT6
4	Unshielded Twisted Pair (UTP) CAT5e or CAT6

Use standard Ethernet 100 Mbit pinout connectors. The plug type to be used is a shielded RJ45 plug, maximum length 40 mm (1.57 in).

The maximum length of the CAT5e or CAT6 cable between two RJ45 ports is 100 meters. You can get cables that have a certain length, or get cable in bulk and assemble the connectors at commissioning. Obey the instructions of the manufacturer if you assemble the connectors manually. If you make the cables by yourself, be sure to select correct crimp tools and use precaution. The individual contacts of the RJ45 socket are allocated as per the T568-B standard.

In basic use, it is important that the RJ45 connectors in the cable (or the ones assembled) connect the cable shield to the ground level of the Ethernet terminal in the AC drive.

4.3 Grounding the Cable Shield

Equipotential bonding refers to using metal parts to make ground potential everywhere in the installation the same, the system ground. If the ground potential of all the devices is the same, you can prevent current from flowing through paths that are not designed to have current. You can also shield cables efficiently.

An error in the equipotential bonding can cause bad quality or malfunction of the fieldbus communication. It is not easy to find an error in equipotential bonding. It is also not easy to correct errors in large installations after commissioning. Thus, in the planning phase it is important to plan the installation to get good equipotential bonding. In the commissioning phase, make the equipotential bonding connections carefully.

Do grounding with low HF impedance, for example, via backplane mounting. If ground connection wires are necessary, use wires that are as short as possible. Paint coating acts as an insulator on metal and prevents grounding. Remove paint coating before doing grounding.

When equipotential bonding is good, the RJ45 connectors in the cable (or the ones assembled) must connect the cable shield to the ground level of the Ethernet terminal in the AC drive. The cable shield can be connected to the ground level at both ends via the built-in RC circuit (Illustration 6). This grounds the disturbances and, to some degree, prevents current from flowing in the cable shield. To do this, use shielded Ethernet cable (S/FTP or STP) which grounds devices via a RJ45 connector and thus uses a built-in drive RC circuit.

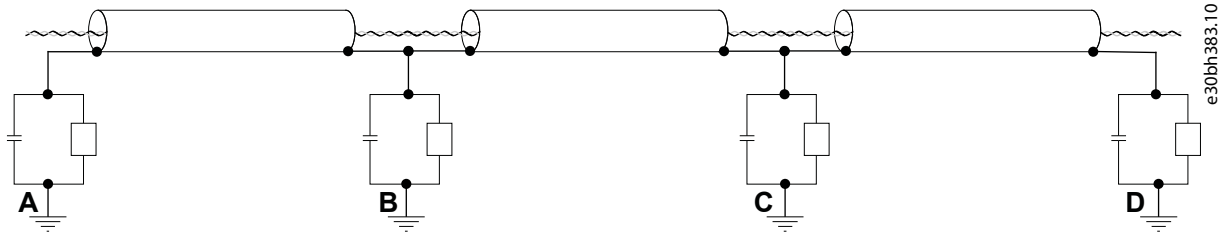


Illustration 6: Grounding via the Built-in RC Circuit

When disturbances are strong, the cable shield can be exposed and then 360 degrees grounded (see Illustration 9) directly to the AC drive ground (see Illustration 8).

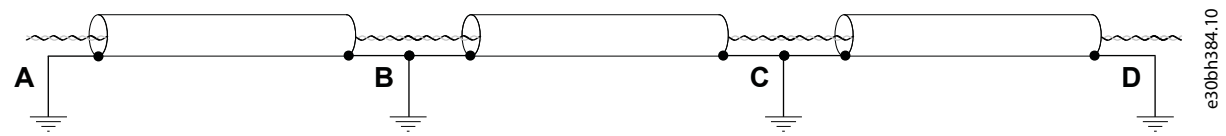


Illustration 7: Grounding in noisy environment with good equipotential. If potentials at points A, B, C, and D are very different and cannot be made similar, cut the shields as in Illustration Grounding in noisy environment with poor equipotential.

If ground potentials of the connected devices are different, cable shield that is connected at both ends causes current to flow in the shield. To prevent this, the cable shield must be disconnected or cut at some point between the devices. Grounding should be done at a location nearest to the place where the disturbances meet the cable (see Illustration 8).

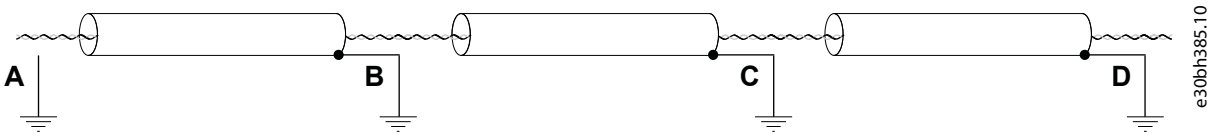


Illustration 8: Grounding in Noisy Environment with Poor Equipotential. Example of Cutting Shield.

We recommend grounding the cable shield as in examples A and C (see Illustration 9). Do not ground the cable shield as in example B.

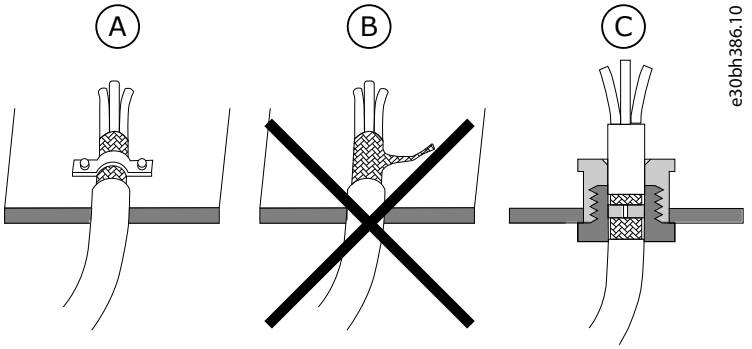


Illustration 9: Grounding the Cable Shield

A	Cable clamp	C	Cable gland
B	Ground terminal		

4.4 The OPTEA and OPTE9 Option Boards

The OPTEA and OPTE9 Dual Port Ethernet option boards have a built-in unmanaged Ethernet switch. It allows the option boards to be connected in daisy-chain (line) and ring topologies. They can also be used in a star topology. To connect the option board to the Ethernet network, use either one of the RJ45 ports of the option board.

Do not commission long daisy-chains. Each switch in the chain causes some latency, and the total delay can be significant. The accepted number of devices in a daisy-chain varies, but we recommend that the number of devices is not more than 32.

When using PROFINET I/O protocol and the topology feature of PROFINET, connect cables in ports specified in the topology map. Otherwise it does not matter which ports the cables are connected to since the internal switch in the option board sends packets to the correct destination.

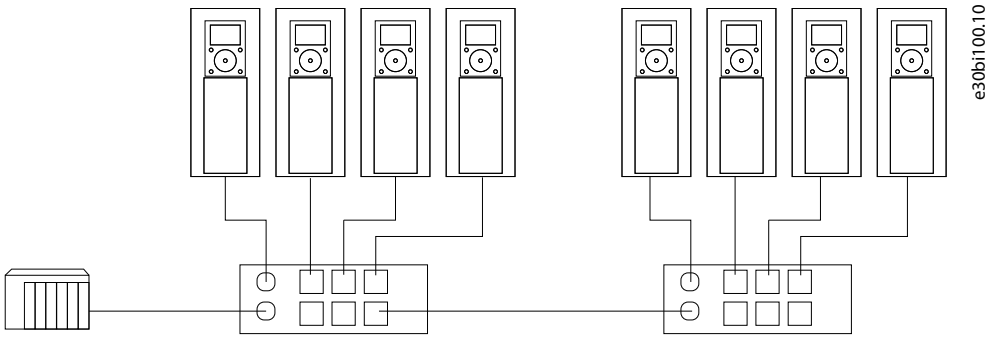


Illustration 10: A Traditional Star Topology

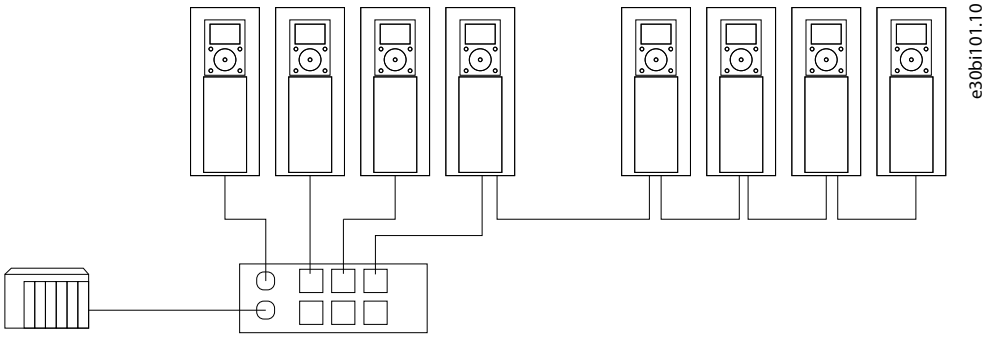


Illustration 11: A Combination of Star and Line Topology

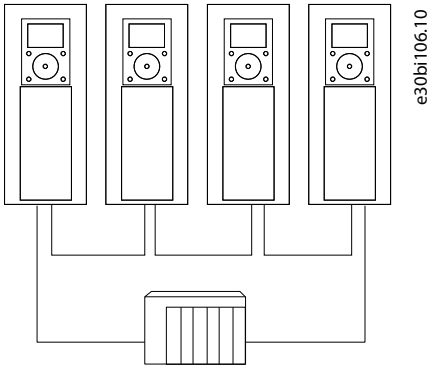


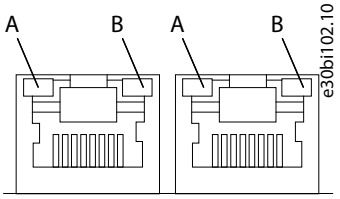
Illustration 12: A Ring Topology

The OPTEA and OPTE9 option boards support the following ring protocols:

- MRP with PROFINET I/O
- DLR with EtherNet/IP
- RSTP with PROFINET I/O, EtherNet/IP, and Modbus TCP/UDP

Ethernet ring network requires that at least one device is the ring master and logically breaks the ring. It can be either PLC or switch, but the option board can only be the ring slave.

The RJ45 connector LEDs of the OPTEA and OPTE9 option boards give information about line speed and network traffic.



A	Network speed indicator
B	Network activity indicator

Illustration 13: The OPTE9 RJ45 Connectors

The left LED of the RJ45 connector is a network speed indicator.

- LED is dimmed (dark) when the port is connected to a 10 Mbit/s network.
- LED is yellow when the port is connected to a 100 Mbit/s network.
- LED is dimmed (dark) when the port is connected to a 1000 Mbit/s network. The option board does not support a 1000 Mbit/s Ethernet, so there is no communication.

The right LED of the RJ45 connector is a network activity indicator. It blinks green when the port sends or transmits network packages. Usually this LED starts to blink immediately when the option board is connected to the Ethernet network. For example, broadcast queries that are transmitted to the option board cause the network activity LED to blink.

4.5 The OPTEC Option Board

The OPTEC EtherCAT option board has two RJ45 ports to connect it to network. Notice the IN/OUT direction. The cable coming from the OUT port of the master or the previous device must be connected to the IN port of the option board.

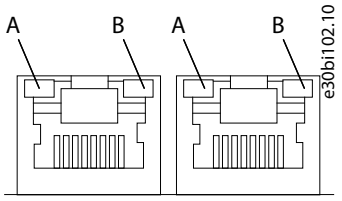
The OPTEC option board can also be used in the EtherCAT ring network (Cable Redundancy). EtherCat also supports star topology when using EtherCat hub devices.

Do not install the OPTEC option board into a standard Ethernet network, but only into dedicated EtherCAT networks.

Illustration 14: Connecting the Option Boards IN to OUT

1	OUT
2	IN

The LED of the RJ45 connector of the option board gives information about network activity.



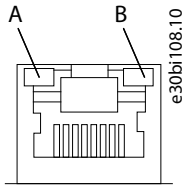
A	Led is not used
B	Network activity indicator

Illustration 15: The OPTEC RJ45 Connectors

The left LED of the RJ45 connector is not used and thus it is always dimmed (dark). The right LED of the RJ45 connector is network activity indicator. It blinks when the port sends or transmits network packages.

4.6 The OPTCI, OPTCP, and OPTCQ Option Boards

The OPTCI Modbus TCP, OPTCP PROFINET I/O, and OPTCQ EtherNet/IP option boards have one Ethernet port. Thus, these option boards can only be connected to star topology.



A	Network activity indicator
B	Network speed indicator

Illustration 16: The OPTCI, OPTCP, OPTCQ RJ45 Connector

NOTE! The LEDs in these option boards are in the opposite order when compared to OPTEA and OPTE9, and they function differently.

The right LED of the RJ45 connector is a network speed indicator.

- LED is dimmed (dark) when the port is connected to network with half duplex.
- LED is yellow when the port is connected to network with full duplex.
- LED is dimmed (dark) when the port is connected to a 1000 Mbit/s network. The option board does not support a 1000 Mbit/s Ethernet, so there is no communication.

The left LED of the RJ45 connector is a network activity indicator. It blinks green when the port sends or transmits network packages.

5 Layout and Connections

5.1 The OPTEA/E9 Option Board Layout

The VACON® Ethernet option boards are connected to the Ethernet bus using the standard RJ45 connectors (1 and 2). The communication between the control board and the AC drive takes place through a standard VACON® Interface Board Connector. OPTEA and OPTE9 boards have identical layout and connections.

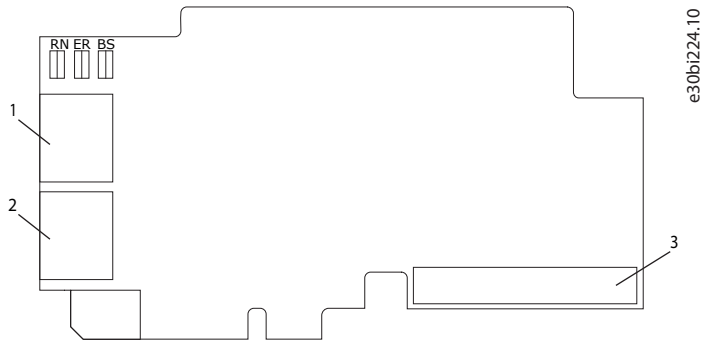


Illustration 17: The OPTEA/OPTE9 Board Layout

1	Ethernet port 1 (PHY1)	3	Interface Board connector
2	Ethernet port 2 (PHY2)		

5.2 The OPTEC Option Board Layout

The VACON® EtherCAT option board is connected to EtherCAT bus using the RJ45 connectors compatible with Ethernet standard (ISO/IEC 8802-3). The communication between the control board and the AC drive takes place through a standard VACON® Interface Board Connector.

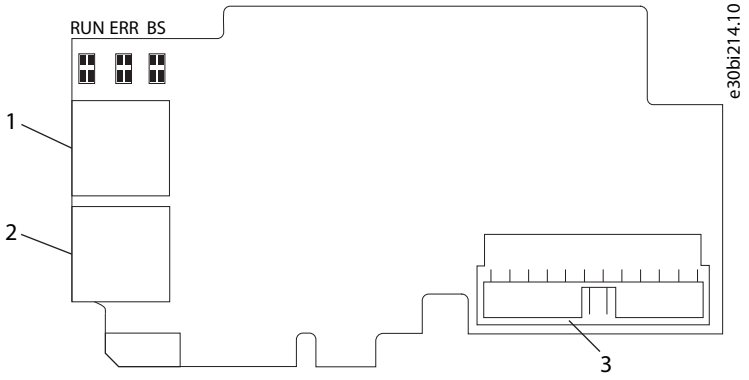


Illustration 18: The OPTEC Board Layout

1	EtherCAT bus connector OUT	3	Interface Board Connector
2	EtherCAT bus connector IN		

Table 5: EtherCAT Connectors

EtherCAT connector	Description
J1	EtherCAT bus IN (PHY1)
J2	EtherCAT bus OUT (PHY2)

Table 6: EtherCAT Connector Pin Assignment

Pin	Core coloring	Signal	Description
1	yellow	TD +	Transmission Data +
2	orange	TD -	Transmission Data -
3	white	RD +	Receiver Data +
6	blue	RD -	Receiver Data -

6 Troubleshooting

6.1 LED Indications on VACON® OPTEA/OPTE9 Option Boards

The LED indications are the same on both OPTEA and OPTE9 option boards. When the EtherNet/IP is active, the option board follows CIP standard for LED indications. Therefore, the indications described in Table 7 do not apply. See 6.2 LED Indications with EtherNet/IP.

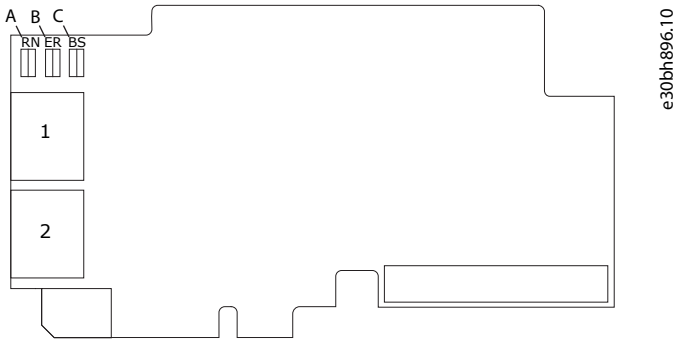


Illustration 19: LED Indications on VACON® OPTEA/OPTE9 Option Board

A	RN = Network status indicator	C	BS = Module status indicator
B	ER = I/O connection indicator		

Table 7: List of Possible LED Combinations

LED combinations	Description
RN ER BS	No power. All LEDs are OFF.
RN ER BS	Option board firmware is corrupted or its software is missing. ER is blinking red (0.25 s ON, 0.25 s OFF)
RN ER BS	Option board failure. Option board is not operational. BS is steady red and ER is possibly blinking red (2.5 s ON, 2.5 s OFF)
RN ER BS	Option board is operational. BS is steady green.
RN ER BS	Protocol is ready for communications. RN is blinking green (2.5 s ON, 2.5 s OFF), BS is steady green.

LED combinations	Description
	Protocol is communicating, RN and BS are steady green.
	Protocol communication fault. ER is blinking red to indicate a fault. RN is blinking green to indicate that protocol is again ready for communications. BS is steady red.
	Protocol is communicating with an active fault. ER is blinking red. RN and BS are steady green.
	Duplicate IP address detected. RN is blinking red. BS is steady green.
	PROFINET only! In node flashing test, all 3 LEDs are blinking green.
	If option board detects hardware failure or some other non-recoverable fault situation, it generates a slot fault (F54), and all 3 LEDs are steady red. Try to update option board firmware. If situation is not resolved with the update, replacing the option board can help.

Node Flashing Test function

To determine to which device the station is directly connected, use the "Node Flashing Test" function.

For example, in Siemens S7, go to the menu command *PLC* > *Diagnostics/Setting* > *Node Flashing Test*.... If all 3 LEDs are flashing green, the station is directly connected to the PG/PC.

6.2 LED Indications with EtherNet/IP

The LED indications of the option board follow the CIP standard when the EtherNet/IP is set as the active protocol. The labels of the LEDs on the option board differ from the CIP definitions. Check the corresponding LED labels in the following tables.

Module Status LED

The Module status LED is labeled on the board as "BS". It shows the status of the module, that is, if a fault has occurred or if the module has been configured. The MS LED functionality is described in the following table.

Table 8: EtherNet/IP Module Status LED Functionality

CIP definition	LEDs	Description
MS		No power is supplied to the device.

CIP definition	LEDs	Description
		Device operational. The device is operating correctly. LED is green.
		Standby. The device has not been configured. The module status indicator is blinking green.
		Minor fault. The device has detected a recoverable minor fault and the module status indicator is blinking red.
		Major fault. The device has detected a non-recoverable major fault. LED is red.
		Self-test. The device is performing its power up testing and the module status indicator is blinking red and green.

Network Status LED

The Network status LED is labeled on the board as "RN". It shows the connectivity status of the device, that is, if there is a connection to the device, or the IP settings status. The NS LED functionality is described in the following table.

Table 9: EtherNet/IP Network Status LED Functionality

CIP definition	LEDs	Description
NS		Not powered, no IP address. The device is powered off, or is powered on but with no IP address configured (Interface Configuration attribute of the TCP/IP Interface Object).
		No connections. An IP address is configured, but no CIP connections are established, and an Exclusive Owner connection has not timed out. The network status indicator blinks green.
		Connected. At least one CIP connection (any transport class) is established, and an Exclusive Owner connection) has not timed out. LED is green.
		Connection timeout. An Exclusive Owner connection for which this device is the target has timed out. The LED returns to steady green only when all timed out Exclusive Owner connections are re-established. Timeout of connections other than Exclusive Owner connections do not the network status indicator to blink red.
		Duplicate IP. The device has detected that its IP address is already in use by another device in the network. LED is red.

CIP definition	LEDs	Description
	RN	Self-test. The device is performing its power-up testing and the network status indicator is blinking red and green.

I/O Indicator LED

IO Indicator LED is labeled on board as "ER". It shows the status of IO connection. This functionality was added in OPTE9 firmware V009 and in OPTEA firmware V002. The LED functionality is described in the following table.

Table 10: I/O Indicator LED Functionality

LEDs	Description
ER	I/O connection is not opened or it has been closed.
ER	I/O connection is open and in RUN state. LED is green.
ER	I/O connection is open but in IDLE state. LED is red.

6.3 LED Indications on VACON® OPTEC Option Board

The RUN LED indicator describes the state of the bus and the ERR LED indicator describes the status of the board. OPTEC EtherCAT stays in INITIALISATION state until EtherCAT master device commands it into another state.

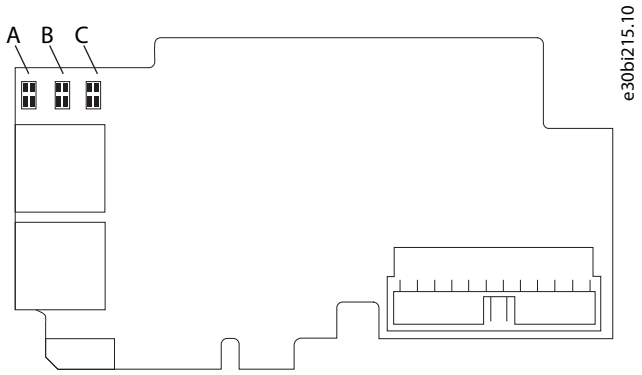


Illustration 20: LED Indications on VACON® OPTEC Option Board

A	RUN, Green	C	BS, Green
B	ERR, Red/Green		

Table 11: EtherCAT RUN, GREEN

LED RUN	Description
OFF	OPTEC EtherCAT is in INITIALISATION state.

LED RUN	Description
Blinking (once per 0.2 s)	OPTEC EtherCAT is in PRE-OPERATIONAL state.
Single Flash (once per 2 s)	OPTEC EtherCAT is in SAFE-OPERATIONAL state.
Flickering	OPTEC EtherCAT is in INITIALISATION state.
ON	OPTEC EtherCAT is in OPERATIONAL state.

Table 12: EtherCAT ERR, RED

LED ERR	Description
OFF	No Error
Blinking (once per 0.4 s)	Invalid configuration
Single Flash (once per 2 s)	ASIC synchronization error
Double Flash	Process Data Watchdog Timeout/EtherCAT Watchdog Timeout
Flickering	ASIC hardware failure
ON	Application Controller Failure

LED ERR Green is used by EtherCAT option board only at startup to indicate boot status.

Table 13: EtherCAT ERR, GREEN

LED ERR	Description
OFF	No Error
Blink once	Option board is powered on
Blinking	Option board boot failure

LED BS provides information about the EtherCAT option board internal state.

Table 14: BS = OPTEC board status, GREEN

LED BS	Description
OFF	Option board is not activated.
ON	Option board is in initialization state, waiting activation command from the AC drive.
Blinking fast (once per 1 s)	Option board is activated and in RUN state • Option board is ready for external communication

If there is an unrecoverable error, the OPTEC board notifies of this by using the red error LED. The cause of the error is coded into a series of long and short flashes. The sequence coded error message repeats indefinitely. If more than one error has occurred the board cycles through each error code repeatedly.

Table 15: Error codes

Error number	Error name	Long flashes	Short flashes	Description
1	Initialization Error	1	2	Board Initialization Failed
2	Setup Error	1	3	Board Setup Failed
3	System Error 1	1	4	Internal System Error 1

Error number	Error name	Long flashes	Short flashes	Description
4	System Error 2	2	1	Internal System Error 2
5	System Error 3	2	2	Internal System Error 3
6	EEPROM Error	2	3	Option Board EEPROM Read/Write Error
7	ASIC Error	2	4	EtherCAT ASIC Communication Error
8	Fieldbus Error	3	1	Fieldbus Interface Error
9	OB Service Error	3	2	Option Board Service Error
10	OB Manager Error	3	3	Option Board Manager Error

6.4 LED Indications on VACON® OPTCI, OPTCQ, and OPTCP Option Boards

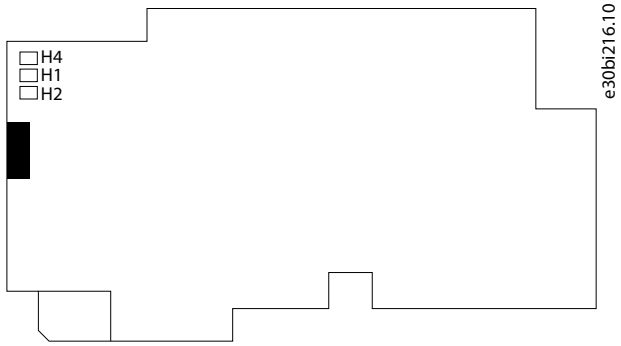


Illustration 21: LED Indications on VACON® OPTCI,OPTCQ, and OPTCP Option Boards

Table 16: LED Indications on OPTCI, OPTCQ, and OPTCP Option Boards

LED	Description
H4	LED in ON when board is powered
H1	• Blinking 0.25 s ON/0.25 s OFF when board firmware is corrupted. • OFF when board is operational.
H2	• Blinking 2.5 s ON/2.5 s OFF when board is ready for external communication. • OFF when board is not operational.

Node Flashing Test function

To determine to which device the station is directly connected, use the "Node Flashing Test" function.

For example, in Siemens S7, go to the menu command *PLC* > *Diagnostics/Setting* > *Node Flashing Test*.... The flashing FORCE LED identifies the station connected directly to the PG/PC.

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Vacon Ltd
Member of the Danfoss Group
Runsorintie 7
65380 Vaasa
Finland
www.danfoss.com

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