Honeywell

# User Manual


# SmartVFD HVAC

**Variable Frequency Drives for Constant and Variable Torque Applications**

# INDEX

Document: DPD00049B
Version release date: 7.9.09

# 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** |
|  | **= Caution! Hot surface** |

*Table 1. Warning signs*

## 1.1 Danger

| | |
|---|---|
|  | The **components of the power unit of the Smart VFD HVAC 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 and the brake resistor terminals are live** when the drive is connected to mains, even if the motor is not running. |
|  | **After disconnecting** the drive from the mains, **wait** until the indicators on the keypad go out (if no keypad is attached see the indicators on the cover). Wait 5 more minutes before doing any work on the connections of the drive. Do not open the cover 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 the drive is disconnected from mains. |
|  | **Before connecting** the drive to mains make sure that the front and cable covers of the drive are closed. |
|  | 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 drive before the motor has completely stopped. Wait until the indicators on the keypad go out (if no keypad is attached see the indicators on the cover). Wait additional 5 minutes before starting any work on the drive. |

## 1.2 Warnings

| | |
|---|---|
| ⚠ | The Honeywell Smart VFD HVAC is meant for **fixed installations only**. |
| ⚠ | **Do not perform any measurements** when the drive is connected to the mains. |
| ⚠ | The **ground leakage current** of the Honeywell Smart VFD HVAC exceeds 3.5mA AC. According to standard EN61800-5-1, **a reinforced protective ground connection** must be ensured. See chapter 1.3. |
| ⚠ | If the 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 Honeywell 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 drive. |
| ⚠ | **Do not touch the components on the circuit boards**. Static voltage discharge may damage the components. |
| ⚠ | Check that the **EMC level** of the drive corresponds to the requirements of your supply network. See chapter 1.4. |
| ⚠ | In a domestic environment, this product may cause radio interference in which case supplementary mitigation measures may be required. |

## 1.3 Grounding and ground fault protection

### ⚠ CAUTION!

The Honeywell Smart VFD HVAC AC drive must always be grounded with an grounding conductor connected to the grounding terminal marked with ⏚.

The ground leakage current of the 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) The protective conductor shall have a cross-sectional area of at least 10 mm² Cu or 16 mm² Al, through its total run.

b) Where the protective conductor has a cross-sectional area of less than 10 mm² Cu or 16 mm² Al, a second protective conductor of at least the same cross-sectional area shall be provided up to a point where the protective conductor has a cross-sectional area not less than 10 mm² Cu or 16 mm² Al.

c) Automatic disconnection of the supply in case of loss of continuity of the protective conductor. See chapter 4.

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

- 2.5mm² if mechanical protection is provided or
- 4mm² if mechanical protection is not provided.

The ground fault protection inside the drive protects only the drive itself against ground faults in the motor or the motor cable. It is not intended for personal safety.

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

| | |
|---|---|
| ⚠ | **Do not perform any voltage withstand tests** on any part of the drive. There is a certain procedure according to which the tests shall be performed. Ignoring this procedure may result in damaged product. |

## 1.4 Changing EMC protection class

If your supply network is an IT (impedance-grounded) system but your drive is EMC-protected according to classes C1 or C2 you need to modify the EMC protection of the drive to EMC-level **T**. This is done by removing the built-in RFI-filters from ground with a simple procedure described below:

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

### 1.4.1 Frames MR4 to MR7

| | |
|---|---|
| **1** | Remove the main cover (frames MR4 to MR7) and the cable cover (frames MR6 and MR7) of the drive (see pages 25 and 26) and locate the jumpers connecting the built-in RFI-filters to ground. See Figure 1. |

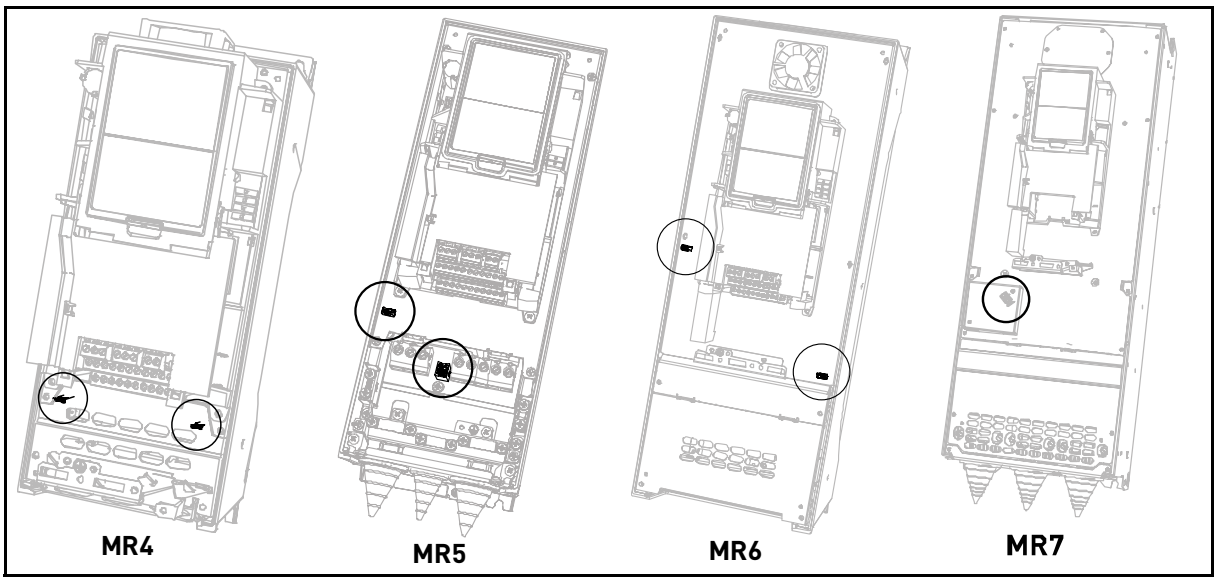



*Figure 1. Locations of the built-in RFI-filters in frames MR4 to MR7*

| | |
|---|---|
| **2** | Disconnect the RFI-filters from ground by **lifting** the jumpers **up** from their default positions. See Figure 2. |
| **3** | **NOTE!** Secure the upper position of jumpers with locking clip (provided in Accessories bag, see chapter 2.4) as shown in Figure 2. in order to prevent the jumpers from being accidentally pushed down. |

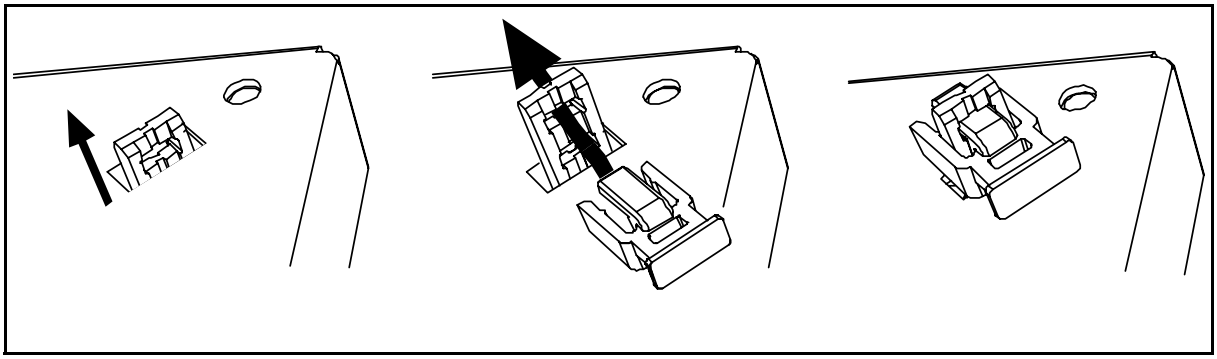


*Figure 2. Disconnecting the jumper and locking to upper position (MR7 as example)*

| | |
|---|---|
| **4** | Additionally **for MR7**, locate the DC grounding busbar between connectors R- and U and connect the busbar to the frame with an M4 screw (provided in the Accessories bag). |

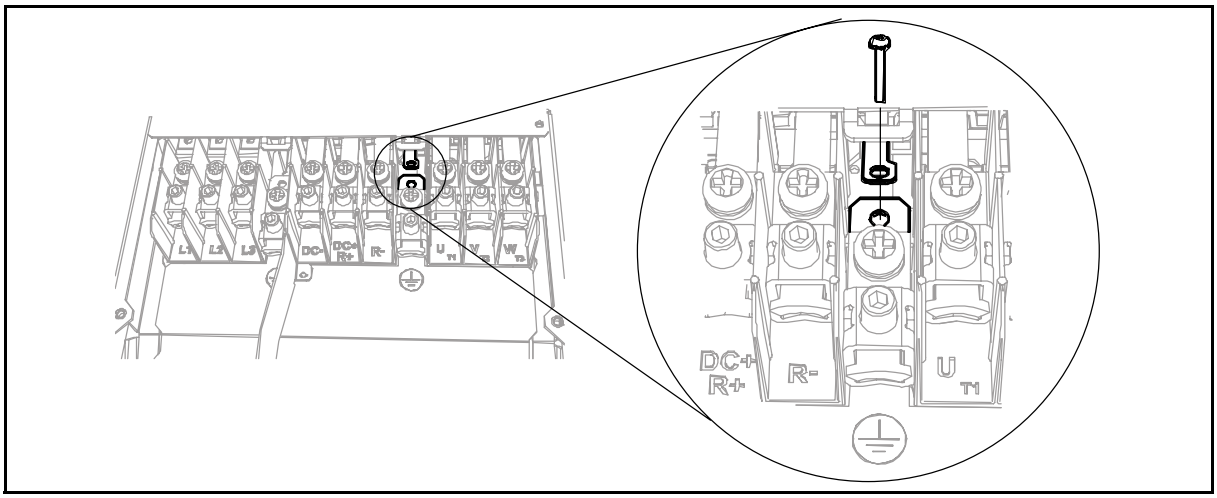



*Figure 3. MR7: Connecting the DC grounding busbar to frame*

| | |
|---|---|
| | **CAUTION!** Before connecting the drive to mains make sure that the EMC protection class of the drive has the proper setting on. |

| | |
|---|---|
| | **NOTE!** After having performed the change write *'EMC level modified'* on the sticker included with the drive delivery (see below) and note the date. Unless already done, attach the sticker close to the name plate the drive.<br>  <br> |

## 1.5 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. |

# 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. See chapter 2.3.

## 2.1 'Product modified' sticker

In the small plastic bag included with 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 drive. Attach the sticker on the side of the drive to avoid losing it. Should the drive be later modified mark the change on the sticker.

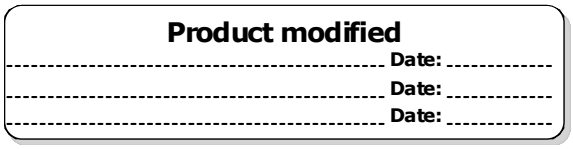



*Figure 4. 'Product modified' sticker*

## 2.2 Unpacking and lifting the drive

The weights of the drives vary greatly according to the size. You may need to use a piece of special lifting equipment to remove the drive from its package. Note the weights of each individual frame size in Table 2 below.

| Frame | Weight [kg] |
|---|---|
| MR4 | 6.0 |
| MR5 | 10.0 |
| MR6 | 20.0 |
| MR7 | 37.5 |

*Table 2. Frame weights*

If you decide to use a piece of lifting equipment see picture below for recommendations to lift the drive.

### 2.2.1 Lifting frames MR4 to MR7

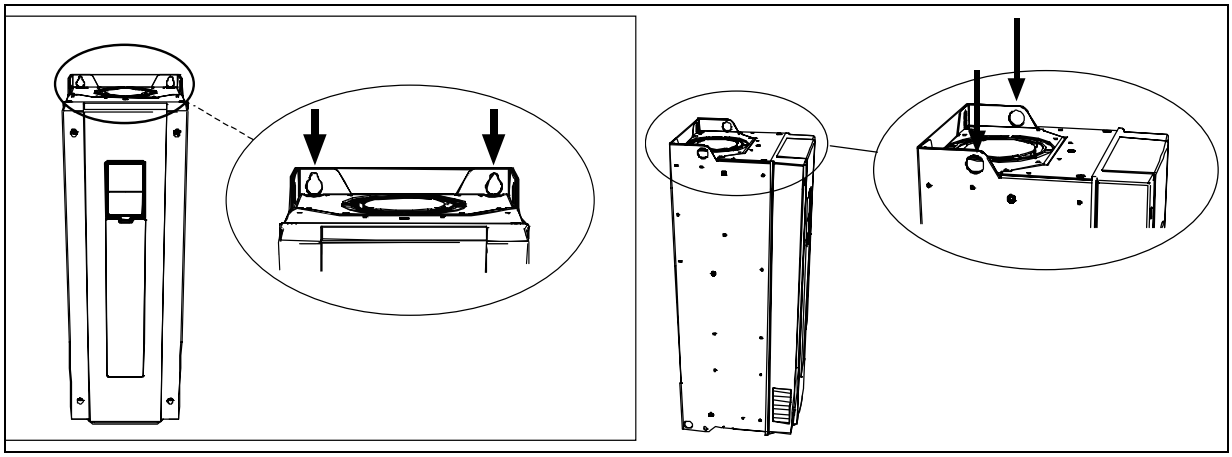


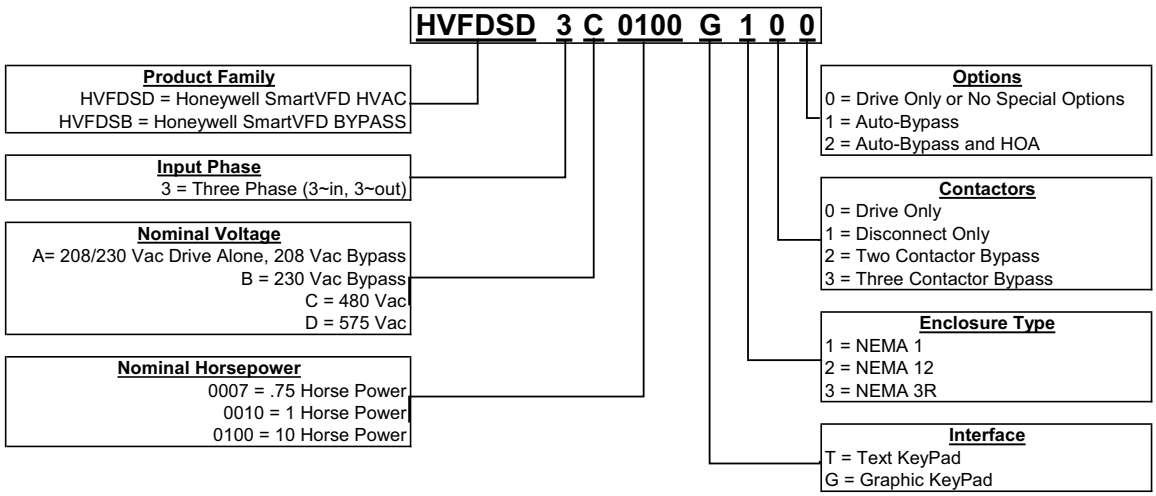
*Figure 5. Placing the lifting hooks, MR4-MR6 (left) and MR7 (right)*

The Honeywell Smart VFD HVAC undergoes scrupulous tests and quality checks at the factory before it is 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.

## 2.3 Type designation code

Honeywell type designation code is formed of a nine-segment code and optional +codes. Each segment of the type designation code uniquely corresponds to the product and options you have ordered. The code is of the following format:



# 3. MOUNTING

The drive must be mounted in vertical position on the wall. Ensure that the mounting plane is relatively even.

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

## 3.1 Dimensions

### 3.1.1 Normal mount, MR4-MR7

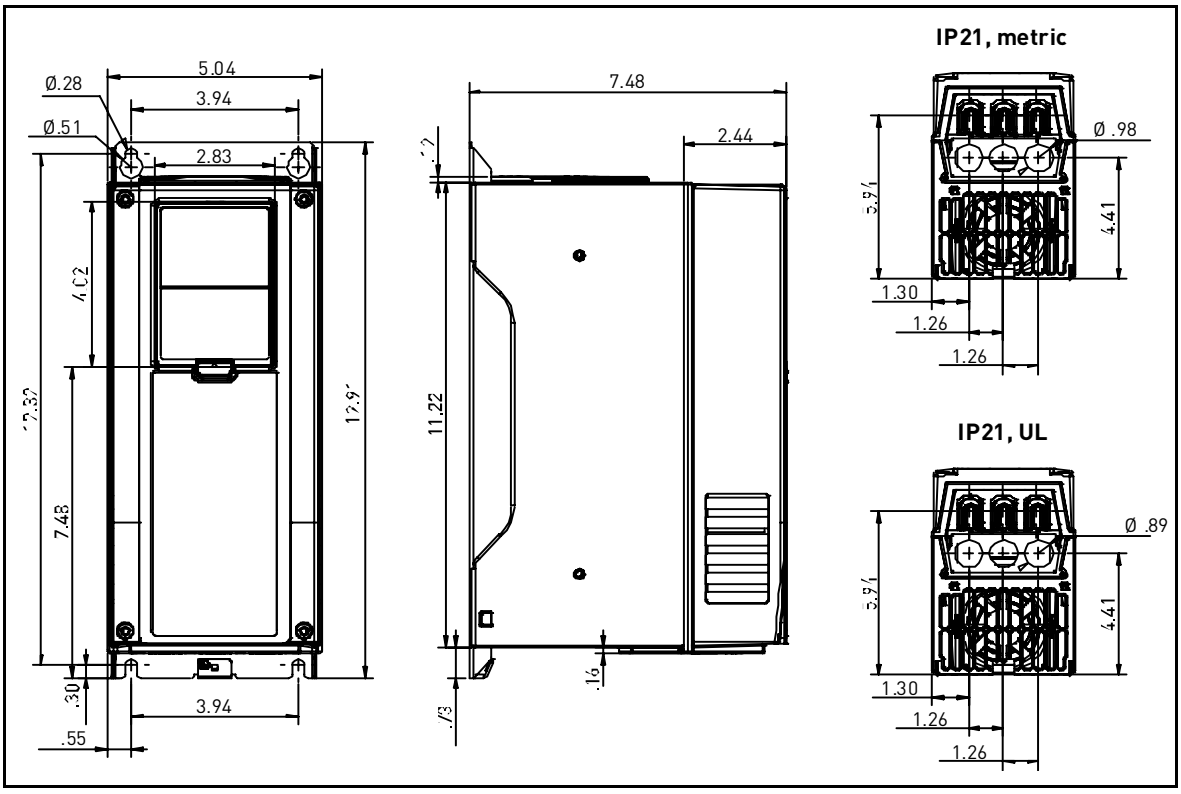



*Figure 6. SmartVFD HVAC dimensions, MR4, normal mount*

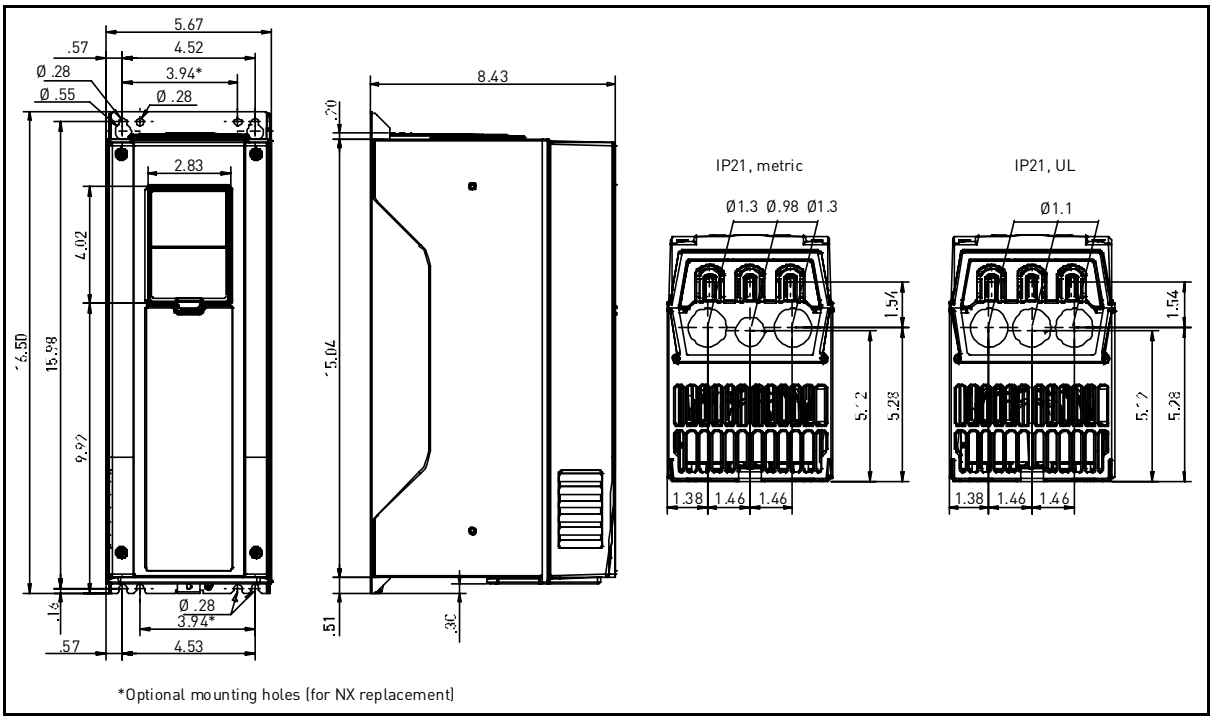



*Figure 7. SmartVFD HVAC dimensions, MR5, normal mount*

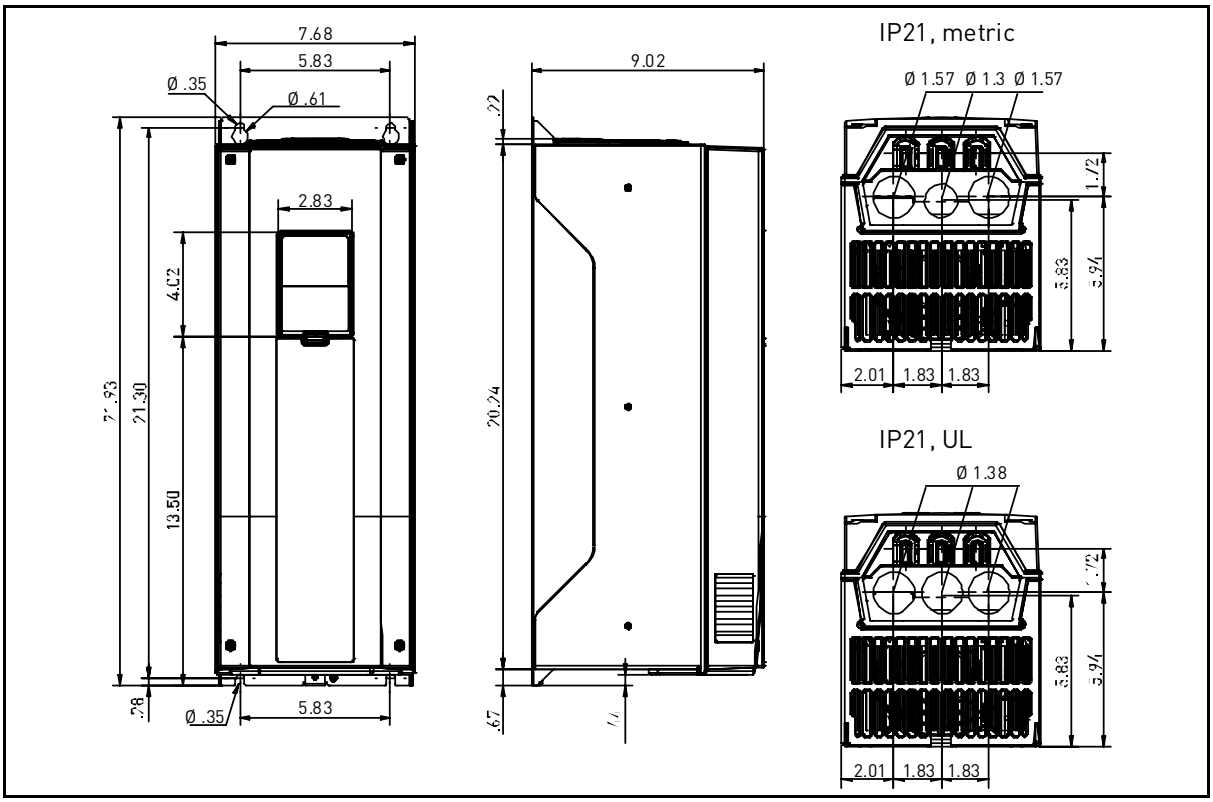



*Figure 8. SmartVFD HVAC dimensions, MR6, normal mount*

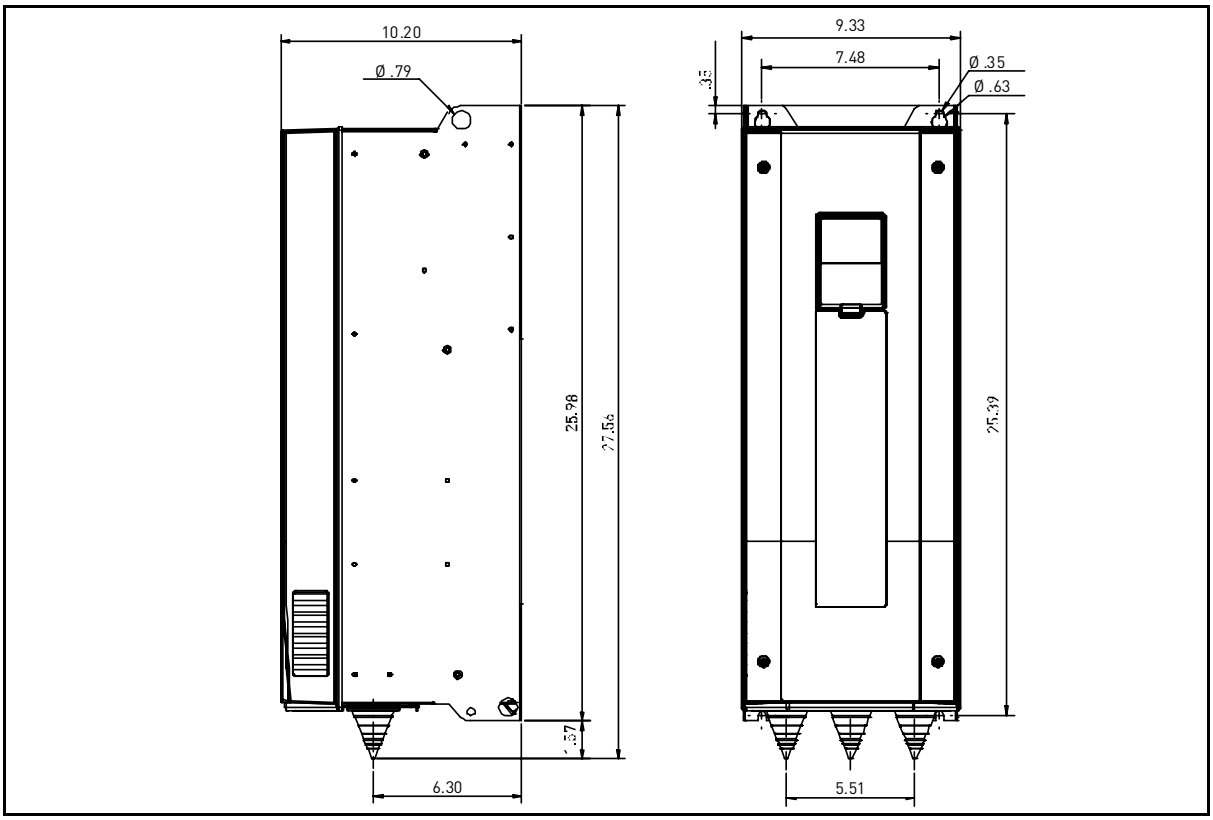



*Figure 9. SmartVFD HVAC dimensions, MR7, normal mount*

### 3.1.2 Flush mount, MR4 to MR7

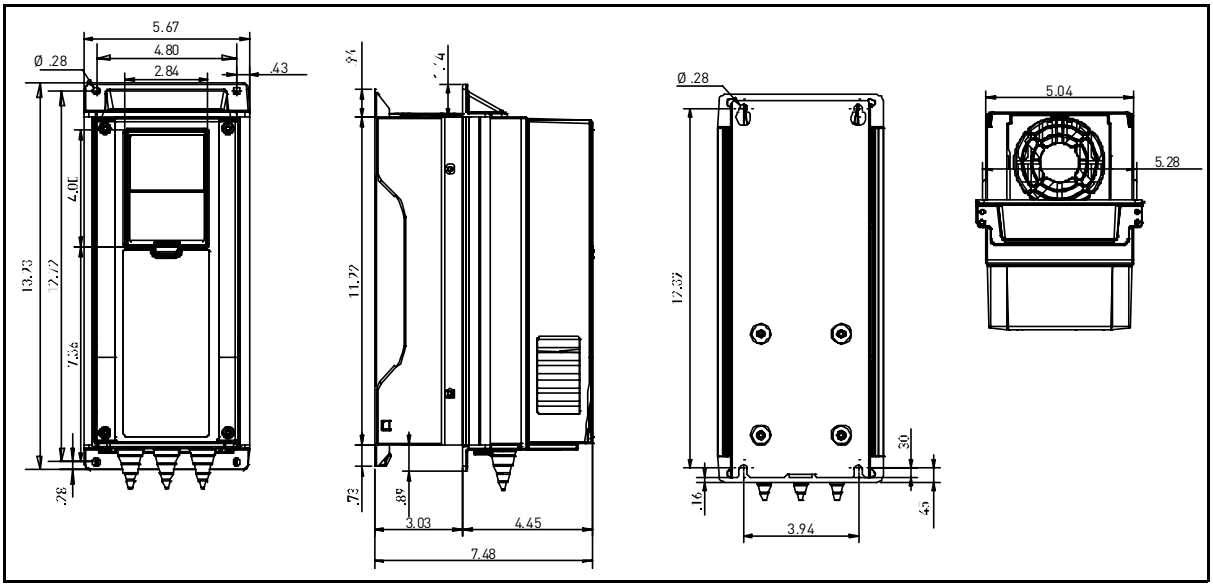



*Figure 10. SmartVFD HVAC dimensions, MR4, flush mount*

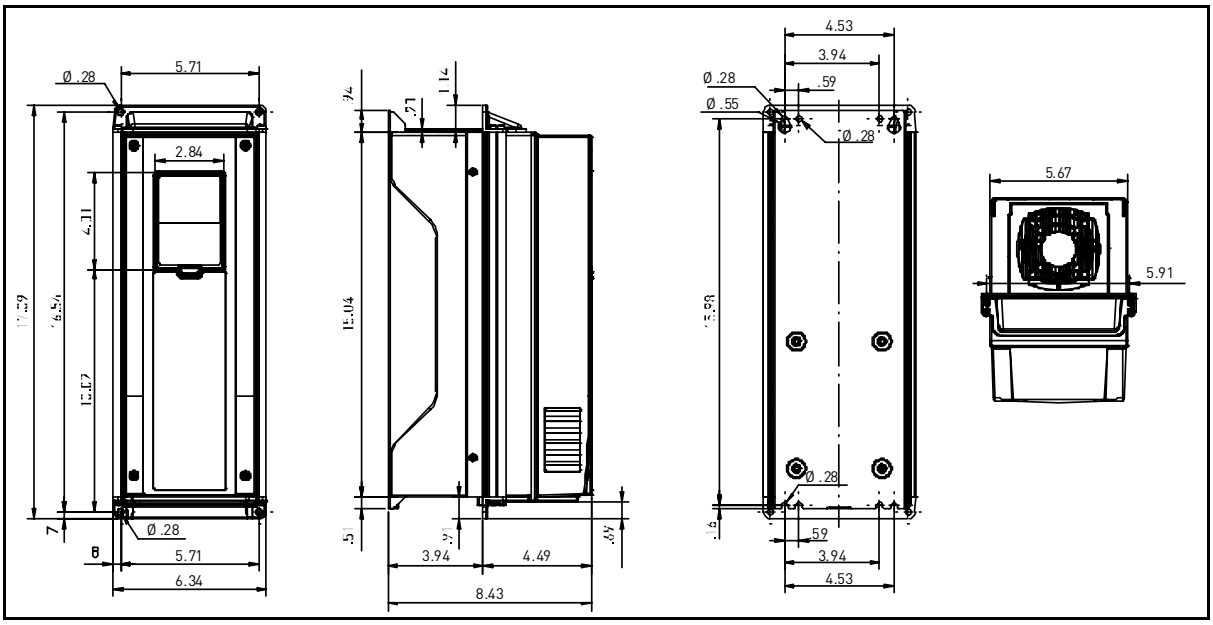



*Figure 11. SmartVFD HVAC dimensions, MR5, flush mount*

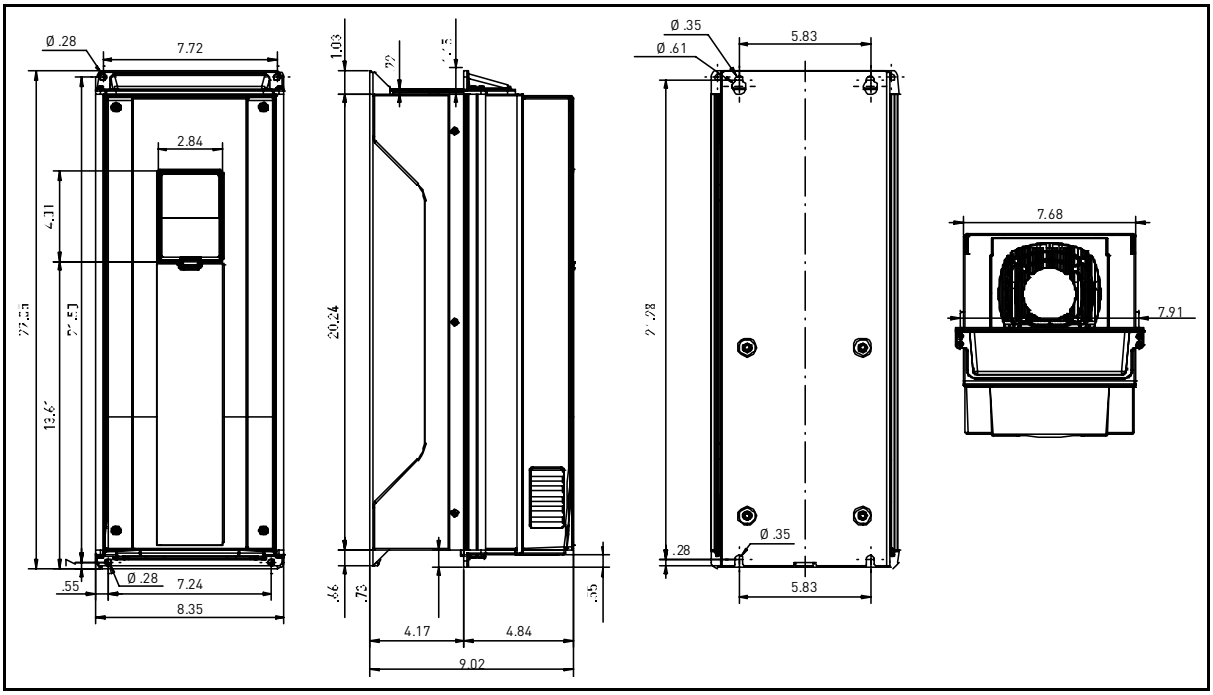



*Figure 12. SmartVFD HVAC dimensions, MR6, flush mount*

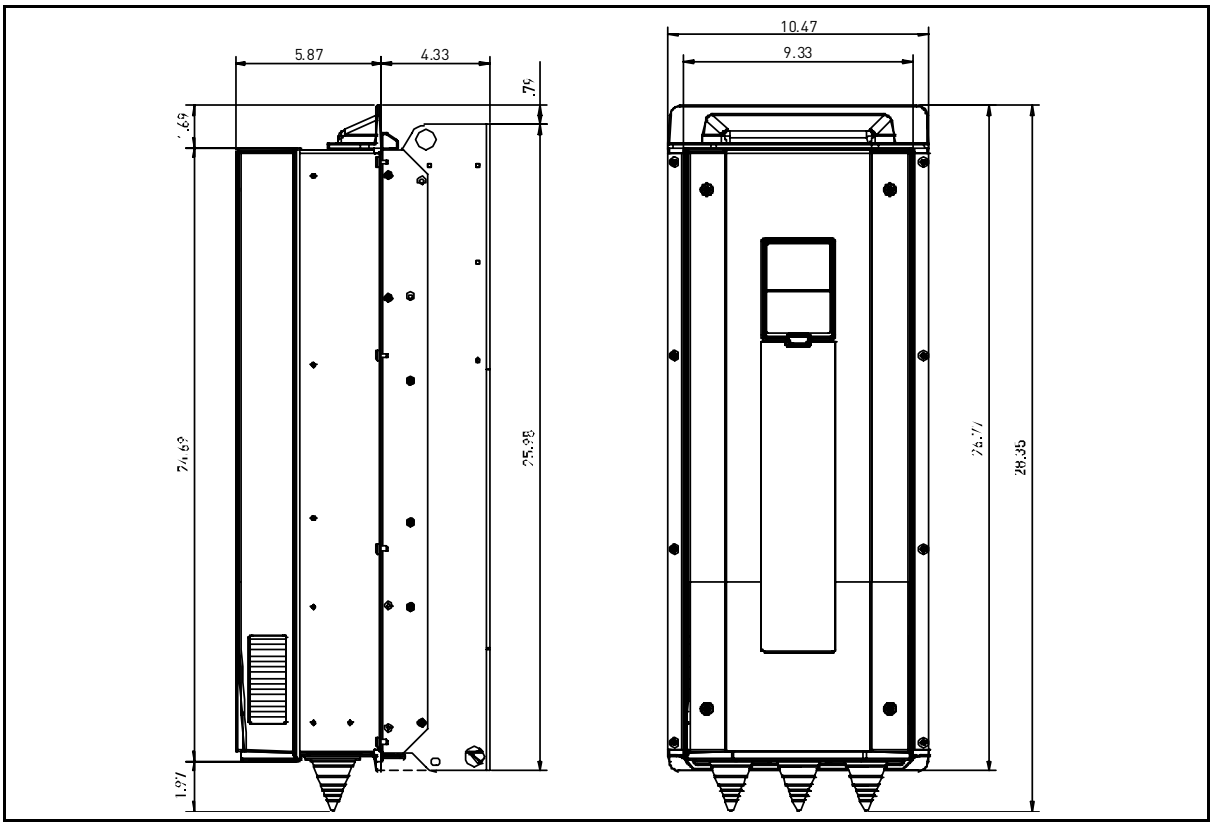



*Figure 13. SmartVFD HVAC dimensions, MR7, flush mount*

## 3.2 Cooling

The drive produces heat in operation and is cooled by air circulated by a fan. Enough free space needs to be left around the drive to ensure sufficient air circulation and cooling. Different acts of maintenance also require a certain amount of free space.

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

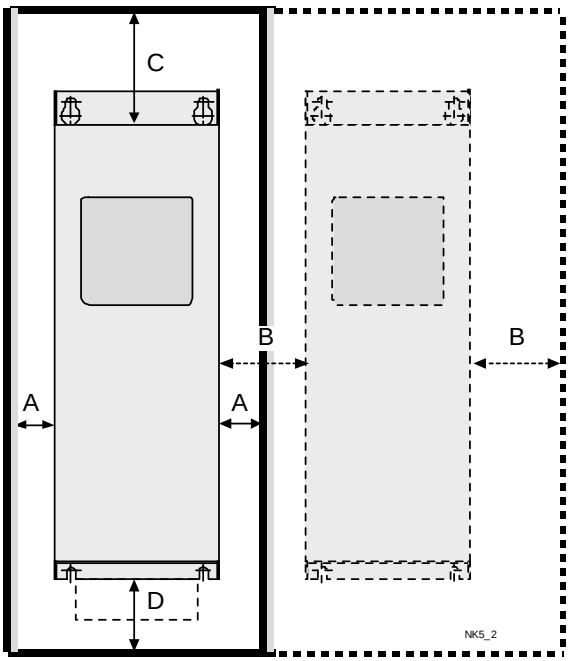



*Figure 14. Installation space*

| Min clearance [in], IP21 | | | | |
|---|---|---|---|---|
| **Type** | **A*** | **B*** | **C** | **D** |
| MR4 | .79 | .79 | 3.94 | 1.97 |
| MR5 | .79 | .79 | 4.72 | 2.36 |
| MR6 | .79 | .79 | 6.30 | 3.15 |
| MR7 | 1.18 | 1.18 | 9.84 | 3.94 |

*. Min clearances A and B for drives with IP54 enclosure is 0 in.

*Table 3. Min. clearances around drive*

**A** = clearance around the drive (see also B)
**B** = distance from one drive to another or distance to cabinet wall
**C** = free space above the drive
**D** = free space underneath the drive

Note that if several units are mounted above one another the required free space equals C + D (see Figure 14.). Moreover, the outlet air used for cooling by the lower unit must be directed away from the air intake of the upper unit.

| Type | Cooling air required [cfm] |
|---|---|
| MR4 | 26 |
| MR5 | 44 |
| MR6 | 112 |
| MR7 | 109 |

*Table 4. Required cooling air*

# 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 Table 5 for the cable recommmendations for different EMC levels.

Use cables with heat resistance of at least +158°F. The cables and the fuses must be dimensioned according to the drive nominal OUTPUT current which you can find on the rating plate.

| Cable type | 1st environment 2nd environment<br>EMC levels<br>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 5. 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 15.
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 (1Mhz...30MHz) max. 100mohm/m]. See Figure 15.
*360º grounding 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).

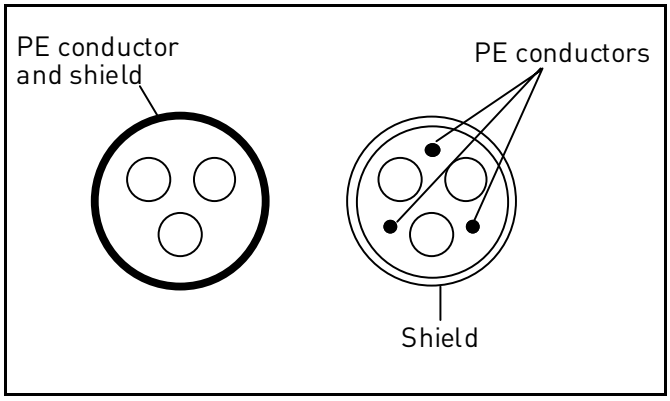



*Figure 15.*

**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 +140/167°F. 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 6 shows the minimum dimensions of the Cu/Al-cables and the corresponding fuse sizes. Recommended fuse types are gG/gL.

If the motor temperature protection of the drive (see Application Manual) is used as an overload protection, the cable shall be chosen accordingly.

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

#### 4.1.1.1 Cable and fuse sizes, frames MR4 to MR6, North America

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. Honeywell 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 (class T) [A] | Mains, motor and ground cable Cu | Terminal cable size | |
|---|---|---|---|---|---|---|
| | | | | | Main terminal | Ground terminal |
| MR4 | C 0015 | 3.4 | 6 | AWG14 | AWG24-AWG10 | AWG17-AWG10 |
| | C 0020 | 4.8 | 6 | AWG14 | AWG24-AWG10 | AWG17-AWG10 |
| | C 0030 | 5.6 | 10 | AWG14 | AWG24-AWG10 | AWG17-AWG10 |
| | C 0050 | 8.0 | 10 | AWG14 | AWG24-AWG10 | AWG17-AWG10 |
| | C 0075 | 12.0 | 20 | AWG14 | AWG24-AWG10 | AWG17-AWG10 |
| MR5 | C 0100 | 16.0 | 25 | AWG10 | AWG20-AWG5 | AWG17-AWG8 |
| | C 0150 | 23.0 | 30 | AWG10 | AWG20-AWG5 | AWG17-AWG8 |
| | C 0200 | 31.0 | 40 | AWG8 | AWG20-AWG5 | AWG17-AWG8 |
| MR6 | C 0250 | 38.0 | 50 | AWG4 | AWG13-AWG0 | AWG13-AWG2 |
| | C 0300 | 46.0 | 60 | AWG4 | AWG13-AWG0 | AWG13-AWG2 |
| | C 0400** | 61.0 | 80 | AWG4 | AWG13-AWG0 | AWG13-AWG2 |

*. For more information on type code, see page 10.
**. The 460V models require 90-degree wire to meet UL regulations

*Table 6. Cable and fuse sizes for Honeywell Smart VFD HVAC (MR4 to MR6)*

The cable dimensioning is based on the criteria of the Underwriters' Laboratories UL508C:Cables must be PVC-isolated; Max ambient temperature +86°F, max temperature of cable surface +158°F; 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 grounding conductor, see standard Underwriters' Laboratories UL508C.

For the correction factors for each temperature, see the instructions of standard Underwriters' Laboratories UL508C.

#### 4.1.1.2 Cable and fuse sizes, frame MR7, North America

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. Honeywell 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 (class T) [A] | Mains, motor and ground cable Cu | Terminal cable size | |
|---|---|---|---|---|---|---|
| | | | | | Main terminal | Ground terminal |
| MR7 | C 0500 | 72,0 | 100 | AWG2 | AWG9-AWG2/0 | AWG9-AWG2/0 |
| | C 0600 | 87,0 | 110 | AWG1 | AWG9-AWG2/0 | AWG9-AWG2/0 |
| | C 0750 | 105,0 | 150 | AWG1/0 | AWG9-AWG2/0 | AWG9-AWG2/0 |

*Table 7. Cable and fuse sizes for Honeywell Smart VFD HVAC (MR7 to MR9)*

The cable dimensioning is based on the criteria of the Underwriters' Laboratories UL508C:Cables must be PVC-isolated; Max ambient temperature +86°F, max temperature of cable surface +158°F; 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 grounding conductor, see standard Underwriters' Laboratories UL508C.

For the correction factors for each temperature, see the instructions of standard Underwriters' Laboratories UL508C.

## 4.2 Brake resistor cables

The SmartVFD HVAC is equipped with terminals for an optional external brake resistor. These terminals are marked with R+ and R- (MR4-MR6) or DC+/R+ and R- (MR7 and bigger).

## 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 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, [in] | Shielded cable, [ft] |
|---|---|
| 11.8 | ≤ 164 |
| 39.4 | ≤ 656 |

- The given distances also apply between the motor cables and signal cables of other systems.
- The maximum lengths of motor cables are 328 ft. (MR4), 492 ft. (MR5 and MR6) and 656 ft. (MR7).
- 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:

### 4.4.1 Frames MR4 to MR7

| | |
|---|---|
| **1** | Strip the motor and mains cables as advised below. |

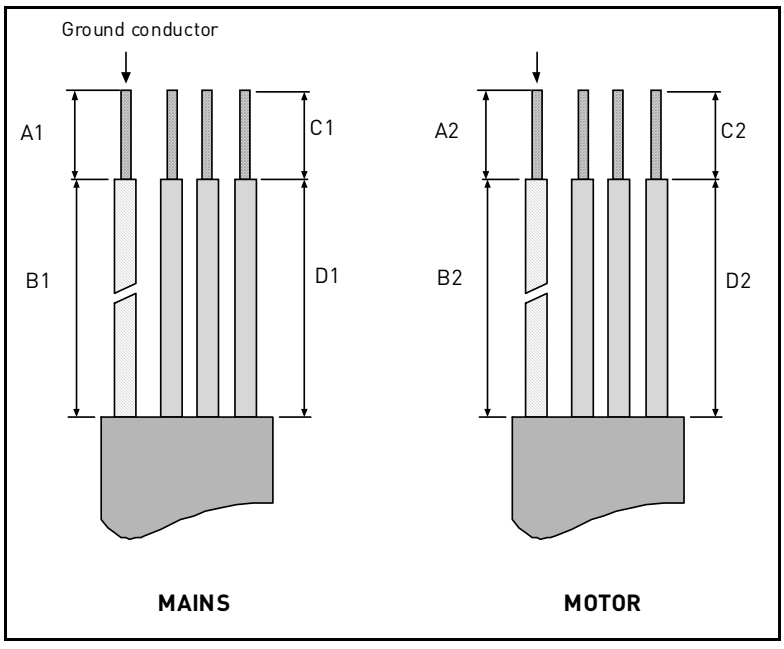



*Figure 16. Stripping of cables*

| Frame | A1 | B1 | C1 | D1 | A2 | B2 | C2 | D2 |
|---|---|---|---|---|---|---|---|---|
| **MR4** | .59 | 1.38 | .39 | .79 | .28 | 1.97 | .28 | 1.38 |
| **MR5** | .79 | 1.57 | .39 | 1.18 | .79 | 2.36 | .39 | 1.57 |
| **MR6** | .79 | 3.54 | .59 | 2.36 | .79 | 3.54 | .59 | 2.36 |
| **MR7** | .79 | 3.15 | .79 | 3.15 | .79 | 3.15 | .79 | 3.15 |

*Table 8. Cables stripping lengths [in]*

| | |
|---|---|
| **2** | Open the cover of the drive. |

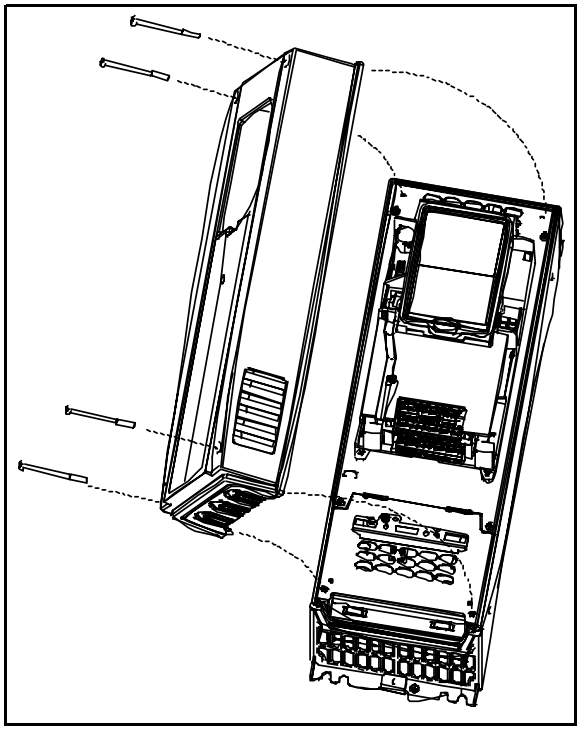


*Figure 17.*

| | |
|---|---|
| **3** | **Remove the screws** of the cable protection plate. Do not open the cover of the power unit! |

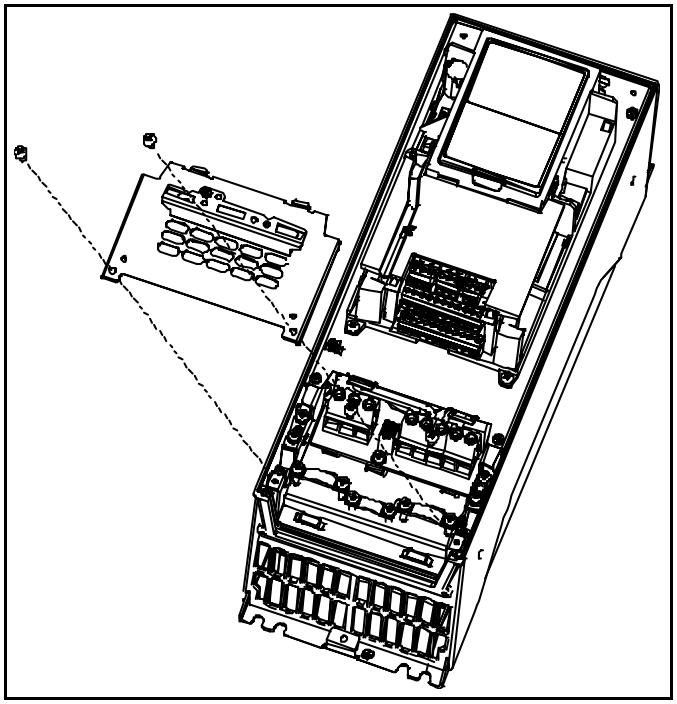


*Figure 18.*

| | |
|---|---|
| **4** | Insert the cable grommets (included in the delivery) in the openings of the cable entry plate (included) as shown in the picture. |

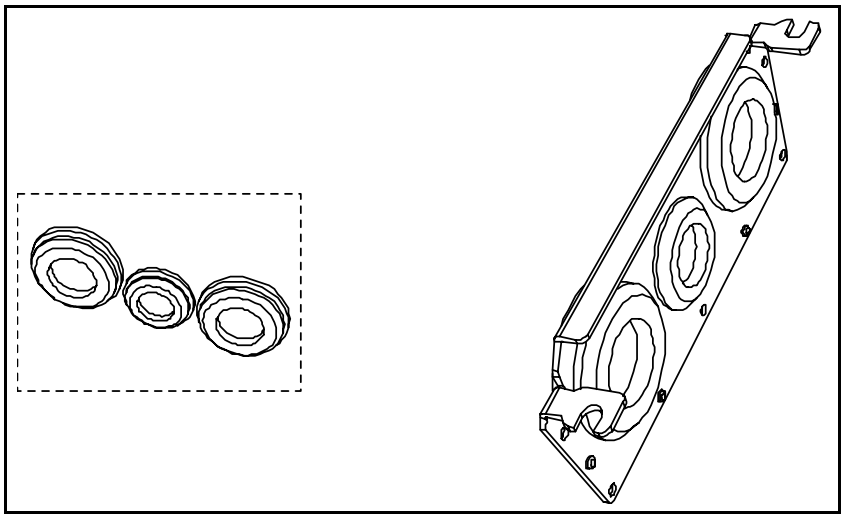


*Figure 19.*

| | |
|---|---|
| **5** | Insert the cables - supply cable, motor cable and optional brake cable - in the openings of the cable entry plate. Then cut the rubber grommets open to slide the cables through. Do not cut the grommet openings wider than what is necessary for the cables you are using.<br>**IMPORTANT NOTE FOR IP54 INSTALLATION:**<br>To meet the requirements of the enclosure class IP54, the connection between the grommet and the cable must be tight. Therefore, lead the first bit of the cable out of the grommet straight before letting it bend. If this is not possible, the tightness of the connection must be ensured with insulation tape or a cable tie. |

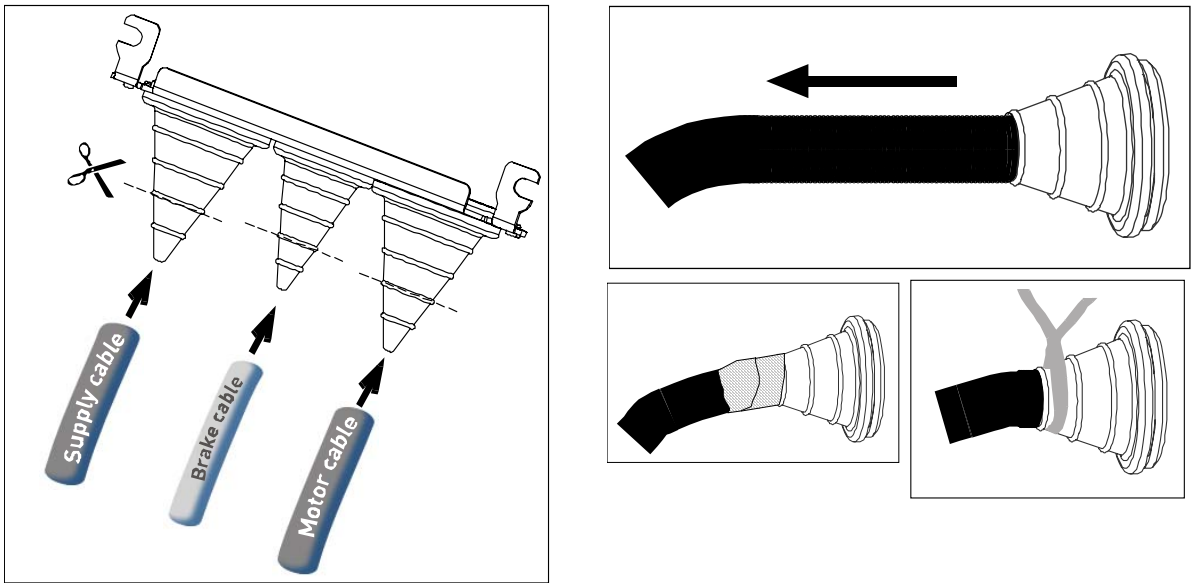



*Figure 20.*

| | |
|---|---|
| **6** | Detach the cable clamps and the grounding clamps (Figure 21) and place the cable entry plate with the cables in the groove on the drive frame (Figure 22). |

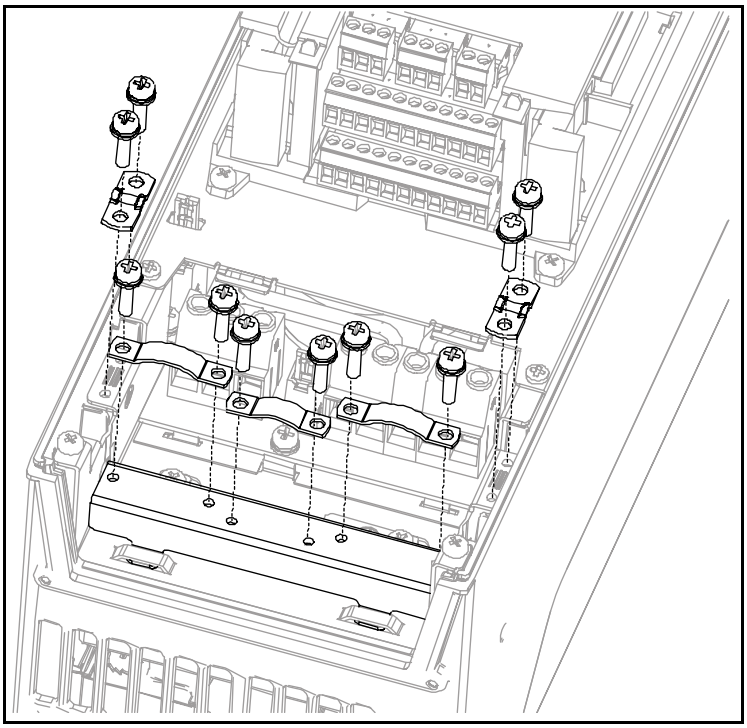


*Figure 21.*

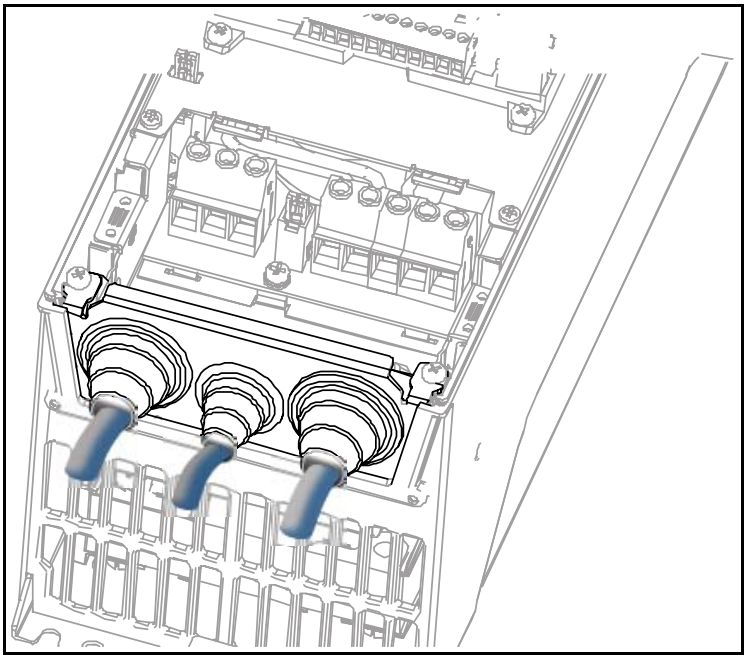


*Figure 22.*

| | |
|---|---|
| **7** | Connect the stripped cables as shown in Figure 23.<br>• Expose the shield of all three cables in order to make a 360-degree connection with the cable clamp (1).<br>• Connect the (phase) conductors of the supply, brake and motor cables into their respective terminals (2).<br>• Form the rest of the cable shield of all three cables into “pigtails” and make a grounding connection with a clamp as shown in Figure 23 (3). |

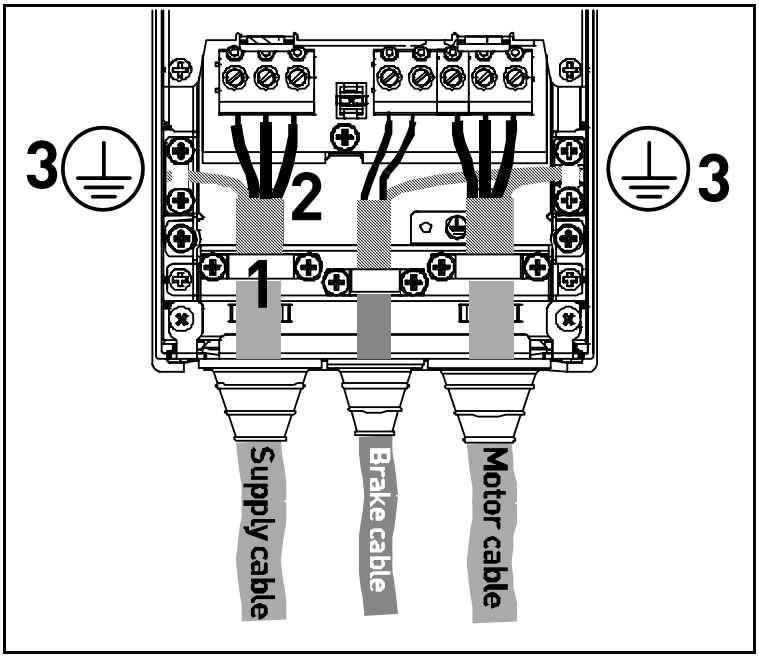



*Figure 23.*

**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. |
| **MR4** | C 0015—C 0075 | 0.5—0.6 | 4.5—5.3 | 1.5 | 13.3 | 2.0 | 17.7 |
| **MR5** | C 0100—C 0200 | 1.2—1.5 | 10.6—13.3 | 1.5 | 13.3 | 2.0 | 17.7 |
| **MR6** | C 0250—C 0400 | 10 | 88.5 | 1.5 | 13.3 | 2.0 | 17.7 |
| **MR7** | C 0500—C 0750 | 8/15* | 70.8/132.8* | 1.5 | 13.3 | 8/15* | 70.8/132.8* |

*. Cable clamping (Ouneva Pressure Terminal Connector)

*Table 9. Tightening torques of terminals*

| | |
|---|---|
| **8** | Check the connection of the grounding cable to the motor and the drive terminals marked with ⏚ .<br>**NOTE**: Two protective conductors are required according to standard EN61800-5-1. See Figure 24 and chapter Grounding and ground fault protection. Use an M5 size screw and tighten it to 2.0 Nm (17.7 lb-in.). |

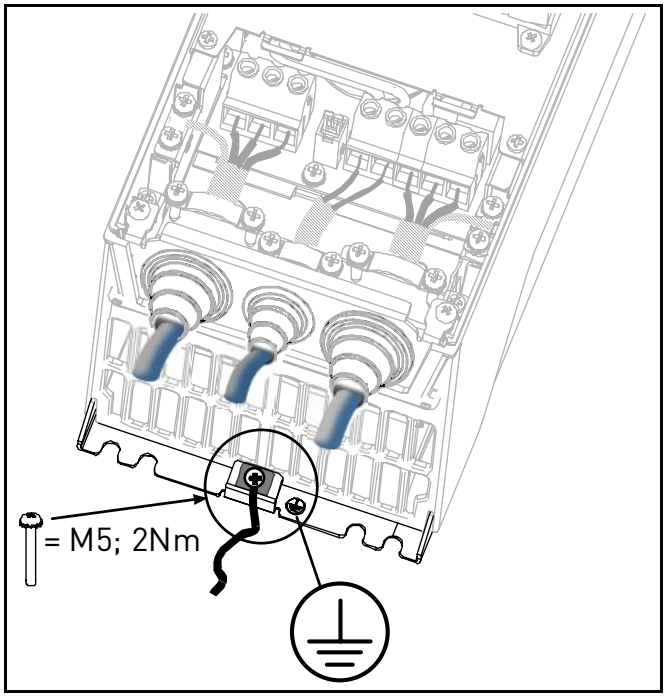



*Figure 24. Additional protective grounding connector*

| | |
|---|---|
| **9** | Re-mount the cable protection plate (Figure 25) and the cover of the drive. |

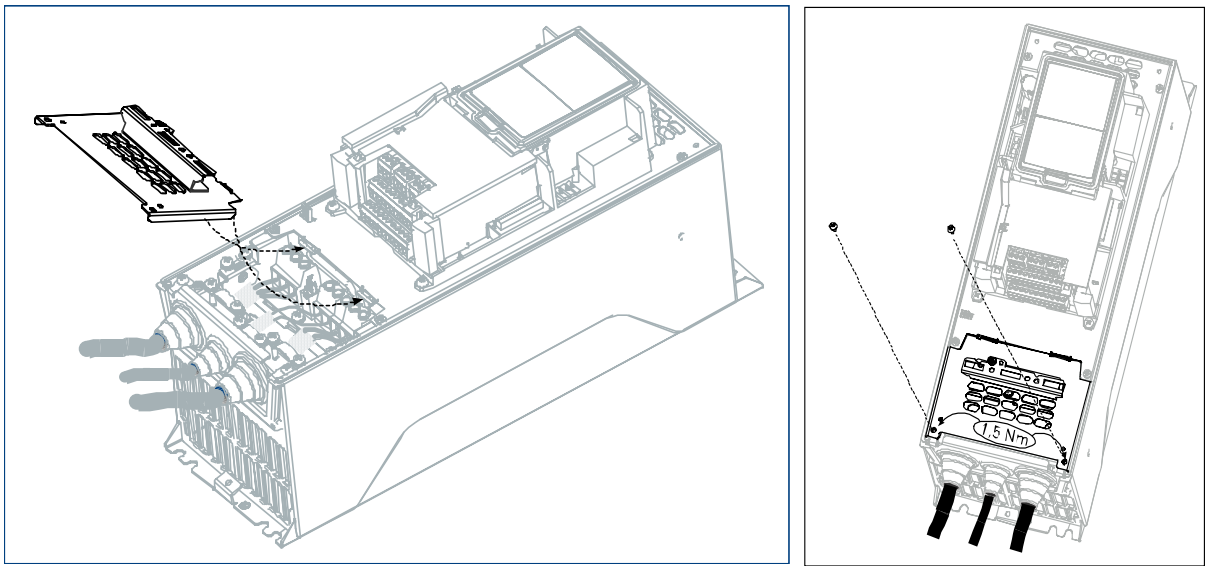



*Figure 25. Re-mounting of cover components*

### 4.4.2 Cable and motor insulation checks

1. Motor cable insulation checks
   Disconnect the motor cable from terminals U, V and W of the 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 68°F.
2. Mains cable insulation checks
   Disconnect the mains cable from terminals L1, L2 and L3 of the 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 68°F.
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 68°F.

# 5. COMMISSIONING

*Before commissioning, note the following directions and warnings:*

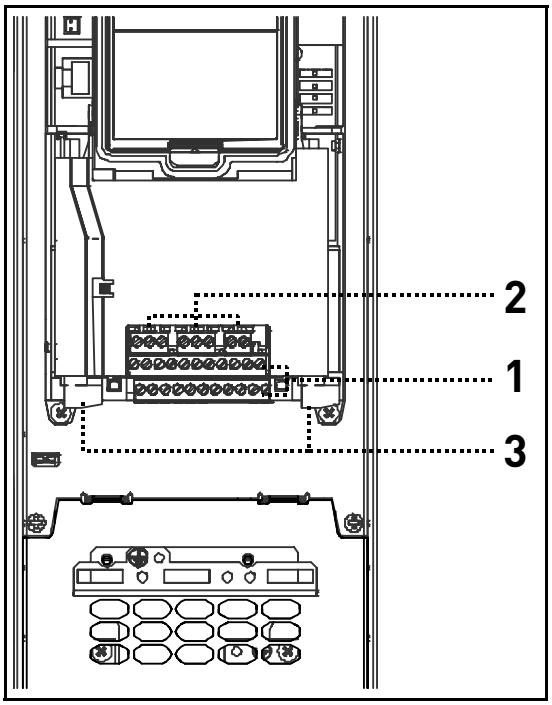
| | |
|---|---|
|  | Internal components and circuit boards of the drive (except for the galvanically isolated I/O terminals) are live when it is connected to mains potential. **Coming into contact with this voltage is extremely dangerous and may cause death or severe injury.** |
|  | The motor terminals **U**, **V**, **W** and the brake resistor terminals **B-/B+ are live** when the 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 the drive is disconnected from mains. |
|  | Do not make any connections to or from the drive when it is connected to the mains. |
|  | **After disconnecting** the drive from the mains, **wait** until the fan stops and the indicators on the keypad go out (if no keypad is attached see the indicators on the cover). Wait 5 more minutes before doing any work on the connections of the drive. Do not open the cover before this time has expired. After expiration of this time, use a measuring equipment to absolutely ensure that no voltage is present. **Always ensure abscence of voltage before electrical work!** |
|  | **Before connecting** the frequency converter to mains make sure that the front and cable covers of the drive are closed. |

## 5.1 Commissioning of the SmartVFD HVAC

| | |
|---|---|
| **1** | Read carefully the safety instructions in Chapter 1 and above and follow them. |
| **2** | After the installation, make sure that:<br>• both the drive and the motor are grounded.<br>• the mains and motor cables comply with the requirements given in chapter 4.1.1.<br>• the control cables are located as far as possible from the power cables, see chapter 4.4.<br>• the shields of the shielded cables are connected to protective ground marked with ⏚.<br>• the wires do not touch the electrical components of the drive.<br>• the common inputs of digital input groups are connected to +24V or ground of the I/O terminal or the external supply. |
| **3** | Check the quality and quantity of cooling air (chapter 3.2 and Table 4). |
| **4** | Check the inside of the drive for condensation. |
| **5** | **Check that all Start/Stop switches connected to the I/O terminals are in Stop-position.** |
| **6** | Connect the drive to mains. |
| **7** | Run the Startup Wizard (see the Application Manual). |

# 6. CONTROL UNIT

The control unit of the drive consists of the control board and additional boards (option boards) connected to the slot connectors of the control board.




Locations of essential control unit components:

1 = Control terminals of the control board

2 = Terminals of relay board; **NOTE:** There are two different compilations of relay boards available. See section 6.1.

3 = Optional boards

*Figure 26. Location of control unit components*

When delivered from the factory, the control unit of the 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, ±10%) by connecting the external power source to terminal #30, see page 36. 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 basic control unit connections are presented in Figure 27 below. The control board is equipped with 22 fixed control I/O terminals and the relay board with 8 or 9. The relay board is available in two different configurations (see Table 12 and 13 ). All signal descriptions are given in Tables 11 to 13.

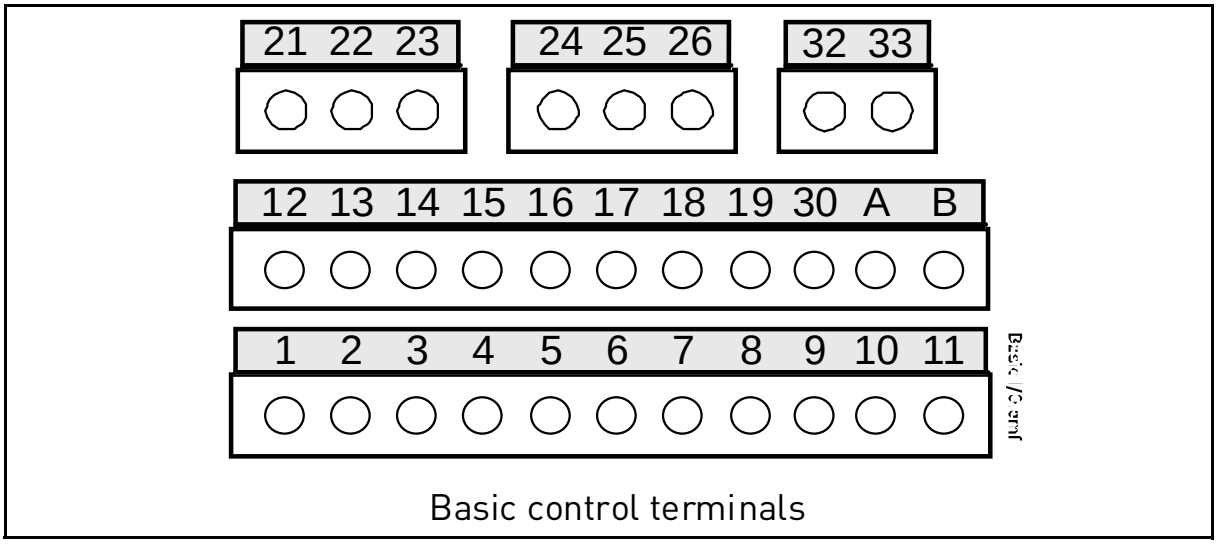



*Figure 27.*

### 6.1.1 Control cable sizing

The control cables shall be at least 0.5 mm² screened multicore cables, see Table 5. The maximum terminal wire size is 2.5 mm² for the relay and other terminals.

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

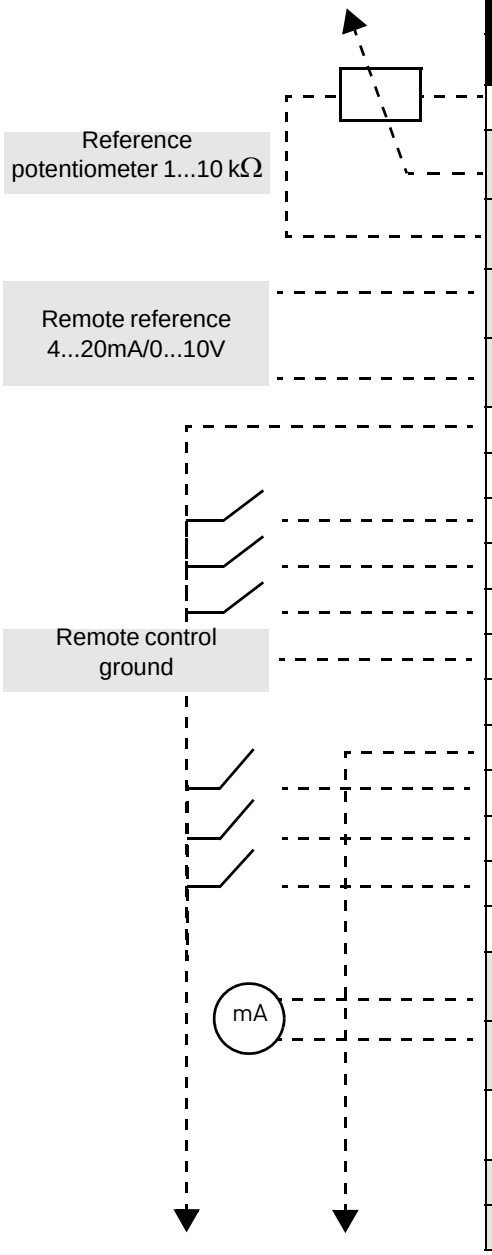
| Terminal screw | Tightening torque | |
|---|---|---|
| | Nm | lb-in. |
| All I/O and relay terminals (screw M3) | 0.5 | 4.5 |

*Table 10. Control cable tightening torques*

### 6.1.2 Control terminals and DIP switches

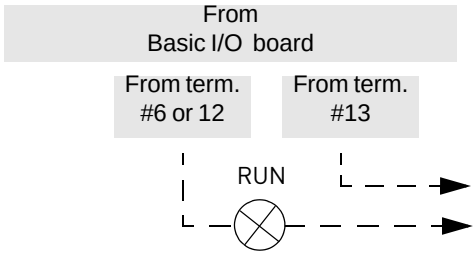
The terminals of the *Basic I/O board* and the *Relay boards* are described below. For more information on the connections, see chapter 7.2.1.

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 36.



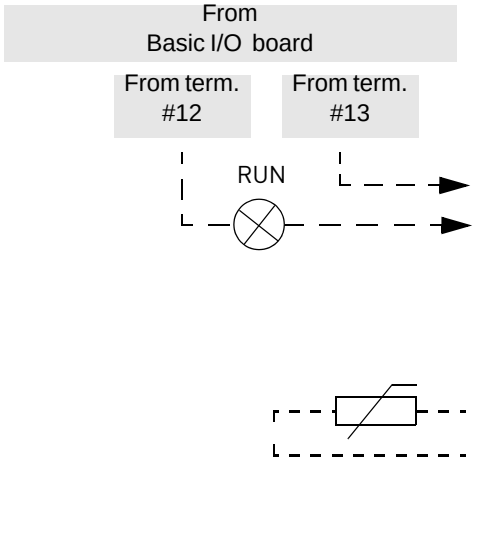

| Basic I/O board | | |
|---|---|---|
| Terminal | | Signal |
| **1** | +10 Vref | Reference output |
| **2** | AI1+ | Analogue input, voltage or current |
| **3** | AI1- | Analogue input common (current) |
| **4** | AI2+ | Analogue input, voltage or current |
| **5** | AI2- | Analogue input common (current) |
| **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-DI3. |
| **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 DI4-DI6. |
| **18** | AO1+ | Analogue signal (+output) |
| **19** | AO-/GND | Analogue output common |
| **30** | +24 VDCin | 24VDC auxiliary input voltage |
| **A** | RS485 | Negative |
| **B** | RS485 | Positive |

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




| Relay board 1 | | |
|---|---|---|
| **Terminal** | | **Signal** |
| **21** | RO1/1 NC | Relay output 1 |
| **22** | RO1/2 CM | |
| **23** | RO1/3 NO | |
| **24** | RO2/1 NC | Relay output 2 |
| **25** | RO2/2 CM | |
| **26** | RO2/3 NO | |
| **32** | RO3/1 CM | Relay output 3 |
| **33** | RO3/2 NO | |

*Table 12. Control I/O terminal signals on relay board 1 and connection example*




| Relay board 2 | | |
|---|---|---|
| **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 13. 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 two functional selections each with the so-called *dip switches*. The switches have two positions, left and right. See figure to locate the switches and make appropriate selections for your requirements.

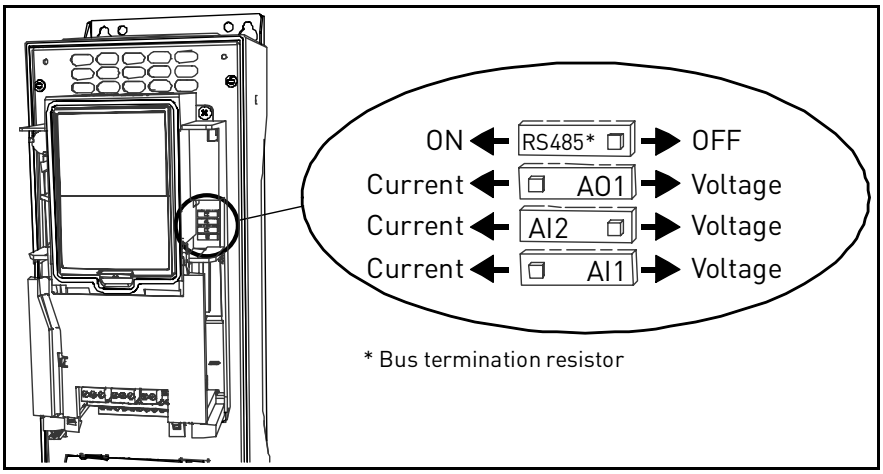



*Figure 28. Dip switches*

## 6.2 Fieldbus connection

The 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 under the drive cover, left to the control keypad. See Figure 29.

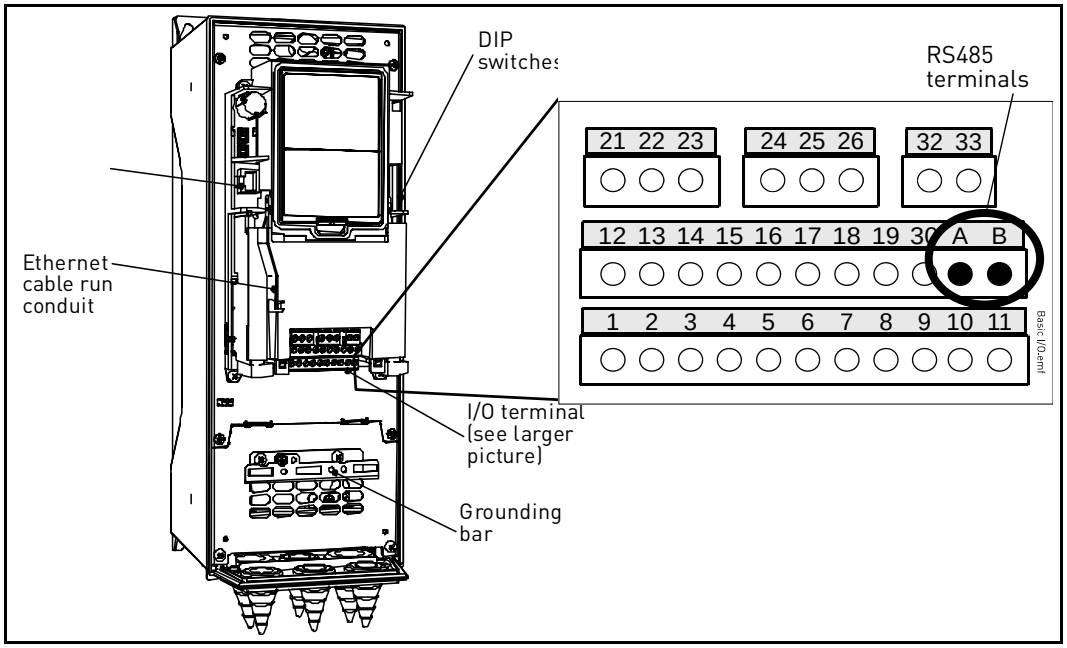



*Figure 29.*

### 6.2.1 Prepare for use through ethernet

| | |
|---|---|
| **1** | Connect the Ethernet cable (see specification on page 39) to its terminal and run the cable through the conduit as shown in Figure 30. |

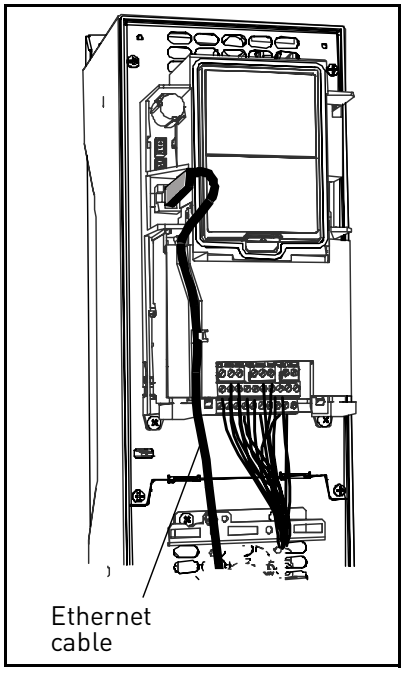



*Figure 30.*

| | |
|---|---|
| **2** | Cut free the opening on the drive cover for the Ethernet cable (protection class IP21). |

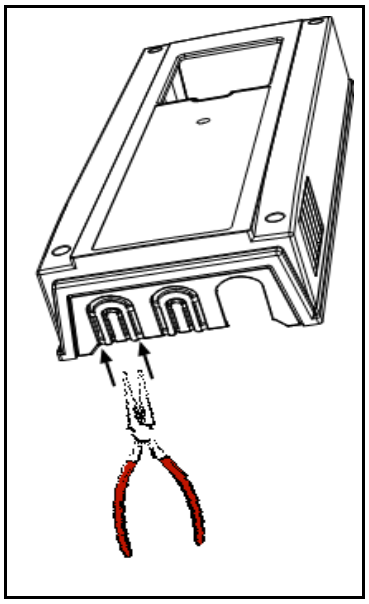


*Figure 31.*

| | |
|---|---|
| **3** | Remount the drive cover. **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**. |

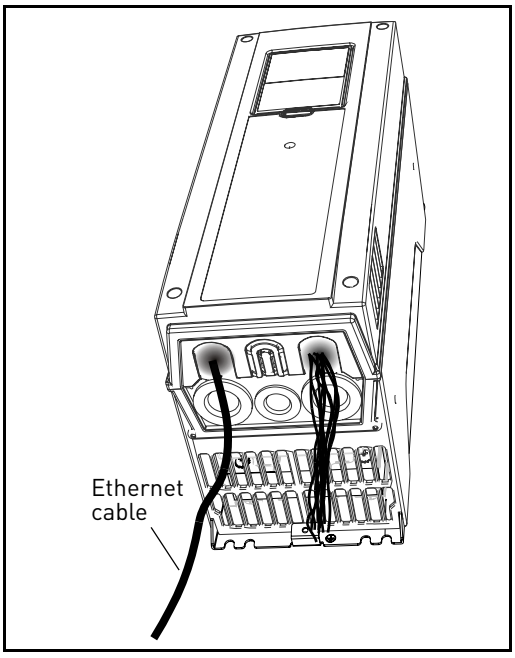



*Figure 32.*

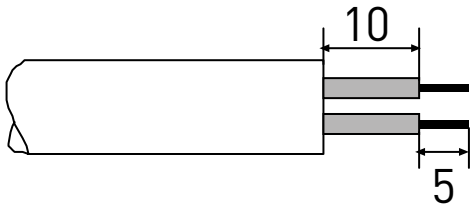
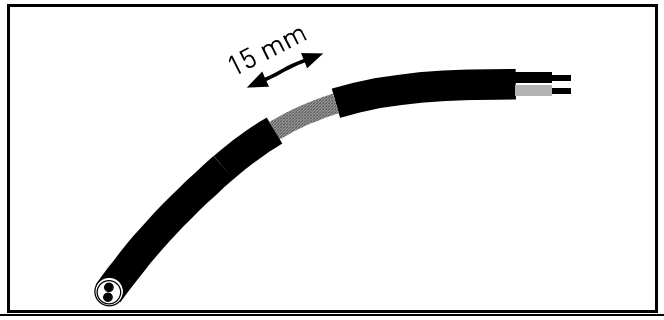
For more detailed information, see the user's manual of the fieldbus you are using.

#### 6.2.1.1 Ethernet cable data

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

*Table 14. Ethernet cable data*

### 6.2.2 Prepare for use through MS/TP

| | |
|---|---|
| **1** | Strip about 15 mm of the RS485 cable (see specification on page 42) and cut off the grey cable shield. Remember to do this for both bus cables (except for the last device).<br>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.<br>  <br>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!**<br>  |

| | |
|---|---|
| **2** | Then connect the cable to its appropriate terminals on Honeywell Smart VFD HVAC AC drive standard terminal block, terminals **A and B** (A = negative, B = positive). See Figure 33. |

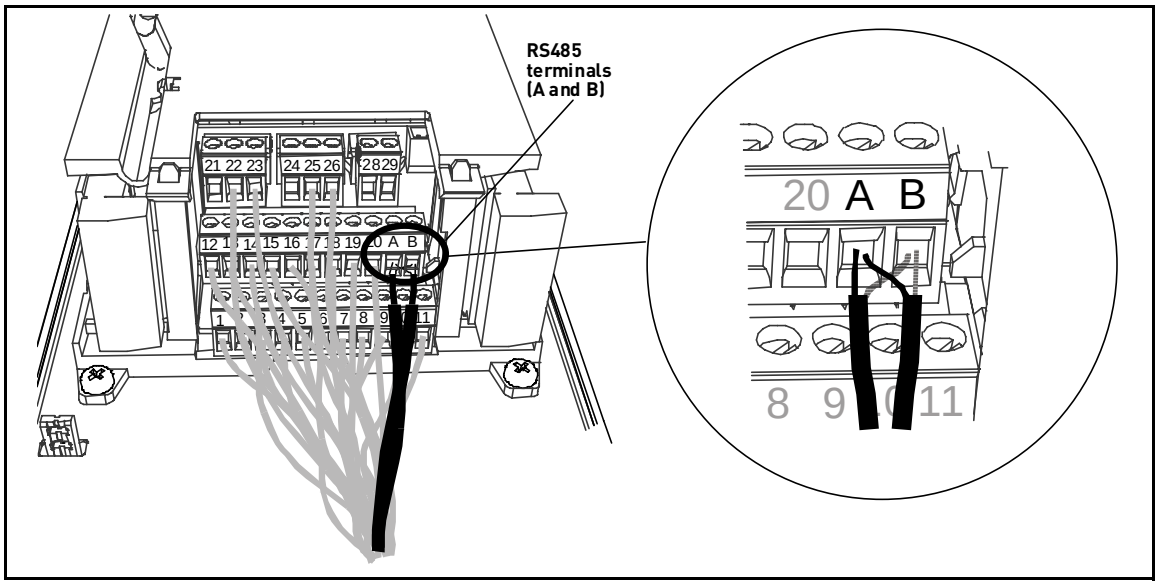
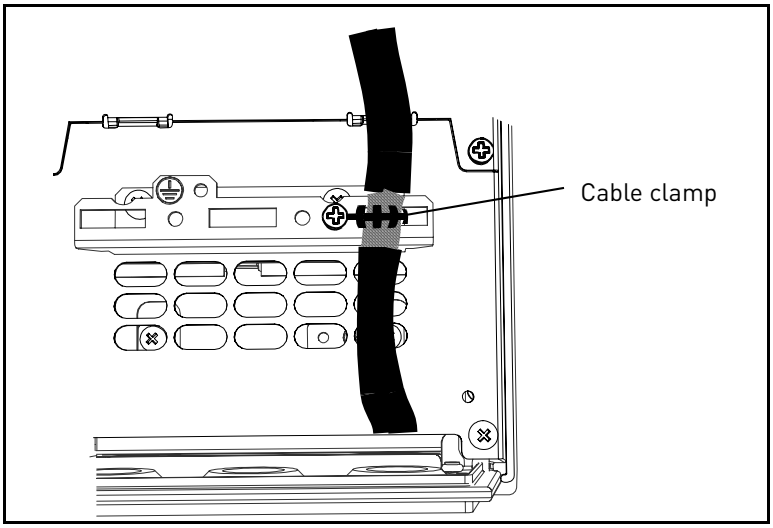
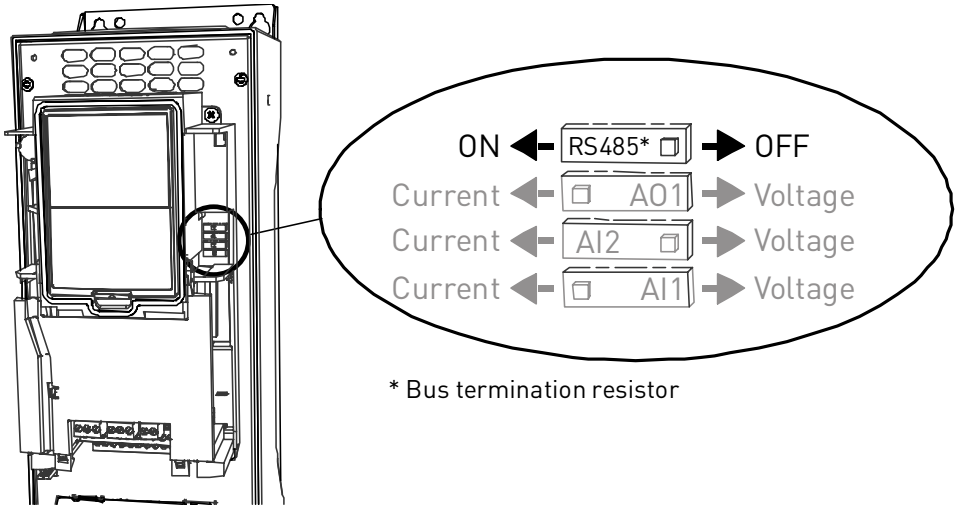
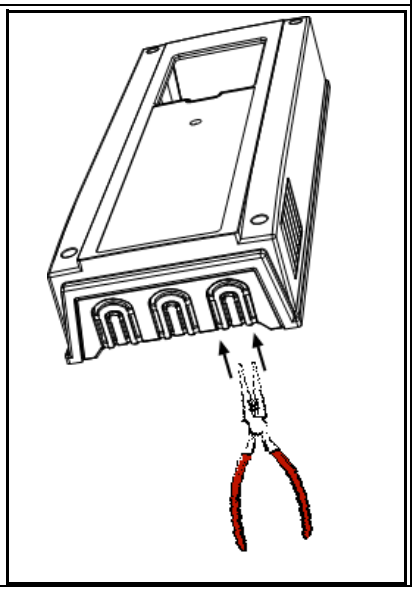
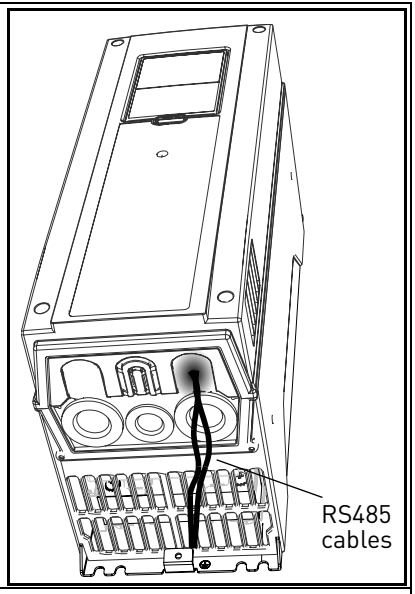
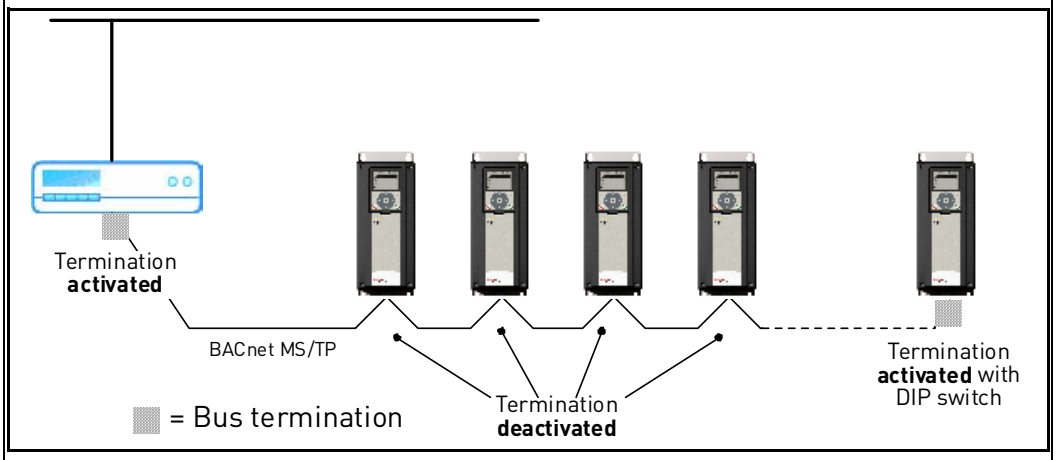



*Figure 33.*

| | |
|---|---|
| **3** | Using the cable clamp included in the delivery of the drive, ground the shield of the RS485 cable to the frame of the drive.   |

| | |
|---|---|
| **4** | **If the drive is the last device on the bus**, the bus termination must be set. Locate the DIP switches to the right of the control keypad of the drive and turn the switch for the RS485 bus termination resistor to position ON. Biasing is built in the termination resistor. See also step 7 on page 42.<br>  <br>* Bus termination resistor |
| **5** | Unless already done for the other control cables, cut free the opening on the drive cover for the RS485 cable (protection class IP21).<br>  |

| | |
|---|---|
| **6** | Remount the drive cover and run the RS485 cables as shown in picture.<br>**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**.<br>  <br> |
| **7** | 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 41. We recommend that the first device on the bus and, thus, terminated was the Master device.<br>  <br> |

### 6.2.3 RS485 cable data

| | |
|---|---|
| Connector | 2.5 $mm^2$ |
| Cable type | STP (Shielded Twisted Pair), type Belden 9841 or similar |
| Cable length | Depends on the used fieldbus. See respective bus manual. |

*Table 15. RS485 cable data*

## 6.3 Battery installation for Real Time Clock (RTC)

Enabling the functions of the *Real Time Clock (RTC)* requires that a battery is installed in the Smart VFD HVAC drive.

The place for the battery can be found in all frames MR4 to MR9 left to the control keypad (see Figure 34).

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

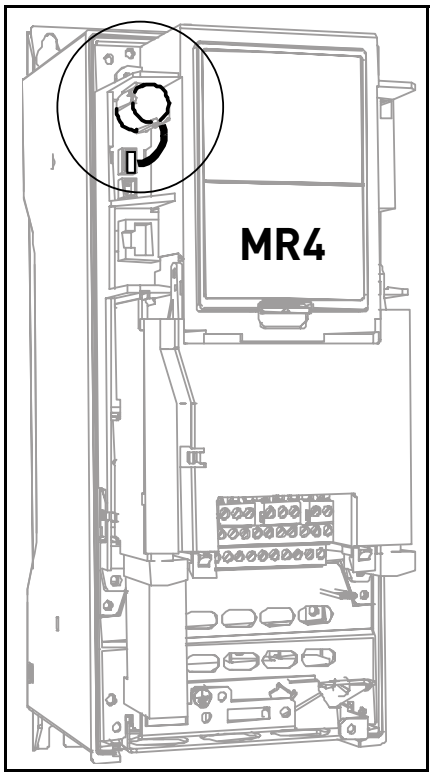



*Figure 34. Real Time Clock battery*

## 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 35.

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).

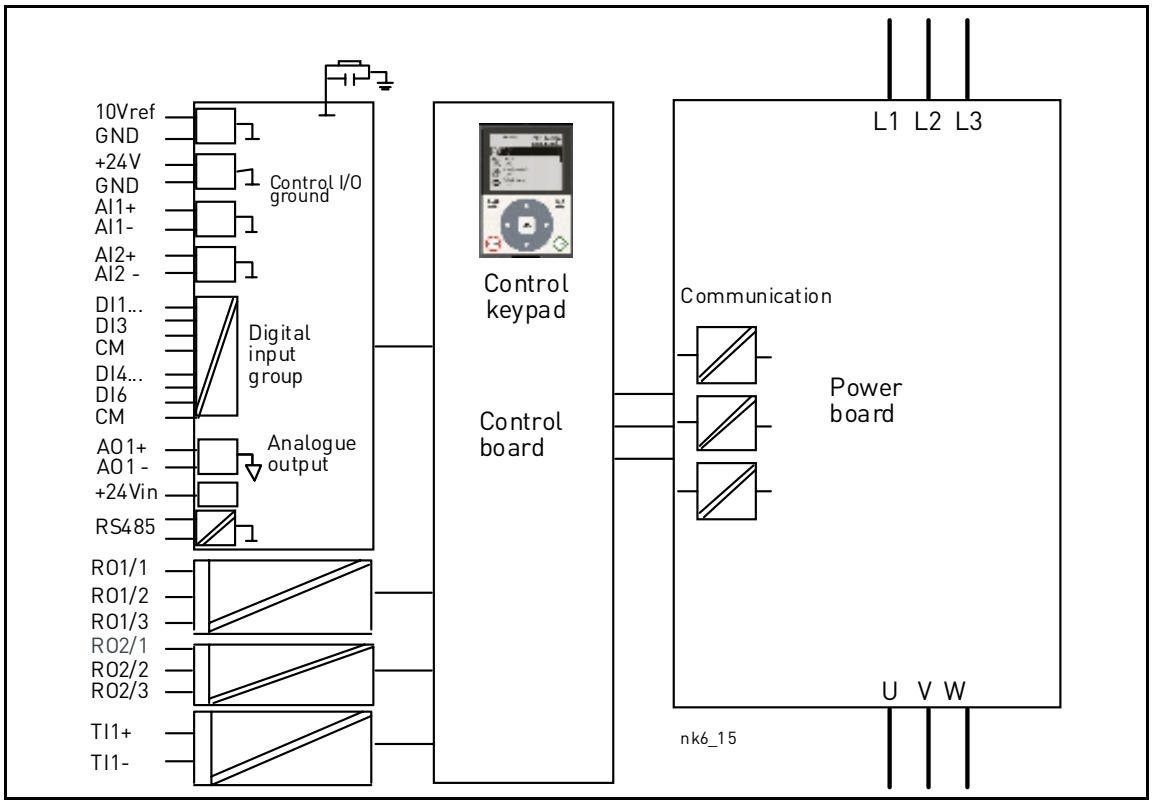



*Figure 35. Galvanic isolation barriers*

# 7. PRODUCT DATA

## 7.1 Power ratings

| | Mains voltage 380-480V, 50-60 Hz, 3~ | | | | | |
|---|---|---|---|---|---|---|
| | Converter type | Loadability | | | Motor shaft power | |
| | | Low* | | | 400V supply | 480V supply |
| | | Rated continuous current $I_L$ [A] | 10% overload current [A] | Max current $I_S$ | 10% overload 104°F [kW] | 10% overload 104°F [HP] |
| MR4 | C 0015 | 3.4 | 3.7 | 5.2 | 1.1 | 1.5 |
| | C 0020 | 4.8 | 5.3 | 6.8 | 1.5 | 2.0 |
| | C 0030 | 5.6 | 6.2 | 8.6 | 2.2 | 3.0 |
| | C 0050 | 8.0 | 8.8 | 11.2 | 3.0 | 5.0 |
| | C 0075** | 12.0 | 13.2 | 19.2 | 5.5 | 7.5 |
| MR5 | C 0100 | 16.0 | 17.6 | 24.0 | 7.5 | 10 |
| | C 0150 | 23.0 | 25.3 | 32.0 | 11.0 | 15.0 |
| | C 0200** | 31.0 | 34.1 | 46.0 | 15.0 | 20.0 |
| MR6 | C 0250 | 38.0 | 41.8 | 62.0 | 18.5 | 25.0 |
| | C 0300 | 46.0 | 50.6 | 76.0 | 22.0 | 30.0 |
| | C 0400** | 61.0 | 67.1 | 92.0 | 30.0 | 40.0 |
| MR7 | C 0500 | 72.0 | 79.2 | 122.0 | 37.0 | 50.0 |
| | C 0600 | 87.0 | 95.7 | 144.0 | 45.0 | 60.0 |
| | C 0750 | 105.0 | 115.5 | 174.0 | 55.0 | 75.0 |

* See chapter 7.1.1

** Given low loadabilities valid for 480V drives at a switching frequency of 4kHz

*Table 16. Power ratings, supply voltage 380-480V.*

**NOTE:** The rated currents in given ambient temperatures (in Table 17) are achieved only when the switching frequency is equal to or less than the factory default.

### 7.1.1 Definitions of overloadability

**Low overload** =Following continuous operation at rated output current $I_L$, the converter is fed with 110% * $I_L$ for 1 min, followed by a period of $I_L$.

Example: If the duty cycle requires 110% rated current $I_L$ for 1 min in every 10 min, the remaining 9 min must be at rated current or less.

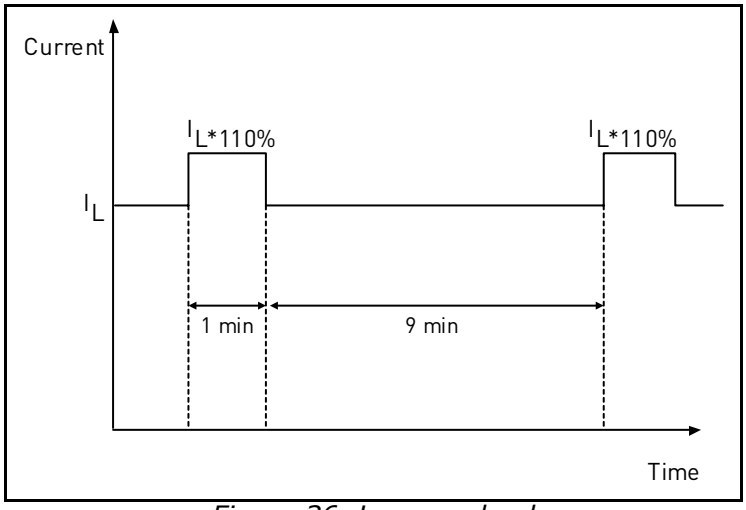



*Figure 36. Low overload*

## 7.2 SmartVFD HVAC - technical data

| | | |
|---|---|---|
| **Mains connection** | Input voltage $U_{in}$ | 380…480V; -10%…+10% |
| | Input frequency | 47…66 Hz |
| | Connection to mains | Once per minute or less |
| | Starting delay | 2 s (MR4 to MR6); 6 s (MR7) |
| **Motor connection** | Output voltage | 0-$U_{in}$ |
| | Continuous output current | $I_L$:Ambient temperature max. +104°F, overload 1.1 x $I_L$ (1 min./10 min.) |
| | Starting current | $I_S$ for 2 s every 20 s |
| | Output frequency | 0…320 Hz (standard) |
| | Frequency resolution | 0.01 Hz |
| **Control characteristics** | Switching frequency (see parameter 3.2.1.9) | 1.5…10 kHz;<br>Defaults: 6 kHz (MR4-6), 4 kHz (MR7)<br>Automatic switching frequency derating in case of overheating |
| | Frequency reference<br>Analogue input<br>Panel reference | <br>Resolution 0.1% (10-bit), accuracy ±1%<br>Resolution 0.01 Hz |
| | Field weakening point | 8…320 Hz |
| | Acceleration time | 0.1…3000 sec |
| | Deceleration time | 0.1…3000 sec |
| **Ambient conditions** | Ambient operating temperature | **MR4-MR7:**<br>$I_L$ : 14°F (no frost)…+104°F |
| | Storage temperature | -40°F…+158°F |
| | Relative humidity | 0 to 95% $R_H$, non-condensing, non-corrosive |
| | Air quality:<br>chemical vapours<br>mechanical particles | <br>IEC 60721-3-3, unit in operation, class 3C2<br>IEC 60721-3-3, unit in operation, class 3S2 |
| | Altitude | 100% load capacity (no derating) up to 3,280ft.<br>1-% derating for each 328ft. above 3,280ft.<br>Max. altitudes:<br>**380...480V:** 9,842ft. (TN and IT systems) |

| | | |
|---|---|---|
| **Ambient conditions (cont.)** | Vibration EN61800-5-1/ EN60068-2-6 | 5…150 Hz<br>**Displacement amplitude** 1 mm (peak) at 5…15.8 Hz (MR4…MR9)<br>**Max acceleration amplitude** 1 G at 15.8…150 Hz (MR4…MR9) |
| | Shock EN61800-5-1 EN60068-2-27 | UPS Drop Test (for applicable UPS weights)<br>Storage and shipping: max 15 G, 11 ms (in package) |
| | Enclosure class | IP21/NEMA 1 standard in entire kW/HP range<br>IP54/NEMA12 option<br>Note! Keypad required for IP54/NEMA12 |
| **EMC (at default settings)** | Immunity | Fulfils EN61800-3 (2004), first and second environment |
| | Emissions | Depend on EMC level.<br>+EMC2: EN61800-3 (2004), Category C2<br>Honeywell Smart VFD HVAC will be delivered with class C2 EMC filtering, if not otherwise specified.<br>Honeywell Smart VFD HVAC can be modified for IT-networks. See chapter1.4. |
| **Safety** | | EN 61800-5-1 (2007), CE, cUL; (see unit nameplate for more detailed approvals) |
| **Control connections** | **See chapter 7.2.1.** | |
| **Protections** | Overvoltage trip limit<br>Undervoltage trip limit | Yes<br>Yes |
| | Ground fault protection | In case of ground fault in motor or motor cable, only the drive is protected |
| | Mains supervision | Yes |
| | Motor phase supervision | Trips if any of the output phases is missing |
| | Overcurrent protection | Yes |
| | Unit overtemperature protection | Yes |
| **Protections (cont.)** | Motor overload protection | Yes |
| | Motor stall protection | Yes |
| | Motor underload protection | Yes |
| | Short-circuit protection of +24V and +10V reference voltages | Yes |

*Table 17. Smart VFD HVAC technical data*

### 7.2.1 Technical information on control connections

| Basic 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<br>0- +10V (Ri = 200 kΩ)<br>4-20 mA (Ri =250 Ω)<br>Resolution 0.1 %, accuracy ±1 %<br>Selection V/mA with dip-switches (see page 38) |
| **3** | Analogue input common (current) | Differential input if not connected to ground;<br>Allows ±20V differential mode voltage to GND |
| **4** | Analogue input, voltage or current | Analogue input channel 1<br>Defauit:4-20 mA (Ri =250 Ω)<br>0-10 V (Ri=200kΩ)<br>Resolution 0.1 %, accuracy ±1 %<br>Selection V/mA with dip-switches (see page 38) |
| **5** | Analogue input common (current) | Differential input if not connected to ground;<br>Allows 20V differential mode voltage to GND |
| **6** | 24V aux. voltage | +24VDC, ±10%, max volt. ripple < 100mVrms; max. 250mA<br>Dimensioning: max. 1000mA/control box.<br>Short-circuit protected |
| **7** | I/O ground | Ground for reference and controls (connected internally to frame ground through 1MΩ) |
| **8** | Digital input 1 | Positive or negative logic<br>Ri = min. 5kΩ<br>18…30V = "1" |
| **9** | Digital input 2 | |
| **10** | Digital input 3 | |
| **11** | Common A for DIN1-DIN6 | |
| **12** | 24V aux. voltage | +24VDC, ±10%, max volt. ripple < 100mVrms; max. 250mA<br>Dimensioning: max. 1000mA/control box.<br>Short-circuit protected |
| **13** | I/O ground | Ground for reference and controls (connected internally to frame ground through 1MΩ) |
| **14** | Digital input 4 | Positive or negative logic<br>Ri = min. 5kΩ<br>18…30V = "1" |
| **15** | Digital input 5 | |
| **16** | Digital input 6 | |
| **17** | Common A for DIN1-DIN6 | |
| **18** | Analogue signal (+output) | Analogue output channel 1, selection 0 -20mA,<br>load <500 Ω<br>Default:0-20 mA<br>0-10V<br>Resolution 0.1 %, accuracy ±2 %<br>Selection V/mA with dip-switches (see page 38) |
| **19** | Analogue output common | |
| **30** | 24V auxiliary input voltage | Can be used as external power backup for the control unit (and fieldbus) |
| **A** | RS485 | Differential receiver/transmitter<br>Set bus termination with dip switches (see page 38) |
| **B** | RS485 | |

*Table 18. Technical information on basic I/O board*

| **Relay board 1** | Relay board with two Type 8A/STST and one Type 8A/STDT relays.<br>5,5 mm isolation between channels.<br>External interface connector<br>See chapter 6. | |
|---|---|---|
| | | |
| **21** | Relay output 1* | Switching capacity24VDC/8A<br>250VAC/8A<br>125VDC/0.4A<br>Min.switching load5V/10mA |
| **22** | | |
| **23** | | |
| **24** | Relay output 2* | Switching capacity24VDC/8A<br>250VAC/8A<br>125VDC/0.4A<br>Min.switching load5V/10mA |
| **25** | | |
| **26** | | |
| **32** | Relay output 3* | Switching capacity24VDC/8A<br>250VAC/8A<br>125VDC/0.4A<br>Min.switching load5V/10mA |
| **33** | | |

* 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 overvoltage spikes. This is to prevent welding on the relay contacts. Refer to standard EN 60204-1, section 7.2.9

*Table 19. Technical information on Relay board 1*

| **Relay board 2** | Relay board with two Type 8A/STST and standard thermistor input.<br>5,5 mm isolation between channels.<br>External interface connector<br>See chapter 6. | |
|---|---|---|
| | | |
| **21** | Relay output 1* | Switching capacity24VDC/8A<br>250VAC/8A<br>125VDC/0.4A<br>Min.switching load5V/10mA |
| **22** | | |
| **23** | | |
| **24** | Relay output 2* | Switching capacity24VDC/8A<br>250VAC/8A<br>125VDC/0.4A<br>Min.switching load5V/10mA |
| **25** | | |
| **26** | | |
| **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 20. Technical information on Relay board 2*

**Automation and Control Solutions**

Honeywell Intemational Inc.
1985 Douglas Drive North
Golden Valley, MN 55422
customer.honeywell.com

Honeywell Limited-Honeywell Limitée
35 Dynamic Drive
Toronto, Ontario M1V 4Z9

Honeywell