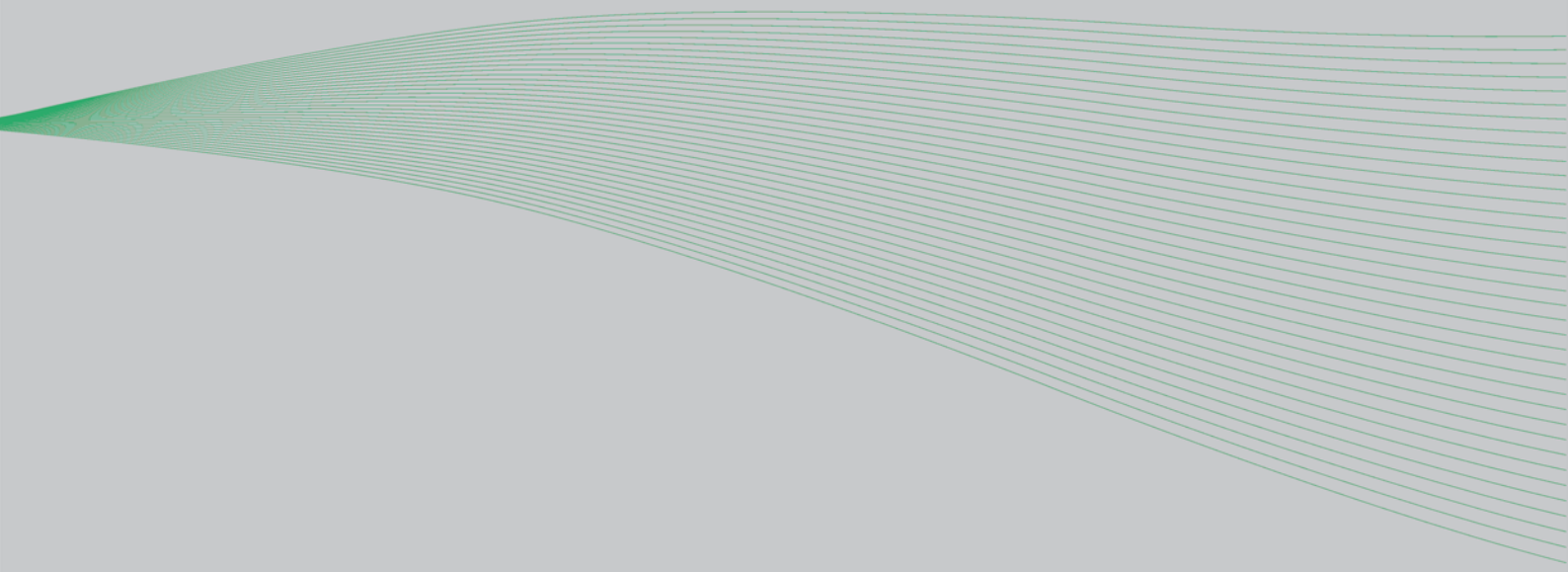
VACON 100

MOTOR-MOUNTABLE AC DRIVES

INSTALLATION MANUAL



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INDEX

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1. SAFETY

This manual contains clearly marked cautions and warnings which are intended for your personal safety and to avoid any unintentional damage to the product or connected appliances.

Please read the information included in cautions and warnings carefully.

The cautions and warnings are marked as follows:

	**= DANGEROUS VOLTAGE!**
	**= WARNING or CAUTION**

Table 1. Warning signs

1.1 DANGER

	The **components of the power unit of** Vacon 100 Motor Mountable Drives **are live** when the drive is connected to mains potential. Coming into contact with this voltage is **extremely dangerous** and may cause death or severe injury.
	The **motor terminals (U, V, W), brake resistor terminals and the DC-terminals are live** when Vacon 100 Motor Mountable Drive is connected to mains, even if the motor is not running.
	It is **imperative** to equip the installation with a **main switch** to be installed between mains and the AC drive to guarantee **absence of voltage** on the drive.
	**After disconnecting** the AC drive from the mains, **wait** until the indicators on the powerhead go out. Wait 5 more minutes before doing any work on the connections of Vacon100 Motor Mountable Drive. Do not open the unit before this time has expired. After expiration of this time, use a measuring equipment to absolutely ensure that no voltage is present. **Always ensure absence of voltage before starting any electrical work!**
	The control I/O-terminals are isolated from the mains potential. However, the **relay outputs and other I/O-terminals may have a dangerous control voltage** present even when Vacon 100 Motor Mountable Drive is disconnected from mains.
	**Before connecting** the AC drive to mains make sure that the powerhead Vacon 100 Motor Mountable Drive is mounted firmly on the terminal box.
	During a ramp stop (see the Application Manual), the motor is still generating voltage to the drive. Therefore, do not touch the components of the AC drive before the motor has completely stopped. Wait until the indicators on the powerhead go out. Wait additional 5 minutes before starting any work on the drive.

1.2 WARNINGS

⚠	Vacon 100 Motor Mountable AC drive is meant for **fixed installations** (on the motor or on the wall) **only**.
⚠	**Do not perform any measurements** when the AC drive is connected to the mains.
⚠	The **touch current** of Vacon 100 Motor Mountable drives exceeds 3.5mA AC. According to standard EN61800-5-1, **a reinforced protective ground connection** must be ensured. See chapter 1.3.
⚠	If the AC drive is used as a part of a machine, the **machine manufacturer is responsible** for providing the machine with a **supply disconnecting device** (EN 60204-1).
⚠	Only **spare parts** delivered by Vacon can be used.
⚠	At power-up, power brake or fault reset **the motor will start immediately** if the start signal is active, unless the pulse control for Start/Stop logic has been selected. Futhermore, the I/O functionalities (including start inputs) may change if parameters, applications or software are changed.Disconnect, therefore, the motor if an unexpected start can cause danger.
⚠	The **motor starts automatically** after automatic fault reset if the autoreset function is activated. See the Application Manual for more detailed information.
⚠	**Prior to measurements on the motor or the motor cable**, disconnect the motor cable from the AC drive.
⚠	**Do not touch the components on the circuit boards**. Static voltage discharge may damage the components.
⚠	Check that the **EMC level** of the AC drive corresponds to the requirements of your supply network. See chapter 5.2.
⚠	In a domestic environment, this product may cause radio interference in which case supplementary mitigation measures may be required.

1.3 EARTHING AND EARTH FAULT PROTECTION

CAUTION!

The Vacon 100 Motor Mountable AC drive must always be earthed with an earthing conductor connected to the earthing terminal marked with ⏚.

Protective earth connection **between the terminal box and the powerhead** is made by a metal aglet on one of the front edges of the terminal box that fits into a spring basket on the power-head. Please pay attention to not to lose, damage or remove this aglet. See Figure 1.

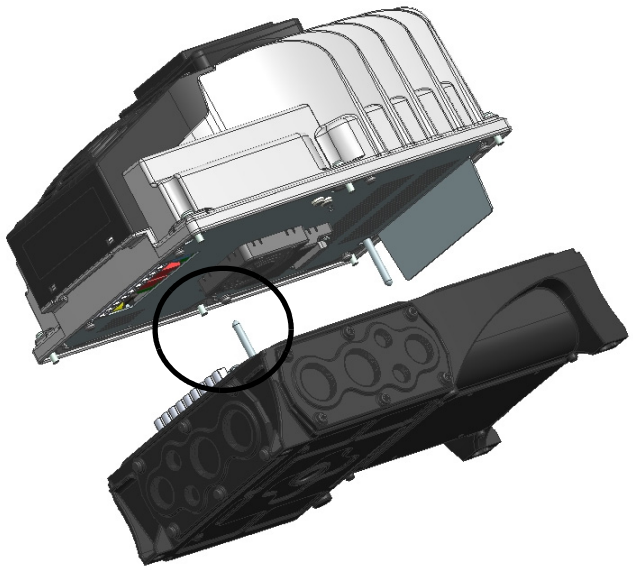

Figure 1.

The touch current of Vacon 100 Motor Mountable drive exceeds 3.5mA AC. According to EN61800-5-1, one or more of the following conditions for the associated protective circuit shall be satisfied:

A fixed connection and

a) the **protective earthing conductor** shall have a cross-sectional area of at least 10 mm² Cu or 16 mm² Al.

   or

b) an automatic disconnection of the supply in case of discontinuity of the **protective earthing conductor**. See chapter 4.

   or

c) provision of an additional terminal for a second **protective earthing conductor** of the same cross-sectional area as the original **protective earthing conductor**.

Cross-sectional area of phase conductors [mm²]	Minimum cross-sectional area of the corresponding **protective earthing conductor** [mm²]
$S \leq 16$ $16 < S \leq 35$ $35 < S$	S 16 $S/2$
The values above 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 shall be determined in a manner which produces a conductance equivalent to that which results from the application of this table.	

Table 2. Protective earthing conductor cross-section

The cross-sectional area of every protective earthing conductor which does not form a part of the supply cable or cable enclosure shall, in any case, be not less than

- 2.5 mm² if mechanical protection is provided or
- 4 mm² if mechanical protection is not provided. For cord-connected equipment, provisions shall be made so that the protective earthing conductor in the cord shall, in the case of failure of the strain-relief mechanism, be the last conductor to be interrupted.

However, always follow the local regulations for the minimum size of the protective earthing conductor.

NOTE: Due to the high capacitive currents present in the AC drive, fault current protective switches may not function properly.

Do not perform any voltage withstand tests on any part of Vacon 100 Motor Mountable drive. There is a certain procedure according to which the tests shall be performed. Ignoring this procedure may result in damaged product.

1.4 ELECTRO-MAGNETIC COMPATIBILITY (EMC)

This equipment complies with IEC 61000-3-12 provided that the short-circuit power S_{SC} is greater than or equal to 120 at the interface point between the user's supply and the public system. It is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator if necessary, that the equipment is connected only to a supply with a short-circuit power S_{SC} greater than or equal to 120.

2. RECEIPT OF DELIVERY

Check the correctness of delivery by comparing your order data to the drive information found on the package label. If the delivery does not correspond to your order, contact the supplier immediately.

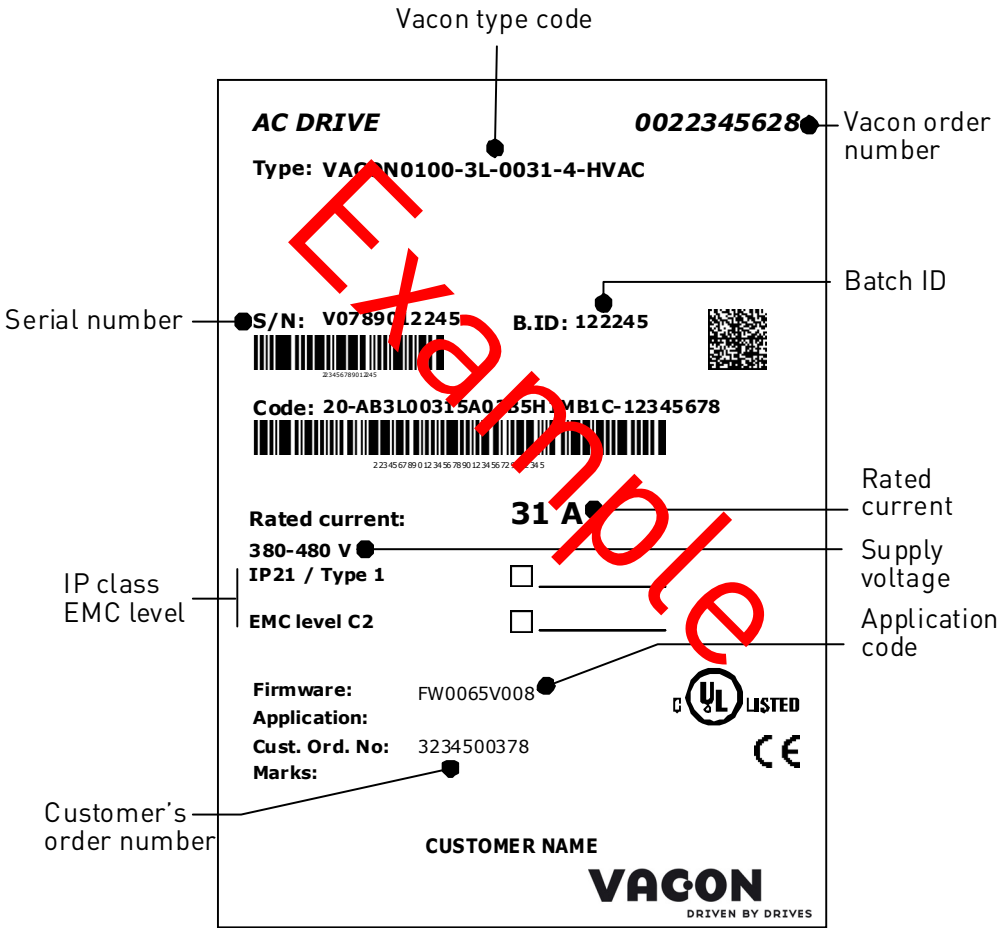

Figure 2. Vacon package label

2.1 'PRODUCT MODIFIED' STICKER

In the small plastic bag included in the delivery you will find a silver *Product modified* sticker. The purpose of the sticker is to notify the service personnel about the modifications made in the AC drive. Attach the sticker on the side of the AC drive to avoid losing it. Should the AC drive be later modified mark the change on the sticker.

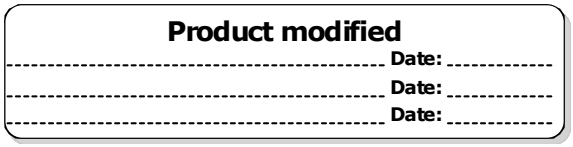

Figure 3. 'Product modified' sticker

2.2 UNPACKING AND LIFTING THE AC DRIVE

The weights of the AC drives vary according to frame size. You may need to use a piece of special lifting equipment to move the converter from its package. Note the weights of each individual frame size in Table 3 below.

Frame	Weight [kg]
MM4	8.8
MM5	14.9

Table 3. Frame weights

Vacon 100 Motor Mountable drives have undergone scrupulous tests and quality checks at the factory before they are delivered to the customer. However, after unpacking the product, check that no signs of transport damages are to be found on the product and that the delivery is complete.

Should the drive have been damaged during the shipping, please contact primarily the cargo insurance company or the carrier.

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2.3 INTRODUCTION OF MODULES

The mechanical concept of Vacon 100 Motor Mountable drive is based on two segregated parts, power and control, connected to each other by pluggable terminals. The power unit, called the powerhead, includes all the power electronics such as the EMC-filter, IGBTs, capacitors, choke or power boards while the control boards and the control unit are located in the terminal box.

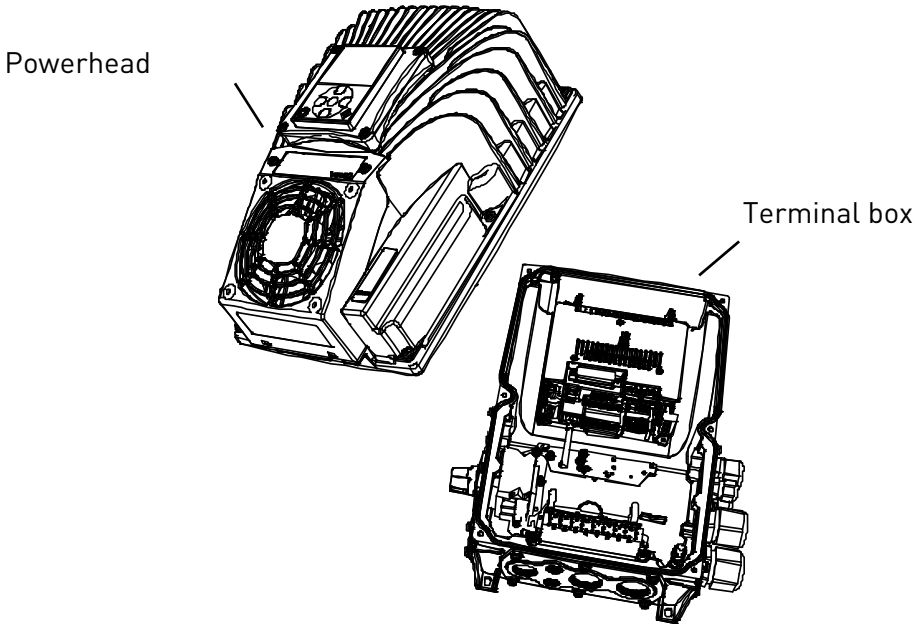

Figure 4. Vacon 100 Motor Mountable drive modules

3. MOUNTING

The Vacon 100 Motor Mountable drive is the ideal solution for decentralized installation. It can be installed outside a cabinet and close to or directly on the motor and thus helping saving space and reducing cabling complexity.

The drive shall be fixed with four screws (or bolts, depending on the unit size) (wall mounting).

3.1 DIMENSIONS

3.1.1 FRAME MM4

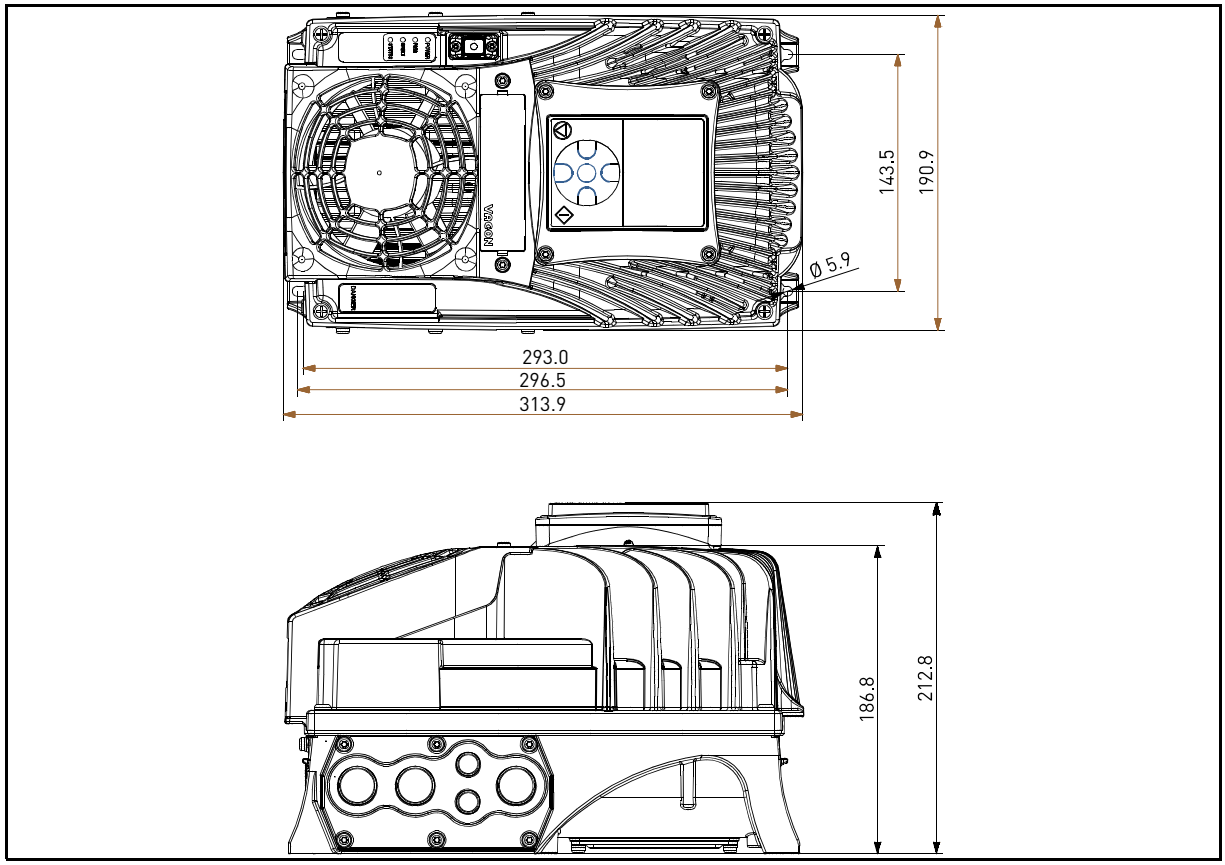

Figure 5. Vacon 100 Motor Mountable drive dimensions, MM4

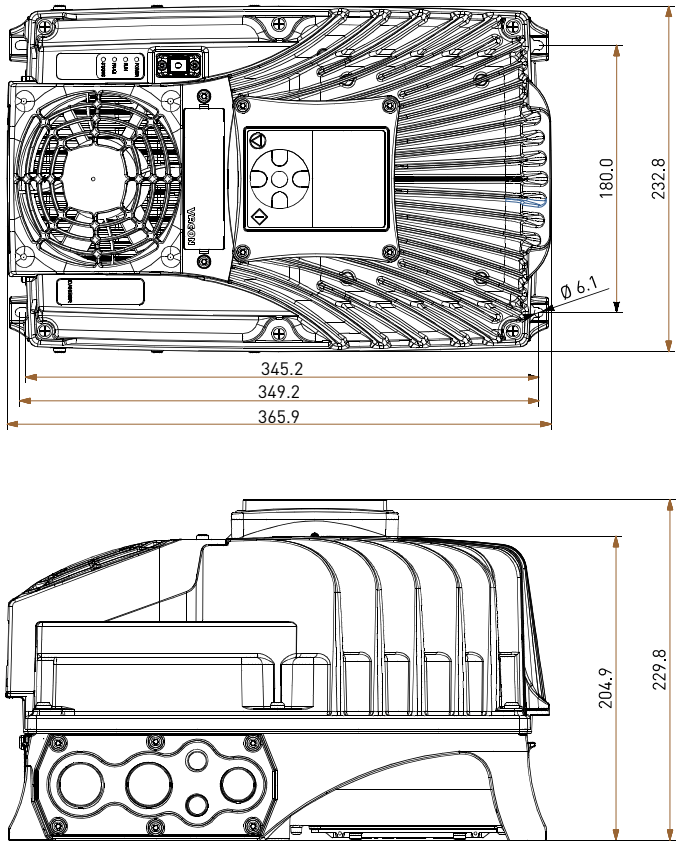

Figure 6. Vacon Motor Mountable drive dimensions, MM5

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3.2 MOUNTING

The drive consists of two main elements:

1. The terminal box that includes the power terminals and control board with the control terminals and
2. the powerhead containing all the power electronics.

To install the drive, both parts need be separated. The terminal box must be fixed first and all cabling done. After this, the powerhead will be plugged on the terminal box and fixed with 4 (MM4) or 6 (MM5) dedicated screws located on top side of the powerhead (see Figure 7.). In oder to guarantee specified IP protection, recommended fastening torque is 2-3 Nm. The screws should be tightened crosswise.

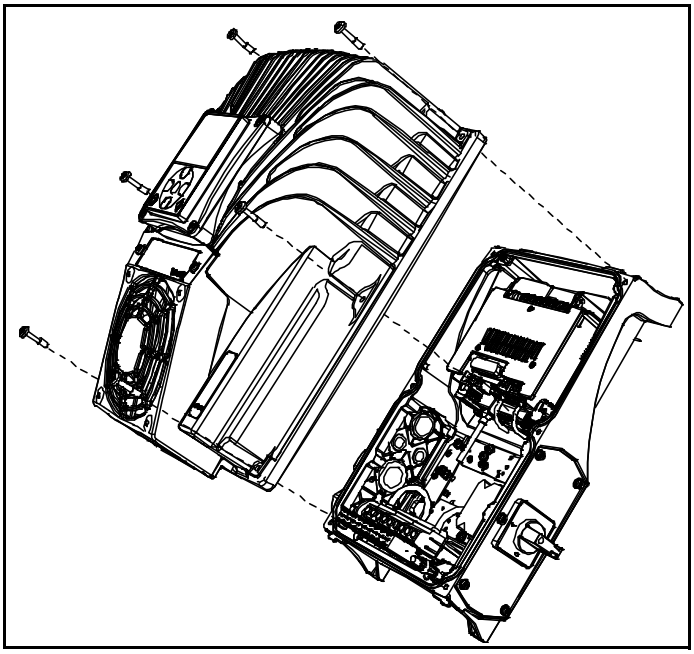

Figure 7. Separation of modules

3.2.1 MOUNTING CLOSE TO MOTOR (WALL-MOUNTING)

The drive can be mounted in vertical or horizontal positon on the wall or any other relatively even mounting plane or machine frame and fixed with 4 screws or bolts. Recommended screw or bolt size for MM4 is M6 and for MM5 it is M8.

3.2.2 MOTOR MOUNT

The drive can also be mounted in horizontal position on top or on any side of the motor. The drive is equipped with a cooling system independent of the motor. Motor-mounting requires special adapting components . Contact factory for additional information.

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3.3 COOLING

The AC drive produces heat in operation and is cooled down by air circulated by a fan. The cooling concept is independent of the motor fan.

Enough free space shall therefore be left around the AC drive to ensure sufficient air circulation and cooling. Different acts of maintenance may also require certain amount of free space.

Make sure that the temperature of the cooling air does not exceed the maximum ambient temperature of the converter.

Contact factory for more information on required clearances in different installations.

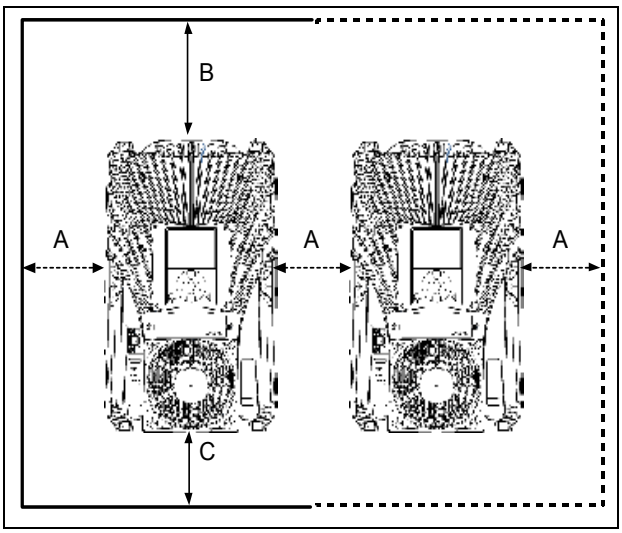

Figure 8. Installation space

Min clearance [mm]			
Type	**A**	**B**	**C**
All types	80	160	60

Table 4. Min. clearances around AC drive

A = Clearance left and right from the drive
B = Clearance above the drive
C = Clearance underneath the AC drive

Type	Cooling air required [m^3/h]
MM4	140
MM5	140

Table 5. Required cooling air

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4. POWER CABLING

The mains cables are connected to terminals L1, L2 and L3 and the motor cables to terminals marked with U, V and W. See principal connection diagram in Figure 9. See also Table 6 for the cable recommmendations for different EMC levels.

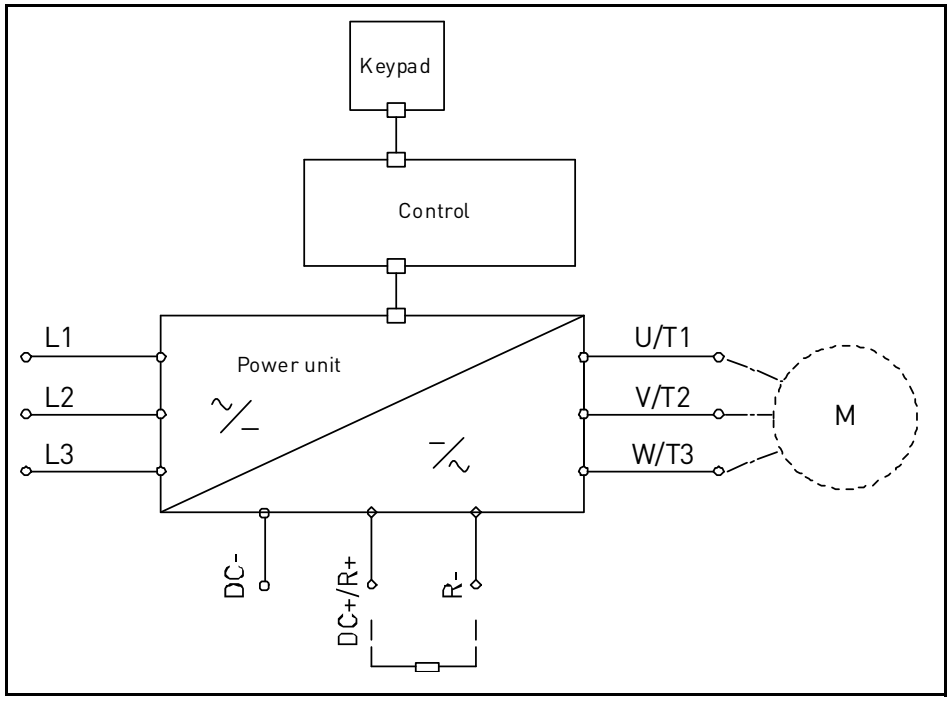


Figure 9. Principal connection diagram

The cable leading-ins can be done from both sides and from the front of the drive. For detailed instructions, see chapter 4.4.

Use cables with heat resistance of at least +70°C. The cables and the fuses must be dimensioned according to the AC drive nominal OUTPUT current which you can find on the rating plate.

Cable type	1st environment 2nd environment EMC levels According to EN61800-3 (2004)		
	Category C2	Category C3	Level T
Mains cable	1	1	1
Motor cable	3*	2	2
Control cable	4	4	4

Table 6. Cable types required to meet standards

1 = Power cable intended for fixed installation and the specific mains voltage. Shielded cable not required. (MCMK or similar recommended).
2 = Symmetrical power cable equipped with concentric protection wire and intended for the specific mains voltage. (MCMK or similar recommended). See Figure 10.

3 = Symmetrical power cable equipped with compact low-impedance shield and intended for the specific mains voltage. [MCCMK, EMCMK or similar recommended; Recommended cable transfer impedance (1...30MHz) max. 100mohm/m]. See Figure 10. *360º earthing of the shield with cable glands in motor end needed for EMC level C2.
4 = Screened cable equipped with compact low-impedance shield (JAMAK, SAB/ÖZCuY-O or similar).

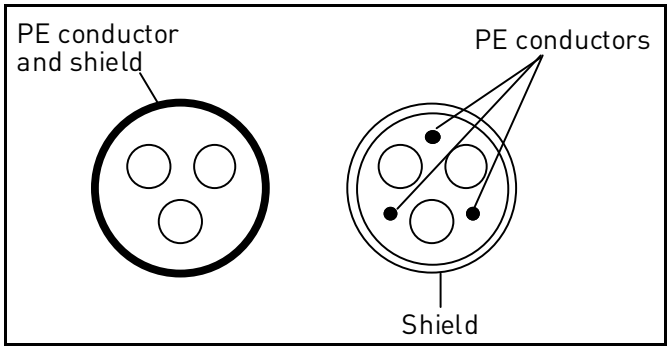


Figure 10.

NOTE: The EMC requirements are fulfilled at factory defaults of switching frequencies (all frames).
NOTE: If safety switch is connected the EMC protection shall be continuous over the whole cable installation.

4.1 UL STANDARDS ON CABLING

To meet the UL (Underwriters Laboratories) regulations, use a UL-approved copper cable with a minimum heat-resistance of +60/75°C. Use Class 1 wire only.

The units are suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 600V maximum.

4.1.1 CABLE DIMENSIONING AND SELECTION

Table 7 shows the minimum dimensions of the Cu/Al-cables and the corresponding fuse sizes. Recommended fuse types are gG/gL.

These instructions apply only to cases with one motor and one cable connection from the AC drive to the motor. In any other case, ask the factory for more information.

4.1.1.1 CABLE AND FUSE SIZES, FRAMES MM4 TO MM5

The recommended fuse types are gG/gL (IEC 60269-1) or class T (UL & CSA). The fuse voltage rating should be selected according to the supply network. The final selection should be made according to local regulations, cable installation conditions and cable specification. Bigger fuses than what is recommended below shall not be used.

Check that the fuse operating time is less than 0.4 seconds. Operating time depends on used fuse type and impedance of the supply circuit. Consult the factory about faster fuses. Vacon offers recommendations also for high speed J (UL & CSA), aR (UL recognized, IEC 60269-4) and gS (IEC 60269-4) fuse ranges.

Frame	Type	I_L [A]	Fuse (gG/gL) [A]	Mains and motor cable Cu [mm^2]	Terminal cable size	
					Main terminal [mm^2]	Earth terminal [mm^2]
MM4	0003 4—0004 4	3.4—4.8	6	3*1.5+1.5	1—10 solid 1—6 stranded	1—6
	0005 4—0008 4	5.6—8.0	10	3*1.5+1.5	1—10 solid 1—6 stranded	1—6
	0009 4—0012 4	9.6—12.0	16	3*2.5+2.5	1—10 solid 1—6 stranded	1—6
MM5	0016 4	16.0	20	3*6+6	1—16 Cu	1—10
	0023 4	23.0	25	3*6+6	1—16 Cu	1—10
	0031 4	31.0	32	3*10+10	1—16 Cu	1—10

Table 7. Cable and fuse sizes for Vacon 100 (MM4 and MM5)

The cable dimensioning is based on the criteria of the International Standard **IEC60364-5-52**:Cables must be PVC-isolated; Max ambient temperature +30°C, max temperature of cable surface +70°C; Use only cables with concentric copper shield; Max number of parallel cables is 9.
When using cables in parallel, **NOTE HOWEVER** that the requirements of both the cross-sectional area and the max number of cables must be observed.
For important information on the requirements of the earthing conductor, see chapter Earthing and earth fault protection of the standard.

For the correction factors for each temperature, see International Standard **IEC60364-5-52**.

4.2 BRAKE RESISTOR CABLES

Vacon AC drives are equipped with terminals for an optional external brake resistor. These terminals are marked with **DC+/R+** and **R-**.

4.3 CONTROL CABLES

For information on control cables see chapter Control unit cabling.

4.4 CABLE INSTALLATION

- Before starting, check that none of the components of the AC drive is live. Read carefully the warnings in chapter 1.
- Place the motor cables sufficiently far from other cables
- Avoid placing the motor cables in long parallel lines with other cables.
- If the motor cables run in parallel with other cables note the minimum distances between the motor cables and other cables given in table below.

Distance between cables, [m]	Shielded cable, [m]
0.3	≤ 50
1.0	≤ 200

- The given distances also apply between the motor cables and signal cables of other systems.
- The **maximum length with full EMC compliance** for motor cables is 5m (wall-mounted version)
- The motor cables should cross other cables at an angle of 90 degrees.
- If cable insulation checks are needed, see chapter Cable and motor insulation checks.

Start the cable installation according to the instructions below:

1	Strip the motor and mains cables as advised below.

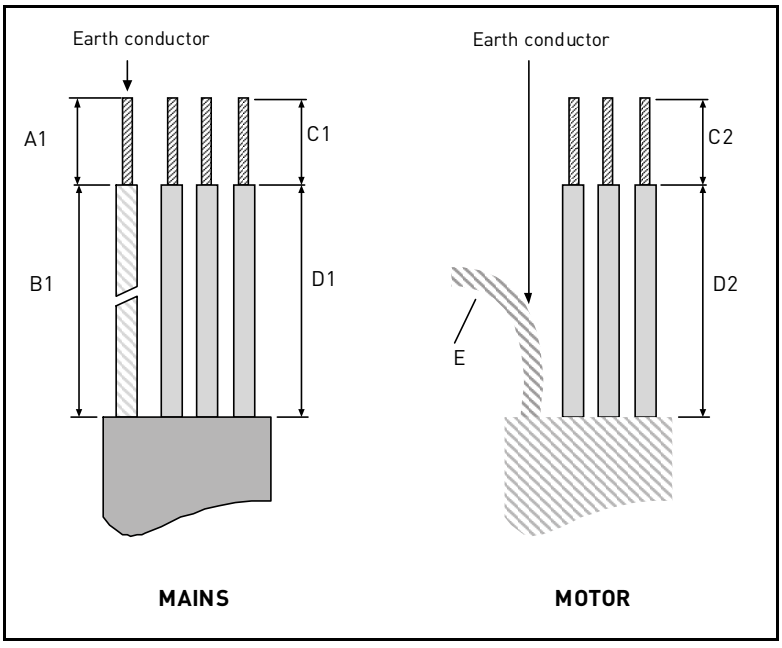


Figure 11. Stripping of cables

Frame	A1	B1	C1	D1	C2	D2	E
MM4	12		12		12		
MM5	10		10		10		

Table 8. Cables stripping lengths [mm]

Tightening torques of cable terminals:

Frame	Type	Tightening torque [Nm]/[lb-in.] Power and motor terminals		Tightening torque [Nm]/[lb-in.] EMC grounding clamps		Tightening torque, [Nm]/[lb-in.] Grounding terminals	
		[Nm]	lb-in.	[Nm]	lb-in.	[Nm]	lb-in.
MM4	0003 4—0012 4	1.2—1.5	10.6—13.3	1.5	13.3	2.0	17.7
MM5	0016 4—0031 4	1.2—1.5	10.6—13.3	1.5	13.3	2.0	17.7

Table 9. Tightening torques of terminals

5. COMMISSIONING

Before commissioning, note the following directions and warnings:

⚠	Internal components and circuit boards of Vacon 100 Motor Mountable drive (except for the galvanically isolated I/O terminals) are live when it is connected to mains potential. **Coming into contact with this voltage is extremely dangerous and may cause death or severe injury.**
⚠	The motor terminals **U**, **V**, **W** and the brake resistor terminals **B-/B+ are live** when Vacon 100 Motor Mountable drive is connected to mains, **even if the motor is not running**.
⚠	The control I/O-terminals are isolated from the mains potential. However, the **relay outputs and other I/O-terminals may have a dangerous control voltage** present even when Vacon 100 Motor Mountable drive is disconnected from mains.
⚠	Do not make any connections to or from the frequency converter when it is connected to the mains.
⚠	**After disconnecting** the AC drive from the mains, **wait** until the indicators on the powerhead go out. Wait 5 more minutes before doing any work on the connections of Vacon100 Motor Mountable Drive. Do not open the unit before this time has expired. After expiration of this time, use a measuring equipment to absolutely ensure that no voltage is present. **Always ensure absence of voltage before starting any electrical work!**
⚠	**Before connecting** the AC drive to mains make sure that the powerhead Vacon 100 Motor Mountable Drive is mounted firmly on the terminal box.

5.1 COMMISSIONING OF THE DRIVE

Read carefully the safety instructions in Chapter 1 and above and follow them.

After the installation:

- ☐ Check that both the frequency converter and the motor are **grounded**.
- ☐ Check that the mains and motor cables **comply with the requirements** given in chapter 4.1.1.
- ☐ Check that the control cables are **located as far as possible** from the power cables, see chapter 4.4.
- ☐ Check that the **shields** of the shielded cables are **connected to protective earth** marked with  .
- ☐ Check the **tightening torques** of all terminals
- ☐ Check that the **wires do not touch** the electrical components of the drive.
- ☐ Check that the common inputs of digital input groups are connected to +24V or ground of the I/O terminal or the external supply.
- ☐ Check the **quality and quantity** of cooling air (chapter 3.3 and Table 5).
- ☐ Check the inside of the frequency converter for **condensation**.
- ☐ **Check that all Start/Stop switches connected to the I/O terminals are in Stop-position.**
- ☐ Before connecting the frequency converter to mains: Check **mounting and condition** of all fuses and other protective devices.
- ☐ Run the Startup Wizard (see the Application Manual).

5.2 CHANGING EMC PROTECTION CLASS

If your supply network is an IT (impedance-grounded) system but your AC drive is EMC-protected according to class C2 you need to modify the EMC protection of the AC drive to EMC-level T. This is done by removing the EMC screws as described below:

⚠	Warning! Do not perform any modifications on the AC drive when it is connected to mains.

1	Separate the powerhead and the terminal box. Turn the powerhead upside down and remove the two screws marked in Figure 12 (for MM4) and Figure 13 (for MM5).

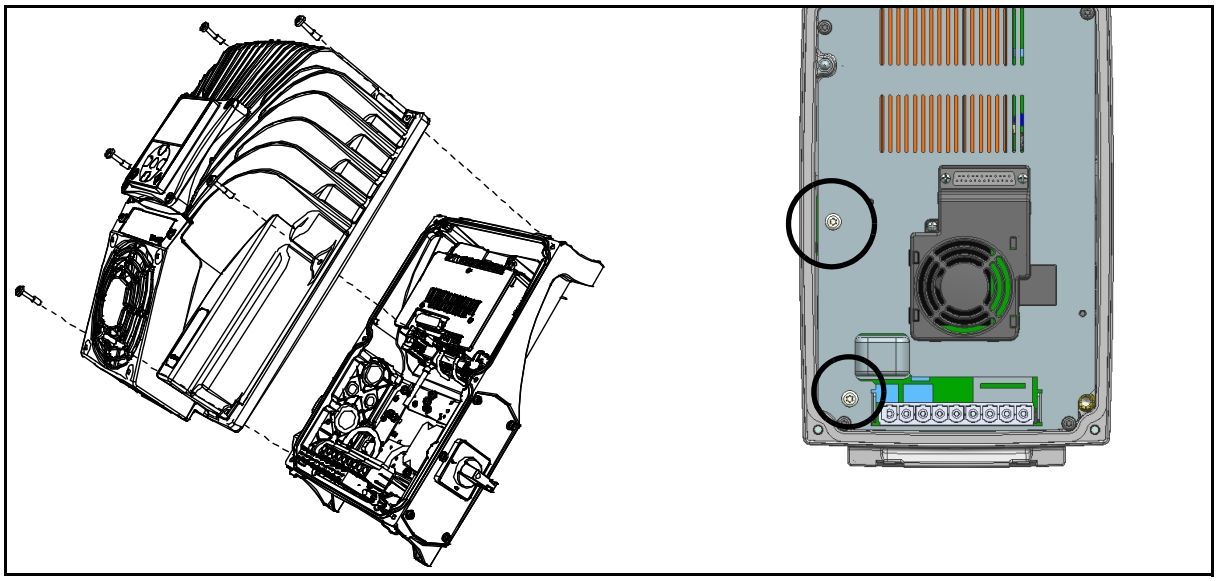


Figure 12.

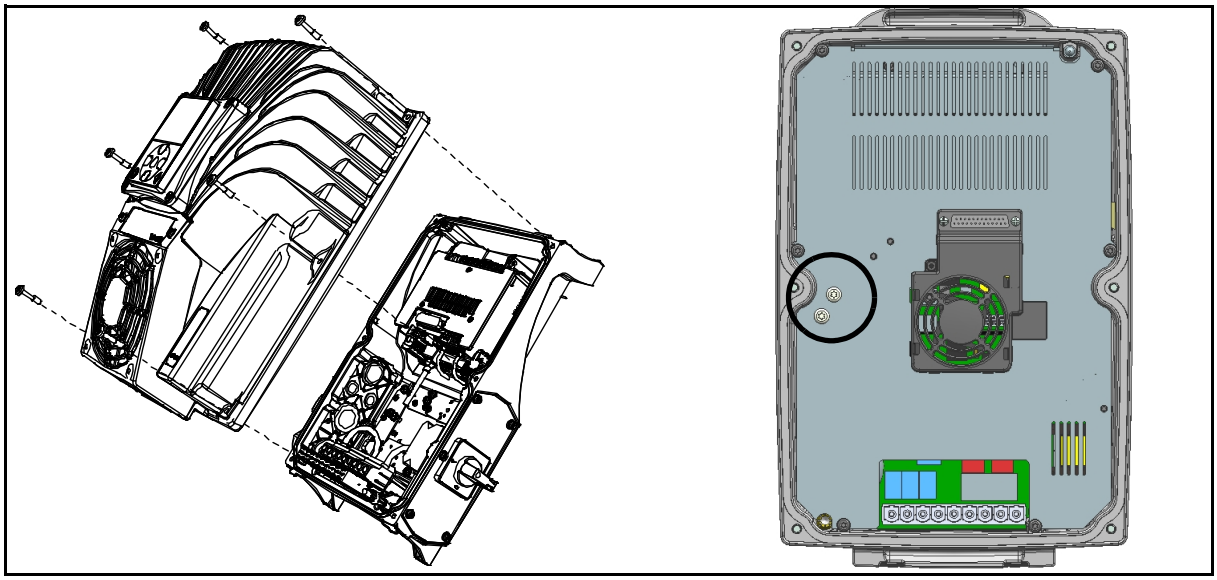
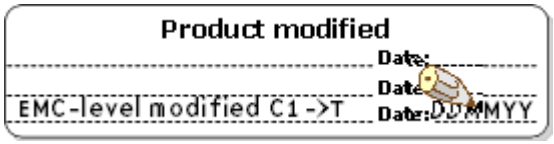


Figure 13.

	CAUTION! Before connecting the AC drive to mains make sure that the EMC protection class settings of the drive are appropriately made.
	NOTE! After having performed the change write *'EMC level modified'* on the sticker included in the Vacon 100 delivery (see below) and note the date. Unless already done, attach the sticker close to the name plate of the AC drive. 

5.3 RUNNING THE MOTOR

MOTOR RUN CHECK LIST

⚠	**Before starting the motor**, check that the motor is **mounted properly** and ensure that the machine connected to the motor allows the motor to be started.
⚠	Set the maximum motor speed (frequency) according to the motor and the machine connected to it.
⚠	**Before reversing the motor** make sure that this can be done safely.
⚠	Make sure that no power correction capacitors are connected to the motor cable.
⚠	Make sure that the motor terminals are not connected to mains potential.

5.3.1 CABLE AND MOTOR INSULATION CHECKS

1. Motor cable insulation checks
   Disconnect the motor cable from terminals U, V and W of the AC drive and from the motor. Measure the insulation resistance of the motor cable between each phase conductor as well as between each phase conductor and the protective ground conductor. The insulation resistance must be >1MΩ at ambient temperature of 20°C.
2. Mains cable insulation checks
   Disconnect the mains cable from terminals L1, L2 and L3 of the AC drive and from the mains. Measure the insulation resistance of the mains cable between each phase conductor as well as between each phase conductor and the protective ground conductor. The insulation resistance must be >1MΩ at ambient temperature of 20°C.
3. Motor insulation checks
   Disconnect the motor cable from the motor and open the bridging connections in the motor connection box. Measure the insulation resistance of each motor winding. The measurement voltage must equal at least the motor nominal voltage but not exceed 1000 V. The insulation resistance must be >1MΩ at ambient temperature of 20°C.

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5.4 MAINTENANCE

In normal conditions, the AC drive is maintenance-free. However, regular maintenance is recommended to ensure a trouble-free operation and a long lifetime of the drive. We recommend to follow the table below for maintenance intervals.

NOTE: Because of capacitor type (thin film capacitors), reforming of capacitors is not necessary.

Maintenance interval	Maintenance action
Regularly and according to general maintenance interval	• Check tightening torques of terminals
6...24 months (depending on environment)	• Check input and output terminals and control I/O terminals. • Check operation of cooling fan • Check for corrosion on terminals and other surfaces • Check the heatsink for dust and clean if necessary
6...10 years	• Change main fan

6. CONTROL UNIT

Remove the powerhead of the drive to reveal the terminal box with the control terminals.

The control unit of the AC drive consists of the control board and additional boards (option boards) connected to the slot connectors of the control board. The locations of boards, terminals and switches are presented in Figure 14 below.

Number	Meaning
1	Control terminals 1-11 (see chapter 6.1.2)
2	Control terminals 12-30, A-B (see chapter 6.1.2)
3	Relay terminals (see chapter 6.1.2)
4	Termistor input (see chapter 6.1.2)
5	DIP switches (see chapter 6.1.2.1)
6	Jumper switches (see chapter 6.1.2.2)
7	Ethernet terminal (see chapter 6.2.1)
8	Option boards

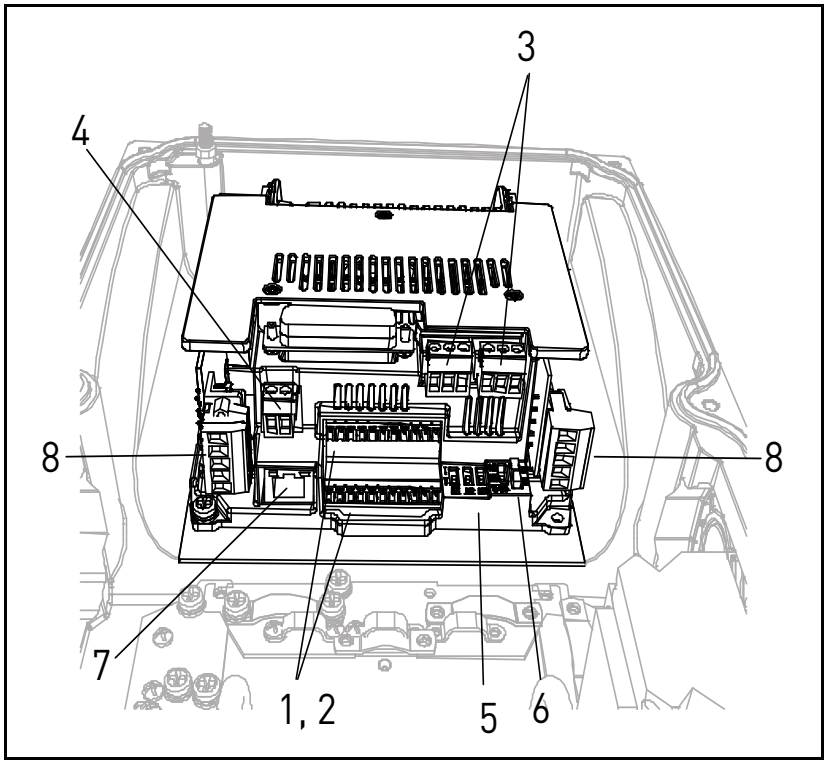

Figure 14. Location of control unit components

When delivered from the factory, the control unit of the AC drive contains the standard controlling interface - the control terminals of the control board and the relay board - unless otherwise specifically ordered. On the next pages you will find the arrangement of the control I/O and the relay terminals, the general wiring diagram and the control signal descriptions.

The control board can be powered externally (+24VDC, 100mA, ±10%) by connecting the external power source to terminal #30, see page 30. This voltage is sufficient for parameter setting

and for keeping the control unit active. Note however that the measurements of the main circuit (e.g. DC-link voltage, unit temperature) are not available when the mains is not connected.

6.1 CONTROL UNIT CABLING

The principal terminal block placement is presented in Figure 15 below. The control board is equipped with 22 fixed control I/O terminals and the relay board with 6+2. All signal descriptions are given in Tables 11 to 12.

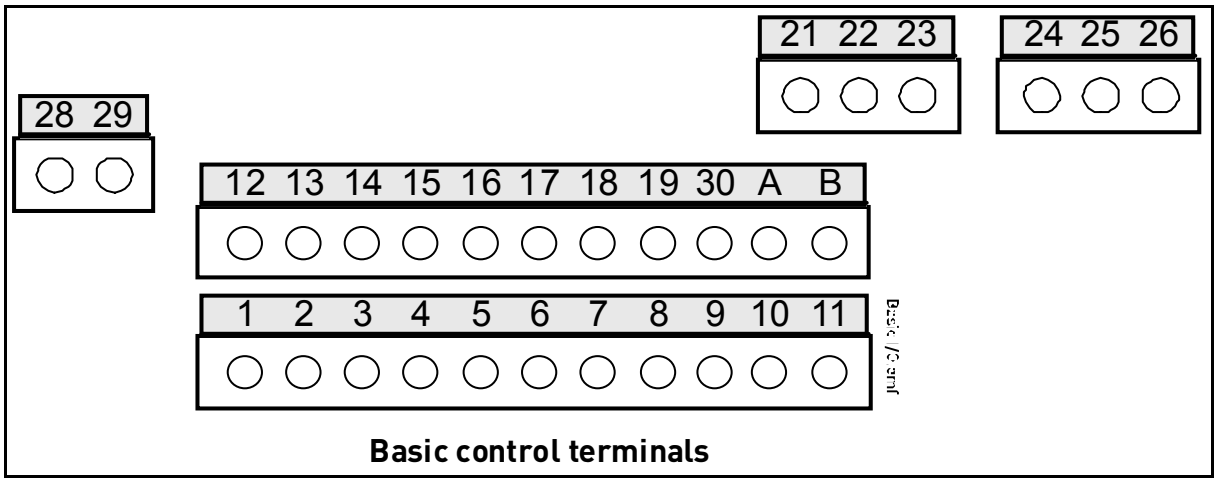

Figure 15.

6.1.1 CONTROL CABLE SIZING

The control cables shall be at least 0.5 mm² screened multicore cables, see Table 6. The maximum terminal wire size is 2.5 mm² for the relay terminals and 1.5 mm² for other terminals.

Find the tightening torques of the control and relay board terminals in Table 10 below.

Terminal screw	Tightening torque	
	Nm	lb-in.
I/O terminals (screw M2)	0.2	1.8
Relay terminals (screw M3)	0.5	4.5

Table 10. Control cable tightening torques

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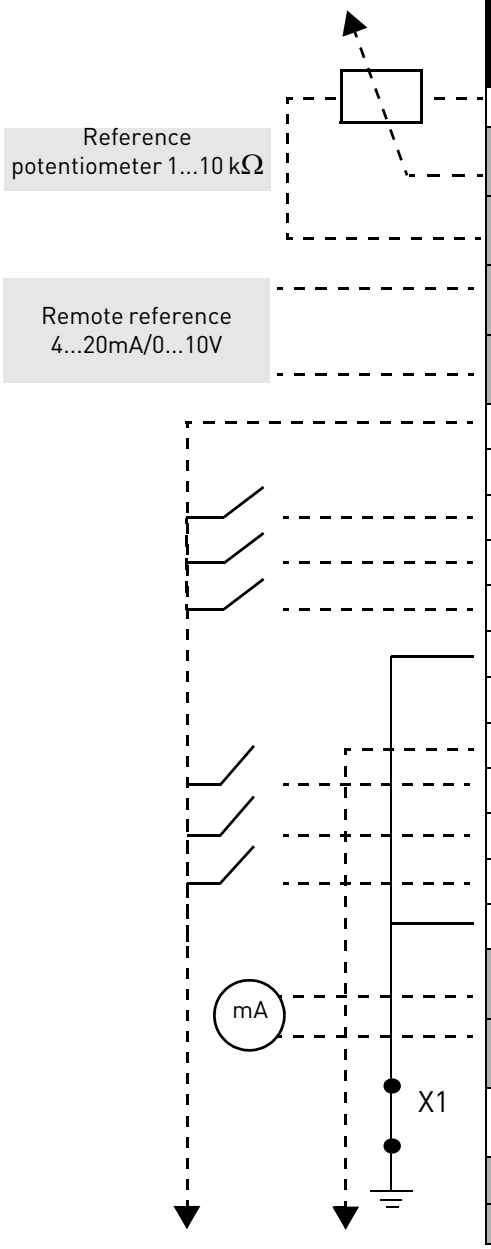
6.1.2 CONTROL TERMINALS AND DIP SWITCHES

The terminals of the *Basic I/O board* and the *Relay boards* are described below. For more information on the connections, see chapter 7.2.1.

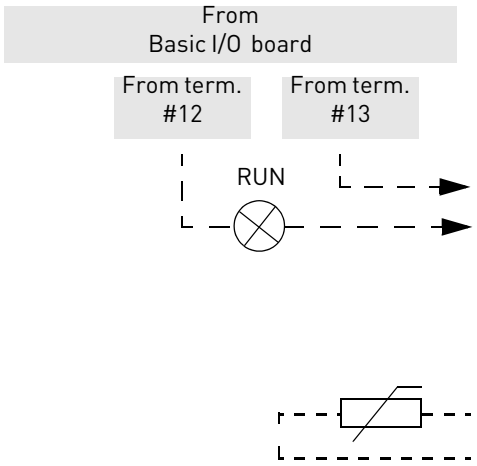
The terminals shown on shadowed background are assigned for signals with optional functions selectable with DIP switches. See more information in chapter 6.1.2.1 on page 31.



Basic I/O board		
Terminal		Signal
1	+10 Vref	Reference output
2	AI1+	Analogue input, voltage or current
3	AI1-	Analogue input common (current)
4	AI2+	Analogue input, voltage or current
5	AI2-	Analogue input common (current)
6	24Vout	24V aux. voltage
7	GND	I/O ground
8	DI1	Digital input 1
9	DI2	Digital input 2
10	DI3	Digital input 3
11	CM	Common for DI1-DI6*
12	24Vout	24V aux. voltage
13	GND	I/O ground
14	DI4	Digital input 4
15	DI5	Digital input 5
16	DI6	Digital input 6
17	CM	Common for DI1-DI6*
18	AO1+	Analogue signal (+output)
19	AO-/GND	Analogue output common
30	+24 Vin	24V auxiliary input voltage
A	RS485	Serial bus, negative**
B	RS485	Serial bus, positive**

*. Can be isolated from ground, see chapter 6.1.2.2.
**. Can be isolated from earth, see chapter 6.1.2.3.

Table 11. Control I/O terminal signals on basic I/O board and connection example



Relay board		
Terminal		Signal
21	RO1/1	Relay output 1
22	RO1/2	
23	RO1/3	
24	RO2/1	Relay output 2
25	RO2/2	
26	RO2/3	
28	TI1+	Thermistor input
29	TI1-	

Table 12. Control I/O terminal signals on relay board 2 and connection example

6.1.2.1 SELECTION OF TERMINAL FUNCTIONS WITH DIP SWITCHES

The shadowed terminals in Table 11 allow for three functional selections each with the so-called *dip switches*. The switches have three positions, up, middle and down. The middle position is for *Test mode*. See Figure 14 to locate the switches and make appropriate selections for your requirements.

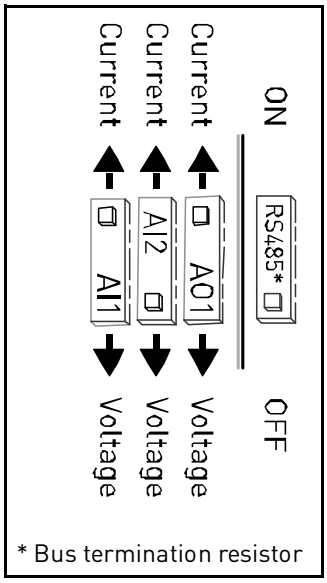


Figure 16. Dip switches

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6.1.2.2 ISOLATING DIGITAL INPUTS FROM GROUND

The digital inputs (terminals 8-10 and 14-16) on the basic I/O board can be **isolated** from ground by lifting up jumper X1 on the control board. See Figure 17. Locate the jumper and apply long-nose pliers or similar to lift it up.

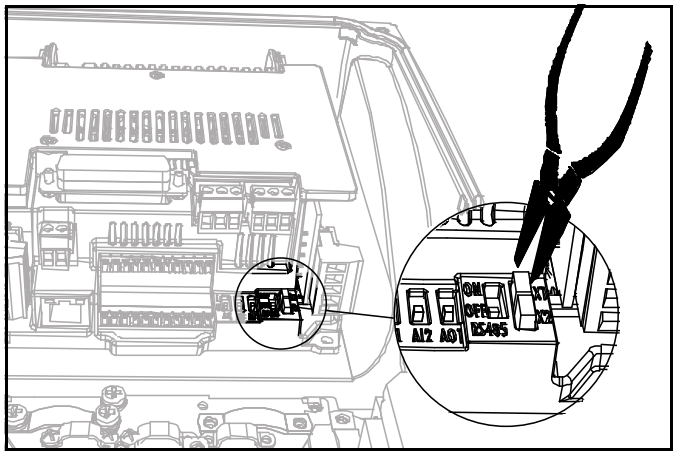


Figure 17. Lift jumper X1 up to disconnect the digital inputs from ground.

6.1.2.3 ELIMINATING EARTH REFERENCE OF RS485 SUPPLY

The earth reference of the RS485 supply (terminals A and B) on the basic I/O board can be **eliminated** by lifting up jumper X2 on the control board. See Figure 17. Locate the jumper and apply long-nose pliers or similar to lift it up. See also Figure 22.

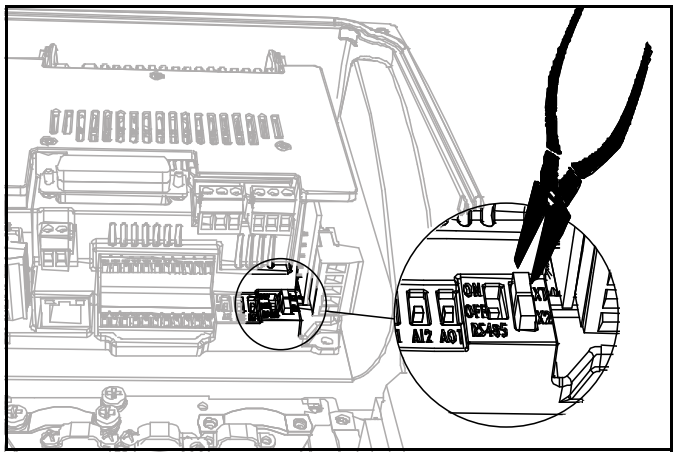


Figure 18. Lift jumper X2 up to eliminate the earth reference of the RS485 supply.

6.2 I/O CABLING AND FIELDBUS CONNECTION

The AC drive can be connected to fieldbus either through RS485 or Ethernet. The connection for RS485 is on the basic I/O board (terminals A and B) and the connection for Ethernet is left to the control terminals. See Figure 19.

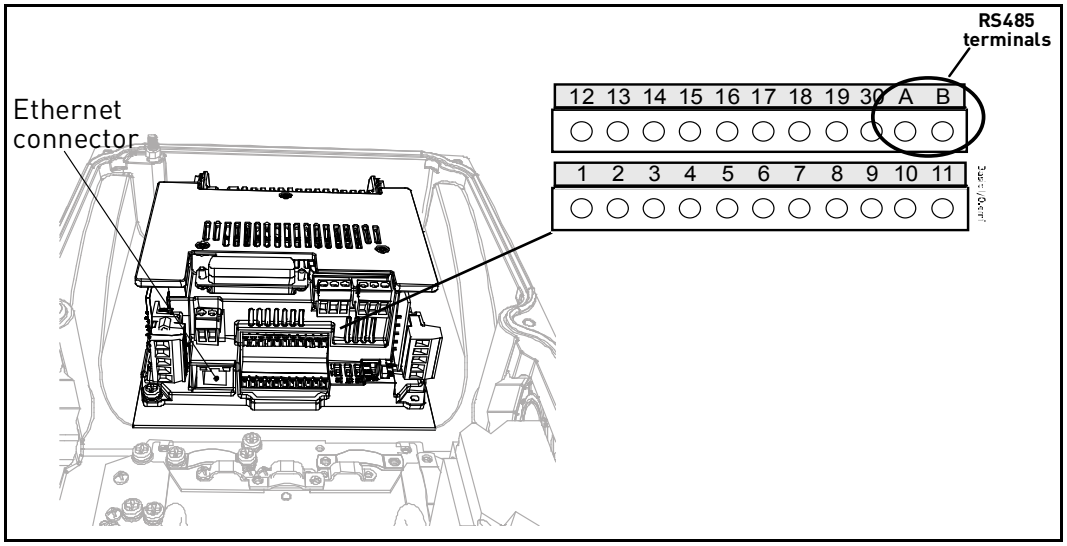


Figure 19.

6.2.1 PREPARE FOR USE THROUGH ETHERNET

1	Connect the Ethernet cable (see specification on page 33) to its terminal.

2	Remount the powerhead. **NOTE:** When planning the cable runs, remember to keep the distance between the Ethernet cable and the motor cable at a **minimum of 30 cm**.

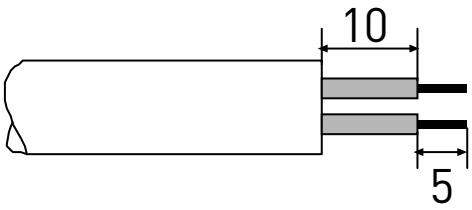
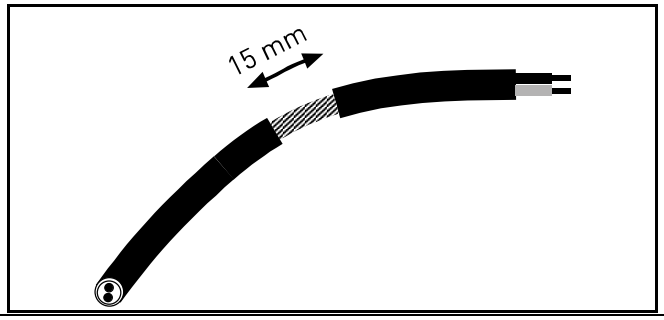
For more detailed information, see the user's manual of the fieldbus you are using.

6.2.1.1 ETHERNET CABLE DATA

Connector	Shielded RJ45 connector
Cable type	CAT5e STP
Cable length	Max .100m

Table 13. Ethernet cable data

6.2.2 PREPARE FOR USE THROUGH RS485

1	Strip about 15 mm of the RS485 cable (see specification on page 35) and cut off the grey cable shield. Remember to do this for both bus cables (except for the last device). Leave no more than 10 mm of the cable outside the terminal block and strip the cables at about 5 mm to fit in the terminals. See picture below.  Also strip the cable now at such a distance from the terminal that you can fix it to the frame with the grounding clamp. Strip the cable at a maximum length of 15 mm. **Do not strip the aluminum cable shield!** 

2	Then connect the cable to its appropriate terminals on Vacon 100 AC drive standard terminal block, terminals **A and B** (A = negative, B = positive). See Figure 20.

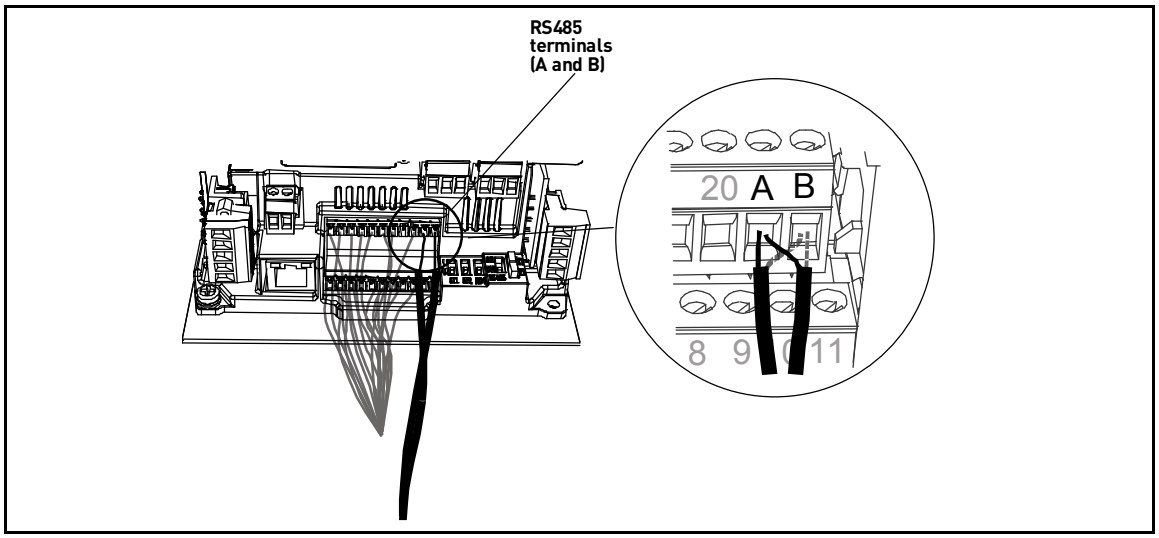
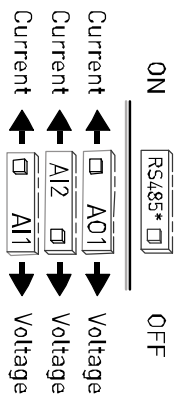
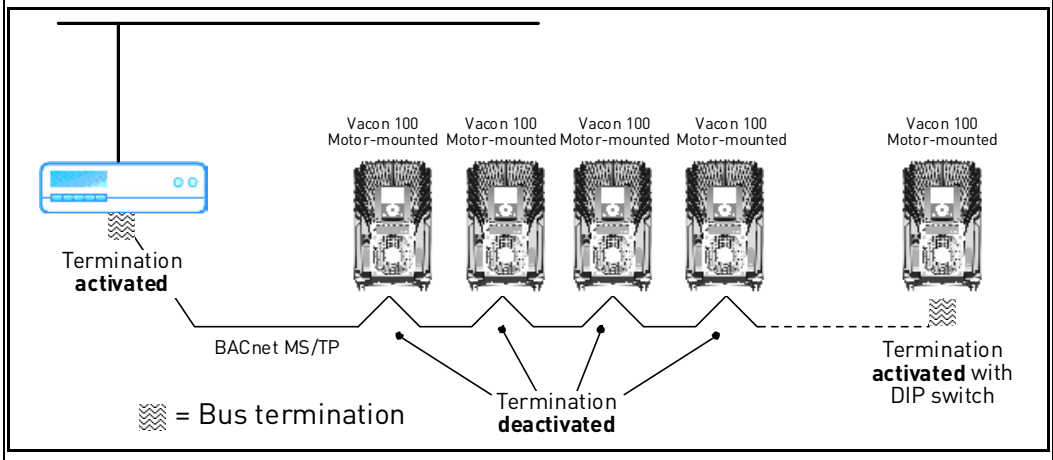


Figure 20.

3	Using the cable clamp included in the delivery of the drive, ground the shield of the RS485 cable to the frame of the AC drive.
4	**If Vacon 100 Motor Mountable drive is the last device on the bus**, the bus termination must be set. Locate the DIP switches to the right of the control terminals (see Figure 16) and turn the rightmost switch to position ON. Biasing is built in the termination resistor. See also step 6 on page 35.  * Bus termination resistor
5	**NOTE:** When planning the cable runs, remember to keep the distance between the fieldbus cable and the motor cable at a **minimum of 30 cm**.
6	The bus termination must be set for the first and the last device of the fieldbus line. See picture below. See also step 4 on page 35. We recommend that the first device on the bus and, thus, terminated was the Master device. 

6.2.3 RS485 CABLE DATA

Connector	2.5 mm²
Cable type	STP (Shielded Twisted Pair), type Belden 9841 or similar
Cable length	Depends on the used fieldbus. See respective bus manual.

Table 14. RS485 cable data

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6.3 BATTERY INSTALLATION FOR REAL TIME CLOCK (RTC)

Enabling the functions of the *Real Time Clock (RTC)* requires that an optional battery is installed in the Vacon 100 Motor Mountable drive.

The place for the battery can be found under the control box cover as shown in Figure 21.

Detailed information on the functions of the *Real Time Clock (RTC)* can be found in the Vacon 100 HVAC Application Manual.

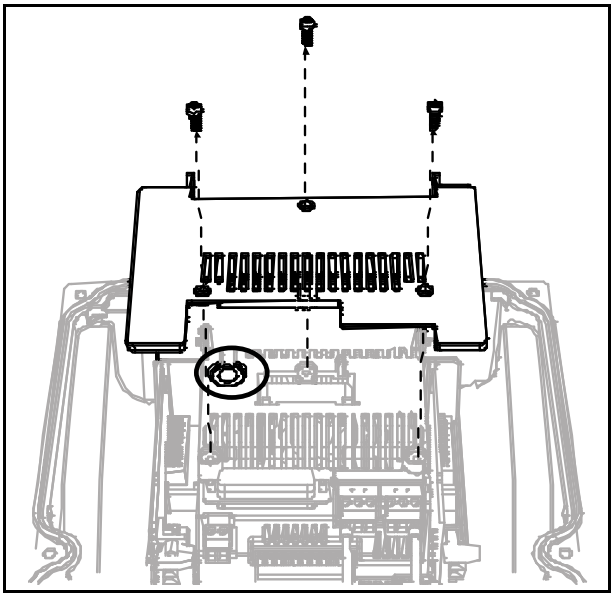

Figure 21. Optional battery

6.4 GALVANIC ISOLATION BARRIERS

The control connections are isolated from the mains potential and the GND terminals are permanently connected to ground. See Figure 22.

The digital inputs are galvanically isolated from the I/O ground. The relay outputs are additionally double-isolated from each other at 300VAC (EN-50178).

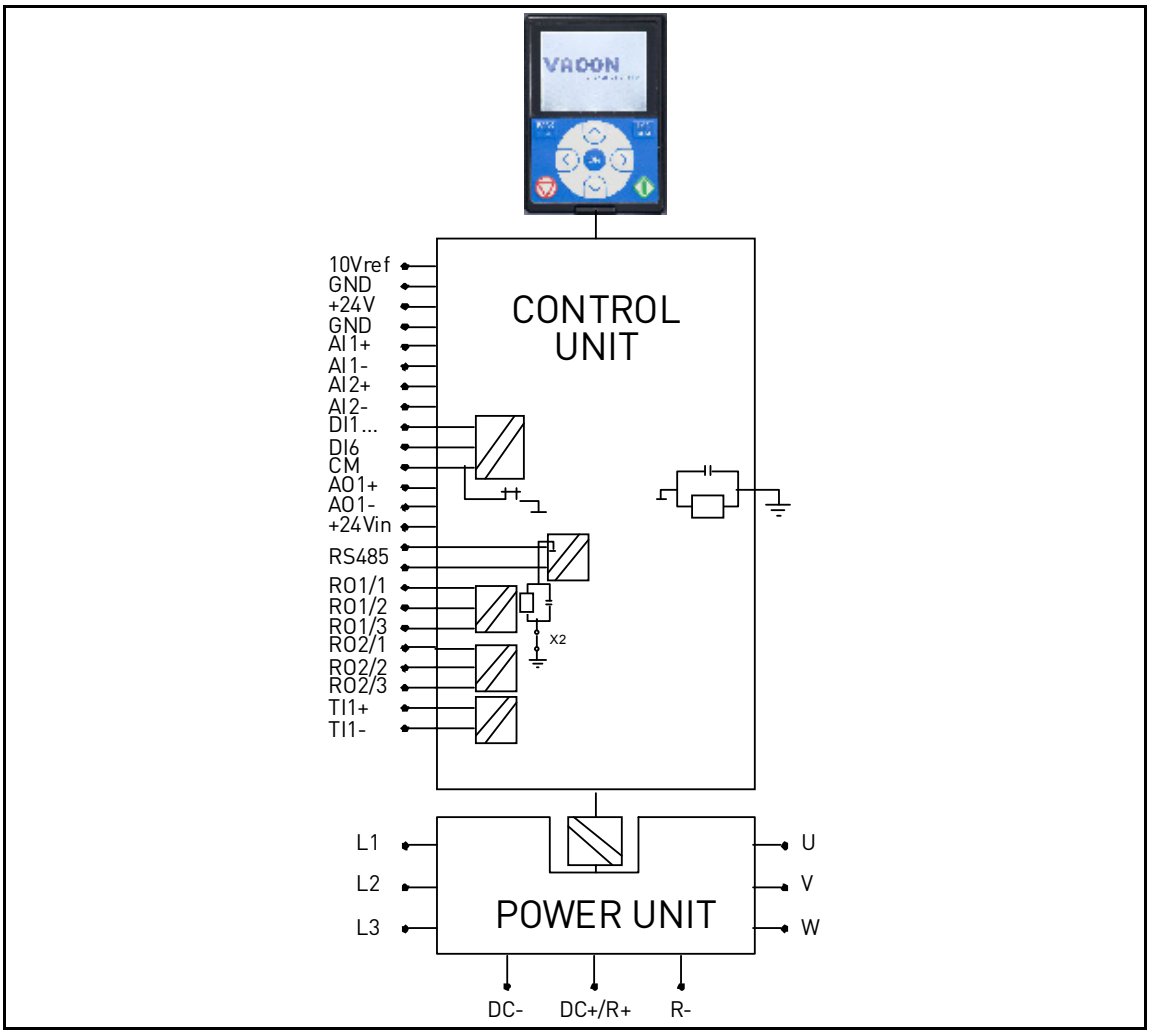

Figure 22. Galvanic isolation barriers

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7. TECHNICAL DATA

7.1 AC DRIVE POWER RATINGS

7.1.1 MAINS VOLTAGE 380-480 V

	Mains voltage 380-480V, 50-60 Hz, 3~					
	Converter type	Loadability			Motor shaft power 400V-480V supply	
		Rated continuous current I_N [A]	50% overload current [A]	Max current I_S	[kW]	[HP]
MM4	0003	**3,4**	5,1	6,8	**1,1**	**1,5**
	0004	**4,8**	7,2	9,6	**1,5**	**2,0**
	0005	**5,6**	8,4	11,2	**2,2**	**3,0**
	0008	**8,0**	12,0	16,0	**3,0**	**5,0**
	0009	**9,6**	14,4	19,2	**4,0**	**5,0**
	0012	**12,0**	18,0	24,0	**5,5**	**7,5**
MM5	0016	**16,0**	24,0	32,0	**7,5**	**10**
	0023	**23,0**	34,5	46,0	**11,0**	**15**
	0031	**31,0**	46,5	62,0	**15,0**	**20**

Table 15. Power ratings of Vacon 100 MM, supply voltage 400-480V.

NOTE: The rated currents in given ambient temperatures (in Table 16) are achieved only when the switching frequency is equal to or less than the factory default.

7.1.2 DEFINITIONS OF OVERLOADABILITY

Overload ability =Following continuous operation at rated output current I_N, the converter is fed with 150 % * I_N for 1 min, followed by a period of I_N.

Example: If the duty cycle requires 150 % rated current for 1 min in every 10 min, the remaining 9 min must be at rated current I_N or less.

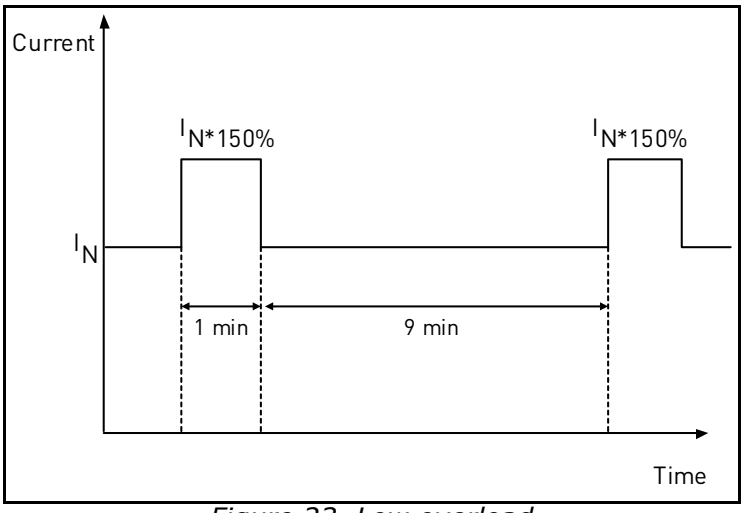

Figure 23. Low overload

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7.2 VACON 100 - TECHNICAL DATA

Mains connection	Input voltage U_{in}	380...480V; -10%...+10% continuosly
	Input frequency	45...66 Hz
	Connection to mains	Once per minute or less
	Starting delay	4 s (MM4 to MM6)
	Maintenance switch	Optional
Motor connection	Output voltage	0...[0,95...1,0] x U_{in}
	Continuous output current	I_N: Ambient temperature max. +40°C,overload 1.5 x I_N (1 min/10 min), 2.0 x I_N (2 s/20 s)
	Starting current Starting torque	I_S for 2 s every 20 s (I_S = 2.0 * I_N) Depends on motor
	Output frequency	0...320 Hz (standard)
	Frequency resolution	0.1 Hz
	Motor characteristics	AC squirrel cage motors Permanent magnet motors
Control characteristics	Switching frequency (See par. P3.1.2.2)	Programmable 6...15 kHz; ≤ 15 kW: 6 kHz (std.)...15 kHz (with derating) > 15 kW: 6 kHz (std.)...10 kHz (with derating) Automatic switching frequency derating in case of overheating
	Motor control methods	Quadratic and Constant Torque
	Frequency reference Analogue input Panel reference	 Resolution 0.1% (10-bit), accuracy ±1% Resolution 0.01 Hz
	Field weakening point	8...320 Hz
	Acceleration time	0.1...300 sec
	Deceleration time	0.1...300 sec
	Braking	Brake chopper standard for ≤ 30kW External brake resistor optional
Control connections	See chapter 7.2.1.	
Communication interface	Fieldbus	Standard: Serial communication (RS485/Modbus); Ethernet Optional: CANOpen; Profibus
	Status indicators	Drive status indicators (LED) on top side (POWER, RUN, FAULT, READY)

Ambient conditions	Ambient operating temperature	I_N : -10°C (no frost)...+40°C (...+50°C with derating)
	Storage temperature	-40°C...+70°C
	Relative humidity	0 to 95% R_H, non-condensing, non-corrosive
	Air quality: • chemical vapours • mechanical particles	 IEC 60721-3-3, unit in operation, class 3C2 IEC 60721-3-3, unit in operation, class 3S2
	Pollution degree PCB coating	NEMA ICS-1, IEC60664 and UL840: Degree 2 Varnished boards as standard
	Altitude	100% load capacity (no derating) up to 1,000m 1-% derating for each 100m at 1,000...2,000m
	Enclosure class	IP55 option (incl. motor independent cooling system (fans)) IP66 (enclosure only)
	Flammability of materials	**Covers and external plastic materials:** UL94B 5VA **Internal materials:** V0
EMC (at default settings)	Immunity	Fulfils EN61800-3 (2004), 2nd environment
	Emissions	Depend on EMC level. +EMC2: EN61800-3 (2004), Category C2 The drive can be modified for IT-networks.
	THD	Comply with EN61000-3-12
Safety		EN 61800-5-1 (2007); See unit nameplate for more detailed approvals Safe Torque Off (STO): Contact factory

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Protections	Overvoltage trip limit	Supply voltage 400-480 V: **911 V**
	Undervoltage trip limit	Depends on supply voltage (0,8775*supply voltage): Supply voltage 400 V: Trip limit **351 V** Supply voltage 480 V: Trip limit **421 V**
	Earth fault protection	Yes
	Mains supervision	Yes
	Motor phase supervision	Yes
	Overcurrent protection	Yes
	Unit overtemperature protection	Yes
	Motor overload protection	Yes
	Motor stall protection	Yes
	Motor underload protection	Yes
	Short-circuit protection of +24V and +10V reference voltages	Yes
	Thermal motor protection	Yes (by PTC)
	Dynamic motor protection	Yes (by speed limit (I^2t))

Table 16. Vacon 100 technical data

7.2.1 TECHNICAL INFORMATION ON CONTROL CONNECTIONS

Standard I/O board		
Terminal	**Signal**	**Technical information**
1	Reference output	+10V, +3%; Maximum current 10 mA
2	Analogue input, voltage or current	Analogue input channel 1 0- +10V (Ri = 200 kΩ) 4-20 mA (Ri =250 Ω) Resolution 0.1 %, accuracy ±1 % Selection V/mA with dip-switches (see page 31) Short-circuited protected.
3	Analogue input common (current)	Differential input if not connected to ground; Allows ±20V differential mode voltage to GND
4	Analogue input, voltage or current	Analogue input channel 2 Defauit: 4-20 mA (Ri =250 Ω) 0-10 V (Ri=200kΩ) Resolution 0.1 %, accuracy ±1 % Selection V/mA with dip-switches (see page 31) Short-circuited protected.
5	Analogue input common (current)	Differential input if not connected to ground; Allows 20V differential mode voltage to GND
6	24V aux. voltage	+24V, ±10%, max volt. ripple < 100mVrms; max. 250mA Dimensioning: max. 1000mA/control unit. Short-circuit protected
7	I/O ground	Ground for reference and controls (connected internally to frame earth through 1MΩ)
8	Digital input 1	Positive or negative logic Ri = min. 5kΩ 18...30V = "1"
9	Digital input 2	
10	Digital input 3	
11	Common A for DIN1-DIN6.	Digital inputs can be isolated from ground, see chapter 6.1.2.2.
12	24V aux. voltage	+24V, ±10%, max volt. ripple < 100mVrms; max. 250mA Dimensioning: max. 1000mA/control unit. Short-circuit protected
13	I/O ground	Ground for reference and controls (connected internally to frame earth through 1MΩ)
14	Digital input 4	Positive or negative logic Ri = min. 5kΩ 18...30V = "1"
15	Digital input 5	
16	Digital input 6	
17	Common A for DIN1-DIN6.	Digital inputs can be disconnected from ground, see chapter 6.1.2.2.
18	Analogue signal (+output)	Analogue output channel 1, selection 0 -20mA, load <500 Ω Default: 0-20 mA 0-10V Resolution 0.1 %, accuracy ±2 % Selection V/mA with dip-switches (see page 31) Short-circuited protected.
19	Analogue output common	
30	24V auxiliary input voltage	Can be used as external power backup for the control unit (and fieldbus)

Standard I/O board		
Terminal	**Signal**	**Technical information**
A	RS485	Differential receiver/transmitter Set bus termination with dip switches (see page 31)
B	RS485	

Table 17. Technical information on standard I/O board

Relay board 2	Relay board with two change-over contact (SPDT) relays and a PTC thermistor input. 5,5 mm isolation between channels.	
Terminal	**Signal**	**Technical information**
21	Relay output 1*	Switching capacity 24VDC/8A 250VAC/8A 125VDC/0.4A
22		
23		Min.switching load 5V/10mA
24	Relay output 2*	Switching capacity 24VDC/8A 250VAC/8A 125VDC/0.4A
25		
26		Min.switching load 5V/10mA
28	Thermistor input	Rtrip = 4.7 kΩ (PTC); Measuring voltage 3.5V
29		

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

Table 18. Technical information on Relay board 2

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