Operating Guide

VACON® 100 Wall-mounted Drives

VACON® 100 INDUSTRIAL, VACON® 100 FLOW

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VACON®

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1 Introduction

1.1 Purpose of this Operating Guide

This operating guide provides information for safe installation and commissioning of the product. It is intended for use by qualified personnel. To use the drive safely and professionally, read and follow the instructions. Pay particular attention to the safety instructions and general warnings. Always keep this operating guide available with the product.

1.2 Additional Resources

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

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

Supplementary publications and guides are available from Danfoss.

For US and Canadian markets:

NOTE! Download the English and French product guides with applicable safety, warning, and caution information from www.danfoss.com/en/service-and-support/.

REMARQUE Vous pouvez télécharger les versions anglaise et française des guides produit contenant l'ensemble des informations de sécurité, avertissements et mises en garde applicables sur le site www.danfoss.com/en/service-and-support/.

1.3 Version History

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

The original language of this guide is English.

Table 1: Version History

Version	Remarks
DPD01711H	Information about the new enclosure size MR9B and internal fieldbuses was added. Information about option boards was updated. EC declaration was removed. Information about VACON® 100 IP00 drive modules was removed. Hyperlink to the company web page was updated. The structure of the guide was changed. Minor changes throughout the guide.
DPD01711I	Added information about ground fault alarms and compatibility with RCDs. Minor changes throughout the guide.
DPD01711J	Added chapters Purpose of this Operating Guide and Intended Use. Added warning about electromagnetic interference. Updated the Preventive Maintenance Recommendations. Updates to the Technical Data tables. Information about VACON® 100 HVAC Drives was removed.

1.4 Recommended Disposal

When the product reaches the end of its service life, its primary components can be recycled.

Before the materials can be removed, the product must be disassembled. Product parts and materials can be dismantled and separated. Generally, all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, and cardboard can be used in energy recovery. Printed circuit boards and large electrolytic capacitors with a diameter of over 2.5 cm (1 in) need further treatment according to IEC 62635 guidelines. To ease recycling, plastic parts are marked with an appropriate identification code.

Contact the local Danfoss office for further information on environmental aspects and recycling instructions for professional recyclers. End-of-life treatment must follow international and local regulations.

All products are designed and manufactured in accordance with Danfoss company guidelines on prohibited and restricted substances. A list of these substances is available at www.danfoss.com.

This symbol on the product indicates that it must not be disposed of as household waste. Do not dispose of equipment containing electrical components together with domestic waste.

It must be handed over to the applicable take-back scheme for the recycling of electrical and electronic equipment.

- Dispose of the product through channels provided for this purpose.
- Comply with all local and currently applicable laws and regulations.

1.5 Type Approvals and Certifications

The table shows examples of possible type approvals and certifications for VACON® drives. The specific approvals and certification for the drive are on the product label of the drive. For more information, contact the local Danfoss office or partner.

Table 2: Type Approvals and Certifications

CE	ErP READY		DNV·GL
c UL us	EAC	089	OSHPD
BUREAU VERITAS	LR		RINA
ClassNK			
ABS			

2 Safety

2.1 Safety Symbols

The following symbols are used in Danfoss documentation and products.

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

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

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

2.2 Safety Precautions

⚠ DANGER

SHOCK HAZARD FROM POWER UNIT COMPONENTS

The components of the power unit 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.

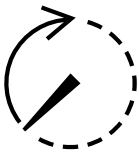
DANGER

SHOCK HAZARD FROM TERMINALS

The motor terminals U, V, and W, and the DC terminals must be treated as live when the drive is connected to mains. Contact with voltage can lead to death or serious injury.

- Do not touch the motor terminals U, V, and W, and the DC terminals when the drive is connected to mains.
- Do not work on live equipment.
- Before doing any work on internal drive components, follow proper lock out and tag out procedure.
- Before connecting the drive to mains, make sure that all covers are installed on the drive, and the cabinet doors are closed.

DANGER



SHOCK HAZARD FROM DC LINK OR EXTERNAL SOURCE

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

- Do not touch the main circuit of the drive or the motor before the system is powered off and grounded.
- Disconnect the drive from the mains and ensure that the motor has stopped.
- Disconnect the motor.
- Lock out and tag out the power source to the drive.
- Ensure that no external source generates unintended voltage during work.
- Ground the drive for work.
- Wait for the capacitors to discharge fully before opening the door or the cover of the drive. Refer to the label on the drive for the correct discharge time. If the device is broken or fuses have blown, the discharge time is longer.
- Use a suitable measuring device to make sure that there is no voltage in the drive.

  Before and after the measurement, verify the correct operation of the voltage tester on a known voltage source.

  Confirm that there is no voltage between the power terminals (input, output, and DC) and ground (PE).

  Confirm that there is no voltage between the DC terminals (DC+ and DC-).

WARNING

SHOCK HAZARD FROM CONTROL TERMINALS

The control terminals can have a dangerous voltage also when the drive is disconnected from DC supply. 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

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 device (RCD) Type B or a residual current-operated monitoring device (RCM) 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.

⚠ 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 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 the auto reset function is activated, 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.

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

⚠ WARNING

ELECTROMAGNETIC INTERFERENCE

Drives and filters can produce electromagnetic interference up to 300 GHz that can affect the functionality of pacemakers and other implanted medical devices.

⚠ CAUTION

CUT HAZARD

Sharp edges in the drive can cause cuts.

- Wear protective gloves during installation, cabling, and service 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.

⚠ CAUTION

ACOUSTIC NOISE

Exposure to acoustic noise can cause hearing damage.

- When the acoustic noise level is >70 dB(A), use hearing protection.

NOTICE

DAMAGE TO THE DRIVE FROM INCORRECT MEASUREMENTS

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

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

NOTICE

DAMAGE TO THE 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.

NOTICE

DAMAGE TO THE DRIVE FROM INSUFFICIENT GROUNDING

Not using a grounding conductor can damage the drive.

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

NOTICE

DAMAGE TO THE DRIVE FROM STATIC VOLTAGE

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

- Use ESD protection when working with electronic components of the drive.
- Do not touch the components on the circuit boards without proper ESD protection.

NOTICE

DAMAGE TO THE DRIVE FROM MOVEMENT

Movement after installation can damage the drive.

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

NOTICE

DAMAGE TO THE DRIVE FROM INCORRECT EMC LEVEL

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

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

NOTICE

RADIO INTERFERENCE

This product can cause radio interference.

- Take supplementary mitigation measures.

NOTICE

MAINS DISCONNECTION DEVICE

- If the 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 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 drive. The manufacturer has already done the tests.

3 Product Overview

3.1 Intended Use

The VACON® 100 Wall-mounted Drive is an electronic motor controller intended for:

- Regulation of motor speed in response to system feedback or to remote commands from external controllers. A power drive system consists of the AC drive, the motor, and equipment driven by the motor.
- System and motor status surveillance.

The drive can also be used for motor overload protection.

VACON® 100 Wall-mounted Drives can be used as programmable logic controller (PLC) in many applications due to extensive I/O and fieldbus options and easy programmability. Custom application development can be done with the VACON® Programming tool and standard PLC programming languages defined in the IEC 61131/3.

Depending on the configuration, the drive can be used in standalone applications or form part of a larger appliance or installation.

The drive is allowed for use in residential, industrial, and commercial environments in accordance with local laws and standards.

NOTICE

FORESEEABLE MISUSE

- Do not use the drive in applications which are not compliant with specified operating conditions and environments. Ensure compliance with the ambient conditions specified in the *Technical Data* section.

3.2 Package Label

The package label gives detailed information about the delivery.

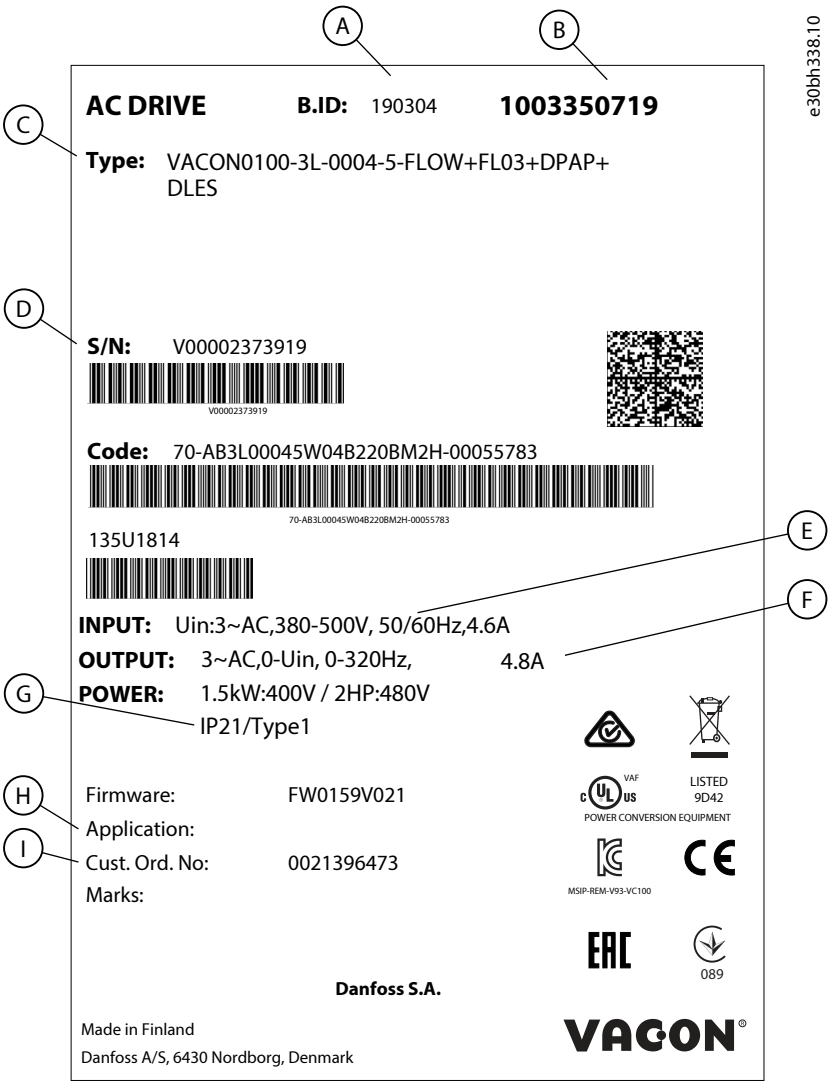


Figure 1: Package Label of VACON® 100 Wall-mounted Drives

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		

3.3 Description of the Type Code

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

The code can have this format, for example:

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

Table 3: Description of the Type Code

Code	Description
VACON0100	The product family: VACON0100 = VACON® 100 product family
3L	Input/Function: 3L = 3-phase input
0061	The rated continuous current of the drive rating in amperes. For example, 0061 = 61 A. For a list of the drive ratings, see 10.6.1 List of Power Rating Information.
5	The mains voltage: 2 = 208–240 V 5 = 380–500 V 6 = 525–600 V 7 = 525–690 V
FLOW	The product: (empty) = VACON® 100 INDUSTRIAL FLOW = VACON® 100 FLOW
+IP54	The optional codes. There are many options, for example +IP54 (a drive with the protection rating IP54). For a complete list of options, refer to the *VACON® 100 Selection Guide*.

3.4 Enclosure Sizes

The codes for rated continuous 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 rated continuous current is 0003 and the code for nominal mains voltage is 5. For a list of the drive ratings, see 10.6.1 List of Power Rating Information.

In the following table, 'Model number' refers to the type code without the option codes, for example, "VACON0100-3L-0061-5".

Table 4: Enclosure Sizes

Nominal mains voltage	Model number	Enclosure size
2 (208–240 V)	VACON 0100-3L-0003-2	MR4
	VACON 0100-3L-0004-2	
	VACON 0100-3L-0007-2	
	VACON 0100-3L-0008-2	
	VACON 0100-3L-0011-2	
	VACON 0100-3L-0012-2	
	VACON 0100-3L-0018-2	MR5
	VACON 0100-3L-0024-2	
	VACON 0100-3L-0031-2	
	VACON 0100-3L-0048-2	MR6
	VACON 0100-3L-0062-2	
	VACON 0100-3L-0075-2	MR7
	VACON 0100-3L-0088-2	
	VACON 0100-3L-0105-2	
	VACON 0100-3L-0140-2	MR8
	VACON 0100-3L-0170-2	
	VACON 0100-3L-0205-2	
	VACON 0100-3L-0261-2	MR9A
	VACON 0100-3L-0310-2	

Table 4: Enclosure Sizes - (continued)

Nominal mains voltage	Model number	Enclosure size
5 (380–500 V)	VACON 0100-3L-0003-5	MR4
	VACON 0100-3L-0004-5	
	VACON 0100-3L-0005-5	
	VACON 0100-3L-0008-5	
	VACON 0100-3L-0009-5	
	VACON 0100-3L-0012-5	
	VACON 0100-3L-0016-5	MR5
	VACON 0100-3L-0023-5	
	VACON 0100-3L-0031-5	
	VACON 0100-3L-0038-5	MR6
	VACON 0100-3L-0046-5	
	VACON 0100-3L-0061-5	
	VACON 0100-3L-0072-5	MR7
	VACON 0100-3L-0087-5	
	VACON 0100-3L-0105-5	
	VACON 0100-3L-0140-5	MR8
	VACON 0100-3L-0170-5	
	VACON 0100-3L-0205-5	
	VACON 0100-3L-0261-5	MR9A
	VACON 0100-3L-0310-5	
	VACON 0100-3L-0386-5	MR9B

Table 4: Enclosure Sizes - (continued)

Nominal mains voltage	Model number	Enclosure size
6 (525–600 V)	VACON 0100-3L-0004-6	MR5
	VACON 0100-3L-0006-6	
	VACON 0100-3L-0009-6	
	VACON 0100-3L-0011-6	
	VACON 0100-3L-0018-6	MR6
	VACON 0100-3L-0022-6	
	VACON 0100-3L-0027-6	
	VACON 0100-3L-0034-6	
	VACON 0100-3L-0041-6	MR7
	VACON 0100-3L-0052-6	
	VACON 0100-3L-0062-6	
	VACON 0100-3L-0080-6	MR8
	VACON 0100-3L-0100-6	
	VACON 0100-3L-0125-6	
	VACON 0100-3L-0144-6	MR9A
	VACON 0100-3L-0208-6	
	VACON 0100-3L-0262-6	MR9B
7 (525–690 V)	VACON 0100-3L-0007-7	MR6
	VACON 0100-3L-0010-7	
	VACON 0100-3L-0013-7	
	VACON 0100-3L-0018-7	
	VACON 0100-3L-0022-7	
	VACON 0100-3L-0027-7	
	VACON 0100-3L-0034-7	
	VACON 0100-3L-0041-7	MR7
	VACON 0100-3L-0052-7	
	VACON 0100-3L-0062-7	
	VACON 0100-3L-0080-7	MR8
	VACON 0100-3L-0100-7	
	VACON 0100-3L-0125-7	
	VACON 0100-3L-0144-7	MR9A
	VACON 0100-3L-0170-7	
	VACON 0100-3L-0208-7	
	VACON 0100-3L-0262-7	MR9B

4 Receiving the Delivery

4.1 Checking the Delivery

1. After removing 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 the order data to the data on the package label. See 3.2 Package Label.
   a. If the delivery does not agree with the order, speak to the vendor immediately.
3. To make sure that the contents of the delivery is correct and complete, compare the type code of the product to the type code. See 3.3 Description of the Type Code.
4. Check that the accessories bag contains the items listed in 4.2 Accessories.

These accessories are part of the electrical installation. The contents of the accessories bag are different for different enclosure sizes and protection ratings.

4.2 Accessories

Table 5: The Contents of the Accessories Bag for MR4

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

Table 6: The Contents of the Accessories Bag for MR5

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
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

Table 6: The Contents of the Accessories Bag for MR5 - (continued)

Item	Quantity	Description
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

Table 7: The Contents of the Accessories Bag for MR6

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

Table 8: The Contents of the Accessories Bag for MR7

Item	Quantity	Description
M6x30 slotted nut	6	Nuts for the grounding clamps for the cable shield
M4x16 screw	3	Screws for the grounding clamps for the control cable
M6x12 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	3	Sealing for the cables

Table 9: The Contents of the Accessories Bag for MR8

Item	Quantity	Description
M4x16 screw	3	Screws for the grounding clamps for the control cable
Grounding clamp for control cable	3	Control cable grounding
Grounding clamp for cable shield KP40	3	Clamping the power cables

Table 9: The Contents of the Accessories Bag for MR8 - (continued)

Item	Quantity	Description
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

Table 10: The Contents of the Accessories Bag for MR9

Item	Quantity	Description
M4x16 screw	3	Screws for the grounding clamps for the 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
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

If the product has to be stored before installing it, follow these instructions.

1. If the AC drive must be stored before using it, make sure that the ambient conditions agree to the following:
   - Storage temperature: -40…+70 °C (-40...+158 °F)
   - Relative humidity: 0–95%, no condensation
2. If the AC drive must be kept in storage for a more than 2 months, keep it in controlled conditions.
   a. Make sure that the temperature variation is small.
   b. Make sure that the humidity is less than 50%.

4.4 Lifting the Enclosure Sizes MR8 and MR9

The weights of different enclosure sizes are different. It can be necessary to use a lifting device to move the drive from its package. See the weights of the different enclosure sizes in 10.1 Weight of the Drive.

⚠ WARNING

LIFTING HEAVY LOAD

Not following the safe lifting instructions can result in death or serious injury and damage to the equipment.

- Follow the lifting and moving instructions and the local safety regulations on lifting.
- Use a lifting device that is in proper working condition and appropriate for the weight of the load.
- If the package must be lifted manually, follow local safety regulations and make sure that the number of lifting personnel is such that the weight limit per lifter is not exceeded.
- Check the weight of the drive. The weight is provided on the outside of the shipping box.
- Test lift the load to verify the proper center of gravity. Reposition the lifting point if not level.
- Do not walk under, or place any part of your body under a suspended load.

1. Remove the drive from the pallet where it was bolted to.
2. Put the lifting hooks symmetrically in a minimum of 2 holes. The maximum lifting angle is 45 °.

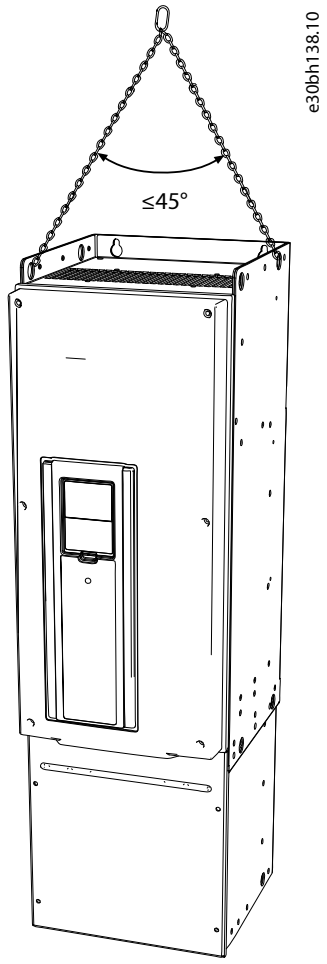


Figure 2: Lifting the Enclosure Sizes MR8 and MR9

4.5 Using the Product Modified Label

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 drive.

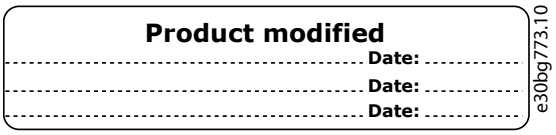


Figure 3: The Product Modified Label

1. Attach the label on the side of the drive, in a place where it is easy to find.
   a. Attach the label, for example, next to the other labels on the power unit.
2. If changes are made to the drive, write the change and date on the label.

5 Mounting

5.1 Protection Ratings

VACON® 100 drives in enclosure sizes MR4–MR9 are available with either IP21 or IP54 rating.

- The IP21 rating is ideal for installation inside indoor or outdoor switchboards.
- The IP54 rating is suitable for mounting on the wall inside a switchroom.

5.2 Wall-mounting Requirements

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

If the drive is installed 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 5.4.2 Cooling).

Make sure that the installation surface is strong enough to hold the drive. Install the drive with the screws and other components included in the delivery.

5.3 Flange-mounting Requirements

It is also possible to install the AC drive into the cabinet wall with a flange mounting option.

NOTICE

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

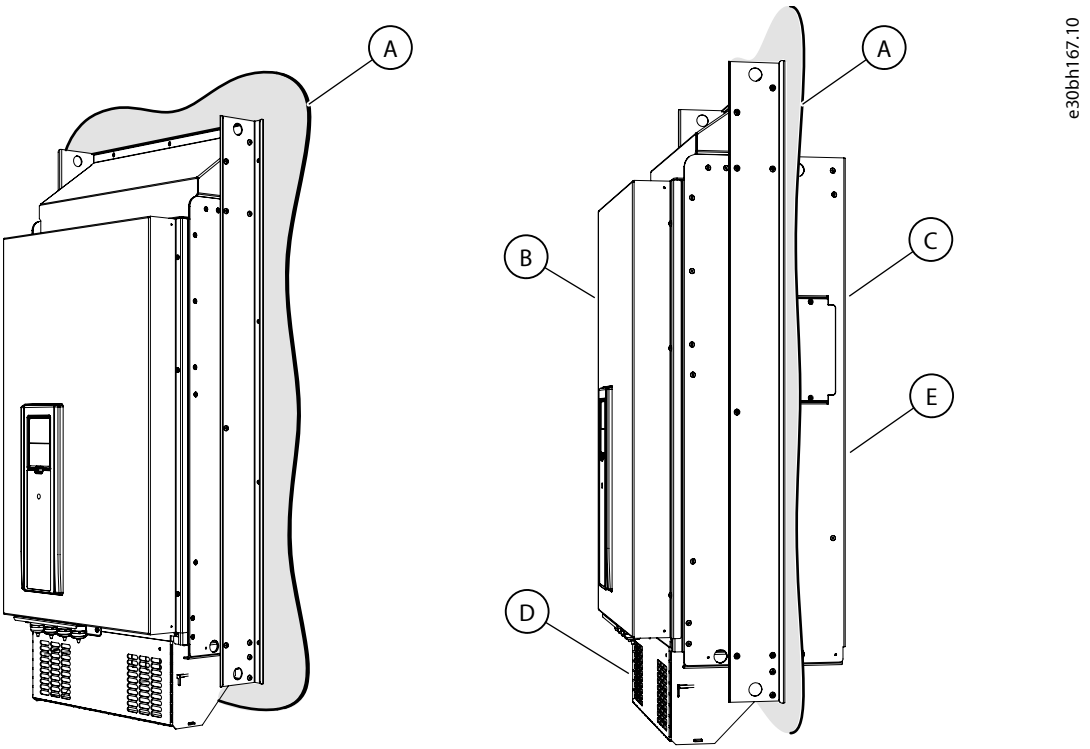


Figure 4: Example of Flange Mounting

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

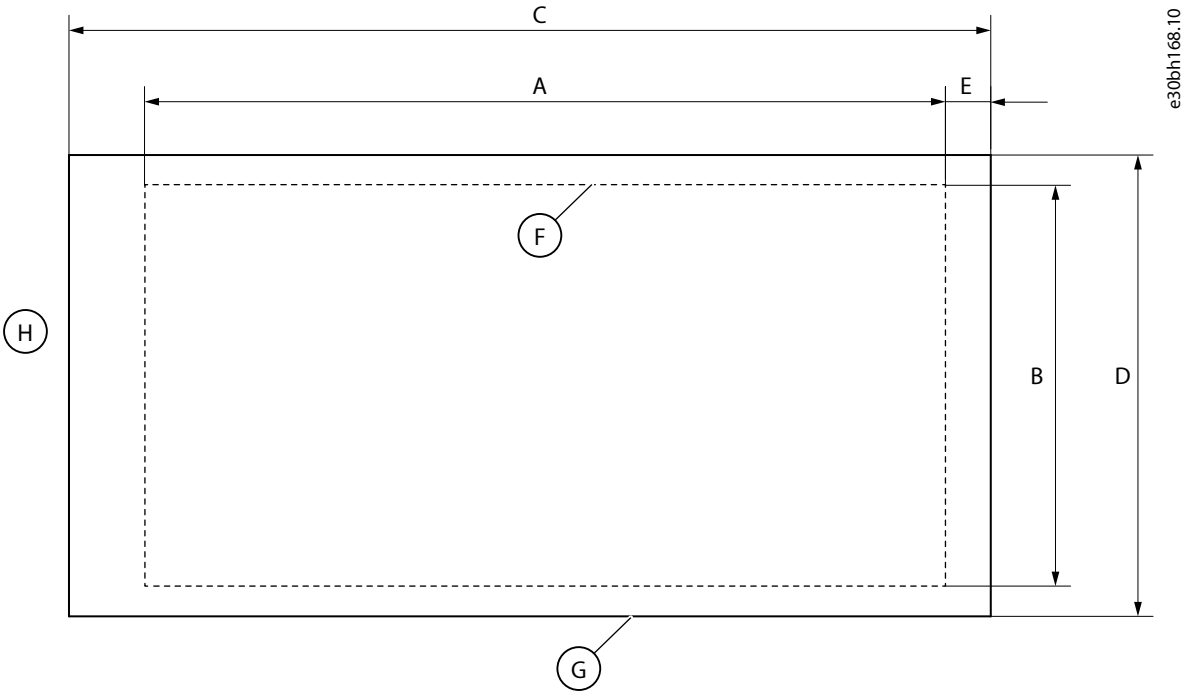


Figure 5: Dimensions of the Opening and Drive Outline with Flange

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

Table 11: The Dimensions of the Drive, MR4–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 12: The Dimensions of the Opening for the Flange Mounting, MR4–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)

5.4 Cooling Requirements

5.4.1 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.

5.4.2 Cooling

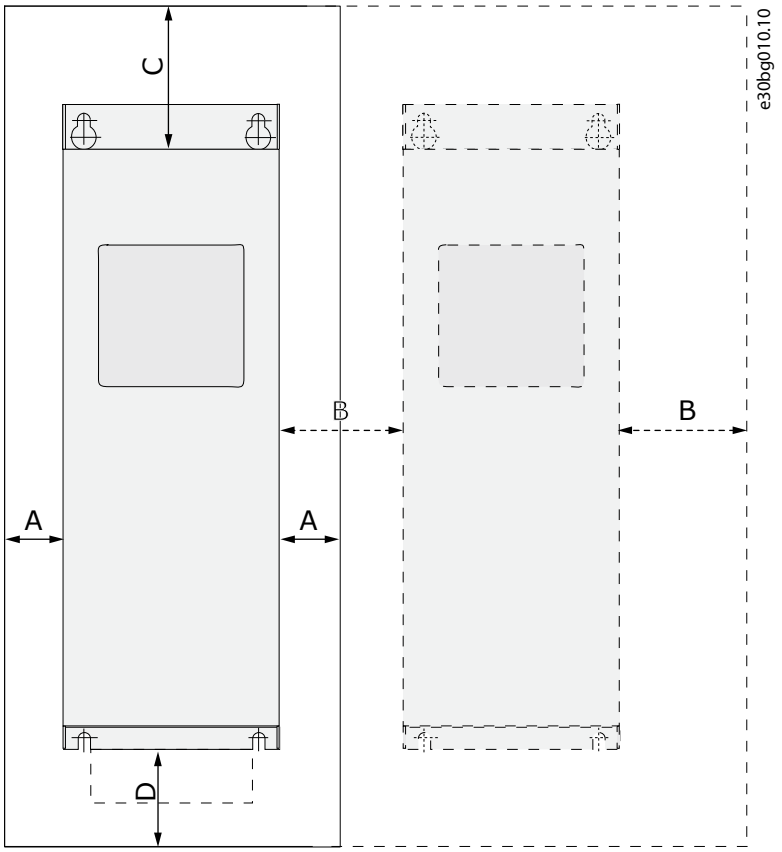


Figure 6: Installation Space

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

Table 13: 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)

Table 13: Minimum Clearances around the AC Drive in mm (in inch) - (continued)

Enclosure size	A (1)	B (1)	C	D
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.

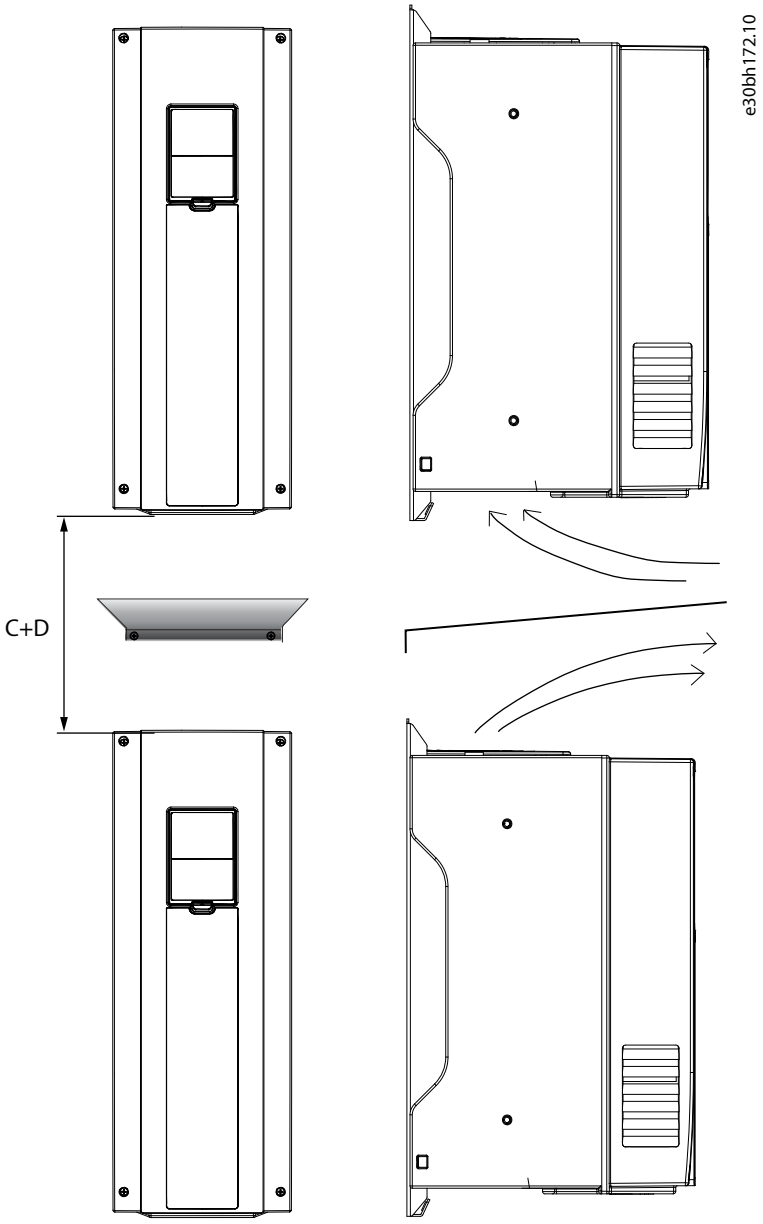


Figure 7: Installation Space when Drives Are Installed on Top of Each Other

- If many AC drives are installed above each other, the necessary free space is C + D (see Figure 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.

5.4.3 Necessary Quantity of Cooling Air

Table 14: 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

6.1.1 Overview of Cable Connections

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

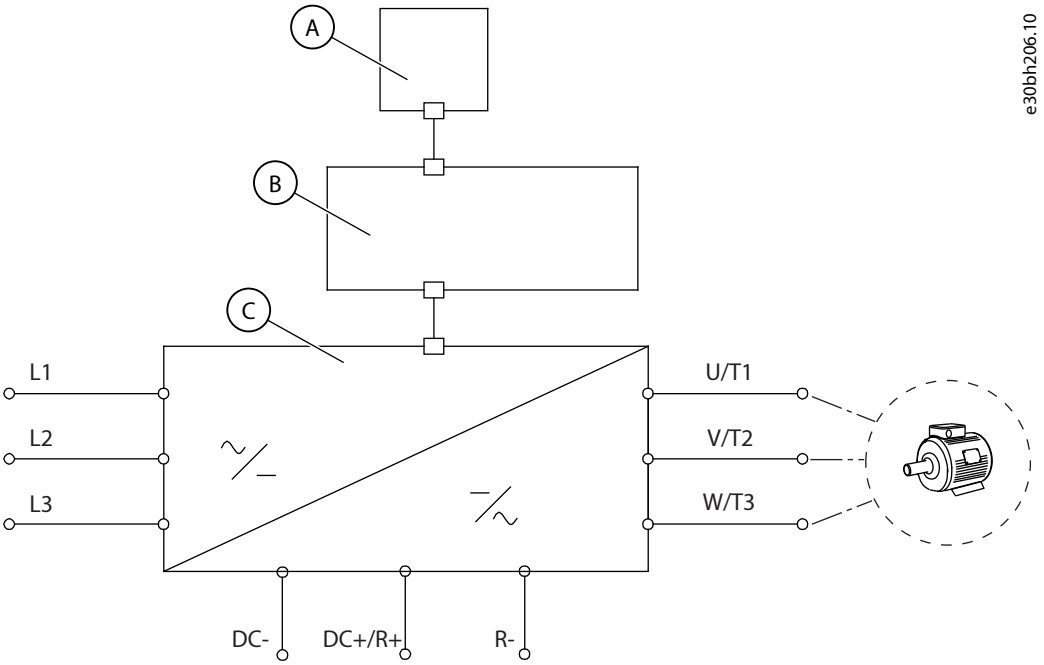


Figure 8: Principal Connection Diagram

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

For guidelines on EMC-compliant installation, see 6.2.1 EMC-compliant Installation.

6.1.2 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 product label.

For information on how to make the cable installation to comply with the UL standards, see 6.1.3 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.

6.1.3 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. To get the branch circuit protection, obey the National Electric Code and any additional local codes. Only fuses give the branch circuit protection.

For the tightening torques of the terminals, see 10.5 Tightening Torques of the Terminals.

6.1.4 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 6.3.1 Grounding.

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

6.1.5 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.

6.1.6 Fuse Selection

It is recommended to use 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.

6.1.7 Fuse Selection, North America

It is recommended to use 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 recognized) 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.

6.1.8 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 recommended dimensions 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 List of Brake Resistor Rating Information.

⚠ 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 software does not have the dynamic brake or the brake resistor functions.

6.2 EMC-compliant Installation Requirements

6.2.1 EMC-compliant Installation

For cable selections in different EMC levels, see Table 15.

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 15: Recommendations for Cables

Cable type	Category C2[1]	Category C3 [2]	Category C4 [2]
Motor cable	A symmetrical power cable with a compact low-impedance shield. A cable for the specified mains voltage. The recommended cable type is MCCMK or EMCMK. See Figure 9. The recommended maximum for the cable transfer impedance (1–30 MHz) is 100 mΩ/m.	A symmetrical power cable with a concentric protection wire. A cable for the specified mains voltage. The recommended cable type is MCMK. See Figure 9.	
Mains cable	A power cable for a fixed installation. A cable for the specified mains voltage. A shielded cable is not necessary. The recommended cable type is MCMK.		
Control cable	A shielded cable with a compact low-impedance shield, for example a JAMAK, or an SAB/ÖZCuY-O cable.		

1) 1st environment

2) 2nd environment

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

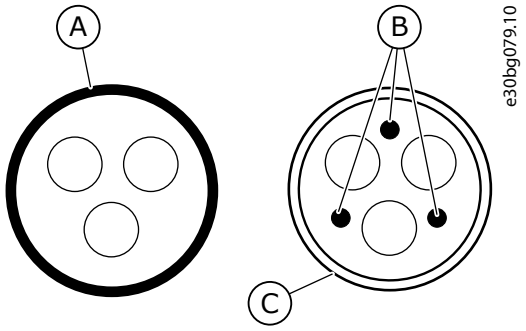


Figure 9: Cables with PE Conductors

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

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.

6.2.2 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 6.6.1 Requirements for Installation in an IT System.

6.3 Grounding Requirements

6.3.1 Grounding

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

⚠ 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.

NOTICE

DAMAGE TO THE DRIVE FROM INSUFFICIENT GROUNDING

Not using a grounding conductor can damage the drive.

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

To comply with EN 61800-5-1, make sure that 1 or more of the following conditions for the protective circuit are fulfilled:

- The protective earthing conductor must have a cross-sectional area of minimum 10 mm^2 Cu or 16 mm^2 Al.
- There must be an automatic disconnection of the mains, if the protective earthing conductor breaks.
- There must be a terminal for a second protective earthing conductor in the same cross-sectional area as the first protective earthing conductor.

IMPORTANT: The connection must be fixed.

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 ≤ 16	S
16 < S ≤ 35	16
35 < S	S/2

The values stated in the preceding 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 mm^2 if there is mechanical protection, and

- 4 mm^2 if there is no 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.

⚠ 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 device (RCD) Type B or a residual current-operated monitoring device (RCM) 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.

NOTICE

MALFUNCTION OF FAULT CURRENT PROTECTIVE SWITCHES

Because there are high capacitive currents in the 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 drive. The manufacturer has already done the tests.

6.3.2 Earth Fault Alarm

The earth fault can be retrieved through:

- Drive keypad
- Fieldbus communication
- Relay output

Select one of these methods to provide a fault or alarm, in accordance with the requirements of AS/NZS 5033.

6.3.3 Compatibility with RCDs

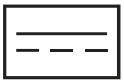
⚠ WARNING

SHOCK HAZARD FROM PE CONDUCTOR

The leakage current to protective earth exceeds 3.5 mA. Contact with the current can cause death or serious injury.

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

If VACON® 100 is connected to an electrical installation where a residual current-operated protective device (RCD) is used as extra protection, the RCD must be of type B. The RCD must be marked with the following symbol:



The total leakage current of all the electrical equipment in the installation must be considered. During start-up and in asymmetrical supply systems, the leakage current can be higher than normal and can cause the RCD to trip.

6.4 Get Access and Locate the Terminals

6.4.1 Get Access and Locate the Terminals for MR4–MR7

1. Open the cover of the AC drive.

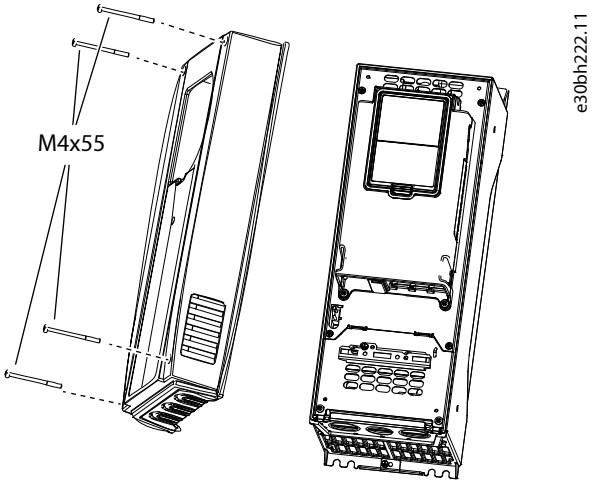


Figure 10: Removing the Cover of MR4–MR7

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

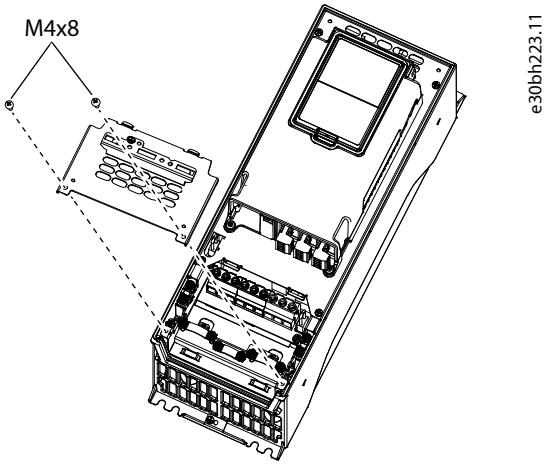


Figure 11: Removing the Cable Cover of MR4–MR7

3. Locate the terminals.

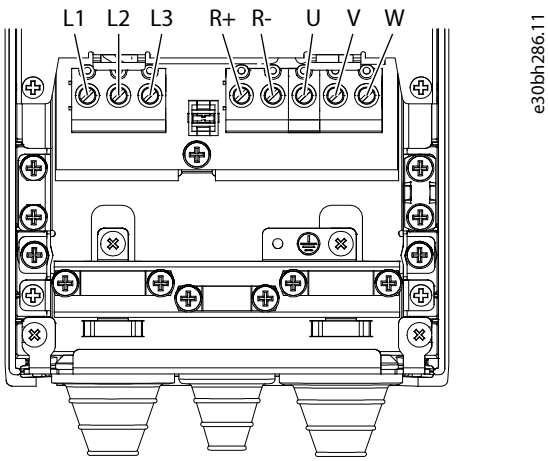


Figure 12: Locating the Terminals of MR4–MR7

6.4.2 Get Access and Locate the Terminals for MR8

1. Remove the cable cover.

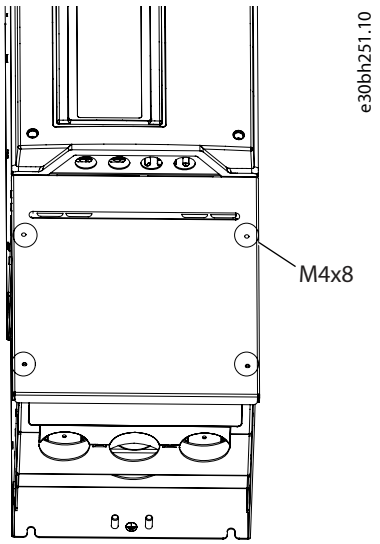


Figure 13: Removing the Cable Cover of MR8

2. Remove the cable entry plate.

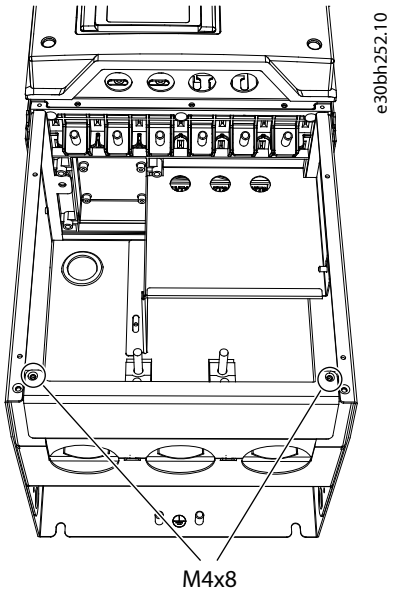


Figure 14: Removing the Cable Entry Plate of MR8

3. Remove the EMC shield plate.

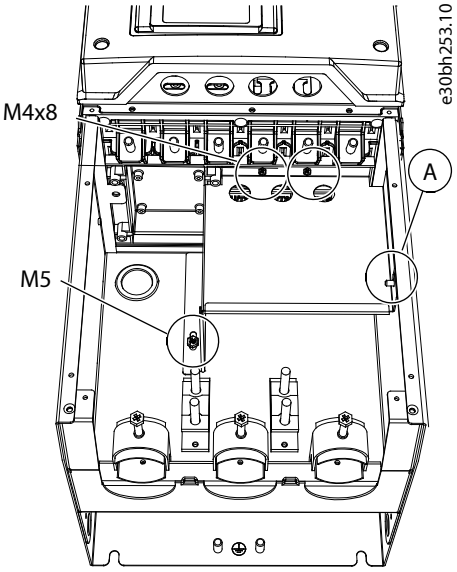


Figure 15: Removing the EMC Shield Plate of MR8

A	The wing nut

4. Locate the terminals.

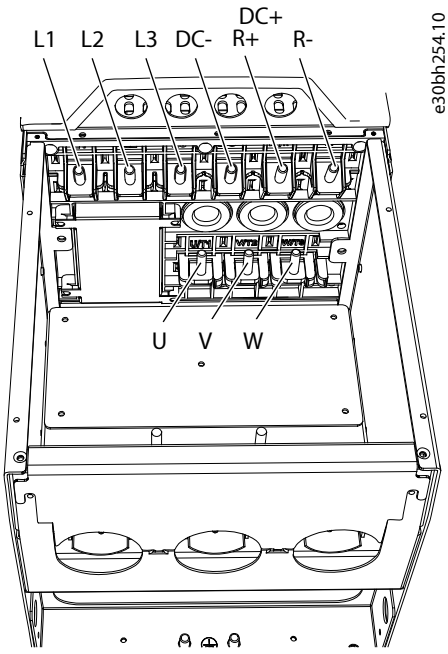


Figure 16: Locating the Terminals of MR8

6.4.3 Get Access and Locate the Terminals for MR9

1. Open the cover of the AC drive.

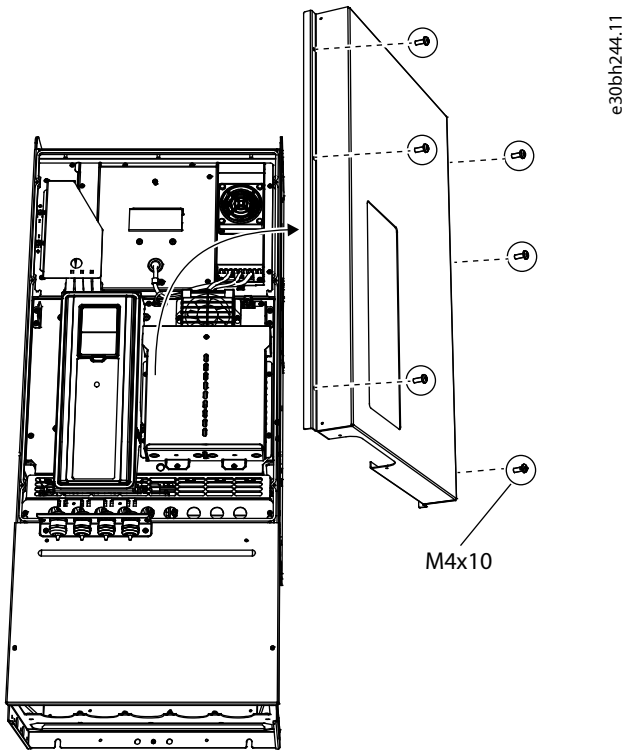


Figure 17: Removing the Cover of MR9

2. Remove the cable cover.

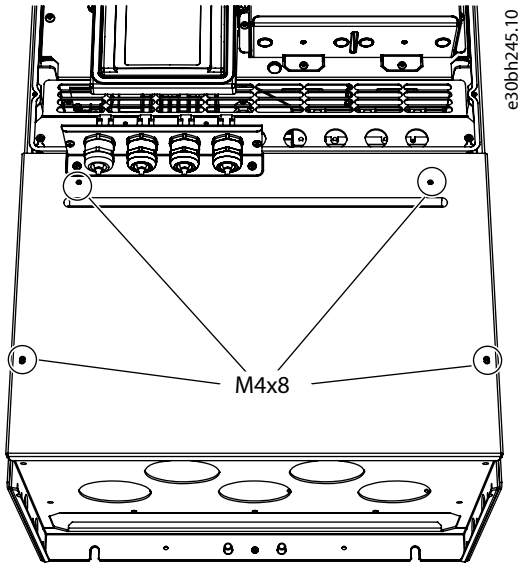


Figure 18: Removing the Cable Cover of MR9

3. Remove the cable entry plate.

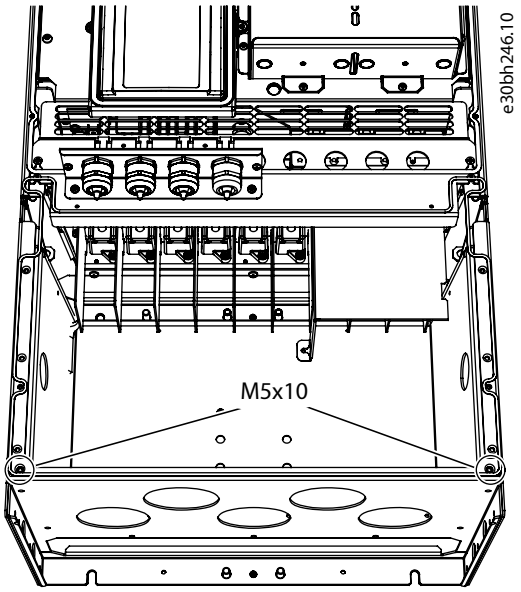


Figure 19: Removing the Cable Entry Plate of MR9

4. Loosen the screws and remove the sealing plate.

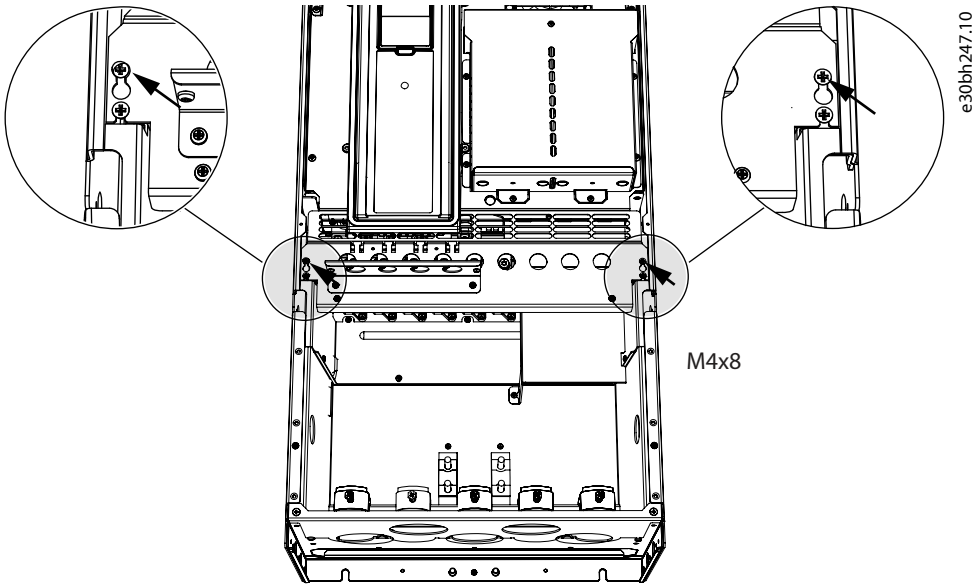


Figure 20: Removing the Sealing Plate of MR9

5. Remove the EMC shield plate.

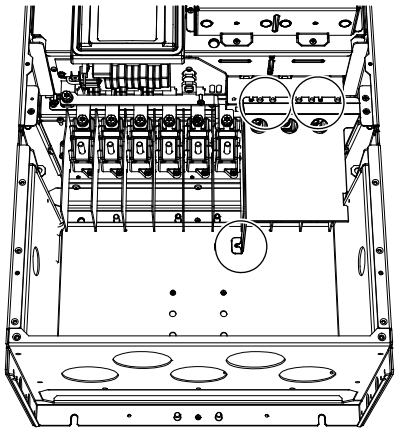


Figure 21: Removing the EMC Shield Plate of MR9

6. Locate the terminals.

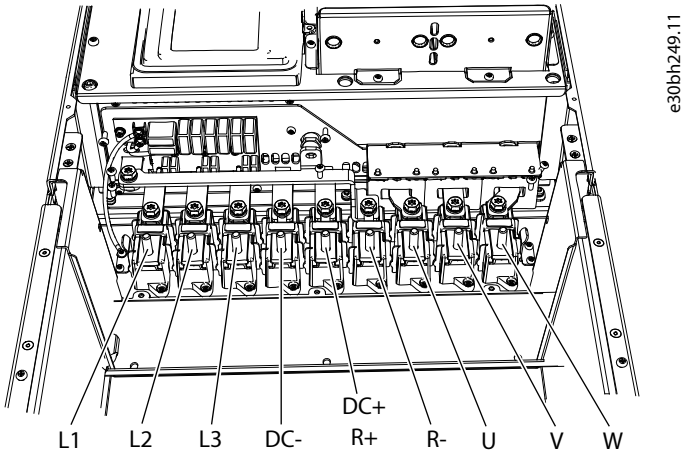


Figure 22: Locating the Terminals of MR9

6.5 Installing the Cables

6.5.1 Additional Instructions for Cable Installation

- Before starting, make sure that none of the components of the AC drive are live. Read carefully the warnings in the Safety section of this guide.
- 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 16).
- The distances are also valid between the motor cables and the signal cables of other systems.
- The maximum lengths of shielded motor cables are:
  - MR4 = 100 m/328 ft
  - MR5 and MR6 = 150 m/492 ft
  - MR7, MR8, and MR9 = 200 m/656 ft
- If the cable insulation checks are necessary, see 8.3.1 Measuring the Cable and Motor Insulation.

Table 16: 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

Prerequisites:

Make sure that the delivery contains all the 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.

To install the cables and cable accessories, follow these instructions. For information on how to comply with the UL regulations in cable installation, see 6.1.3 UL Standards on Cabling.

1. Strip the motor cable, the mains cable, and the brake resistor cable. See 10.4 Cable Stripping Lengths.

   The VACON® 100 FLOW software does not have the dynamic brake or the brake resistor functions.

2. Put the grommets in the openings of the cable entry plate.

   These parts are included in the delivery.

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

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

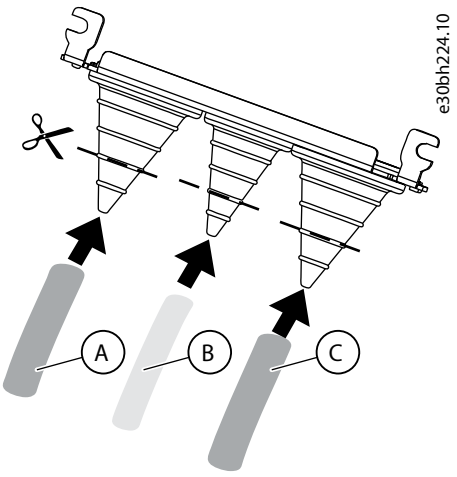


Figure 23: Installing Cables through the Grommets

A	The mains cable	B	The brake cable
C	The motor cable		

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

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

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.

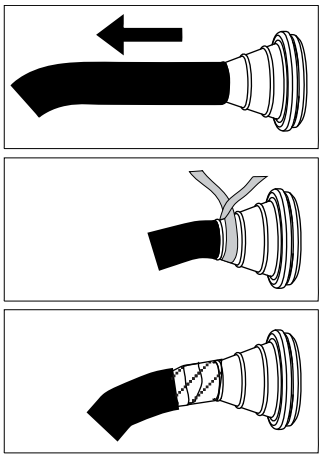


Figure 24: IP54 Cable Entry

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 in-lb.

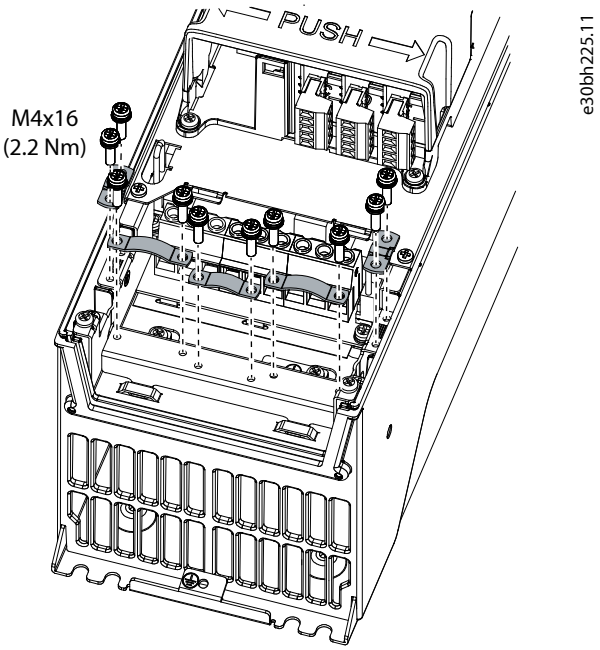


Figure 25: Removing the Grounding Clamps

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

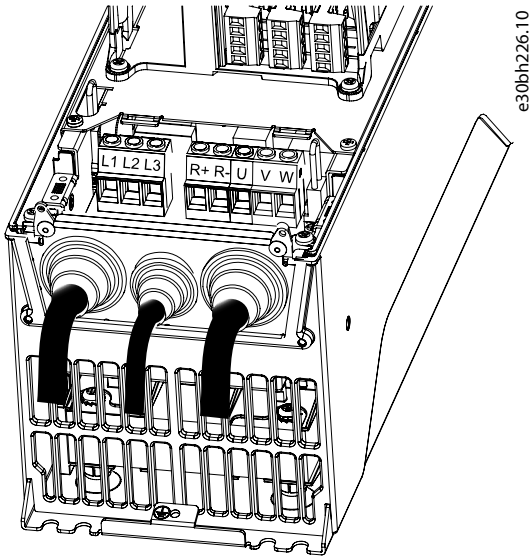


Figure 26: Installing the Cable Entry Plate

8. Connect the cables. See the correct tightening torques in 10.5 Tightening Torques of the Terminals.
   a. To make a 360° connection with the grounding clamps for the cable shield, expose the shield of all the 3 cables.
   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 the grounding conductor.
   d. Make sure that the external grounding conductor is connected to the grounding bar. See 6.3.1 Grounding.

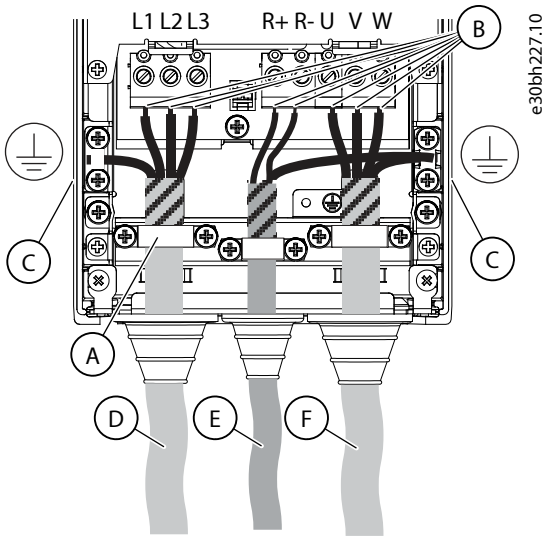


Figure 27: Connecting the Stripped Cables

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

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 6.3.1 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 in-lb.

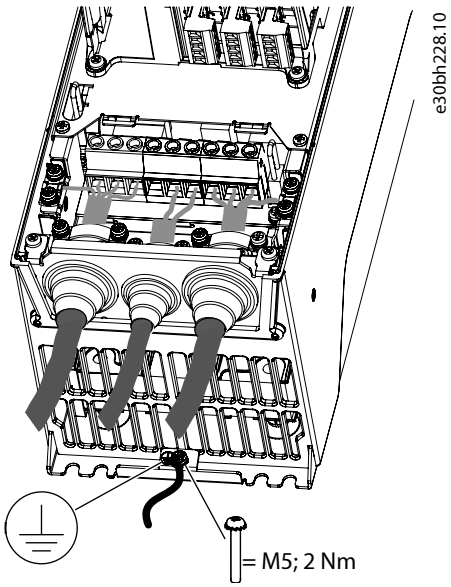


Figure 28: Grounding Terminal under the Drive

10. Attach again the cable cover.

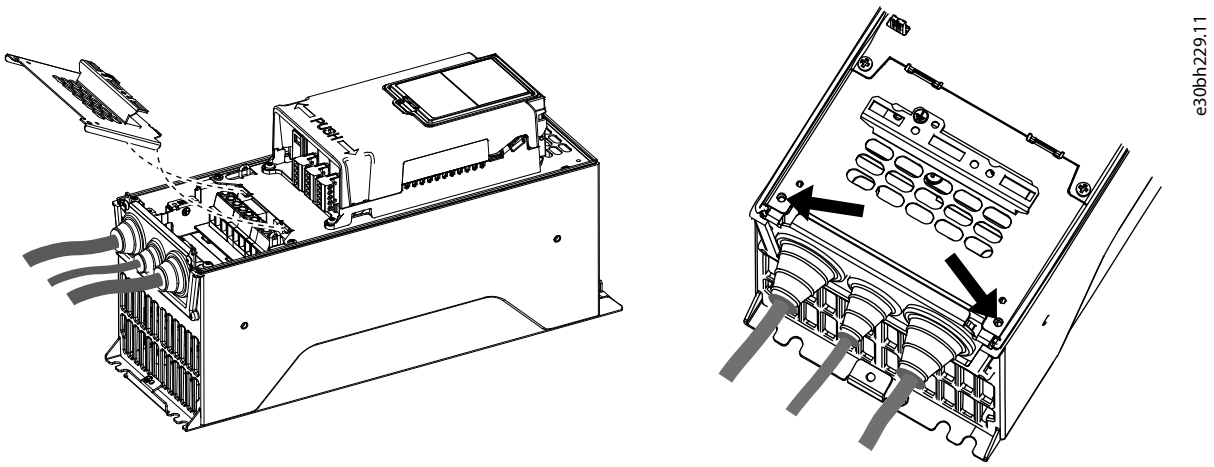


Figure 29: Installing the Cable Cover

11. Close the cover of the drive.

6.5.3 Installing the Cables, MR8–MR9

Prerequisites:

Make sure that the delivery contains all the 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.

To install the cables and cable accessories, follow these instructions. For information on how to comply with the UL regulations in cable installation, see 6.1.3 UL Standards on Cabling.

1. Strip the motor cable, the mains cable, and the brake resistor cable. See 10.4 Cable Stripping Lengths.

The VACON® 100 FLOW software does not have the dynamic brake 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.

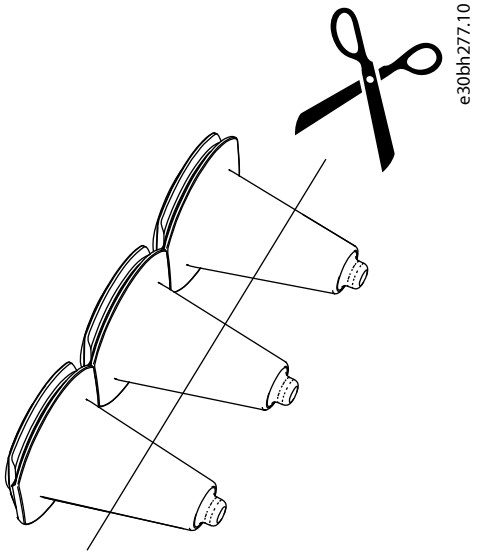


Figure 30: Cutting the Grommets

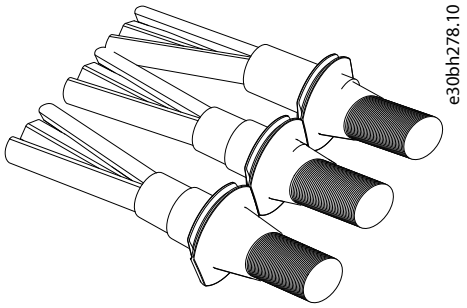


Figure 31: Cables through the Grommets

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.

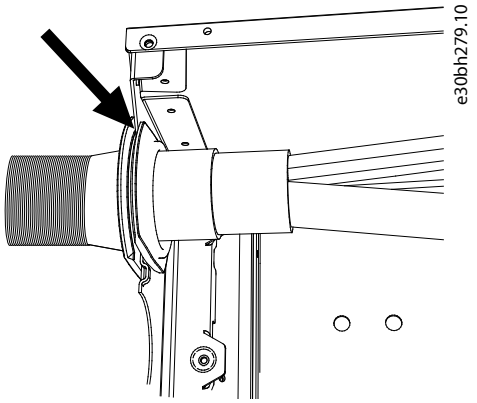


Figure 32: Attaching the Grommet to the Frame

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

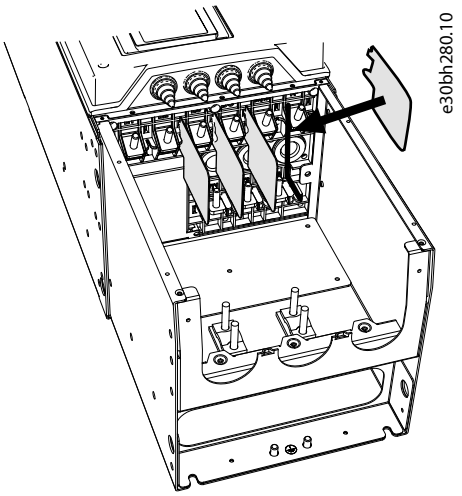


Figure 33: Installing Cable Insulators

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 the grounding conductor.
   c. Make sure that the external grounding conductor is connected to the grounding bar. See 6.3.1 Grounding.

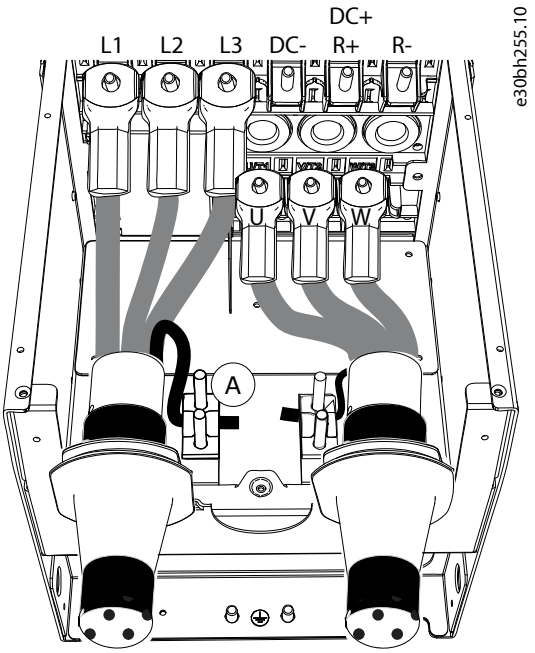


Figure 34: Connecting the Cables, MR8

A	The grounding connection

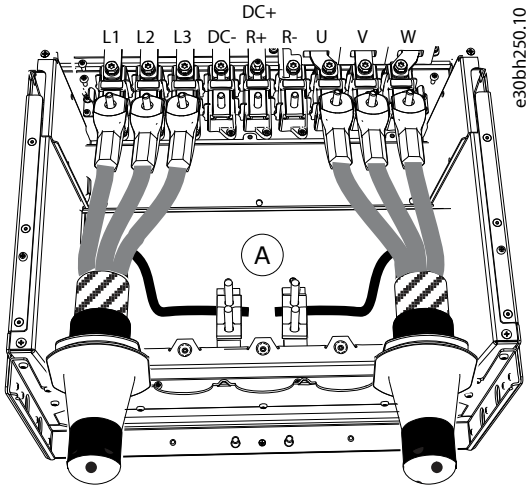


Figure 35: Connecting the Cables, MR9

A	The grounding connection

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

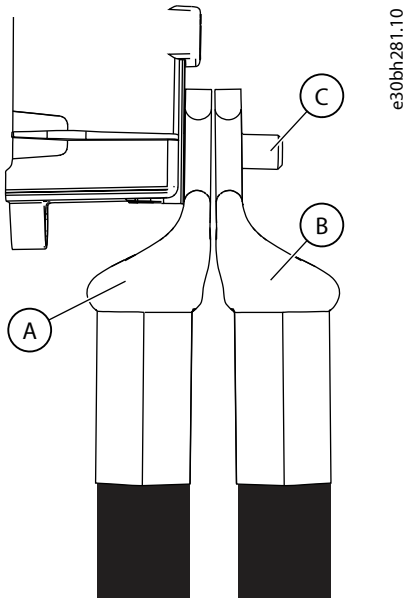


Figure 36: 2 Cables Mounted on 1 Terminal

A	First cable lug	B	Second cable lug
C	Terminal		

7. To make a 360° connection with the grounding clamp for the cable shield, expose the shield of all 3 cables.

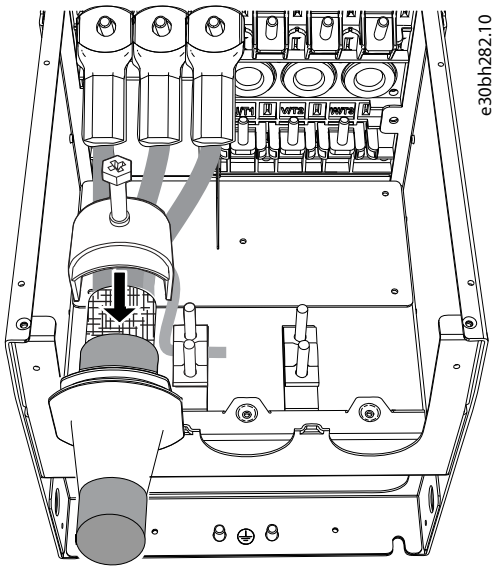


Figure 37: Installing the Grounding Clamp

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 6.3.1 Grounding.
   b. Connect the protective conductor to one of the screw connectors with a cable shoe and an M8 screw.

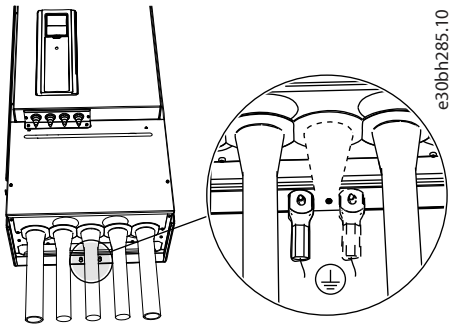


Figure 38: Grounding Connection

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

6.6.1 Requirements for Installation in an IT System

If the 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 change the EMC protection level, 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 drive when it is connected to mains.

NOTICE

DAMAGE TO THE DRIVE FROM INCORRECT EMC LEVEL

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

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

NOTICE

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

6.6.2 Installing the Drive in an IT System, MR4–MR6

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.

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

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

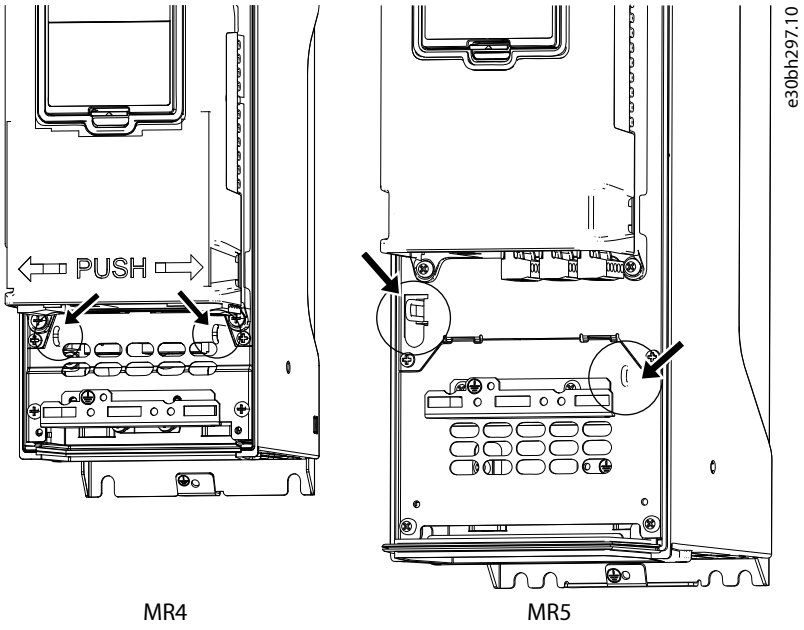


Figure 39: Locations of the EMC Jumpers in MR4 and MR5

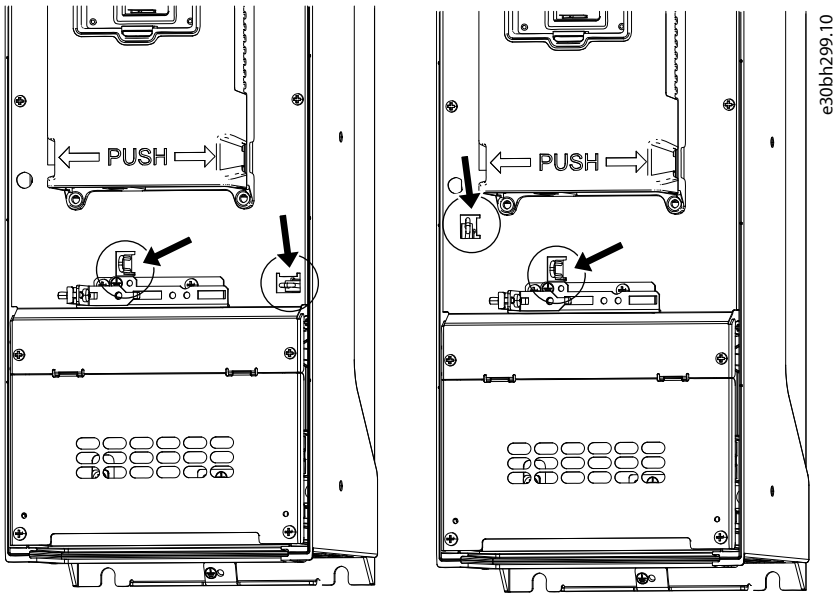


Figure 40: Locations of the EMC Jumpers in MR6 200–500 V and MR6 600/690 V

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

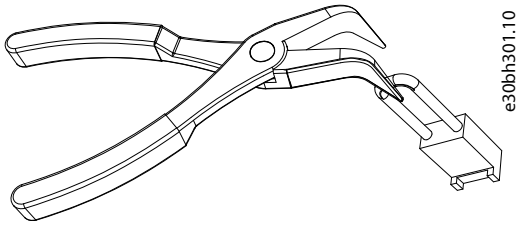


Figure 41: Disconnecting the EMC Jumper

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 product label.

See 4.5 Using the Product Modified Label.

6.6.3 Installing the Drive in an IT System, MR7 200–500 V

Prerequisites:

Open the cover of the drive as instructed in 6.4.1 Get Access and Locate the Terminals for MR4–MR7.

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

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

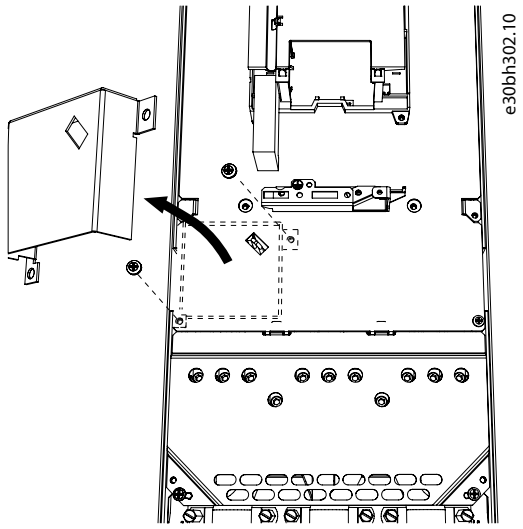


Figure 42: Removing the Cover of the EMX Box

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

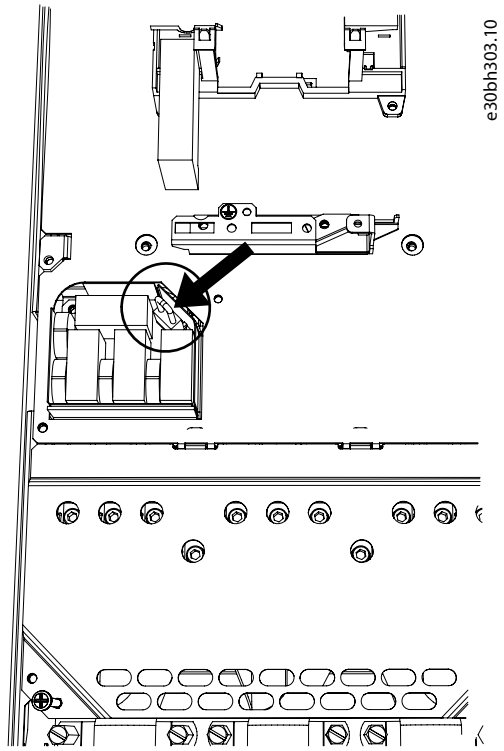


Figure 43: Location of the EMC Jumper

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

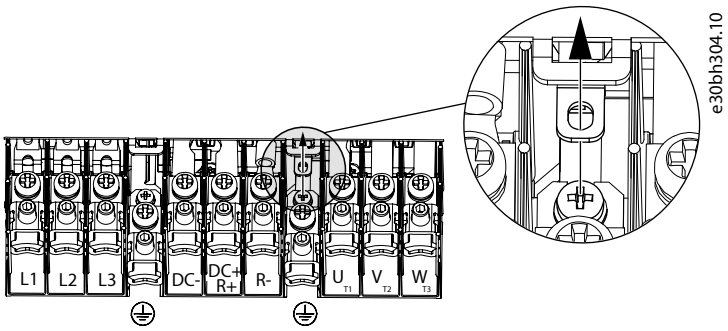


Figure 44: Location of the DC Grounding Busbar

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 product label.

See 4.5 Using the Product Modified Label.

6.6.4 Installing the Drive in an IT System, MR7 600/690 V

Prerequisites:

Open the cover of the drive and remove the cable cover as instructed in 6.4.1 Get Access and Locate the Terminals for MR4–MR7.

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

1. Remove the EMC jumper.

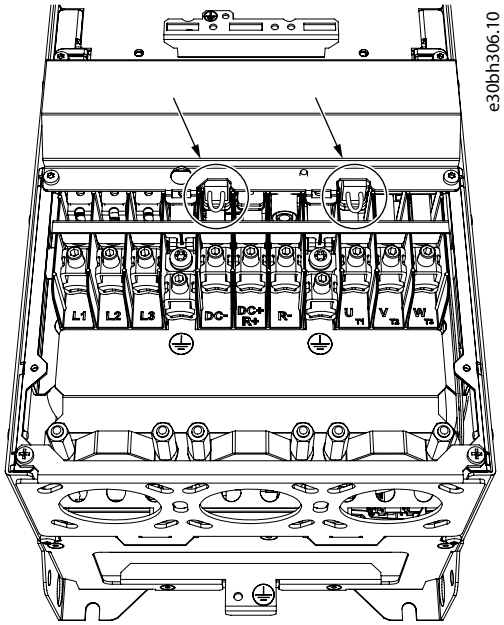


Figure 45: Locations of the EMC Jumpers

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 product label.

See 4.5 Using the Product Modified Label.

6.6.5 Installing the Drive in an IT System, MR8

Prerequisites:

Open the cover of the drive and remove the cable cover as instructed in 6.4.2 Get Access and Locate the Terminals for MR8.

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

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

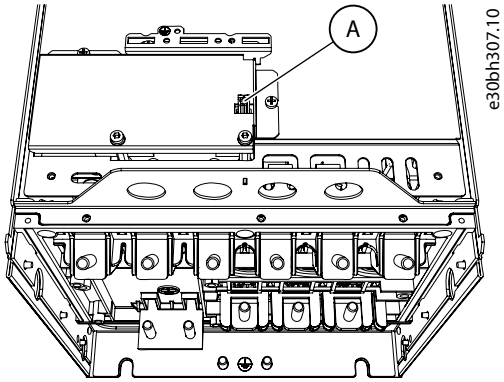


Figure 46: Removing the EMC Box Cover, MR8

A	The EMC jumper

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

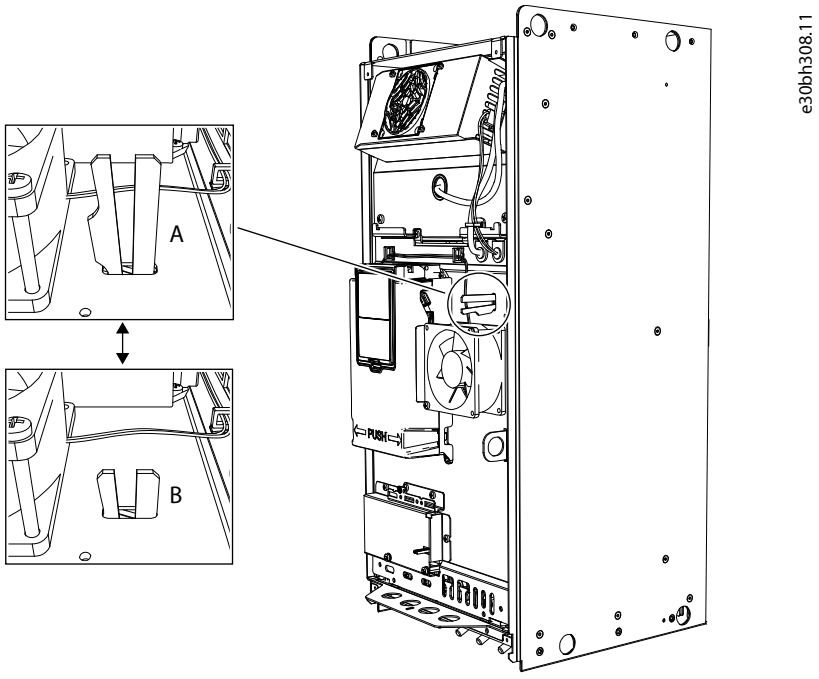


Figure 47: Finding the Grounding Arm, MR8

A	The grounding arm is up	B	The grounding arm is down (level C4)

4. Attach the cable cover.
5. Close the cover of the 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 product label.

See 4.5 Using the Product Modified Label.

6.6.6 Installing the Drive in an IT System, MR9A

Prerequisites:

Open the cover of the AC drive as instructed in 6.4.3 Get Access and Locate the Terminals for MR9.

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

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.

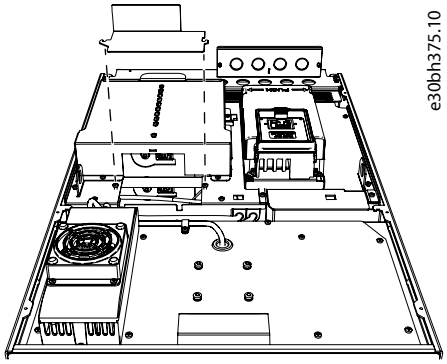


Figure 48: Removing the Cover Plate

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

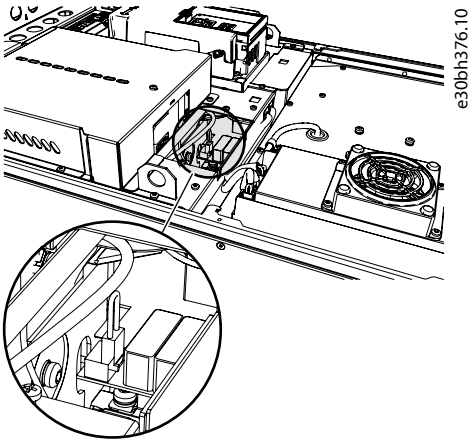


Figure 49: Location of EMC Jumper 1

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

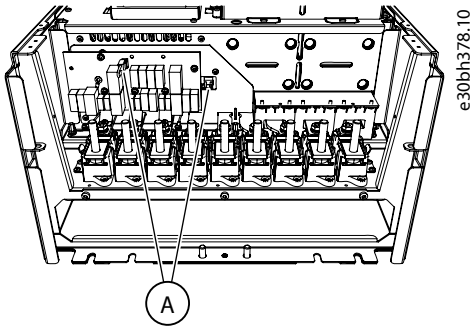


Figure 50: Locations of EMC Jumpers 2 and 3

A	The EMC jumpers

7. Attach the I/O plate with the I/O grommet plate, the touch shield, and the cover of the enclosure extension.
8. Attach the cover plate.
9. In IP54, attach the fan and the cover of the fan.
10. Close the cover of the AC drive.
11. 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 product label.

See 4.5 Using the Product Modified Label.

6.6.7 Installing the Drive in an IT System, MR9B

Prerequisites:

Open the cover of the AC drive as instructed in 6.4.3 Get Access and Locate the Terminals for MR9.

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

1. Remove the EMC jumper.

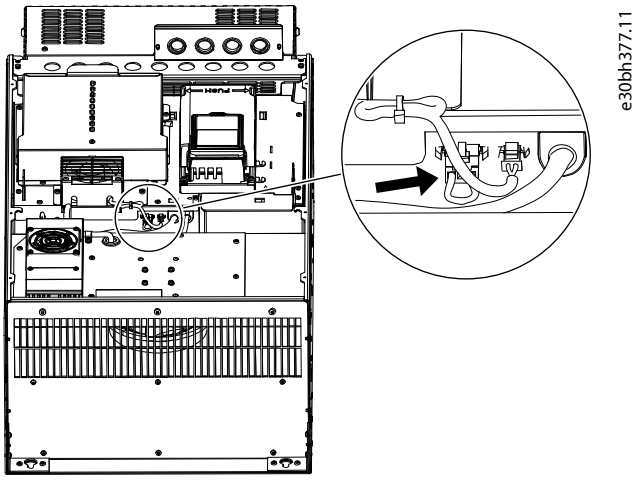


Figure 51: Location of EMC Jumper 1

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

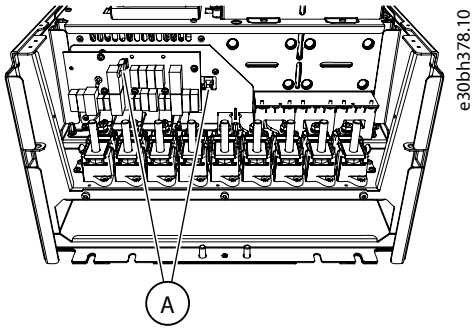


Figure 52: Locations of EMC Jumpers 2 and 3

A	The EMC jumpers

4. Attach the I/O plate with the I/O grommet plate, the touch shield, and the cover of the enclosure extension.
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 product label.

See 4.5 Using the Product Modified Label.

6.7 Installation in a Marine Environment

If the drive is to be installed in a marine environment, see the instructions in the *VACON® 100 Marine Installation Guide*.

7 Control Unit

7.1 Control Unit Components

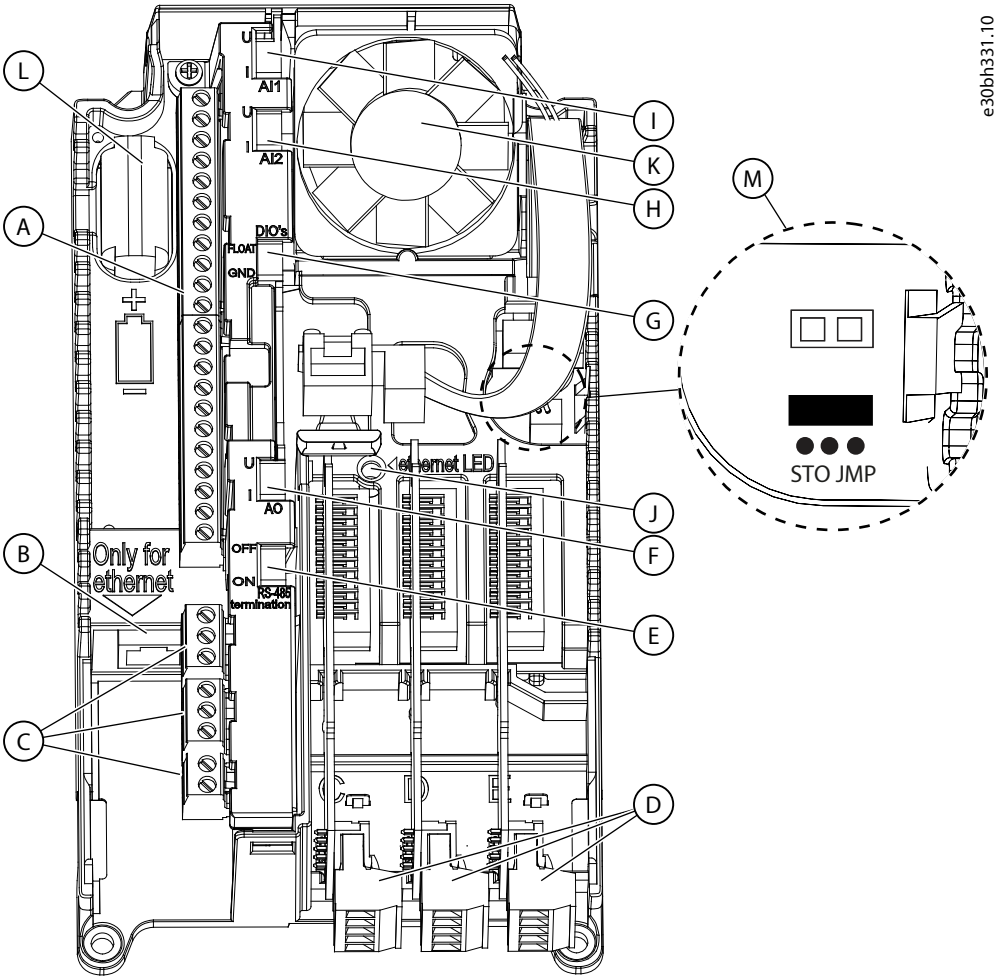


Figure 53: Components of the Control Unit

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 RS-485 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		

On delivery of the drive, the control unit contains the default control interface (graphical control panel). 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 ±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 on the control panel, below the keypad, and it can show five different statuses.

Table 17: Control Unit Indicator Light Status Definitions

Color/status of the indicator light	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 mm^2 (AWG20) multi-core shielded cables. The terminal wires must be a maximum of 2.5 mm^2 (AWG13) for the relay board terminals and other terminals.

Table 18: 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 7.3.1 Selection of Terminal Functions with DIP Switches.

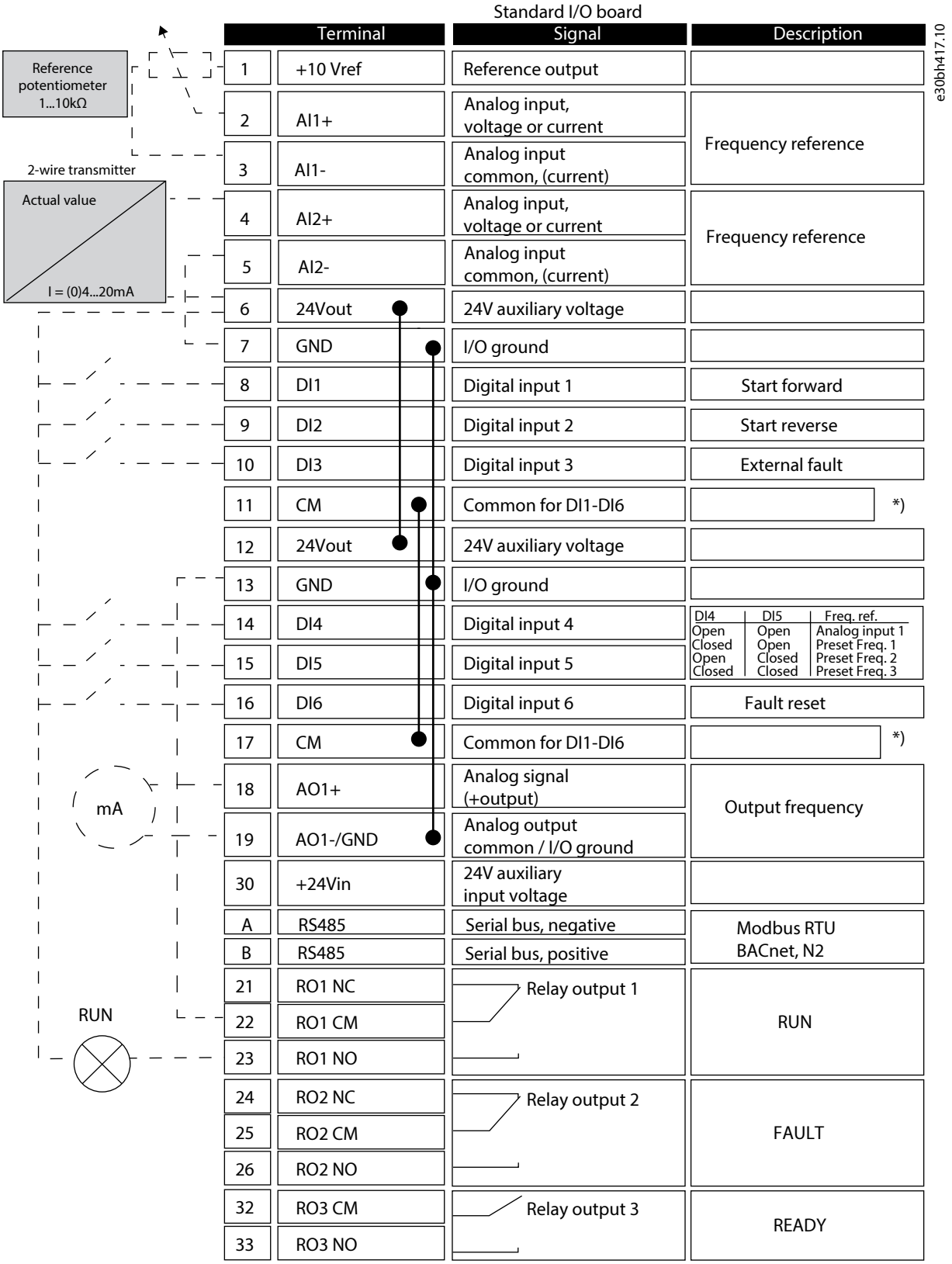


Figure 54: The Signals of the Control Terminals on the Default I/O Board and the Default Control Connections

*) The digital inputs can be isolated 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 the optional code +SBF4 is included in the 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.

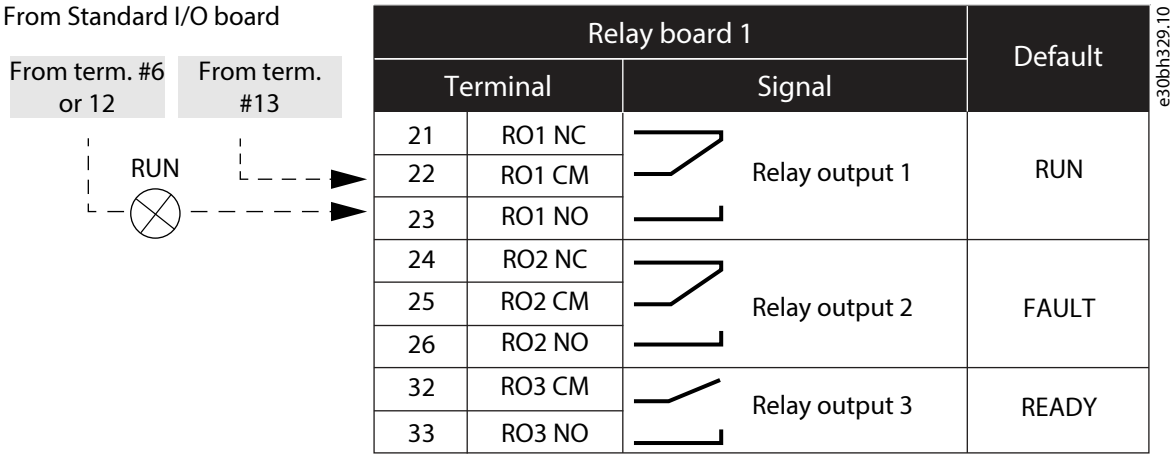


Figure 55: Standard Relay Board (+SBF3)

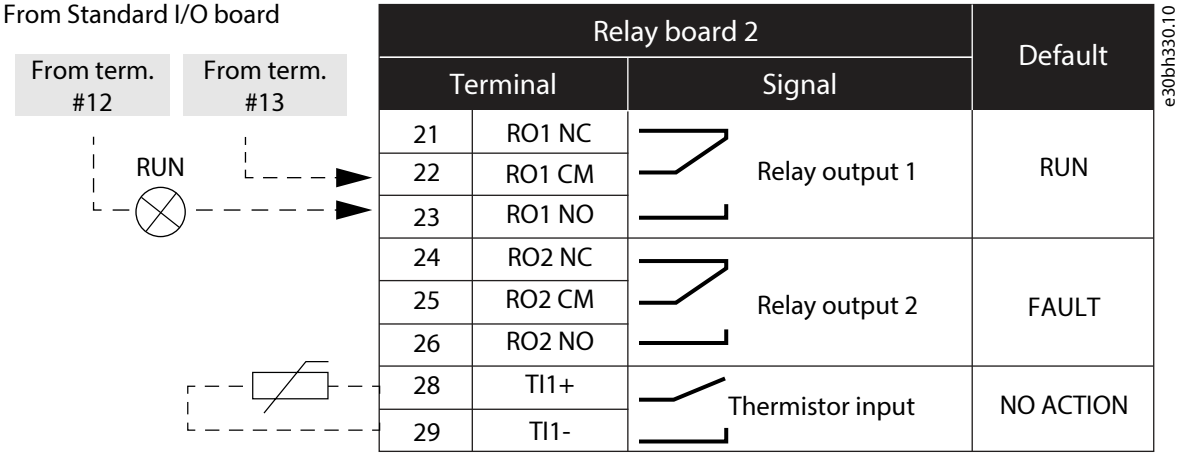


Figure 56: Optional Relay Board (+SBF4)

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 Figure 57.

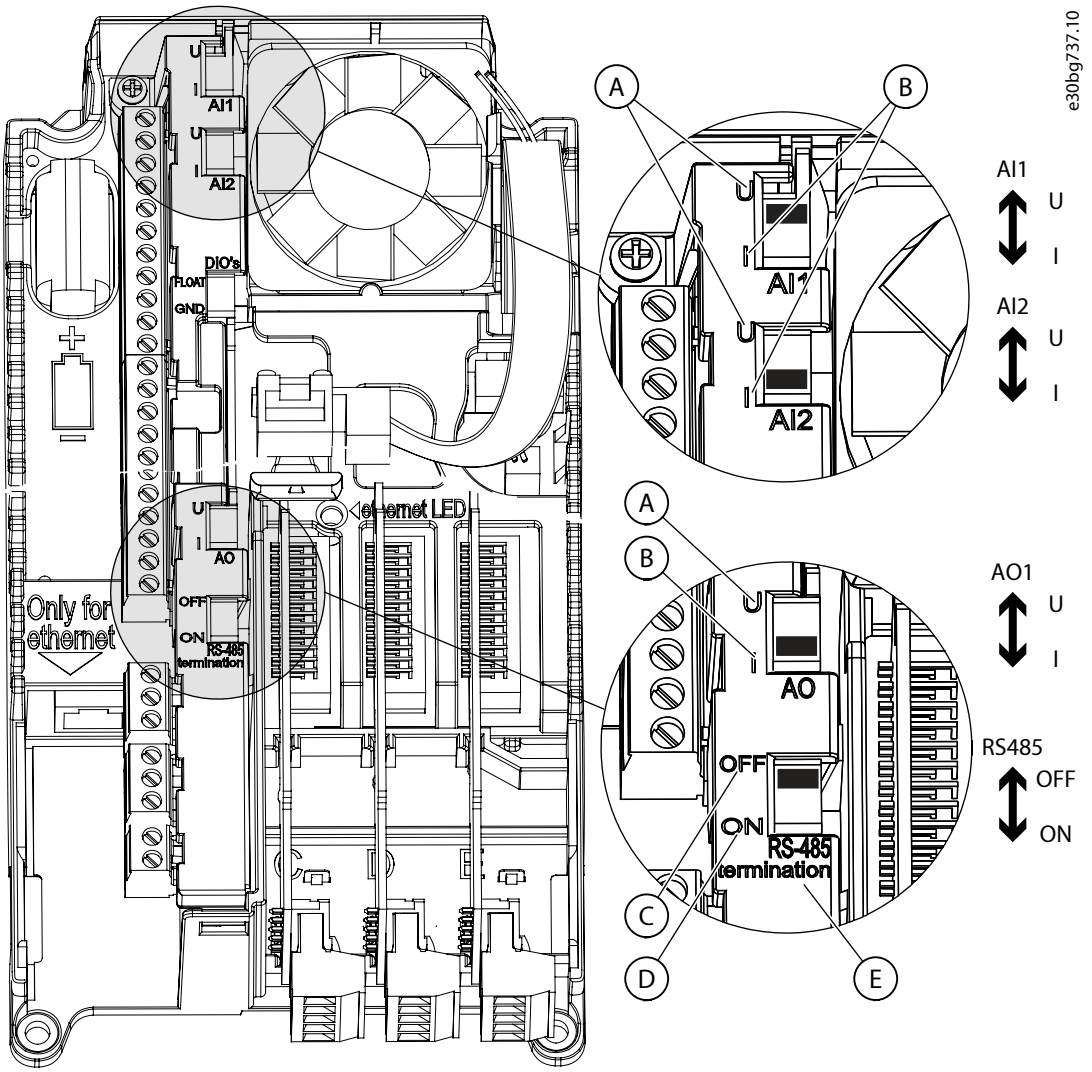


Figure 57: The Selections of the DIP Switches

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		

Table 19: 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.

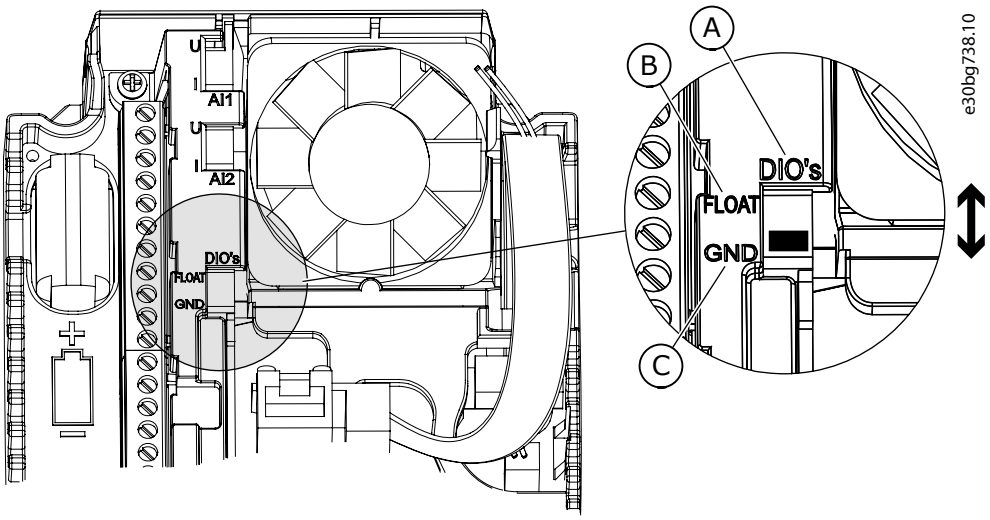


Figure 58: Change the Position of This Switch to Isolate the Digital Inputs from Ground

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

7.4 Fieldbus Connection

7.4.1 Fieldbus Terminals

The drive can be connected to a fieldbus with an RS-485 or an Ethernet cable.

- If an RS-485 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.

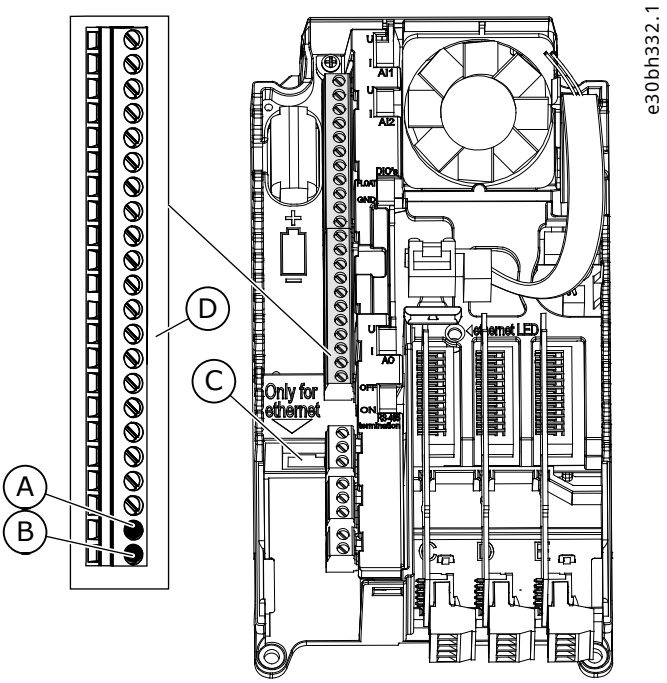


Figure 59: Ethernet and RS-485 Connections

A	RS-485 terminal A = Data -	B	RS-485 terminal B = Data +
C	The Ethernet terminal	D	The control terminals

7.4.2 Internal Fieldbuses in VACON® 100 Products

The VACON® 100 product family supports internally 4 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 indicator lights. Instead it has a single indicator light in the middle of the drive. The indicator light cannot be seen unless the covers are removed. The indicator light works as follows:

- Indicator light is dimmed (dark) when the port is connected to a 10 Mbit/s network.
- Indicator light is yellow when the port is connected to a 100 Mbit/s network.
- Indicator light 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 3 RS-485 fieldbuses:

- Modbus RTU
- BACnet MSTP
- Metasys N2

7.4.3 Fieldbus Cabling

7.4.3.1 General Cabling Instructions for Fieldbus

To keep the response time and the number of incorrect dispatches to a 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.

7.4.3.2 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.

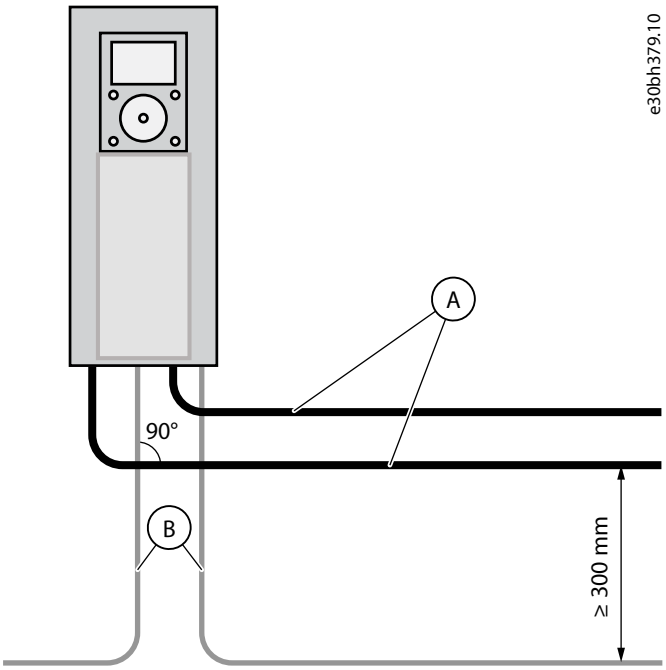


Figure 60: Routing the Motor and Fieldbus Cables

A	Motor cables	B	Fieldbus cables

Use cables with the right length. If there is extra cable, put it in a noise free location. Multiple rounds of cable and a large circumstance area make an antenna (see Figure 61). Noise connects to fieldbus cable and can cause communication problems.

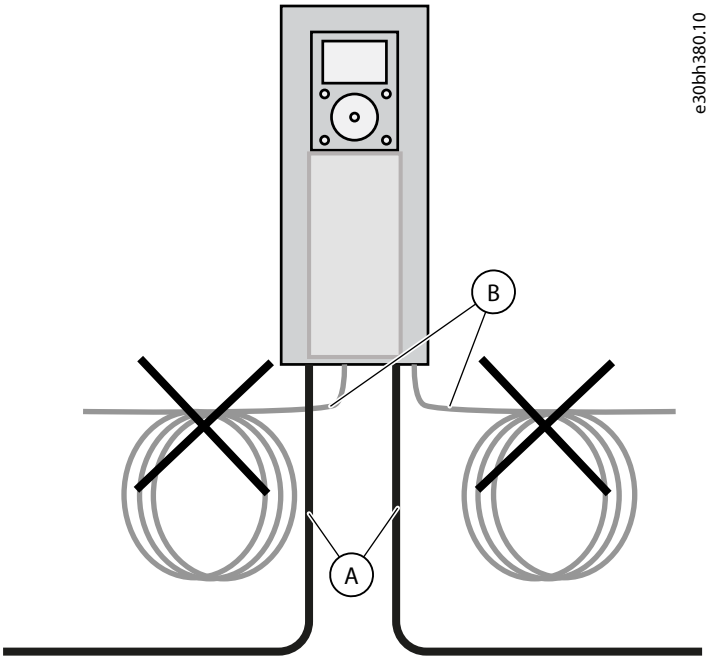


Figure 61: Installation that Makes an Antenna

A	Motor cables	B	Fieldbus cables

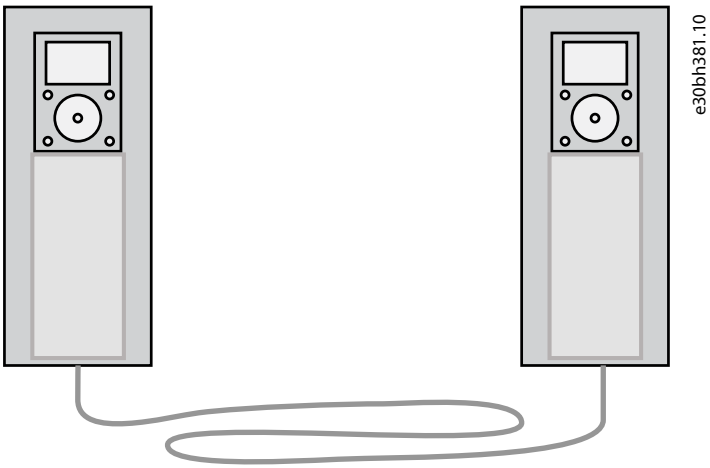


Figure 62: Example of Good Routing of Extra Fieldbus Cable

NOTICE

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

7.4.3.3 Strain Relief

If there is a possibility of tensile load on the cable, install it with a strain relief. If possible, do not make the strain relief of the fieldbus cables at the shield connection to ground. Using the shield connection as strain relief can 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 20: 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. It is possible to get cables that have a certain length, or get cable in bulk and assemble the connectors at commissioning. If the connectors are assembled manually, obey the instructions of the manufacturer. If making 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, it is possible to prevent current from flowing through paths that are not designed to have current. Cables can also be shielded 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 drive. The cable shield can be connected to the ground level at both ends via the built-in RC circuit (see Figure 63). This connection grounds the disturbances and, to some degree, prevents current from flowing in the cable shield. To do this, use a shielded Ethernet cable (S/FTP or STP) which grounds devices via an RJ45 connector and thus uses a built-in drive RC circuit.

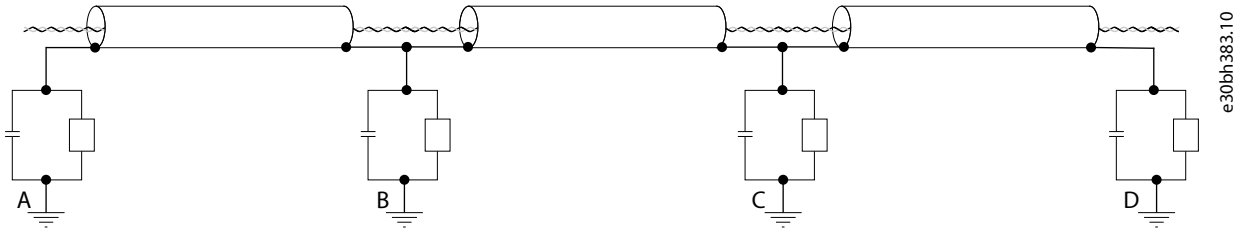


Figure 63: Grounding via the Built-in RC Circuit

When disturbances are strong, the cable shield can be exposed and then 360° grounded (see Figure 66) directly to the AC drive ground (see Figure 64).

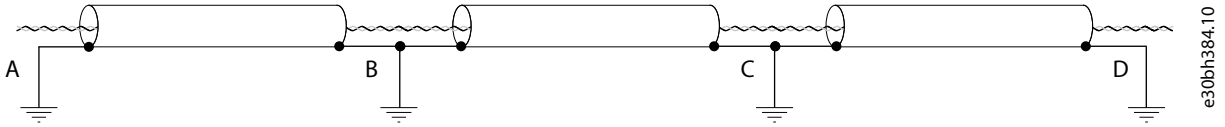


Figure 64: Grounding in a Noisy Environment with Good Equipotential

If potentials at points A, B, C, and D are different and cannot be made similar, cut the cable shields as in Figure 65.

If the ground potentials of the connected devices are different, a cable shield that is connected at both ends causes current to flow in the shield. To prevent the current flow, the cable shield must be disconnected or cut at some point between the devices. Do the grounding at the location nearest to the place where the disturbances meet the cable (see Figure 65).

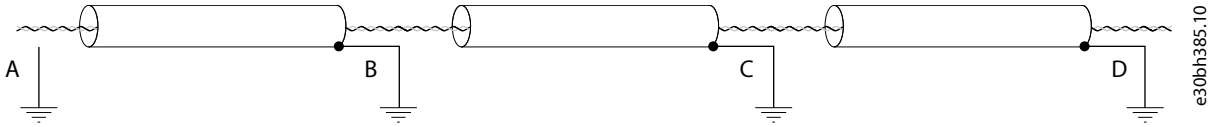


Figure 65: Grounding in Noisy Environment with Poor Equipotential, an Example of Cutting the Cable Shield

Ground the cable shield as in examples A and C (see Figure 66). Do not ground the cable shield as in example B.

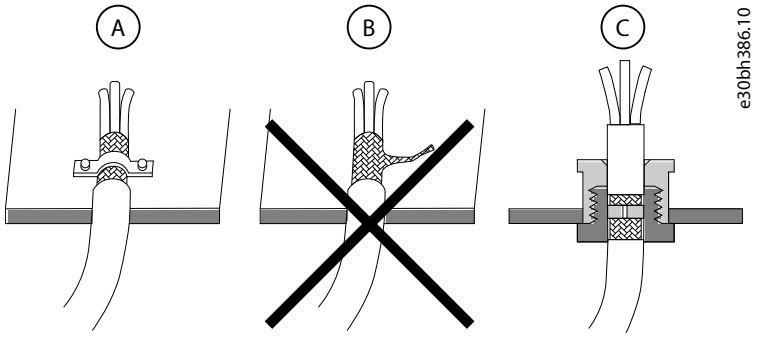


Figure 66: Grounding the Cable Shield

A	Cable clamp	B	Ground terminal
C	Cable gland		

7.4.4.3 Using Fieldbus through an Ethernet Cable

Prerequisites:

Open the covers according to the 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
- 6.4.3 Get Access and Locate the Terminals for MR9

1. Connect the Ethernet cable to its terminal.

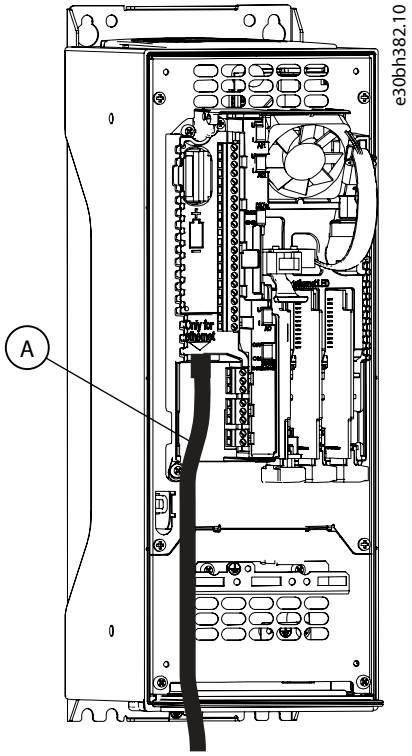


Figure 67: Ethernet Cable Installation Location

A	The Ethernet cable

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

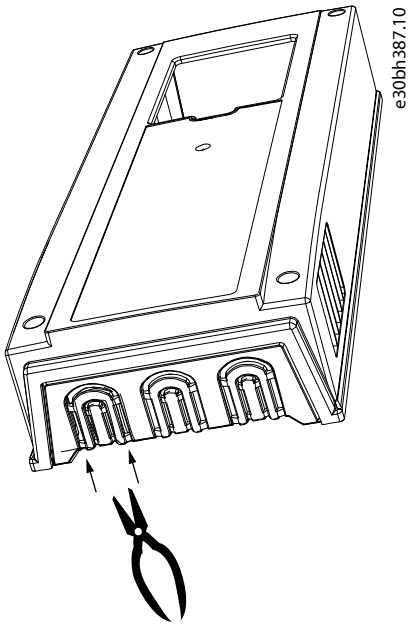


Figure 68: Creating the Opening for the Ethernet Cable

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.

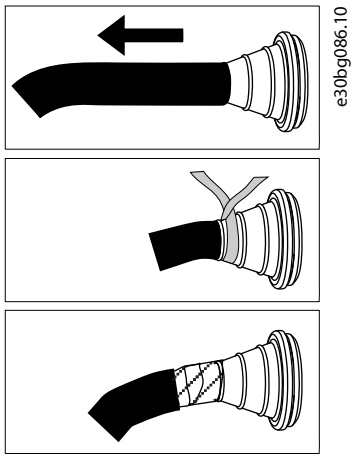


Figure 69: Installing Cables through the Grommets

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

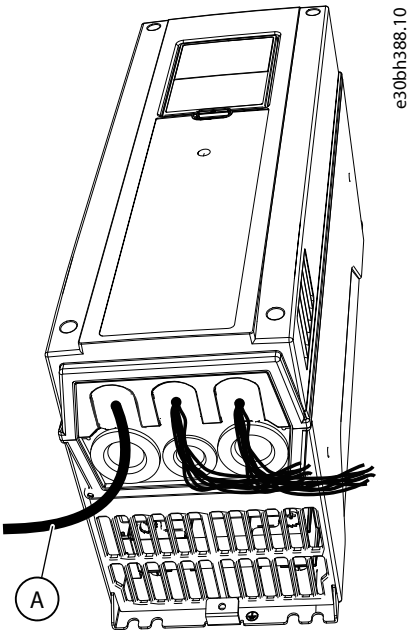


Figure 70: Routing the Ethernet Cables in IP21

A	Ethernet cable

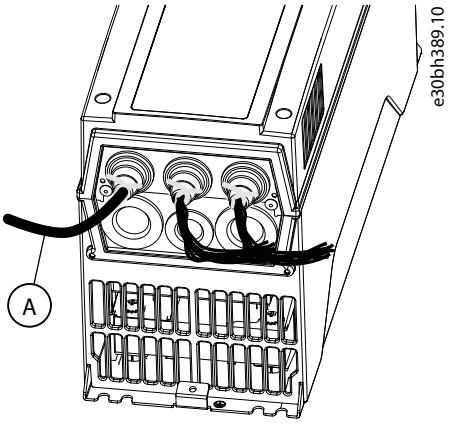


Figure 71: Routing the Ethernet Cables in IP54

A	Ethernet cable

For more information, see the installation guide of the used fieldbus.

7.4.5 RS-485 Commissioning and Cabling

7.4.5.1 General Cabling Instructions for RS-485

Use only shielded cables with twisted-pair signal wires.

For example, the following cables are recommended:

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

The plug type to be used is 2.5 mm^2 (AWG13).

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

Table 21: The RS-485 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, it is possible to prevent current from flowing through paths that are not designed to have current. Cables can also be shielded 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 RS-485 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 Figure 72 and Figure 74).

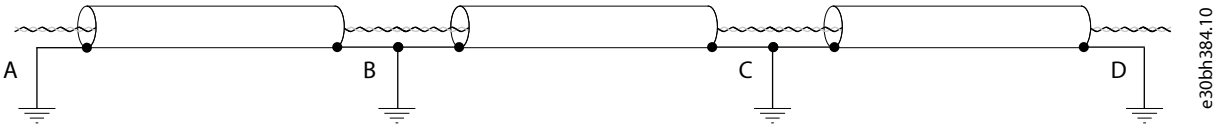


Figure 72: Grounding in Noisy Environment with Good Equipotential

If potentials at points A, B, C, and D are different and cannot be made similar, cut the shields as in Figure 73.

If the ground potentials of the connected devices are different, a cable shield that is connected at both ends causes current to flow in the shield. To avoid the current flow, the cable shield must be disconnected or cut at some point between the devices (see Figure 73).

When disturbances are strong, the cable shield can be exposed and then 360° grounded directly to the AC drive ground (see Figure 74). When the connection is made like in Figure 73, grounding must be done at a location nearest to the place where the disturbances meet the cable.

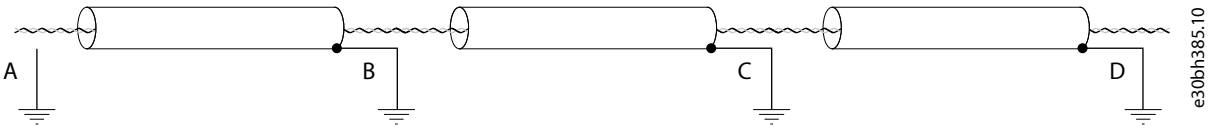


Figure 73: Grounding in Noisy Environment with Poor Equipotential, an Example of Cutting the Cable Shield

Ground the cable shield as in examples A and C (see Figure 74). Do not ground the cable shield as in example B.

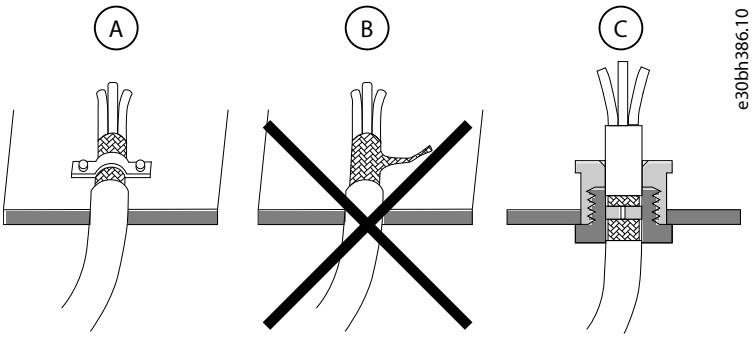


Figure 74: Grounding the Cable Shield

A	Cable clamp	B	Ground terminal
C	Cable gland		

7.4.5.3 RS-485 Bus Biasing

When no device on the RS-485 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. The indefinite state can cause problems in character reception because the RS-485 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 RS-485 bus line have a built-in bus biasing function, a separate active termination resistor specially designed for the RS-485 bus must be added (for example, Siemens active RS-485 terminating element 6ES7972-0DA00-0AA0).

7.4.5.4 Using Fieldbus through an RS-485 Cable

Prerequisites:

Open the covers according to the 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
- 6.4.3 Get Access and Locate the Terminals for MR9

1. Remove approximately 15 mm (0.59 in) of the gray shield of the RS-485 cable. Do this for the 2 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.

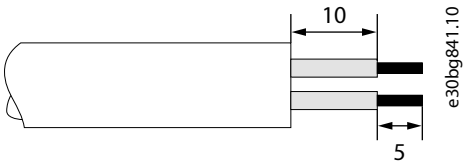


Figure 75: Stripping the Ends of the Cables

   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.

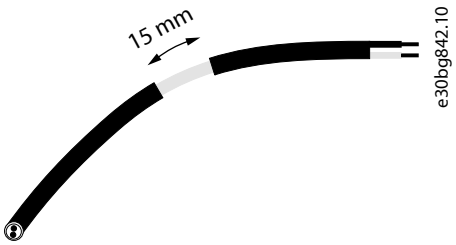


Figure 76: Stripping the Cable for Grounding

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

   - A = negative
   - B = positive

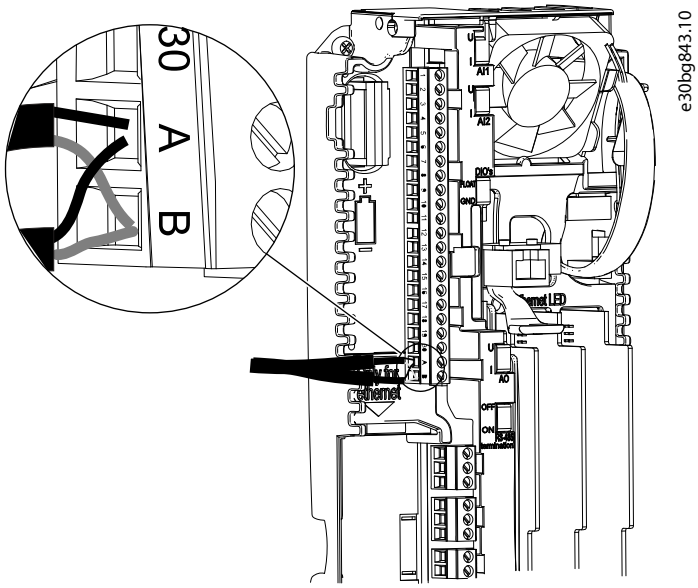


Figure 77: Terminals A and B on the I/O Board

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.

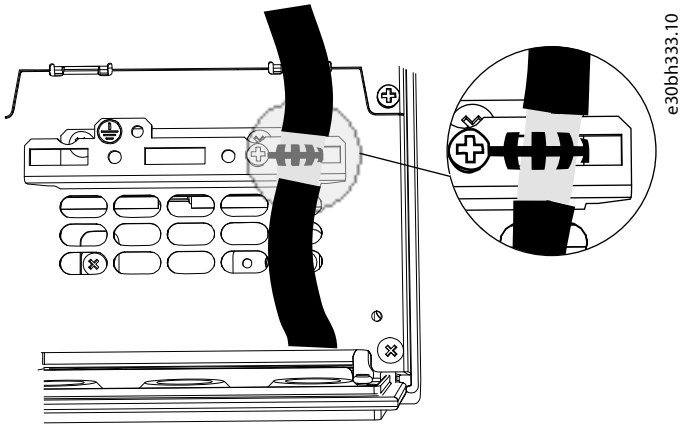


Figure 78: Grounding the Cable with a Grounding Clamp

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.

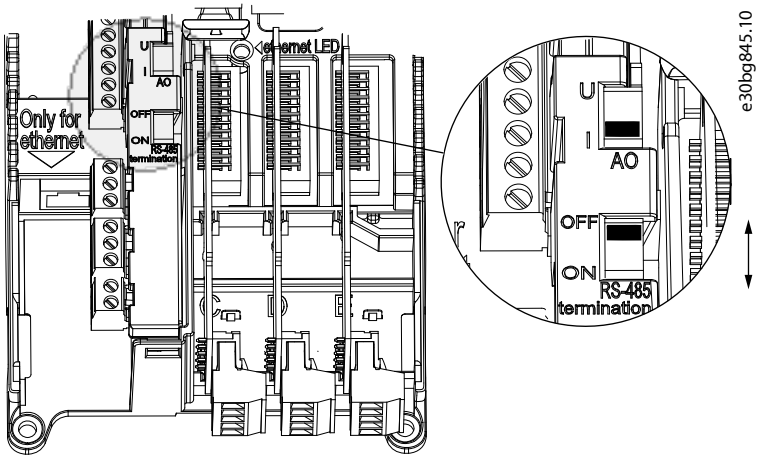


Figure 79: Location of the DIP Switches

b. Set the DIP switch of the RS-485 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.

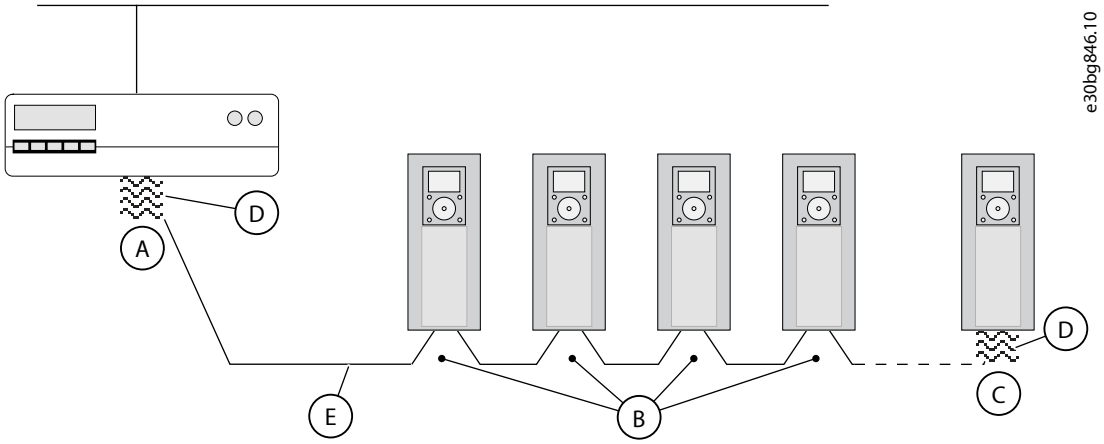


Figure 80: Setting the Bus Termination for a Fieldbus Line

A	The termination is activated	B	The termination is deactivated
C	The termination is activated with a DIP switch	D	The bus termination. The resistance is 220 Ω.
E	The fieldbus		

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.

5. In IP21, unless openings were already made for other cables, cut an opening on the cover of the drive for the RS-485 cable.

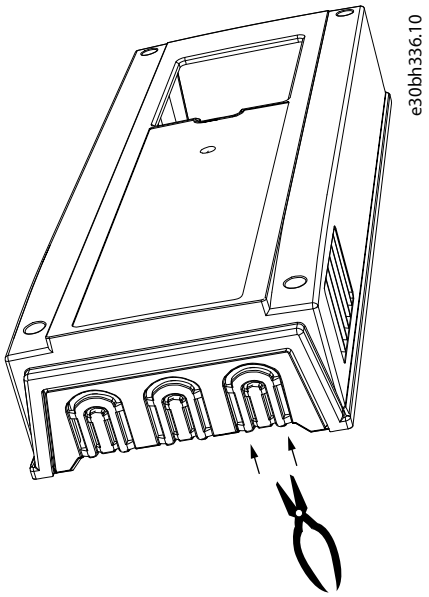


Figure 81: Making the Opening for the Cables

6. Put the cover of the drive back. Pull the RS-485 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.

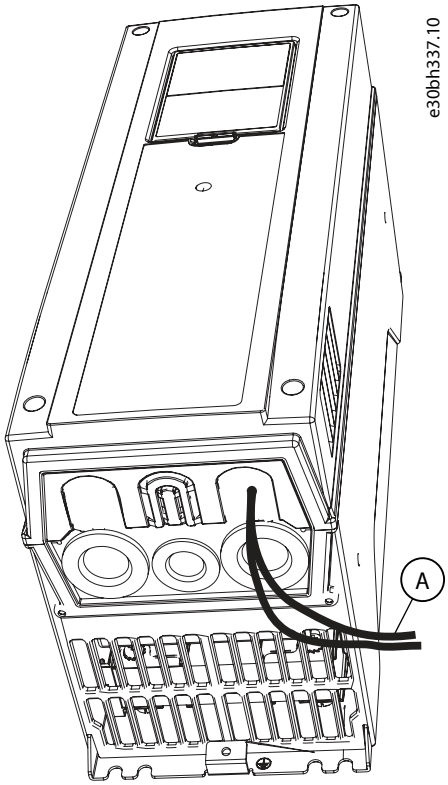


Figure 82: Routing the Fieldbus Cables

A	The fieldbus cables

7.5 Available Option Boards

Table 22: Option Boards and their Correct Option 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 RS-485 (Modbus/N2) fieldbus board	D, E
OPTE3	The PROFIBUS DP-V1 fieldbus board	D, E
OPTE5	The PROFIBUS DP-V1 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 RS-485 (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.

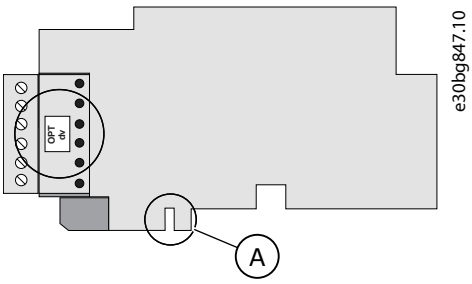


Figure 83: Label on the Option Board

A	The slot coding

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

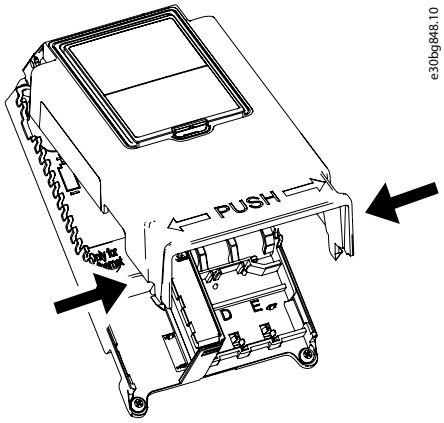


Figure 84: Opening the Cover of the Control Unit

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.

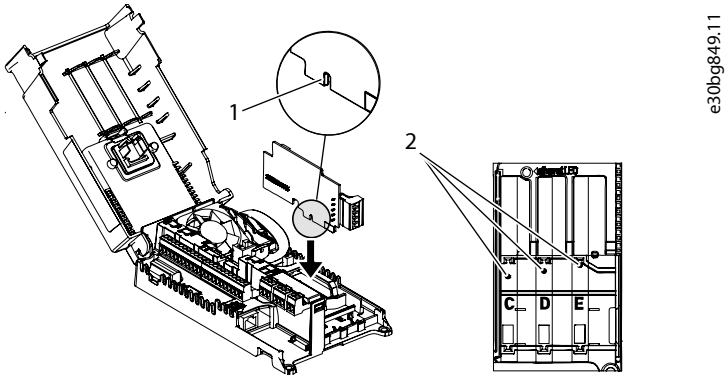


Figure 85: Installing the Option Boards

1	The slot coding	2	The option slots

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.

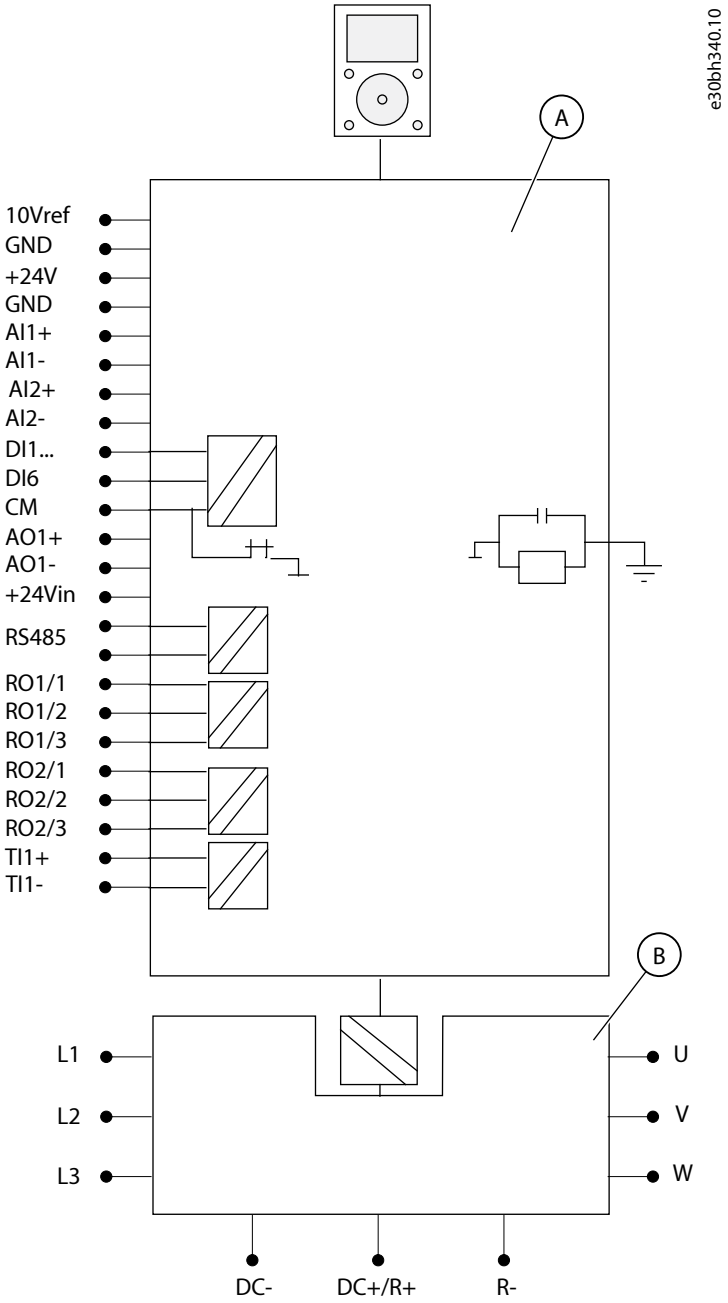


Figure 86: Galvanic isolation barriers

A	The control unit	B	The power unit

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, it is possible to control the speed of a motor and monitor the status of the AC drive. It is also possible to set the parameters of the AC drive.

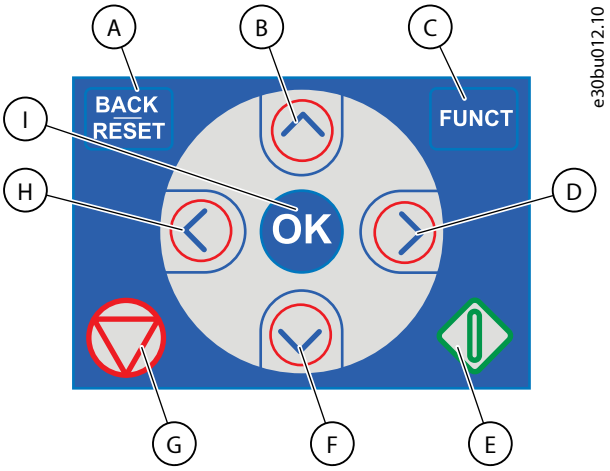


Figure 87: Buttons of the VACON® 100 Keypad

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 up the menu 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.		

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.

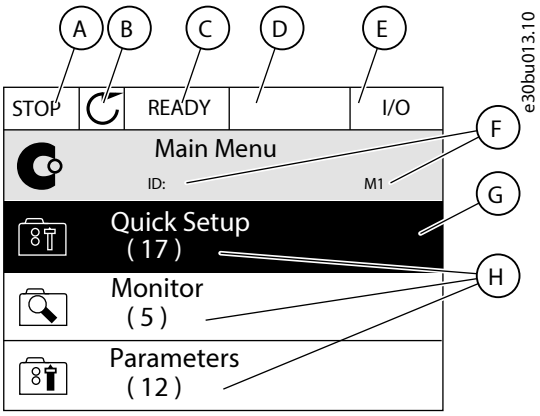


Figure 88: Graphical Display of the Control Panel

A	The first status field: *STOP/RUN*	B	The rotation direction of the motor
C	The second status field: *READY/NOT READY/FAULT*	D	The alarm field: *ALARM/-*
E	The control place field: *PC/I/O/KEYPAD/ FIELDBUS*	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

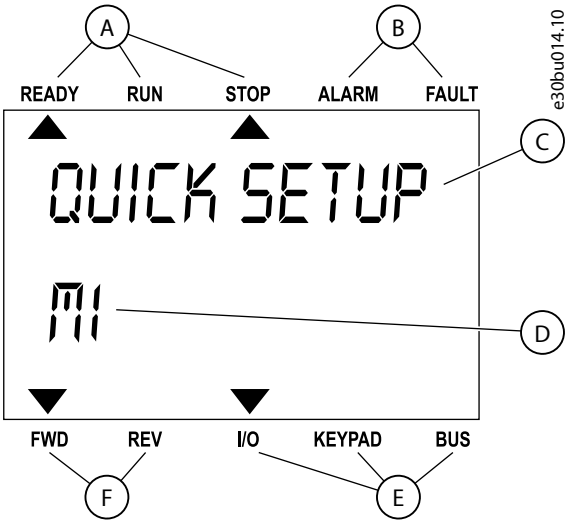


Figure 89: Text Display of the Control Panel

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 control place

See more information in the VACON® 100 INDUSTRIAL and VACON® 100 FLOW 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 components of the power unit 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.

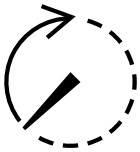
DANGER

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 several minutes after the drive is disconnected from the mains and the motor has stopped. The load side of the drive can also generate voltage. Contact with voltage can lead to death or serious injury.

- Do not touch the main circuit of the drive or the motor before the system is powered off and grounded.
- Disconnect the drive from the mains and ensure that the motor has stopped.
- Disconnect the motor.
- Lock out and tag out the power source to the drive.
- Ensure that no external source generates unintended voltage during work.
- Ground the drive for work.
- Wait for the capacitors to discharge fully before opening the door or the cover of the drive. Refer to the label on the drive for the correct discharge time. If the device is broken or fuses have blown, the discharge time is longer.
- Use a suitable measuring device to make sure that there is no voltage in the drive.

  Before and after the measurement, verify the correct operation of the voltage tester on a known voltage source.

  Confirm that there is no voltage between the power terminals (input, output, and DC) and ground (PE).

  Confirm that there is no voltage between the DC terminals (DC+ and DC-).

⚠ WARNING

SHOCK HAZARD FROM CONTROL TERMINALS

The control terminals can have a dangerous voltage also when the drive is disconnected from DC supply. 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 Drive

Prerequisites:

Read the safety instructions in 2.2 Safety Precautions and 8.1 Safety Checks before Starting the Commissioning and obey them.

Follow these instructions to commission the drive.

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 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:
   - 6.1.1 Overview of Cable Connections
   - 6.1.4 Cable Selection and Dimensioning and related tables
   - 6.2.1 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:
    - 5.4.1 General Cooling Requirements
    - 5.4.2 Cooling
    - 5.4.3 Necessary Quantity of Cooling Air
12. Make sure that there is no condensation on the surfaces of the 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 Insulation Measurements

8.3.1 Measuring the Cable and Motor Insulation

Do these checks if necessary. The drive is already measured at the factory.

- The insulation checks of the motor cable, see 8.3.2 Measuring the Insulation Resistance of the Motor Cable
- The insulation checks of the mains cable, see 8.3.3 Measuring the Insulation Resistance of the Mains Cable
- The insulation checks of the motor, see 8.3.4 Measuring the Insulation Resistance of the Motor

8.3.2 Measuring the Insulation Resistance of the Motor Cable

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

The drive is already measured at the factory.

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 MΩ at the ambient temperature of 20 °C (68 °F).

8.3.3 Measuring the Insulation Resistance of the Mains Cable

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

The drive is already measured at the factory.

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 MΩ at the ambient temperature of 20 °C (68 °F).

8.3.4 Measuring the Insulation Resistance of the Motor

Use these instructions to check the insulation of the motor.

The drive is already measured at the factory.

NOTICE

Obey the instructions of the motor manufacturer.

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 MΩ at the ambient temperature of 20 °C (68 °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 Drive after Commissioning

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 Preventive Maintenance Recommendations

Generally, all technical equipment, including Danfoss drives, need a minimum level of preventive maintenance. To ensure trouble-free operation and long life of the drive, regular maintenance is recommended. It is also recommended as a good service practice to record a maintenance log with counter values, date, and time describing the maintenance and service actions.

Danfoss recommends the following inspections and service intervals for air-cooled drives/systems.

NOTICE

The service schedule for part replacements can vary depending on operating conditions. Under specific conditions, the combination of stressful operation and environmental conditions work together to reduce the lifetime of the components significantly. These conditions can include, for example, extreme temperature, dust, high humidity, hours of use, corrosive environment, and loading.

For operation in stressful conditions, Danfoss offers the DrivePro® Preventive Maintenance service. DrivePro® services extend the lifetime and increase the performance of the product with scheduled maintenance including customized part replacements. DrivePro® services are tailored to the specific application and operating conditions.

Table 23: Maintenance Schedule for Air-cooled Drives

Component	Inspection interval[1]	Service schedule[2]	Preventive maintenance actions
Installation			
Visual inspection	1 year	–	Check for the unusual, for example, for signs of overheating, aging, corrosion, and for dusty and damaged components.
Auxiliary equipment	1 year	According to manufacturer recommendations	Inspect equipment, switchgear, relays, disconnects, or fuses/circuit breakers. Examine the operation and condition for possible causes of operational faults or defects. The continuity check on fuses must be performed by trained service personnel.
EMC consideration	1 year	–	Inspect the wiring regarding the electromagnetic capability and the separation distance between control wiring and power cables.
Cable routing	1 year	–	Check for parallel routing of motor cables, mains wiring, and signal wiring. Avoid parallel routing. Avoid routing cables through free air without support. Check for aging and wearing of the cable insulation.
Control wiring	1 year	–	Check for tightness, damaged or crimped wires, or ribbon wires. Terminate the connections correctly with solid crimped ends. The use of shielded cables and grounded EMC plate, or a twisted pair is recommended.
Clearances	1 year	–	Check that the external clearances for proper airflow for cooling follow the requirements for the frame and product type. For clearances, refer to the local design regulations.
Sealing	1 year	–	Check that the sealing of the enclosure, the covers, and the cabinet doors are in good condition.
Corrosive environments	1 year	–	Conductive dust and aggressive gases, such as sulphide, chloride, and salt mist, can damage the electrical and mechanical components. Air filters do not remove airborne corrosive chemicals. Act based on the findings.
Drive			

Table 23: Maintenance Schedule for Air-cooled Drives - (continued)

Component	Inspection interval[1]	Service schedule[2]	Preventive maintenance actions
Programming	1 year	–	Check that the drive parameter settings are correct according to the motor, drive application, and I/O configuration. Only trained service personnel are allowed to perform this action.
Control panel	1 year	–	Check that the display pixels are intact. Check the event log for warnings and faults. Repetitive events are a sign of potential issues. If necessary, contact a local service center.
Drive cooling capacity	1 year	–	Check for blockages or constrictions in the air passages of the cooling channel. The heat sinks must be free of dust and condensation.
Capacitors, DC link	1 year	8–15+ years	The expected lifetime of the capacitors depends on the loading profile of the application and the ambient temperature. For applications with heavy loads in demanding environments or high ripple currents, replace electrolytic capacitors every 8 years and plastic foil capacitors every 12 years. If within the specifications of the drive type, replace every 10–15+ years. Only trained service personnel are allowed to perform this action.
Cleaning and filters	1 year	–	Clean the interior of the enclosure annually, and more frequently if necessary. The amount of dust in the filter or inside the enclosure is an indicator for when the next cleaning or filter replacement is required.
Fans	1 year	3–10 years	Inspect the condition and operational status of all cooling fans. With the power off, the fan axis should feel tight, and spinning the fan with a finger, the rotation should be almost silent and not have abnormal rotation resistance. When in RUN mode, fan vibration, excessive or strange noise is a sign of the bearings wearing, and the fan must be replaced.
Grounding	1 year	–	The drive system requires a dedicated ground wire connecting the drive, the output filter, and the motor to the building ground. Check that the ground connections are tight and free of paint or oxidation. Daisy-chain connections are not allowed. If applicable, braided straps are recommended.
PCB	1 year	10–12 years	Visually inspect the printed circuit boards for signs of damage or degrading due to aging, corrosive environments, dust, or environments with high temperatures. Only trained service personnel are allowed to perform the inspection and service action.
Power cables and wiring	1 year	–	Check for loose connections, aging, insulation condition, and proper torque to the drive connections. Check for proper rating of fuses and continuity check. Observe if there are any signs of operation in a demanding environment. For example, discoloration of the fuse housing can be a sign of condensation or high temperatures.
Vibration	1 year	–	Check for abnormal vibration or noise coming from the drive to ensure that the environment is stable for electronic components.
Insulator gaskets	1 year	10–15 years	Inspect the insulators for signs of degradation due to high temperature and aging. Replacement is based on findings or done at the same time as DC capacitor replacement. Only trained service personnel are allowed to perform this action.
Batteries	1 year	7–10 years	Replace the batteries according to the manufacturer recommendation. Replace the real-time clock battery in the control unit every 7–10 years.
Spare parts			

Table 23: Maintenance Schedule for Air-cooled Drives - (continued)

Component	Inspection interval[1]	Service schedule[2]	Preventive maintenance actions
Spare parts	1 year	2 years	Stock spares in their original boxes in a dry and clean environment. Avoid hot storage areas. Electrolytic capacitors require reforming as stated in the service schedule. The reforming must be performed by trained service personnel.
Exchange units and units stored for long periods before commissioning	1 year	2 years	Visually inspect for signs of damage, water, high humidity, corrosion, and dust within the visual field of view without disassembly. The exchange units with mounted electrolytic capacitors require reforming as stated in the service schedule. The reforming must be performed by trained service personnel.

1) Defined as the time after the commissioning/startup or the time from the previous inspection.

2) Defined as the time after the commissioning/startup or the time from the previous service schedule actions.

10 Specifications

10.1 Weight of the Drive

Table 24: 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

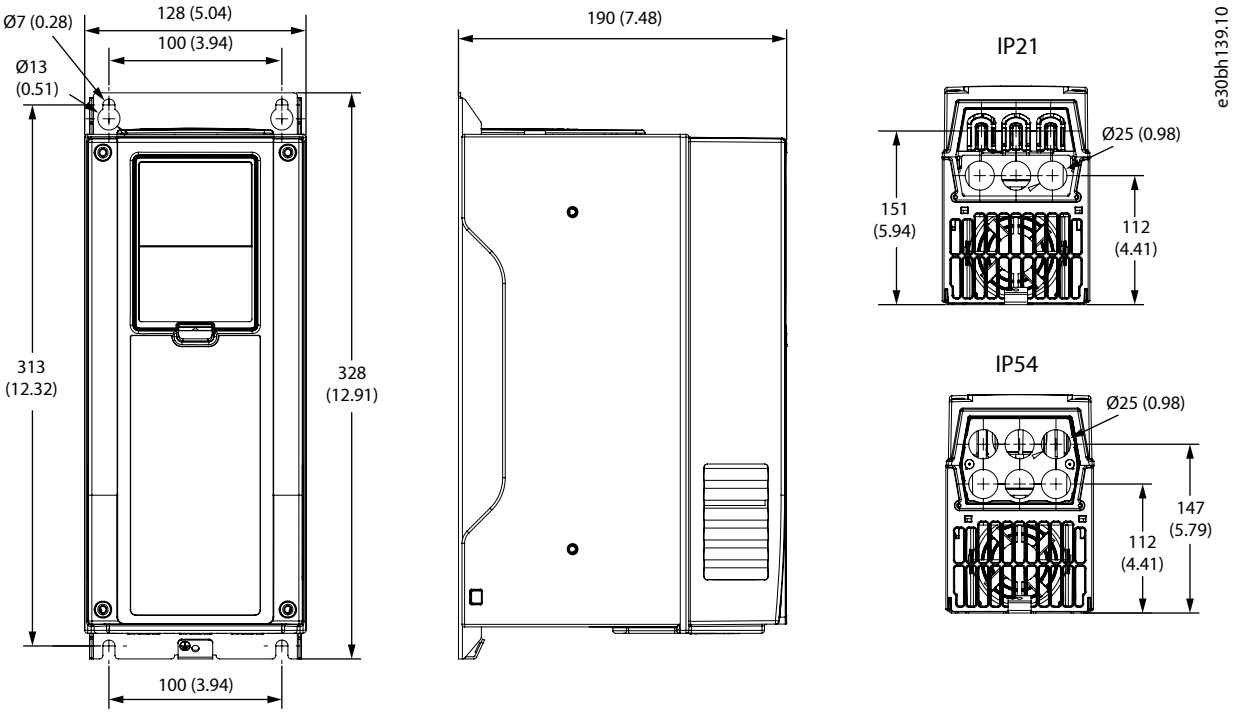


Figure 90: Dimensions of the Drive, MR4, mm (in)

10.2.1.2 Dimensions for Wall Mounting for MR5

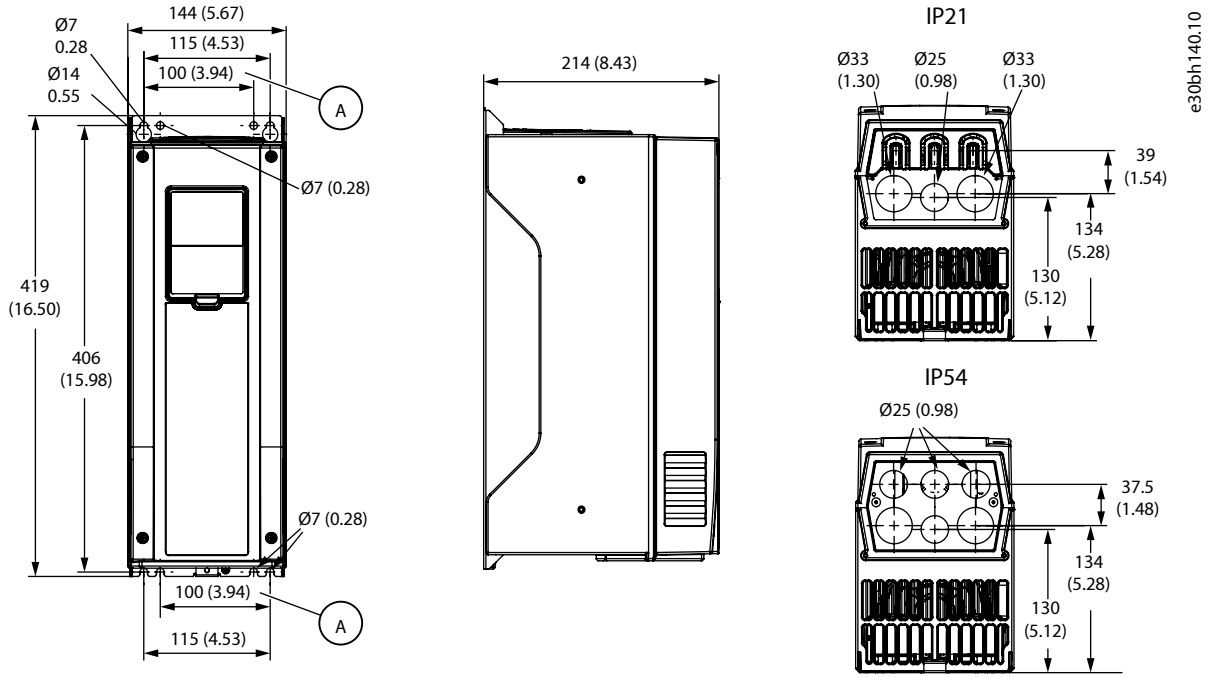


Figure 91: Dimensions of the Drive, MR5, mm (in)

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

10.2.1.3 Dimensions for Wall Mounting for MR6

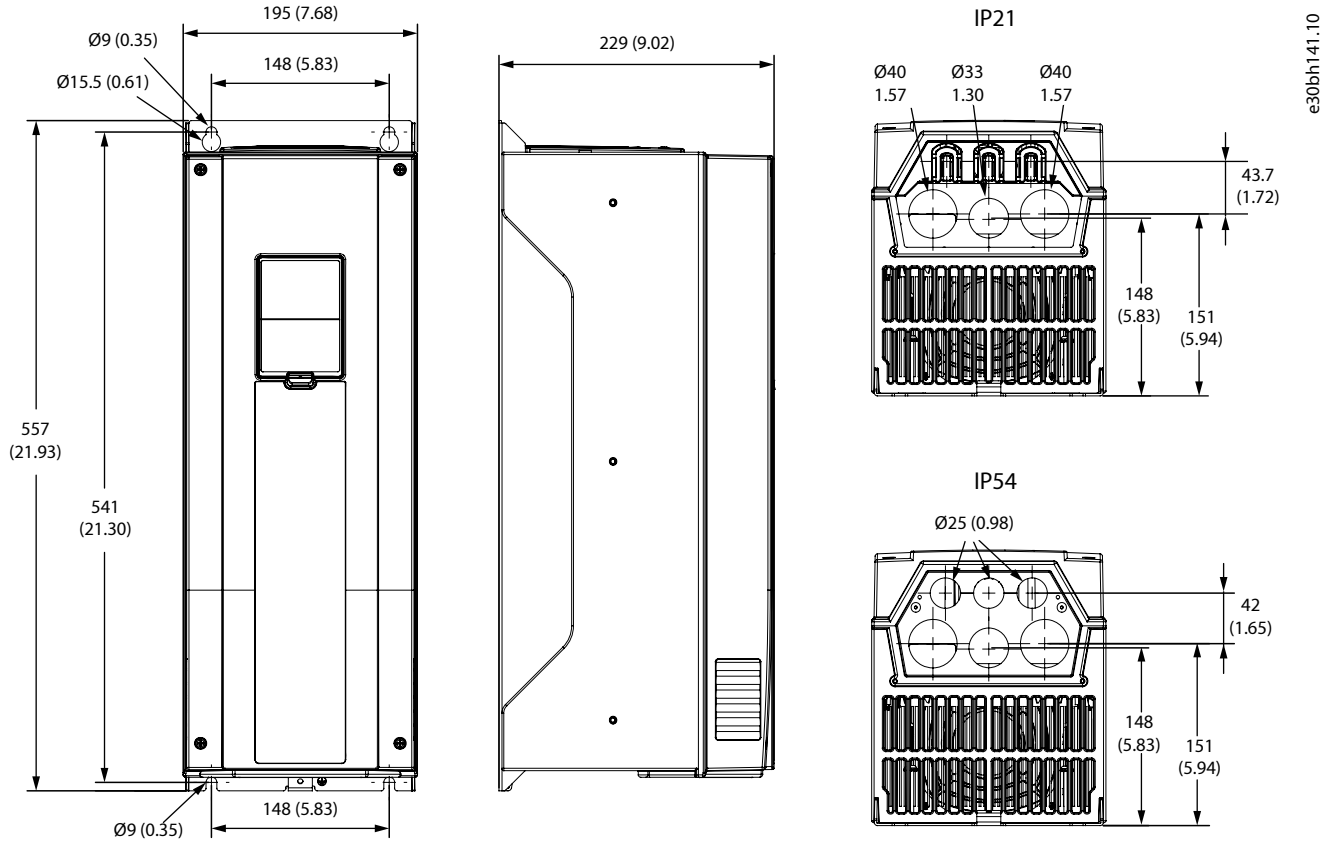


Figure 92: Dimensions of the Drive, MR6, mm (in)

10.2.1.4 Dimensions for Wall Mounting for MR7

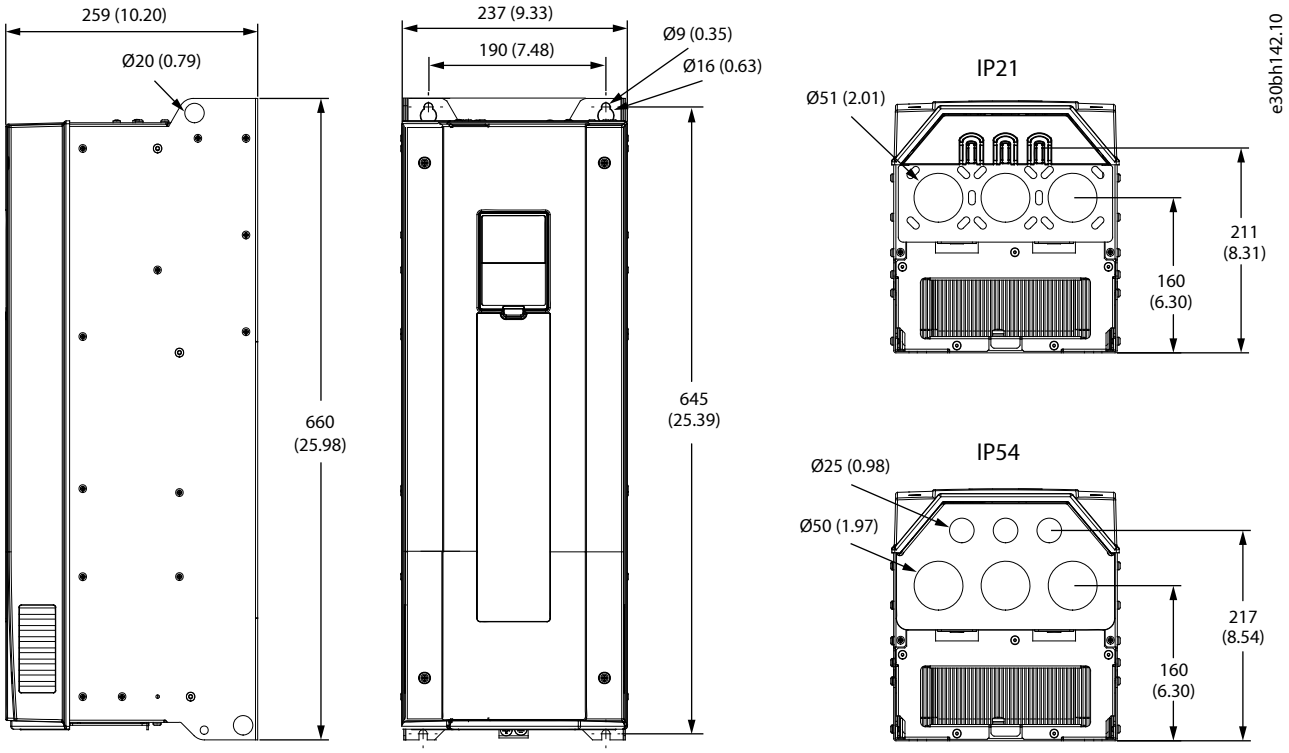


Figure 93: Dimensions of the Drive, MR7, mm (in)

10.2.1.5 Dimensions for Wall Mounting for MR8

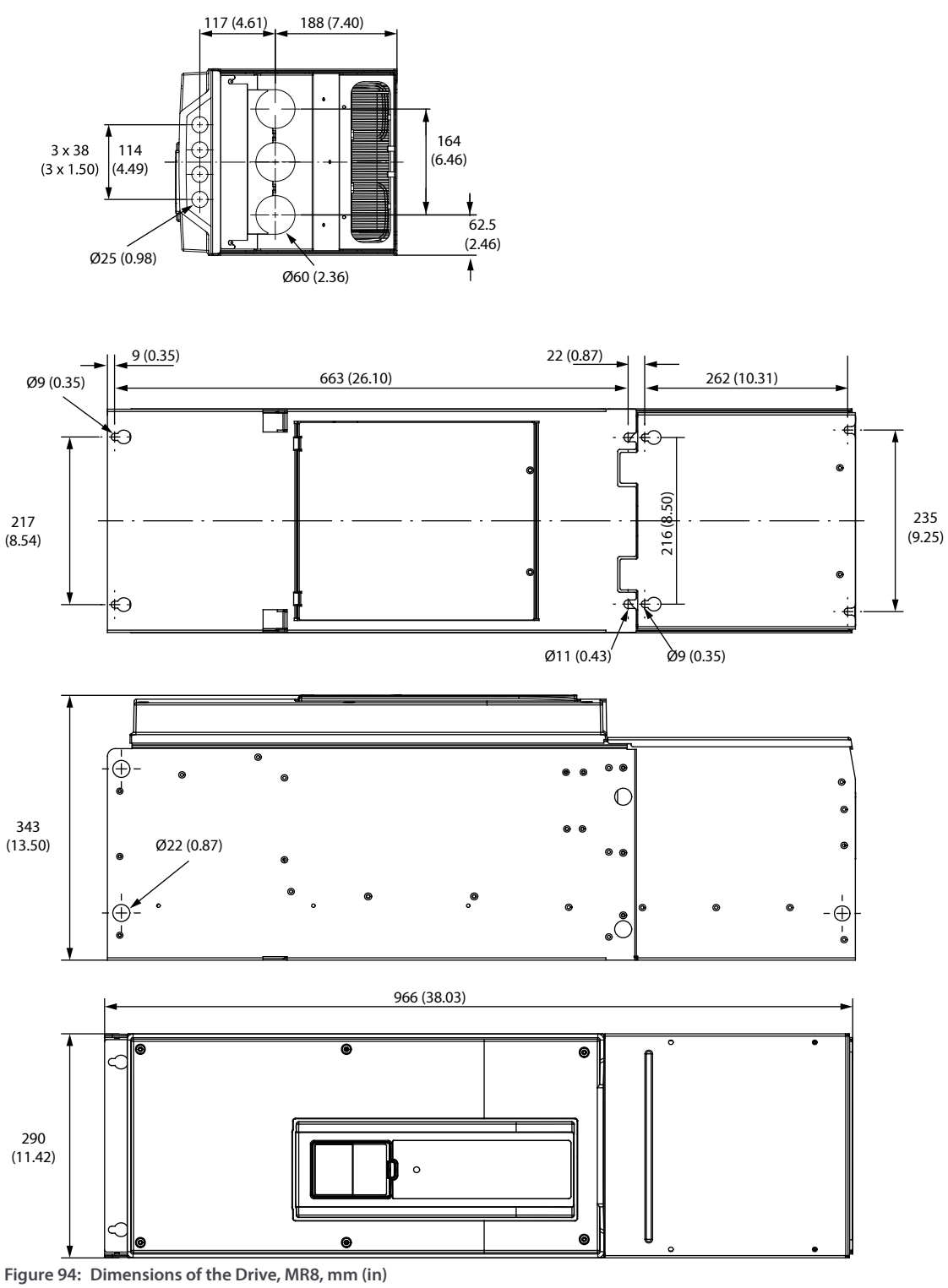


Figure 94: Dimensions of the Drive, MR8, mm (in)

10.2.1.6 Dimensions for Wall Mounting for MR9

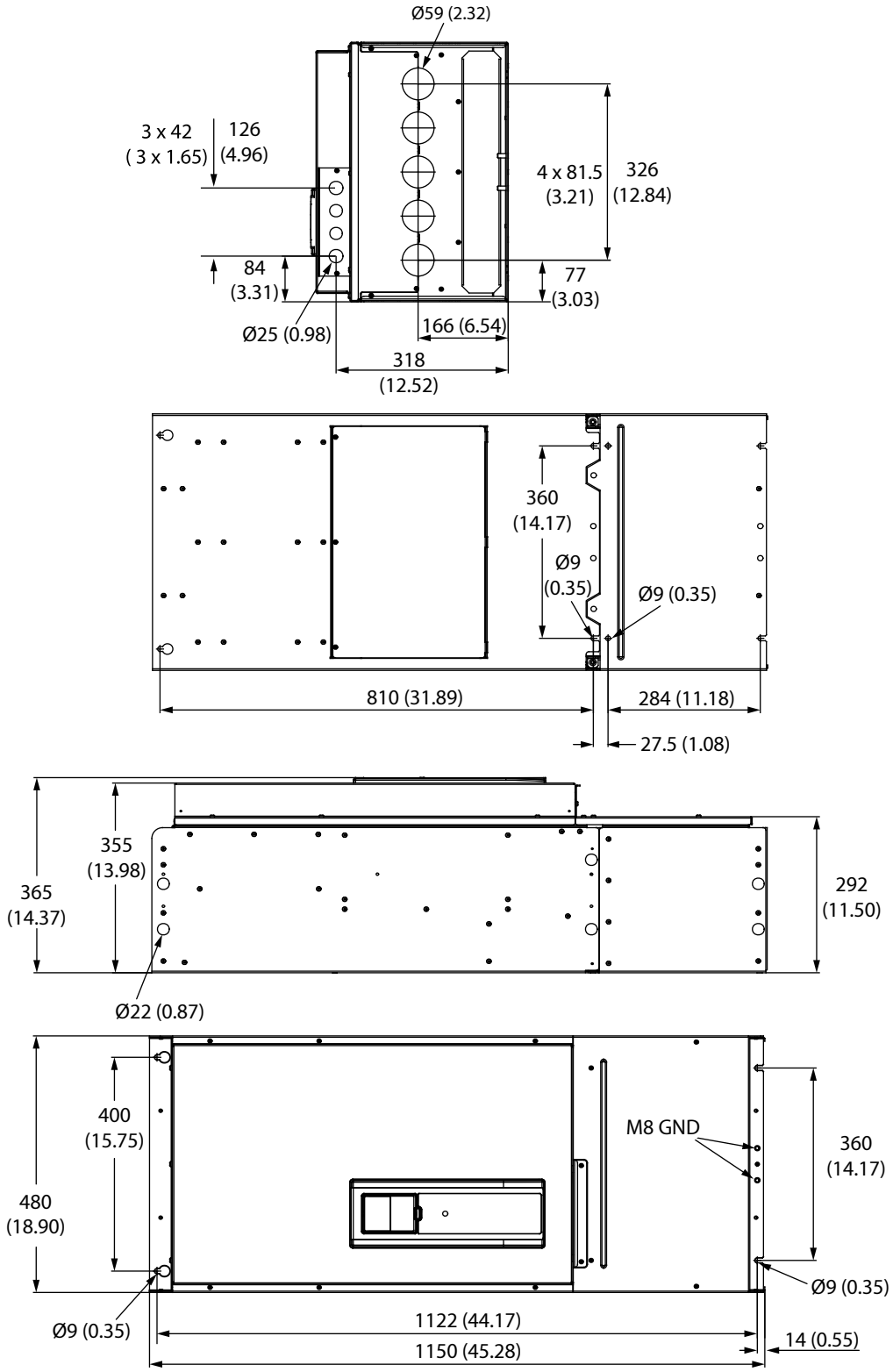


Figure 95: Dimensions of the Drive, MR9, mm (in)

10.2.2 Dimensions for Flange Mounting

10.2.2.1 Dimensions for Flange Mounting for MR4

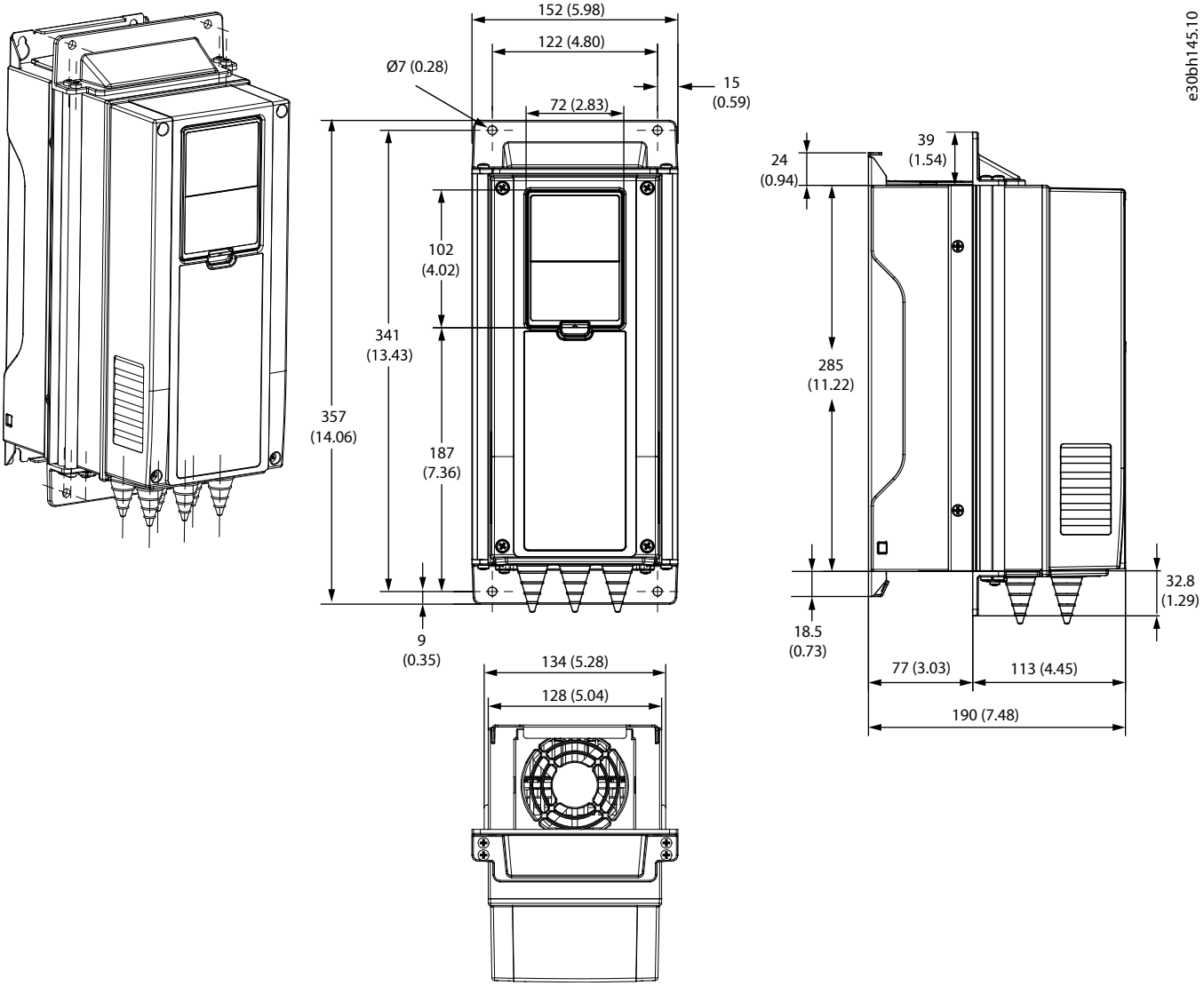


Figure 96: Dimensions of the Drive, MR4, mm (in)

10.2.2.2 Dimensions for Flange Mounting for MR5

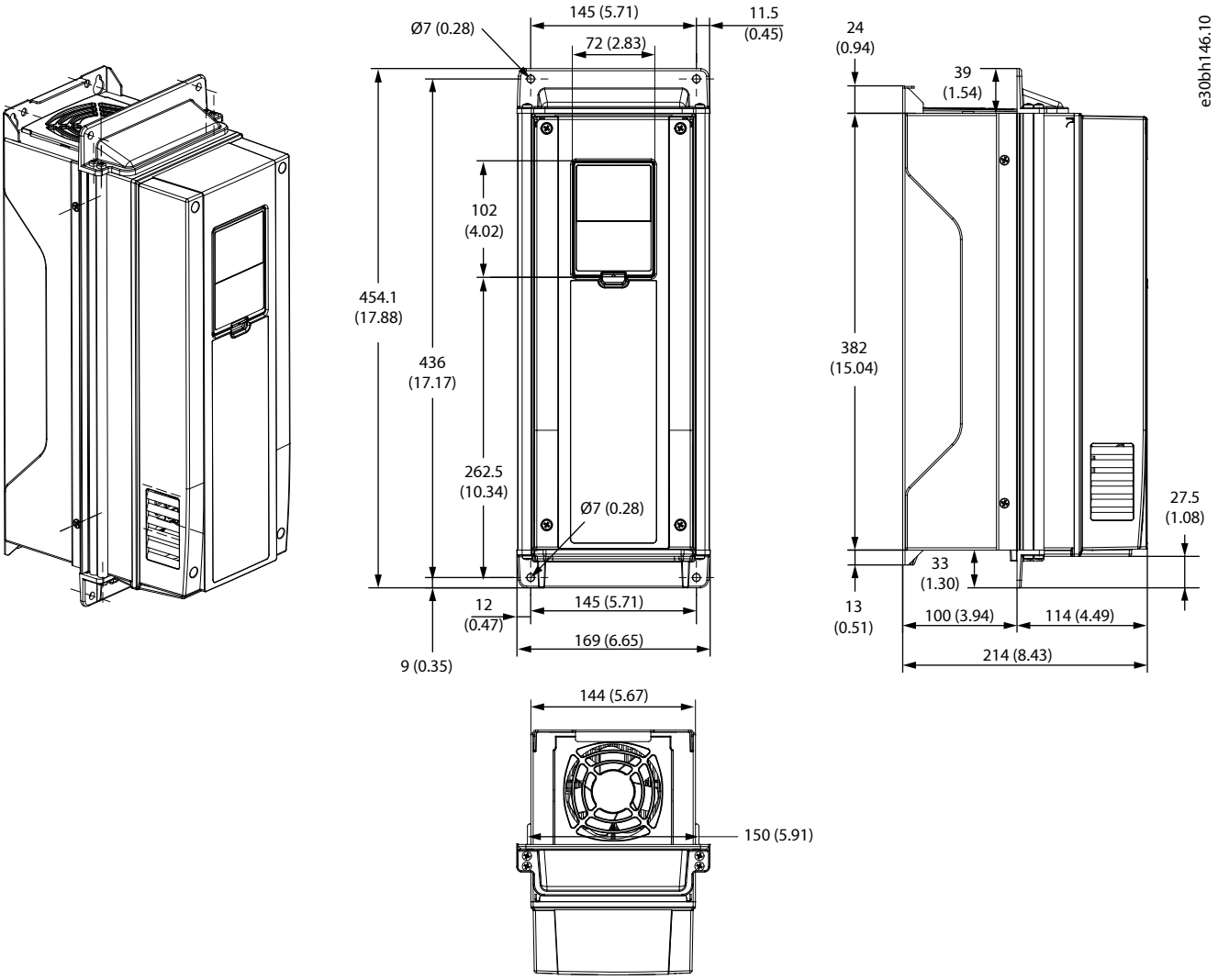


Figure 97: Dimensions of the Drive, MR5, mm (in)

10.2.2.3 Dimensions for Flange Mounting for MR6

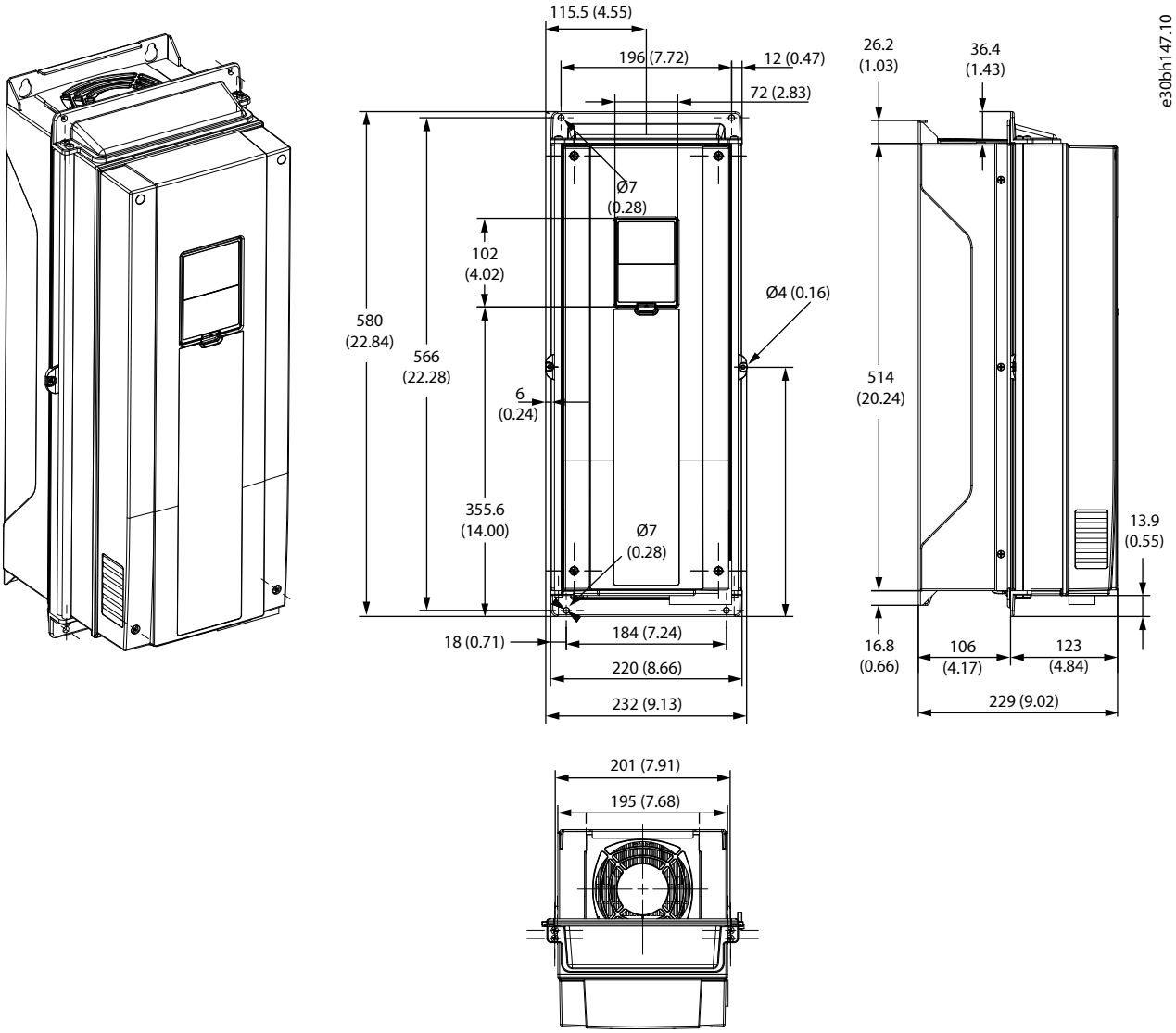


Figure 98: Dimensions of the Drive, MR6, mm (in)

10.2.2.4 Dimensions for Flange Mounting for MR7

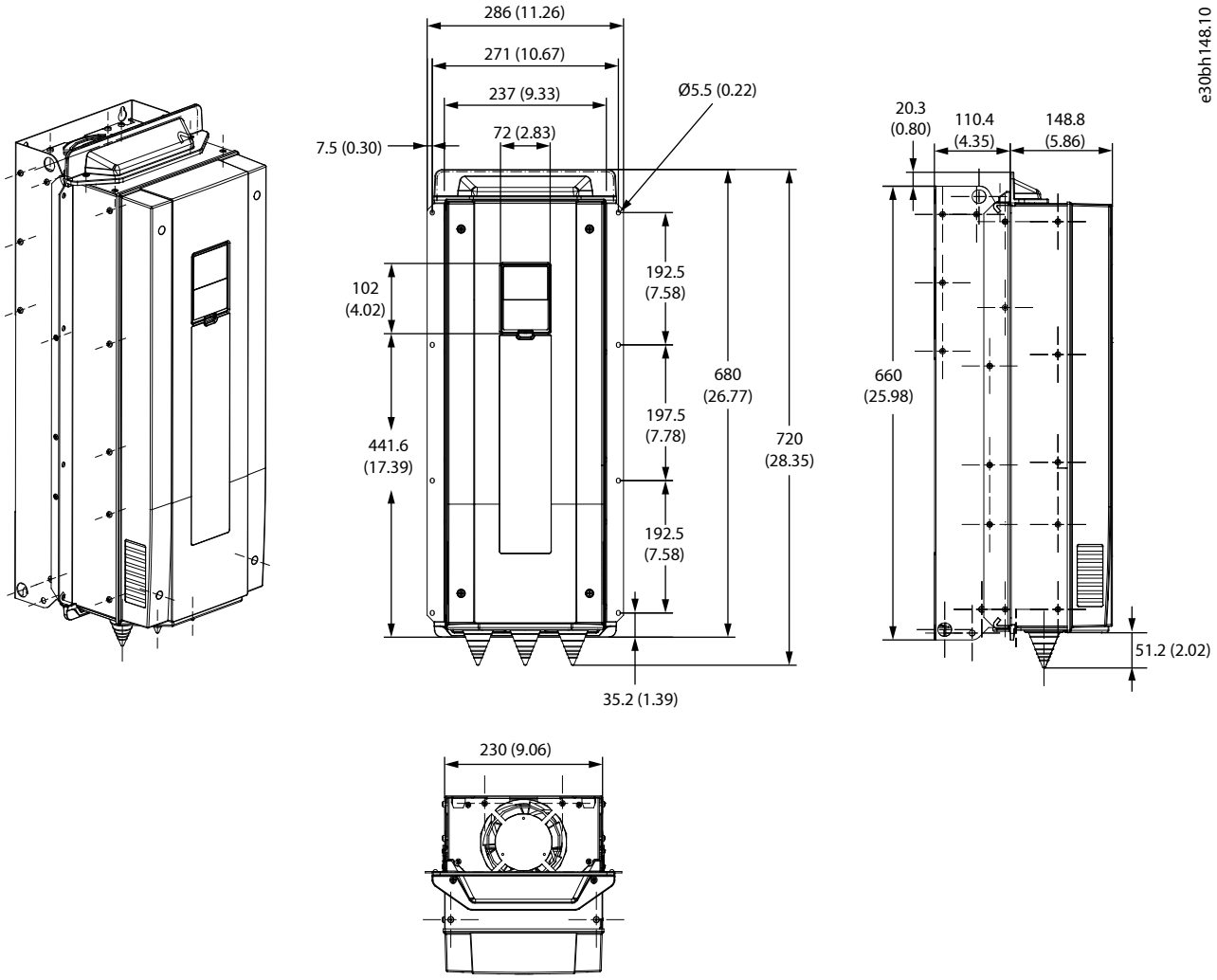


Figure 99: Dimensions of the Drive, MR7, mm (in)

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 the cable and fuse size tables for 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 25: 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 cable Cu [mm^2] (1)	Mains terminal cable size [mm^2]	Grounding terminal cable size [mm^2]
MR4	0003 2–0004 2 0003 5–0004 5	3.7–4.8 3.4–4.8	6	3x1.5+1.5	1–6 solid 1–4 stranded	1–6
	0006 2–0008 2 0005 5–0008 5	6.6–8.0 5.6–8.0	10	3x1.5+1.5	1–6 solid 1–4 stranded	1–6
	0011 2–0012 2 0009 5–0012 5	11.0–12.5 9.6–12.0	16	3x2.5+2.5	1–6 solid 1–4 stranded	1–6
MR5	0018 2 0016 5	18.0 16.0	20	3x6+6	1–10 Cu	1–10
	0024 2 0023 5	24.0 23.0	25	3x6+6	1–10 Cu	1–10
	0031 2 0031 5	31.0 31.0	32	3x10+10	1–10 Cu	1–10
MR6	0038 5	38.0	40	3x10+10	2.5–50 Cu/Al	2.5–35
	0048 2 0046 5	48.0 46.0	50	3x16+16 (Cu) 3x25+16 (Al)	2.5–50 Cu/Al	2.5–35
	0062 2 0061 5	62.0 61.0	63	3x25+16 (Cu) 3x35+16 (Al)	2.5–50 Cu/Al	2.5–35
MR7	0075 2 0072 5	75.0 72.0	80	3x35+16 (Cu) 3x50+16 (Al)	6–70 Cu/Al	6–70
	0088 2 0087 5	88.0 87.0	100	3x35+16 (Cu) 3x70+21 (Al)	6–70 Cu/Al	6–70
	0105 2 0105 5	105.0	125	3x50+25 (Cu) 3x70+21 (Al)	6–70 Cu/Al	6–70
MR8	0140 2 0140 5	140.0	160	3x70+35 (Cu) 3x95+29 (Al)	Bolt size M8	Bolt size M8
	0170 2 0170 5	170.0	200	3x95+50 (Cu) 3x150+41 (Al)	Bolt size M8	Bolt size M8
	0205 2 0205 5	205.0	250	3x120+70 (Cu) 3x185+57 (Al)	Bolt size M8	Bolt size M8
MR9A	0261 2 0261 5	261.0	315	3x185+95 (Cu) 2x(3x120+41) (Al)	Bolt size M10	Bolt size M8
	0310 2 0310 5	310.0	350	2x(3x95+50) (Cu) 2x(3x120+41) (Al)	Bolt size M10	Bolt size M8
MR9B	0386 5	385.0	400	2x(3x120+70) (Cu) 2x(3x185+57) (Al)	Bolt size M10	Bolt size M8

1) If a multi-conductor cable is used, 1 of the conductors of the brake resistor cable stays unconnected. If the minimum cross- sectional area of the cable is obeyed, it is also possible to use a single cable.

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

Table 26: 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 cable Cu [mm²] (1)	Mains terminal cable size [mm²]	Grounding terminal cable size [mm²]
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
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 0018 7	18.0	20	3x10+10	2.5–50 Cu/Al	2.5–35
	0022 6 0022 7	22.0	25	3x10+10	2.5–50 Cu/Al	2.5–35
	0027 6 0027 7	27.0	32	3x10+10	2.5–50 Cu/Al	2.5–35
	0034 6 0034 7	34.0	35	3x16+16	2.5–50 Cu/Al	2.5–35
MR7	0041 6 0041 7	41.0	50	3x16+16 (Cu) 3x25+16 (Al)	6–70 Cu/Al	6–70
	0052 6 0052 7	52.0	63	3x25+16 (Cu) 3x35+16 (Al)	6–70 Cu/Al	6–70
	0062 6 0062 7	62.0	63	3x25+16 (Cu) 3x35+16 (Al)	6–70 Cu/Al	6–70
MR8	0080 6 0080 7	80.0	80	3x35+16 (Cu) 3x50+21 (Al)	Bolt size M8	Bolt size M8
	0100 6 0100 7	100.0	100	3x50+25 (Cu) 3x70+21 (Al)	Bolt size M8	Bolt size M8
	0125 6 0125 7	125.0	125	3x70+35 (Cu) 3x95+29 (Al)	Bolt size M8	Bolt size M8
MR9A	0144 6 0144 7	144.0	160	3x70+35 (Cu) 3x120+41 (Al)	Bolt size M10	Bolt size M8
	0170 6 0170 7	170.0	200	3x95+50 (Cu) 3x150+41 (Al)	Bolt size M10	Bolt size M8
	0208 6 0208 7	208.0	250	3x120+70 (Cu) 3x185+57 (Al)	Bolt size M10	Bolt size M8
MR9B	0262 6 0262 7	261.0	315	3x185+95 2x(3x95+29)	Bolt size M10	Bolt size M8

1) If a multi-conductor cable is used, 1 of the conductors of the brake resistor cable stays unconnected. If the minimum cross- sectional area of the cable is obeyed, it is also possible to use a single cable.

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

Table 27: 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 cable Cu [AWG] (1)	Mains terminal cable size [AWG]	Grounding terminal cable size [AWG]
MR4	0003 2 0003 5	3.7 3.4	6	14	24–10	17–10
	0004 2 0004 5	4.8	6	14	24–10	17–10
	0006 2 0005 5	6.6 5.6	10	14	24–10	17–10
	0008 2 0008 5	8.0	10	14	24–10	17–10
	0011 2 0009 5	11.0 9.6	15	14	24–10	17–10
	0012 2 0012 5	12.5 12.0	20	14	24–10	17–10
MR5	0018 2 0016 5	18.0 16.0	25	10	20–6	17–8
	0024 2 0023 5	24.0 23.0	30	10	20–6	17–8
	0031 2 0031 5	31.0	40	8	20–6	17–8
MR6	0038 5	38.0	50	4	13–0	13–2
	0048 2 0046 5	48.0 46.0	60	4	13–0	13–2
	0062 2 0061 5 (2)	62.0 61.0	80	4	13–0	13–2
MR7	0075 2 0072 5	75.0 72.0	100	2	9–2/0	9–2/0
	0088 2 0087 5	88.0 87.0	110	1	9–2/0	9–2/0
	0105 2 0105 5	105.0	150	1/0	9–2/0	9–2/0
MR8	0140 2 0140 5	140.0	200	3/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0170 2 0170 5	170.0	225	250 kcmil	1 AWG–350 kcmil	1 AWG–350 kcmil
	0205 2 0205 5	205.0	250	350 kcmil	1 AWG–350 kcmil	1 AWG–350 kcmil

Table 27: Cable and Fuse Sizes, Mains Voltage 208–240 V and 380–500 V, North America - (continued)

Enclosure size	Drive type	I_L [A]	Fuse (Class T/J) [A]	Mains, motor, and brake resistor cable Cu [AWG] (1)	Mains terminal cable size [AWG]	Grounding terminal cable size [AWG]
MR9A	0261 2 0261 5	261.0	350	2x250 kcmil	1 AWG–350 kcmil	1 AWG–350 kcmil
	0310 2 0310 5	310.0	400	2x250 kcmil	1 AWG–350 kcmil	1 AWG–350 kcmil
MR9B	0386 5	385.0	500	2x250 kcmil	1 AWG-350 kcmil	1 AWG-350 kcmil

1) If a multi-conductor cable is used, 1 of the conductors of the brake resistor cable stays unconnected. If the minimum cross- sectional area of the cable is obeyed, it is also possible to use a single 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 28: 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 cable Cu [AWG] (1)	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 0018 7	18.0	20	10	13–0	13–2
	0022 6 0022 7	22.0	25	10	13–0	13–2
	0027 6 0027 7	27.0	30	8	13–0	13–2
	0034 6 0034 7	34.0	40	8	13–0	13–2
MR7	0041 6 0041 7	41.0	50	6	9–2/0	9–2/0
	0052 6 0052 7	52.0	60	6	9–2/0	9–2/0
	0062 6 0062 7	62.0	70	4	9–2/0	9–2/0

Table 28: Cable and Fuse Sizes, Mains Voltage 525–690 V, North America - (continued)

Enclosure size	Drive type	I_L [A]	Fuse (Class T/J) [A]	Mains, motor, and brake resistor cable Cu [AWG] (1)	Mains terminal cable size [AWG]	Grounding terminal cable size [AWG]
MR8	0080 6 0080 7	80.0	90	1/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0100 6 0100 7	100.0	110	1/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0125 6 0125 7	125.0	150	2/0	1 AWG–350 kcmil	1 AWG–350 kcmil
MR9A	0144 6 0144 7	144.0	175	3/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0170 7	170.0	200	4/0	1 AWG–350 kcmil	1 AWG–350 kcmil
	0208 6 0208 7	208.0	250	300 kcmil	1 AWG–350 kcmil	1 AWG–350 kcmil
MR9B	0262 6 0262 7	261.0	350	2xAWG2/0	1 AWG-350 kcmil	1 AWG-350 kcmil

1) If a multi-conductor cable is used, 1 of the conductors of the brake resistor cable stays unconnected. If the minimum cross- sectional area of the cable is obeyed, it is also possible to use a single cable.

10.4 Cable Stripping Lengths

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

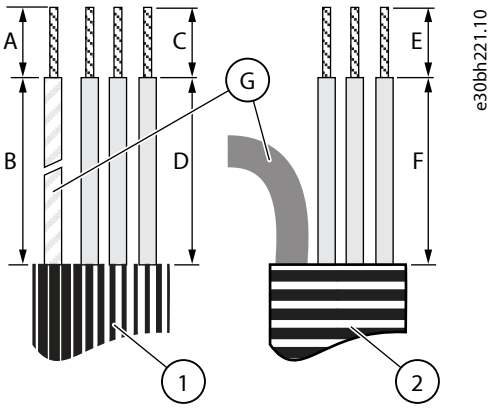


Figure 100: Cable Stripping

1	Mains cable	2	Motor cable

Table 29: 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

Table 29: Cable Stripping Lengths, in mm - (continued)

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 30: 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 31: Tightening Torques of the Terminals, in Nm (in-lb)

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 (70.8) (1) 5.6 (49.6) (2)	1.5 (13.3)	8 (70.8) (1) 5.6 (49.6) (2)
MR8	0140 2–0205 2 0140 5–0205 5 0080 6–0125 6 0080 7–0125 7	30 (266)	1.5 (13.3)	20 (177)
MR9	0261 2–0310 2 0261 5–0386 5 0144 6–0262 6 0144 7–0262 7	40 (354)	1.5 (13.3)	20 (177)

1) The tightening torque for a Torx screw.

2) The tightening torque for an Allen screw.

10.6 Power Ratings

10.6.1 List of Power Rating Information

This topic lists the links to find the power rating tables for VACON® 100 Wall-mounted Drives.

VACON® 100 INDUSTRIAL:

- 10.6.2 Power Ratings of VACON® 100 INDUSTRIAL, 208–240 V
- 10.6.3 Power Ratings of VACON® 100 INDUSTRIAL, 380–500 V
- 10.6.4 Power Ratings of VACON® 100 INDUSTRIAL, 525–600 V
- 10.6.5 Power Ratings of VACON® 100 INDUSTRIAL, 525–690 V

VACON® 100 FLOW:

- 10.6.6 Power Ratings of VACON® 100 FLOW, 208–240 V
- 10.6.7 Power Ratings of VACON® 100 FLOW, 380–500 V
- 10.6.8 Power Ratings of VACON® 100 FLOW, 525–600 V
- 10.6.9 Power Ratings of VACON® 100 FLOW, 525–690 V

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

Table 32: Power Ratings of VACON® 100 INDUSTRIAL, 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]	High loadability: Continuous current I_H [A] [2]	High loadability: Input current I_{in} [A] [2]	High loadability: 50% overload current [A] [2]	Loadability: Max current I_s 2 s [2]	Motor shaft power [3]: 10% overload 40 °C [kW]	Motor shaft power [3]: 50% overload 50 °C [kW]	Motor shaft power [3]: 10% overload 40 °C [hp]	Motor shaft power [3]: 50% overload 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
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

Table 32: Power Ratings of VACON® 100 INDUSTRIAL, Mains Voltage 208–240 V, 50–60 Hz, 3~ - (continued)

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]	High loadability: Continuous current I_H [A] [2]	High loadability: Input current I_{in} [A] [2]	High loadability: 50% overload current [A] [2]	Loadability: Max current I_s 2 s [2]	Motor shaft power [3]: 10% overload 40 °C [kW]	Motor shaft power [3]: 50% overload 50 °C [kW]	Motor shaft power [3]: 10% overload 40 °C [hp]	Motor shaft power [3]: 50% overload 50 °C [hp]
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 setting.

2) See 10.7 Overload Capability

3) 230 V

If the process includes a cyclic 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, 380–500 V

Table 33: Power Ratings of VACON® 100 INDUSTRIAL, 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]	High loadability: Continuous current I_H [A] [2]	High loadability: Input current I_{in} [A] [2]	High loadability: 50% overload current [A] [2]	Loadability: Max current I_s 2 s [2]	Motor shaft power [3]: 10% overload 40 °C [kW]	Motor shaft power [3]: 50% overload 50 °C [kW]	Motor shaft power [4]: 10% overload 40 °C [hp]	Motor shaft power [4]: 50% overload 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

Table 33: Power Ratings of VACON® 100 INDUSTRIAL, Mains Voltage 380–500 V, 50–60 Hz, 3~ - (continued)

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]	High loadability: Continuous current I_H [A] [2]	High loadability: Input current I_{in} [A] [2]	High loadability: 50% overload current [A] [2]	Loadability: Max current I_s 2 s [2]	Motor shaft power [3]: 10% overload 40 °C [kW]	Motor shaft power [3]: 50% overload 50 °C [kW]	Motor shaft power [4]: 10% overload 40 °C [hp]	Motor shaft power [4]: 50% overload 50 °C [hp]
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 setting.

2) See 10.7 Overload Capability.

3) 400 V

4) 480 V

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

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

Table 34: 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

Table 34: Power Ratings of VACON® 100 INDUSTRIAL, Mains Voltage 525–600 V, 50–60 Hz, 3~ - (continued)

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]
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

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

Table 35: Power Ratings of VACON® 100 INDUSTRIAL, 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]	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]	Motor shaft power (2): 10% overload 40 °C [kW]	Motor shaft power (2): 50% overload 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

Table 35: Power Ratings of VACON® 100 INDUSTRIAL, Mains Voltage 525–690 V, 50–60 Hz, 3~ - (continued)

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]	Motor shaft power (2): 10% overload 40 °C [kW]	Motor shaft power (2): 50% overload 50 °C [kW]
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

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

Table 36: 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 setting.

2) See 10.7 Overload Capability.

3) 230 V

If the process includes a cyclic 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, 380–500 V

Table 37: 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 setting.

2) See 10.7 Overload Capability.

3) 400 V

4) 480 V

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

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

Table 38: 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% overload 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

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

Table 39: 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
MR7	0041	41.0	38.4	45.1	68.0	40.0	37.0
	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

Table 39: Power Ratings of VACON® 100 FLOW, Mains Voltage 525–690 V, 50–60 Hz, 3~ - (continued)

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]
MR8	0080	80.0	72.0	88.0	124.0	75.0	75.0
	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
MR9A	0144	144.0	156.0	158.4	250.0	150.0	132.0
	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

10.7 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 RMS current is not more than I_L during the duty cycle.

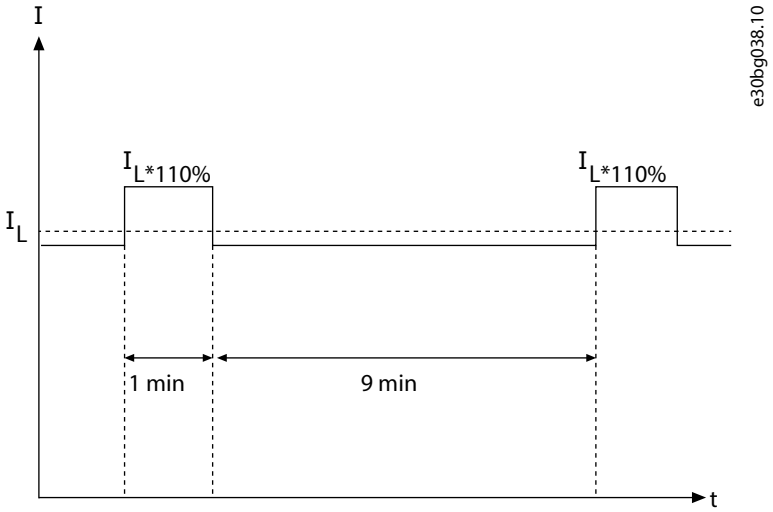


Figure 101: Low Overload

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 RMS current is not more than I_H during the duty cycle.

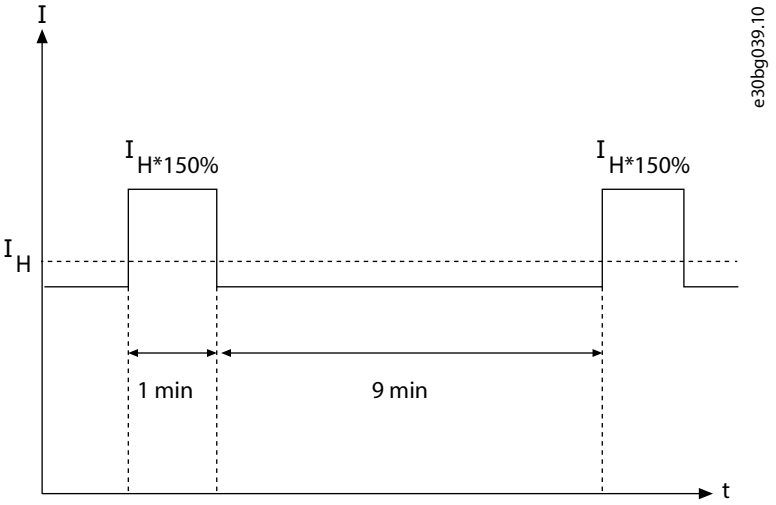


Figure 102: High Overload

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 List of Brake Resistor Rating Information

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 s period). The light duty resistor is rated for a 5 s ramp from full power to 0.

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

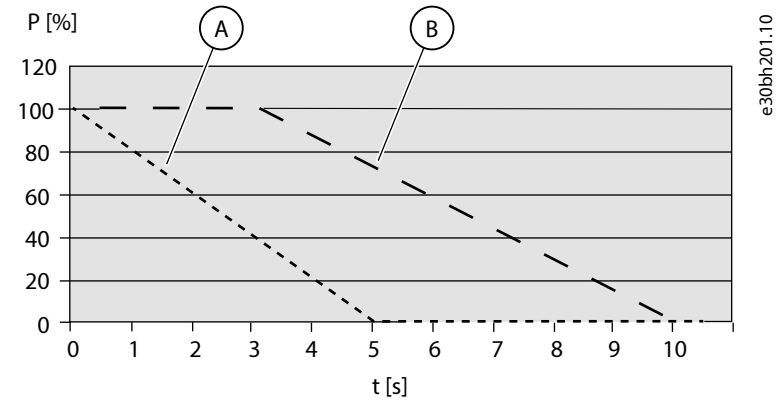


Figure 103: LD and HD Pulses

A	Light duty (LD)	B	Heavy duty (HD)
P	Brake power		

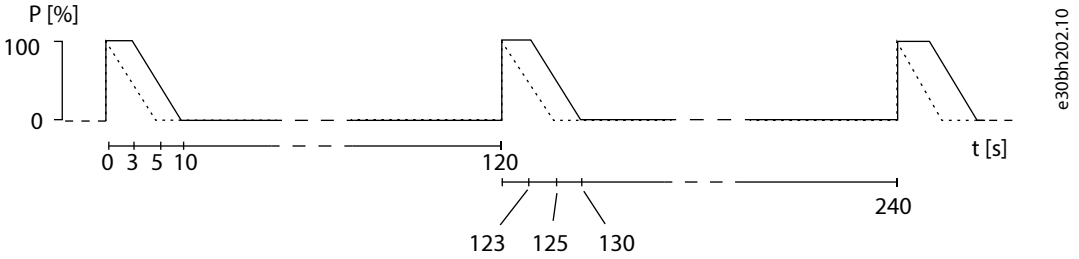


Figure 104: Duty Cycles of the LD and HD Pulses

P	Brake power

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

Table 40: 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 41: 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
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 42: The Minimum Brake Resistance and Brake Power, Mains Voltage 208–240 V

Enclosure size	The minimum brake resistance [Ω]	Brake power @405 V DC [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 the recommended resistor types.

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

Table 43: The Minimum Brake Resistance and Brake Power, Mains Voltage 380–500 V

Enclosure size	The minimum brake resistance [Ω]	Brake power @845 V DC [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 the recommended resistor types.

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

Table 44: The Minimum Brake Resistance and Brake Power, Mains Voltage 525–600 V

Enclosure size	The minimum brake resistance [Ω]	Brake power @1014 V DC [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 the recommended resistor types.

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

Table 45: The Minimum Brake Resistance and Brake Power, Mains Voltage 525–690 V

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

1) When using the recommended resistor types.

10.9 Control Connections

Table 46: 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 (Ri = 200 kΩ) 4–20 mA (Ri = 250 Ω) Resolution 0.1%, accuracy ±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 ±20 V common-mode voltage to GND
4	Analog input, voltage or current	Analog input channel 2 0–10 V (Ri = 200 kΩ) 4–20 mA (Ri = 250 Ω) Resolution 0.1%, accuracy ±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 ±20 V common-mode voltage to GND
6	24 V auxiliary voltage	+24 V, ±10%, max volt. ripple < 100 mVrms Maximum 250 mA Short-circuit protected
7	I/O ground	Ground for reference and controls (connected internally to frame ground through 1 MΩ)
8	Digital input 1	Positive or negative logic Ri = min. 5 kΩ 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).
12	24 V auxiliary voltage	+24 V, ±10%, max volt. ripple < 100 mVrms Maximum 250 mA Short-circuit protected
13	I/O ground	Ground for reference and controls (connected internally to frame ground through 1 MΩ)
14	Digital input 4	Positive or negative logic Ri = min. 5 kΩ 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).

Table 46: The Standard I/O Board - (continued)

Terminal	Signal	Technical information
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 ±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 backup for the control unit
A	RS-485	Differential receiver/transmitter Set bus termination with DIP switches (see 7.3.1 Selection of Terminal Functions with DIP Switches). Termination resistance = 220 Ω.
B	RS-485	

Table 47: 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. Switching capacity: • 24 V DC/8 A • 250 V AC/8 A • 125 V DC/0.4 A Minimum switching load: • 5 V/10 mA
22		
23		
24	Relay output 2 (1)	Change-over contact (SPDT) relay. 5.5 mm isolation between channels. Switching capacity: • 24 V DC/8 A • 250 V AC/8 A • 125 V DC/0.4 A Minimum switching load: • 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: • 24 V DC/8 A • 250 V AC/8 A • 125 V DC/0.4 A Minimum switching load: • 5 V/10 mA
33		

1) If 230 V AC is used 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 avoid welding on the relay contacts. Refer to standard EN 60204-1, section 7.2.9.

Table 48: The Optional Relay Board (+SBF4)

Terminal	Signal	Technical information
21 22 23	Relay output 1 (1)	Change-over contact (SPDT) relay. 5.5 mm isolation between channels. Switching capacity: • 24 V DC/8 A • 250 V AC/8 A • 125 V DC/0.4 A Minimum switching load: • 5 V/10 mA
24 25 26	Relay output 2 (1)	Change-over contact (SPDT) relay. 5.5 mm isolation between channels. Switching capacity: • 24 V DC/8 A • 250 V AC/8 A • 125 V DC/0.4 A Minimum switching load: • 5 V/10 mA
28 29	TI1+ TI1-	Thermistor input Rtrip = 4.7 kΩ (PTC) Measuring voltage 3.5 V

1) If 230 V AC is used 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 avoid welding on the relay contacts. Refer to standard EN 60204-1, section 7.2.9.

10.10 Technical Data, VACON® 100 INDUSTRIAL

Table 49: Technical Data of VACON® 100 INDUSTRIAL

Technical item or function	Technical item or function	Technical information
Mains connection, Protective Class I	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	Maximum ±3% of the nominal voltage
	Mains	Mains types: TN, TT, and IT Short-circuit current: The maximum short-circuit current must be < 100 kA.
	Overvoltage category (IEC/EN 60664-1)	Category III
Motor connection	Output voltage	0–U_{in}
	Continuous output current	I_L: Ambient temperature maximum +40 °C overload 1.1 x I_L (1 min/10 min) I_H: Ambient temperature maximum +50 °C overload 1.5 x I_H (1 min/10 min) I_H in 600/690 V drives: Ambient temperature maximum +40 °C overload 1.5 x I_H (1 min/10 min)
	Output frequency	0–320 Hz (standard)
	Frequency resolution	0.01 Hz

Table 49: Technical Data of VACON® 100 INDUSTRIAL - (continued)

Technical item or function	Technical item or function	Technical information
Control characteristics	Switching frequency (see parameter P3.1.2.3)	**200–500 V** MR4–MR6: • 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: • 1.5–6 kHz • Default: MR7: 4 kHz, MR8: 3 kHz, MR9: 2 kHz **600–690 V** MR5–MR9: • 1.5–6 kHz • Default: 2 kHz • For a product that is configured for a C4 installation on an IT network the maximum switching frequency is limited to default 2 kHz. Automatic switching frequency derating if there is an overload.
	Frequency reference: • Analog input • Panel reference	Resolution 0.1% (10-bit), accuracy ±1% Resolution 0.01 Hz
	Field weakening point	8–320 Hz
	Acceleration time	0.1–3000 s
	Deceleration time	0.1–3000 s

Table 49: Technical Data of VACON® 100 INDUSTRIAL - (continued)

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
	Environmental conditions operation (IEC 60721-3-3)	Climatic conditions: Class 3K22
	Air quality: • chemical vapors • mechanical particles	Tested according to IEC 60068-2-60 Test Ke: Flowing mixed gas corrosion test, Method 1 (H2S [hydrogen sulfide] and SO2 [sulfur dioxide]) Designed according to • 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: • 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: • 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 6.2.2 Installation in a Corner-grounded Network).
	Pollution degree	PD2
	Vibration: • 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: • EN 60068-2-27	UPS Drop Test (for applicable UPS weights) Storage and shipping: Maximum 15 G, 11 ms (in package)
	Protection rating	IP21/UL Type 1: Standard in the entire kW/HP range IP54/UL Type 12: Option NOTE! For IP54/Type 12, a control panel adapter is necessary.
EMC (at default settings)	Immunity	Fulfills EN 61800-3 (2004), 1st and 2nd environment
	Emissions	200–500 V: EN 61800-3 (2004), category C2. 600–690 V: EN 61800-3 (2004), category C3. All: The product is configurable to category C4 for installation on IT networks. The drive can be modified for IT type mains. See 6.6.1 Requirements for Installation in an IT System. The IP00/UL Open Type drive has by default category C4.

Table 49: Technical Data of VACON® 100 INDUSTRIAL - (continued)

Technical item or function	Technical item or function	Technical information
Noise level	Sound pressure level (minimum–maximum)	The sound pressure depends on the cooling fan speed, which is controlled in accordance with the drive temperature. • MR4: 45–56 dB(A) • MR5: 57–65 dB(A) • MR6: 63–72 dB(A) • MR7: 43–73 dB(A) • MR8: 58–73 dB(A) • MR9: 54–75 dB(A)
Safety standards	-	IEC/EN 61800-5-1, UL 61800-5-1, CSA C22.2 No.274.
Approvals	-	CE, cULus, RCM, KC, EAC, UA. (See the product label of the drive for more approvals.) The UL Approval is valid for input voltage up to 600 V.
Decisive Voltage Class (DVC)	DVC D circuits/terminals	-
	DVC C circuits/terminals	Mains terminals, motor output terminals, DC/brake terminals
	DVC B circuits/terminals	-
	DVC As circuits/terminals	24 V DC output

Table 49: Technical Data of VACON® 100 INDUSTRIAL - (continued)

Technical item or function	Technical item or function	Technical information
Protections	Overvoltage trip limit	Mains voltage 240 V: 456 V DC Mains voltage 500 V: 911 V DC Mains voltage 600 V: 1094 V DC Mains voltage 690 V: 1258 V DC
	Undervoltage trip limit	Depends on mains voltage (0.8775 x mains voltage): Mains voltage 240 V: Trip limit 211 V DC Mains voltage 400 V: Trip limit 351 V DC Mains voltage 500 V: Trip limit 438 V DC Mains voltage 525 V: Trip limit 461 V DC Mains voltage 600 V: Trip limit 527 V DC Mains voltage 690 V: Trip limit 606 V DC
	Earth fault protection	Yes
	Mains supervision	Yes
	Motor phase supervision	Yes
	Overcurrent protection	Yes
	Unit overtemperature protection	Yes
	Motor overload protection	Yes. The motor overload protection activates at 110% of the full load current.[1]
	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, use system software version FW0072V007 or a newer version. If an older system software version is used, install a motor overtemperature protection to obey the UL regulations. For more information about the motor overload protection parameters, see the VACON® 100 INDUSTRIAL Application Guide.

10.11 Technical Data, VACON® 100 FLOW

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

Technical item or function	Technical item or function	Technical information
Mains connection, Protective Class I	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	Maximum ±3% of the nominal voltage
	Mains	Mains types: TN, TT, and IT Short-circuit current: The maximum short-circuit current must be < 100 kA.
	Overvoltage category (IEC/EN 60664-1)	Category III
Motor connection	Output voltage	0–U_{in}
	Continuous output current	I_L: Ambient temperature maximum +40 °C overload 1.1 x I_L (1 min/10 min)
	Output frequency	0–320 Hz (standard)
	Frequency resolution	0.01 Hz
Control characteristics	Switching frequency (see parameter P3.1.2.3)	**200–500 V** MR4–MR6: • 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: • 1.5–6 kHz • Default: MR7: 4 kHz, MR8: 3 kHz, MR9: 2 kHz **600–690 V** MR5–MR9: • 1.5–6 kHz • Default: 2 kHz • For a product that is configured for a C4 installation on an IT network the maximum switching frequency is limited to default 2 kHz. Automatic switching frequency derating if there is an overload.
	Frequency reference: • Analog input • Panel reference	Resolution 0.1% (10-bit), accuracy ±1% Resolution 0.01 Hz
	Field weakening point	8–320 Hz
	Acceleration time	0.1–3000 s
	Deceleration time	0.1–3000 s

Table 50: Technical Data of the VACON® 100 FLOW AC Drive - (continued)

Technical item or function	Technical item or function	Technical information
Ambient conditions	Ambient operating temperature	I_L current: -10 °C (no frost)...+40 °C Maximum operating temperature: +50 °C with derating (1.5%/1 °C)
	Storage temperature	-40 °C...+70 °C
	Relative humidity	0–95% RH, non-condensing, non-corrosive
	Environmental conditions operation (IEC 60721-3-3)	Climatic conditions: Class 3K22
	Air quality: • chemical vapors • mechanical particles	Tested according to IEC 60068-2-60 Test Ke: Flowing mixed gas corrosion test, Method 1 (H2S [hydrogen sulfide] and SO2 [sulfur dioxide]) Designed according to • 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: • 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: • 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 6.2.2 Installation in a Corner-grounded Network).
	Pollution degree	PD2
	Vibration: • 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: • EN 60068-2-27	UPS Drop Test (for applicable UPS weights) Storage and shipping: Maximum 15 G, 11 ms (in package)
	Protection rating	IP21/UL Type 1: Standard in the entire kW/HP range IP54/UL Type 12: Option NOTE! For IP54/Type 12, a control panel adapter is necessary.
EMC (at default settings)	Immunity	Fulfills EN 61800-3 (2004), 1st and 2nd environment
	Emissions	200–500 V: EN 61800-3 (2004), category C2. 600–690 V: EN 61800-3 (2004), category C3. All: The product is configurable to category C4 for installation on IT networks. The drive can be modified for IT type mains. See 6.6.1 Requirements for Installation in an IT System. The IP00/UL Open Type drive has by default category C4.

Table 50: Technical Data of the VACON® 100 FLOW AC Drive - (continued)

Technical item or function	Technical item or function	Technical information
Noise level	Sound pressure level (minimum–maximum)	The sound pressure depends on the cooling fan speed, which is controlled in accordance with the drive temperature. • MR4: 45–56 dB(A) • MR5: 57–65 dB(A) • MR6: 63–72 dB(A) • MR7: 43–73 dB(A) • MR8: 58–73 dB(A) • MR9: 54–75 dB(A)
Safety standards	-	IEC/EN 61800-5-1, UL 61800-5-1, CSA C22.2 No.274.
Approvals	-	CE, cULus, RCM, KC, EAC, UA. (See the product label of the drive for more approvals.) The UL Approval is valid for input voltage up to 600 V.
Decisive Voltage Class (DVC)	DVC D circuits/terminals	-
	DVC C circuits/terminals	Mains terminals, motor output terminals, DC/brake terminals
	DVC B circuits/terminals	-
	DVC As circuits/terminals	24 V DC output

Table 50: Technical Data of the VACON® 100 FLOW AC Drive - (continued)

Technical item or function	Technical item or function	Technical information
Protections	Overvoltage trip limit	Mains voltage 240 V: 456 V DC Mains voltage 500 V: 911 V DC Mains voltage 600 V: 1094 V DC Mains voltage 690 V: 1258 V DC
	Undervoltage trip limit	Depends on mains voltage (0.8775 x mains voltage): Mains voltage 240 V: Trip limit 211 V DC Mains voltage 400 V: Trip limit 351 V DC Mains voltage 500 V: Trip limit 438 V DC Mains voltage 525 V: Trip limit 461 V DC Mains voltage 600 V: Trip limit 527 V DC Mains voltage 690 V: Trip limit 606 V DC
	Earth fault protection	Yes
	Mains supervision	Yes
	Motor phase supervision	Yes
	Overcurrent protection	Yes
	Unit overtemperature protection	Yes
	Motor overload protection	Yes. The motor overload protection activates at 110% of the full load current. (1)
	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, use system software version FW0159V003 or a newer version. If an older system software version is used, install a motor overtemperature protection to obey the UL regulations. For more information about the motor overload protection parameters, see the VACON® 100 FLOW Application Guide.

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