

ENGINEERING
TOMORROW



Operating Guide

VACON® 100 Wall-mounted Drives VACON® 100 INDUSTRIAL, VACON® 100 FLOW, VACON® 100 HVAC



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1 Introduction

1.1 Additional Resources

Other resources are available to understand advanced AC drive functions and operation.

- VACON® 100 INDUSTRIAL Application Guide
- VACON® 100 FLOW Application Guide
- VACON® 100 HVAC Application Guide
- VACON® 100 Enclosed Drives Installation Manual
- VACON® 100 IP00 Drive Modules Installation Manual
- VACON® 100 X Installation Manual
- Instructions for operation with option boards and other optional equipment.

Supplementary publications and manuals are available from Danfoss.

For US and Canada market:

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/>.

1.2 Disposal



















Context:

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



1.3 Type Approvals and Certifications

The following list is a selection of possible type approvals and certifications for Danfoss drives:

NOTICE

The specific approvals and certification for the drive are on the nameplate of the drive. For more information, contact the local Danfoss office or partner.

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 Danger and Warnings

DANGER

SHOCK HAZARD FROM POWER UNIT COMPONENTS

The power unit components are live when the drive is connected to mains. A contact with this voltage can lead to death or serious injury.

- Do not touch the components of the power unit when the drive is connected to mains. Before connecting the drive to mains, make sure that the covers of the drive are closed.

DANGER

SHOCK HAZARD FROM TERMINALS

The motor terminals U, V, W, the brake resistor terminals, or the DC terminals are live when the drive is connected to mains, also when the motor does not operate. A contact with this voltage can lead to death or serious injury.

- Do not touch the motor terminals U, V, W, the brake resistor terminals, or the DC terminals when the drive is connected to mains. Before connecting the drive to mains, make sure that the covers of the drive are closed.

⚠ DANGER ⚠**SHOCK HAZARD FROM DC LINK OR EXTERNAL SOURCE**

The terminal connections and the components of the drive can be live 5 minutes after the drive is disconnected from the mains and the motor has stopped. Also the load side of the drive can generate voltage. A contact with this voltage can lead to death or serious injury.

- Before doing electrical work on the drive:
 - Disconnect the drive from the mains and make sure that the motor has stopped.
 - Lock out and tag out the power source to the drive.
 - Make sure that no external source generates unintended voltage during work.
 - Wait 5 minutes before opening the cabinet door or the cover of the AC drive.
 - Use a measuring device to make sure that there is no voltage.

⚠ 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.

⚠ WARNING ⚠**ACCIDENTAL MOTOR START**

When there is a power-up, a power break, or a fault reset, the motor starts immediately if the start signal is active, unless the pulse control for Start/Stop logic is selected. If the parameters, the applications or the software change, the I/O functions (including the start inputs) can change. If you activate the auto reset function, the motor starts automatically after an automatic fault reset. See the Application Guide. Failure to ensure that the motor, system, and any attached equipment are ready for start can result in personal injury or equipment damage.

- Disconnect the motor from the drive if an accidental start can be dangerous. Make sure that the equipment is safe to operate under any condition.

⚠ WARNING ⚠**LEAKAGE CURRENT HAZARD**

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

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

⚠ WARNING ⚠**SHOCK HAZARD FROM PE CONDUCTOR**

The drive can cause a DC current in the PE conductor. Failure to use a residual current-operated protective (RCD) device Type B or a residual current-operated monitoring (RCM) device can lead to the RCD not providing the intended protection and therefore can result in death or serious injury.

- Use a type B RCD or RCM device on the mains side of the drive.

2.3 Cautions and Notices

⚠ CAUTION ⚠

DAMAGE TO THE AC DRIVE FROM INCORRECT MEASUREMENTS

Doing measurements on the AC drive when it is connected to mains can damage the drive.

- Do not do measurements when the AC drive is connected to mains.

⚠ CAUTION ⚠

DAMAGE TO THE AC DRIVE FROM INCORRECT SPARE PARTS

Using spare parts that are not from the manufacturer can damage the drive.

- Do not use spare parts that are not from the manufacturer.

⚠ CAUTION ⚠

DAMAGE TO THE AC DRIVE FROM INSUFFICIENT GROUNDING

Not using a grounding conductor can damage the drive.

- Make sure that the AC drive is always grounded with a grounding conductor that is connected to the grounding terminal that is identified with the PE symbol.

⚠ CAUTION ⚠

CUT HAZARD FROM SHARP EDGES

There can be sharp edges in the AC drive that can cause cuts.

- Wear protective gloves when mounting, cabling, or doing maintenance operations.

⚠ CAUTION ⚠

BURN HAZARD FROM HOT SURFACES

Touching surfaces, which are marked with the 'hot surface' sticker, can result in injury.

- Do not touch surfaces which are marked with the 'hot surface' sticker.

NOTICE

DAMAGE TO THE AC DRIVE FROM STATIC VOLTAGE

Some of the electronic components inside the AC drive are sensitive to ESD. Static voltage can damage the components.

- Remember to use ESD protection always when working with electronic components of the AC drive. Do not touch the components on the circuit boards without proper ESD protection.

NOTICE

DAMAGE TO THE AC DRIVE FROM MOVEMENT

Movement after installation can damage the drive.

- Do not move the AC drive during operation. Use a fixed installation to prevent damage to the drive.

NOTICE

DAMAGE TO THE AC DRIVE FROM INCORRECT EMC LEVEL

The EMC level requirements for the AC drive depend on the installation environment. An incorrect EMC level can damage the drive.

- Before connecting the AC drive to the mains, make sure that the EMC level of the AC drive is correct for the mains.

NOTICE

RADIO INTERFERENCE

In a residential environment, this product can cause radio interference.

- Take supplementary mitigation measures.

NOTICE

MAINS DISCONNECTION DEVICE

If the AC drive is used as a part of a machine, the machine manufacturer must supply a mains disconnection device (refer to EN 60204-1).

NOTICE

MALFUNCTION OF FAULT CURRENT PROTECTIVE SWITCHES

Because there are high capacitive currents in the AC drive, it is possible that the fault current protective switches do not operate correctly.

NOTICE

VOLTAGE WITHSTAND TESTS

Doing voltage withstand tests can damage the drive.

- Do not do voltage withstand tests on the AC drive. The manufacturer has already done the tests.

3 Product Overview

3.1 Manual Version

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

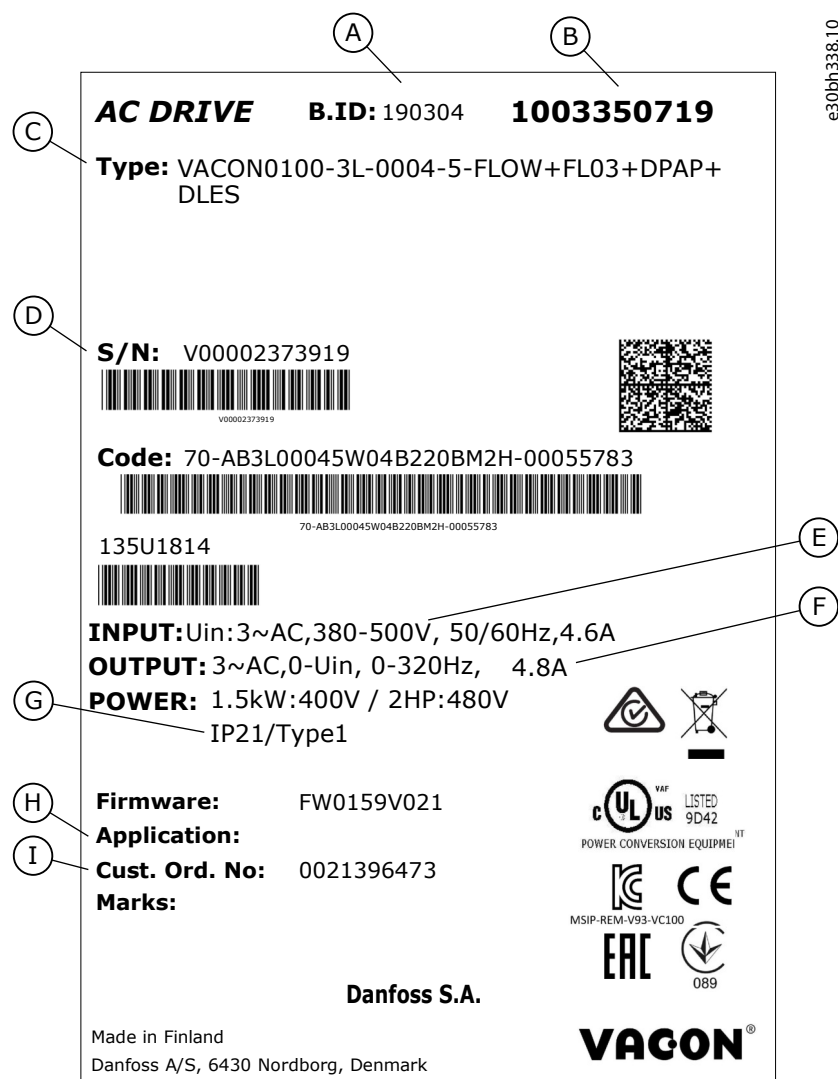
The original language of this manual is English.

Table 1: Manual and Software Version

Edition	Remarks
DPD01711H	<p>Information about the new enclosure size MR9B and internal fieldbuses was added.</p> <p>Information about option boards was updated.</p> <p>EC declaration was removed.</p> <p>Information about VACON® 100 IP00 drive modules was removed.</p> <p>Hyperlink to company web page was updated.</p> <p>Structure of the manual was changed.</p> <p>Minor changes throughout the manual.</p>

3.2 Package Label

The package label gives detailed information about the delivery.



A The batch ID	B The VACON® order number
C The type code	D The serial number
E The mains voltage	F The nominal output current
G The protection rating	H The application code
I The order number of the customer	

Illustration 1: Package Label of VACON® 100 Wall-mounted Drives

3.3 Description of the Type Code

The type code of VACON® is made of standard codes and optional codes. Each part of the type code agrees to the data in the order.

Example:

The code can have this format, for example:

- VACON0100-3L-0061-5+IP54
- VACON0100-3L-0061-5-FLOW

Table 2: Description of the Type Code

Code	Description
VACON0100	The product family: VACON0100 = the VACON® 100 product family
3L	Input/Function: 3L = A 3-phase input
0061	The drive rating in amperes. For example, 0061 = 61 A
5	The mains voltage: 2 = 208–240 V 5 = 380–500 V 6 = 525–600 V 7 = 525–690 V
FLOW	The product: (empty) = The VACON® 100 INDUSTRIAL AC drive FLOW = The VACON® 100 FLOW AC drive HVAC = The VACON® 100 HVAC AC drive
+IP54	The optional codes. There are many options, for example +IP54 (an AC drive with the protection rating IP54).

3.4 Enclosure Sizes

The codes for nominal current and nominal mains voltage are part of the type code (see [3.3 Description of the Type Code](#)) on the package label (see [3.2 Package Label](#)). Use these values to find out the enclosure size of the AC drive from the table.

In the example "VACON0100-3L-0061-5+IP54", the code for nominal current is 0003 and the code for nominal mains voltage is 5.

Table 3: Enclosure Sizes

Nominal mains voltage	Nominal current	Enclosure size
2 (208–240 V)	0003	MR4
	0004	
	0007	
	0008	
	0011	
	0012	
	0018	MR5
	0024	
	0031	
	0048	MR6
	0062	
	0075	MR7
	0088	
	0105	
	0140	MR8
	0170	
	0205	
	0261	MR9A
	0310	

Nominal mains voltage	Nominal current	Enclosure size
5 (380–500 V)	0003	MR4
	0004	
	0005	
	0008	
	0009	
	0012	
	0016	MR5
	0023	
	0031	
	0038	MR6
	0046	
	0061	
	0072	MR7
	0087	
	0105	
	0140	MR8
	0170	
	0205	
	0261	MR9A
	0310	
	0386	MR9B

Nominal mains voltage	Nominal current	Enclosure size
6 (525–600 V)	0004	MR5
	0006	
	0009	
	0011	
	0018	MR6
	0022	
	0027	
	0034	
	0041	MR7
	0052	
	0062	
	0080	MR8
	0100	
	0125	
	0144	MR9A
	0208	
	0262	MR9B
7 (525–690 V)	0007	MR6
	0010	
	0013	
	0018	
	0022	
	0027	
	0034	
	0041	MR7
	0052	
	0062	
	0080	MR8
	0100	
	0125	
	0144	MR9A
	0170	
	0208	
	0262	MR9B

4 Receiving the Delivery

4.1 Checking the Delivery

Context:

Procedure

1. After you remove the packaging, examine the drive for transport damages.
 - A If the drive was damaged during the shipping, speak to the cargo insurance company or the carrier.
2. To make sure that the delivery is correct, compare your order data to the data on the package label.
 - A If the delivery does not agree with your order, speak to the vendor immediately.
3. To make sure that the contents of the delivery is correct and complete, compare the type designation of the product to the type code.

4.2 Accessories

4.2.1 Accessories Bag, MR4

Table 4: The Content of the Accessories Bag

Item	Quantity	Description
M4x16 screw	11	Screws for the grounding clamps for cable shield (6), the grounding clamps for control cable (3), and the grounding clamps for grounding conductor (2)
M4x8 screw	1	Screw for the optional grounding
M5x12 screw	1	Screw for the external grounding of the drive
Grounding clamp for control cable	3	Control cable grounding
Grounding clamp for cable shield, size M25	3	Clamping the power cables
Grounding clamp for grounding conductor	2	Power cable grounding
"Product modified" label	1	Data about changes
IP21: Cable grommet	3	Sealing for the cables
IP54: Cable grommet	6	Sealing for the cables

4.2.2 Accessories Bag, MR5

Table 5: The Content of the Accessories Bag

Item	Quantity	Description
M4x16 screw	13	Screws for the grounding clamps for cable shield (6), the grounding clamps for control cable (3), and the grounding clamps for grounding conductor (4)
M4x8 screw	1	Screw for the optional grounding

Item	Quantity	Description
M5x12 screw	1	Screw for the external grounding of the drive
Grounding clamp for control cable	3	Control cable grounding
Grounding clamp for cable shield, size M25	1	Clamping the brake cable
Grounding clamp for cable shield, size M32	2	Clamping the power cables
Grounding clamp for grounding conductor	2	Power cable grounding
"Product modified" label	1	Data about changes
IP21: Cable grommet, hole diameter 25.3 mm	1	Sealing for the cables
IP54: Cable grommet, hole diameter 25.3 mm	4	Sealing for the cables
Cable grommet, hole diameter 33.0 mm	2	Sealing for the cables

4.2.3 Accessories Bag, MR6

Table 6: The Content of the Accessories Bag

Item	Quantity	Description
M4x20 screw	10	Screws for the grounding clamps for cable shield (6), and the grounding clamps for grounding conductor (4)
M4x16 screw	3	Screws for the control cable clamps
M4x8 screw	1	Screw for the optional grounding
M5x12 screw	1	Screw for the external grounding of the drive
Grounding clamp for control cable	3	Control cable grounding
Grounding clamp for cable shield, size M32	1	Clamping the brake resistor cable
Grounding clamp for cable shield, size M40	2	Clamping the power cables
Grounding clamp for grounding conductor	2	Power cable grounding
"Product modified" label	1	Data about changes
Cable grommet, hole diameter 33.0 mm	1	Sealing for the cables
Cable grommet, hole diameter 40.3 mm	2	Sealing for the cables
IP54: Cable grommet, hole diameter 25.3 mm	3	Sealing for the cables

4.2.4 Accessories Bag, MR7

Table 7: The Content of the Accessories Bag

Item	Quantity	Description
M6x30 slotted nut	6	Nuts for the grounding clamps for cable shield
M4x16 screw	3	Screws for the grounding clamps for control cable
M6x12 screw	1	Screw for the external grounding of the drive
Grounding clamp for control cable	3	Control cable grounding

Item	Quantity	Description
Grounding clamp for cable shield, size M25	3	Clamping the power cables
Grounding clamp for grounding conductor	2	Power cable grounding
"Product modified" label	1	Data about changes
IP21: Cable grommet	3	Sealing for the cables
IP54: Cable grommet	3	Sealing for the cables

4.2.5 Accessories Bag, MR8

Table 8: The Content of the Accessories Bag

Item	Quantity	Description
M4x16 screw	3	Screws for the grounding clamps for control cable
Grounding clamp for control cable	3	Control cable grounding
Grounding clamp for cable shield KP40	3	Clamping the power cables
Cable insulator	11	To prevent contact between cables
Cable grommet, hole diameter 25.3 mm	4	Sealing for the cables
Bushing rubber	4	Sealing for the control cables
M8 hexagon nut	15	For cable installation
Conical spring washer	11	For cable installation
Split spring washer	4	For grounding clamp installation
M4x10 pan head screw	2	For touch cover installation (IP00)
Grounding clamp for grounding conductor	2	Clamping the grounding conductor of the power cables
Product modified label	1	Data about changes

4.2.6 Accessories Bag, MR9

Table 9: The Content of the Accessories Bag

Item	Quantity	Description
M4x16 screw	3	Screws for the grounding clamps for control cable
Grounding clamp for control cable	3	Control cable grounding
Cable insulator	10	To prevent contact between cables
Cable grommet, hole diameter 25.3 mm	4	Sealing for the cables
Bushing rubber	4	Sealing for the control cables
M4x8 screw	2	For installation
M8 hexagon nut	6	For installation
Split spring washer	4	For grounding clamp installation

Item	Quantity	Description
M10 hexagon nut	9	For cable installation
Conical spring washer	9	For cable installation
Grounding clamp for grounding conductor	2	Grounding cover
Product modified label	1	Data about changes

4.3 Storing the Product

Context:

If you need to store the product before installing it, follow these instructions.

Procedure

- Make sure that the ambient conditions agree to these:
 - Temperature: -40...+70 °C (-40...+158°F)
 - Humidity: 0...95%, no condensation
- If you keep the package in storage for more than 2 months, keep it in controlled conditions.
 - Make sure that the temperature variation is small.
 - Make sure that the humidity is less than 50%.

4.4 Lifting the Enclosure Sizes MR8 and MR9

Context:

The weights of AC drives of different enclosure sizes are different. It can be necessary for you to use a lifting device to move the drive from its package. See the weights of the different enclosure sizes in [table 23](#).

⚠ WARNING ⚠

LIFTING HEAVY LOAD

Not following the safe lifting instructions can result in death or serious injury.

- Do not walk under suspended loads. Use lifting devices that are appropriate for the weight of the unit. Use the recommended lifting method.

Procedure

1. Remove the drive from the pallet where it was bolted to.
2. Use a lifting device that is sufficiently strong for the weight of the drive.
3. Put the lifting hooks symmetrically in a minimum of 2 holes.

A The maximum lifting angle is 45 °.

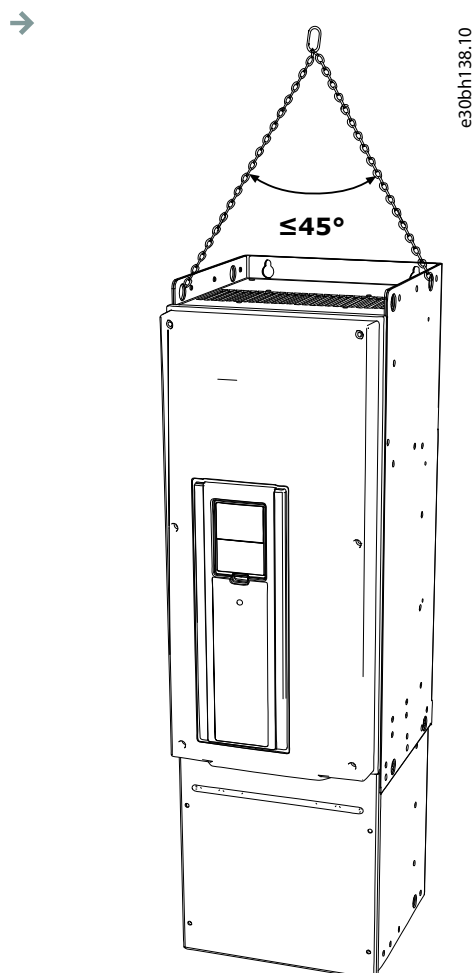


Illustration 2: Maximum Lifting Angle

4.5 Using the Product Modified Label

Context:

In the accessories bag, there is also a "product modified" label. The function of the label is to tell the service personnel about the changes that are made in the AC drive.

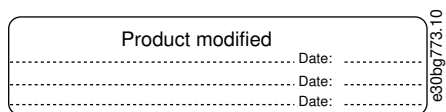


Illustration 3: The Product Modified Label

Procedure

1. Attach the label on the side of the AC drive to know where to find it.
2. If changes are made in the AC drive, write the change on the label.

5 Mounting

5.1 Wall-mounting Requirements

Install the AC drive in a vertical position on the wall.

If you install the drive in a horizontal position, there is no protection against drops of water that fall vertically. Use the same mounting points as with vertical installation and pay special attention to cooling requirements (see [5.3.2 Cooling](#)).

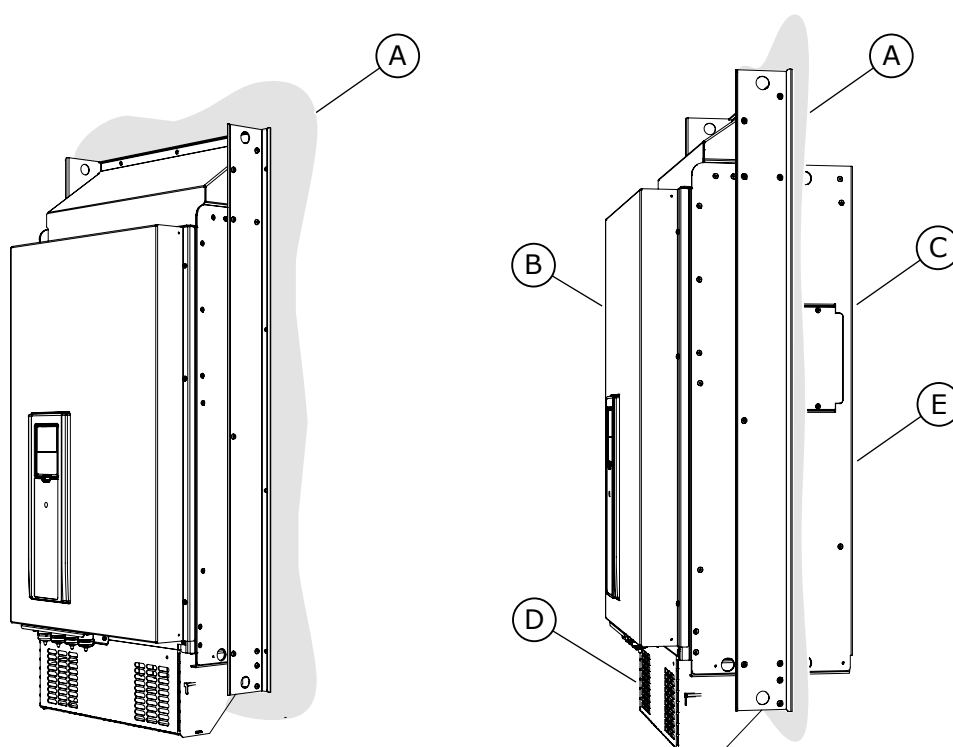
Install the AC drive with the screws and other components included in the delivery.

5.2 Flange-mounting Requirements

You can also install the AC drive into the cabinet wall with a flange mounting option.

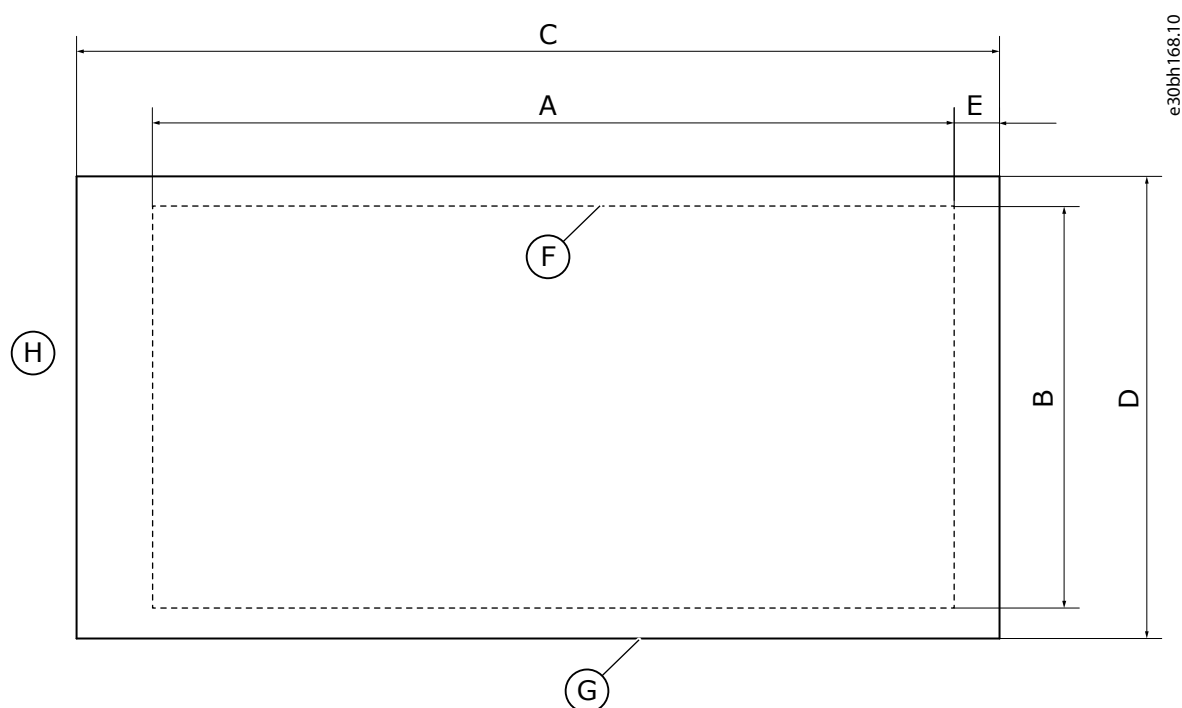
NOTICE

The protection classes are different in different sections of the drive.



A The cabinet wall or other surface	B The front
C The rear	D IP21/UL Type 1
E IP54/UL Type 12	

Illustration 4: Example of Flange Mounting



A The height of the opening	B The width of the opening
C The height of the drive	D The width of the drive
E The distance between the bottom of the drive and the bottom of the opening	F The outline of the opening
G The outline of the drive	H The top of the drive

Illustration 5: Dimensions of the Opening and Drive Outline with Flange

Table 10: The Dimensions of the Drive, MR4 to MR7, in mm (in inch)

Enclosure size	C	D
MR4	357 (14.1)	152 (6.0)
MR5	454 (17.9)	169 (6.7)
MR6	580 (22.8)	220 (8.7)
MR7	680 (26.8)	286 (11.3)

Table 11: The Dimensions of the Opening for the Flange Mounting, MR4 to MR7, in mm (in inch)

Enclosure size	A	B	E
MR4	315 (12.4)	137 (5.4)	24 (0.9)
MR5	408 (16.1)	152 (6.0)	23 (0.9)
MR6	541 (21.3)	203 (8.0)	23 (0.9)
MR7	655 (25.8)	240 (9.4)	13 (0.5)

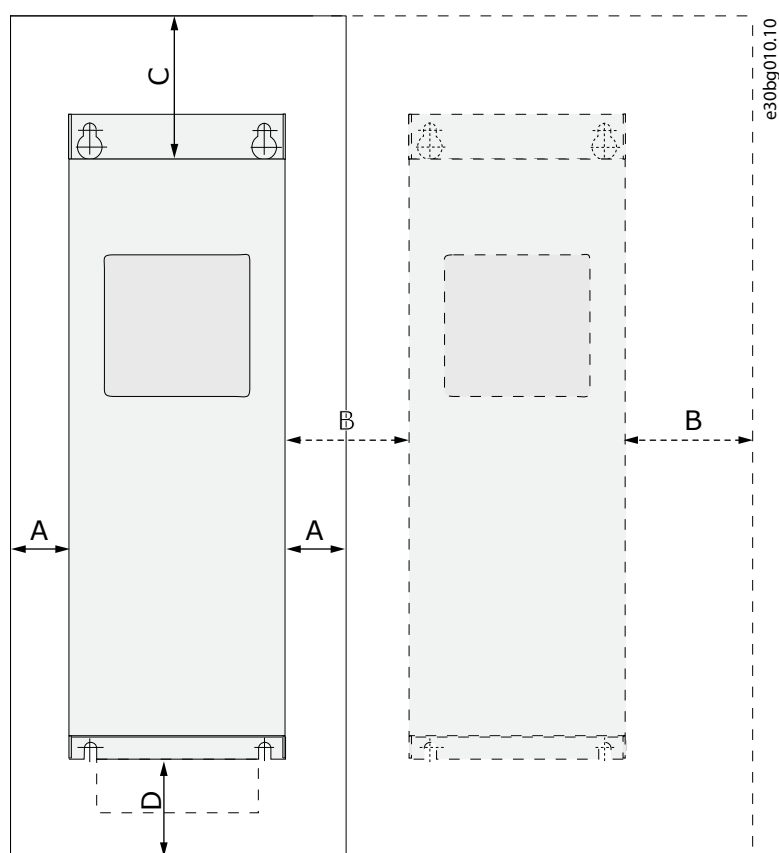
5.3 Cooling Requirements

5.3.1 General Cooling Requirements

The AC drive produces heat in operation. The fan moves air and decreases the temperature of the drive. Make sure that there is sufficiently free space around the drive. Some free space is also necessary for maintenance.

Make sure that the temperature of the cooling air does not go above the maximum ambient operating temperature or below the minimum ambient operating temperature of the drive.

5.3.2 Cooling



A The clearance around the drive (see also B and C)	B The distance from a drive to a second drive, or the distance to the cabinet wall
C The free space above the drive	D The free space below the drive

Illustration 6: Installation Space

Table 12: Minimum Clearances around the AC Drive in mm (in inch)

Enclosure size	A ⁽¹⁾	B ⁽¹⁾	C	D
MR4	20 (0.8)	20 (0.8)	100 (3.9)	50 (2.0)
MR5	20 (0.8)	20 (0.8)	120 (4.7)	60 (2.4)
MR6	20 (0.8)	20 (0.8)	160 (6.3)	80 (3.1)
MR7	20 (0.8)	20 (0.8)	250 (9.8)	100 (3.9)
MR8	20 (0.8)	20 (0.8)	300 (11.8)	150 (5.9)
MR9	20 (0.8)	20 (0.8)	350 (13.8)	200 (7.9)

¹ For a drive with IP54/UL Type 12, the minimum clearances A and B are 0 mm/0 in.

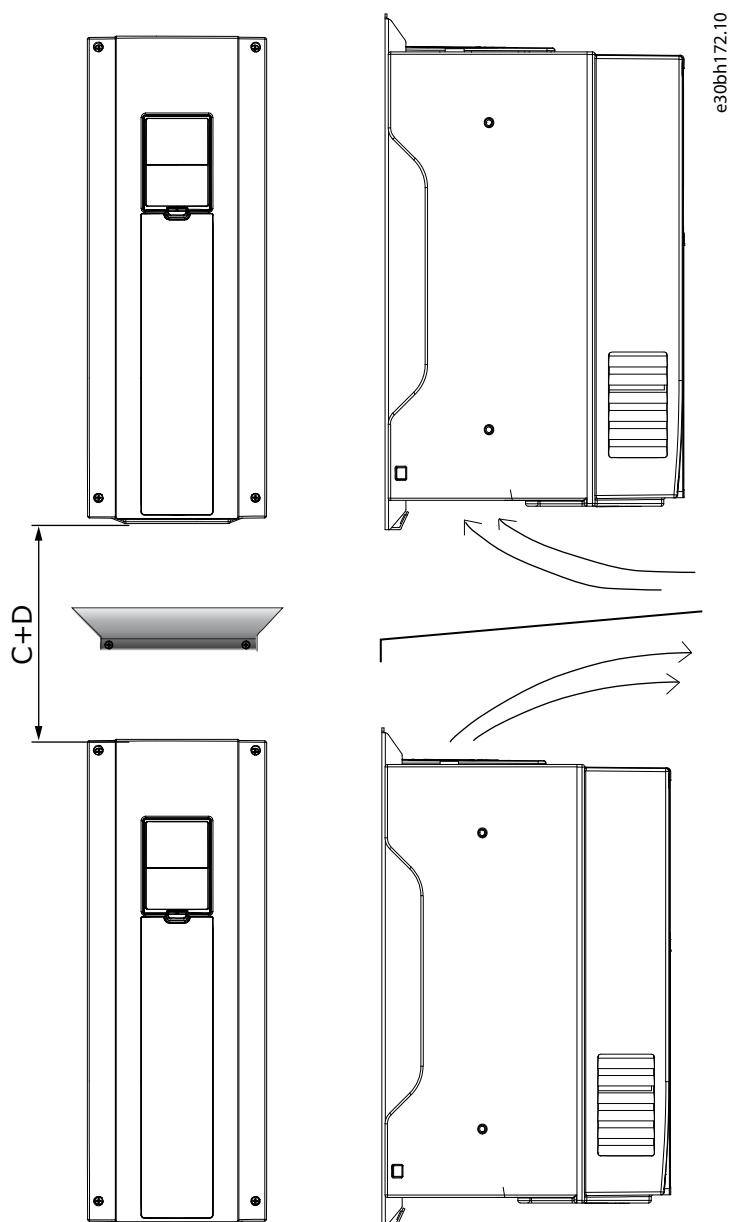


Illustration 7: Installation Space when Drives Are Installed on Top of Each Other

- If many AC drives are installed above each other, the necessary free space is $C + D$ (see [illustration 6](#)).
- Make also sure that the outlet air from the lower drive goes to a different direction than the air intake of the top drive. To do this, attach a metal plate to the cabinet wall between the drives.
- When the drives are installed in a cabinet, make sure to prevent recirculation of air.

5.3.3 Necessary Quantity of Cooling Air

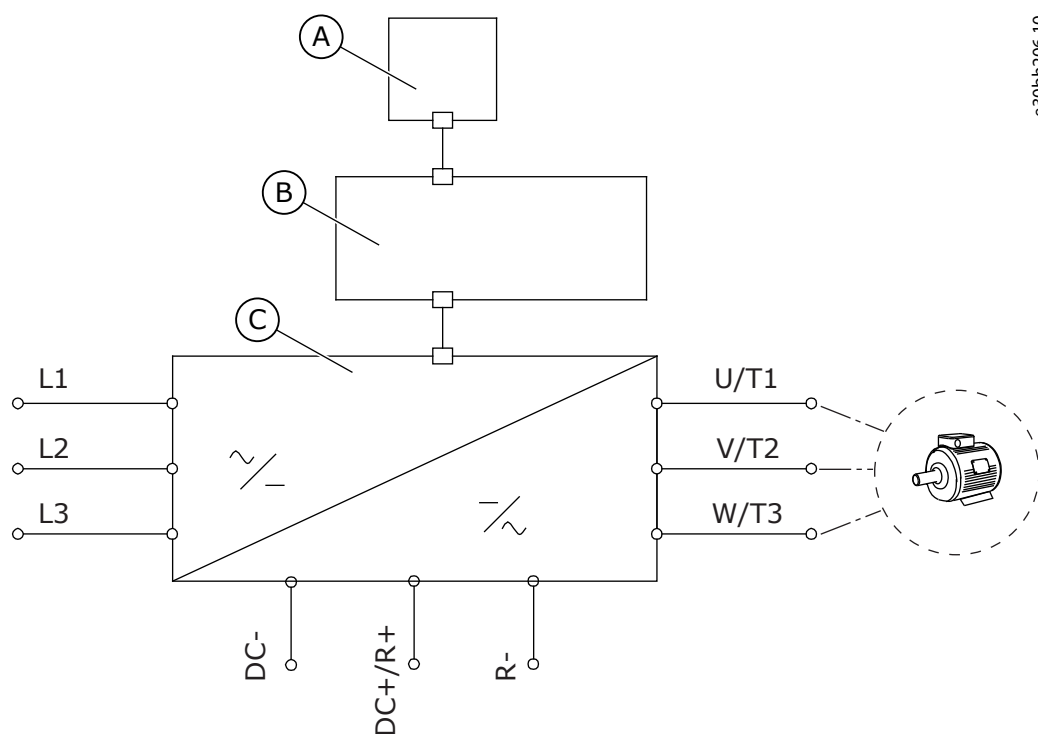
Table 13: The Necessary Quantity of Cooling Air

Enclosure size	The quantity of cooling air, m ³ /h	The quantity of cooling air, CFM
MR4	45	26
MR5	75	44
MR6	190	112
MR7	185	109
MR8	335	197
MR9	620	365

6 Electrical Installation

6.1 Cable Connections

The mains cables are connected to terminals L1, L2, and L3. The motor cables are connected to terminals U, V, and W.



A The control panel	B The control unit
C The power unit	

Illustration 8: Principal Connection Diagram

For EMC-compliant installation, see [6.2 EMC-compliant Installation](#).

6.1.1 General Cable Requirements

Use cables with a minimum heat resistance of +70 °C (158 °F). In the selection of the cables and the fuses, refer to the nominal output current of the drive. Find the nominal output current on the nameplate.

For information on how to make the cable installation to comply with the UL standards, see [6.1.2 UL Standards on Cabling](#).

These instructions are valid only for processes that have 1 motor and 1 cable connection from the AC drive to the motor. In other conditions, speak to the manufacturer to get more information.

6.1.2 UL Standards on Cabling

To comply with the UL (Underwriters Laboratories) regulations, use a UL-approved copper wire with a minimum heat resistance of 60 °C or 75 °C (140 °F or 167 °F).

To comply with the standards, use cables with +90 °C (194 °F) heat resistance for the 500 V drive.

Use Class 1 wire only.

When the drive has Class T and J fuses, it can be used on a circuit that gives a maximum of 100 000 rms symmetrical amperes, and a maximum of 600 V.

The integral solid-state short-circuit protection does not give a branch circuit protection. Obey the National Electric Code and any additional local codes to get the branch circuit protection. Only fuses give the branch circuit protection.

For the tightening torques of the terminals, see [10.5 Tightening Torques of the Terminals](#).

6.1.3 Cable Selection and Dimensioning

Find the typical sizes and types of cables used with the AC drive in the tables in [10.3.1 List of Cable and Fuse Size Information](#). In the selection of cables, refer to local regulations, cable installation conditions, and cable specification.

The dimensions of the cables must comply with the requirements of the standard IEC60364-5-52.

- The cables must be PVC-isolated.
- The maximum ambient temperature is +30 °C.
- The maximum temperature of the cable surface is +70 °C.
- Use only cables with a concentric copper shield.
- The maximum number of parallel cables is 9.

When using parallel cables, make sure to obey the requirements of the cross-sectional area and the maximum number of cables.

For important information on the requirements of the grounding conductor, see [6.3 Grounding](#).

For the correction factors for each temperature, see the standard IEC60364-5-52.

6.1.4 Cable Selection and Dimensioning, North America

Find the typical sizes and types of cables used with the AC drive in the tables in [10.3.1 List of Cable and Fuse Size Information](#). In the selection of cables, refer to local regulations, cable installation conditions, and cable specification.

The dimensions of the cables must comply with the requirements of the Underwriters Laboratories UL 61800-5-1.

- The cables must be PVC-isolated.
- The maximum ambient temperature is +86 °F.
- The maximum temperature of the cable surface is +158 °F.
- Use only cables with a concentric copper shield.
- The maximum number of parallel cables is 9.

When using parallel cables, make sure to obey the requirements of the cross-sectional area and the maximum number of cables.

For important information on the requirements of the grounding conductor, see the Underwriters Laboratories standard UL 61800-5-1.

For the correction factors for each temperature, see the instructions of the Underwriters Laboratories UL 61800-5-1.

6.1.5 Fuse Selection

We recommend the fuse type gG/gL (IEC 60269-1). To make a selection of the fuse voltage rating, refer to the mains. Refer also to local regulations, cable installation conditions, and cable specification. Do not use larger fuses than what is recommended.

Find the recommended fuses in tables in [10.3.1 List of Cable and Fuse Size Information](#).

Make sure that the operation time of the fuse is less than 0.4 s. The operation time agrees with the fuse type and the impedance of the supply circuit. For more information on faster fuses, speak to the manufacturer. The manufacturer can also recommend some aR (UL recognized, IEC 60269-4) and gS (IEC 60269-4) fuse ranges.

6.1.6 Fuse Selection, North America

We recommend the fuse class T (UL & CSA). To make a selection of the fuse voltage rating, refer to the mains. Refer also to local regulations, cable installation conditions, and cable specification. Do not use larger fuses than what is recommended.

Find the recommended fuses in tables in [10.3.1 List of Cable and Fuse Size Information](#).

Make sure that the operation time of the fuse is less than 0.4 s. The operation time agrees with the fuse type and the impedance of the supply circuit. For more information on faster fuses, speak to the manufacturer. The manufacturer can also recommend some high-speed Class J (UL & CSA) and aR (UL recognised) fuse ranges.

The solid-state short circuit protection does not supply protection for the branch circuit of the AC drive. To supply the branch circuit protection, refer to the National Electric Code and the local regulations. Do not use other devices than fuses to supply branch circuit protection.

6.1.7 Brake Resistor Cables

VACON® 100 wall-mounted drives have terminals for an optional external brake resistor. These terminals are identified with R+ and R- (in MR4) or DC+/R+ and R- (in MR5, MR6, MR7, MR8, and MR9). Find the dimensions that we recommend for the brake resistor cables in the tables linked in [10.3.1 List of Cable and Fuse Size Information](#). See also the brake resistor ratings in [10.8.1 Brake Resistor Ratings](#).

⚠ CAUTION ⚠

SHOCK HAZARD FROM MULTI-CONDUCTOR CABLES

With a multi-conductor cable, the conductors that are not connected can cause an accidental contact with a conducting component.

- If a multi-conductor cable is used, cut off all conductors that are not connected.

The enclosure sizes MR7, MR8, and MR9 have the brake chopper only if their type code has the code +DBIN. The frames MR4, MR5, and MR6 have the brake chopper as standard.

NOTICE

The VACON® 100 FLOW and HVAC software do not have the dynamic braking or the brake resistor functions.

6.2 EMC-compliant Installation

For cable selections in different EMC levels, see [table 14](#).

To comply with the EMC levels, use a grommet when installing the motor cable at the two ends. For the EMC level C2, it is necessary to have a 360° grounding of the shield with grommets in the motor end.

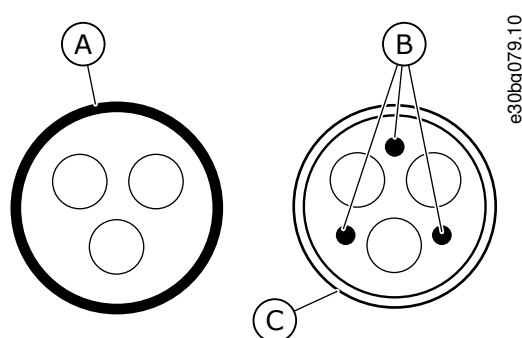
Table 14: Recommendations for Cables

Cable type	Category C2 ⁽¹⁾	Category C3 ⁽²⁾	Category C4 ⁽²⁾
Motor cable	<p>A symmetrical power cable with a compact low-impedance shield.</p> <p>A cable for the specified mains voltage.</p> <p>We recommend an MCCMK, or an EMCCK cable. See illustration 9.</p> <p>We recommend that the cable transfer impedance (1–30 MHz) is a maximum of 100 mΩ/m.</p>	<p>A symmetrical power cable with a concentric protection wire.</p> <p>A cable for the specified mains voltage.</p> <p>We recommend an MCCMK cable. See illustration 9.</p>	
Mains cable	<p>A power cable for a fixed installation.</p> <p>A cable for the specified mains voltage.</p> <p>A shielded cable is not necessary.</p> <p>We recommend an MCCMK cable.</p>		
Control cable	<p>A shielded cable with a compact low-impedance shield, for example a JAMAK, or an SAB/ÖZCuY-O cable.</p>		

¹ 1st environment

² 2nd environment

For the definitions of EMC protection levels, see IEC/EN 61800-3 + A1.



A The PE conductor and the shield	B The PE conductors
C The shield	

Illustration 9: Cables with PE Conductors

In all the enclosure sizes, to comply with the EMC standards, use the default values of the switching frequencies.

If installing a safety switch, make sure that the EMC protection continues from the start of the cables until their ends.

The drive must obey the standard IEC 61000-3-12. To obey it, the short circuit power S_{SC} must be a minimum of $120 R_{SCE}$ at the interface point between mains and the public mains. Make sure to connect the drive and the motor to mains with a short circuit power S_{SC} that is a minimum of $120 R_{SCE}$. If necessary, contact the mains operator.

6.2.1 Installation in a Corner-grounded Network

Corner grounding can be used in these conditions:

- Enclosure sizes MR4-MR6 with mains voltage 208–240 V up to 2000 m
- Enclosure sizes MR7-MR9 with a rating of 75–310 A and with mains voltage 208–240 V
Enclosure sizes MR7-MR9 with a rating of 72–385 A and with mains voltage 380–500 V

Do not use corner grounding in these conditions:

- Enclosure sizes MR4-MR6 with a rating of 3.4–61 A and with mains voltage 380–500 V
- Drives with mains voltage 525–600 V or 525–690 V

When using corner grounding, the drive must have EMC protection level C4. To change the EMC protection level from C2 or C3 to C4, see instructions in [6.6 Installation in an IT System](#).

6.3 Grounding

Ground the AC drive in accordance with applicable standards and directives.

⚠ CAUTION ⚠

DAMAGE TO THE AC DRIVE FROM INSUFFICIENT GROUNDING

Not using a grounding conductor can damage the drive.

- Make sure that the AC drive is always grounded with a grounding conductor that is connected to the grounding terminal that is identified with the PE symbol.

⚠ WARNING ⚠

LEAKAGE CURRENT HAZARD

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

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

The standard EN 61800-5-1 tells that 1 or more of these conditions for the protective circuit must be true.

The connection must be fixed.

- The protective earthing conductor must have a cross-sectional area of minimum 10 mm² Cu or 16 mm² Al. OR
- There must be an automatic disconnection of the mains, if the protective earthing conductor breaks. OR
- There must be a terminal for a second protective earthing conductor in the same cross-sectional area as the first protective earthing conductor.

Cross-sectional area of the phase conductors (S) [mm ²]	The minimum cross-sectional area of the protective earthing conductor in question [mm ²]
$S \leq 16$	S
$16 < S \leq 35$	16
$35 < S$	S/2

The values of the table are valid only if the protective earthing conductor is made of the same metal as the phase conductors. If this is not so, the cross-sectional area of the protective earthing conductor must be determined in a manner that produces a conductance equivalent to that which results from the application of this table.

The cross-sectional area of each protective earthing conductor that is not a part of the mains cable or the cable enclosure, must be a minimum of:

- 2.5 mm² if there is mechanical protection, and
- 4 mm² if there is not mechanical protection. With cord-connected equipment, make sure that the protective earthing conductor in the cord is the last conductor to be interrupted, if the strain-relief mechanism breaks.

Obey the local regulations on the minimum size of the protective earthing conductor.

NOTICE

MALFUNCTION OF FAULT CURRENT PROTECTIVE SWITCHES

Because there are high capacitive currents in the AC drive, it is possible that the fault current protective switches do not operate correctly.

NOTICE

VOLTAGE WITHSTAND TESTS

Doing voltage withstand tests can damage the drive.

- Do not do voltage withstand tests on the AC drive. The manufacturer has already done the tests.

⚠ WARNING ⚠

SHOCK HAZARD FROM PE CONDUCTOR

The drive can cause a DC current in the PE conductor. Failure to use a residual current-operated protective (RCD) device Type B or a residual current-operated monitoring (RCM) device can lead to the RCD not providing the intended protection and therefore can result in death or serious injury.

- Use a type B RCD or RCM device on the mains side of the drive.

6.4 Get Access and Locate the Terminals

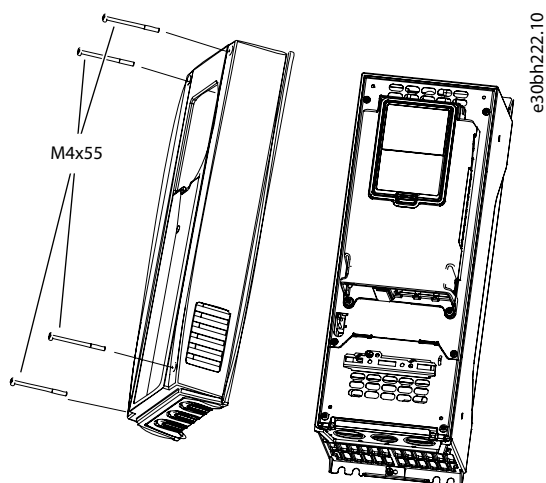
6.4.1 Get Access and Locate the Terminals for MR4-MR7

Context:

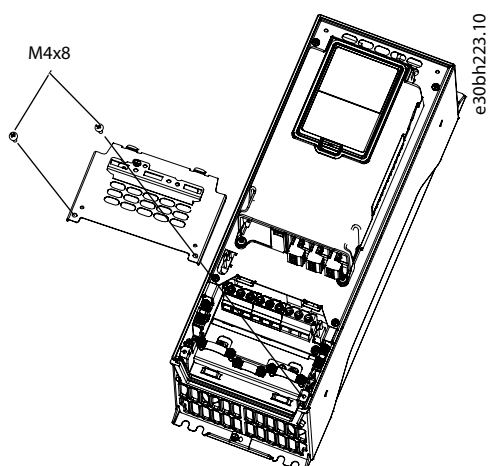
Follow these instructions to open the AC drive for installing the cables, for example.

Procedure

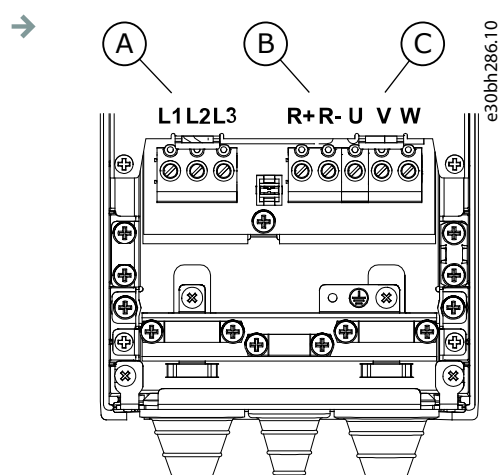
1. Open the cover of the AC drive.



2. Remove the screws of the cable cover. Remove the cable cover. Do not open the cover of the power unit.



3. Locate the terminals.



A Mains terminals	B Brake resistor terminals
C Motor terminals	

Illustration 10: Locating the Terminals, MR4-MR7

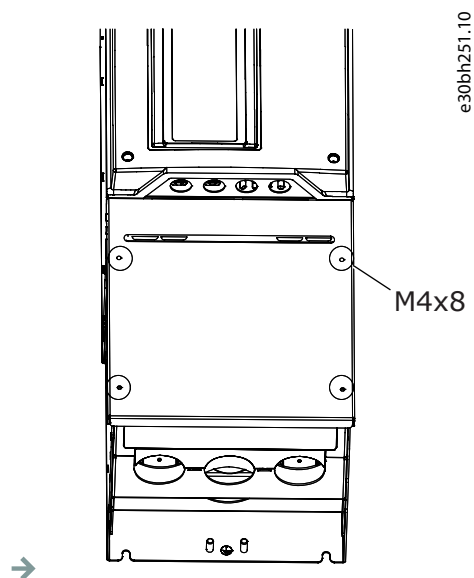
6.4.2 Get Access and Locate the Terminals for MR8

Context:

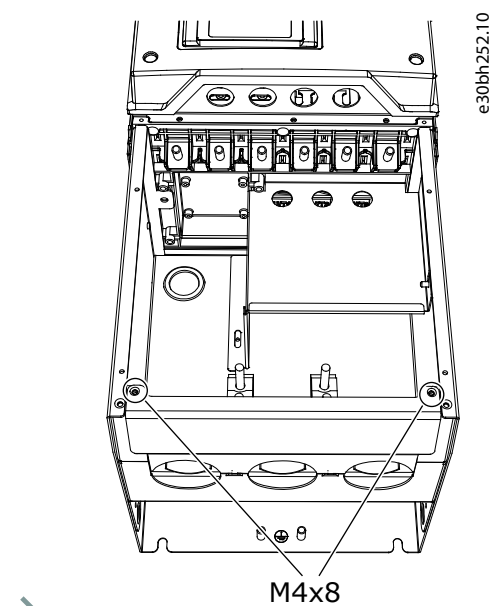
Follow these instructions to open the AC drive for installing the cables, for example.

Procedure

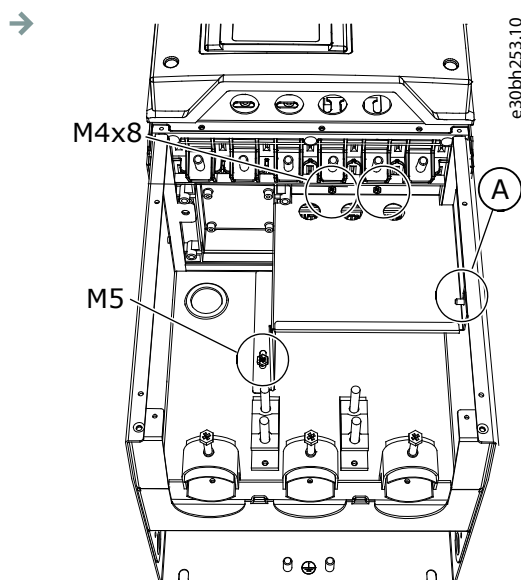
1. Open the cover of the AC drive.
2. Remove the cable cover.



3. Remove the cable entry plate.



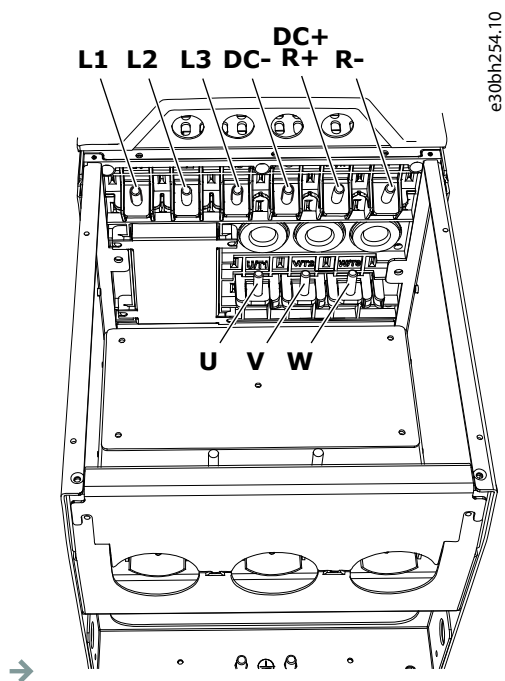
4. Remove the EMC shield plate.



A The wing nut

Illustration 11: Removing the EMC Shield Plate, MR8

5. Find the motor terminals. The location of the terminals is different than usually, especially in MR8.



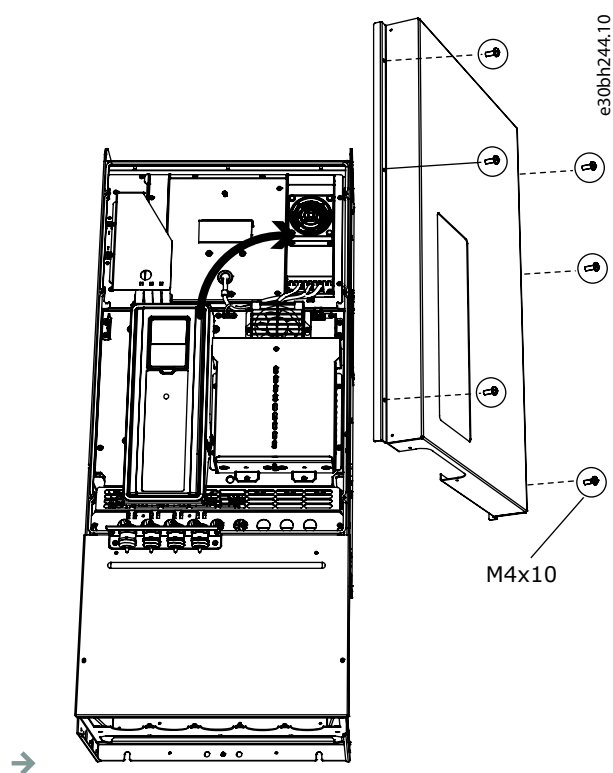
6.4.3 Get Access and Locate the Terminals for MR9

Context:

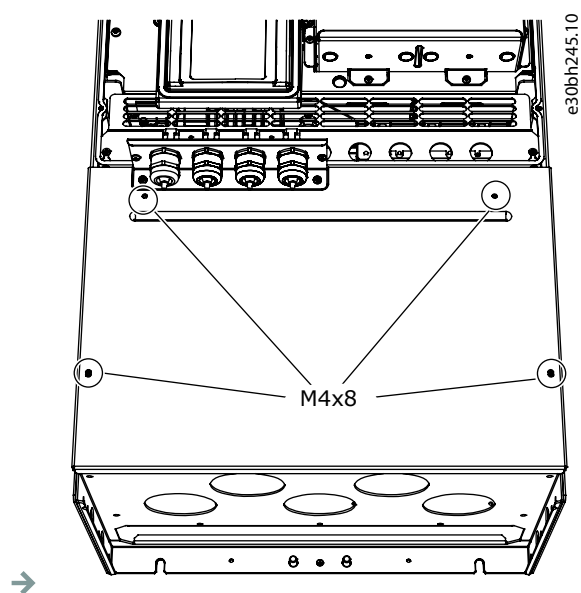
Follow these instructions to open the AC drive for installing the cables, for example.

Procedure

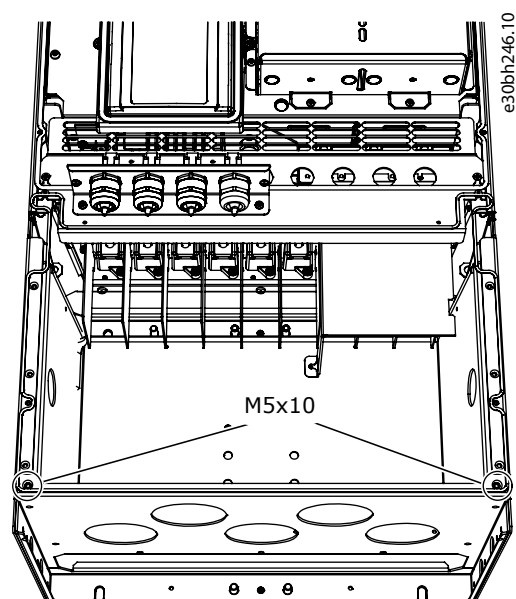
1. Open the cover of the AC drive.



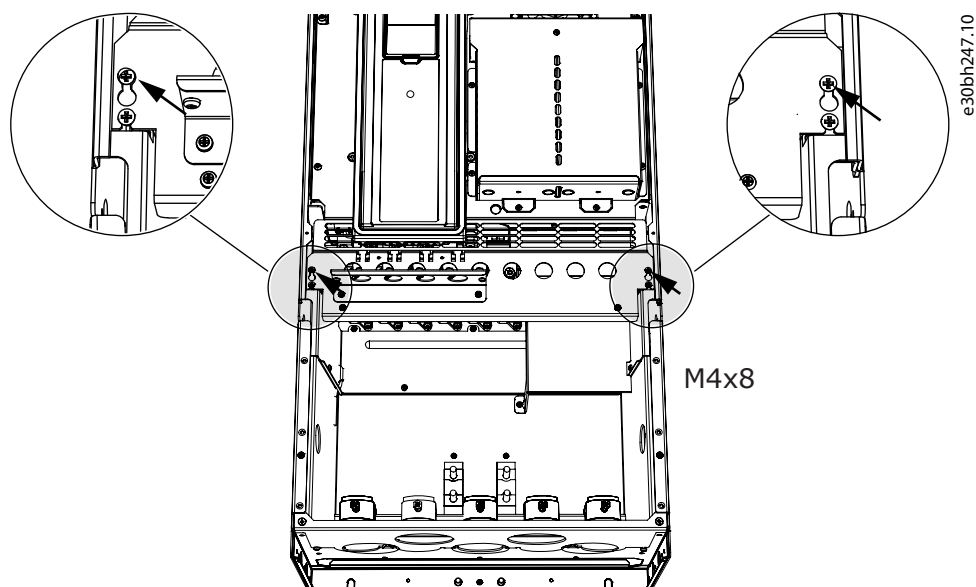
2. Remove the cable cover.



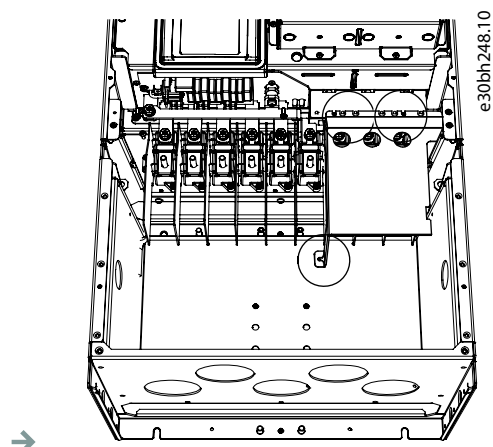
3. Remove the cable entry plate.



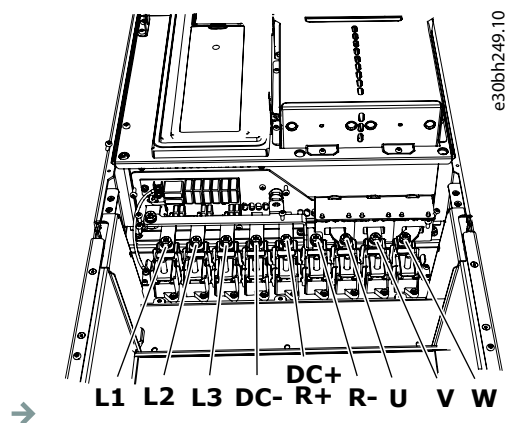
4. Loosen the screws and remove the sealing plate.



5. Remove the EMC shield plate.



6. Find the motor terminals. The location of the terminals is different than usually, especially in MR8.



6.5 Installation of Cables

6.5.1 Additional Instructions for Cable Installation

- Before starting, make sure that none of the components of the AC drive is live. Read carefully the warnings in Safety section.
- Make sure that the motor cables are sufficiently far from other cables.
- The motor cables must go across other cables at an angle of 90°.
- If it is possible, do not put the motor cables in long parallel lines with other cables.
- If the motor cables are in parallel with other cables, obey the minimum distances (see [table 15](#)).
- The distances are also valid between the motor cables and the signal cables of other systems.
- The maximum lengths of shielded motor cables are 100 m/328 ft (for MR4), 150 m/492 ft (for MR5 and MR6), and 200 m/656 ft (for MR7, MR8, and MR9).
- If the cable insulation checks are necessary, see [8.3 Measuring the Cable and Motor Insulation](#).

Table 15: Minimum Distances between Cables

The distance between cables [m]	The length of the shielded cable [m]	The distance between cables [ft]	The length of the shielded cable [ft]
0.3	≤ 50	1.0	≤ 164.0
1.0	≤ 300	3.3	≤ 656.1

6.5.2 Installing the Cables, MR4-MR7

Context:

Follow these instructions to install the cables and cable accessories. For information on how to comply with the UL regulations in cable installation, see [6.1.2 UL Standards on Cabling](#).

Prerequisites:

Make sure that the delivery contains all necessary components. For the installation, the contents of the accessories bag is needed, see [4.2 Accessories](#).

Open the covers according to instructions in [6.4.1 Get Access and Locate the Terminals for MR4-MR7](#).

Procedure

1. Strip the motor cable, the mains cable, and the brake resistor cable. See [10.4 Cable Stripping Lengths](#).

The VACON® 100 FLOW and HVAC software do not have the dynamic braking or the brake resistor functions.

2. Put the grommets in the openings of the cable entry plate. These parts are included in the package.

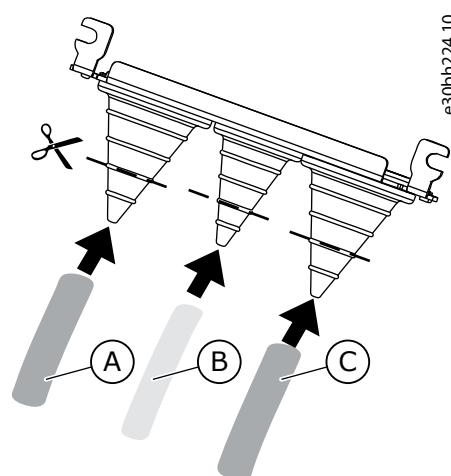


3. Put the cables in the openings of the cable entry plate.

4. Cut the grommets open to move the cables through them.

A Do not cut the grommet openings wider than what is necessary for the used cables.

B If the grommets fold in when putting the cable, pull the cable back to make the grommets straight.



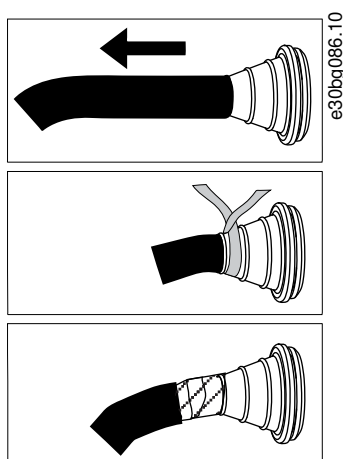
A The mains cable

B The brake cable

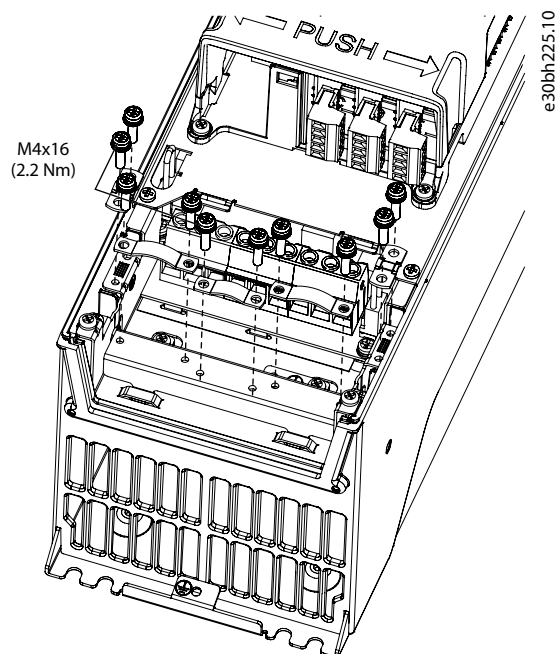
C The motor cable

Illustration 12: Installing Cables through Grommets

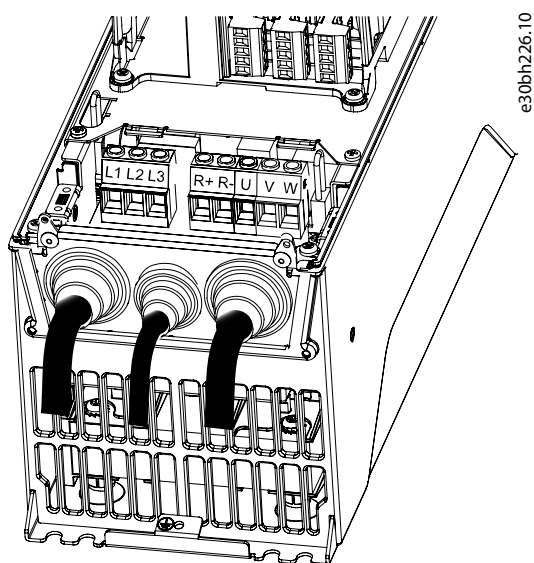
5. With the protection rating IP54, the connection between the grommet and the cable must be tight. Pull the first bit of the cable out of the grommet so that it stays straight. If this is not possible, make the connection tight with some insulation tape or a cable tie.



6. Remove the grounding clamps for cable shield and the grounding clamps for grounding conductor. The tightening torque is 2.2 Nm or 19.5 lb-in.

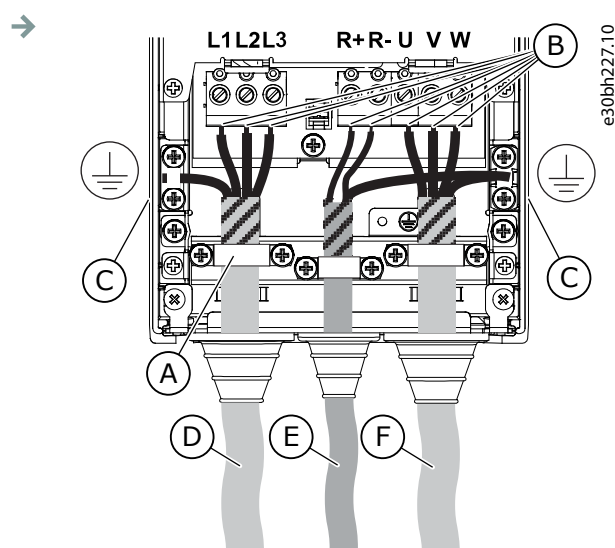


7. Put the cable entry plate with the cables into the groove on the frame of the drive.



8. Connect the cables. See the correct tightening torques in [10.5 Tightening Torques of the Terminals](#).

- A Expose the shield of all the 3 cables to make a 360-degree connection with the grounding clamps for cable shield.
- B Connect the phase conductors of the mains cable and of the motor cable, and the conductors of the brake resistor cable into the correct terminals.
- C Attach the grounding conductor of each cable to a grounding terminal with a grounding clamp for grounding conductor.
- D Make sure that the external grounding conductor is connected to the grounding bar. See [6.3 Grounding](#).



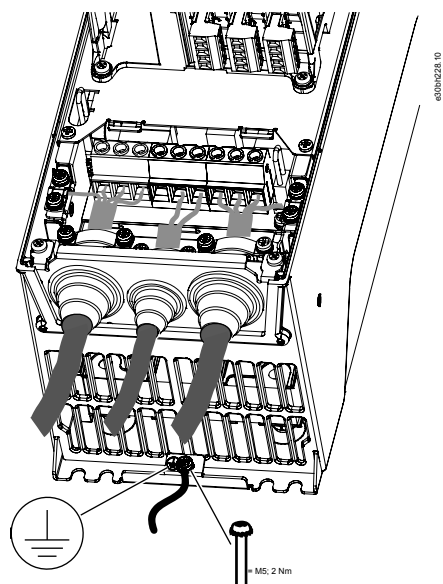
A The grounding clamp for cable shield	B The terminals
C The grounding terminal	D The mains cable
E The brake resistor cable	F The motor cable

Illustration 13: Connecting the Stripped Cables

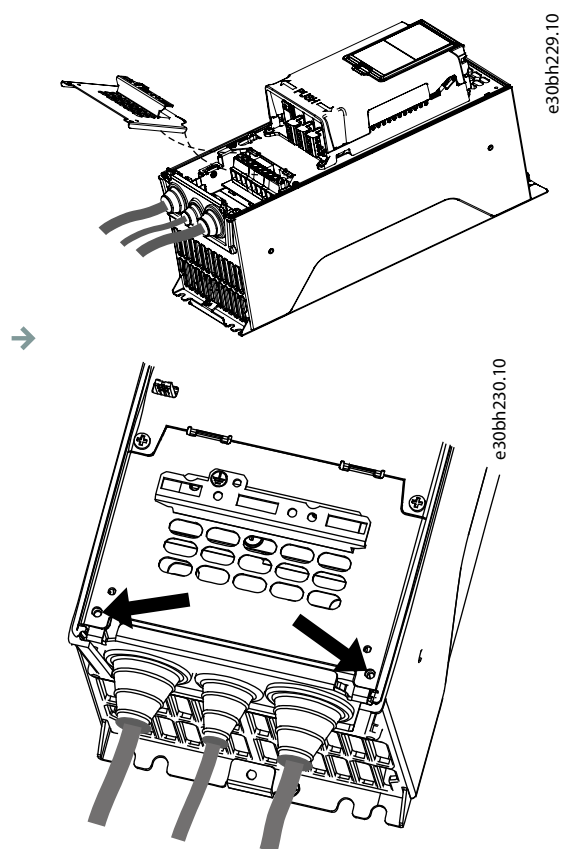
9. Make sure that the grounding conductor is connected to the motor and also to the terminals that are identified with the PE symbol.

A To comply with the requirements of the standard EN 61800-5-1, obey the instructions in [6.3 Grounding](#).

B If a double grounding is necessary, use the grounding terminal under the drive. Use an M5 screw and tighten it to 2.0 Nm or 17.7 lb-in.



10. Attach again the cable cover.



11. Close the cover of the drive.

6.5.3 Installing the Cables, MR8-MR9

Context:

Follow these instructions to install the cables and cable accessories. For information on how to comply with the UL regulations in cable installation, see [6.1.2 UL Standards on Cabling](#).

Prerequisites:

Make sure that the delivery contains all necessary components. For the installation, the contents of the accessories bag is needed, see [4.2 Accessories](#).

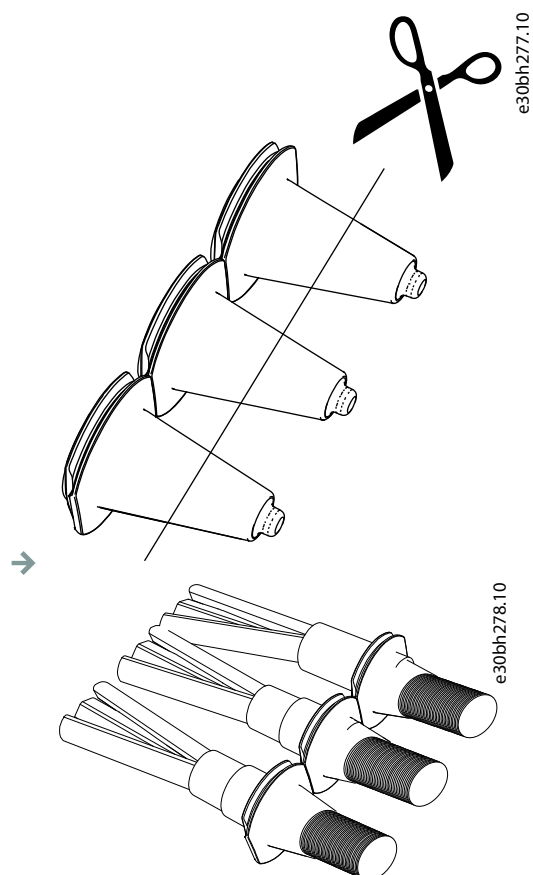
Open the covers according to instructions in [6.4.2 Get Access and Locate the Terminals for MR8](#) and [6.4.3 Get Access and Locate the Terminals for MR9](#).

Procedure

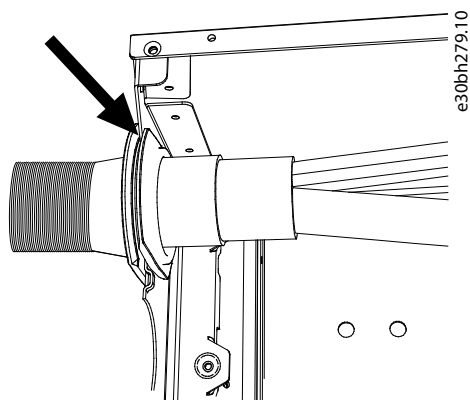
1. Strip the motor cable, the mains cable, and the brake resistor cable. See [10.4 Cable Stripping Lengths](#).

The VACON® 100 FLOW and HVAC software do not have the dynamic braking or the brake resistor functions.

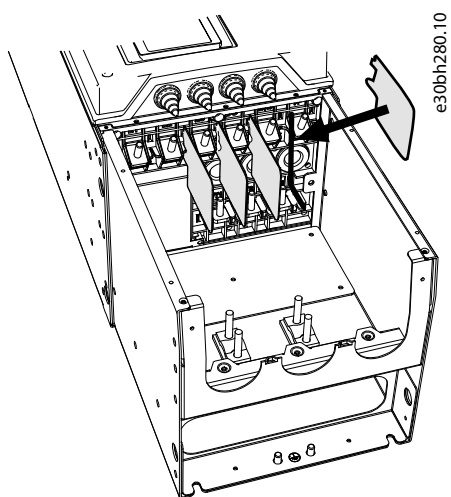
2. Cut the grommets open to move the cables through them.
 - A Do not cut the grommet openings wider than what is necessary for the used cables.
 - B If the grommets fold in when putting the cable, pull the cable back to make the grommets straight.



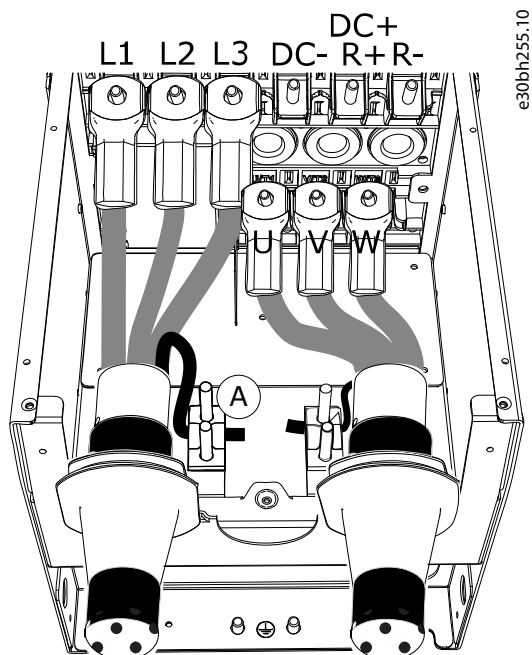
3. Attach the grommet and the cable so that the frame of the drive goes into the groove of the grommet.
 - A With the protection rating IP54 (UL Type 12), the connection between the grommet and the cable must be tight. Pull the first bit of the cable out of the grommet so that it stays straight.
 - B If this is not possible, make the connection tight with some insulation tape or a cable tie.



4. If thick cables are used, put the cable insulators in between the terminals to prevent contact between the cables.

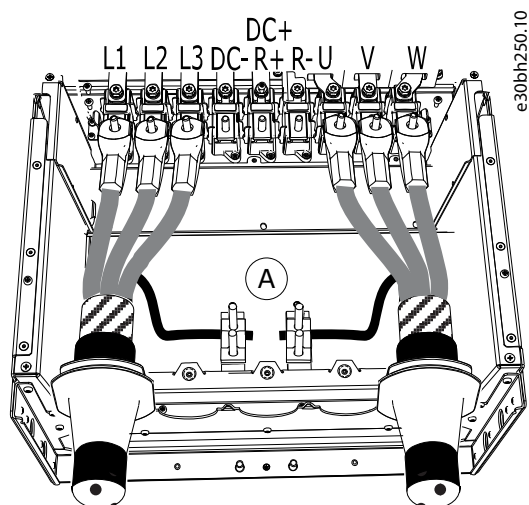


5. Connect the cables. See the correct tightening torques in [10.5 Tightening Torques of the Terminals](#).
- A Connect the phase conductors of the mains cable and of the motor cable into the correct terminals. If a brake resistor cable is used, connect its conductors into the correct terminals.
 - B Attach the grounding conductor of each cable to a grounding terminal with a grounding clamp for grounding conductor.
 - C Make sure that the external grounding conductor is connected to the grounding bar. See [6.3 Grounding](#).



A The grounding connection

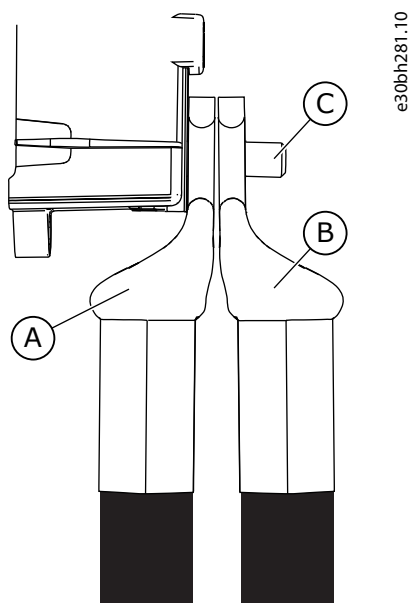
Illustration 14: Connecting the Cables, MR8



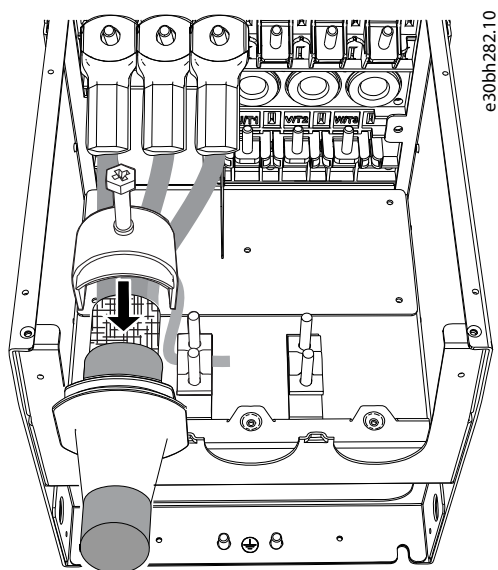
A The grounding connection

Illustration 15: Connecting the Cables, MR9

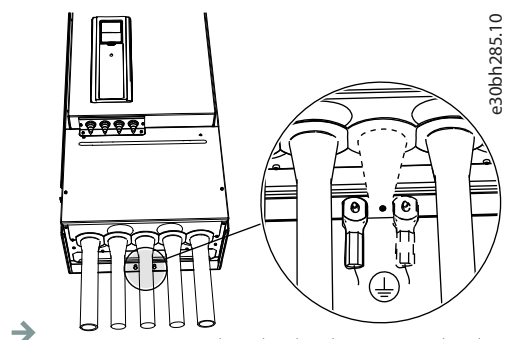
6. If many cables are used on one connector, put the cable lugs on top of each other.



7. Expose the shield of all 3 cables to make a 360° connection with the grounding clamp for cable shield.



8. Make sure that the grounding conductor is connected to the motor and also to the terminals that are identified with the PE symbol.
- A To comply with the requirements of the standard EN 61800-5-1, obey the instructions in [6.3 Grounding](#).
 - B Connect the protective conductor to one of the screw connectors with a cable shoe and an M8 screw.



9. For MR8, attach the EMC shield plate, the cable entry plate, and the cable cover.
10. For MR9, attach the EMC shield plate, the sealing plate, the cable entry plate, and the cable cover.
11. Close the cover of the drive.

6.6 Installation in an IT System

If your mains is impedance-grounded (IT), the AC drive must have the EMC protection level C4. If the drive has the EMC protection level C2 or C3, it is necessary to change it to C4. To do this, remove the EMC jumpers.

⚠ WARNING ⚠

SHOCK HAZARD FROM THE COMPONENTS

The components of the drive are live when the drive is connected to mains.

- Do not make changes in the AC drive when it is connected to mains.

NOTICE

DAMAGE TO THE AC DRIVE FROM INCORRECT EMC LEVEL

The EMC level requirements for the AC drive depend on the installation environment. An incorrect EMC level can damage the drive.

- Before connecting the AC drive to the mains, make sure that the EMC level of the AC drive is correct for the mains.

NOTICE

For a 600 and 690V product that is configured for a C4 installation on IT network, the maximum switching frequency is limited to the default 2 kHz.

6.6.1 Installing the AC drive in an IT System, MR4-MR6

Context:

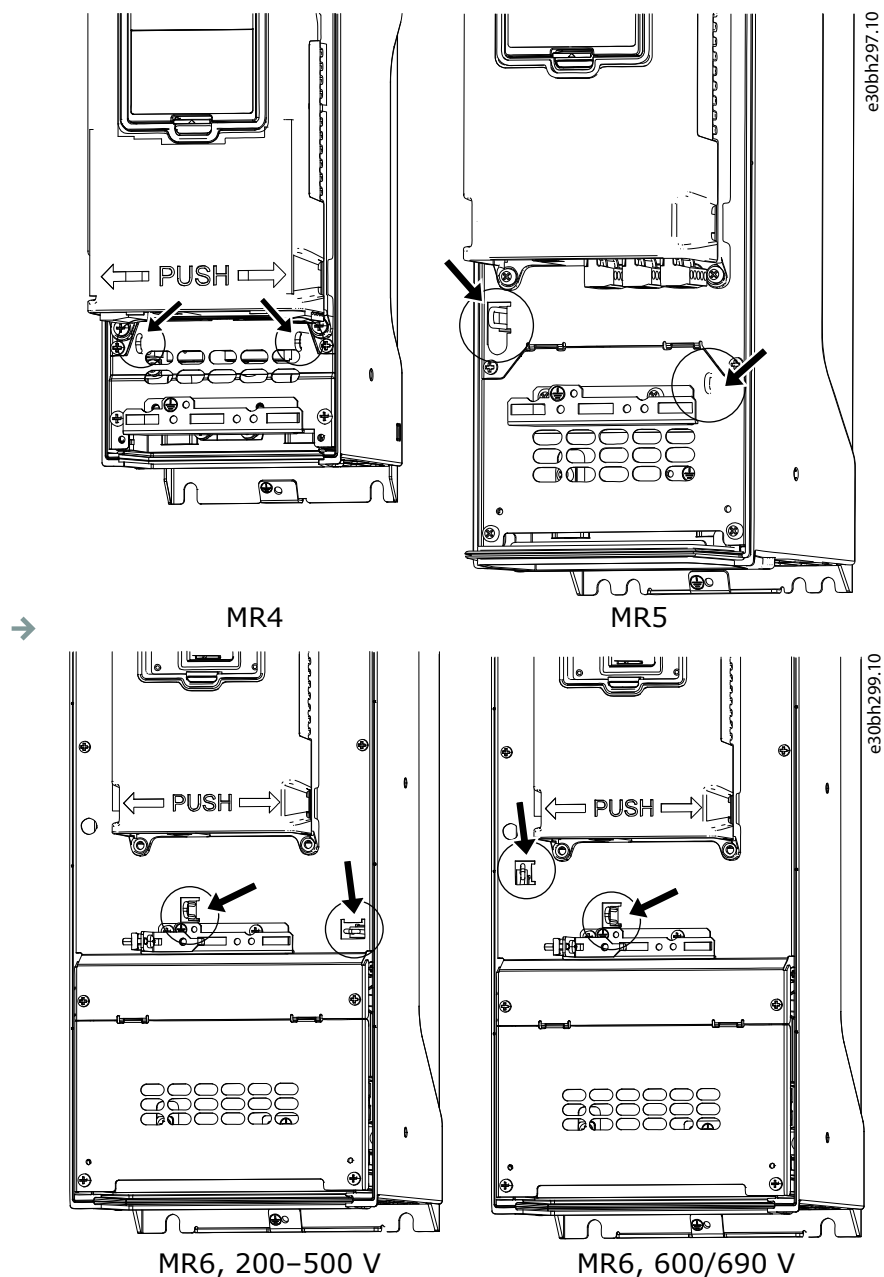
Use these instructions to change the EMC protection of the AC drive to level C4.

Prerequisites:

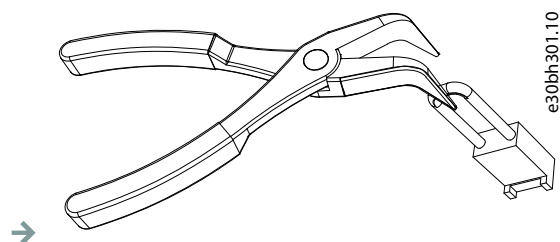
Open the cover of the AC drive (for MR4-MR6) and remove the cable cover (for MR4-MR5) as instructed in [6.4.1 Get Access and Locate the Terminals for MR4-MR7](#).

Procedure

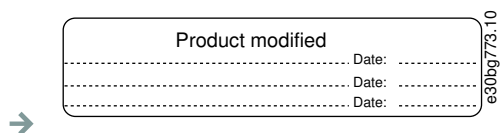
1. Find the EMC jumpers that connect the RFI filters to ground.



2. To disconnect the RFI filters from ground, remove the EMC jumpers. Pull the EMC jumper out with the tool.



3. For MR4 and MR5, attach the cable cover.
4. Close the cover of the AC drive.
5. After the change, write "The EMC level was changed" and the date on the "product modified" label. If the label is not yet attached, attach it on the drive near the nameplate.



6.6.2 Installing the AC drive in an IT System, MR7

Context:

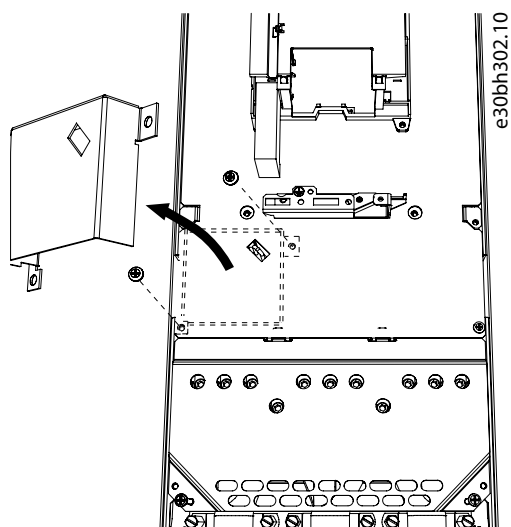
Use these instructions to change the EMC protection of the AC drive to level C4.

Prerequisites:

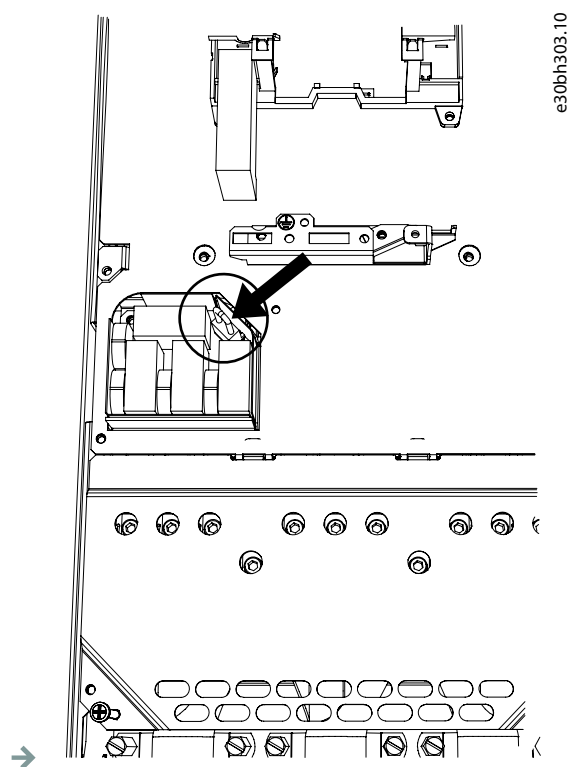
Open the cover of the AC drive and remove the cable cover (for 600/690 V) as instructed in [6.4.1 Get Access and Locate the Terminals for MR4-MR7](#).

Procedure for 200–500 V

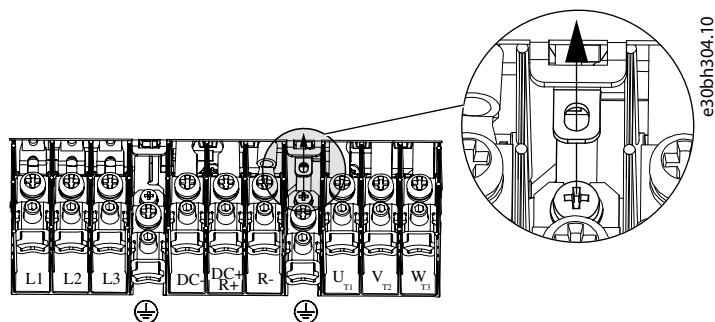
1. Find the EMC box. To get access to the EMC jumper, remove the cover of the EMC box.



2. Remove the EMC jumper. Attach the cover of the EMC box again.



3. Find the DC grounding busbar between the terminals R- and U. To remove the busbar from the frame, remove the M4 screw.



4. Close the cover of the AC drive.
5. After the change, write "The EMC level was changed" and the date on the "product modified" label. If the label is not yet attached, attach it on the drive near the nameplate.

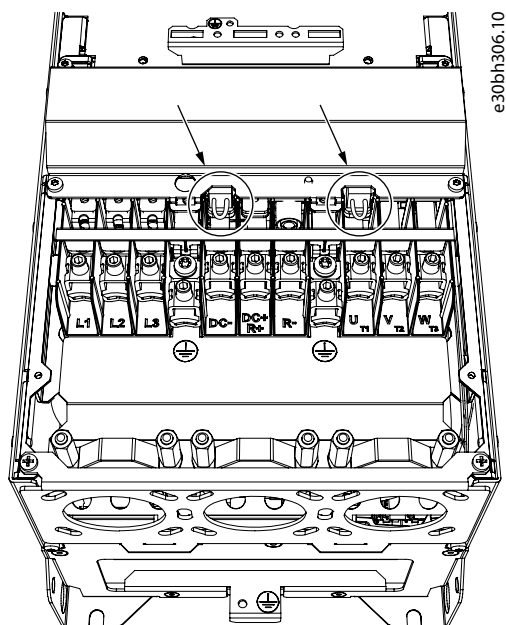
Product modified	
.....	Date:
.....	Date:
.....	Date:

e30bg773.10



Procedure for 600/690 V

1. Remove the EMC jumper.



2. Attach the cable cover.
3. Close the cover of the AC drive.
4. After the change, write "The EMC level was changed" and the date on the "product modified" label. If the label is not yet attached, attach it on the drive near the nameplate.

Product modified	
.....	Date:
.....	Date:
.....	Date:

e30bg773.10



6.6.3 Installing the AC drive in an IT System, MR8

Context:

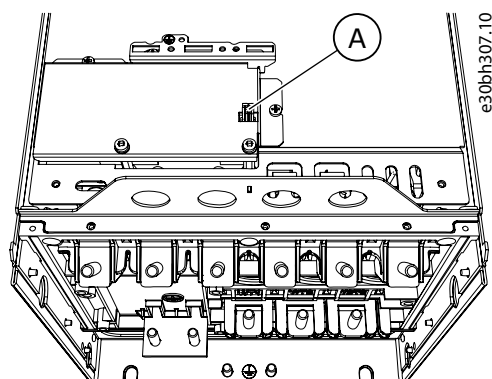
Use these instructions to change the EMC protection of the AC drive to level C4.

Prerequisites:

Open the cover of the AC drive and remove the cable cover as instructed in [6.4.2 Get Access and Locate the Terminals for MR8](#).

Procedure

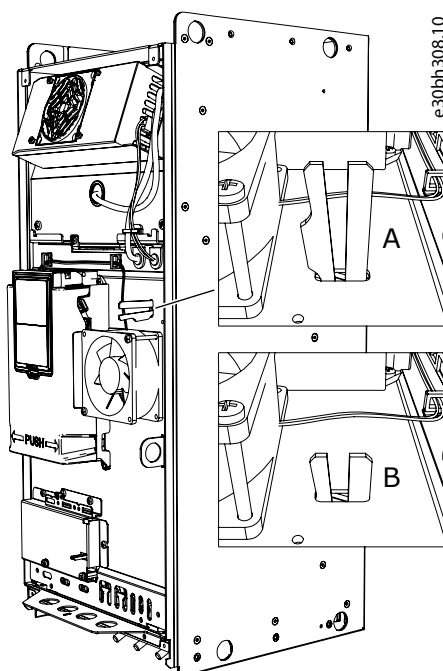
1. Find the EMC box. To get access to the EMC jumper, remove the cover of the EMC box.



A The EMC jumper

Illustration 16: Removing the EMC Box Cover, MR8

2. Remove the EMC jumper. Attach the cover of the EMC box again.
3. Find the grounding arm and push it down.

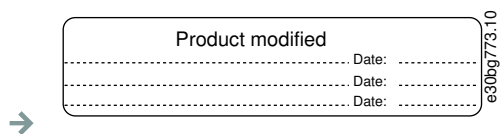


A The grounding arm is up

B The grounding arm is down (level C4)

Illustration 17: Finding the Grounding Arm, MR8

4. Attach the cable cover.
5. Close the cover of the AC drive.
6. After the change, write "The EMC level was changed" and the date on the "product modified" label. If the label is not yet attached, attach it on the drive near the nameplate.



6.6.4 Installing the AC drive in an IT System, MR9

Context:

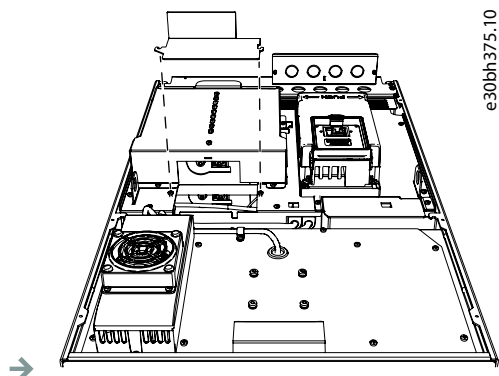
Use these instructions to change the EMC protection of the AC drive to level C4.

Prerequisites:

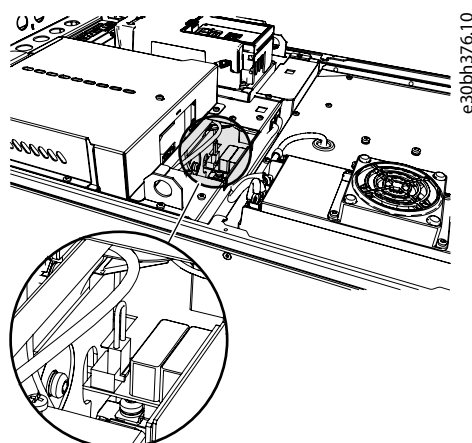
Open the cover of the AC drive as instructed in [6.4.3 Get Access and Locate the Terminals for MR9](#).

Procedure for EMC Jumper 1, MR9A

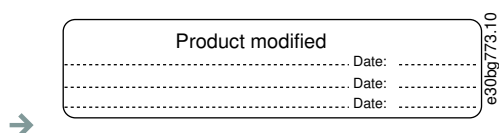
1. Remove the cover of the fan.
2. In IP54, also remove the fan.
3. Loosen the screws of the cover plate and remove it.



4. Find the place of the jumper behind the fan. Remove the EMC jumper.

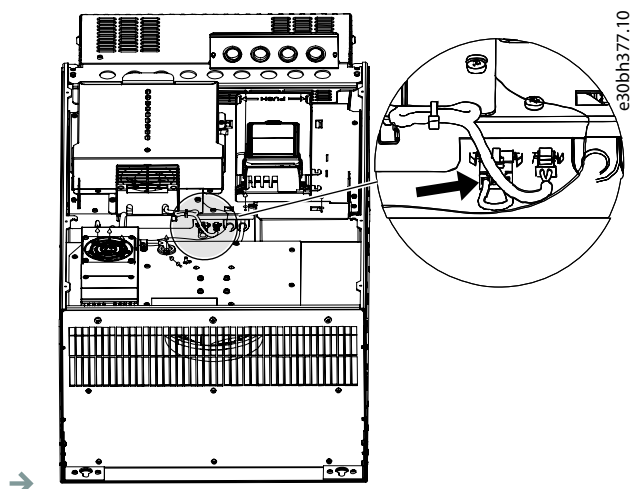


5. Attach the cover plate.
6. In IP54, attach the fan.
7. Attach the cover of the fan.
8. After the change, write "The EMC level was changed" and the date on the "product modified" label. If the label is not yet attached, attach it on the drive near the nameplate.

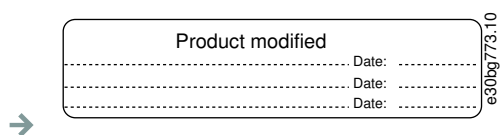


Procedure for EMC Jumper 1, MR9B

1. Remove the EMC jumper.

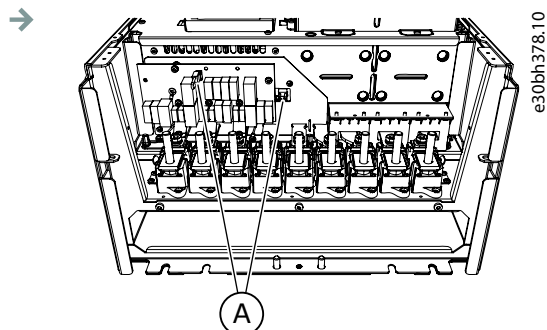


2. After the change, write "The EMC level was changed" and the date on the "product modified" label. If the label is not yet attached, attach it on the drive near the nameplate.



Procedure for EMC Jumpers 2 + 3, MR9A and MR9B

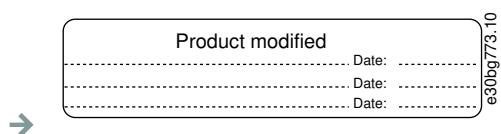
1. Remove the cover of the extension box, the touch shield, and the I/O plate with the I/O grommet plate.
2. Find the 2 EMC jumpers on the EMC board. They are not next to each other. Remove the EMC jumpers.



A The EMC jumpers

Illustration 18: EMC Jumpers 2 and 3, MR9A and MR9B

3. Attach the I/O plate with the I/O grommet plate, the touch shield, and the cover of the extension box.
4. Close the cover of the AC drive.
5. After the change, write "The EMC level was changed" and the date on the "product modified" label. If the label is not yet attached, attach it on the drive near the nameplate.

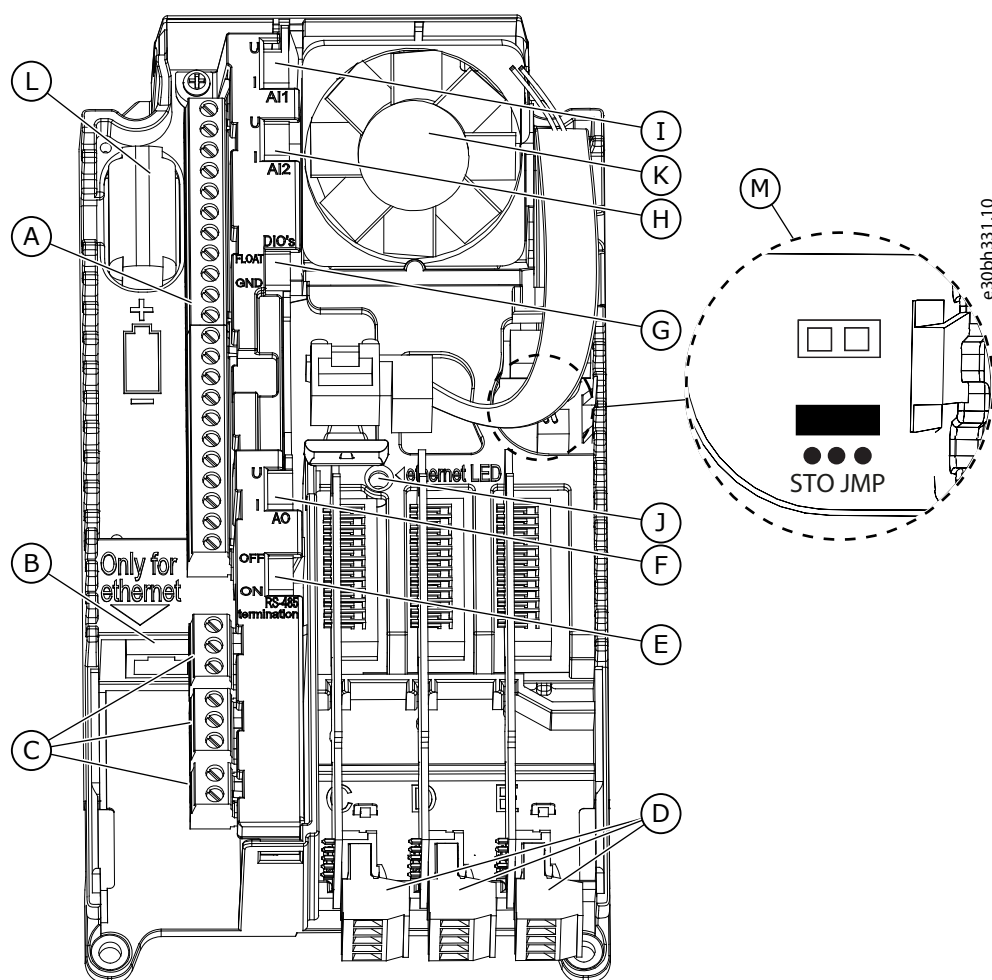


6.7 Installation in a Marine Environment

When you install the AC drive in a marine environment, see the Marine Installation Guide.

7 Control Unit

7.1 Control Unit Components



A The control terminals for the standard I/O connections	B The Ethernet connection
C The relay board terminals for 3 relay outputs or 2 relay outputs and a thermistor	D The option boards
E A DIP switch for the RS485 bus termination	F A DIP switch for the signal selection of Analog Output
G A DIP switch for the isolation of the digital inputs from ground	H A DIP switch for the signal selection of Analog Input 2
I A DIP switch for the signal selection of Analog Input 1	J The status indicator of the Ethernet connection
K A fan (only in IP54 of MR4 and of MR5)	L The battery for the RTC
M The location and the default position of the Safe Torque Off (STO) jumper	

Illustration 19: Components of the Control Unit

On delivery of the AC drive, the control unit contains the default control interface (graphical keypad). If special options were selected in the order, the option boards are included loose in the delivery. On the next pages, there is information on the terminals and general wiring examples.

It is possible to use the drive with an external power source with these properties: +24 V DC $\pm 10\%$, minimum 1000 mA. Connect the external power source to terminal 30. This voltage is sufficient to keep the control unit on and for setting the parameters. The measurements of the main circuit (for example, the DC-link voltage, and the unit temperature) are not available when the drive is not connected to mains.

The status indicator on the control unit shows the status of the drive. The status indicator is located in the control panel, below the keypad, and it can show five different statuses.

Table 16: Control Unit LED Status Definitions

Color/status of the LED	Status of the drive
Blinking slowly	Ready
Green	Run
Red	Fault
Orange	Alarm
Blinking fast	Downloading software

7.2 Control Unit Cabling

7.2.1 Selection of the Control Cables

NOTICE

CABLE SELECTION

Obey regional low-voltage standards in the cable selection.

The control cables must be a minimum of 0.5 mm² (AWG20) multi-core shielded cables. The terminal wires must be a maximum of 2.5 mm² (AWG13) for the relay board terminals and other terminals.

Table 17: The Tightening Torques of the Control Cables

Terminal	Terminal screw size	Tightening torque (Nm)	Tightening torque (lb-in)
All the terminals of the I/O board and the relay board	M3	0.5	4.5

7.2.2 Control Unit Terminals

Here is the basic description of the terminals of the default I/O and relay board. The standard I/O board has 22 fixed control terminals and 8 relay board terminals.

Some terminals are assigned for signals that have optional functions that can be used with the DIP switches. For more information, see [7.3 DIP Switches on the Control Unit](#).

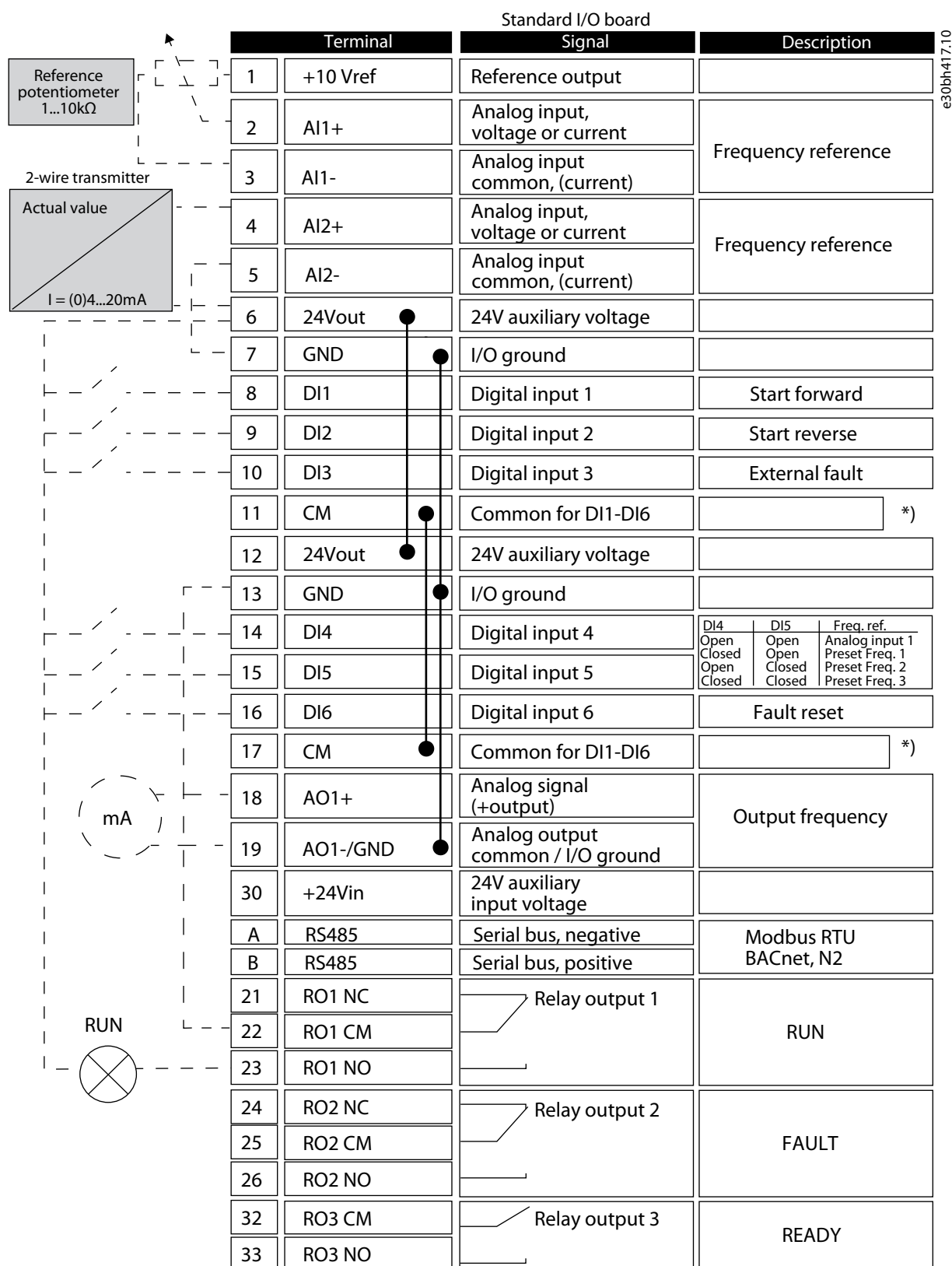


Illustration 20: The Signals of the Control Terminals on the Default I/O Board and the Default Control Connections

*) You can isolate digital inputs from ground with a DIP switch. See [7.3.2 Isolation of the Digital Inputs from Ground](#).

There are 2 different relay boards available. If you include the optional code +SBF4 in your order, the relay output 3 is replaced with a thermistor input.

The thermistor input function is not automatically active. To use the thermistor input function, activate the parameter Thermistor Fault in the software. See the Application Guide.

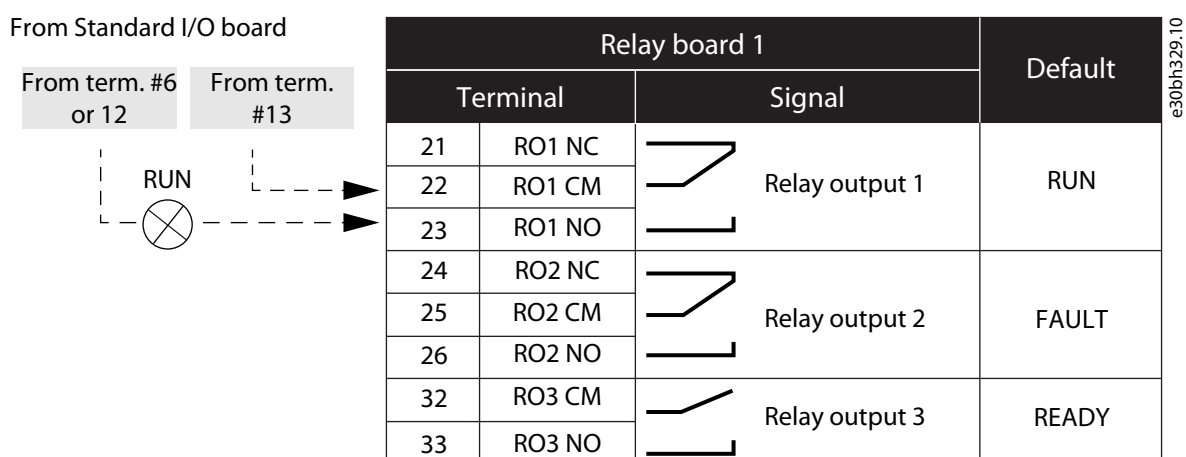


Illustration 21: Standard Relay Board (+SBF3)

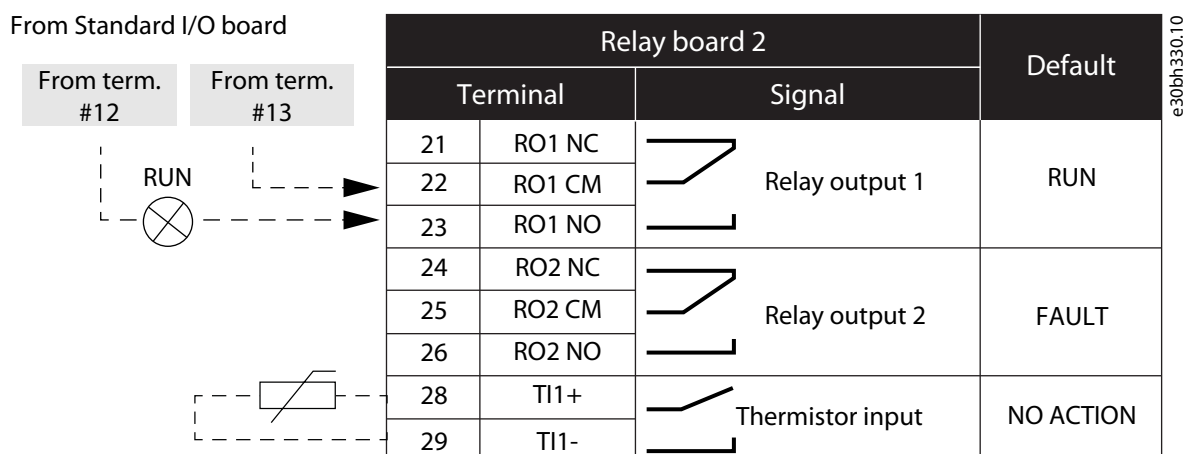
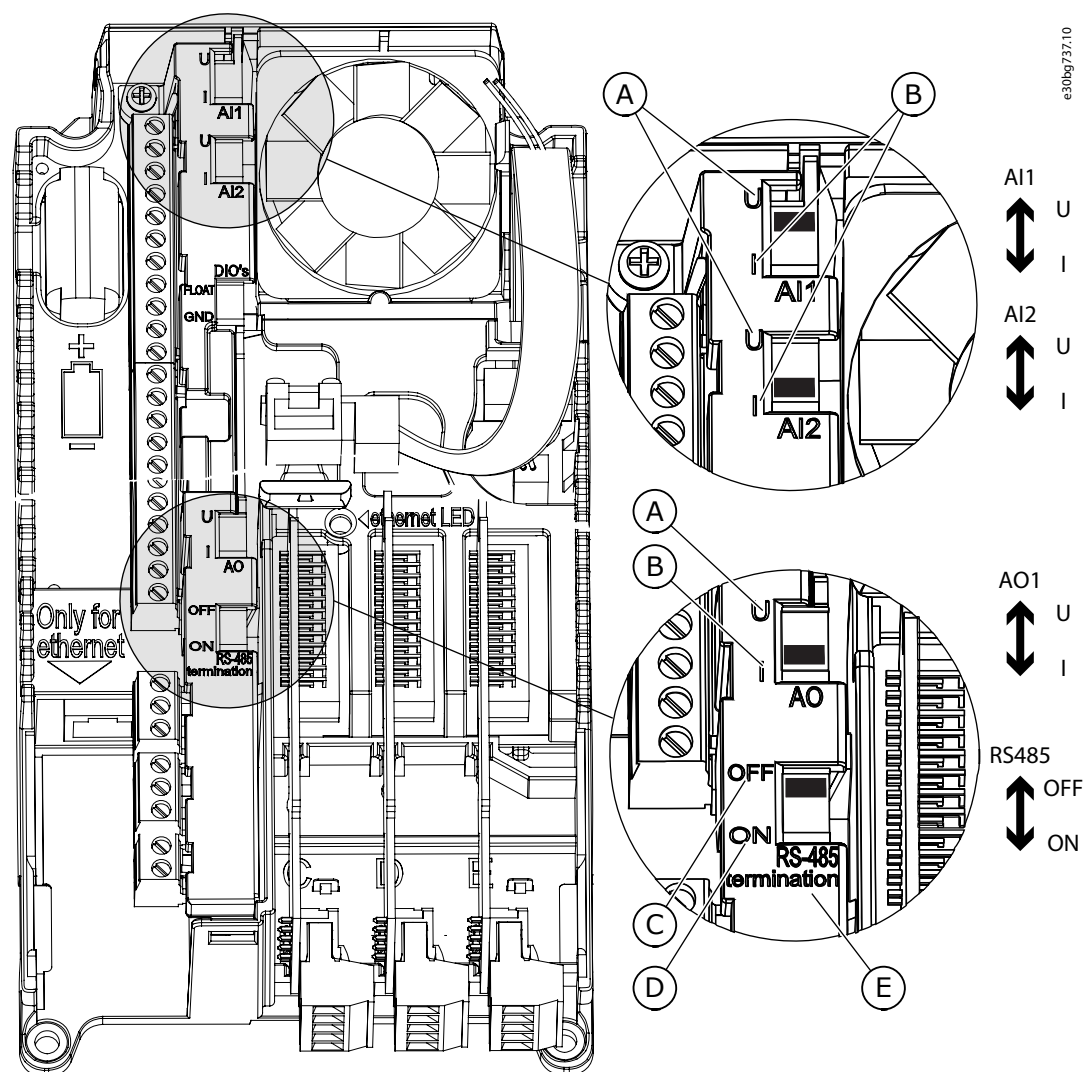


Illustration 22: Optional Relay Board (+SBF4)

7.3 DIP Switches on the Control Unit

7.3.1 Selection of Terminal Functions with DIP Switches

Two selections for specified terminals can be done with the DIP switches. The switches have two positions: up and down. See the location of the DIP switches and the possible selections in [illustration 23](#).



A The voltage signal (U), 0–10 V input	B The current signal (I), 0–20 mA input
C OFF	D ON
E The RS485 bus termination	

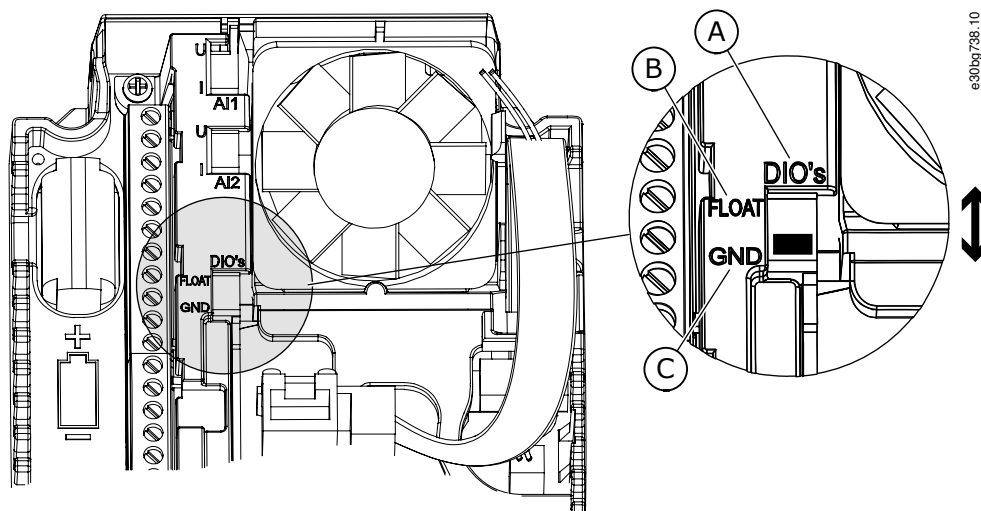
Illustration 23: The Selections of the DIP Switches

Table 18: The Default Positions of the DIP Switches

The DIP switch	The default position
AI1	U
AI2	I
AO1	I
RS485 bus termination	OFF

7.3.2 Isolation of the Digital Inputs from Ground

It is possible to isolate from ground the digital inputs (terminals 8–10 and 14–16) on the standard I/O board. To do this, change the position of a DIP switch on the control board.



A The digital inputs	B Floating
C Connected to ground (default)	

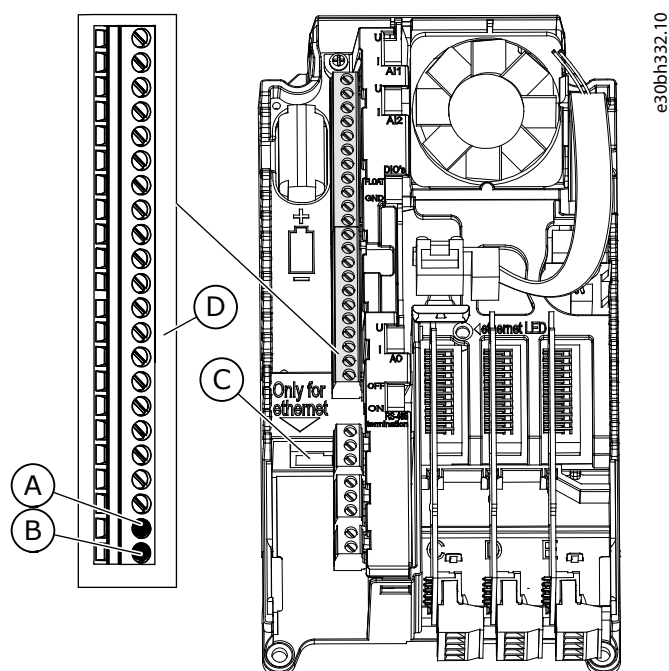
Illustration 24: Change the Position of This Switch to Isolate the Digital Inputs from Ground

7.4 Fieldbus Connection

7.4.1 Fieldbus Terminals

The drive can be connected to fieldbus with an RS485 or an Ethernet cable.

- If an RS485 cable is used, connect it to terminals A and B of the standard I/O board.
- If an Ethernet cable is used, connect it to the Ethernet terminal.



A RS485 terminal A = Data -	B RS485 terminal B = Data +
C The Ethernet terminal	D The control terminals

Illustration 25: Ethernet and RS485 Connections

7.4.2 Internal Fieldbuses in VACON® 100 Products

VACON® 100 product family supports internally four Ethernet fieldbuses:

- Modbus TCP/UDP
- BACnet/IP
- PROFINET IO (requires +FBIE license)
- EtherNet/IP (requires +FBIE license)

Having a single Ethernet port, the Ethernet fieldbuses can be connected to networks with star topology.

The VACON® 100 family RJ45 connector does not have speed or activity LEDs. Instead it has a single LED in the middle of the AC drive. The LED cannot be seen unless the covers are removed. The LED works as listed below:

- 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 AC drive does not support a 1000 Mbit/s Ethernet, so there is no communication.

The VACON® 100 product family supports internally three RS485 fieldbuses:

- Modbus RTU
- BACnet MSTP
- Metasys N2

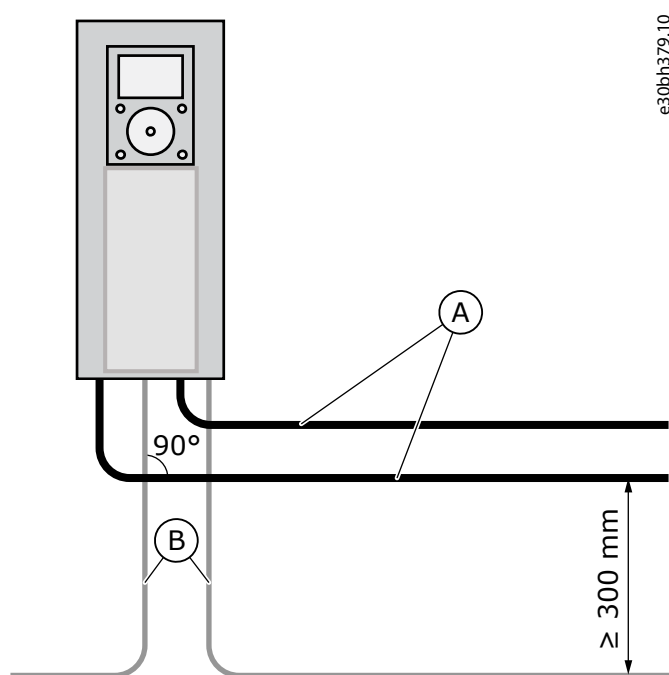
7.4.3 General Cabling Instructions for Fieldbus

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.

7.4.3.1 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.

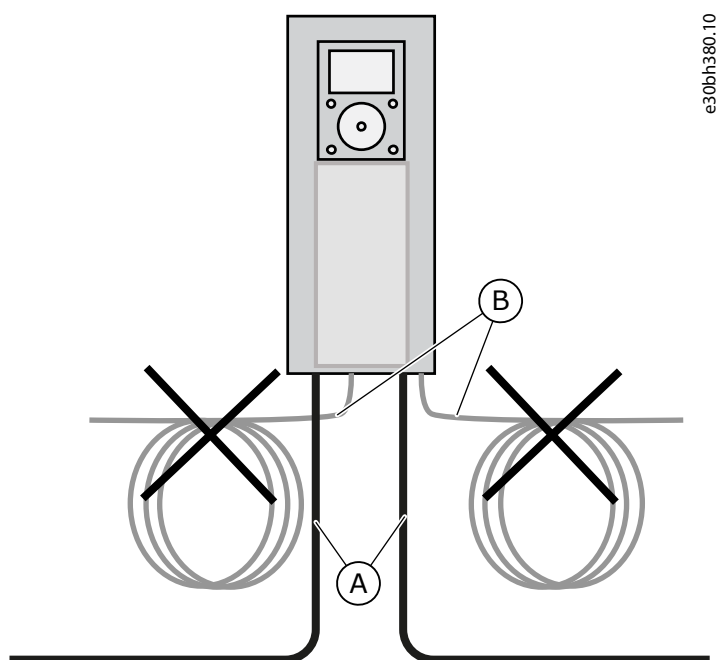


A Motor cables

B Fieldbus cables

Illustration 26: Routing the Motor and 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 circumference area make an antenna (see [illustration 27](#)). Noise connects to fieldbus cable and can cause communication problems.

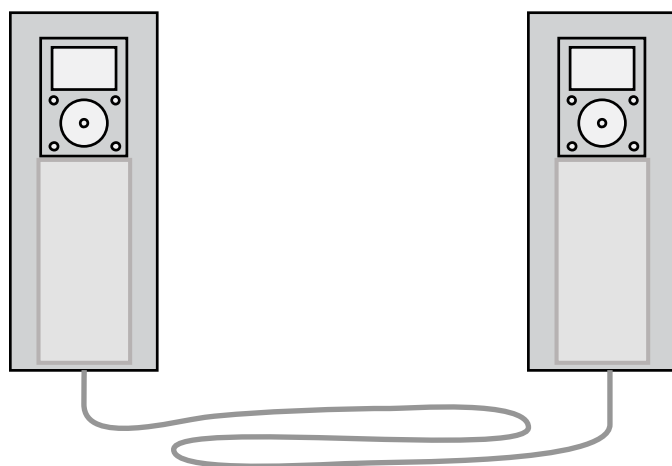


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A Motor cables

B Fieldbus cables

Illustration 27: Installation that Makes an Antenna



e30bh381.10

Illustration 28: Example of Good Routing of Extra Fieldbus Cable

NOTICE

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

7.4.3.2 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.

7.4.4 Ethernet Commissioning and Cabling

7.4.4.1 General Cabling Instructions for Ethernet

Use only shielded cables of category CAT5e or CAT6.

Table 19: 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.

7.4.4.2 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 29](#)). 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.

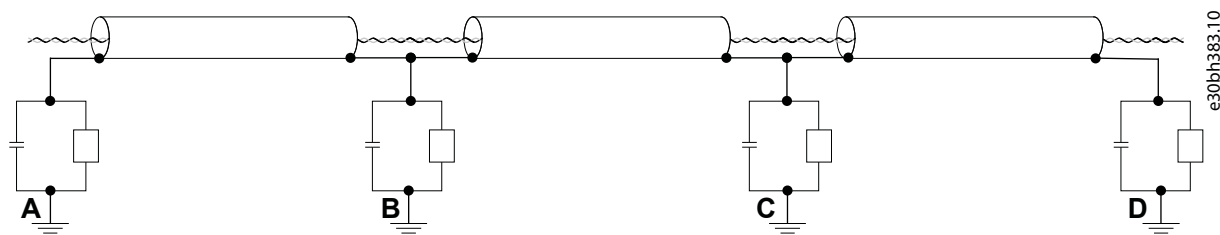


Illustration 29: Grounding via the Built-in RC Circuit

When disturbances are strong, the cable shield can be exposed and then 360 degrees grounded (see [illustration 32](#)) directly to the AC drive ground (see [illustration 31](#)).

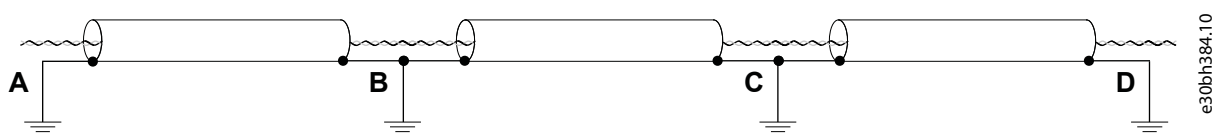


Illustration 30: Grounding in noisy environment with good equipotential. If potentials at points A, B, C, and D are very different and cannot be made similar, cut the shields as in Illustration Grounding in noisy environment with poor equipotential.

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 31](#)).

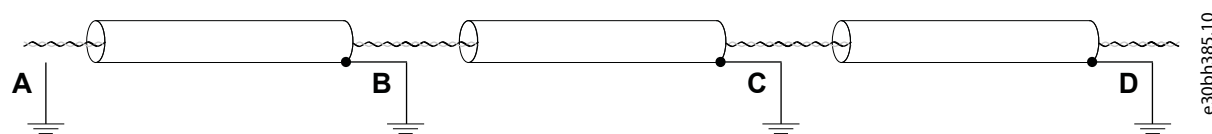
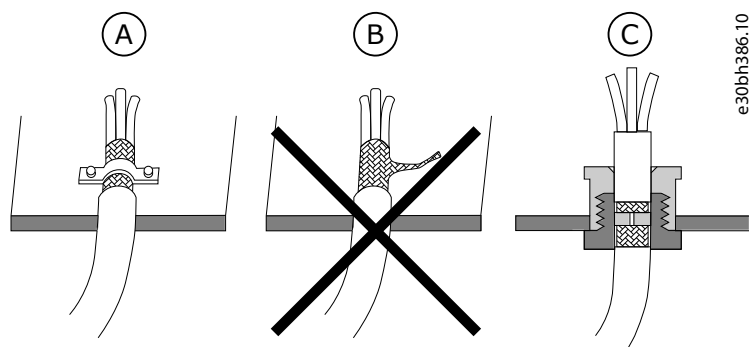


Illustration 31: Grounding in Noisy Environment with Poor Equipotential. Example of Cutting Shield.

We recommend grounding the cable shield as in examples A and C (see [illustration 32](#)). Do not ground the cable shield as in example B.



A Cable clamp	B Ground terminal
C Cable gland	

Illustration 32: Grounding the Cable Shield

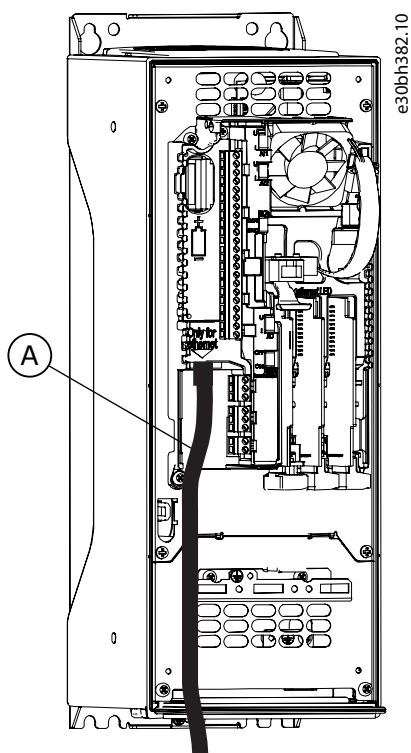
7.4.4.3 Using Fieldbus through an Ethernet Cable

Prerequisites:

Open the covers according to instructions in [6.4.1 Get Access and Locate the Terminals for MR4-MR7](#), [6.4.2 Get Access and Locate the Terminals for MR8](#), or [6.4.3 Get Access and Locate the Terminals for MR9](#).

Ethernet Cabling

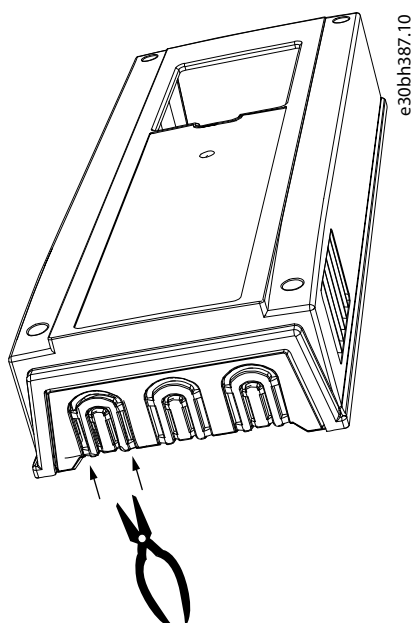
1. Connect the Ethernet cable to its terminal.



A The Ethernet cable

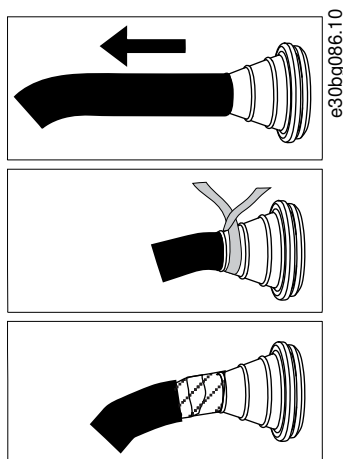
Illustration 33: Ethernet Cable Installation Location

2. In IP21, cut free the opening on the cover of the AC drive for the Ethernet cable.

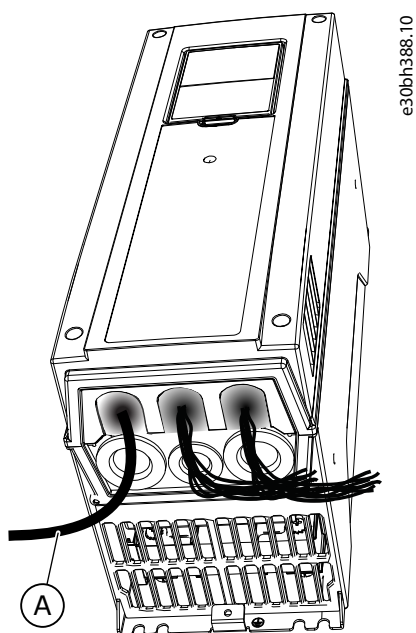


3. In IP54, cut a hole in a grommet and move the cable through it.

- A Do not cut the grommet openings wider than what is necessary for the used cables.
- B If the grommet folds in when putting the cable, pull the cable back to make the grommet straight.
- C Pull the first bit of the cable out of the grommet so that it stays straight. If this is not possible, make the connection tight with some insulation tape or a cable tie.

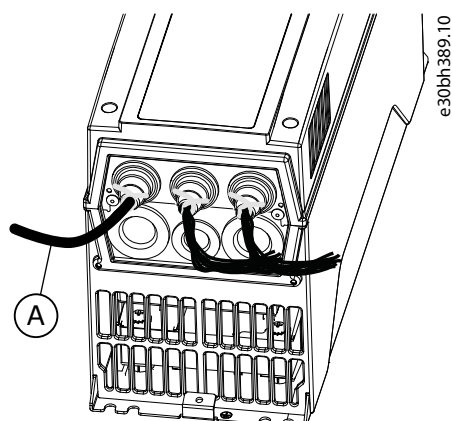


4. Put the cover of the drive back. Pull the fieldbus cables away from other cables.



A Ethernet cable

Illustration 34: Routing the Ethernet Cables in IP21



A Ethernet cable

Illustration 35: Routing the Ethernet Cables in IP54

See more in the installation guide of the used fieldbus.

7.4.5 RS485 Commissioning and Cabling

7.4.5.1 General Cabling Instructions for RS485

Use only shielded cables with twisted-pair signal wires.

For example, the following cables are recommended:

- Lapp Kabel UNITRONIC BUS LD FD P A, part number 2170813 or 2170814
- Belden 9841

The plug type to be used is 2.5 mm² (AWG13).

The theoretical maximum cable length depends on baud rate. See the following table for suggested maximum cable lengths.

Table 20: The RS485 Cable Lengths

Baud rate (kbit/s)	Length of line A (m)	Length of line B (m)
9.6	1200	1200
19.2	1200	1200
93.75	1200	1200
187.5	1000	600
500	400	200
1500	200	-
3000–12000	100	-

7.4.5.2 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. Note that paint coating acts as an insulator on metal and prevents grounding. Remove paint coating before doing grounding.

This chapter describes the principles of cable shield grounding. Notice that the internal RS485 fieldbus in VACON 100® products does not have jumpers for grounding options.

Connect the cable shield directly to the frame of the AC drive (see [illustration 36](#) and [illustration 38](#)).

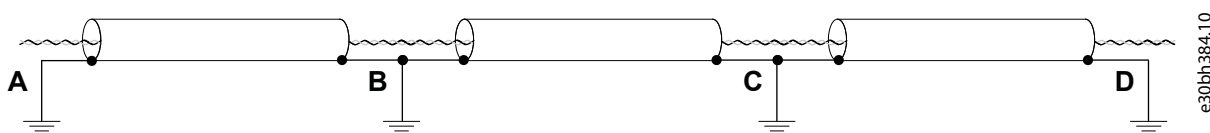


Illustration 36: Grounding in noisy environment with good equipotential. If potentials at points A, B, C and D are very different and cannot be made similar, cut the shields as in [Illustration Grounding in noisy environment with poor equipotential](#).

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 (see [illustration 37](#)).

When disturbances are strong, the cable shield can be exposed and then 360 degrees grounded directly to the AC drive ground (see [illustration 38](#)). When the connection is made like in [illustration 37](#), grounding should be done at a location nearest to the place where the disturbances meet the cable.

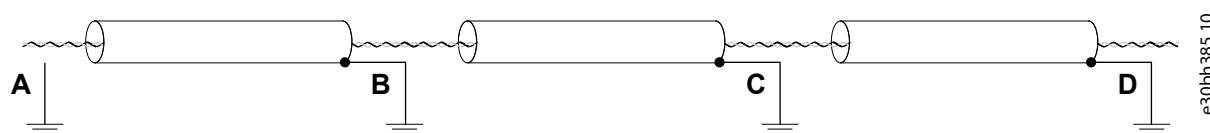
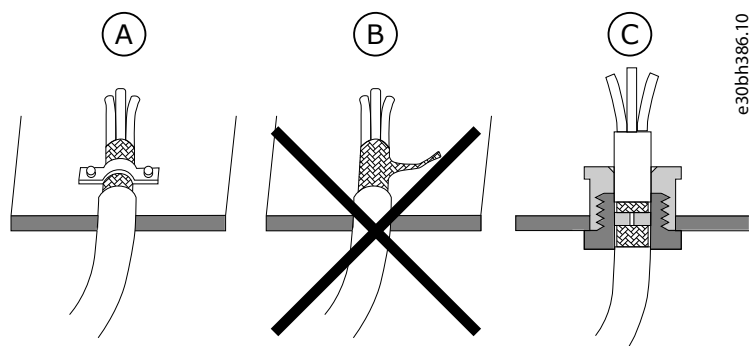


Illustration 37: Grounding in Noisy Environment with Poor Equipotential. An Example of Cutting the Shield.

We recommend grounding the cable shield as in examples A and C (see [illustration 38](#)). Do not ground the cable shield as in example B.



A Cable clamp	B Ground terminal
C Cable gland	

Illustration 38: Grounding the Cable Shield

7.4.5.3 The RS485 Bus Biasing

When no device on the RS485 bus line transmits data, all devices are in an idle state. In such conditions, the bus voltage is in an indefinite state, usually near 0 V, because of the termination resistors. This can cause problems in character reception because the RS485 standard considers the voltage interval from -200 mV to +200 mV as an undefined state. Thus, bus biasing is necessary to keep the voltage in state '1' (above +200 mV) also between the messages.

Unless the first and last device in the RS485 bus line have a built-in bus biasing function, you must add a separate active termination resistor specially designed for the RS485 bus (e.g. Siemens active RS485 terminating element 6ES7972-0DA00-0AA0).

7.4.5.4 Using Fieldbus through an RS485 Cable

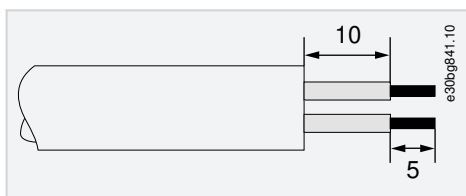
Prerequisites:

Open the covers according to instructions in [6.4.1 Get Access and Locate the Terminals for MR4-MR7](#), [6.4.2 Get Access and Locate the Terminals for MR8](#), or [6.4.3 Get Access and Locate the Terminals for MR9](#).

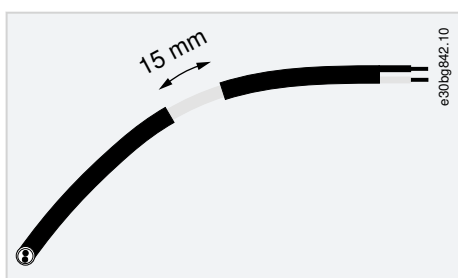
RS485 Cabling

1. Remove approximately 15 mm (0.59 in) of the gray shield of the RS485 cable. Do this for the two fieldbus cables.

- A Strip the cables for approximately 5 mm (0.20 in) to put them in the terminals. Do not keep more than 10 mm (0.39 in) of the cable outside the terminals.

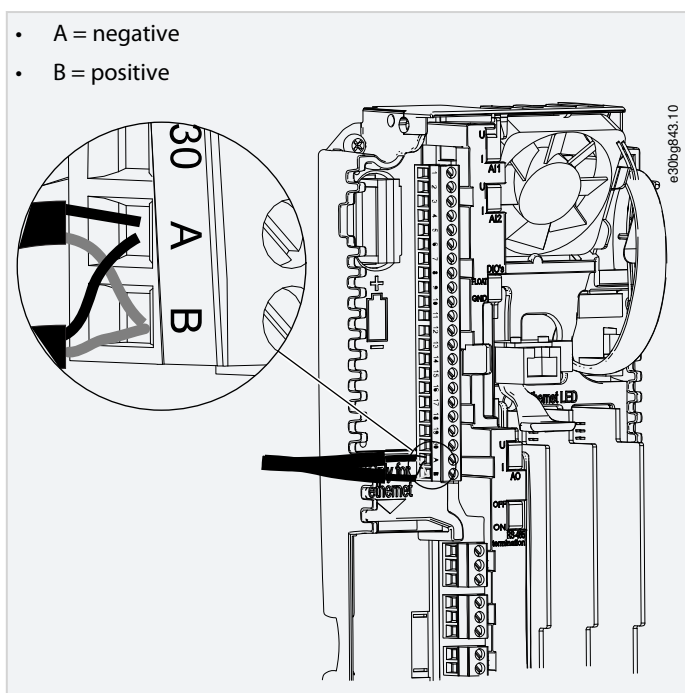


- B Strip the cable at such a distance from the terminal that it can be attached to the frame with the grounding clamp for the control cable. Strip the cable at a maximum length of 15 mm (0.59 in). Do not remove the aluminum shield of the cable.



2. Connect the cable to the default I/O board of the drive, in terminals A and B.

- A = negative
- B = positive



3. Attach the shield of the cable to the frame of the drive with a grounding clamp for the control cable to make a grounding connection.

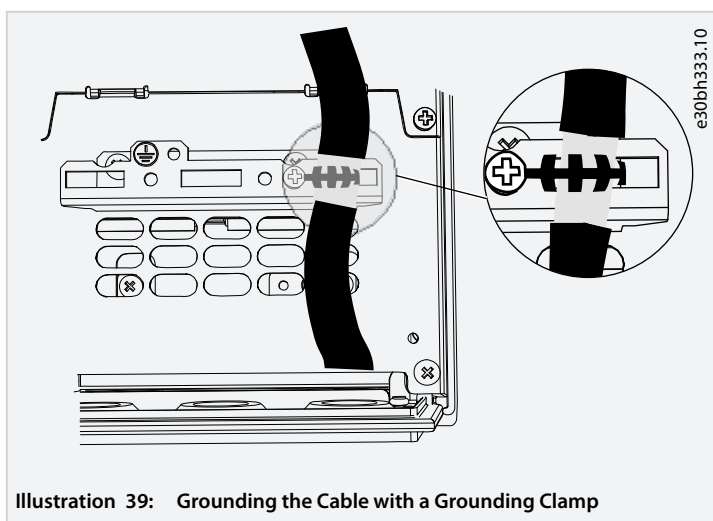
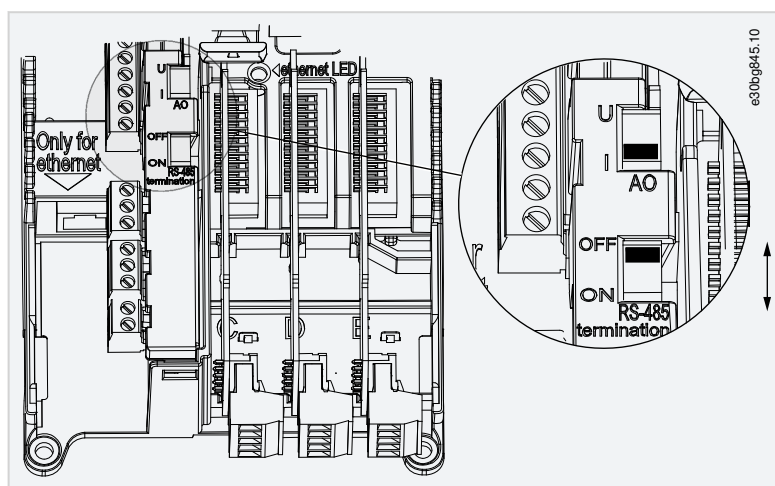


Illustration 39: Grounding the Cable with a Grounding Clamp

4. If the drive is the last device on the fieldbus line, set the bus termination. Set the bus termination for the first and the last device of the fieldbus line. It is recommended that the first device on the fieldbus is the master device.

A Find the DIP switches on the left side of the control unit of the drive.



B Set the DIP switch of the RS485 bus termination to the ON position.

The termination resistors are placed at both ends of the fieldbus line to decrease signal reflections on the line.

Biasing is built in the bus termination resistor. The termination resistance is 220 Ω .

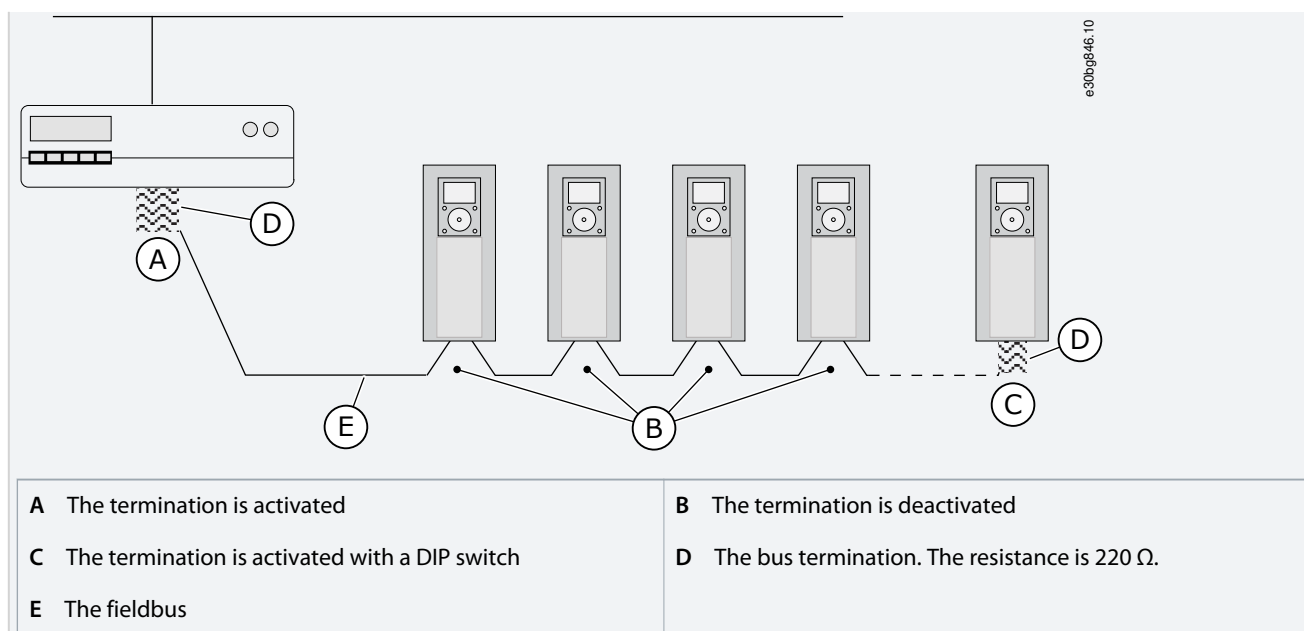


Illustration 40: Setting the Bus Termination for a Fieldbus Line

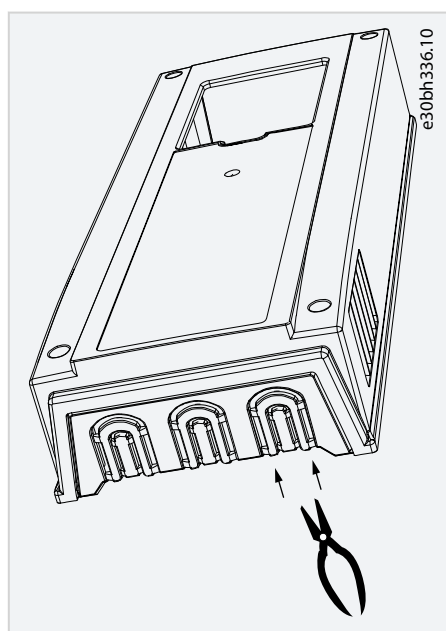
NOTICE

LOSS OF TERMINATION RESISTANCE

If the last device on the fieldbus line is powered down, the termination resistance is lost. The loss of termination resistance causes signal reflections on the line, which can disrupt the fieldbus communication.

- Do not power down the last device on the fieldbus line while the fieldbus is active.

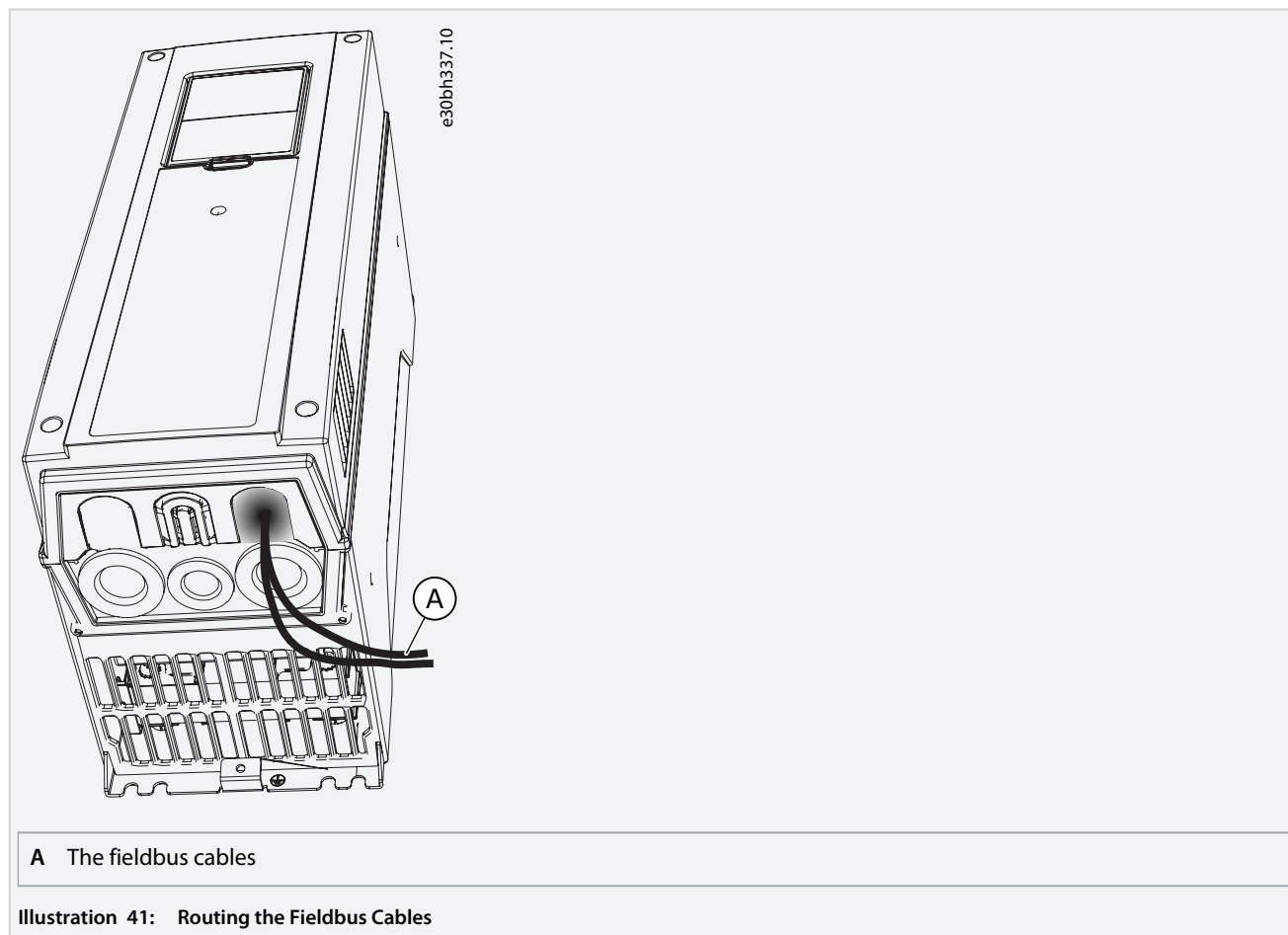
- In IP21, unless you have cut the openings for other cables, cut an opening on the cover of the drive for the RS485 cable.



- Put the cover of the drive back. Pull the RS485 cables to the side.

- A** Keep the distance of the Ethernet, I/O and Fieldbus cables from the motor cable at a minimum of 30 cm (11.81 in).

B Move the fieldbus cables away from the motor cable.



7.5 Available Option Boards

Table 21: Option Boards and their Correct Option Board Slots

The option board	The name of the option board	The correct slot or slots
OPTB1	The I/O expander board	C, D, E
OPTB2	The Thermistor relay board	C, D, E
OPTB4	The I/O expander board	C, D, E
OPTB5	The Relay board	C, D, E
OPTB9	The I/O expander board	C, D, E
OPTBF	The I/O expander board	C, D, E
OPTBH	The Temperature measurement board	C, D, E
OPTBJ	The Safe Torque Off board	E
OPTC4	The LonWorks fieldbus board	D, E
OPTE2	The RS485 (Modbus/N2) fieldbus board	D, E

The option board	The name of the option board	The correct slot or slots
OPTE3	The PROFIBUS DPV1 fieldbus board	D, E
OPTE5	The PROFIBUS DPV1 fieldbus board (with a type D connector)	D, E
OPTE6	The CANopen fieldbus board	D, E
OPTE7	The DeviceNet fieldbus board	D, E
OPTE8	The RS485 (Modbus/N2) fieldbus board (with a type D connector)	D, E
OPTE9	The Dual-port ethernet fieldbus board	D, E
OPTEA	The Advanced dual-port ethernet fieldbus board	D, E
OPTEC	The EtherCAT fieldbus board	D, E

7.6 Option Board Installation

Prerequisites:

⚠ 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.

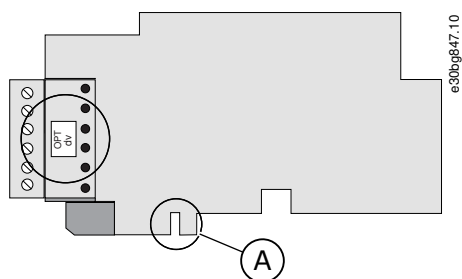
- Switch off the AC drive before installing, removing, or replacing option boards on the drive.

NOTICE

INCOMPATIBLE OPTION BOARDS

It is not possible to install option boards that are not compatible with the drive.

If the installed board is an OPTB or an OPTC option board, make sure that the label on it says "dv" (dual voltage). This marking shows that the option board is compatible with the drive.

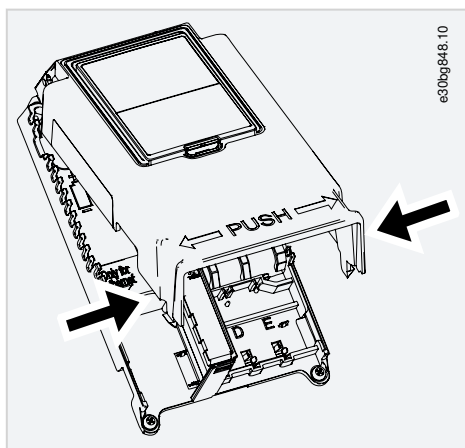


A The slot coding

Illustration 42: Label on the Option Board

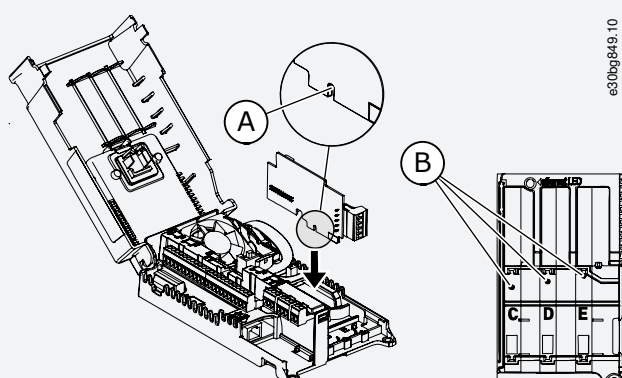
Installation Procedure

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



2. Install the option board into the correct slot: C, D, or E.

The option board has a slot coding, because of which it is not possible to install the option board in an incorrect slot.



A The slot coding

B The option slots

Illustration 43: Installing the Option Boards

3. Close the cover of the control unit.

7.7 Battery for the Real-Time Clock (RTC)

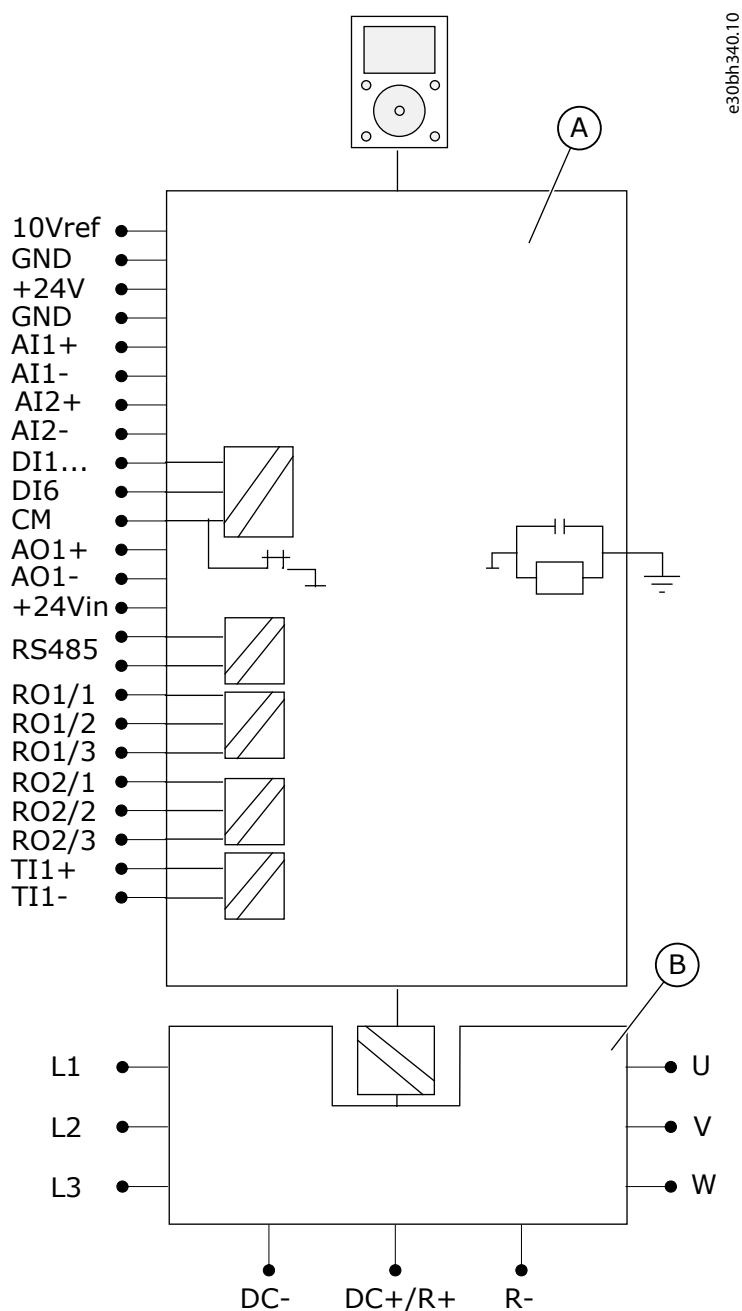
To use the real-time clock (RTC), a battery must be installed in the left side of the control unit. See [7.1 Control Unit Components](#). Use a ½ AA battery with 3.6 V and a capacity of 1000–1200 mAh. Use, for example, a Vitzrocell SB-AA02 battery.

The battery lasts approximately 10 years. See more about the functions of the RTC in the application guides.

7.8 Galvanic Isolation Barriers

The control connections are isolated from the mains. The ground terminals are permanently connected to the I/O ground.

The digital inputs on the standard I/O board can be galvanically isolated from the I/O ground. To isolate the digital inputs, use the DIP switch that has the positions FLOAT and GND. See [7.3.2 Isolation of the Digital Inputs from Ground](#).



A The control unit

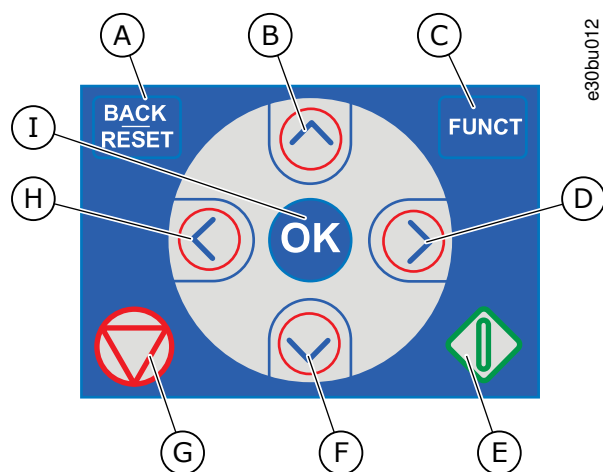
B The power unit

Illustration 44: Galvanic isolation barriers

7.9 Description of the Control Panel

7.9.1 Control Panel and the Keypad

The control panel is the interface between the AC drive and the user. With the control panel, you can control the speed of a motor and monitor the status of the AC drive. You can also set the parameters of the AC drive.



A The [BACK/RESET] button. Use it to move back in the menu, exit the Edit mode, reset a fault.	B The arrow button UP. Use it to scroll the menu up and to increase a value.
C The [FUNCT] button. Use it to change the rotation direction of the motor, access the control page, and change the control place.	D The arrow button RIGHT.
E The START button.	F The arrow button DOWN. Use it to scroll the menu down and to decrease a value.
G The STOP button.	H The arrow button LEFT. Use it to move the cursor left.
I The [OK] button. Use it to go into an active level or item, or to accept a selection.	

Illustration 45: Buttons of the VACON® 100 Keypad

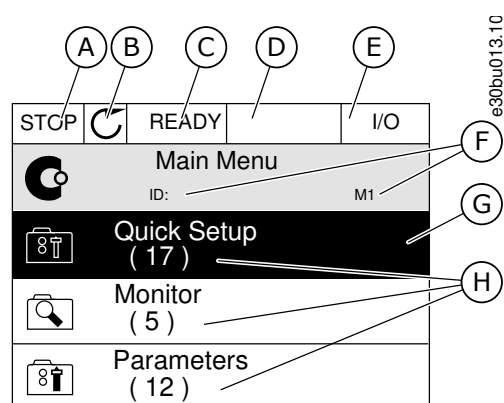
7.9.2 Displays of the Control Panel

There are 2 display types: the graphical display and the text display. The control panel always has the same keypad and buttons.

The display shows this data.

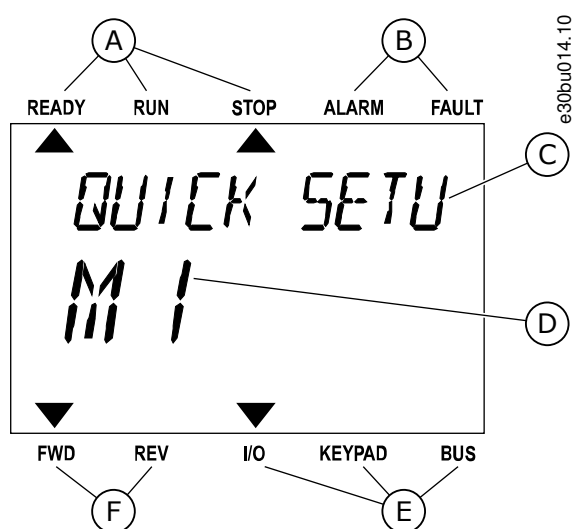
- The status of the motor and the drive.
- Faults in the motor and in the drive.
- Your location in the menu structure.

If the text in the text display is too long for the display, the text scrolls to show the full text string. Some functions are only available in the graphical display.



A The first status field: <i>STOP/RUN</i>	B The rotation direction of the motor
C The second status field: <i>READY/NOT READY/FAULT</i>	D The alarm field: <i>ALARM/-</i>
E The control place field: <i>PC/I/O/KEYPAD/ FIELDBUS</i>	F The location field: the ID number of the parameter and the current location in the menu
G An activated group or item	H The number of items in the group in question

Illustration 46: Graphical Display of the Control Panel



A The indicators of status	B The indicators of alarm and fault
C The name of the group or item of the current location	D The current location in the menu
E The indicators of the control place	F The indicators of the rotation direction

Illustration 47: Text Display of the Control Panel

See more information in the VACON® 100 INDUSTRIAL, VACON® 100 FLOW, and VACON® 100 HVAC Application Guides.

8 Commissioning

8.1 Safety Checks before Starting the Commissioning

Before starting the commissioning, read these warnings.

DANGER

SHOCK HAZARD FROM POWER UNIT COMPONENTS

The power unit components are live when the drive is connected to mains. A contact with this voltage can lead to death or serious injury.

- Do not touch the components of the power unit when the drive is connected to mains. Before connecting the drive to mains, make sure that the covers of the drive are closed.

DANGER

SHOCK HAZARD FROM TERMINALS

The motor terminals U, V, W, the brake resistor terminals, or the DC terminals are live when the drive is connected to mains, also when the motor does not operate. A contact with this voltage can lead to death or serious injury.

- Do not touch the motor terminals U, V, W, the brake resistor terminals, or the DC terminals when the drive is connected to mains. Before connecting the drive to mains, make sure that the covers of the drive are closed.

DANGER

SHOCK HAZARD FROM DC LINK OR EXTERNAL SOURCE

The terminal connections and the components of the drive can be live 5 minutes after the drive is disconnected from the mains and the motor has stopped. Also the load side of the drive can generate voltage. A contact with this voltage can lead to death or serious injury.

- Before doing electrical work on the drive:
 - Disconnect the drive from the mains and make sure that the motor has stopped.
 - Lock out and tag out the power source to the drive.
 - Make sure that no external source generates unintended voltage during work.
 - Wait 5 minutes before opening the cabinet door or the cover of the AC drive.
 - Use a measuring device to make sure that there is no voltage.

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.

8.2 Commissioning the AC Drive

Context:

Follow these instructions to commission the AC drive.

Prerequisites:

Read the safety instructions in [2.2 Danger and Warnings](#) and [8.1 Safety Checks before Starting the Commissioning](#) and obey them.

Procedure

1. Make sure that the motor is installed correctly.
2. Make sure that the motor is not connected to mains.
3. Make sure that the AC drive and the motor are grounded.
4. Make sure to select the mains cable, the brake cable, and the motor cable correctly.

For information on cable selections, see:

- [6.1.3 Cable Selection and Dimensioning](#) and related tables
- [6.1 Cable Connections](#)
- [6.2 EMC-compliant Installation](#)

5. Make sure that the control cables are as far as possible from the power cables. See [6.5.1 Additional Instructions for Cable Installation](#).
6. Make sure that the shields of the shielded cables are connected to a grounding terminal that is identified with the PE symbol.
7. Check the tightening torques of all the terminals.
8. Make sure that no power correction capacitors are connected to the motor cable.
9. Make sure that the cables do not touch the electrical components of the drive.
10. Make sure that the common inputs of the digital input groups are connected to +24 V or ground of the control terminal or the external power source.
11. Check the quality and quantity of the cooling air.

For further information on cooling requirements, see:

 - [5.3.1 General Cooling Requirements](#)
 - [5.3.2 Cooling](#)
 - [5.3.3 Necessary Quantity of Cooling Air](#)
12. Make sure that there is no condensation on the surfaces of the AC drive.
13. Make sure that there are no unwanted objects in the installation space.
14. Before connecting the drive to mains, check the installation and the condition of all the fuses (see [10.3.1 List of Cable and Fuse Size Information](#)) and other protective devices.

8.3 Measuring the Cable and Motor Insulation

Do these checks if necessary.

- The insulation checks of the motor cable, see [8.3.1 Insulation Checks of the Motor Cable](#)
- The insulation checks of the mains cable, see [8.3.2 Insulation Checks of the Mains Cable](#)
- The insulation checks of the motor, see [8.3.3 Insulation Checks of the Motor](#)

8.3.1 Insulation Checks of the Motor Cable

Context:

Use these instructions to check the insulation of the motor cable.

Procedure

1. Disconnect the motor cable from the terminals U, V, and W and from the motor.
2. Measure the insulation resistance of the motor cable between phase conductors 1 and 2, between phase conductors 1 and 3, and between phase conductors 2 and 3.
3. Measure the insulation resistance between each phase conductor and the grounding conductor.
4. The insulation resistance must be $>1\text{ M}\Omega$ at the ambient temperature of $20\text{ }^{\circ}\text{C}$ ($68\text{ }^{\circ}\text{F}$).

8.3.2 Insulation Checks of the Mains Cable

Context:

Use these instructions to check the insulation of the mains cable.

Procedure

1. Disconnect the mains cable from the terminals L1, L2, and L3 and from mains.
2. Measure the insulation resistance of the mains cable between phase conductors 1 and 2, between phase conductors 1 and 3, and between phase conductors 2 and 3.
3. Measure the insulation resistance between each phase conductor and the grounding conductor.
4. The insulation resistance must be $>1\text{ M}\Omega$ at the ambient temperature of $20\text{ }^{\circ}\text{C}$ ($68\text{ }^{\circ}\text{F}$).

8.3.3 Insulation Checks of the Motor

Context:

Use these instructions to check the insulation of the motor.

NOTICE

Obey the instructions of the motor manufacturer.

Procedure

1. Disconnect the motor cable from the motor.
2. Open the bridging connections in the motor connection box.
3. Measure the insulation resistance of each motor winding. The voltage must be the same or higher than the motor nominal voltage, but at least 1000 V .
4. The insulation resistance must be $>1\text{ M}\Omega$ at the ambient temperature of $20\text{ }^{\circ}\text{C}$ ($68\text{ }^{\circ}\text{F}$).
5. Connect the motor cables to the motor.
6. Do the final insulation check on the drive side. Put all phases together and measure to the ground.
7. Connect the motor cables to the drive.

8.4 Checking the AC Drive after Commissioning

Context:

Before starting the motor, do these checks.

Procedure

1. Make sure that all the START and STOP switches that are connected to the control terminals are in the STOP position.
2. Make sure that the motor can be started safely.
3. Activate the Start-up wizard. See the relevant application guide.
4. Set the maximum frequency reference (that is, the maximum speed of the motor) to agree with the motor and the device that is connected to the motor.

9 Maintenance

9.1 Maintenance Schedule

To make sure that the drive operates correctly and has a long life, we recommend doing regular maintenance. Refer to the table for maintenance intervals.

It is not necessary to replace the main capacitors of the drive, because they are thin film type capacitors.

Table 22: Maintenance Intervals and Tasks

Maintenance interval	Maintenance task
Regularly	<p>Check the tightening torques of the terminals.</p> <p>Check the filters.</p>
6–24 months (The interval is different in different environments.)	<p>Check the mains terminals, the motor terminals, and the control terminals.</p> <p>Make sure that the cooling fan operates correctly.</p> <p>Make sure that there is no corrosion on the terminals, the busbars, or other surfaces.</p> <p>Check the door filters, if you have a cabinet installation.</p>
24 months (The interval is different in different environments.)	Clean the heat sink and the cooling channel.
3–6 years	In IP54, change the internal fan.
6–10 years	Change the main fan.
10 years	Replace the battery of the RTC.

10 Specifications

10.1 Weight of the Drive

Table 23: Weight of the Drive

Enclosure size	Weight [kg]	Weight [lb.]
MR4	6.0	13.2
MR5	10.0	20.0
MR6	20.0	44.1
MR7	37.5	82.7
MR8	66.0	145.5
MR9	119.5	263.5

10.2 Dimensions

10.2.1 Dimensions for Wall-mounting

10.2.1.1 Dimensions for Wall-mounting for MR4

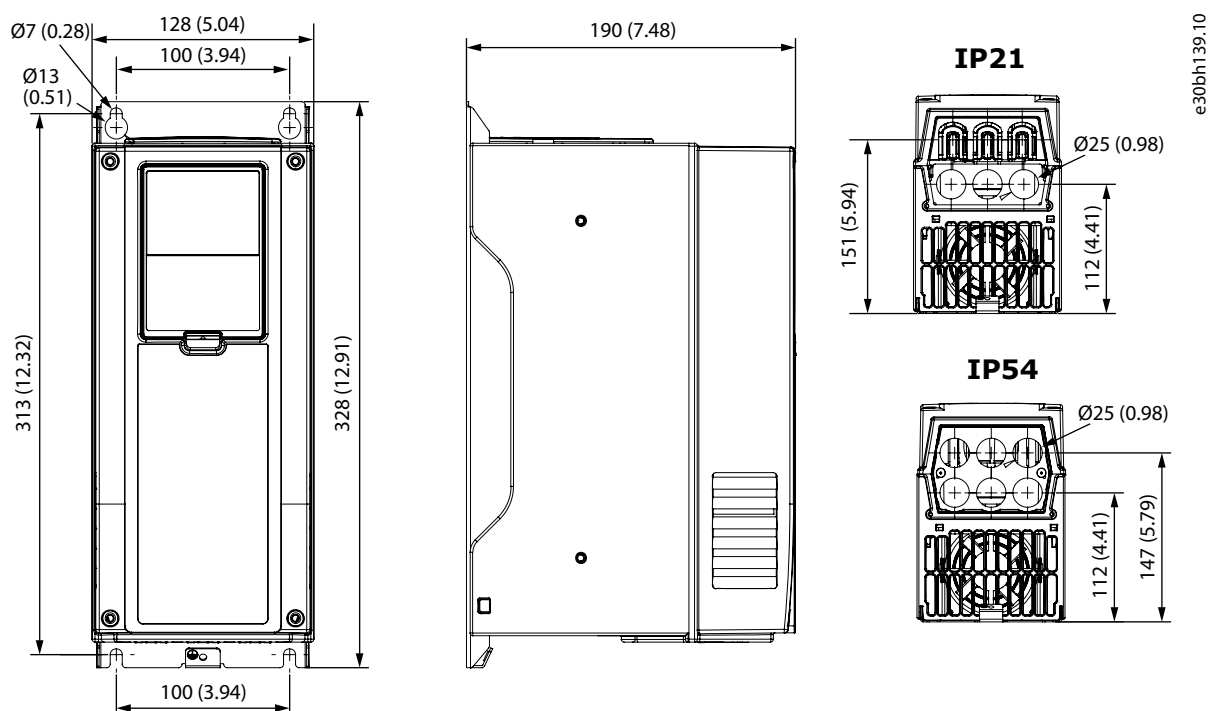
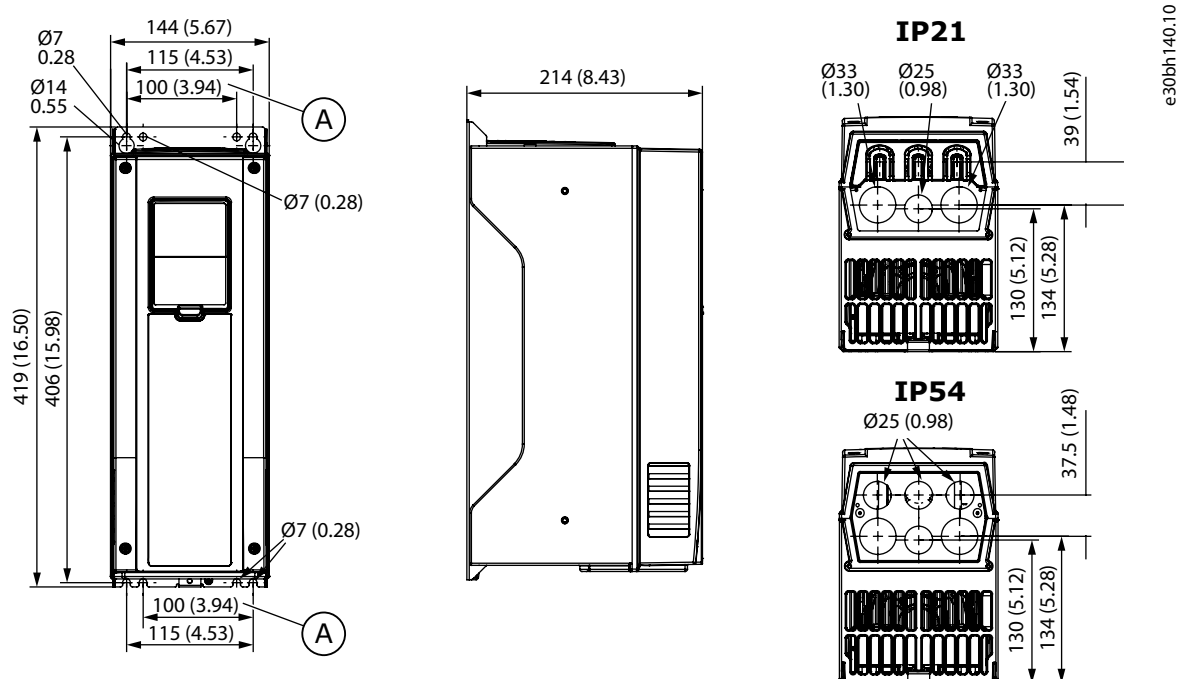


Illustration 48: Dimensions of the AC Drive, MR4, mm (in)

10.2.1.2 Dimensions for Wall-mounting for MR5



A Mounting holes for replacing a VACON® NX AC drive with a VACON® 100 Wall-mounted AC drive

Illustration 49: Dimensions of the AC Drive, MR5, mm (in)

10.2.1.3 Dimensions for Wall-mounting for MR6

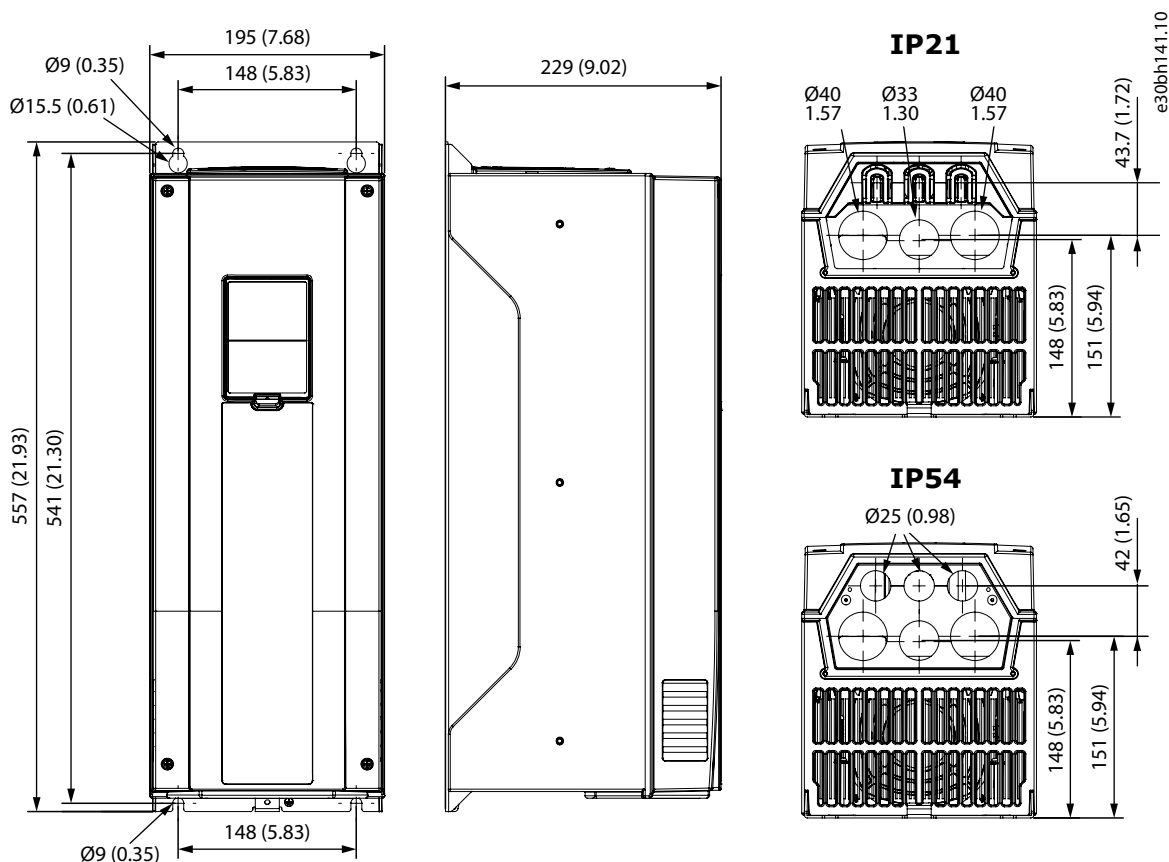


Illustration 50: Dimensions of the AC Drive, MR6, mm (in)

10.2.1.4 Dimensions for Wall-mounting for MR7

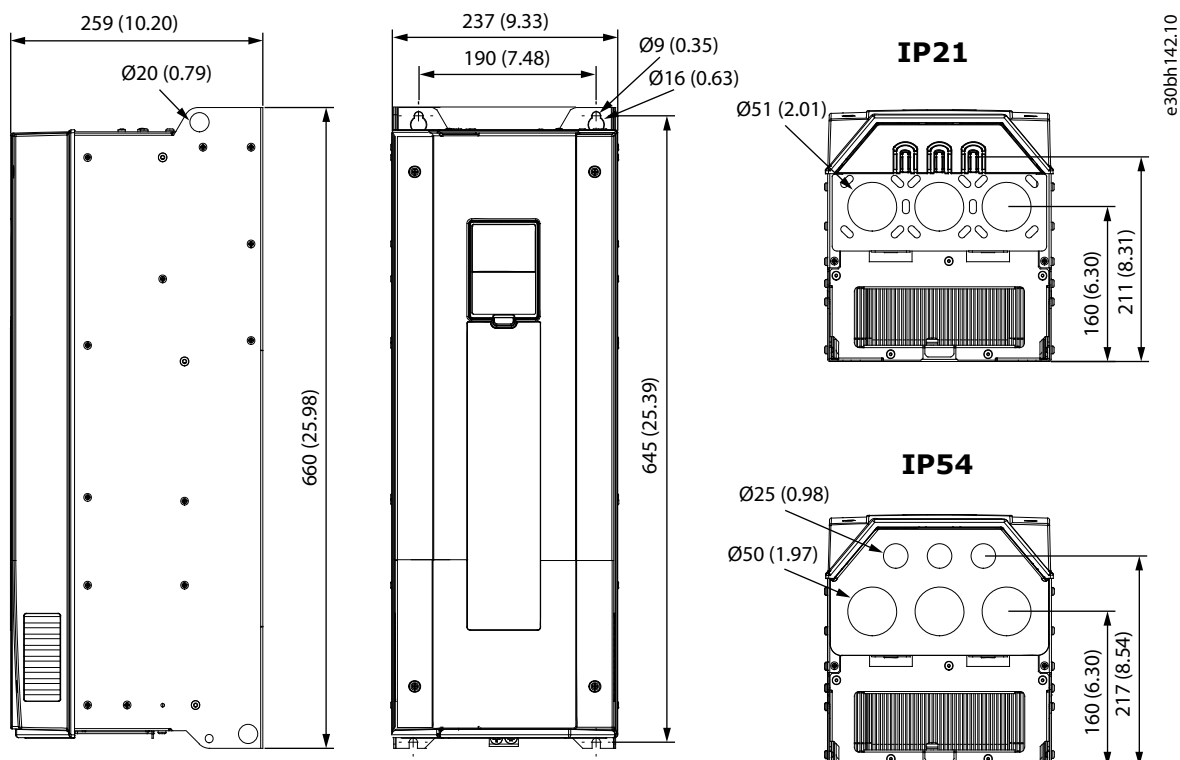
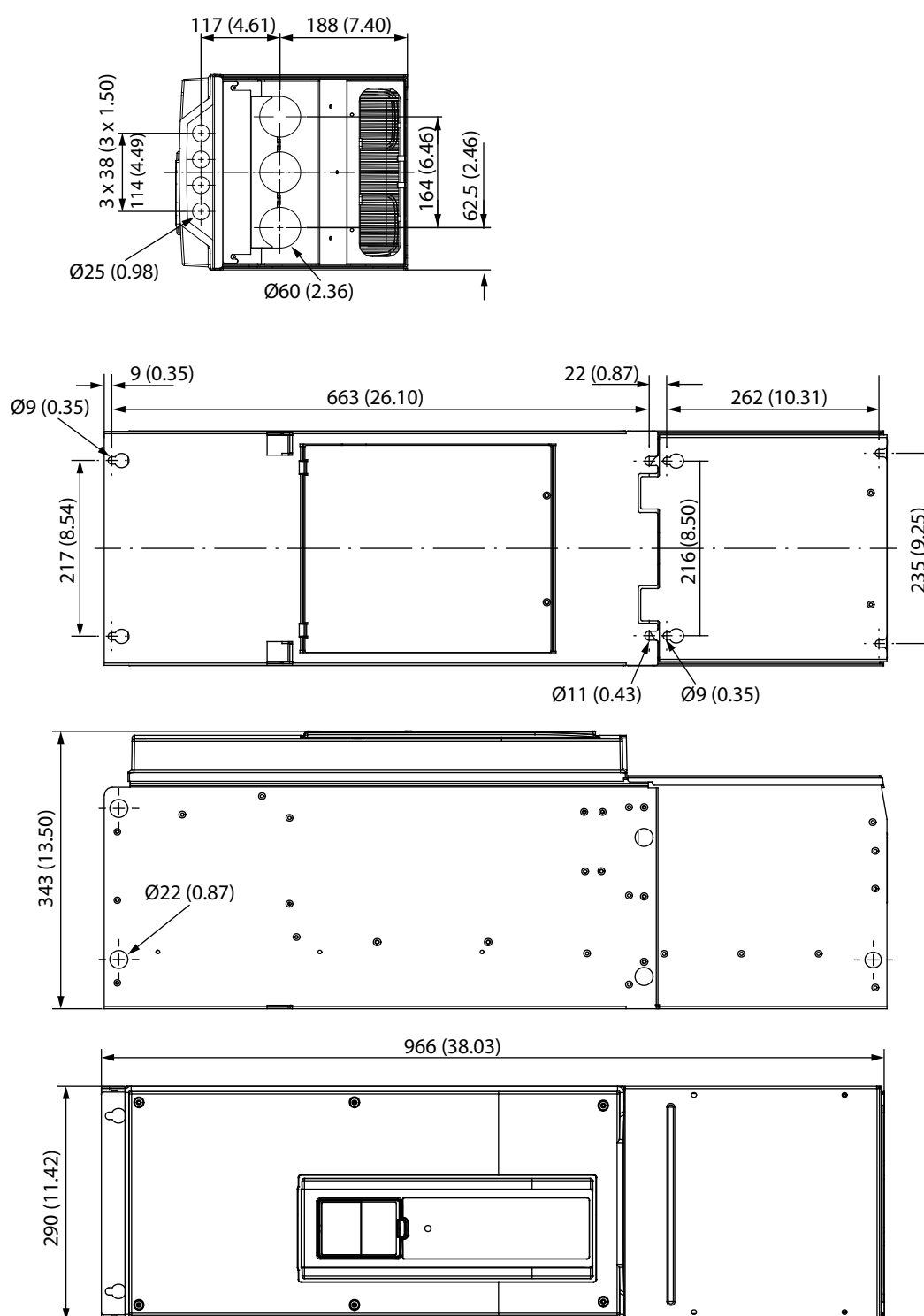


Illustration 51: Dimensions of the AC Drive, MR7, mm (in)

10.2.1.5 Dimensions for Wall-mounting for MR8



e30bh143.10

Illustration 52: Dimensions of the AC Drive, MR8, mm (in)

10.2.1.6 Dimensions for Wall-mounting for MR9

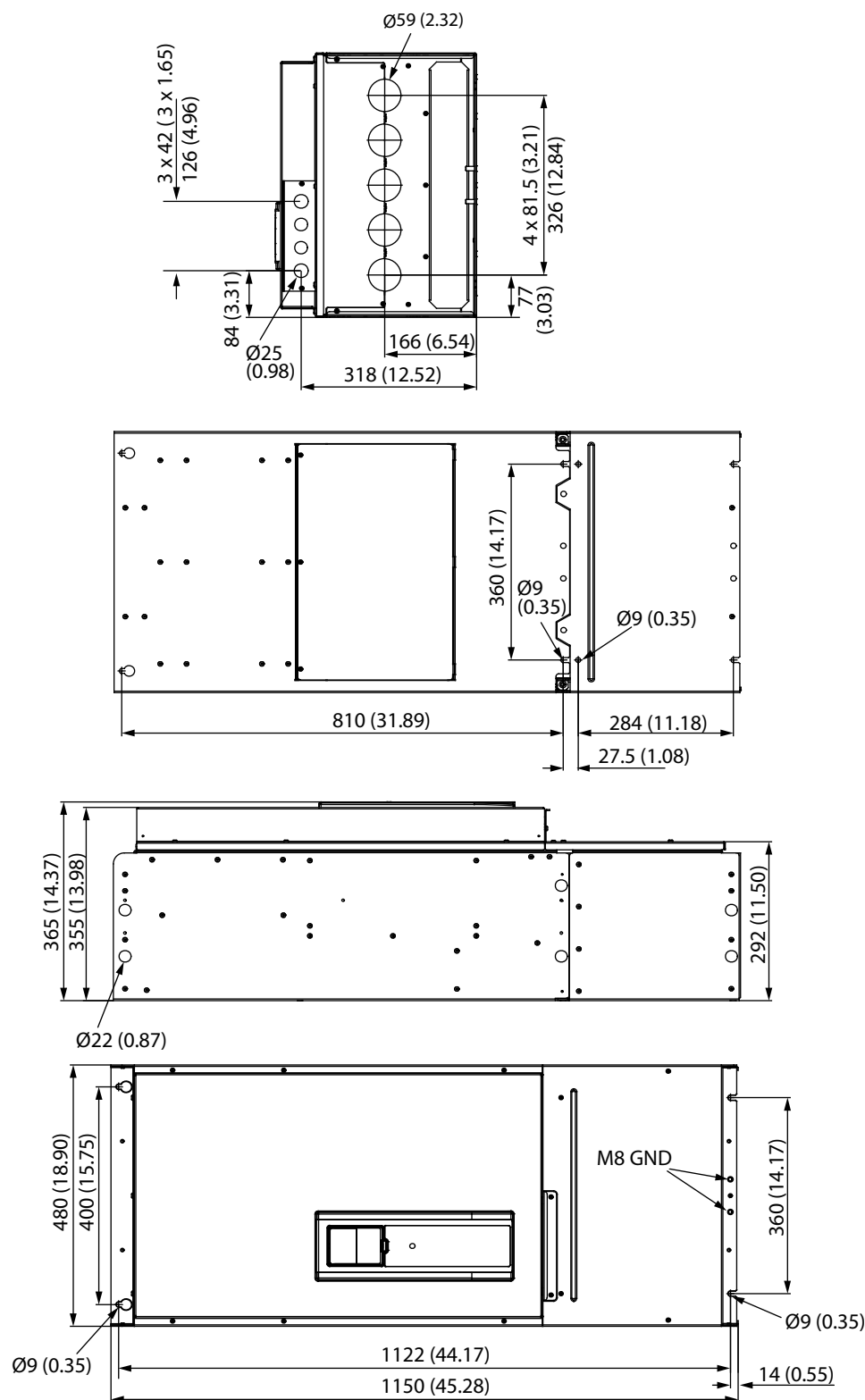
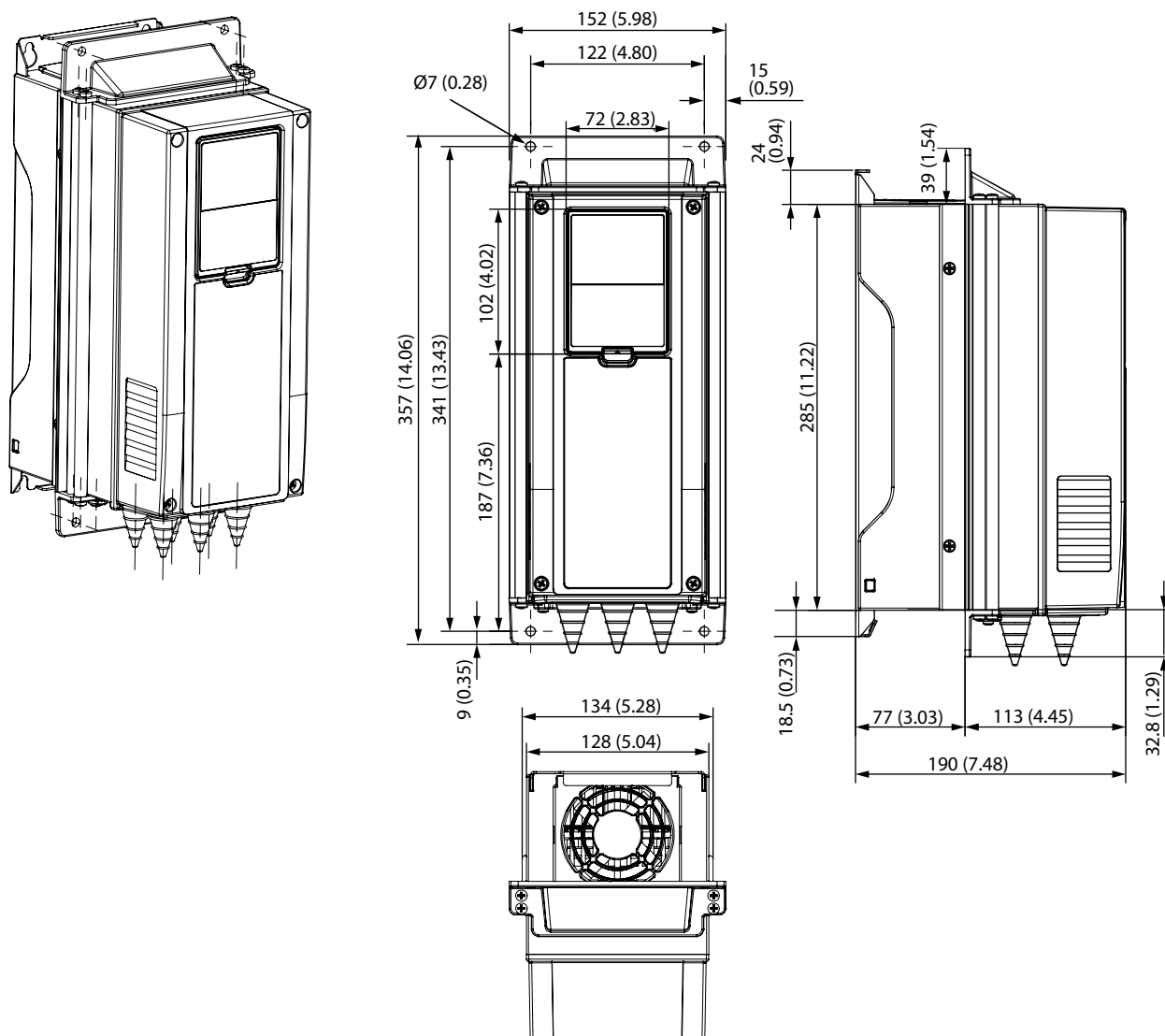


Illustration 53: Dimensions of the AC Drive, MR9, mm (in)

10.2.2 Dimensions for Flange-mounting

10.2.2.1 Dimensions for Flange-mounting for MR4



e30bh145.10

Illustration 54: Flange Mounting Dimensions of MR4, mm (in)

10.2.2.2 Dimensions for Flange-mounting for MR5

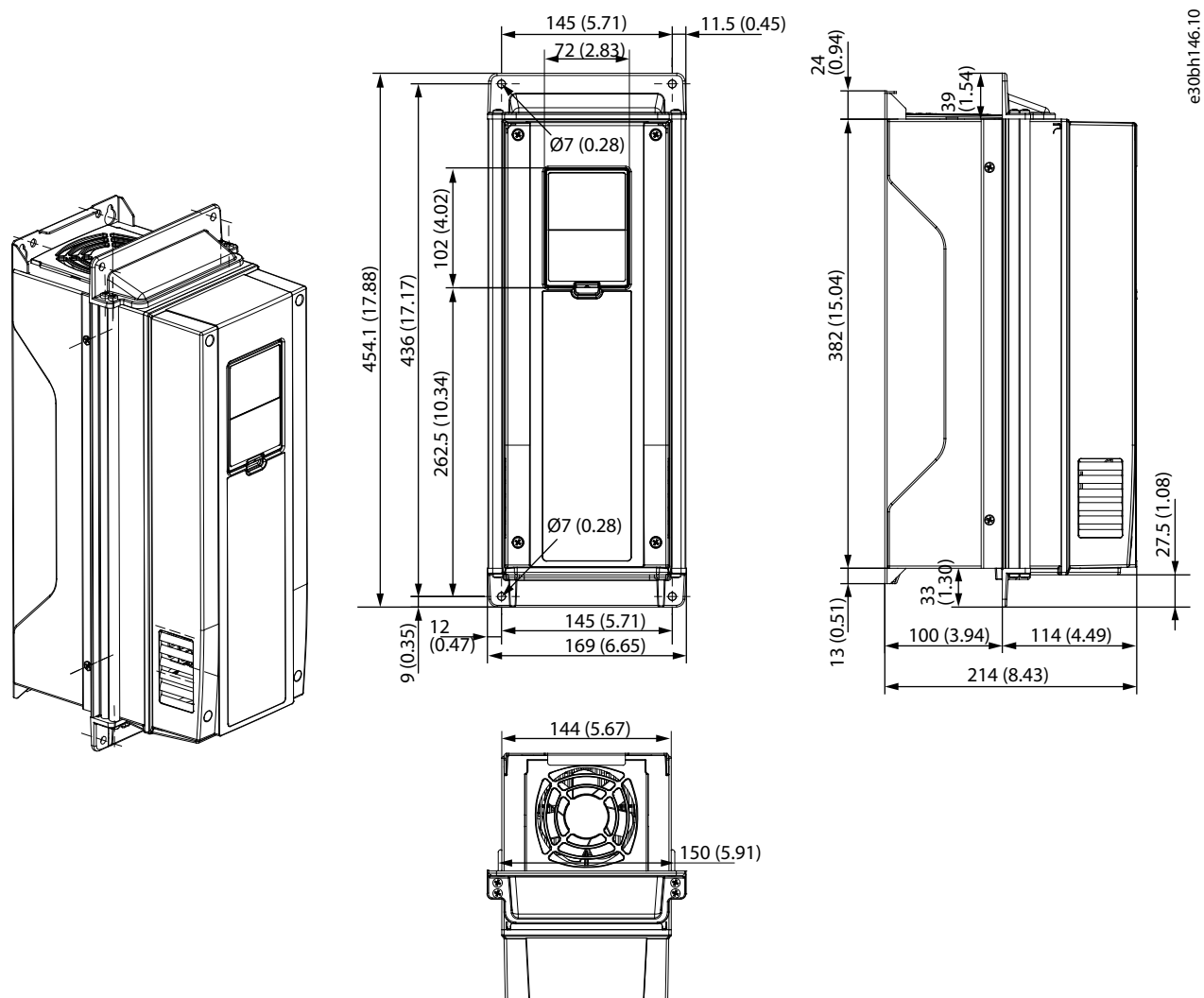


Illustration 55: Flange Mounting Dimensions of MR5, mm (in)

10.2.2.3 Dimensions for Flange-mounting for MR6

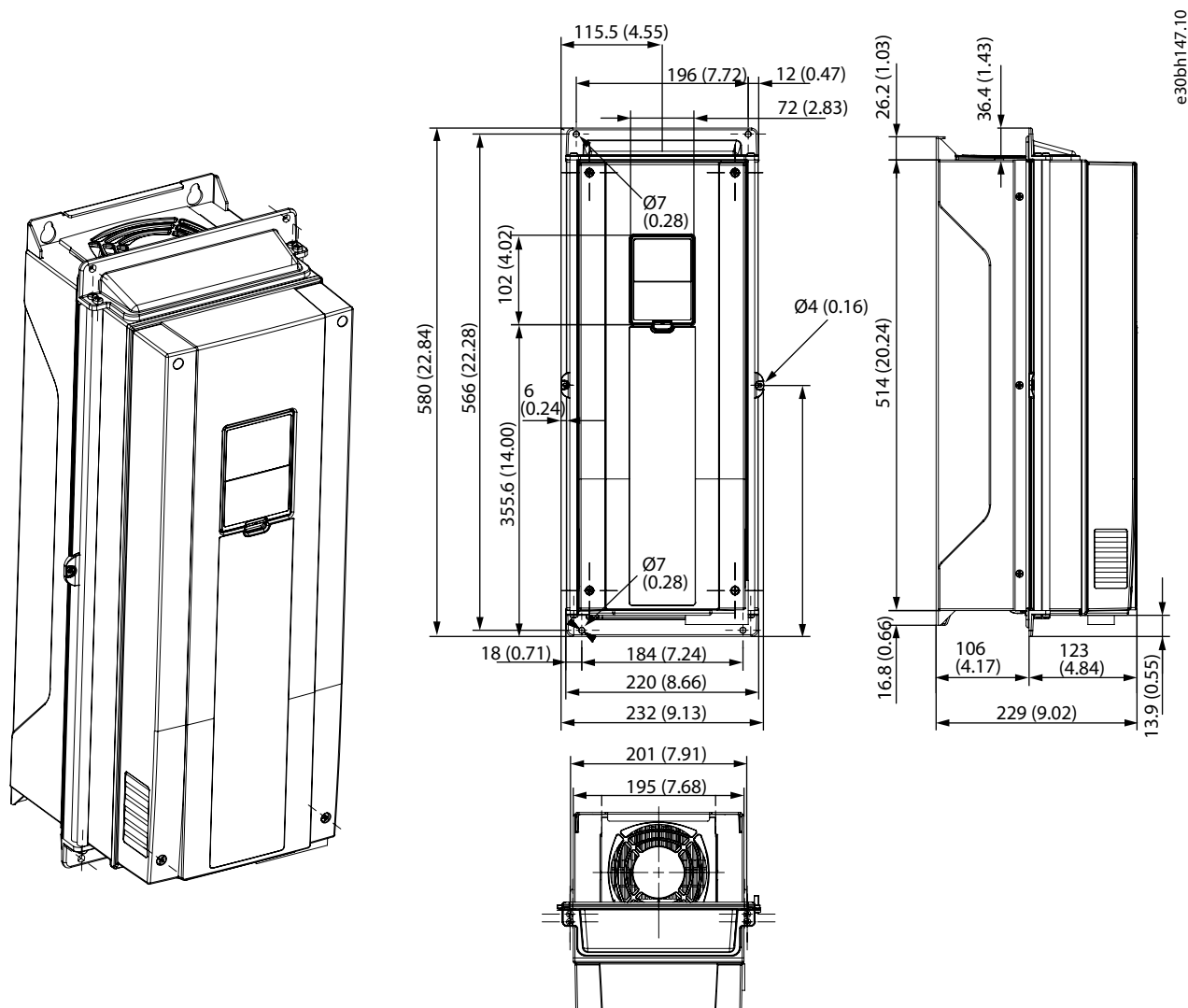


Illustration 56: Flange Mounting Dimensions of MR6, mm (in)

10.2.2.4 Dimensions for Flange-mounting for MR7

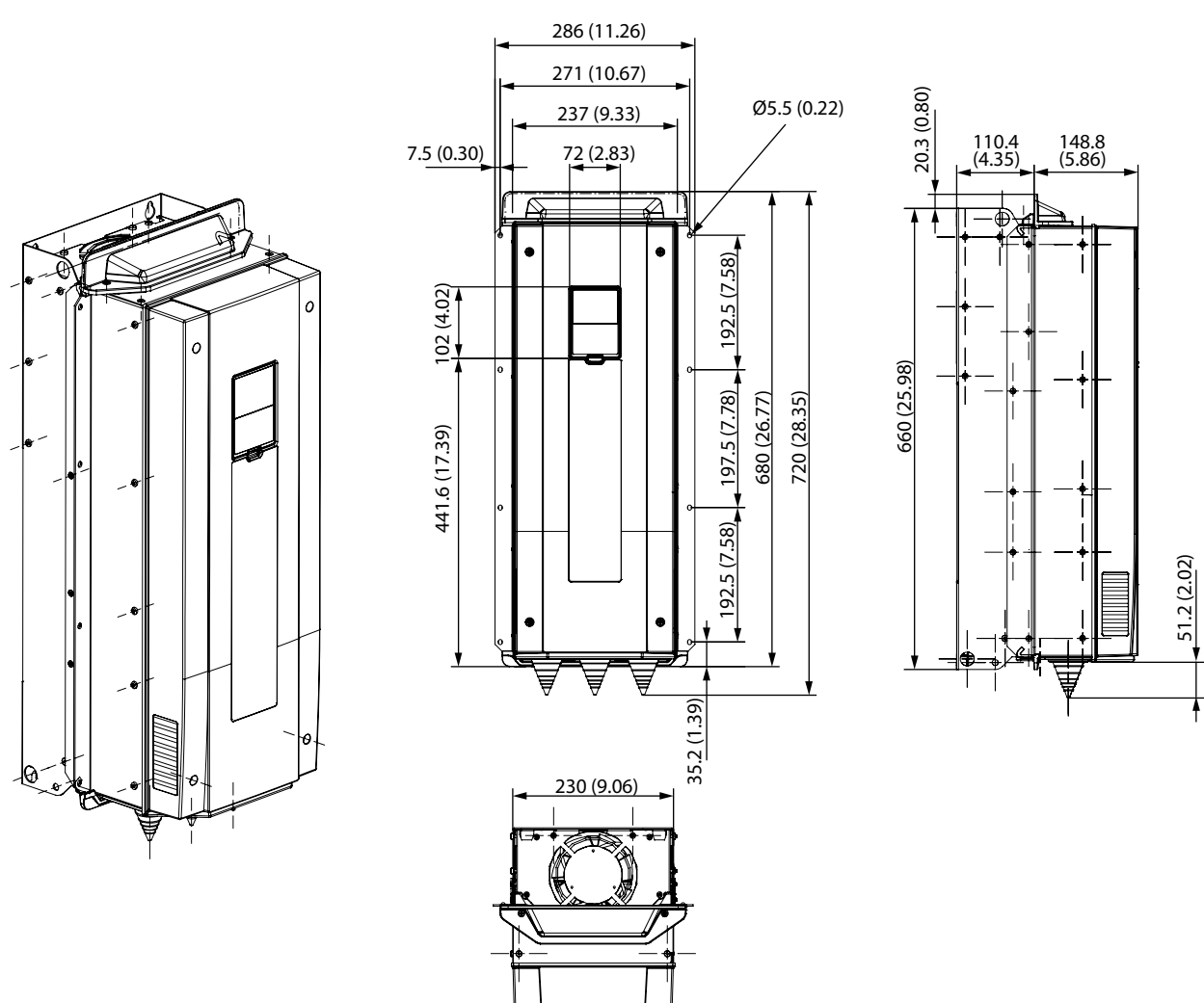


Illustration 57: Flange Mounting Dimensions of MR7, mm (in)

10.3 Cable and Fuse Sizes

10.3.1 List of Cable and Fuse Size Information

This topic lists the links to find the cable and fuse size tables for VACON® 100 wall-mounted drives.

- [10.3.2 Cable and Fuse Sizes, Mains Voltage 208–240 V and 380–500 V](#)
- [10.3.3 Cable and Fuse Sizes, Mains Voltage 525–690 V](#)

For AC Drives in North America, see:

- [10.3.4 Cable and Fuse Sizes, Mains Voltage 208–240 V and 380–500 V, North America](#)
- [10.3.5 Cable and Fuse Sizes, Mains Voltage 525–690 V, North America](#)

10.3.2 Cable and Fuse Sizes, Mains Voltage 208–240 V and 380–500 V

Table 24: Cable and Fuse Sizes, Mains Voltage 208–240 V and 380–500 V

Enclosure size	Drive type	I_L [A]	Fuse (gG/gL) [A]	Mains, motor, and brake resistor ⁽¹⁾ cable Cu [mm ²]	Mains terminal cable size [mm ²]	Grounding terminal cable size [mm ²]
MR4	0003 2–0004 2	3.7–4.8	6	3x1.5+1.5	1–6 solid	1–6
	0003 5–0004 5	3.4–4.8			1–4 stranded	
	0006 2–0008 2	6.6–8.0	10	3x1.5+1.5	1–6 solid	1–6
	0005 5–0008 5	5.6–8.0			1–4 stranded	
	0011 2–0012 2	11.0–12.5	16	3x2.5+2.5	1–6 solid	1–6
	0009 5–0012 5	9.6–12.0			1–4 stranded	
MR5	0018 2	18.0	20	3x6+6	1–10 Cu	1–10
	0016 5	16.0				
	0024 2	24.0	25	3x6+6	1–10 Cu	1–10
	0023 5	23.0				
	0031 2	31.0	32	3x10+10	1–10 Cu	1–10
	0031 5	31.0				
MR6	0038 5	38.0	40	3x10+10	2.5–50 Cu/Al	2.5–35
	0048 2	48.0				
	0046 5	46.0	50	3x16+16 (Cu)	2.5–50 Cu/Al	2.5–35
				3x25+16 (Al)		
	0062 2	62.0	63	3x25+16 (Cu)	2.5–50 Cu/Al	2.5–35
	0061 5	61.0		3x35+10 (Al)		
MR7	0075 2	75.0	80	3x35+16 (Cu)	6–70 Cu/Al	6–70
	0072 5	72.0		3x50+16 (Al)		
	0088 2	88.0	100	3x35+16 (Cu)	6–70 Cu/Al	6–70
	0087 5	87.0		3x70+21 (Al)		
	0105 2	105.0	125	3x50+25 (Cu)	6–70 Cu/Al	6–70
	0105 5			3x70+21 (Al)		

Enclosure size	Drive type	I_L [A]	Fuse (gG/gL) [A]	Mains, motor, and brake resistor ⁽¹⁾ cable Cu [mm ²]	Mains terminal cable size [mm ²]	Grounding terminal cable size [mm ²]
MR8	0140 2	140.0	160	3x70+35 (Cu)	Bolt size M8	Bolt size M8
	0140 5			3x95+29 (Al)		
	0170 2	170.0	200	3x95+50 (Cu)	Bolt size M8	Bolt size M8
	0170 5			3x150+41 (Al)		
	0205 2	205.0	250	3x120+70 (Cu)	Bolt size M8	Bolt size M8
	0205 5			3x185+57 (Al)		
MR9A	0261 2	261.0	315	3x185+95 (Cu)	Bolt size M10	Bolt size M8
	0261 5			2x(3x120+41) (Al)		
	0310 2	310.0	350	2x(3x95+50) (Cu)	Bolt size M10	Bolt size M8
	0310 5			2x(3x120+41) (Al)		
MR9B	0386 5	385.0	400	2x(3x120+70) (Cu)	Bolt size M10	Bolt size M8
				2x(3x185+57) (Al)		

¹ If you use a multi-conductor cable, 1 of the conductors of the brake resistor cable stays unconnected. It is also possible to use a single cable if you obey the minimum cross-sectional area of the cable.

10.3.3 Cable and Fuse Sizes, Mains Voltage 525–690 V

Table 25: Cable and Fuse Sizes, Mains Voltage 525–690 V

Enclosure size	Drive Type	I_L [A]	Fuse (gG/gL) [A]	Mains, motor, and brake resistor ⁽¹⁾ cable Cu [mm ²]	Mains terminal cable size [mm ²]	Grounding terminal cable size [mm ²]
MR5	0004 6	3.9	6	3x1.5+1.5	1–10 Cu	1–10
	0006 6	6.1	10	3x1.5+1.5	1–10 Cu	1–10
	0009 6	9.0	10	3x2.5+2.5	1–10 Cu	1–10
	0011 6	11.0	16	3x2.5+2.5	1–10 Cu	1–10

Enclosure size	Drive Type	I _L [A]	Fuse (gG/g L) [A]	Mains, motor, and brake resistor ⁽¹⁾ cable Cu [mm ²]	Mains terminal cable size [mm ²]	Grounding terminal cable size [mm ²]
MR6	0007 7	7.5	10	3x2.5+2.5	2.5–50 Cu/Al	2.5–35
	0010 7	10.0	16	3x2.5+2.5	2.5–50 Cu/Al	2.5–35
	0013 7	13.5	16	3x6+6	2.5–50 Cu/Al	2.5–35
	0018 6	18.0	20	3x10+10	2.5–50 Cu/Al	2.5–35
	0018 7					
	0022 6	22.0	25	3x10+10	2.5–50 Cu/Al	2.5–35
	0022 7					
	0027 6	27.0	32	3x10+10	2.5–50 Cu/Al	2.5–35
	0027 7					
	0034 6	34.0	35	3x16+16	2.5–50 Cu/Al	2.5–35
	0034 7					
MR7	0041 6	41.0	50	3x16+16 (Cu)	6–70 Cu/Al	6–70
	0041 7			3x25+16 (Al)		
	0052 6	52.0	63	3x25+16 (Cu)	6–70 Cu/Al	6–70
	0052 7			3x35+16 (Al)		
	0062 6	62.0	63	3x25+16 (Cu)	6–70 Cu/Al	6–70
	0062 7			3x35+16 (Al)		
MR8	0080 6	80.0	80	3x35+16 (Cu)	Bolt size M8	Bolt size M8
	0080 7			3x50+21 (Al)		
	0100 6	100.0	100	3x50+25 (Cu)	Bolt size M8	Bolt size M8
	0100 7			3x70+21 (Al)		
	0125 6	125.0	125	3x70+35 (Cu)	Bolt size M8	Bolt size M8
	0125 7			3x95+29 (Al)		
MR9A	0144 6	144.0	160	3x70+35 (Cu)	Bolt size M10	Bolt size M8
	0144 7			3x120+41 (Al)		
	0170 6	170.0	200	3x95+50 (Cu)	Bolt size M10	Bolt size M8
	0170 7			3x150+41 (Al)		
	0208 6	208.0	250	3x120+70 (Cu)	Bolt size M10	Bolt size M8
	0208 7			3x185+57 (Al)		

Enclosure size	Drive Type	I _L [A]	Fuse (gG/gL) [A]	Mains, motor, and brake resistor ⁽¹⁾ cable Cu [mm ²]	Mains terminal cable size [mm ²]	Grounding terminal cable size [mm ²]
MR9B	0262 6	261.0	315	3x185+95	Bolt size M10	Bolt size M8
	0262 7			2x(3x95+29)		

¹ If you use a multi-conductor cable, 1 of the conductors of the brake resistor cable stays unconnected. It is also possible to use a single cable if you obey the minimum cross-sectional area of the cable.

10.3.4 Cable and Fuse Sizes, Mains Voltage 208–240 V and 380–500 V, North America

Table 26: Cable and Fuse Sizes, Mains Voltage 208–240 V and 380–500 V, North America

Enclosure size	Drive type	I _L [A]	Fuse (Class T/J) [A]	Mains, motor and brake resistor ⁽¹⁾ cable Cu [AWG]	Mains terminal cable size [AWG]	Grounding terminal cable size [AWG]
MR4	0003 2	3.7	6	14	24–10	17–10
	0003 5	3.4				
	0004 2	4.8	6	14	24–10	17–10
	0004 5					
	0006 2	6.6	10	14	24–10	17–10
	0005 5	5.6				
	0008 2	8.0	10	14	24–10	17–10
	0008 5					
	0011 2	11.0	15	14	24–10	17–10
	0009 5	9.6				
	0012 2	12.5	20	14	24–10	17–10
	0012 5	12.0				
MR5	0018 2	18.0	25	10	20–6	17–8
	0016 5	16.0				
	0024 2	24.0	30	10	20–6	17–8
	0023 5	23.0				
	0031 2	31.0	40	8	20–6	17–8
	0031 5					

Enclosure size	Drive type	I _L [A]	Fuse (Class T/J) [A]	Mains, motor and brake resistor ⁽¹⁾ cable Cu [AWG]	Mains terminal cable size [AWG]	Grounding terminal cable size [AWG]
MR6	0038 5	38.0	50	4	13-0	13-2
	0048 2	48.0	60	4	13-0	13-2
	0046 5	46.0				
	0062 2	62.0	80	4	13-0	13-2
	0061 5 (2)	61.0				
MR7	0075 2	75.0	100	2	9-2/0	9-2/0
	0072 5	72.0				
	0088 2	88.0	110	1	9-2/0	9-2/0
	0087 5	87.0				
	0105 2	105.0	150	1/0	9-2/0	9-2/0
	0105 5					
MR8	0140 2	140.0	200	3/0	1 AWG-350 kcmil	1 AWG-350 kcmil
	0140 5					
	0170 2	170.0	225	250 kcmil	1 AWG-350 kcmil	1 AWG-350 kcmil
	0170 5					
	0205 2	205.0	250	350 kcmil	1 AWG-350 kcmil	1 AWG-350 kcmil
	0205 5					
MR9A	0261 2	261.0	350	2x250 kcmil	1 AWG-350 kcmil	1 AWG-350 kcmil
	0261 5					
	0310 2	310.0	400	2x250 kcmil	1 AWG-350 kcmil	1 AWG-350 kcmil
	0310 5					
MR9B	0386 5	385.0	500	2x250 kcmil	1 AWG-350 kcmil	1 AWG-350 kcmil

¹ If you use a multi-conductor cable, 1 of the conductors of the brake resistor cable stays unconnected. It is also possible to use a single cable if you obey the minimum cross-sectional area of the cable.

² To obey the UL regulations with the 500 V drive, it is necessary to have cables with a +194 °F heat resistance.

10.3.5 Cable and Fuse Sizes, Mains Voltage 525–690 V, North America

Table 27: Cable and Fuse Sizes, Mains Voltage 525–690 V, North America

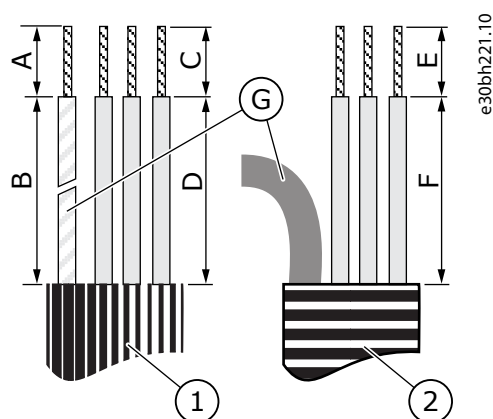
Enclosure size	Drive type	I _L [A]	Fuse (Class T/J) [A]	Mains, motor and brake resistor ⁽¹⁾ cable Cu [AWG]	Mains terminal cable size [AWG]	Grounding terminal cable size [AWG]
MR5 (600 V)	0004 6	3.9	6	14	20–6	17–8
	0006 6	6.1	10	14	20–6	17–8
	0009 6	9.0	10	14	20–6	17–8
	0011 6	11.0	15	14	20–6	17–8
MR6	0007 7	7.5	10	12	13–0	13–2
	0010 7	10.0	15	12	13–0	13–2
	0013 7	13.5	20	12	13–0	13–2
	0018 6	18.0	20	10	13–0	13–2
	0018 7					
	0022 6	22.0	25	10	13–0	13–2
	0022 7					
	0027 6	27.0	30	8	13–0	13–2
	0027 7					
	0034 6	34.0	40	8	13–0	13–2
	0034 7					
MR7	0041 6	41.0	50	6	9–2/0	9–2/0
	0041 7					
	0052 6	52.0	60	6	9–2/0	9–2/0
	0052 7					
	0062 6	62.0	70	4	9–2/0	9–2/0
	0062 7					
MR8	0080 6	80.0	90	1/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0080 7					
	0100 6	100.0	110	1/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0100 7					
	0125 6	125.0	150	2/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0125 7					

Enclosure size	Drive type	I_L [A]	Fuse (Class T/J) [A]	Mains, motor and brake resistor ⁽¹⁾ cable Cu [AWG]	Mains terminal cable size [AWG]	Grounding terminal cable size [AWG]
MR9A	0144 6	144.0	175	3/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0144 7					
	0170 7	170.0	200	4/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0208 6	208.0	250	300 kcmil	1 AWG–350 kcmil	1 AWG–350 kcmil
	0208 7					
MR9B	0262 6	261.0	350	2xAWG2/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0262 7					

¹ If you use a multi-conductor cable, 1 of the conductors of the brake resistor cable stays unconnected. It is also possible to use a single cable if you obey the minimum cross-sectional area of the cable.

10.4 Cable Stripping Lengths

See the illustration for parts of cables to be stripped and check the corresponding stripping length in the table.



1 Mains cable	2 Motor cable
---------------	---------------

Illustration 58: Cable Stripping

Table 28: Cable Stripping Lengths, in mm

Enclosure size	A	B	C	D	E	F	G
MR4	15	35	10	20	7	35	As short as possible
MR5	20	40	10	30	10	40	As short as possible
MR6	20	90	15	60	15	60	As short as possible
MR7	20	80	20	80	20	80	As short as possible

Enclosure size	A	B	C	D	E	F	G
MR8	40	180	25	300	25	300	As short as possible
MR9	40	180	25	300	25	300	As short as possible

Table 29: Cable Stripping Lengths, in inches

Enclosure size	A	B	C	D	E	F	G
MR4	0.6	1.4	0.4	0.8	0.3	1.4	As short as possible
MR5	0.8	1.6	0.4	1.2	0.4	1.6	As short as possible
MR6	0.8	3.6	0.6	2.4	0.6	2.4	As short as possible
MR7	0.8	3.1	0.8	3.1	0.8	3.1	As short as possible
MR8	1.6	7.1	1	11.8	1	11.8	As short as possible
MR9	1.6	7.1	1	11.8	1	11.8	As short as possible

10.5 Tightening Torques of the Terminals

Table 30: Tightening Torques of the Terminals, in Nm (lb-in.)

Enclosure size	Drive type	Mains and motor terminals	Grounding clamps for cable shield	Grounding clamps for grounding conductor
MR4	0003 2 - 0012 2 0003 5 - 0012 5	0.5–0.6 (4.5–5.3)	1.5 (13.3)	2 (17.7)
MR5	0018 2 - 0031 2 0016 5 - 0031 5 0004 6 - 0011 6	1.2–1.5 (10.6–13.3)	1.5 (13.3)	2 (17.7)
MR6	0048 2 - 0062 2 0038 5 - 0061 5 0018 6 - 0034 6 0007 7 - 0034 7	10 (88.5)	1.5 (13.3)	2 (17.7)
MR7	0075 2 - 0105 2 0072 5 - 0105 5 0041 6 - 0062 6 0041 7 - 0062 7	8 ⁽¹⁾ /5.6 ⁽²⁾ (70.8 ⁽¹⁾ /49.6 ⁽²⁾)	1.5 (13.3)	8 ⁽¹⁾ /5.6 ⁽²⁾ (70.8 ⁽¹⁾ /49.6 ⁽²⁾)

Enclosure size	Drive type	Mains and motor terminals	Grounding clamps for cable shield	Grounding clamps for grounding conductor
MR8	0140 2 - 0205 2	30 (266)	1.5 (13.3)	20 (177)
	0140 5 - 0205 5			
	0080 6 - 0125 6			
	0080 7 - 0125 7			
MR9	0261 2 - 0310 2	40 (354)	1.5 (13.3)	20 (177)
	0261 5 - 0386 5			
	0144 6 - 0262 6			
	0144 7 - 0262 7			

¹ The tightening torque for a Torx screw.

² The tightening torque for an Allen screw.

10.6 Power Ratings

10.6.1 Power Ratings of VACON® 100 INDUSTRIAL, 208–240 V

Table 31: Power Ratings of VACON® 100 INDUSTRIAL, Mains Voltage 208–240 V, 50–60 Hz, 3~

En- clo- sure size	Drive type (1)	Low Loada- bility: Contin- uous current I _L [A] (2)	Low Loada- bility: Input current I _{in} [A] (2)	Low Loada- bility: 10% over- load current [A] (2)	High load- abili- ty: Con- tinu- ous cur- rent I _H [A] (2)	High load- abili- ty: In- put cur- rent I _{in} [A] (2)	High loada- bility: 50% over- load cur- rent [A] (2)	Loada- bility: Max cur- rent I _s 2 s (2)	Motor shaft power (3): 10% over- load 40°C [kW]	Motor shaft power (3): 50% over- load 50°C [kW]	Motor shaft power (3): 10% over- load 40°C [hp]	Mo- tor shaft pow- er (3): 50% over- load 50°C [hp]
MR4	0003	3.7	3.2	4.1	2.6	2.4	3.9	5.2	0.55	0.37	0.75	0.5
	0004	4.8	4.2	5.3	3.7	3.2	5.6	7.4	0.75	0.55	1.0	0.75
	0007	6.6	6.0	7.3	4.8	4.5	7.2	9.6	1.1	0.75	1.5	1.0
	0008	8.0	7.2	8.8	6.6	6.0	9.9	13.2	1.5	1.1	2.0	1.5
	0011	11.0	9.7	12.1	8.0	7.2	12.0	16.0	2.2	1.5	3.0	2.0
	0012	12.5	10.9	13.8	9.6	8.6	16.5	19.6	3.0	2.2	4.0	3.0
MR5	0018	18.0	16.1	19.8	12.5	11.5	18.8	25.0	4.0	3.0	5.0	4.0
	0024	24.0	21.7	26.4	18.0	16.1	27.0	36.0	5.5	4.0	7.5	5.0
	0031	31.0	27.7	34.1	25.0	22.5	37.5	46.0	7.5	5.5	10.0	7.5

En- clo- sure size	Drive type (1)	Low Loada- bility: Contin- uous current I_L [A] (2)	Low Loada- bility: Input current I_{in} [A] (2)	Low Loada- bility: 10% over- load current [A] (2)	High load- abili- ty: Con- tinu- ous cur- rent I_H [A] (2)	High load- abili- ty: In- put cur- rent I_{in} [A] (2)	High loada- bility: 50% over- load cur- rent [A] (2)	Loada- bility: Max cur- rent I_s 2 s (2)	Motor shaft power (3): 10% over- load 40°C [kW]	Motor shaft power (3): 50% over- load 50°C [kW]	Motor shaft power (3): 10% over- load 40°C [hp]	Mo- tor shaft pow- er (3): 50% over- load 50°C [hp]
MR6	0048	48.0	43.8	52.8	31.0	28.5	46.5	62.0	11.0	7.5	15.0	10.0
	0062	62.0	57.0	68.2	48.0	44.2	72.0	96.0	15.0	11.0	20.0	15.0
MR7	0075	75.0	69.0	82.5	62.0	57.0	93.0	124.0	18.5	15.0	25.0	20.0
	0088	88.0	82.1	96.8	75.0	70.0	112.5	150.0	22.0	18.5	30.0	25.0
	0105	105.0	99.0	115.5	88.0	82.1	132.0	176.0	30.0	22.0	40.0	30.0
MR8	0140	140.0	135.1	154.0	114.0	109.0	171.0	210.0	37.0	30.0	50.0	40.0
	0170	170.0	162.0	187.0	140.0	133.0	210.0	280.0	45.0	37.0	60.0	50.0
	0205	205.0	200.0	225.5	170.0	163.0	255.0	340.0	55.0	45.0	75.0	60.0
MR9A	0261	261.0	253.0	287.1	211.0	210.0	316.5	410.0	75.0	55.0	100.0	75.0
	0310	310.0	301.0	341.0	251.0	246.0	376.5	502.0	90.0	75.0	125.0	100.0

¹ The currents in given ambient temperatures are achieved only when the switching frequency is the same or smaller than the factory default

² See [10.7 Overload Capability](#).

³ 230 V

If the process includes a cyclical load, for example if there are lifts or winches, speak to the manufacturer to get the dimensioning information.

10.6.2 Power Ratings of VACON® 100 INDUSTRIAL, 380–500 V

Table 32: Power Ratings of VACON® 100 INDUSTRIAL, Mains Voltage 380–500 V, 50–60 Hz, 3~

En- clo- sure size	Drive type (1)	Low Loada- bility: Contin- uous current I_L [A] (2)	Low Loada- bility: Input current I_{in} [A] (2)	Low Loada- bility: 10% over- load current [A] (2)	High load- abili- ty: Con- tinu- ous cur- rent I_H [A] (2)	High load- abili- ty: In- put cur- rent I_{in} [A] (2)	High loada- bility: 50% over- load cur- rent [A] (2)	Loada- bility: Max cur- rent I_s 2 s (2)	Motor shaft power (3): 10% over- load 40°C [kW]	Motor shaft power (3): 50% over- load 50°C [kW]	Motor shaft power (4): 10% over- load 40°C [hp]	Mo- tor shaft pow- er (4): 50% over- load 50°C [hp]
MR4	0003	3.4	3.4	3.7	2.6	2.8	3.9	5.2	1.1	0.75	1.5	1.0
	0004	4.8	4.6	5.3	3.4	3.4	5.1	6.8	1.5	1.1	2.0	1.5
	0005	5.6	5.4	6.2	4.3	4.2	6.5	8.6	2.2	1.5	3.0	2.0
	0008	8.0	8.1	8.8	5.6	6.0	8.4	11.2	3.0	2.2	4.0	3.0
	0009	9.6	9.3	10.6	8.0	8.1	12.0	16.0	4.0	3.0	5.0	4.0
	0012	12.0	11.3	13.2	9.6	9.3	14.4	19.2	5.5	4.0	7.5	5.0
MR5	0016	16.0	15.4	17.6	12.0	12.4	18.0	24.0	7.5	5.5	10.0	7.5
	0023	23.0	21.3	25.3	16.0	15.4	24.0	32.0	11.0	7.5	15.0	10.0
	0031	31.0	28.4	34.1	23.0	21.6	34.5	46.0	15.0	11.0	20.0	15.0
MR6	0038	38.0	36.7	41.8	31.0	30.5	46.5	62.0	18.5	15.0	25.0	20.0
	0046	46.0	43.6	50.6	38.0	36.7	57.0	76.0	22.0	18.5	30.0	25.0
	0061	61.0	58.2	67.1	46.0	45.6	69.0	92.0	30.0	22.0	40.0	30.0
MR7	0072	72.0	67.5	79.2	61.0	58.2	91.5	122.0	37.0	30.0	50.0	40.0
	0087	87.0	85.3	95.7	72.0	72.0	108.0	144.0	45.0	37.0	60.0	50.0
	0105	105.0	100.6	115.5	87.0	85.3	130.5	174.0	55.0	45.0	75.0	60.0
MR8	0140	140.0	139.4	154.0	105.0	109.0	157.5	210.0	75.0	55.0	100.0	75.0
	0170	170.0	166.5	187.0	140.0	139.4	210.0	280.0	90.0	75.0	125.0	100.0
	0205	205.0	199.6	225.5	170.0	166.5	255.0	340.0	110.0	90.0	150.0	125.0
MR9A	0261	261.0	258.0	287.1	205.0	204.0	307.5	410.0	132.0	110.0	200.0	150.0
	0310	310.0	303.0	341.0	251.0	246.0	376.5	502.0	160.0	132.0	250.0	200.0
MR9B	0386	385.0	385.0	423.5	310.0	311.0	465.0	620.0	200.0	160.0	300.0	250.0

¹ The currents in given ambient temperatures are achieved only when the switching frequency is the same or smaller than the factory default

² See [10.7 Overload Capability](#).

³ 400 V

⁴ 480 V

If the process includes a cyclical load, for example if there are lifts or winches, speak to the manufacturer to get the dimensioning information.

10.6.3 Power Ratings of VACON® 100 INDUSTRIAL, 525–600 V

Table 33: Power Ratings of VACON® 100 INDUSTRIAL, Mains Voltage 525–600 V, 50–60 Hz, 3~

Enclosure size	Drive type	Low Loadability: Continuous current I_L [A]	Low Loadability: Input current I_{in} [A]	Low Loadability: 10% overload current [A]	High loadability: Continuous current I_H [A]	High loadability: Input current I_{in} [A]	High loadability: 50% overload current [A]	Loadability: Max current I_s 2 s	Motor shaft power ⁽¹⁾ : 10% overload 40°C [hp]	Motor shaft power ⁽¹⁾ : 50% overload 50°C [hp]
MR5	0004	3.9	4.6	4.3	2.7	3.2	4.1	5.4	3.0	2.0
	0006	6.1	6.8	6.7	3.9	4.5	5.9	7.8	5.0	3.0
	0009	9.0	9.0	9.9	6.1	6.7	9.2	12.2	7.5	5.0
	0011	11.0	10.5	12.1	9.0	8.9	13.5	18.0	10.0	7.5
MR6	0018	18.0	19.9	19.8	13.5	15.2	20.3	27.0	15.0	10.0
	0022	22.0	23.3	24.2	18.0	19.8	27.0	36.0	20.0	15.0
	0027	27.0	27.2	29.7	22.0	23.1	33.0	44.0	25.0	20.0
	0034	34.0	32.8	37.4	27.0	27.0	40.5	54.0	30.0	25.0
MR7	0041	41.0	45.3	45.1	34.0	38.4	51.0	68.0	40.0	30.0
	0052	52.0	53.8	57.2	41.0	44.9	61.5	82.0	50.0	40.0
	0062	62.0	62.2	68.2	52.0	53.2	78.0	104.0	60.0	50.0
MR8	0080	80.0	90.0	88.0	62.0	72.0	93.0	124.0	75.0	60.0
	0100	100.0	106.0	110.0	80.0	89.0	120.0	160.0	100.0	75.0
	0125	125.0	127.0	137.5	100.0	104.0	150.0	200.0	125.0	100.0
MR9A	0144	144.0	156.0	158.4	125.0	140.0	187.5	250.0	150.0	125.0
	0208	208.0	212.0	228.8	170.0	177.0	255.0	340.0	200.0	150.0
MR9B	0262	261.0	272.0	287.1	208.0	223.0	312.0	416.0	250.0	200.0

¹ 600 V

10.6.4 Power Ratings of VACON® 100 INDUSTRIAL, 525–690 V

Table 34: Power Ratings of VACON® 100 INDUSTRIAL, Mains Voltage 525–690 V, 50–60 Hz, 3~

En- clo- sure size	Drive type	Low Loada- bility: Contin- uous current I_L [A]	Low Loada- bility: Input current I_{in} [A]	Low Loada- bility: 10% over- load current [A]	High load- abili- ty: Con- tinu- ous cur- rent I_H [A]	High load- abili- ty: In- put cur- rent I_{in} [A]	High loada- bility: 50% over- load cur- rent [A]	Loada- bility: Max cur- rent I_s 2 s	Motor shaft power ⁽¹⁾ : 10% over- load 40°C [hp]	Motor shaft power ⁽¹⁾ : 50% over- load 50°C [hp]	Motor shaft power ⁽²⁾ : 10% over- load 40°C [kW]	Mo- tor shaft pow- er ⁽²⁾ : 50% over- load 50°C [kW]
MR6	0007	7.5	9.1	8.3	5.5	6.8	8.3	11.0	5.0	3.0	5.5	4.0
	0010	10.0	11.7	11.0	7.5	9.0	11.3	15.0	7.5	5.0	7.5	5.5
	0013	13.5	15.5	14.9	10.0	11.6	15.0	20.0	10.0	7.5	11.0	7.5
	0018	18.0	19.9	19.8	13.5	15.2	20.3	27.0	15.0	10.0	15.0	11.0
	0022	22.0	23.3	24.2	18.0	19.8	27.0	36.0	20.0	15.0	18.5	15.0
	0027	27.0	27.2	29.7	22.0	23.1	33.0	44.0	25.0	20.0	22.0	18.5
	0034	34.0	32.8	37.4	27.0	27.0	40.5	54.0	30.0	25.0	30.0	22.0
MR7	0041	41.0	45.3	45.1	34.0	38.4	51.0	68.0	40.0	30.0	37.0	30.0
	0052	52.0	53.8	57.2	41.0	44.9	61.5	82.0	50.0	40.0	45.0	37.0
	0062	62.0	62.2	68.2	52.0	53.2	78.0	104.0	60.0	50.0	55.0	45.0
MR8	0080	80.0	90.0	88.0	62.0	72.0	93.0	124.0	75.0	60.0	75.0	55.0
	0100	100.0	106.0	110.0	80.0	89.0	120.0	160.0	100.0	75.0	90.0	75.0
	0125	125.0	127.0	137.5	100.0	104.0	150.0	200.0	125.0	100.0	110.0	90.0
MR9A	0144	144.0	156.0	158.4	125.0	140.0	187.5	250.0	150.0	125.0	132.0	110.0
	0170	170.0	179.0	187.0	144.0	155.0	216.0	288.0	-	-	160.0	132.0
	0208	208.0	212.0	228.8	170.0	177.0	255.0	340.0	200.0	150.0	200.0	160.0
MR9B	0262	261.0	272.0	287.1	208.0	223.0	312.0	416.0	250.0	200.0	250.0	200.0

¹ 600 V

² 690 V

10.6.5 Power Ratings of VACON® 100 FLOW, 208–240 V

Table 35: Power Ratings of VACON® 100 FLOW, Mains Voltage 208–240 V, 50–60 Hz, 3~

Enclosure size	Drive type ⁽¹⁾	Low loadability: Continuous current I_L [A] ⁽²⁾	Low loadability: Input current I_{in} [A] ⁽²⁾	Low loadability: 10% overload current [A] ⁽²⁾	Low loadability: Max current I_s 2 s ⁽²⁾	Motor shaft power ⁽³⁾ : 10% overload 40°C [kW]	Motor shaft power ⁽³⁾ : 10% overload 40°C [hp]
MR4	0003	3.7	3.2	4.1	5.2	0.55	0.75
	0004	4.8	4.2	5.3	7.4	0.75	1.0
	0007	6.6	6.0	7.3	9.6	1.1	1.5
	0008	8.0	7.2	8.8	13.2	1.5	2.0
	0011	11.0	9.7	12.1	16.0	2.2	3.0
	0012	12.5	10.9	13.8	19.6	3.0	4.0
MR5	0018	18.0	16.1	19.8	25.0	4.0	5.0
	0024	24.0	21.7	26.4	36.0	5.5	7.5
	0031	31.0	27.7	34.1	46.0	7.5	10.0
MR6	0048	48.0	43.8	52.8	62.0	11.0	15.0
	0062	62.0	57.0	68.2	96.0	15.0	20.0
MR7	0075	75.0	69.0	82.5	124.0	18.5	25.0
	0088	88.0	82.1	96.8	150.0	22.0	30.0
	0105	105.0	99.0	115.5	176.0	30.0	40.0
MR8	0140	143.0	135.1	154.0	210.0	37.0	50.0
	0170	170.0	162.0	187.0	280.0	45.0	60.0
	0205	208.0	200.0	225.5	340.0	55.0	75.0
MR9A	0261	261.0	253.0	287.1	410.0	75.0	100.0
	0310	310.0	301.0	341.0	502.0	90.0	125.0

¹ The currents in given ambient temperatures are achieved only when the switching frequency is the same or smaller than the factory default

² See [10.7 Overload Capability](#).

³ 230 V

If the process includes a cyclical load, for example if there are lifts or winches, speak to the manufacturer to get the dimensioning information.

10.6.6 Power Ratings of VACON® 100 FLOW, 380–500 V

Table 36: Power Ratings of VACON® 100 FLOW, Mains Voltage 380–500 V, 50–60 Hz, 3~

Enclosure size	Drive type ⁽¹⁾	Low loadability: Continuous current I_L [A] ⁽²⁾	Low loadability: Input current I_{in} [A] ⁽²⁾	Low loadability: 10% overload current [A] ⁽²⁾	Low loadability: Max current I_s 2 s ⁽²⁾	Motor shaft power ⁽³⁾ : 10% overload 40°C [kW]	Motor shaft power ⁽⁴⁾ : 10% overload 40°C [hp]
MR4	0003	3.4	3.4	3.7	5.2	1.1	1.5
	0004	4.8	4.6	5.3	6.8	1.5	2.0
	0005	5.6	5.4	6.2	8.6	2.2	3.0
	0008	8.0	8.1	8.8	11.2	3.0	4.0
	0009	9.6	9.3	10.6	16.0	4.0	5.0
	0012	12.0	11.3	13.2	19.2	5.5	7.5
MR5	0016	16.0	15.4	17.6	24.0	7.5	10.0
	0023	23.0	21.3	25.3	32.0	11.0	15.0
	0031	31.0	28.4	34.1	46.0	15.0	20.0
MR6	0038	38.0	36.7	41.8	62.0	18.5	25.0
	0046	46.0	43.6	50.6	76.0	22.0	30.0
	0061	61.0	58.2	67.1	92.0	30.0	40.0
MR7	0072	72.0	67.5	79.2	122.0	37.0	50.0
	0087	87.0	85.3	95.7	144.0	45.0	60.0
	0105	105.0	100.6	115.5	174.0	55.0	75.0
MR8	0140	140.0	139.4	154.0	210.0	75.0	100.0
	0170	170.0	166.5	187.0	280.0	90.0	125.0
	0205	205.0	199.6	225.5	340.0	110.0	150.0
MR9A	0261	261.0	258.0	287.1	410.0	132.0	200.0
	0310	310.0	303.0	341.0	502.0	160.0	250.0
MR9B	0386	385.0	386.0	423.5	620.0	200.0	300.0

¹ The currents in given ambient temperatures are achieved only when the switching frequency is the same or smaller than the factory default

² See [10.7 Overload Capability](#).

³ 400 V

⁴ 480 V

If the process includes a cyclical load, for example if there are lifts or winches, speak to the manufacturer to get the dimensioning information.

10.6.7 Power Ratings of VACON® 100 FLOW, 525–600 V

Table 37: Power Ratings of VACON® 100 FLOW, Mains Voltage 525–600 V, 50–60 Hz, 3~

Enclosure size	Drive type	Low loadability: Continuous current I_L [A]	Low loadability: Input current I_{in} [A]	Low loadability: 10% over-load current [A]	Low loadability: Max continuous current I_s 2 s	Motor shaft power ⁽¹⁾ : 10% overload 40°C [Hp]
MR5	0004	3.9	4.6	4.3	5.4	3.0
	0006	6.1	6.8	6.7	7.8	5.0
	0009	9.0	9.0	9.9	12.2	7.5
	0011	11.0	10.5	12.1	18.0	10.0
MR6	0018	18.0	19.9	19.8	27.0	15.0
	0022	22.0	23.3	24.2	36.0	20.0
	0027	27.0	27.2	29.7	44.0	25.0
	0034	34.0	32.8	37.4	54.0	30.0
MR7	0041	41.0	45.3	45.1	68.0	40.0
	0052	52.0	53.8	57.2	82.0	50.0
	0062	62.0	62.2	68.2	104.0	60.0
MR8	0080	80.0	90.0	88.0	124.0	75.0
	0100	100.0	106.0	110.0	160.0	100.0
	0125	125.0	127.0	137.5	200.0	125.0
MR9A	0144	144.0	156.0	158.4	250.0	150.0
	0208	208.0	212.0	228.8	340.0	200.0
MR9B	0262	261	272	287.1	416	250.0

¹ 600 V

10.6.8 Power Ratings of VACON® 100 FLOW, 525–690 V

Table 38: Power Ratings of VACON® 100 FLOW, Mains Voltage 525–690 V, 50–60 Hz, 3~

Enclosure size	Drive type	Low loadability: Continuous current I_L [A]	Low loadability: Input current I_{in} [A]	Low loadability: 10% overload current [A]	Low loadability: Max continuous current I_s 2 s	Motor shaft power ⁽¹⁾ : 10% overload 40°C [Hp]	Motor shaft power ⁽²⁾ : 10% overload 40°C [kW]
MR6	0007	7.5	6.8	8.3	11.0	5.0	5.5
	0010	10.0	9.0	11.0	15.0	7.5	7.5
	0013	13.5	11.6	14.9	20.0	10.0	11.0
	0018	18.0	15.2	19.8	27.0	15.0	15.0
	0022	22.0	19.8	24.2	36.0	20.0	18.5
	0027	27.0	23.1	29.7	44.0	25.0	22.0
	0034	34.0	27.0	37.4	54.0	30.0	30.0
	0041	41.0	38.4	45.1	68.0	40.0	37.0
MR7	0052	52.0	44.9	57.2	82.0	50.0	45.0
	0062	62.0	53.2	68.2	104.0	60.0	55.0
	0080	80.0	72.0	88.0	124.0	75.0	75.0
MR8	0100	100.0	89.0	110.0	160.0	100.0	90.0
	0125	125.0	104.0	137.5	200.0	125.0	110.0
	0144	144.0	156.0	158.4	250.0	150.0	132.0
MR9A	0170	170.0	179.0	187.0	288.0	-	160.0
	0208	208.0	212.0	228.8	340.0	200.0	200.0
MR9B	0262	261.0	272.0	287.1	416.0	250.0	250.0

¹ 600 V

² 690 V

10.6.9 Power Ratings of VACON® 100 HVAC, 208–240 V

Table 39: Power Ratings of VACON® 100 HVAC, Mains Voltage 208–240 V, 50–60 Hz, 3~

Enclosure size	Drive type ⁽¹⁾	Low Loadability: Continuous current I_L [A] ⁽²⁾	Low Loadability: Input current I_{in} [A] ⁽²⁾	Low Loadability: 10% overload current [A] ⁽²⁾	Motor shaft power ⁽³⁾ : 10% overload 40°C [kW]	Motor shaft power ⁽³⁾ : 10% overload 40°C [hp]
MR4	0003	3.7	3.2	4.1	0.55	0.75
	0004	4.8	4.2	5.3	0.75	1.0
	0007	6.6	6.0	7.3	1.1	1.5
	0008	8.0	7.2	8.8	1.5	2.0
	0011	11.0	9.7	12.1	2.2	3.0
	0012	12.5	10.9	13.8	3.0	4.0
MR5	0018	18.0	16.1	19.8	4.0	5.0
	0024	24.2	21.7	26.4	5.5	7.5
	0031	31.0	27.7	34.1	7.5	10.0
MR6	0048	48.0	43.8	52.8	11.0	15.0
	0062	62.0	57.0	68.2	15.0	20.0
MR7	0075	75.0	69.0	82.5	18.5	25.0
	0088	88.0	82.1	96.8	22.0	30.0
	0105	105.0	99.0	115.5	30.0	40.0
MR8	0140	143.0	135.1	154.0	37.0	50.0
	0170	170.0	162.0	187.0	45.0	60.0
	0205	208.0	200.0	225.5	55.0	75.0
MR9A	0261	261.0	253.0	287.1	75.0	100.0
	0310	310.0	301.0	341.0	90.0	125.0

¹ The currents in given ambient temperatures are achieved only when the switching frequency is the same or smaller than the factory default.

² See [10.7 Overload Capability](#).

³ 230 V

10.6.10 Power Ratings of VACON® 100 HVAC, 380–500 V

Table 40: Power Ratings of VACON® 100 HVAC, Mains Voltage 380–500 V, 50–60 Hz, 3~

Enclosure size	Drive type ⁽¹⁾	Low Loadability: Continuous current I_L [A] ⁽²⁾	Low Loadability: Input current I_{in} [A] ⁽²⁾	Low Loadability: 10% overload current [A] ⁽²⁾	Motor shaft power ⁽³⁾ : 10% overload 40°C [kW]	Motor shaft power ⁽³⁾ : 10% overload 40°C [hp]
MR4	0003	3.4	3.4	3.7	1.1	1.5
	0004	4.8	4.6	5.3	1.5	2.0
	0005	5.6	5.4	6.2	2.2	3.0
	0008	8.0	8.1	8.8	3.0	5.0
	0009	9.6	9.3	10.6	4.0	5.0
	0012	12.0	11.3	13.2	5.5	7.5
MR5	0016	16.0	15.4	17.6	7.5	10.0
	0023	23.0	21.3	25.3	11.0	15.0
	0031	31.0	28.4	34.1	15.0	20.0
MR6	0038	38.0	36.7	41.8	18.5	25.0
	0046	46.0	43.6	50.6	22.0	30.0
	0061	61.0	58.2	67.1	30.0	40.0
MR7	0072	72.0	67.5	79.2	37.0	50.0
	0087	87.0	85.3	95.7	45.0	60.0
	0105	105.0	100.6	115.5	55.0	75.0
MR8	0140	140.0	139.4	154.0	75.0	100.0
	0170	170.0	166.5	187.0	90.0	125.0
	0205	205.0	199.6	225.5	110.0	150.0
MR9A	0261	261.0	258.0	287.1	132.0	200.0
	0310	310.0	303.0	341.0	160.0	250.0

¹ The currents in given ambient temperatures are achieved only when the switching frequency is the same or smaller than the factory default.

² See [10.7 Overload Capability](#).

³ 230 V

10.7 Overload Capability

The **low overload** means that if 110% of the continuous current (I_L) is required for 1 minute every 10 minutes, the remaining 9 minutes must be approximately 98% of I_L or less. This is to make sure that the output current is not more than I_L during the duty cycle.

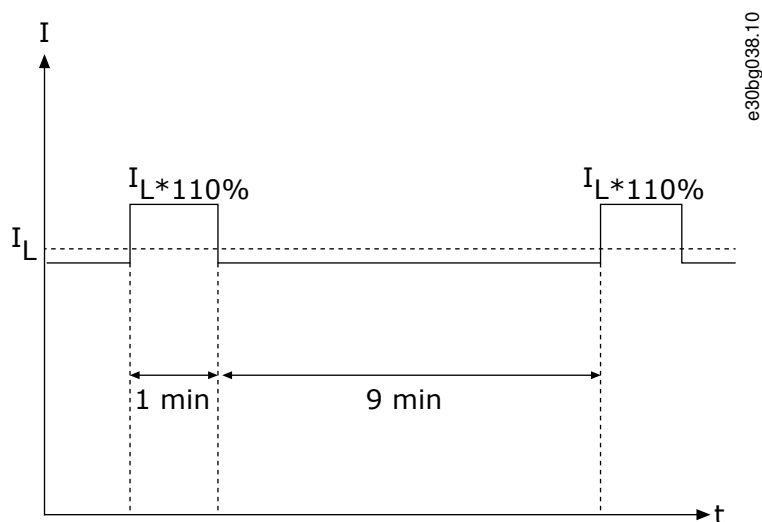


Illustration 59: Low Overload

The **high overload** means that if 150% of the continuous current (I_H) is required for 1 minute every 10 minutes, the remaining 9 minutes must be approximately 92% of I_H or less. This is to make sure that the output current is not more than I_H during the duty cycle.

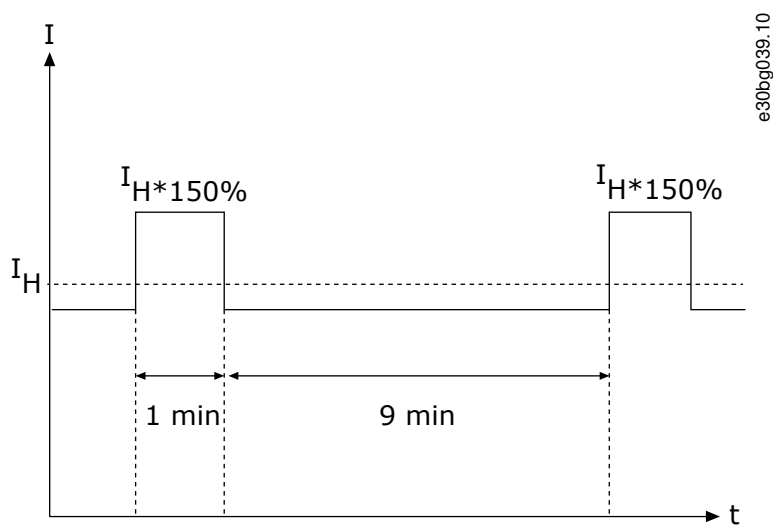


Illustration 60: High Overload

For more information, refer to the standard IEC61800-2.

NOTICE

High overload is available only for VACON® 100 INDUSTRIAL

10.8 Brake Resistor Ratings

10.8.1 Brake Resistor Ratings

NOTICE

The brake resistor function is available for the VACON® 100 INDUSTRIAL.

For brake resistor rating tables, see:

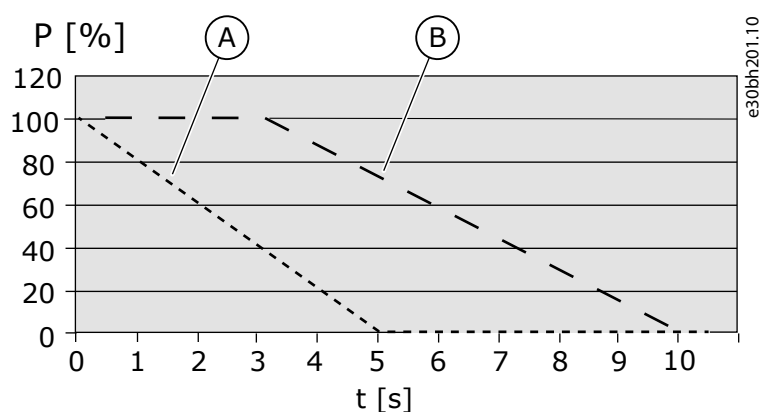
- [10.8.5 Brake Resistance and Brake Power, Mains Voltage 208–240 V](#)
- [10.8.6 Brake Resistance and Brake Power, Mains Voltage 380–500 V](#)
- [10.8.7 Brake Resistance and Brake Power, Mains Voltage 525–600 V](#)
- [10.8.8 Brake Resistance and Brake Power, Mains Voltage 525–690 V](#)

10.8.2 Brake Resistance in Light duty and Heavy Duty

Make sure that the resistance is higher than the set minimum resistance. The power handling capacity must be sufficient for the application.

The light duty cycle is for brake resistor cyclic use (1 LD pulse in a 120-second period). The light duty resistor is rated for a 5-second ramp from full power to 0.

The heavy duty cycle is for brake resistor cyclic use (1 HD pulse in a 120-second period). The heavy duty resistor is rated for a 3-second full power braking with a 7-second ramp to 0.

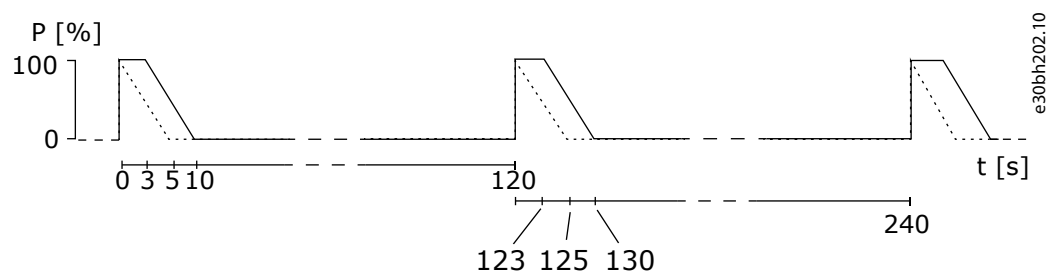


A Light duty (LD)

B Heavy duty (HD)

P Brake power

Illustration 61: LD and HD Pulses



P Brake power

Illustration 62: Duty Cycles of the LD and HD Pulses

10.8.3 Brake Resistor Types, Mains Voltage 208–240 V and 380–500 V

Table 41: Recommended Brake Resistor Types, Mains Voltage 208–240 V and 380–500 V

Enclosure size	Duty cycle	Type of brake resistor	Resistance [Ω]
MR4	Light duty	BRR 0022 LD 5	63.0
	Heavy duty	BRR 0022 HD 5	63.0
MR5	Light duty	BRR 0031 LD 5	41.0
	Heavy duty	BRR 0031 HD 5	41.0
MR6	Light duty	BRR 0045 LD 5	21.0
	Heavy duty	BRR 0045 HD 5	21.0
MR7	Light duty	BRR 0061 LD 5	14.0
	Heavy duty	BRR 0061 HD 5	14.0
MR8	Light duty	BRR 0105 LD 5	6.5
	Heavy duty	BRR 0105 HD 5	6.5
MR9A	Light duty	BRR 0300 LD 5	3.3
	Heavy duty	BRR 0300 HD 5	3.3
MR9B	Light duty	BRR 0520 LD 5	1.4
	Heavy duty	BRR 0520 HD 5	1.4

10.8.4 Brake Resistor Types, Mains Voltage 525–690 V

Table 42: Recommended Brake Resistor Types, Mains Voltage 525–690 V

Enclosure size	Drive type	Duty cycle	Type of brake resistor	Resistance [Ω]
MR5	0004–0011	Light duty	BRR 0013 LD 6	100
		Heavy duty	BRR 0013 HD 6	100

Enclosure size	Drive type	Duty cycle	Type of brake resistor	Resistance [Ω]
MR6	0007–0013	Light duty	BRR 0013 LD 6	100
		Heavy duty	BRR 0013 HD 6	100
	0018–0034	Light duty	BRR 0034 LD 6	30
		Heavy duty	BRR 0034 HD 6	30
MR7	0041	Light duty	BRR 0034 LD 6	30
		Heavy duty	BRR 0034 HD 6	30
	0052–0062	Light duty	BRR 0052 LD 6	18
		Heavy duty	BRR 0052 HD 6	18
MR8	0080	Light duty	BRR 0052 LD 6	18
		Heavy duty	BRR 0052 HD 6	18
	0100–0125	Light duty	BRR 0100 LD 6	9
		Heavy duty	BRR 0100 HD 6	9
MR9A	0144	Light duty	BRR 0100 LD 6	9
		Heavy duty	BRR 0100 HD 6	9
	0170–0208	Light duty	BRR 0208 LD 6	7
		Heavy duty	BRR 0208 HD 6	7
MR9B	262	Light duty	BRR 0416 LD 6	2.5
		Heavy duty	BRR 0416 HD 6	2.5

10.8.5 Brake Resistance and Brake Power, Mains Voltage 208–240 V

Table 43: The Minimum Brake Resistance and Brake Power, Mains Voltage 208–240 V

Enclosure size	The minimum brake resistance [Ω]	Brake power @405 VDC [kW] ⁽¹⁾
MR4	30.0	2.6
MR5	20.0	3.9
MR6	10.0	7.8
MR7	5.5	11.7
MR8	3.0	25.2
MR9A	1.4	49.7

¹ When using recommended resistor types.

10.8.6 Brake Resistance and Brake Power, Mains Voltage 380–500 V

Table 44: The Minimum Brake Resistance and Brake Power, Mains Voltage 380–500 V

Enclosure size	The minimum brake resistance [Ω]	Brake power @845 VDC [kW] ⁽¹⁾
MR4	63.0	11.3
MR5	41.0	17.0
MR6	21.0	34.0
MR7	14.0	51.0
MR8	6.5	109.9
MR9A	3.3	216.4
MR9B	1.4	250

¹ When using recommended resistor types.

10.8.7 Brake Resistance and Brake Power, Mains Voltage 525–600 V

Table 45: The Minimum Brake Resistance and Brake Power, Mains Voltage 525–600 V

Enclosure size	The minimum brake resistance [Ω]	Brake power @1014 VDC [kW] ⁽¹⁾
MR5	100	7.5
MR6	30	22.4
MR7	18	44.8
MR8	9	93.3
MR9A	7	145
MR9B	2.5	183

¹ When using recommended resistor types.

10.8.8 Brake Resistance and Brake Power, Mains Voltage 525–690 V

Table 46: The Minimum Brake Resistance and Brake Power, Mains Voltage 525–690 V

Enclosure size	The minimum brake resistance [Ω]	Brake power @1166 VDC [kW] ⁽¹⁾
MR6	30	30
MR7	18	55
MR8	9	110
MR9A	7	193
MR9B	2.5	250

¹ When using recommended resistor types.

10.9 Control Connections

Table 47: The Standard I/O Board

Terminal	Signal	Technical information
1	Reference output	+10 V, +3%, maximum current: 10 mA
2	Analog input, voltage or current	Analog input channel 1 0–10 V ($R_i = 200\text{ k}\Omega$) 4–20 mA ($R_i = 250\text{ }\Omega$) Resolution 0.1%, accuracy $\pm 1\%$ Selection of V/mA with DIP switches (see 7.3.1 Selection of Terminal Functions with DIP Switches)
3	Analog input common (current)	Differential input if not connected to ground Allows $\pm 20\text{ V}$ common-mode voltage to GND
4	Analog input, voltage or current	Analog input channel 2 0–10 V ($R_i = 200\text{ k}\Omega$) 4–20 mA ($R_i = 250\text{ }\Omega$) Resolution 0.1%, accuracy $\pm 1\%$ Selection of V/mA with DIP switches (see 7.3.1 Selection of Terminal Functions with DIP Switches)
5	Analog input common (current)	Differential input if not connected to ground Allows $\pm 20\text{ V}$ common-mode voltage to GND
6	24 V auxiliary voltage	+24 V, $\pm 10\%$, max volt. ripple < 100 mVrms max. 250 mA Short-circuit protected
7	I/O ground	Ground for reference and controls (connected internally to frame ground through 1 M Ω)
8	Digital input 1	Positive or negative logic $R_i = \text{min. } 5\text{ k}\Omega$ 0–5 V = 0 15–30 V = 1
9	Digital input 2	
10	Digital input 3	
11	Common A for DIN 1–DIN 6	Digital inputs can be disconnected from ground (see 7.3.2 Isolation of the Digital Inputs from Ground).

Terminal	Signal	Technical information
12	24 V auxiliary voltage	+24 V, $\pm 10\%$, max volt. ripple < 100 mVrms max. 250 mA Short-circuit protected
13	I/O ground	Ground for reference and controls (connected internally to frame ground through 1 M Ω)
14	Digital input 4	Positive or negative logic Ri = min. 5 k Ω 0–5 V = 0 15–30 V = 1
15	Digital input 5	
16	Digital input 6	
17	Common A for DIN1-DIN6	Digital inputs can be disconnected from ground (see 7.3.2 Isolation of the Digital Inputs from Ground).
18	Analog signal (+output)	Analog output channel 1, selection 0–20 mA, load <500 Ω 0–10 V 0–20 mA Resolution 0.1%, accuracy $\pm 2\%$ Selection of V/mA with DIP switches (see 7.3.1 Selection of Terminal Functions with DIP Switches) Short-circuit protected
19	Analog output common	
30	24 V auxiliary input voltage	Can be used as an external power back-up for the control unit
A	RS485	Differential receiver/transmitter
B	RS485	Set bus termination with DIP switches (see 7.3.1 Selection of Terminal Functions with DIP Switches). Termination resistance = 220 Ω .

Table 48: The Standard Relay Board (+SBF3)

Terminal	Signal	Technical information
21	Relay output 1 ⁽¹⁾	Change-over contact (SPDT) relay. 5.5 mm isolation between channels.
22		Switching capacity:
23		<ul style="list-style-type: none"> 24 VDC/8 A 250 VAC/8 A 125 VDC/0.4 A Minimum switching load: <ul style="list-style-type: none"> 5 V/10 mA

Terminal	Signal	Technical information
24	Relay output 2 ⁽¹⁾	Change-over contact (SPDT) relay. 5.5 mm isolation between channels. Switching capacity: <ul style="list-style-type: none"> • 24 VDC/8 A • 250 VAC/8 A • 125 VDC/0.4 A Minimum switching load: <ul style="list-style-type: none"> • 5 V/10 mA
25		
26		
32	Relay output 3 ⁽¹⁾	Normally-open (NO or SPST) contact relay. 5.5 mm isolation between channels. Switching capacity: <ul style="list-style-type: none"> • 24 VDC/8 A • 250 VAC/8 A • 125 VDC/0.4 A Minimum switching load: <ul style="list-style-type: none"> • 5 V/10 mA
33		

¹ If you use 230 VAC as control voltage from the output relays, the control circuitry must be powered with a separate isolation transformer to limit the short circuit current and the overvoltage spikes. This is to prevent welding on the relay contacts. Refer to standard EN 60204-1, section 7.2.9.

Table 49: The Optional Relay Board (+SBF4)

Terminal	Signal	Technical information
21	Relay output 1 ⁽²⁾	Change-over contact (SPDT) relay. 5.5 mm isolation between channels. Switching capacity: <ul style="list-style-type: none"> • 24 VDC/8 A • 250 VAC/8 A • 125 VDC/0.4 A Minimum switching load: <ul style="list-style-type: none"> • 5 V/10 mA
22		
23		
24	Relay output 2 ⁽²⁾	Change-over contact (SPDT) relay. 5.5 mm isolation between channels. Switching capacity: <ul style="list-style-type: none"> • 24 VDC/8 A • 250 VAC/8 A • 125 VDC/0.4 A Minimum switching load: <ul style="list-style-type: none"> • 5 V/10 mA
25		
26		

Terminal	Signal	Technical information
28	TI1+	Thermistor input
29	TI1-	Rtrip = 4.7 kΩ (PTC) Measuring voltage 3.5 V

² If you use 230 VAC as control voltage from the output relays, the control circuitry must be powered with a separate isolation transformer to limit the short circuit current and the overvoltage spikes. This is to prevent welding on the relay contacts. Refer to standard EN 60204-1, section 7.2.9.

10.10 Technical Data, VACON® 100 INDUSTRIAL

Table 50: Technical Data of the VACON® 100 INDUSTRIAL AC Drive

Technical item or function	Technical item or function	Technical information
Mains connection	Input voltage U_{in}	208–240 V, 380–500 V, 525–600 V, 525–690 V, -10%... +10%
	Input frequency	50–60 Hz, -5...+10%
	Connection to mains	Once per minute or less
	Starting delay	6 s (MR4-MR6) 8 s (MR7-MR9)
	Network imbalance	Max ±3% of the nominal voltage
Motor connection	Mains	Mains types: TN, TT, and IT Short circuit current: the maximum short circuit current must be < 100 kA.
	Output voltage	0- U_{in}
	Continuous output current	I_L : Ambient temperature max. +40 °C overload 1.1 x I_L (1 min/10 min) I_H : Ambient temperature max. +50 °C overload 1.5 x I_H (1 min/10 min) I_H in 600/690 V drives: Ambient temperature max. +40 °C overload 1.5 x I_H (1 min/10 min)
	Output frequency	0–320 Hz (standard)
	Frequency resolution	0.01 Hz

Technical item or function	Technical item or function	Technical information
Control characteristics	Switching frequency (see parameter P3.1.2.3)	<p>200–500 V</p> <p>MR4-MR6:</p> <ul style="list-style-type: none"> 1.5–10 kHz Default: 6 kHz (except for 0012 2, 0031 2, 0062 2, 0012 5, 0031 5 and 0061 5: 4 kHz) <p>MR7-MR9:</p> <ul style="list-style-type: none"> 1.5–6 kHz Default: MR7: 4 kHz, MR8: 3 kHz, MR9: 2 kHz <p>600–690 V</p> <p>MR5-MR9:</p> <ul style="list-style-type: none"> 1.5–6 kHz Default: 2 kHz For a product that is configured for a C4 installation on IT network the maximum switching frequency is limited to default 2kHz. <p>Automatic switching frequency derating in case of overload.</p>
	Frequency reference: <ul style="list-style-type: none"> Analog input Panel reference 	<p>Resolution 0.1% (10-bit), accuracy $\pm 1\%$</p> <p>Resolution 0.01 Hz</p>
	Field weakening point	8–320 Hz
	Acceleration time	0.1–3000 s
	Deceleration time	0.1–3000 s

Technical item or function	Technical item or function	Technical information
Ambient conditions	Ambient operating temperature	I_L current: -10°C (no frost)...+40 °C I_H current: -10°C (no frost)...+50 °C Maximum operating temperature: +50 °C
	Storage temperature	-40 °C...+70 °C
	Relative humidity	0–95% RH, non-condensing, non-corrosive
	Air quality: <ul style="list-style-type: none"> chemical vapors mechanical particles 	Tested according to IEC 60068-2-60 Test Ke: Flowing mixed gas corrosion test, Method 1 (H ₂ S [hydrogen sulfide] and SO ₂ [sulfur dioxide]) Designed according to <ul style="list-style-type: none"> IEC 60721-3-3, unit in operation, class 3C3 (IP21/UL Type 1 Models 3C2) IEC 60721-3-3, unit in operation, class 3S2
	Altitude	100% nominal rating (no derating) up to 1000 m 1% derating for each 100 m above 1000 m Maximum altitudes: <ul style="list-style-type: none"> 208–240 V: 4000 m (TN and IT systems) 380–500 V: 4000 m (TN and IT systems) 380–500 V: 2000 m (corner-grounded network) 525–690 V: 2000 m (TN and IT systems, no corner grounding) Voltage for relay outputs: <ul style="list-style-type: none"> Up to 3000 m: Allowed up to 240 V 3000–4000 m: Allowed up to 120 V Corner grounding is allowed for MR4-MR6 (main voltage 208–230 V) up to 2000 m (see 6.2.1 Installation in a Corner-grounded Network).
	Pollution degree	PD2
	Vibration: <ul style="list-style-type: none"> EN 61800-5-1 EN 60068-2-6 	5–150 Hz Displacement amplitude 1 mm (peak) at 5–15.8 Hz (MR4-MR9) Maximum acceleration amplitude 1 G at 15.8–150 Hz (MR4-MR9)
	Shock: <ul style="list-style-type: none"> EN 60068-2-27 	UPS Drop Test (for applicable UPS weights) Storage and shipping: maximum 15 G, 11 ms (in package)
	Enclosure class	IP21/UL Type 1: standard in entire kW/HP range IP54/UL Type 12: option NOTE! For IP54/Type 12, a control panel adapter is necessary.

Technical item or function	Technical item or function	Technical information
EMC (at default settings)	Immunity	Fulfils EN 61800-3 (2004), 1st and 2nd environment
	Emissions	<p>200–500 V: EN 61800-3 (2004), category C2.</p> <p>600–690 V: EN 61800-3 (2004), category C3.</p> <p>All: The product is configurable to category C4 for installation on IT networks. The drive can be modified for IT type mains. See 6.6 Installation in an IT System. The IP00/UL Open Type drive has by default category C4.</p>
Noise level	Average noise level (min-max) sound pressure level in dB(A)	<p>The sound pressure depends on the cooling fan speed, which is controlled in accordance with the drive temperature.</p> <ul style="list-style-type: none"> • MR4: 45–56 • MR5: 57–65 • MR6: 63–72 • MR7: 43–73 • MR8: 58–73 • MR9: 54–75
Safety standards	-	IEC/EN 61800-5-1, UL 61800-5-1, CSA C22.2 No.274.
Approvals	-	<p>CE, cULus, RCM, KC, EAC, UA. (See the nameplate of the drive for more approvals.)</p> <p>The UL approval is valid for input voltage up to 600 V.</p>

Technical item or function	Technical item or function	Technical information
Protections	Overvoltage trip limit	Mains voltage 240 V: 456 VDC Mains voltage 500 V: 911 VDC Mains voltage 600 V: 1094 VDC Mains voltage 690 V: 1258 VDC
	Undervoltage trip limit	Depends on mains voltage ($0.8775 \times$ mains voltage): Mains voltage 240 V: trip limit 211 VDC Mains voltage 400 V: trip limit 351 VDC Mains voltage 500 V: trip limit 438 VDC Mains voltage 525 V: trip limit 461 VDC Mains voltage 600 V: trip limit 527 VDC Mains voltage 690 V: trip limit 606 VDC
	Earth fault protection	Yes
	Mains supervision	Yes
	Motor phase supervision	Yes
	Overcurrent protection	Yes
	Unit overtemperature protection	Yes
	Motor overload protection	Yes. ⁽¹⁾ The motor overload protection activates at 110% of the full load current.
	Motor stall protection	Yes
	Motor underload protection	Yes
	Short-circuit protection of +24 V and +10 V reference voltages	Yes

¹ For the motor thermal memory and the memory retention function to obey the UL 61800-5-1 requirements, you must use the system software version FW0072V007 or a newer version. If you use an older system software version, you must install a motor overtemperature protection to obey the UL regulations.

10.11 Technical Data, VACON® 100 FLOW

Table 51: Technical Data of the VACON® 100 FLOW AC Drive

Technical item or function	Technical item or function	Technical information
Mains connection	Input voltage U_{in}	208–240 V, 380–500 V, 525–600 V, 525–690 V, -10%... +10%
	Input frequency	50–60 Hz, -5...+10%
	Connection to mains	Once per minute or less
	Starting delay	6 s (MR4-MR6) 8 s (MR7-MR9)
	Network imbalance	Max $\pm 3\%$ of the nominal voltage
Motor connection	Mains	Mains types: TN, TT, and IT Short circuit current: the maximum short circuit current must be < 100 kA.
	Output voltage	0- U_{in}
	Continuous output current	I_L : Ambient temperature max. +40 °C overload $1.1 \times I_L$ (1 min/10 min)
	Output frequency	0–320 Hz (standard)
Control characteristics	Frequency resolution	0.01 Hz
	Switching frequency (see parameter P3.1.2.3)	200–500 V MR4-MR6: <ul style="list-style-type: none"> 1.5–10 kHz Default: 6 kHz (except for 0012 2, 0031 2, 0062 2, 0012 5, 0031 5 and 0061 5: 4 kHz) MR7-MR9: <ul style="list-style-type: none"> 1.5–6 kHz Default: MR7: 4 kHz, MR8: 3 kHz, MR9: 2 kHz 600–690 V MR5-MR9: <ul style="list-style-type: none"> 1.5–6 kHz Default: 2 kHz For a product that is configured for a C4 installation on IT network the maximum switching frequency is limited to default 2kHz. Automatic switching frequency derating in case of overload.
	Frequency reference: <ul style="list-style-type: none"> Analog input Panel reference 	Resolution 0.1% (10-bit), accuracy $\pm 1\%$ Resolution 0.01 Hz
	Field weakening point	8–320 Hz
	Acceleration time	0.1–3000 s
	Deceleration time	0.1–3000 s

Technical item or function	Technical item or function	Technical information
Ambient conditions	Ambient operating temperature	<p>I_L current: -10°C (no frost)...+40 °C</p> <p>Maximum operating temperature: +50 °C with derating (1.5%/1°C)</p>
	Storage temperature	-40 °C...+70 °C
	Relative humidity	0–95% RH, non-condensing, non-corrosive
	Air quality: <ul style="list-style-type: none"> chemical vapors mechanical particles 	<p>Tested according to IEC 60068-2-60 Test Ke: Flowing mixed gas corrosion test, Method 1 (H₂S [hydrogen sulfide] and SO₂ [sulfur dioxide])</p> <p>Designed according to</p> <ul style="list-style-type: none"> IEC 60721-3-3, unit in operation, class 3C3 (IP21/UL Type 1 Models 3C2) IEC 60721-3-3, unit in operation, class 3S2
	Altitude	<p>100% nominal rating (no derating) up to 1000 m</p> <p>1% derating for each 100 m above 1000 m</p> <p>Maximum altitudes:</p> <ul style="list-style-type: none"> 208–240 V: 4000 m (TN and IT systems) 380–500 V: 4000 m (TN and IT systems) 380–500 V: 2000 m (corner-grounded network) 525–690 V: 2000 m (TN and IT systems, no corner grounding) <p>Voltage for relay outputs:</p> <ul style="list-style-type: none"> Up to 3000 m: Allowed up to 240 V 3000–4000 m: Allowed up to 120 V <p>Corner grounding is allowed for MR4-MR6 (main voltage 208–230 V) up to 2000 m (see 6.2.1 Installation in a Corner-grounded Network).</p>
	Pollution degree	PD2
	Vibration: <ul style="list-style-type: none"> EN 61800-5-1 EN 60068-2-6 	<p>5–150 Hz</p> <p>Displacement amplitude 1 mm (peak) at 5–15.8 Hz (MR4-MR9)</p> <p>Maximum acceleration amplitude 1 G at 15.8–150 Hz (MR4-MR9)</p>
	Shock: <ul style="list-style-type: none"> EN 60068-2-27 	<p>UPS Drop Test (for applicable UPS weights)</p> <p>Storage and shipping: maximum 15 G, 11 ms (in package)</p>
	Enclosure class	<p>IP21/UL Type 1: standard in entire kW/HP range</p> <p>IP54/UL Type 12: option</p> <p>NOTE! For IP54/Type 12, a control panel adapter is necessary.</p>

Technical item or function	Technical item or function	Technical information
EMC (at default settings)	Immunity	Fulfils EN 61800-3 (2004), 1st and 2nd environment
	Emissions	<p>200–500 V: EN 61800-3 (2004), category C2.</p> <p>600–690 V: EN 61800-3 (2004), category C3.</p> <p>All: The product is configurable to category C4 for installation on IT networks. The drive can be modified for IT type mains. See 6.6 Installation in an IT System. The IP00/UL Open Type drive has by default category C4.</p>
Noise level	Average noise level (min-max) sound pressure level in dB(A)	<p>The sound pressure depends on the cooling fan speed, which is controlled in accordance with the drive temperature.</p> <ul style="list-style-type: none"> MR4: 45–56 MR5: 57–65 MR6: 63–72 MR7: 43–73 MR8: 58–73 MR9: 54–75
Safety standards	-	IEC/EN 61800-5-1, UL 61800-5-1, CSA C22.2 No.274.
Approvals	-	<p>CE, cULus, RCM, KC, EAC, UA. (See the nameplate of the drive for more approvals.)</p> <p>The UL approval is valid for input voltage up to 600 V.</p>

Technical item or function	Technical item or function	Technical information
Protections	Overvoltage trip limit	Mains voltage 240 V: 456 VDC Mains voltage 500 V: 911 VDC Mains voltage 600 V: 1094 VDC Mains voltage 690 V: 1258 VDC
	Undervoltage trip limit	Depends on mains voltage ($0.8775 \times$ mains voltage): Mains voltage 240 V: trip limit 211 VDC Mains voltage 400 V: trip limit 351 VDC Mains voltage 500 V: trip limit 438 VDC Mains voltage 525 V: trip limit 461 VDC Mains voltage 600 V: trip limit 527 VDC Mains voltage 690 V: trip limit 606 VDC
	Earth fault protection	Yes
	Mains supervision	Yes
	Motor phase supervision	Yes
	Overcurrent protection	Yes
	Unit overtemperature protection	Yes
	Motor overload protection	Yes. ⁽¹⁾ The motor overload protection activates at 110% of the full load current.
	Motor stall protection	Yes
	Motor underload protection	Yes
	Short-circuit protection of +24 V and +10 V reference voltages	Yes

¹ For the motor thermal memory and the memory retention function to obey the UL 61800-5-1 requirements, you must use the system software version FW0159V003 or a newer version. If you use an older system software version, you must install a motor overtemperature protection to obey the UL regulations.

10.12 Technical Data, VACON® 100 HVAC

Table 52: Technical Data of the VACON® 100 HVAC AC Drive

Technical item or function	Technical item or function	Technical information
Mains connection	Input voltage U_{in}	208–240 V, 380–500 V, -10%... +10%
	Input frequency	50–60 Hz, -5...+10%
	Connection to mains	Once per minute or less
	Starting delay	6 s (MR4-MR6) 8 s (MR7-MR9)
	Network imbalance	Max $\pm 3\%$ of the nominal voltage
Motor connection	Mains	Mains types: TN, TT, and IT Short circuit current: the maximum short circuit current must be < 100 kA.
	Output voltage	0- U_{in}
	Continuous output current	I_L : Ambient temperature max. +40 °C overload 1.1 x I_L (1 min/10 min)
	Output frequency	0–320 Hz (standard)
Control characteristics	Frequency resolution	0.01 Hz
	Switching frequency (see parameter P3.1.2.3)	200–500 V MR4-MR6: <ul style="list-style-type: none"> 1.5–10 kHz Default: 6 kHz (except for 0012 2, 0031 2, 0062 2, 0012 5, 0031 5 and 0061 5: 4 kHz) MR7-MR9: <ul style="list-style-type: none"> 1.5–6 kHz Default: MR7: 4 kHz, MR8: 3 kHz, MR9: 2 kHz Automatic switching frequency derating in case of overload.
	Frequency reference: <ul style="list-style-type: none"> Analog input Panel reference 	Resolution 0.1% (10-bit), accuracy $\pm 1\%$ Resolution 0.01 Hz
	Field weakening point	8–320 Hz
	Acceleration time	0.1–3000 s
	Deceleration time	0.1–3000 s

Technical item or function	Technical item or function	Technical information
Ambient conditions	Ambient operating temperature	<p>I_L current: -10°C (no frost)...+40 °C</p> <p>Maximum operating temperature: +50 °C with derating (1.5%/1°C)</p>
	Storage temperature	-40 °C...+70 °C
	Relative humidity	0–95% RH, non-condensing, non-corrosive
	Air quality: <ul style="list-style-type: none"> chemical vapors mechanical particles 	<p>Tested according to IEC 60068-2-60 Test Ke: Flowing mixed gas corrosion test, Method 1 (H₂S [hydrogen sulfide] and SO₂ [sulfur dioxide])</p> <p>Designed according to</p> <ul style="list-style-type: none"> IEC 60721-3-3, unit in operation, class 3C3 (IP21/UL Type 1 Models 3C2) IEC 60721-3-3, unit in operation, class 3S2
	Altitude	<p>100% nominal rating (no derating) up to 1000 m</p> <p>1% derating for each 100 m above 1000 m</p> <p>Maximum altitudes:</p> <ul style="list-style-type: none"> 208–240 V: 4000 m (TN and IT systems) 380–500 V: 4000 m (TN and IT systems) 380–500 V: 2000 m (corner-grounded network) <p>Voltage for relay outputs:</p> <ul style="list-style-type: none"> Up to 3000 m: Allowed up to 240 V 3000–4000 m: Allowed up to 120 V <p>Corner grounding is allowed for MR4-MR6 (main voltage 208–230 V) up to 2000 m (see 6.2.1 Installation in a Corner-grounded Network).</p>
	Pollution degree	PD2
	Vibration: <ul style="list-style-type: none"> EN 61800-5-1 EN 60068-2-6 	<p>5–150 Hz</p> <p>Displacement amplitude 1 mm (peak) at 5–15.8 Hz (MR4-MR9)</p> <p>Maximum acceleration amplitude 1 G at 15.8–150 Hz (MR4-MR9)</p>
	Shock: <ul style="list-style-type: none"> EN 60068-2-27 	<p>UPS Drop Test (for applicable UPS weights)</p> <p>Storage and shipping: maximum 15 G, 11 ms (in package)</p>
	Enclosure class	<p>IP21/UL Type 1: standard in entire kW/HP range</p> <p>IP54/UL Type 12: option</p> <p>NOTE! For IP54/Type 12, a control panel adapter is necessary.</p>

Technical item or function	Technical item or function	Technical information
EMC (at default settings)	Immunity	Fulfils EN 61800-3 (2004), 1st and 2nd environment
	Emissions	200–500 V: EN 61800-3 (2004), category C2. All: The product is configurable to category C4 for installation on IT networks. The drive can be modified for IT type mains. See 6.6 Installation in an IT System . The IP00/UL Open Type drive has by default category C4.
Noise level	Average noise level (min-max) sound pressure level in dB(A)	The sound pressure depends on the cooling fan speed, which is controlled in accordance with the drive temperature. <ul style="list-style-type: none"> MR4: 45–56 MR5: 57–65 MR6: 63–72 MR7: 43–73 MR8: 58–73 MR9: 54–75
Safety standards and certifications	-	EN 61800-5-1 (2007), CE, cUL (See the nameplate of the drive for more approvals.)
Protections	Overvoltage trip limit	Mains voltage 240 V: 456 VDC Mains voltage 500 V: 911 VDC
	Undervoltage trip limit	Depends on mains voltage (0.8775 x mains voltage): Mains voltage 240 V: trip limit 211 VDC Mains voltage 400 V: trip limit 351 VDC Mains voltage 500 V: trip limit 438 VDC Mains voltage 525 V: trip limit 461 VDC
	Earth fault protection	Yes
	Mains supervision	Yes
	Motor phase supervision	Yes
	Overcurrent protection	Yes
	Unit overtemperature protection	Yes
	Motor overload protection	Yes. ⁽¹⁾ The motor overload protection activates at 110% of the full load current.
	Motor stall protection	Yes
	Motor underload protection	Yes
	Short-circuit protection of +24 V and +10 V reference voltages	Yes

¹ For the motor thermal memory and the memory retention function to obey the UL 61800-5-1 requirements, you must use the system software version FW0065V021 or a newer version. If you use an older system software version, you must install a motor overtemperature protection to obey the UL regulations.

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