## N800-Series

# N800S Inverter
# Complete User Manual

### Notice

Read and understand these manuals before attempt
ing any unpacking, assembly, operation or maintenance
of the inverter
This manual should be applied only to N800S inverter.
This manual dose not include all items regarding install
ation and maintenance procdures.
For more information, please contact authorized parteners.

**HYUNDAI**
**HEAVY INDUSTRIES**

# 1. SAFETY

⚠ **ONLY A COMPETENT ELECTRICIAN IS ALLOWED TO CARRY OUT THE ELECTRICAL INSTALLATION!**

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:**

| ⚡ | **Dangerous voltage**<br>Risk of death or severe injury |
|---|---|
| ⚠ | **General warning**<br>Risk of damage to the product or connected appliances |

## 1.1 Warnings

⚡ The components of the power unit of the frequency converter are live when N800S is connected to mains. Coming into contact with this voltage is extremely dangerous and may cause death or severe injury. The control unit is isolated from the mains potential.

⚡ The motor terminals U, V, W (T1, T2, T3) and the possible brake resistor terminals - / + are live when N800S 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 output terminals may have a dangerous control voltage present even when N800S is disconnected from mains.

⚡ The earth leakage current of N800S frequency converters exceeds 3.5 mA AC. According to standard EN61800-5-1, a reinforced protective ground connection must be ensured.

⚡ If the frequency converter is used as a part of a machine, the machine manufacturer is responsible for providing the machine with a main switch (EN 60204-1).

⚡ If N800S is disconnected from mains while running the motor, it remains live if the motor is energized by the process. In this case the motor functions as a generator feeding energy to the frequency converter.

⚡ After disconnecting the frequency converter from the mains, wait until the fan stops and the indicators on the display go out. Wait 5 more minutes before doing any work on N800S connections.

⚡ The motor can start automatically after a fault situation, if the autoreset function has been activated.

Before you do electrical work, make sure that there is no voltage in the components of the drive.

## 1.2   Safety instructions

The N800S frequency converter has been designed for fixed installations only.

Do not perform any measurements when the frequency converter is connected to the mains.

Do not perform any voltage withstand tests on any part of N800S. The product safety is fully tested at factory.

Prior to measurements on the motor or the motor cable, disconnect the motor cable from the frequency converter.

Do not open the cover of N800S. Static voltage discharge from your fingers may damage the components. Opening the cover may also damage the device. If the cover of N800S is opened, warranty becomes void.

## 1.3   Earthing and earth fault protection

The AC drive must always be earthed with an earth conductor that is ⏚ connected to the earth terminal that is identified with the symbol . Not using an earth conductor can cause damage to the drive.
The touch current of the drive is more than 3.5 mA AC. The standard EN 61800-5-1 tells that 1 or more of these conditions for the protective circuit must be true.

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

Table 1.1: Protective earthing conductor cross-section

| Cross-sectional area of the phase conductors (S) [㎟] | The minimum cross-sectional area of the protective earthing conductor in question [㎟] |
|---|---|
| S ≤ 16 | S |
| 16 < S ≤ 35 | 16 |
| 35 <S | S/2 |

The values of the table are valid only if the protective earthing conductor is made of the same metal as the phase conductors.

If this is not so, the cross-sectional area of the protective earthing conductor must be determined in a manner that produces a conductance equivalent to that which results from the application of this table.

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

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

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

⚠ **CAUTION!**
Do not do voltage withstand tests on the AC drive. The manufacturer has already done the tests. Doing voltage withstand tests can cause damage to the drive.

The N800S frequency converter **must always** be earthed with an earthing conductor connected to the earthing terminal. See figure below:



MI1 - MI3

MI4



MI5
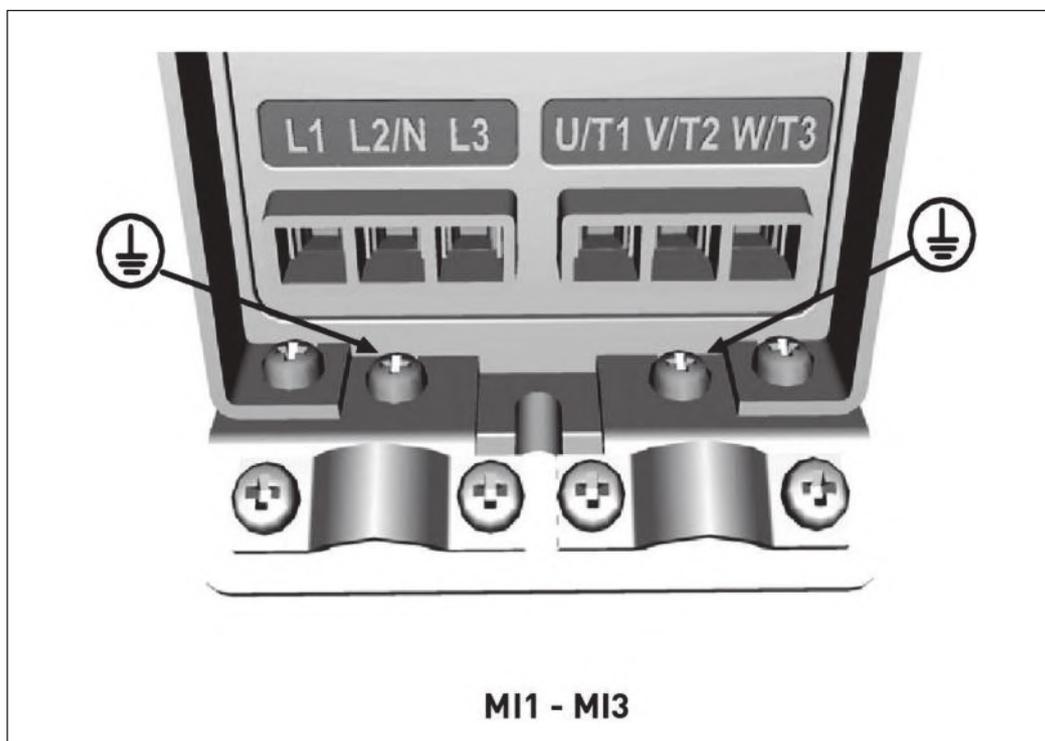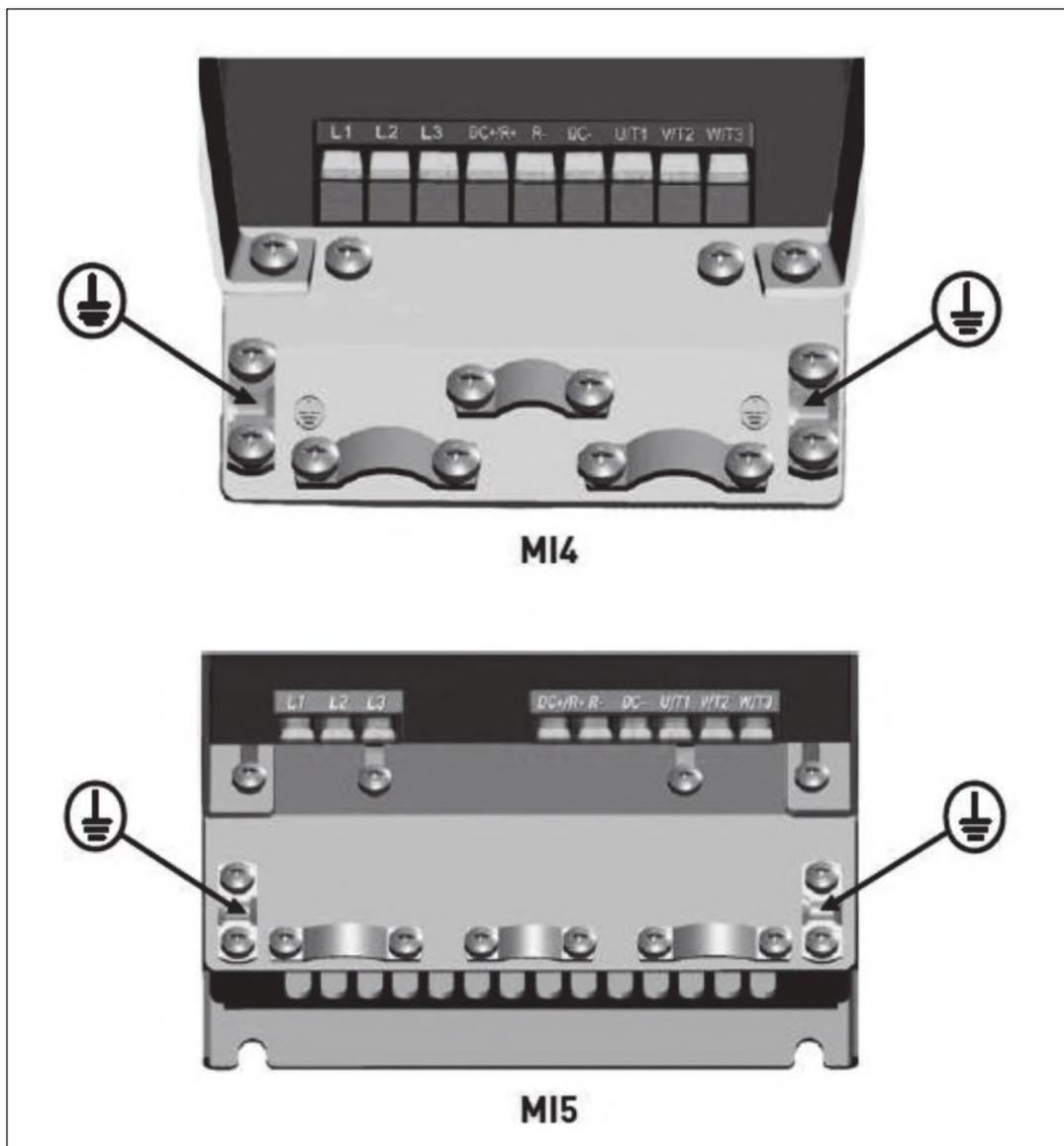
**Refer to Chapter 4.6.6 to connect earth cables with MR frames.**

- The earth fault protection inside the frequency converter protects only the converter itself against earth faults.
- If fault current protective switches are used they must be tested with the drive with earth fault currents that are possible to arise in fault situations.

## 1.4  Electro-magnetic compatibility (EMC)

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

### 1.5 Using a residual current-operated protective device (RCD) or a residual current-operated monitoring device (RCM)

The drive can cause a current in the protective earthing conductor. You can use a residual current-operated protective (RCD) device, or a residual current-operated monitoring (RCM) device to give protection against a direct or an indirect contact. Use a type B RCD or RCM device on the mains side of the drive.

### 1.6 Before running the motor

Checklist:

⚠ 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 shaft rotation direction make sure that this can be done safely.

⚠ Make sure that no power correction capacitors are connected to the motor cable.

### 1.7 DISPOSAL

| | When the drive is at the end of its operation life, do not discard it as a part of municipal waste. You can recycle the primary components of the drive. You must disassemble some components before you can remove the different materials. Recycle the electrical and electronic components as waste. To make sure that the waste is recycled correctly, send the waste to a recycling centre. You can also send the waste back to the manufacturer. Obey the local and other applicable regulations. |
|---|---|

# 2. RECEIPT OF DELIVERY

After unpacking the product, check that no signs of transport damages are to be found on the product and that the delivery is complete (compare the type designation of the product to the code below).

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

If the delivery does not correspond to your order, contact the supplier immediately.

## 2.1   Type designation code
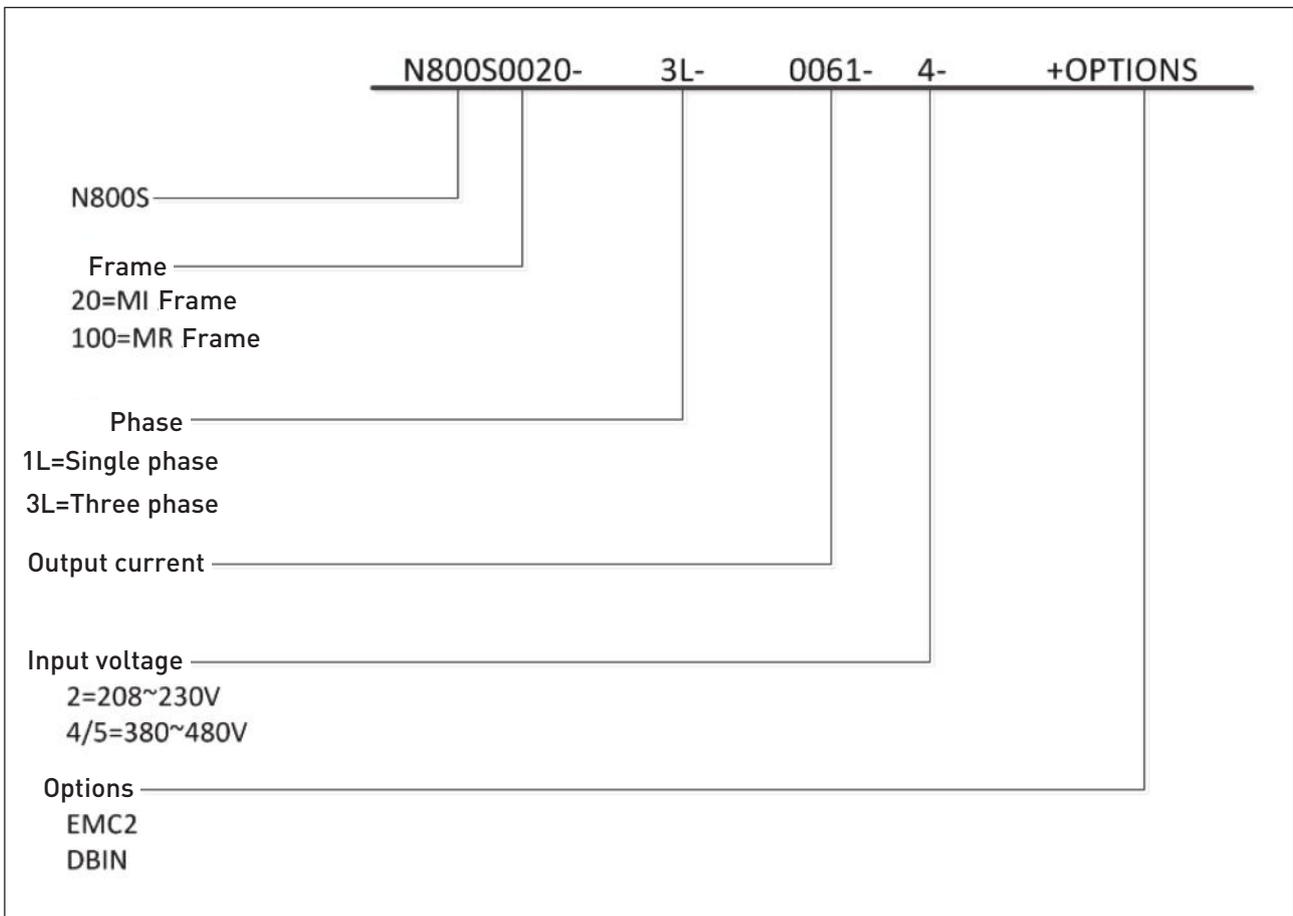


Figure 2.1: N800S type designation code

## 2.2   Storage

If the frequency converter is to be kept in store before use make sure that the ambient conditions are acceptable:

Storing temperature -40...+70 °C
Relative humidity ‹ 95%, no condensation

### 2.3   Maintenance

In normal operating conditions, N800S frequency converters are maintenancefree. However, regular maintenance is recommended to ensure a trouble-free operating and a long lifetime of the drive. We recommended to follow the table below for maintenance intervals.

| Maintenance interval | Maintenance action |
|---|---|
| Whenever necessary | • Clean heatsink* |
| Regular | • Check tightening torques of terminals |
| 12 months (If stored) | • Check input and output terminals and control I / O terminals. <br> • Clean cooling tunnel.* <br> • Check operation of cooling fan, check for corrosion on terminals, bus-bars and other surfaces.* |
| 6 - 24 months (depending on environment) | • Check and clean and clean cooling fans: <br> - Main fan* <br> - Interminal fan* |

* Only for frame MI4 and frame MI5 and MR frames.

#### 2.3.1   Capacitor recharge

After a longer storage time the capacitors need to be recharge in order to avoid capacitor damage. Possible high leakage current through the capacitors must be limited. The best way to achieve this is to use a DC-power supply with adjustable current limit.

1) Set the current limit to 300...800 mA according to the size of the drive.
2) Then connect the DC-power supply to the input phase L1 and L2.
3) Then set the DC-voltage to the nominal DC-voltage level of the (1.35*Un AC) and supply the converter for at least 1 h.

    - If the drive's input voltage is 220VAC, supply 297VDC.
    - If the drive's input voltage is 230VAC, supply 310VDC.

If DC-voltage is not available and the unit has been stored much longer than 12 months deenergized, consult the factory before connecting power.

**NOTE:** It case of MR frame(N800S0100), it is not necessary to recharge the capacitor because of using film capacitors.

## 2.4   Warranty

Only manufacturing defects are covered by the warranty. The manufacturer assumes no responsibility for damages caused during or resulting from transport, receipt of the delivery, installation, commissioning or use.

The manufacturer shall in no event and under no circumstances be held responsible for damages and failures resulting from misuse, wrong installation, unacceptable ambient temperature, dust, corrosive substances or operation outside the rated specifications. Neither can the manufacturer be held responsible for consequential damages.

The Manufacturer's time of warranty is 18 months from the delivery or 12 months from the commissioning whichever expires first (N800S Warranty Terms).

The local distributor may grant a warranty time different from the above. This warranty time shall be specified in the distributor's sales and warranty terms. N800S assumes no responsibility for any other warranties than that granted by N800S itself.

In all matters concerning the warranty, please contact first your distributor.

# 3. INSTALLATION AND COMMISSIONING OF MI FRAMES

## 3.1 Mechanical installation

There are two possible ways to mount the AC drive in the wall. For MI1-MI3, either screw or DIN-rail mounting; For MI4-MI5, screw or flange mounting.
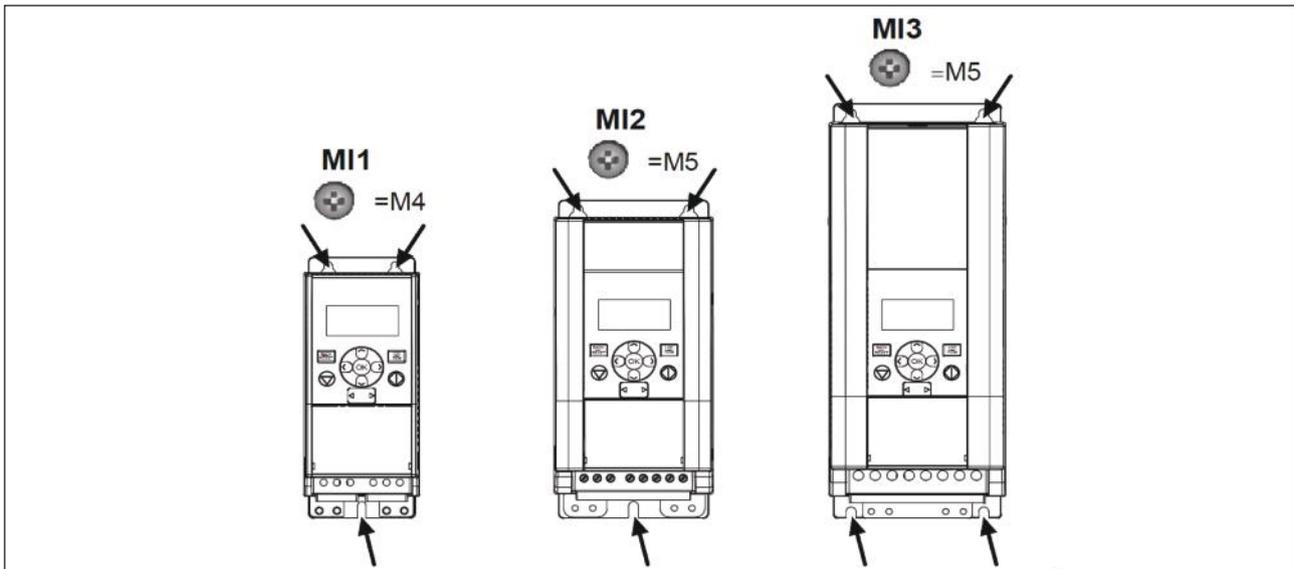


Figure 3.1: Screw mounting, MI1 - MI3
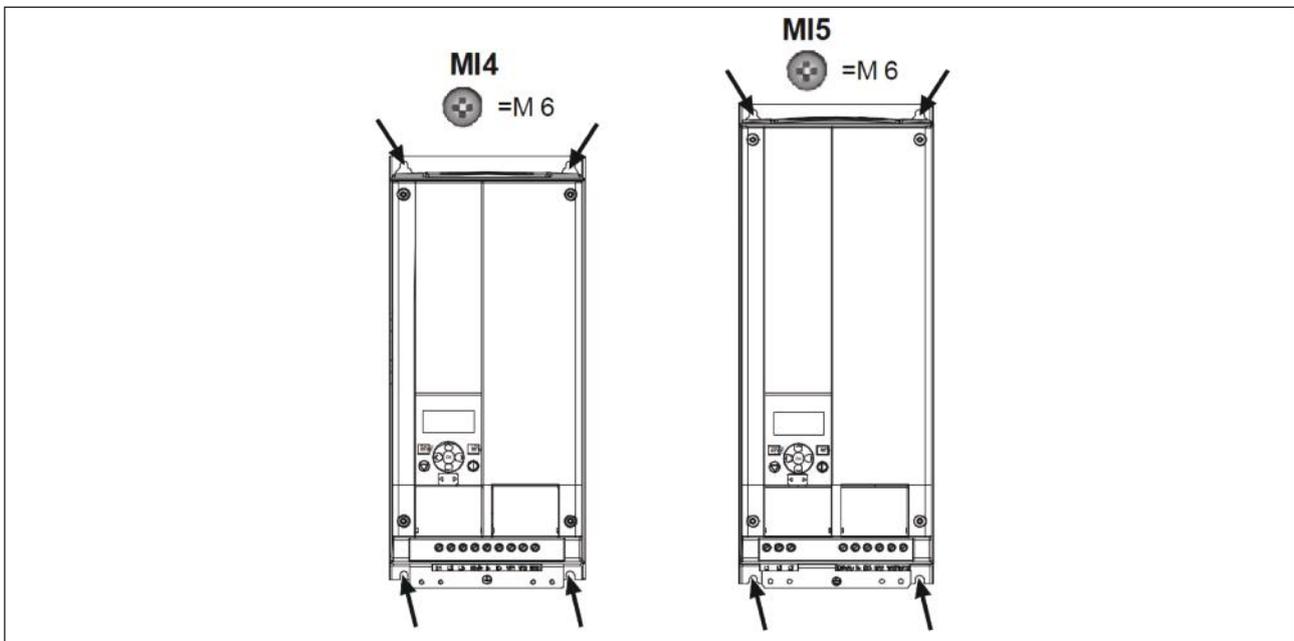


Figure 3.2: Screw mounting, MI4 - MI5

**NOTE!** See the mounting dimensions on the back of the drive. More details in Chapter 3.1.1.
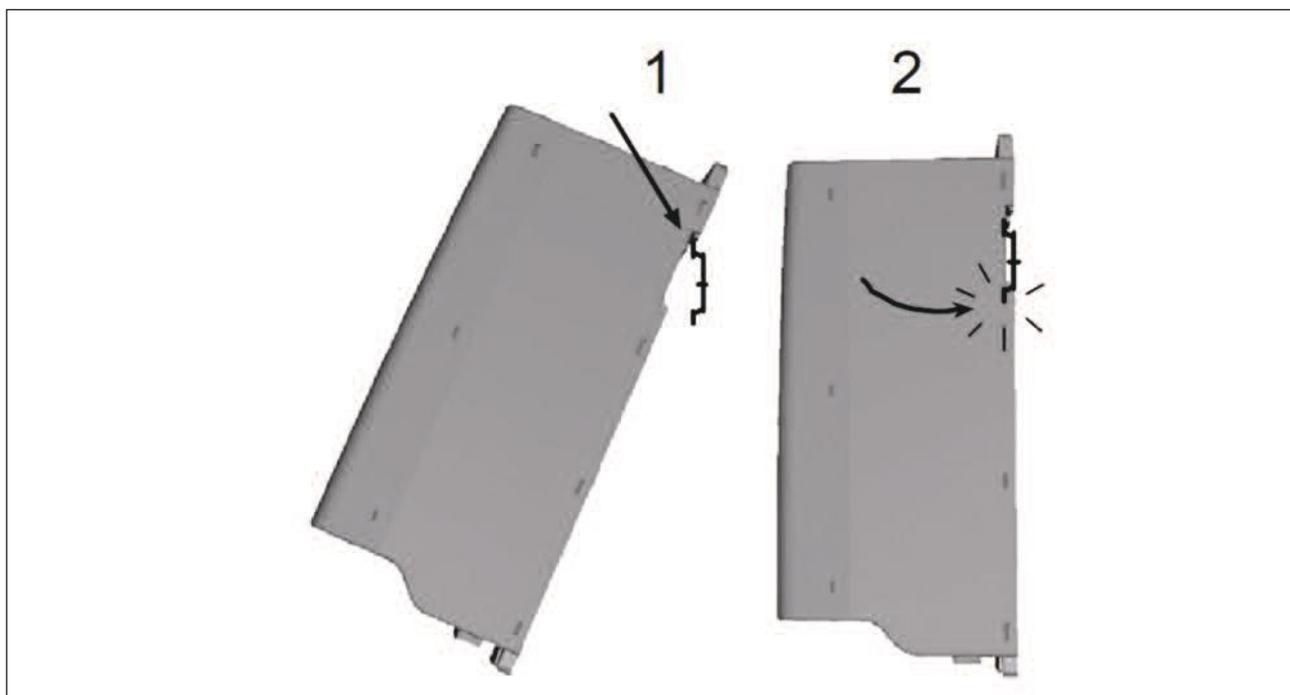
Figure 3.3: DIN-rail mounting, MI1 - MI3
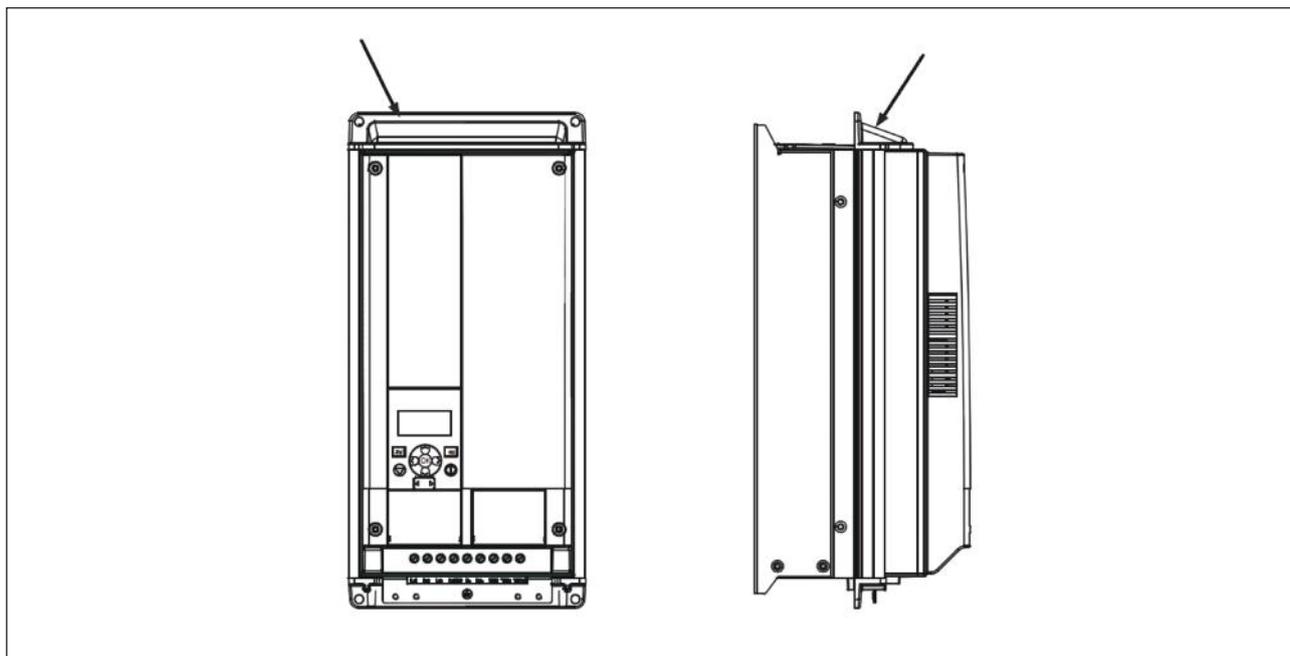


Figure 3.4: Flange mounting, MI4 - MI5
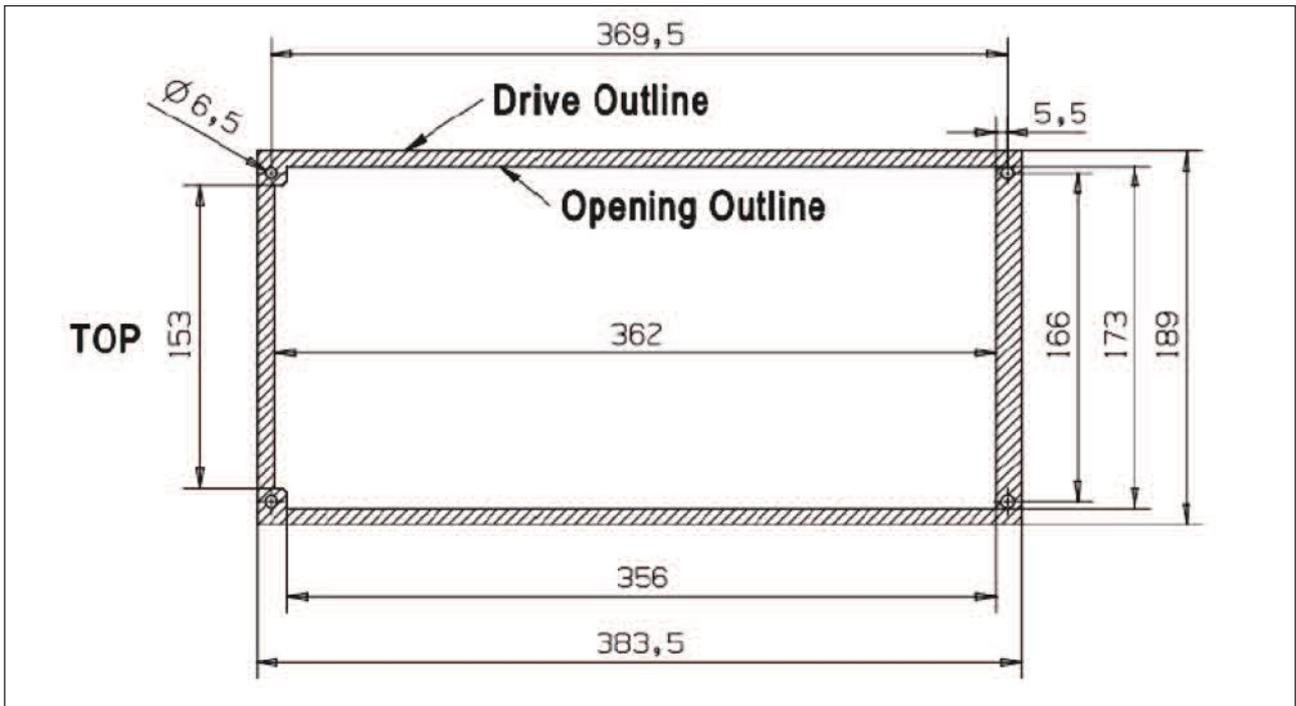
Figure 3.5: Flange mounting cutout dimensions for MI4 (Unit: mm)
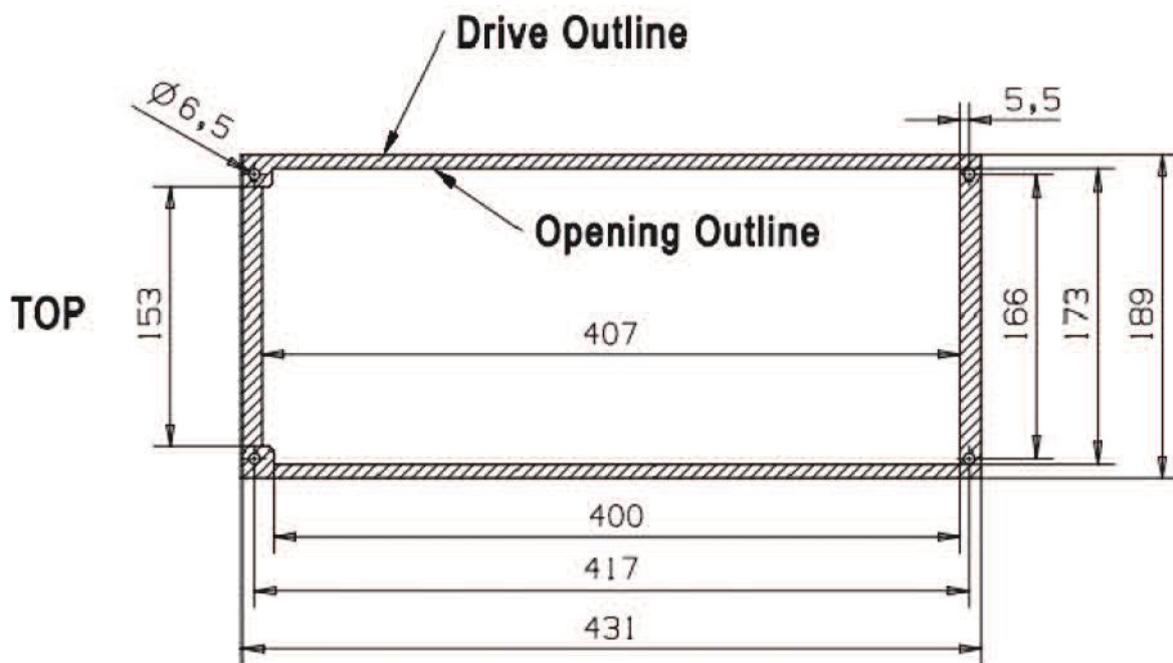


Figure 3.6: Flange mounting cutout dimensions for MI5 (Unit: mm)
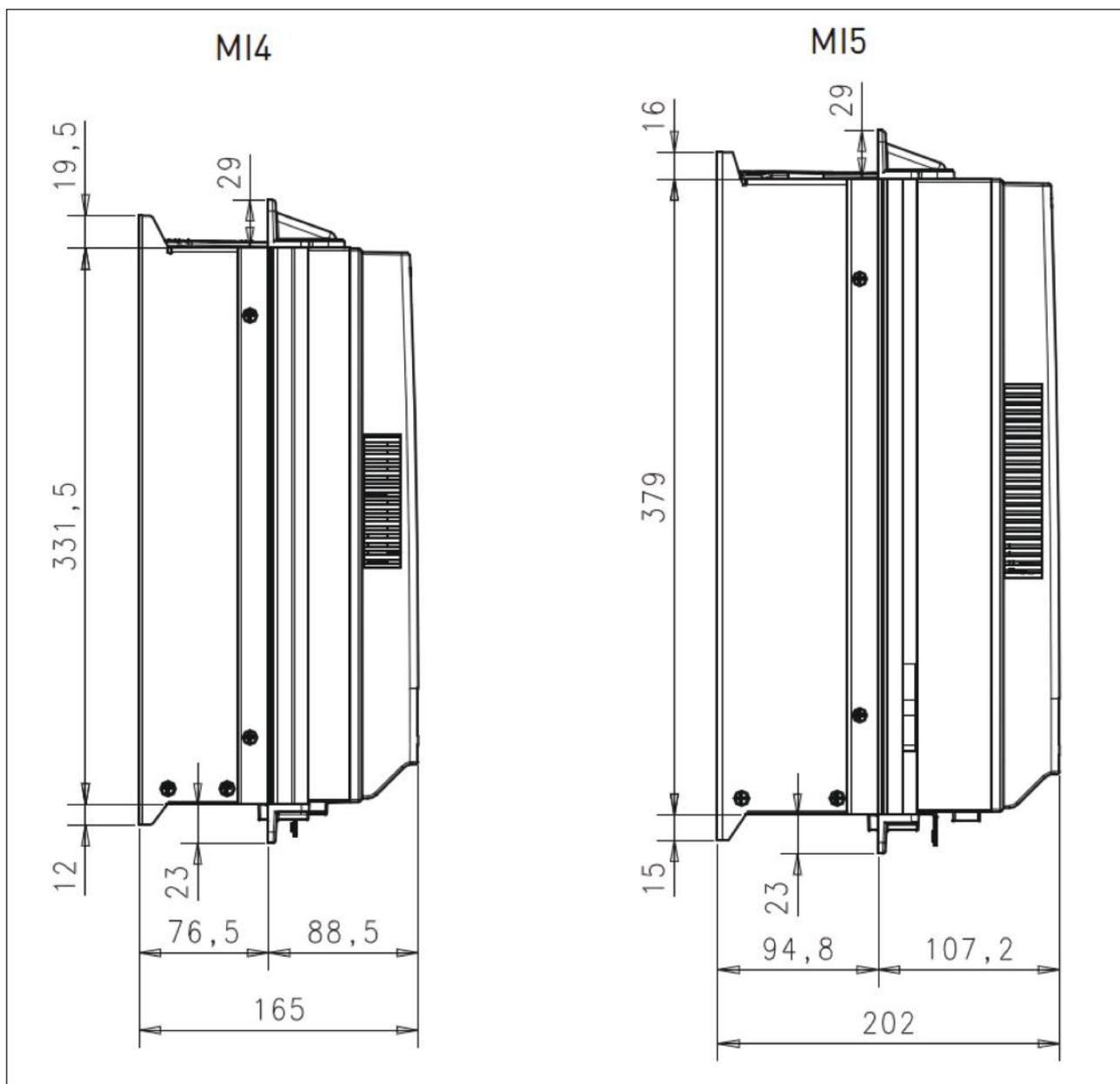
Figure 3.7: Flange mounting depth dimensions for MI4 and MI5 (Unit: mm)

### 3.1.1 N800S dimensions
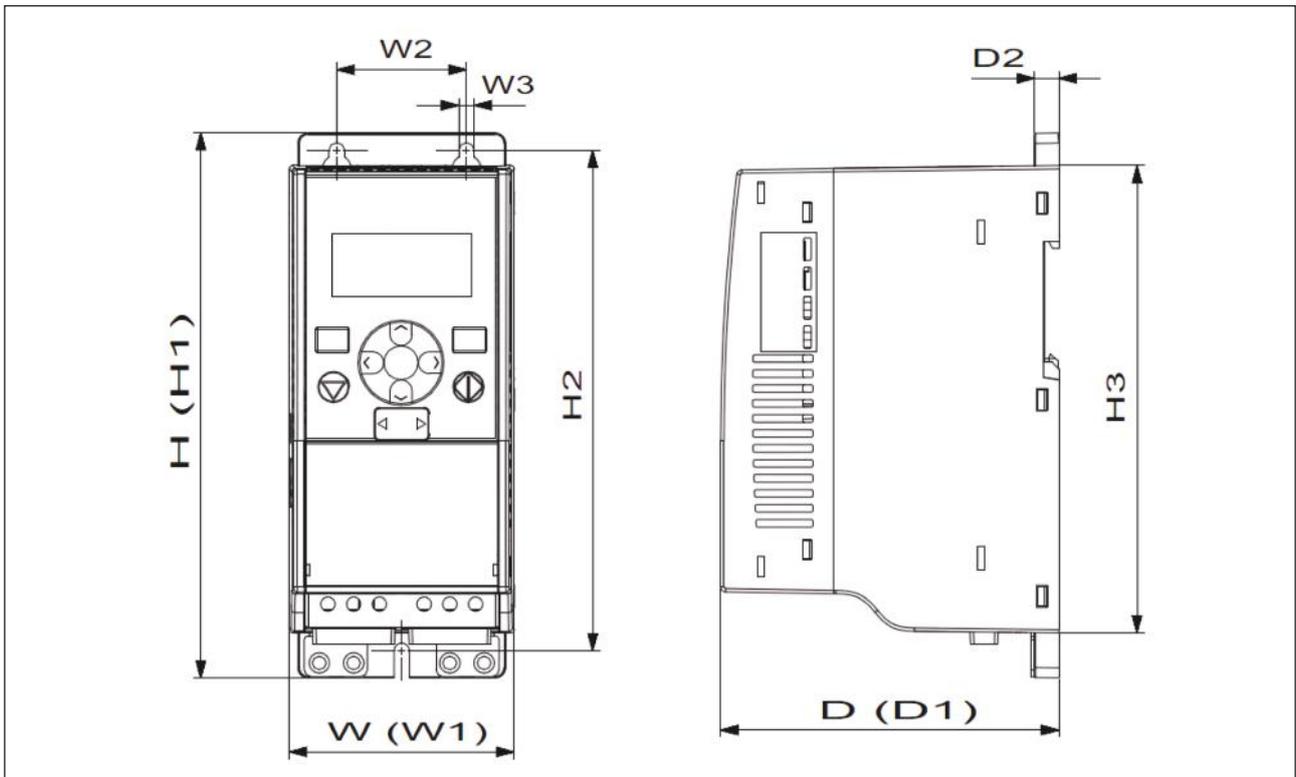


Figure 3.8: Dimensions, MI1 - MI3
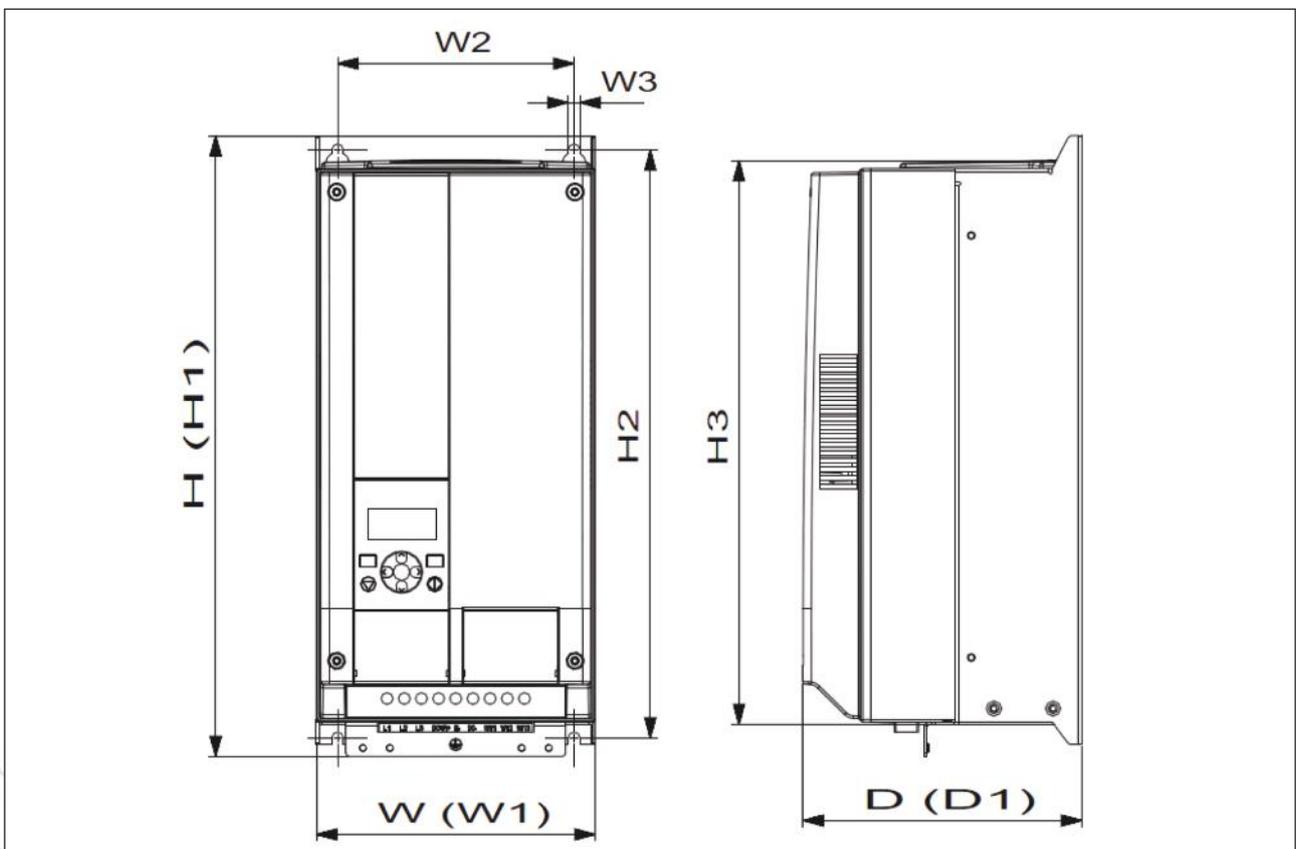


Figure 3.9: Dimensions, MI4 - MI5

| Frame | H1 | H2 | H3 | W1 | W2 | W3 | D1 | D2 |
|-------|------|-------|-------|------|------|-----|-------|-----|
| MI1 | 160.1 | 147 | 137.3 | 65.5 | 37.8 | 4.5 | 98.5 | 7 |
| MI2 | 195 | 183 | 170 | 90 | 62.5 | 5.5 | 101.5 | 7 |
| MI3 | 254.3 | 244 | 229.3 | 100 | 75 | 5.5 | 108.5 | 7 |
| MI4 | 370 | 350.5 | 336.5 | 165 | 140 | 7 | 165 | - |
| MI5 | 414 | 398 | 383 | 165 | 140 | 7 | 202 | - |

Table 3.1: Dimensions in millimetres

| Frame | Dimensions(mm) | | | Weight* |
|-------|------|------|------|------|
| | W | H | D | (kg.) |
| MI1 | 66 | 160 | 98 | 0.5 |
| MI2 | 90 | 195 | 102 | 0.7 |
| MI3 | 100 | 254.3 | 109 | 1 |
| MI4 | 165 | 370 | 165 | 8 |
| MI5 | 165 | 414 | 202 | 10 |

Table 3.2: Frame dimensions (mm) and weights (kg)

| Frame | Dimensions(Inches) | | | Weight* |
|-------|------|------|------|------|
| | W | H | D | (Ibs.) |
| MI1 | 2.6 | 6.3 | 3.9 | 1.2 |
| MI2 | 3.5 | 9.9 | 4 | 1.2 |
| MI3 | 3.9 | 10 | 4.3 | 2.2 |
| MI4 | 6.5 | 14.6 | 6.5 | 18 |
| MI5 | 6.5 | 16.3 | 8 | 22 |

Table 3.3: Frame dimensions (Inch) and weights (Ibs)
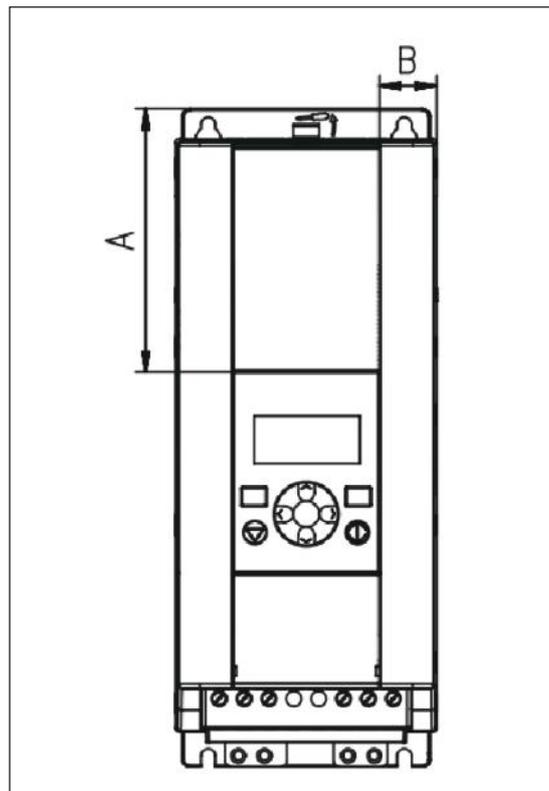
Figure 3.10: Dimensions, MI2 - MI3 Display Location

| Dimensions (mm) | Frame | |
|---|---|---|
| | MI2 | MI3 |
| A | 17 | 22.3 |
| B | 44 | 102 |
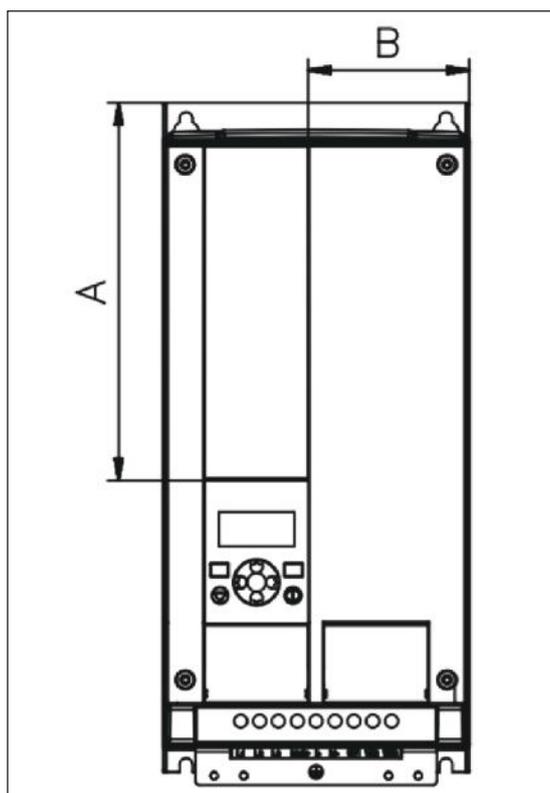
Figure 3.11: Dimensions, MI4 - MI5 Display Location

| Dimensions (mm) | Frame | |
|---|---|---|
| | MI4 | MI5 |
| A | 205 | 248.5 |
| B | 87 | 87 |

### 3.1.2 Cooling

Enough free space shall be left above and below the frequency converter to ensure sufficient air circulation and cooling. You will find the required dimensions for free space in the table below.

If several units are mounted above each other the required free space equals C + D (see figure below). Moreover, the outlet air used for cooling by the lower unit must be directed away from the air intake of the upper unit.

The amount of cooling air required is indicated below. Also make sure that the temperature of the cooling air does not exceed the maximum ambient temperature of the converter.

| Min clearance (mm) | | | | |
|---|---|---|---|---|
| Type | A* | B* | C | D |
| MI1 | 20 | 20 | 100 | 50 |
| MI2 | 20 | 20 | 100 | 50 |
| MI3 | 20 | 20 | 100 | 50 |
| MI4 | 20 | 20 | 100 | 100 |
| MI5 | 20 | 20 | 120 | 100 |

Table 3.4: Min. clearances around AC drive

* Min clearance A and B for drives for MI1 ~ MI3 can be
0 mm if the ambient temperature is below 40 degrees.



Figure 3.12: Installation space

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

> **NOTE!** See the mounting dimensions on the back of the drive.
> Leave **free space** for cooling above **(100 mm)**, below **(50 mm)**, and on the sides **(20 mm)**
> of N800S! (For MI1 - MI3, side-to-side installation allowed only if the ambient temperature is below
> 40 °C; For MI4-MI5, side-to-side installation is not allowed.

| Type | Cooling air required (m³/h) |
|---|---|
| MI1 | 10 |
| MI2 | 10 |
| MI3 | 30 |
| MI4 | 45 |
| MI5 | 75 |

Table 3.5: Required cooling air

### 3.1.3 EMC levels

EN61800-3 defines the division of frequency converters into four classes according to the level of electromagnetic disturbances emitted, the requirements of a power system network and the installation environment (see below). The EMC class of each product is defined in the type designation code.

**Category C1:** Frequency converters of this class comply with the requirements of category C1 of the product standard EN 61800-3 (2004). Category C1 ensures the best EMC characteristics and it includes converters the rated voltage of which is less than 1000 V and which are intended for use in the 1st environment.

**NOTE:** The requirements of class C are fulfilled only as far as the conducted emissions are concerned.

**Category C2:** Frequency converters of this class comply with the requirements of category C2 of the product standard EN 61800-3 (2004). Category C2 includes converters in fixed installations and the rated voltage of which is less than 1000 V. The class C2 frequency converters can be used both in the 1st and the 2nd environment.

**Category C3:** Frequency converters of this class comply with the requirements of category C3 of the product standard EN 61800-3 (2004). Category C3 includes converters the rated voltage of which is less than 1000 V and which are intended for use in the second environment only.

**Category C4:** The drives of this class do not provide EMC emission protection. These kinds of drives are mounted in enclosures.

Environments in product standard EN 61800-3 (2004)

**First environment:** Environment that includes domestic premises. It also includes establishments directly connected without intermediate transformers to a low-voltage power supply network which supplies buildings used for domestic purposes.

**NOTE:** houses, apartments, commercial premises or offices in a residential building are examples of first environment locations.

**Second environment:** Environment that includes all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.

**NOTE:** industrial areas, technical areas of any building fed from a dedicated transformer are examples of second environment locations.

### 3.1.4 Changing the EMC protection class from C2 or C3 to C4

The EMC protection class of MI1-MI3 frequency converters can be changed from class C2 or C3 to class C4 by **removing the EMC-capacitor disconnecting screw**, see figure below. MI4 & 5 can also be changed by removing the EMC jumpers.

**Note!** Do not attempt to change the EMC level back to class C2 or C3. Even if the procedure above is reversed, the frequency converter will no longer fulfil the EMC requirements of class C2 / C3!
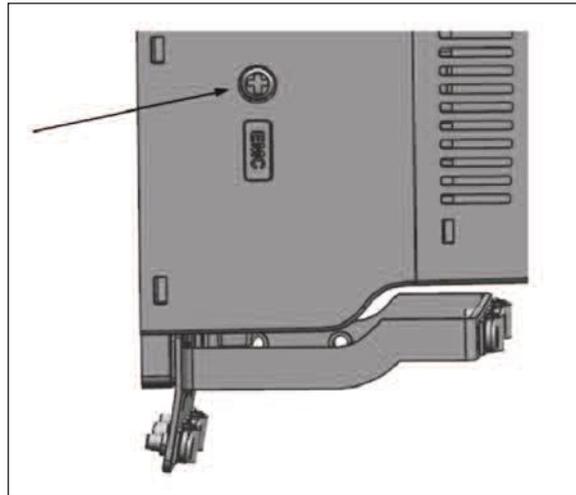


Figure 3.13: EMC protection class, MI1 - MI3
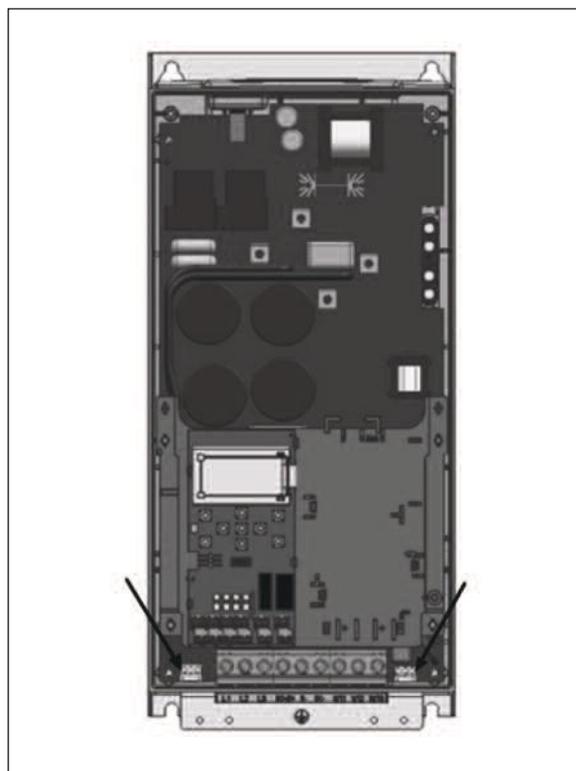


Figure 3.14: EMC protection class, MI4
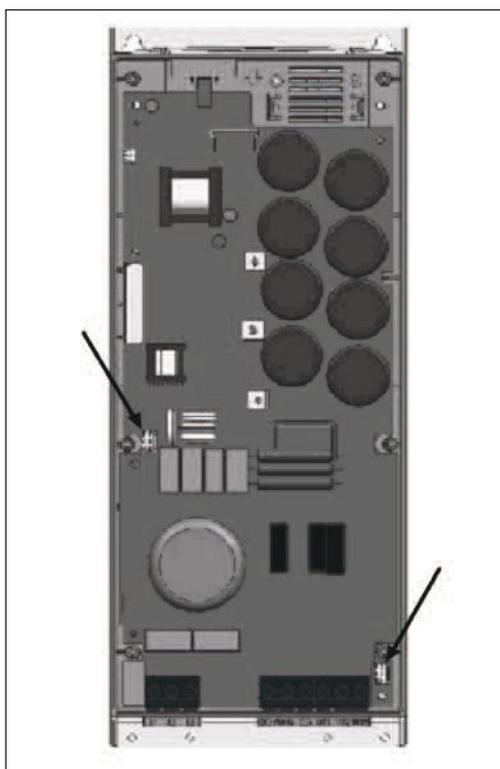
Figure 3.15: EMC protection class, MI5
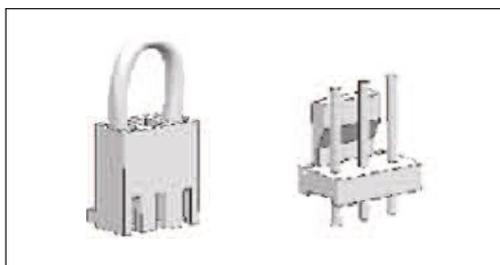


Figure 3.16: Jumpers

- Remove the main cover and locate the two jumpers.
- Disconnect the RFI-filters from ground by lifting the jumpers up from their default positions. See Figure 3.16

## 3.2 Cabling and connections

### 3.2.1 Power cabling

**Note!** Tightening torque for power cables is 0.5 - 0.6 Nm (4-5 in.lbs).
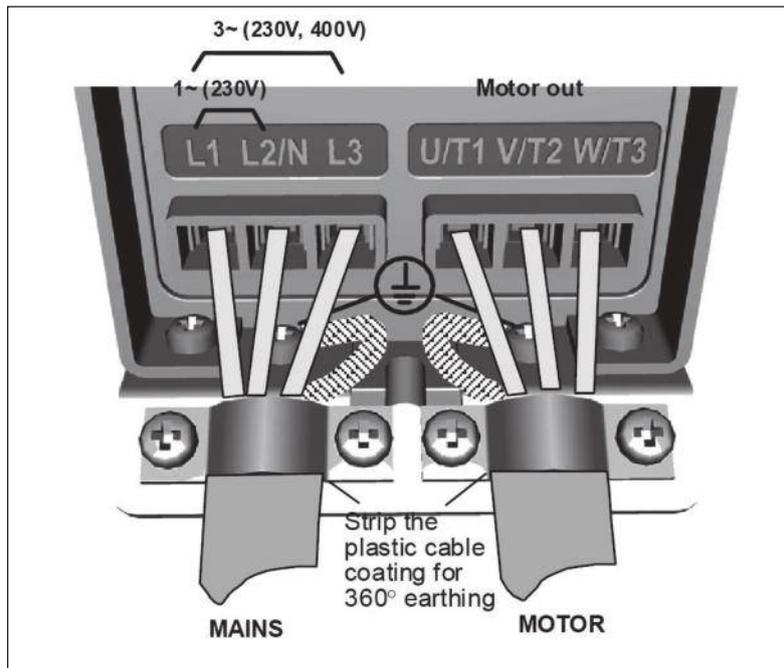


Figure 3.17: Power connections, MI1
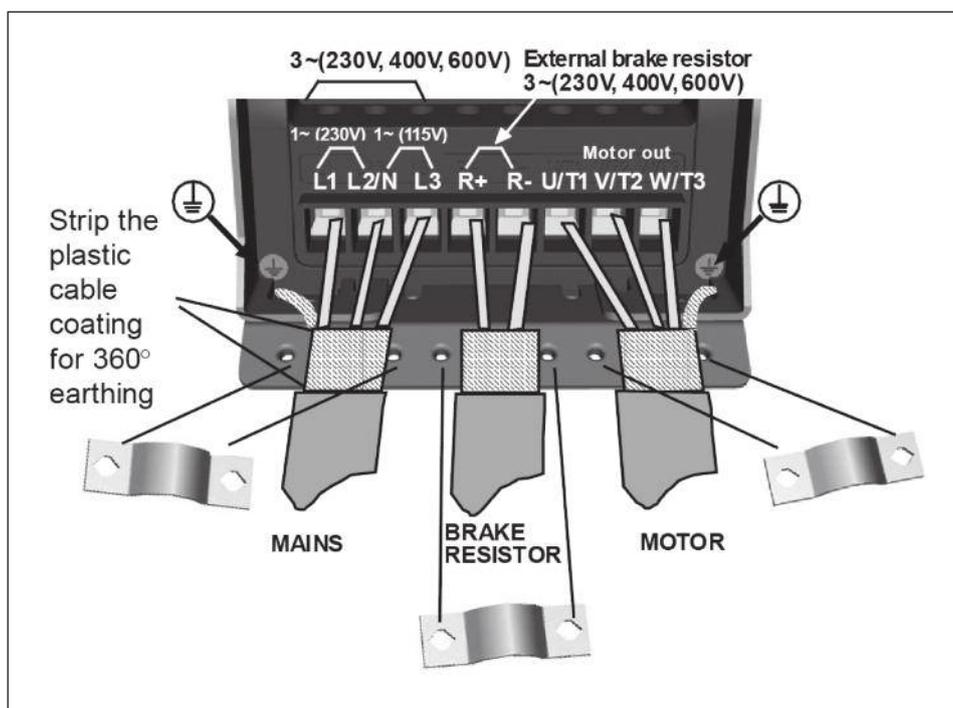


Figure 3.18: Power connections, MI2 - MI3
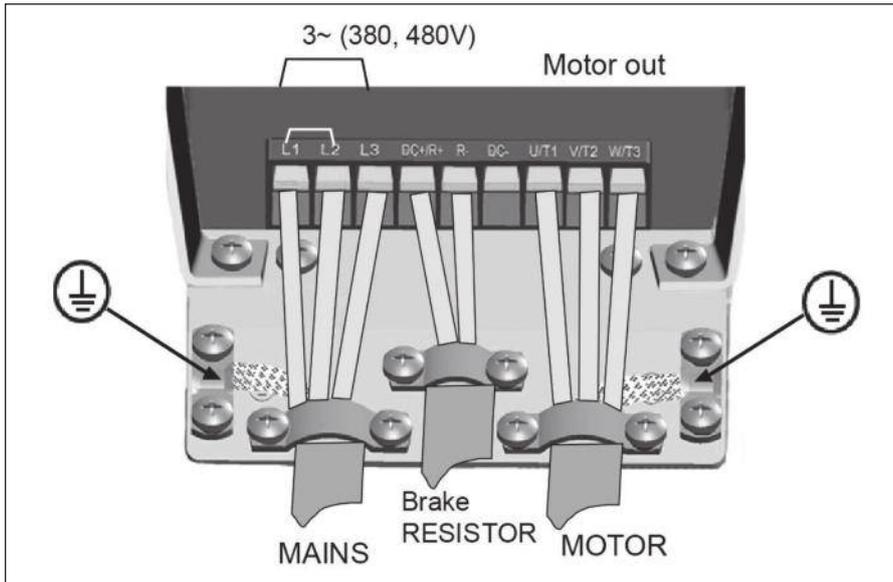
Figure 3.19: Power connections, MI4
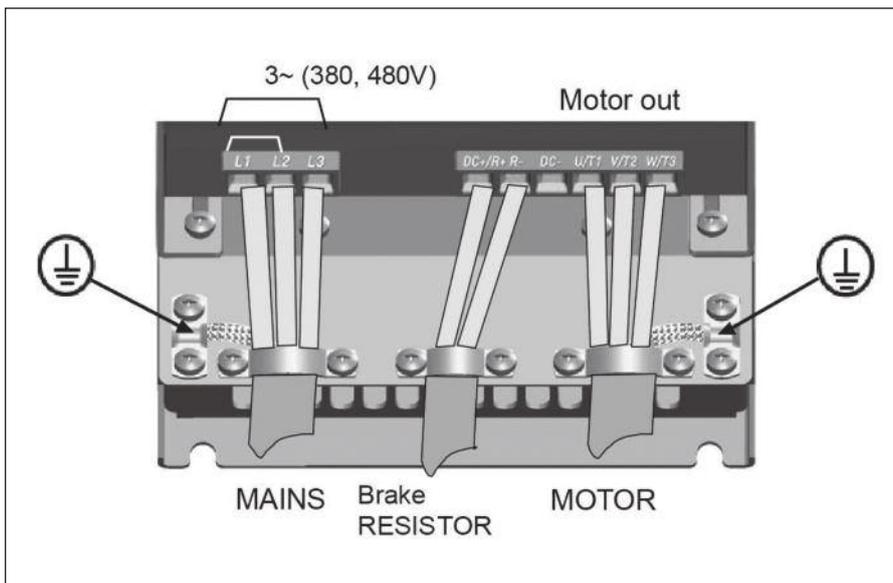


Figure 3.20: Power connections, MI5

### 3.2.2  Control cabling



Attach the support
AFTER installing
the power cables

Attach this plate
BEFORE installing
the power cables
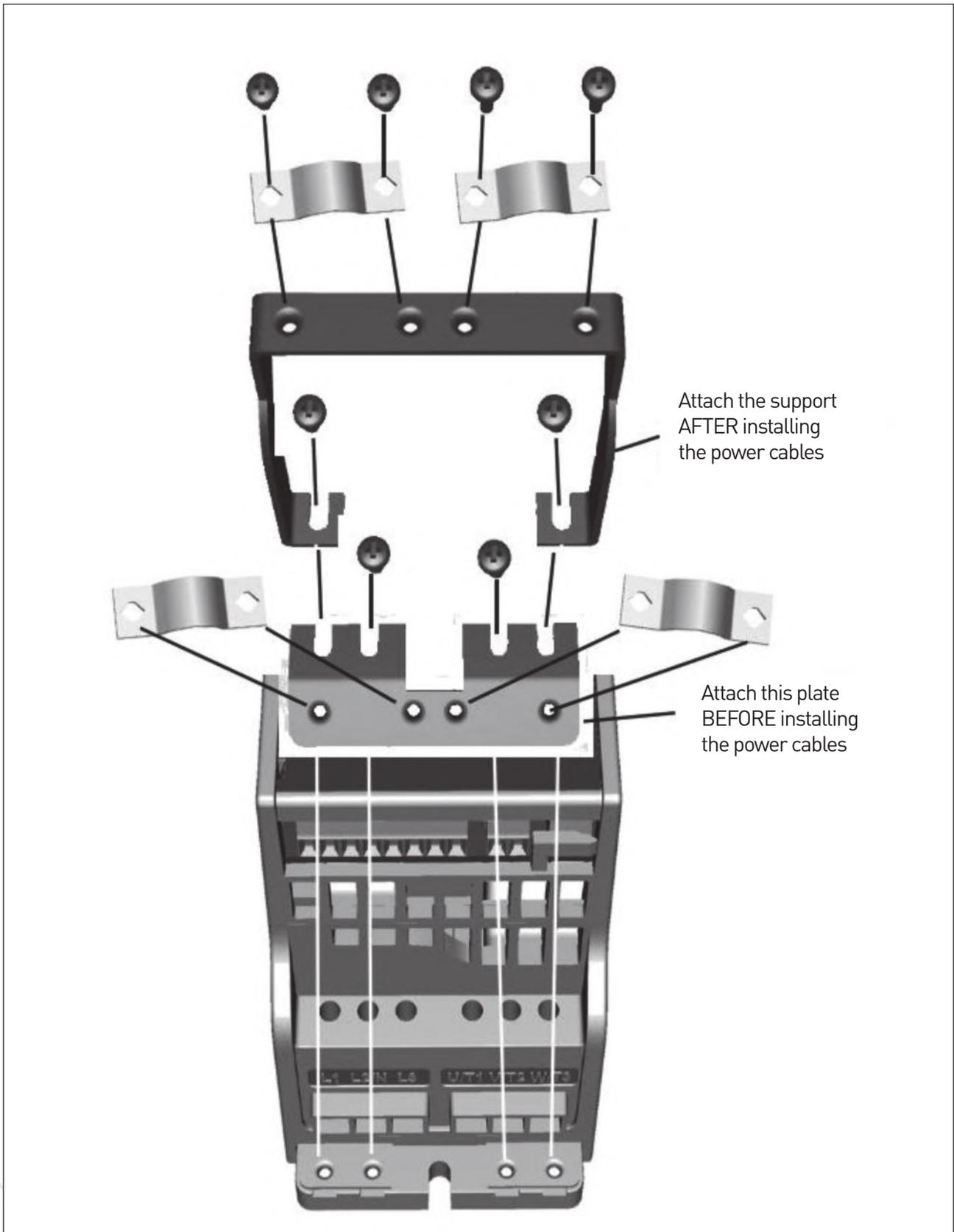
Figure 3.21: Mount the PE-plate and API cable support, MI1 - MI3

Attach the support AFTER installing

Attach this plate BEFORE installing the power cables
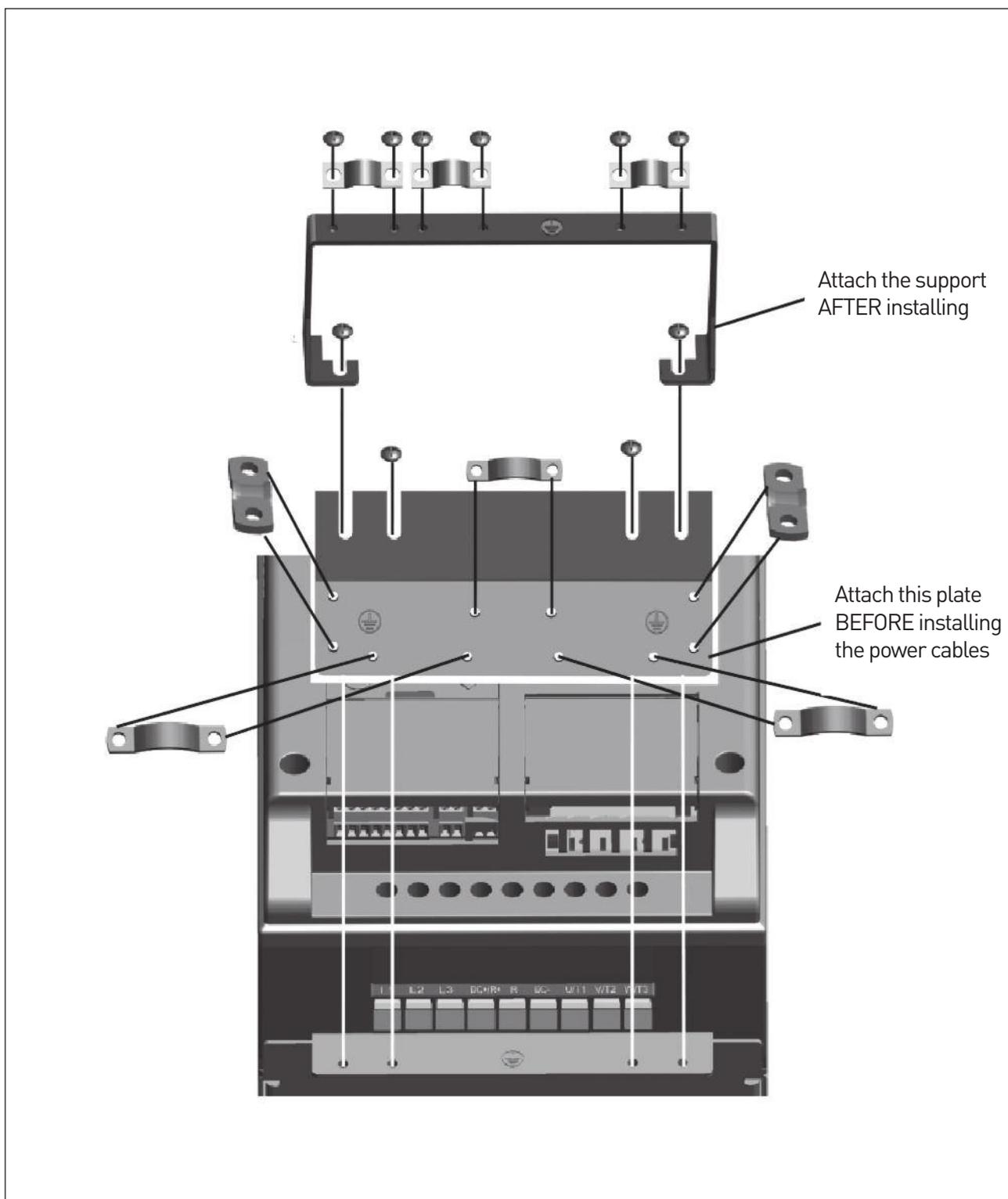
Figure 3.22: Mount the PE-plate and API cable support, MI4 - MI5

Figure 3.23: Open the lid, MI1 - MI3
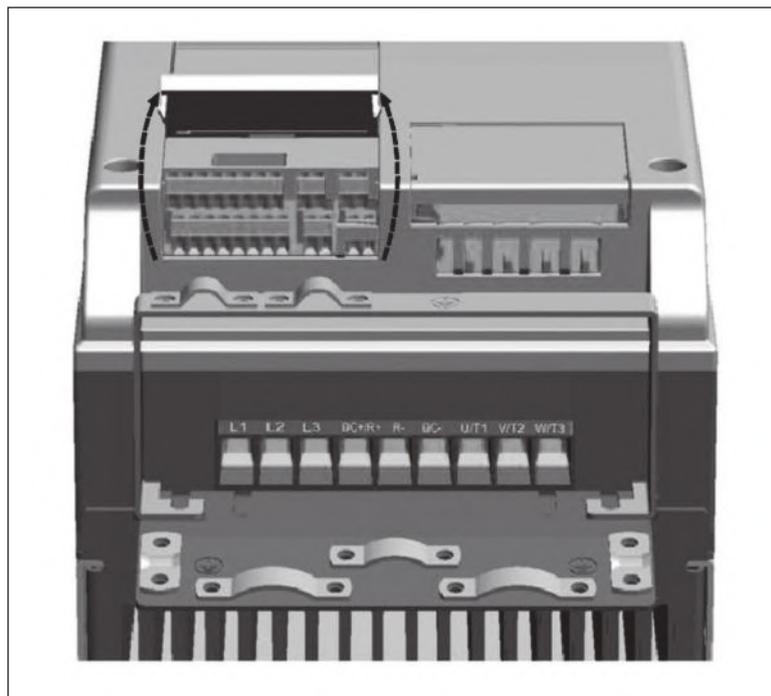


Figure 3.24: Open the lid, MI4 - MI5

Control cable tightening torque: 0.4 Nm

Strip the plastic cable coating for 360°earthing
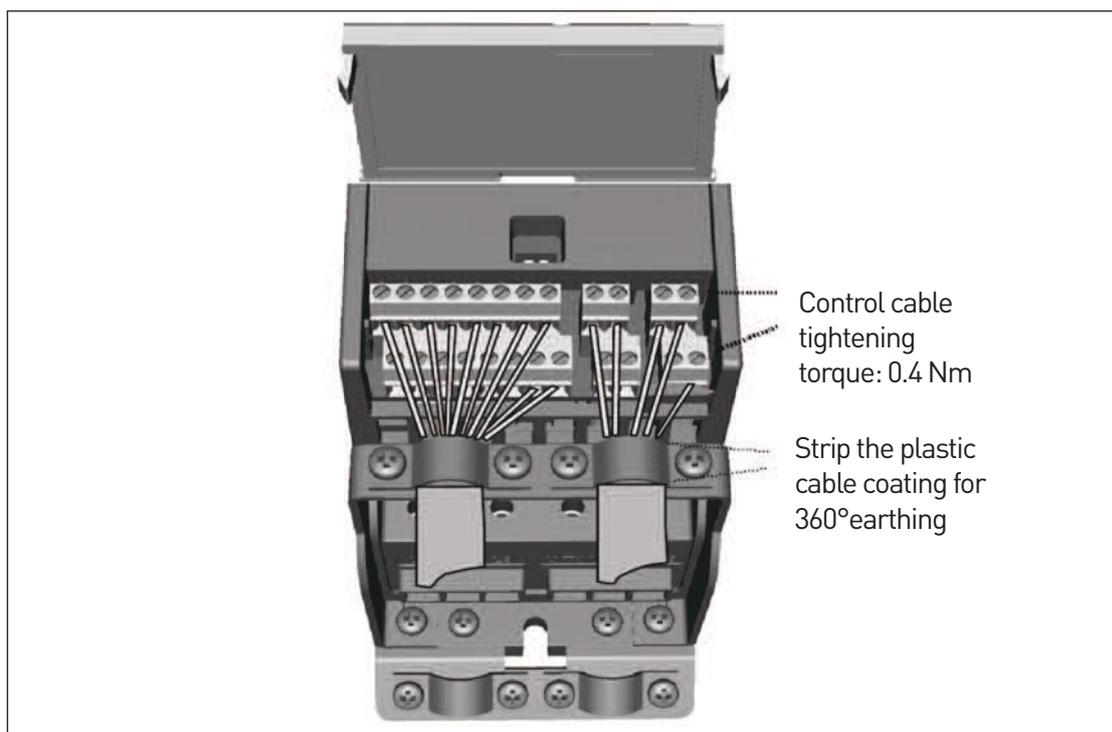
Figure 3.25: Install the control cables. MI1 - MI3.
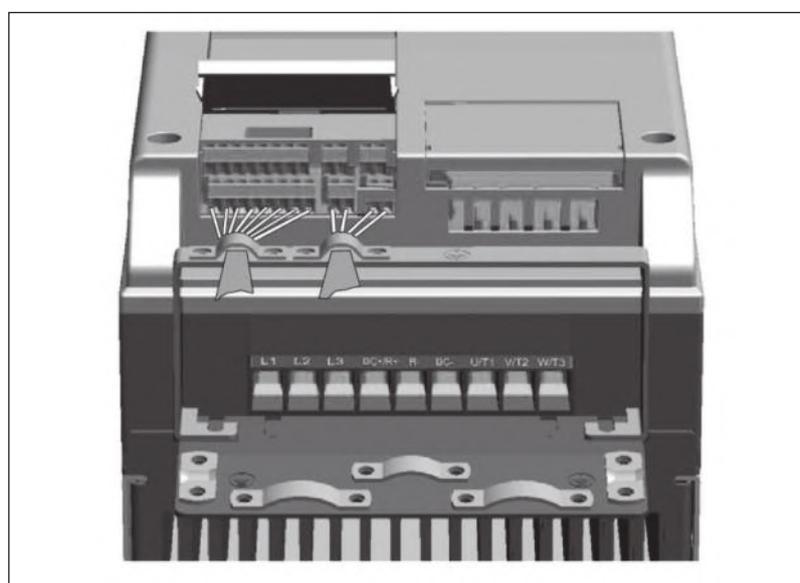
Figure 3.26: Install the control cables. MI4 - MI5.

### 3.2.3   Allowed option boards in N800S

See below for the allowed option boards in the slot:

| SLOT | EC | E3 | E5 | E6 | E7 | B1 | B2 | B4 | B5 | B9 | BH | BF |
|------|----|----|----|----|----|----|----|----|----|----|----|----|

**Note!** When OPT-B1-V / OPT-B4 -V used in N800S, +24VDC (±10%, min. 300mA) power should be supplied to Termianl 6(+24V_out) and Terminal 3 (GND) in control board.

Option board assembly structure:

| Option boards | |
|---|---|
| OPT-EC-V | EtherCat |
| OPT-E3-V | Profibus DPV1(Screw connector) |
| OPT-E5-V | Profibus DPV1(D9 connector) |
| OPT-E6-V | CANopen |
| OPT-E7-V | DeviveNet |
| OPT-B1-V | 6 x DI/DO, each I/O can be individually |
| OPT-B2-V | 2 x Relay output + Thermistor |
| OPT-B4-V | 1 x AI, 2 x AO(Insulated) |
| OPT-B5-V | 3 x Relay output |
| OPT-B9-V | 1 x RO, 5 x DI(42-240VAC) |
| OPT-BH-V | 3 x Temperature measurement( Support for PT100, PT1000, NI1000, KTY84-130, KTY84-150, KTY84-131 sensors) |
| OPT-BF-V | 1 x AO, 1 x DO, 1 x RO |

Option board assembly structure:

| | |
|---|---|
| 1 |  |
| 2 |  |
| 3 |  |

| | |
|---|---|
| 4 |  |
| 5 |  |
| 6 |  |
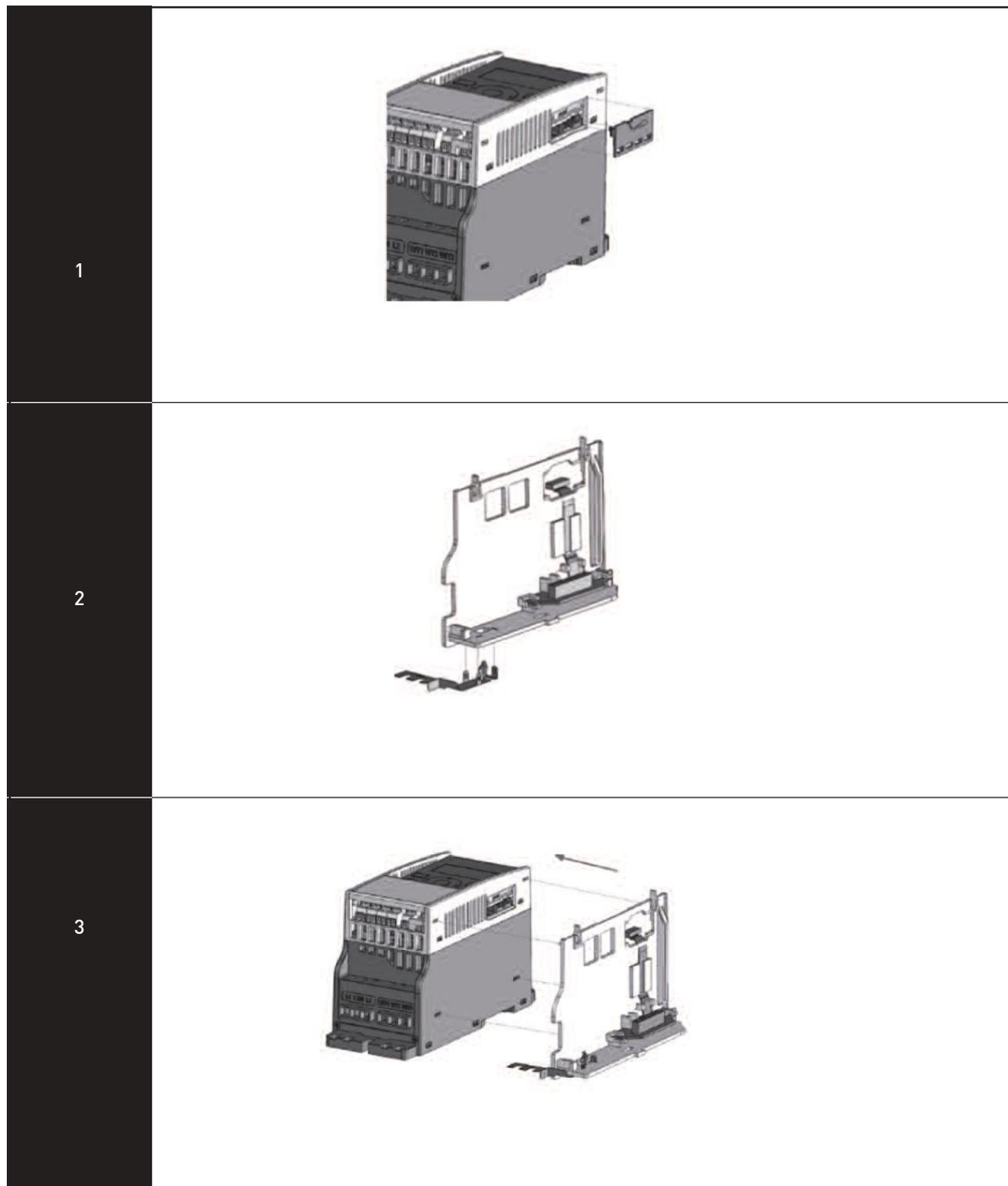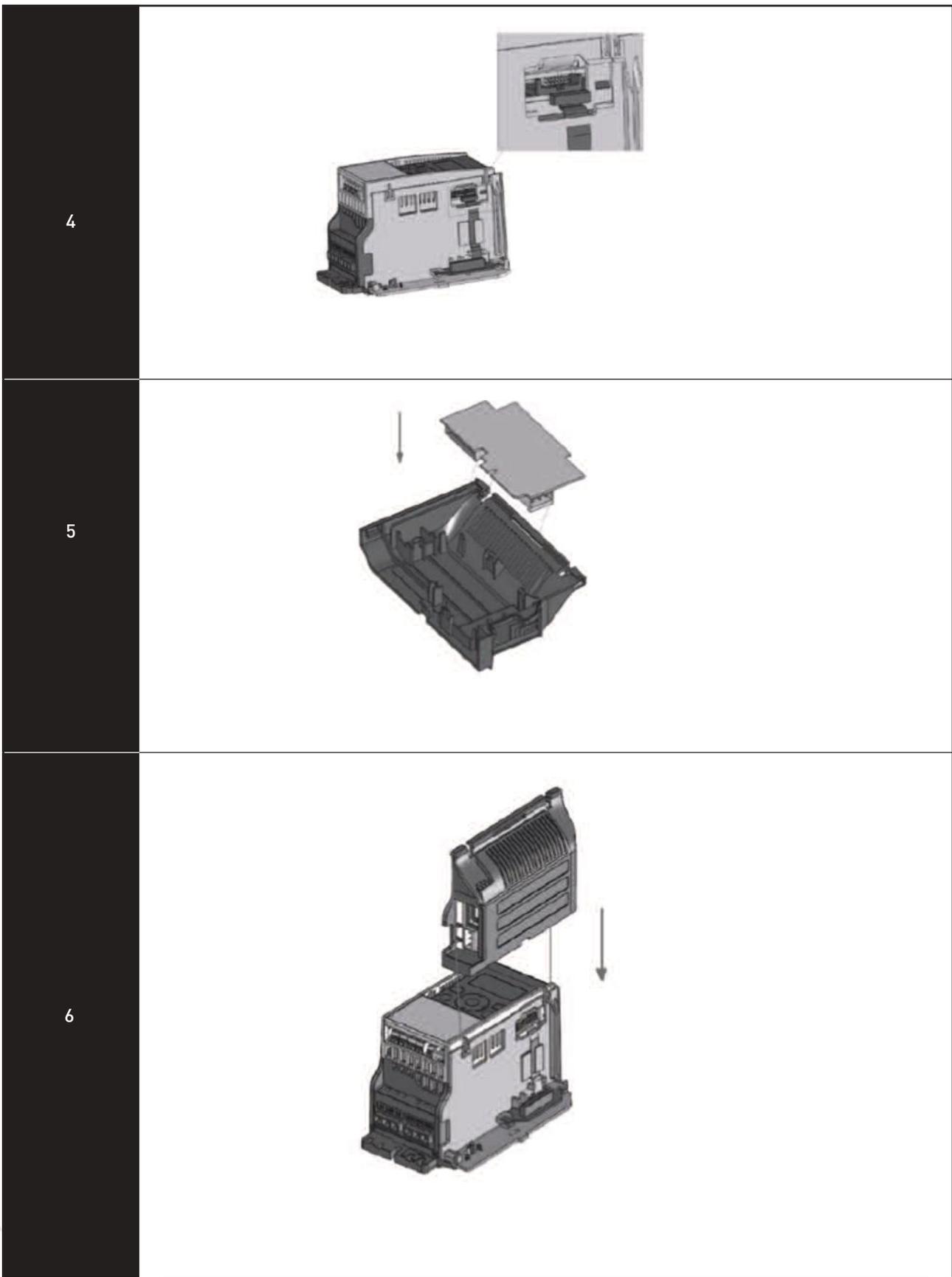
### 3.2.4 Screw of cables
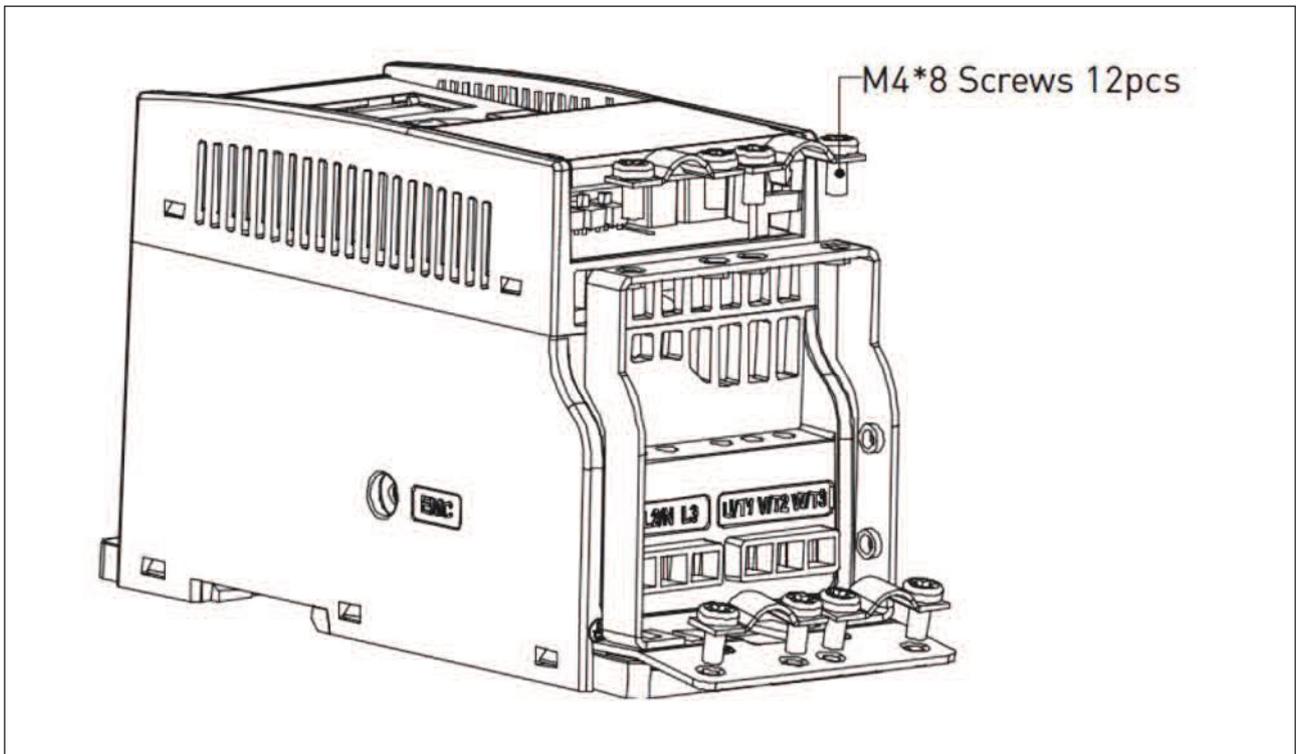


Figure 3.27: MI1 screws
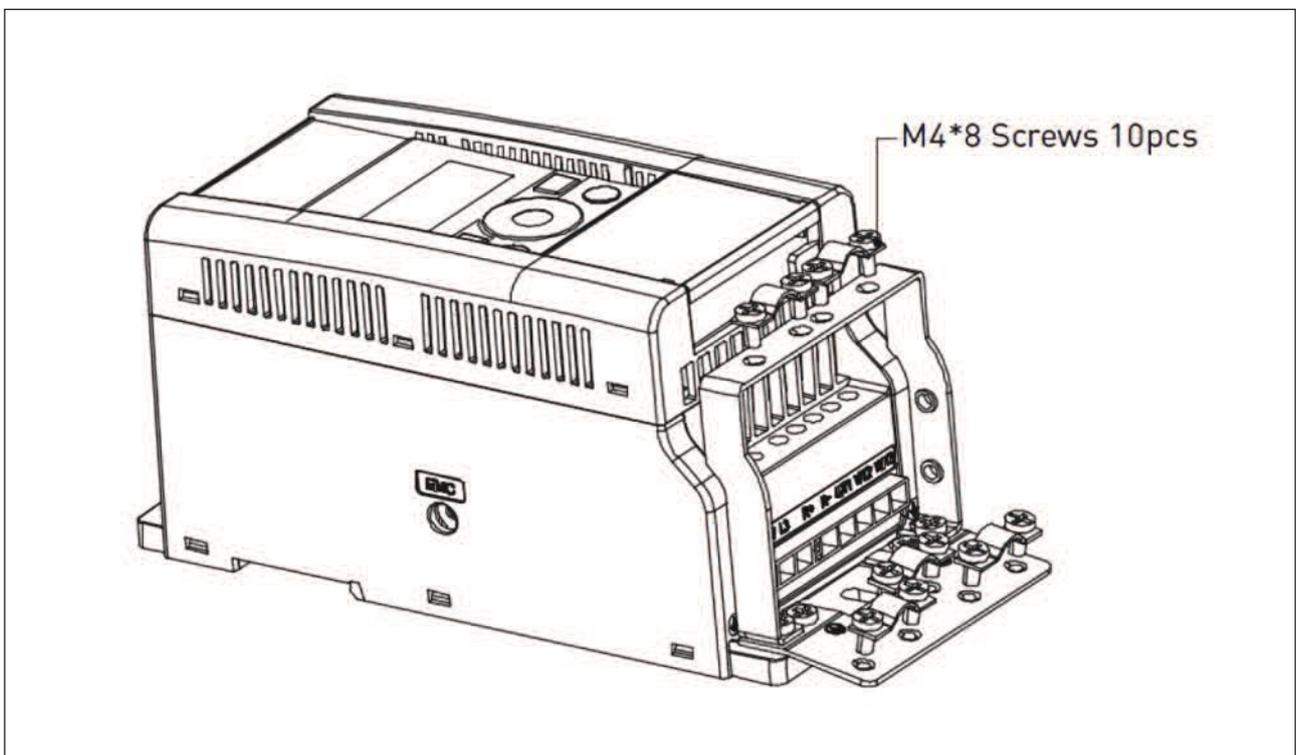


Figure 3.28: MI2 screws
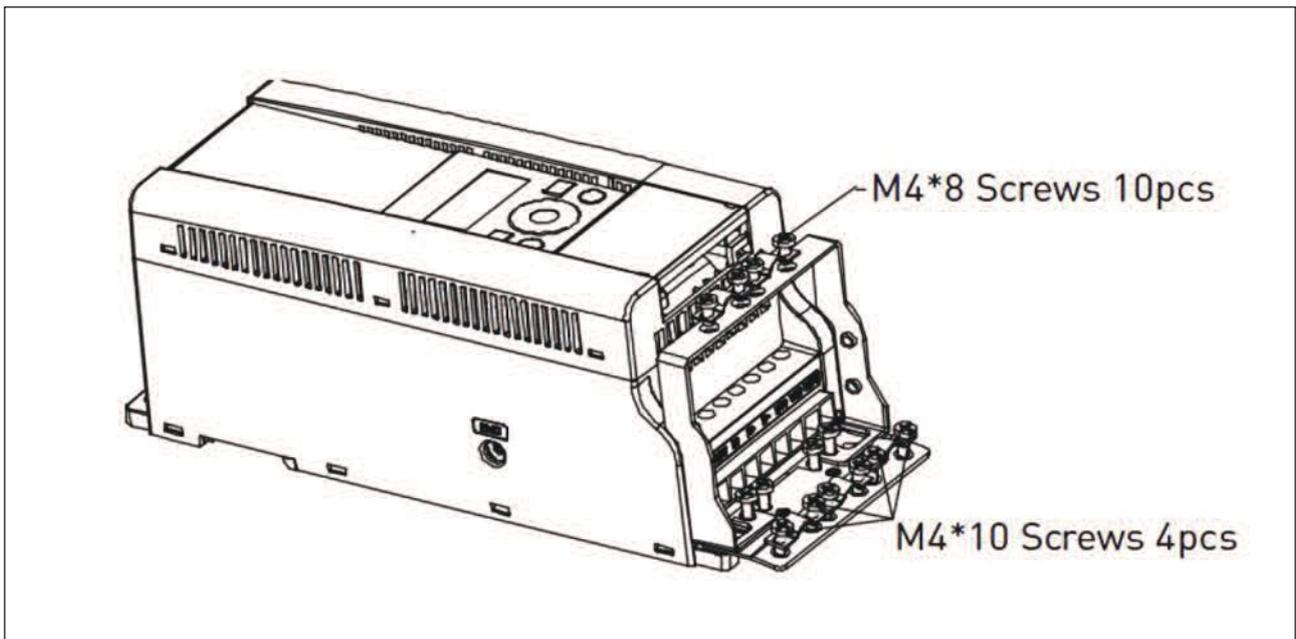
Figure 3.29: MI3 screws
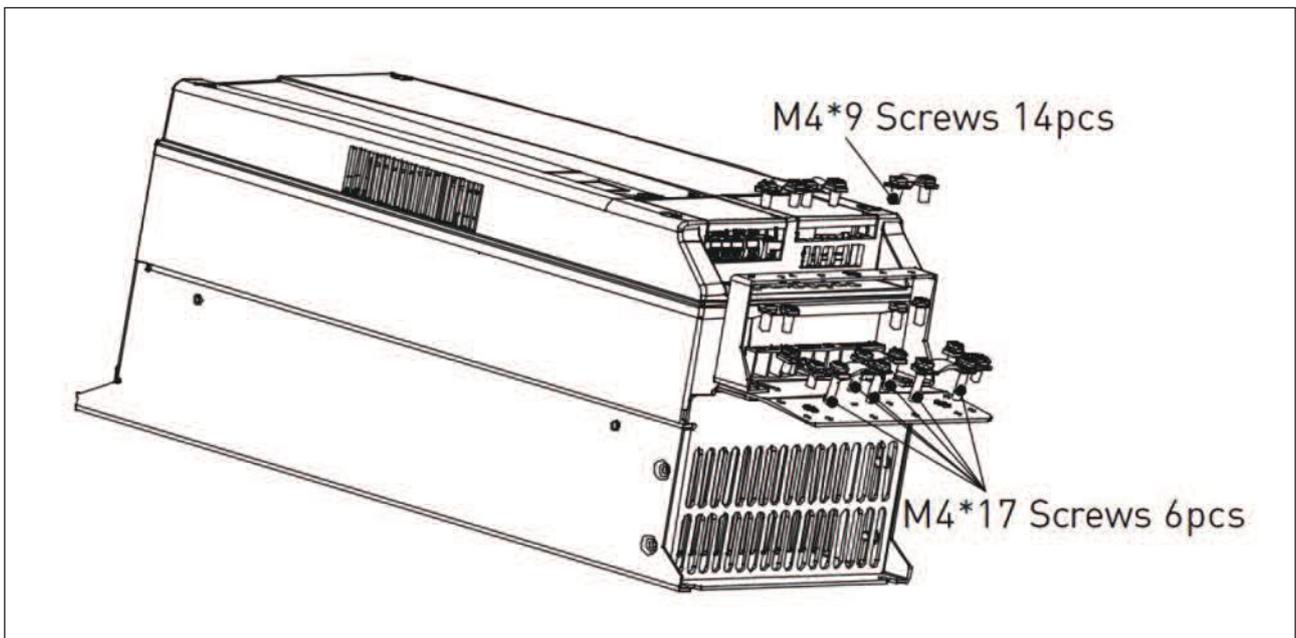


Figure 3.30: MI4 - MI5 screw

### 3.2.5  Cable and fuse specifications

Use cables with heat resistance of at least +70 °C. The cables and the fuses must be dimensioned according to the tables below. Installation of cables according to UL regulations is presented in Chapter 3.2.8.

The fuses function also as cable overload protection.

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

| EMC category | cat. C2 | cat. C3 | cat. C4 |
|---|---|---|---|
| Mains cable types | 1 | 1 | 1 |
| Motor cable types | 3 | 2 | 1 |
| Control cable types | 4 | 4 | 4 |

Table 3.6: Cable types required to meet standards. EMC categories are described in Chapter 3.1.3

| Cable type | Description |
|---|---|
| 1 | Power cable intended for fixed installation and the specific mains voltage. Shielded cable not required. (NKCABLES / MCMK or similar recommended) |
| 2 | Power cable equipped with concentric protection wire and intended for the specific mains voltage. (NKCABLES / MCMK or similar recommended). |
| 3 | Power cable equipped with compact low-impedance shield and intended for the specific mains voltage. (NKCABLES / MCCMK, SAB / ÖZCUY-J or similar recommended). *360º earthing of both motor and FC connection required to meet the standard |
| 4 | Screened cable equipped with compact low-impedance shield (NKCABLES /Jamak, SAB / ÖZCuY-O or similar). |

Table 3.7: Cable type descriptions

| Frame | Type | Fuse [A]] | Mains cable Cu [mm2] | Motor cable Cu [mm2] | Terminal cable size (min/max) | | | |
|-------|------|-----------|----------------------|----------------------|------------------------------|---|---|---|
| | | | | | Main terminal [mm2] | Earth terminal [mm2] | Control terminal [mm2] | Relay terminal [mm2] |
| MI1 | 0001-0003 | 10 | 2*1.5+1.5 | 3*1.5+1.5 | 1.5-4 | 1.5-4 | 0.5-1.5 | 0.5-1.5 |
| MI2 | 0004-0007 | 20 | 2*2.5+2.5 | 3*1.5+1.5 | 1.5-4 | 1.5-4 | 0.5-1.5 | 0.5-1.5 |
| MI3 | 0009 | 32 | 2*6+6 | 3*1.5+1.5 | 1.5-6 | 1.5-6 | 0.5-1.5 | 0.5-1.5 |

Table 3.8: Cable and fuse sizes for N800S, 208 - 240 V, 1~

| Frame | Type | Fuse [A]] | Mains cable Cu [mm2] | Motor cable Cu [mm2] | Terminal cable size (min/max) | | | |
|-------|------|-----------|----------------------|----------------------|------------------------------|---|---|---|
| | | | | | Main terminal [mm2] | Earth terminal [mm2] | Control terminal [mm2] | Relay terminal [mm2] |
| MI1 | 0001-0003 | 6 | 3*1.5+1.5 | 3*1.5+1.5 | 1.5-4 | 1.5-4 | 0.5-1.5 | 0.5-1.5 |
| MI2 | 0004-0007 | 10 | 3*1.5+1.5 | 3*1.5+1.5 | 1.5-4 | 1.5-4 | 0.5-1.5 | 0.5-1.5 |
| MI3 | 0011 | 20 25 40 | 3*2.5+2.5 | 3*2.5+2.5 | 1.5-6 | 1.5-6 | 0.5-1.5 | 0.5-1.5 |
| MI4 | 0012-0025 | 20 25 40 | 3*6+6 | 3*6+6 | 1-10Cu | 1-10 | 0.5-1.5 | 0.5-1.5 |
| MI5 | 0031-0038 | 40 | 3*10+10 | 3*10+10 | 2.5-50 Cu / Al | 2.5-35 | 0.5-1.5 | 0.5-1.5 |

Table 3.9: Cable and fuse sizes for N800S, 208 - 240 V, 3~

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| Frame | Type | Fuse [A]] | Mains cable Cu [mm2] | Motor cable Cu [mm2] | Terminal cable size (min/max) | | | |
|-------|------|-----------|---------------------|---------------------|------------------------------|---|---|---|
| | | | | | Main terminal [mm2] | Earth terminal [mm2] | Control terminal [mm2] | Relay terminal [mm2] |
| MI1 | 0001-0003 | 6 | 3*1.5+1.5 | 3*1.5+1.5 | 1.5-4 | 1.5-4 | 0.5-1.5 | 0.5-1.5 |
| MI2 | 0004-0007 | 10 | 3*1.5+1.5 | 3*1.5+1.5 | 1.5-4 | 1.5-4 | 0.5-1.5 | 0.5-1.5 |
| MI3 | 0008-0012 | 20 | 3*2.5+2.5 | 3*2.5+2.5 | 1.5-6 | 1.5-6 | 0.5-1.5 | 0.5-1.5 |
| MI4 | 0016-0023 | 25 | 3*6+6 | 3*6+6 | 1-10Cu | 1-10 | 0.5-1.5 | 0.5-1.5 |
| MI5 | 0031-0038 | 40 | 3*10+10 | 3*10+10 | 2.5-50 Cu / Al | 2.5-35 | 0.5-1.5 | 0.5-1.5 |

Table 3.10: Cable and fuse sizes for N800S, 380 - 480 V, 3~

**Note!** To fulfil standard EN61800-5-1, the protective conductor should be **at least 10 ㎟ Cu or 16 ㎟ Al**. Another possibility is to use an additional protective conductor of at least the same size as the original one.

### 3.2.6  General cabling rules

| | |
|---|---|
| 1 | Before starting the installation, check that none of the components of the frequency converter is live. |
| 2 | Place the motor cables sufficiently far from other cables:<br><br>• **Avoid** placing the motor cables in long **parallel lines** with other cables.<br><br>• If the motor cable runs in parallel with other cables, the **minimum distance** between the motor cable and other cables is **0.3 m**.<br><br>• The given distance also applies between the motor cables and signal cables of other systems.<br><br>• The **maximum length** of the motor cables for MI1-3 is **30 m**. For MI4 & 5, maximum length is 50 m, if use longer cable, current accuracy will be decreased.<br><br>• The **motor cables** should cross other cables at an angle of **90 degrees**. |
| 3 | If cable insulation checks are needed, see Chapter 3.2.9. |
| 4 | Connecting the cables:<br><br>• Strip the motor and mains cables as advised in Figure 3.31.<br><br>• Connect the mains, motor and control cables into their respective terminals, see Figures 3.17 - 3.26.<br><br>• Note the tightening torques of **power cables and control cables** given in chapter 3.2.1 and 3.2.2.<br><br>• For information on cable installation according to UL regulations see Chapter 3.2.8 .<br><br>• Make sure that the control cable wires do not come in contact with the electronic components of the unit.<br>• If an **external brake resistor** (option) is used, connect its cable to the appropriate terminal.<br>• **Check the connection** of the earth cable to the motor and the frequency converter terminals marked with<br><br><br><br>• Connect the **separate shield of the motor cable to the earth plate** of the frequency converter, motor and the supply centre. |

### 3.2.7 Stripping lengths of motor and mains cables
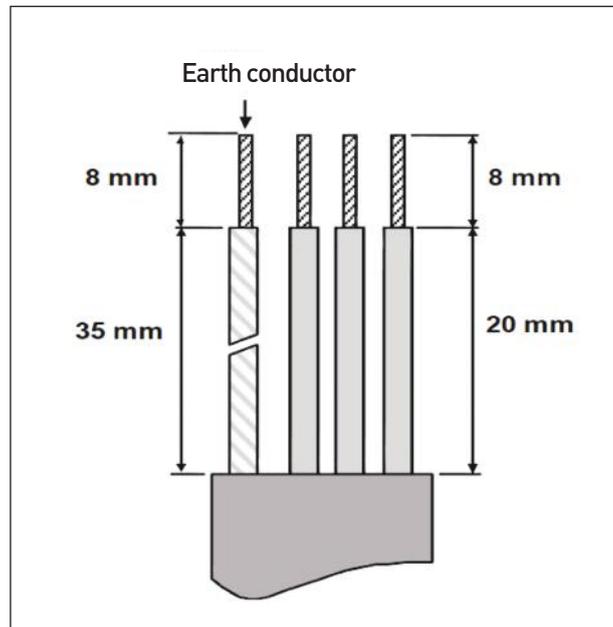


Figure 3.31: Stripping of cables

**Note!** Strip also the plastic cover of the cables for 360 degree earthing. See Figures 3.17, 3.18 and 3.25.

### 3.2.8 Cable installation and the UL standards

To meet the UL (Underwriters Laboratories) regulations, a UL-approved copper cable with a minimum heat-resistance of +60 / 75 °C must be used.

Use Class 1 wire only.

The units are suitable for use on a circuit capable of delivering not more than 50,000 rms symmetrical amperes, 600V maximum, when protected by T and J Class fuses. For MI4 without DC-choke, maximum short circuit current has to be not more than 2.3 kA, for MI5 without DC-choke, maximum short circuit current has to be not more than 3.8 kA.

Integral solid state short circuit protection does not provide branch circuit protection.
Branch circuit protection must be provided in accordance with the National Electric Code and any additional local codes. Branch circuit protection provided by fuses only.

Motor overload protection provided at 110% of full load current.

### 3.2.9 Cable and motor insulation checks

These checks can be performed as follows if motor or cable insulations are suspected to be faulty.

1. Motor cable insulation checks

Disconnect the motor cable from terminals U / T1, V / T2 and W / T3 of the frequency converter 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.

### 2. Mains cable insulation checks

Disconnect the mains cable from terminals L1, L2 / N and L3 of the frequency converter 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 >1 MOhm.

### 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 >1 MOhm.

## 3.3   COMMISSIONING

**Before commissioning, read the warnings and instructions listed in Chapter 1!**

### 3.3.1   Commissioning steps

| | |
|---|---|
| 1 | Read carefully the safety instructions in Chapter 1 and follow them. |
| 2 | After the installation, make sure that:<br><br>• both the frequency converter and the motor are grounded.<br><br>• the mains and motor cables comply with the requirements given in Chapter 3.2.5.<br><br>• the control cables are located as far as possible from the power. cables<br><br>(see Chapter 3.2.6, step 2) and the shields of the shielded cables are connected to protective earth. |
| 3 | Check the quality and quantity of cooling air (Chapter 3.1.2). |
| 4 | Check that all Start / Stop switches connected to the I / O terminals are in **Stop** position. |
| 5 | Connect the frequency converter to mains. |
| 6 | Set the parameters of group 1 according to the requirements of your application.<br><br>At least the following parameters should be set:<br><br>• motor nominal speed (par. 1.3)<br><br>• motor nominal current (par. 1.4)<br><br>• application type (par. 17.1)<br><br>You will find the values needed for the parameters on the motor rating plate. |

| | |
|---|---|
| 7 | Perform test run **without motor**. Perform either Test A or Test B:<br><br>**A)** Control from the I / O terminals:<br><br>   • Turn the Start/Stop switch to ON position.<br>   • Change the frequency reference (potentiometer).<br>   • Check the Monitoring Menu and make sure that the value of Output frequency changes according to the change of frequency reference.<br>   • Turn the Start / Stop switch to OFF position.<br><br>**B)** Control from the keypad:<br><br>   • Select the keypad as the control place with par 2.1. You can also move to keypad control by pressing Loc / Rem button or select Local control with par 2.5.<br>   • Push the Start button on the keypad.<br>   • Check the Monitoring Menu and make sure that the value of Output frequency. changes according to the change of frequency reference.<br>   • Push the Stop button on the keypad. |
| 8 | Run the no-load tests without the motor being connected to the process, if possible.<br><br>If this is impossible, secure the safety of each test prior to running it. Inform your co-workers of the tests.<br><br>   • Switch off the supply voltage and wait up until the drive has stopped.<br>   • Connect the motor cable to the motor and to the motor cable terminals of the frequency converter.<br>   • See to that all Start / Stop switches are in Stop positions.<br>   • Switch the mains ON.<br>   • Repeat test 7A or 7B. |
| 9 | Perform an identification run (see par. 1.18), especially if the application requires a high startup torque or a high torque with low speed. |
| 10 | Connect the motor to the process (if the no-load test was running without the motor being connected).<br>   • Before running the tests, make sure that this can be done safely.<br>   • Inform your co-workers of the tests.<br>   • Repeat test 7A or 7B. |

### 3.4.  N800S MI APPLICATION INTERFACE

#### 3.4.1  Introduction

There is only one version of control board available for the N800S MI frame.

| Version | Composition |
|---|---|
| N800S MI | 6 Digital inputs |
| | 2 Analogue inputs |
| | 1 Analogue output |
| | 1 Digital output |
| | 2 Relay outputs |
| | RS-485 Interface |

Table 3.11: Available Control Board

This section provides you with a description of the I / O-signals for N800S MI and instructions for using the N800S MI general purpose application.

The frequency reference can be selected from Preset Speed 0, Keypad, Fieldbus, AI1, AI2, AI1+AI2, PID, Motor potentiometer and Pulse train / Encoder.

Basic properties:
- Digital inputs DI1...DI6 are freely programmable. The user can assign a single input to many functions.
- Digital-, relay- and analogue outputs are freely programmable.
- Analog output can be programmed as current or voltage output.
- Analog input 1 can be as voltage input,analog input 2 can be programmed as current or voltage input.
- DI5/6 can be used as pulse train or Encoder.

Special features:
- Programmable Start / Stop and Reverse signal logic
- Motor pre-heat
- Reference scaling
- DC-brake at start and stop
- Programmable U / f curve
- Adjustable switching frequency
- Autoreset function after fault

- Protections and supervisions (all fully programmable; off, alarm, fault):
- Analog input low fault
- External fault
- Undervoltage fault
- Earth fault
- Motor thermal, stall and underload protection
- Fieldbus communication
- Output phase fault
- Thermistor fault
- 8 preset speeds
- Analogue input range selection, signal scaling and filtering
- PID-controller

### 3.4.2   Control I / O

| Terminal | | Signal | Factory preset | Description |
|---|---|---|---|---|
| 1 | +10 Vref | Ref. voltage out | | Maximum load 10 mA |
| 2 | AI1 | Analog signal in 1 | Freq. reference P) | 0 - 10 V, Ri = 250 kΩ |
| 3 | GND | I / O signal ground | | |
| 6 | 24V Output | 24 V output for DI's | | ±20%, max. load 50 mA |
| 7 | DI_C | Digital Input Common | | Digital Input Common for DI1-DI6, refer to Table 3.13 for DI sink type |
| 8 | DI1 | Digital input 1 | Start forward P) | Positive, Logic1: 18...30V, Logic0: 0...5V; Negative, Logic1: 0...10V, Logic0: 18...30V; Ri=10K(floating) |
| 9 | DI2 | Digital input 2 | Start reverse P) | |
| 10 | DI13 | Digital input 3 | Fault reset P) | |
| A | A | RS485 signal A | FB Communication | Negative |
| B | B | RS485 signal B | FB Communication | Positive |
| 4 | AI2 | Analog signal in 2 | PID actual value and Freq. reference P) | Default: 0(4) - 20 mA, Ri ≤ 250 Ω Other: 0 - + 10 V, Ri = 250 kΩ Selectable through microswitch |
| 5 | GND | I / O signal ground | | |
| 13 | DO- | Digital Outpu Common | | Digital Output Common |
| 14 | D14 | Digital input 4 | Preset speed B0 P) | Positive, Logic1: 18...+30V, Logic0: 0...5V; Negative, Logic1: 0...10V, Logic0: 18...30V; Ri = 10KΩ (floating) |
| 15 | D15 | Digital input 5 | Preset speed B1 P) | As DI, Other: Encoder Input A (frequency up to 10 kHz) Selectable through microswitch |
| 16 | D16 | Digital input 6 | External Fault P) | As DI, Other: Encoder Input B (frequency up to 10 kHz), Pulse Train Input (frequency up to 5 kHz) |
| 18 | AO | Analog Output | Output frequency P) | 0 - 10 V, RL ≥ 1 KΩ 0(4) - 20 mA, RL ≤ 500Ω Selectable through microswitch |
| 20 | DO | Digital signal out | Active = READY P) | Open collector, max. load 35 V / 50 mA |

Table 3.12: N800S (MI frame) General purpose application default I / O configuration and connections for control board
P) = Programmable function, see parameter lists and descriptions, chapters 7 and 8.

| | Terminal | Signal | Factory preset | Description |
|---|---|---|---|---|
| 22 | RO1 NO | Relay out 1 | Active=RUN P) | Switching load: 250 Vac / 3 A |
| 23 | RO1 CM | | | |
| 24 | RO2 NC | Relay out 2 | Active=FAULT P) | Switching load: 250 Vac / 3 A |
| 25 | RO2 CM | | | |
| 26 | RO2 NO | | | |

Table 3.12: N800S (MI frame) General purpose application default I / O configuration and connections for control board

P) = Programmable function, see parameter lists and descriptions, chapters 7 and 8.

| | Terminal | Signal | Factory preset | Description |
|---|---|---|---|---|
| 3 | GND | I / O signal ground | | |
| 6 | 24 V out | 24 V output for DI's | Freq. reference P) | ±20%, max. load 50 mA |
| 7 | DI_C | Digital Input Common | | Digital Input Common for DI1-DI6 |
| 8 | DI1 | Digital input 1 | Start forward P) | Positive, Logic1: 18...+30V, Logic0: 0...5V; Negative, Logic1: 0...10V, Logic0: 18...30V; Ri = 10KΩ (floating) |
| 9 | DI2 | Digital input 2 | Start reverse P) | |
| 10 | DI3 | Digital input 3 | Fault reset P) | |
| 14 | DI4 | Digital input 4 | Preset speed B0 P) | Positive, Logic1: 18...+30V, Logic0: 0...5V; Negative, Logic1: 0...10V, Logic0: 18...30V; Ri = 10KΩ (floating) |
| 15 | DI5 | Digital input 5 | Preset speed B1 P) | Only for DI. |
| 16 | DI6 | Digital input 6 | External Fault P) | Only for DI. |

Table 3.13: DI Sink Type, remove jumper J500 and connect the wire using table 3.13
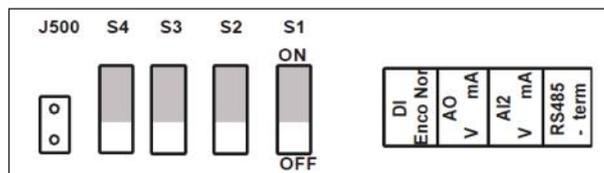


Figure 3.32: Microswitchs

MI frame I / O terminals:
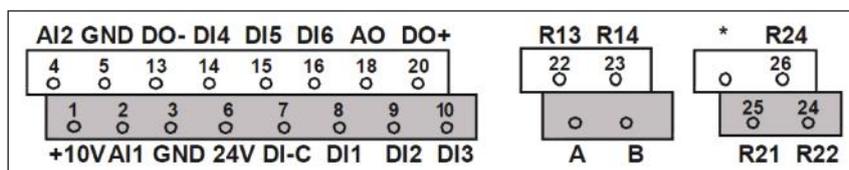
# 4. INSTALLATION AND COMMISSIONING OF MR FRAMES

## 4.1   UNPACKING AND LIFTING THE AC DRIVE

### 4.1.1   WEIGHT OF THE AC DRIVE

The weights of AC drives of different frames are very different. It can be necessary for you to use a lifting device to move the drive from its package.

Table 4.1: The weights of the different frames

| Frame | Weight, IP21/IP54 [kg]] | Weight, IP00 [kg] | Weight, UL Type 1 / Type 12 [lb.]] | Weight, UL Open Type [lb.] |
|:---:|:---:|:---:|:---:|:---:|
| MR6 | 20.0 | | 44.1 | |
| MR7 | 37.5 | | 82.7 | |
| MR8 | 66.0 | 62.0 | 145.5 | 136.7 |
| MR9 | 119.5 | 103.5 | 263.5 | 228.2 |

### 4.1.2   LIFTING THE FRAMES MR8 AND MR9

1)  Remove the drive from the pallet where it was bolted to.

2)  Use a lifting device that is sufficiently strong for the weight of the drive.

3)  Put the lifting hooks symmetrically in a minimum of 2 holes.

4)  The maximum lifting angle is 45 degrees.
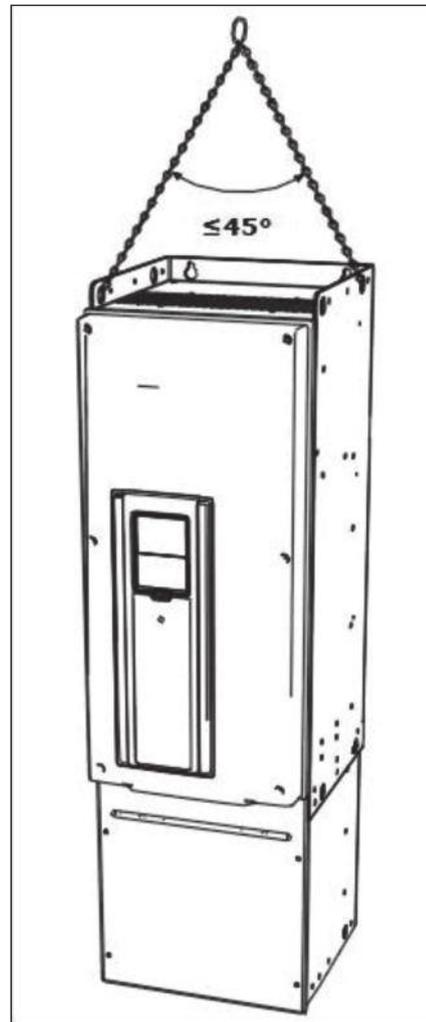
Before a inverter is sent to the customer, the manufacturer makes many tests on the drive. After you lift the drive, do a check for signs of damage on the drive. Make sure that the contents of the package are correct.
If the drive was damaged during the shipping, speak to the cargo insurance company or the carrier.

### 4.2  ACCESSORIES

After you open the package and lift the drive out, make sure that you received all the accessories. The content of the accessories bag is different for the different frames and protection classes.

### 4.2.1 FRAME MR6

Table 4.2: The content of the accessories bag

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

### 4.2.2   FRAME MR7

Table 4.3: The content of the accessories bag

| Item | Quantity | Purpose |
|------|----------|---------|
| M6x30 slotted nut | 6 | Nuts for the power cable clamps |
| M4x16 screw | 3 | Screws for the control cable clamps |
| M6x12 screw | 1 | Screw for the external grounding of the drive |
| Control cable grounding lamella | 3 | Control cable grounding |
| EMC cable clamps, size M25 | 3 | Clamping the power cables |
| Grounding clamp | 2 | Power cable grounding |
| 'Product modified' label | 1 | Data about changes |
| IP21: Cable grommet | 3 | Sealing for the cables |

### 4.2.3   FRAME MR8

Table 4.4: The content of accessories bag

| Item | Quantity | Purpose |
|------|----------|---------|
| M4x16 screw | 3 | Screws for the control cable clamps |
| Control cable grounding lamella | 3 | Control cable grounding |
| Cable lugs KP40 | 3 | Clamping power cables |
| Cable insulator | 11 | To prevent contact between cables |
| Cable grommet, hole diameter 25.3 mm | 4 | Sealing for the cables |
| IP00: Touch shield | 1 | To prevent contact with live parts |
| IP00: M4x8 screw | 2 | To attach the touch protection shield |

### 4.2.4   FRAME MR9

Table 4.5: The content of the accessories bag

| Item | Quantity | Purpose |
|------|----------|---------|
| M4x16 screw | 3 | Screws for the control cable clamps |
| Control cable grounding lamella | 3 | Control cable grounding |
| Cable lugs KP40 | 5 | Clamping power cables |
| Cable insulator | 10 | To prevent contact between cables |
| Cable grommet, hole diameter 25.3 mm | 4 | Sealing for the cables |
| IP00: Touch shield | 1 | To prevent contact with live parts |
| IP00: M4x8 screw | 2 | To attach the touch protection shield |

## 4.3   "PRODUCT MODIFIED" LABEL

In the accessories bag, there is also a "product modified" label. The function of the label is to tell the service personnel about the changes that are made in the AC drive. Attach the label on the side of the AC drive to know where to find it. If you make changes in the AC drive, write the change on the label.

**Product modified**

---------------------------------------------- Date: ------------

---------------------------------------------- Date: ------------

---------------------------------------------- Date: ------------

## 4.4   INSTALLATION

### 4.4.1   GENERAL INFORMATION ABOUT MOUNTING

Install the AC drive in a vertical position on the wall. If you install the drive in a horizontal position. It is possible that some functions with the nominal values that are found in chapter 10 are not available.
Attach the AC drive with the screws and other components that you received in the delivery.

### 4.4.2   DIMENSIONS FOR WALL MOUNTING

#### 4.4.2.1   WALL MOUNTING OF MR6
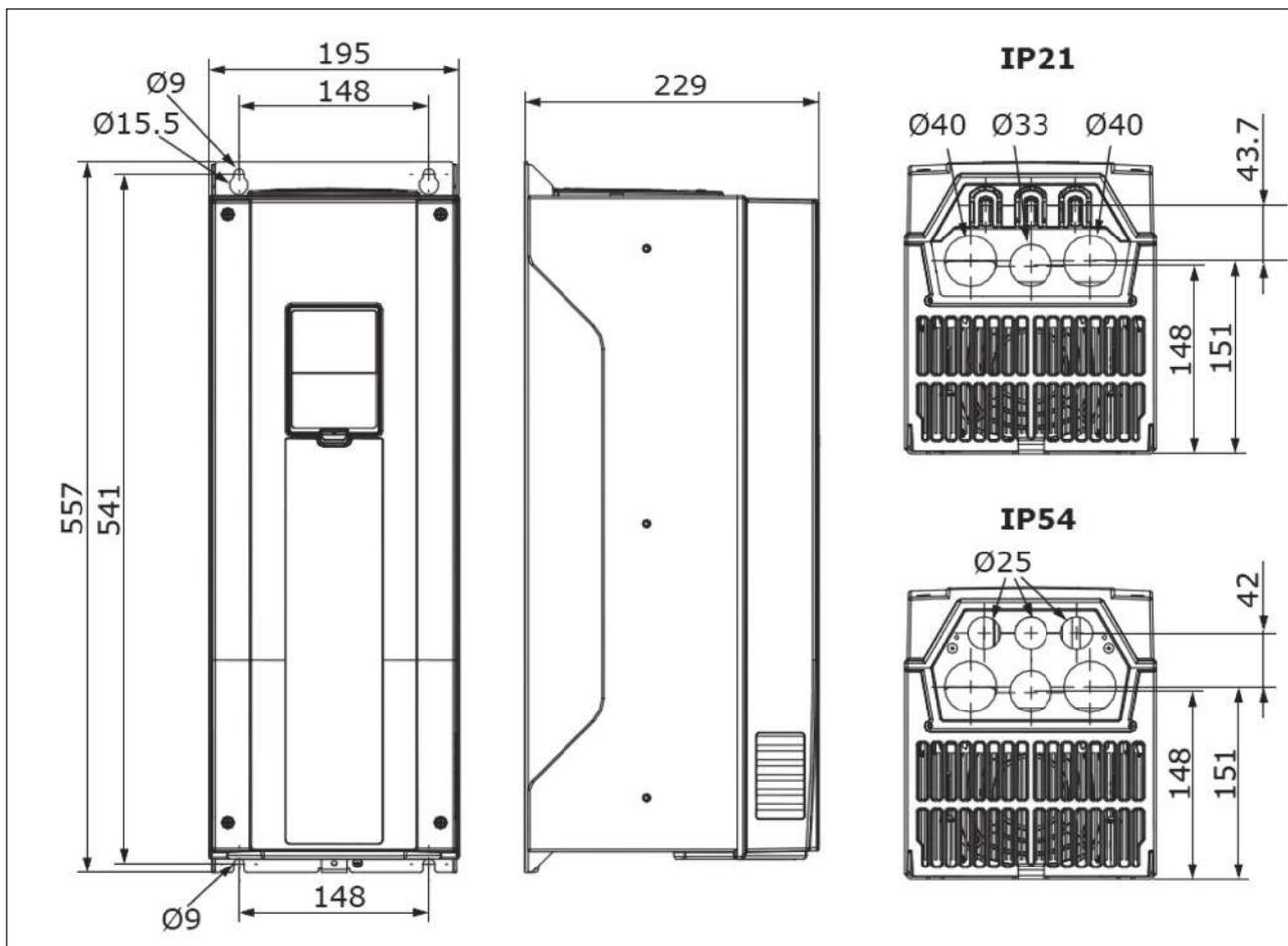


Fig. 4.1: The dimensions of the AC drive, MR6

#### 4.4.2.2 WALL MOUNTING OF MR7
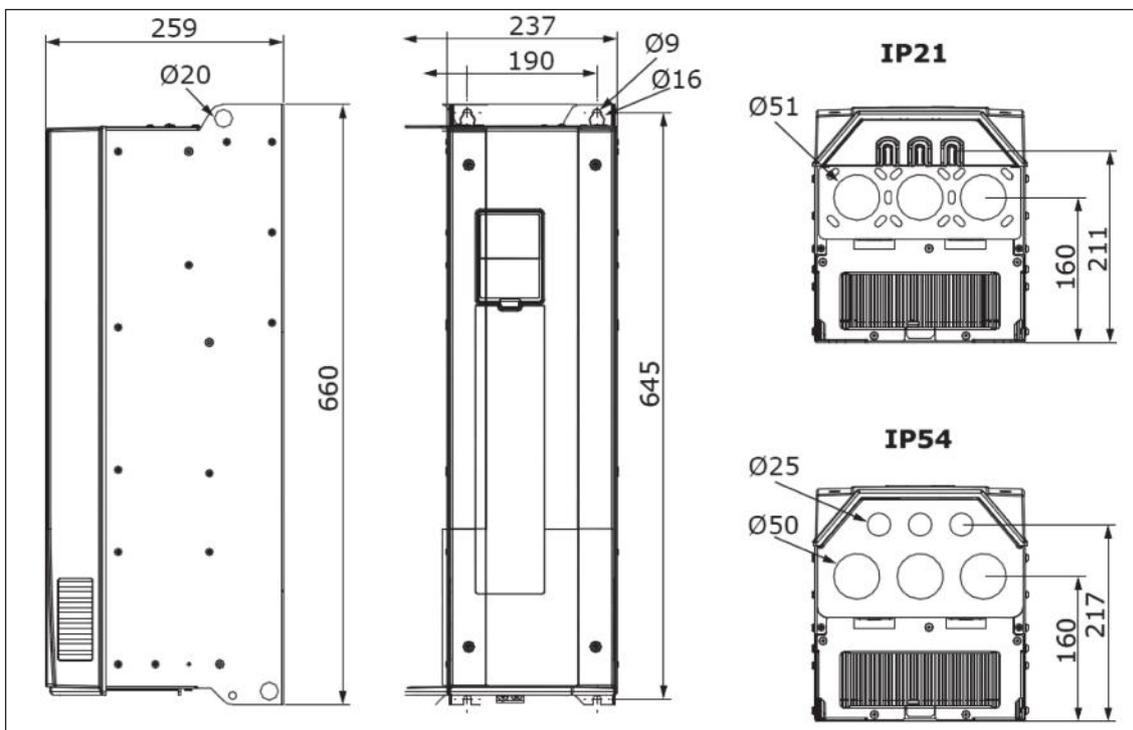
Fig. 4.2: The dimensions of the AC drive, MR7

### 4.4.2.3 WALL MOUNTING OF MR8, IP00
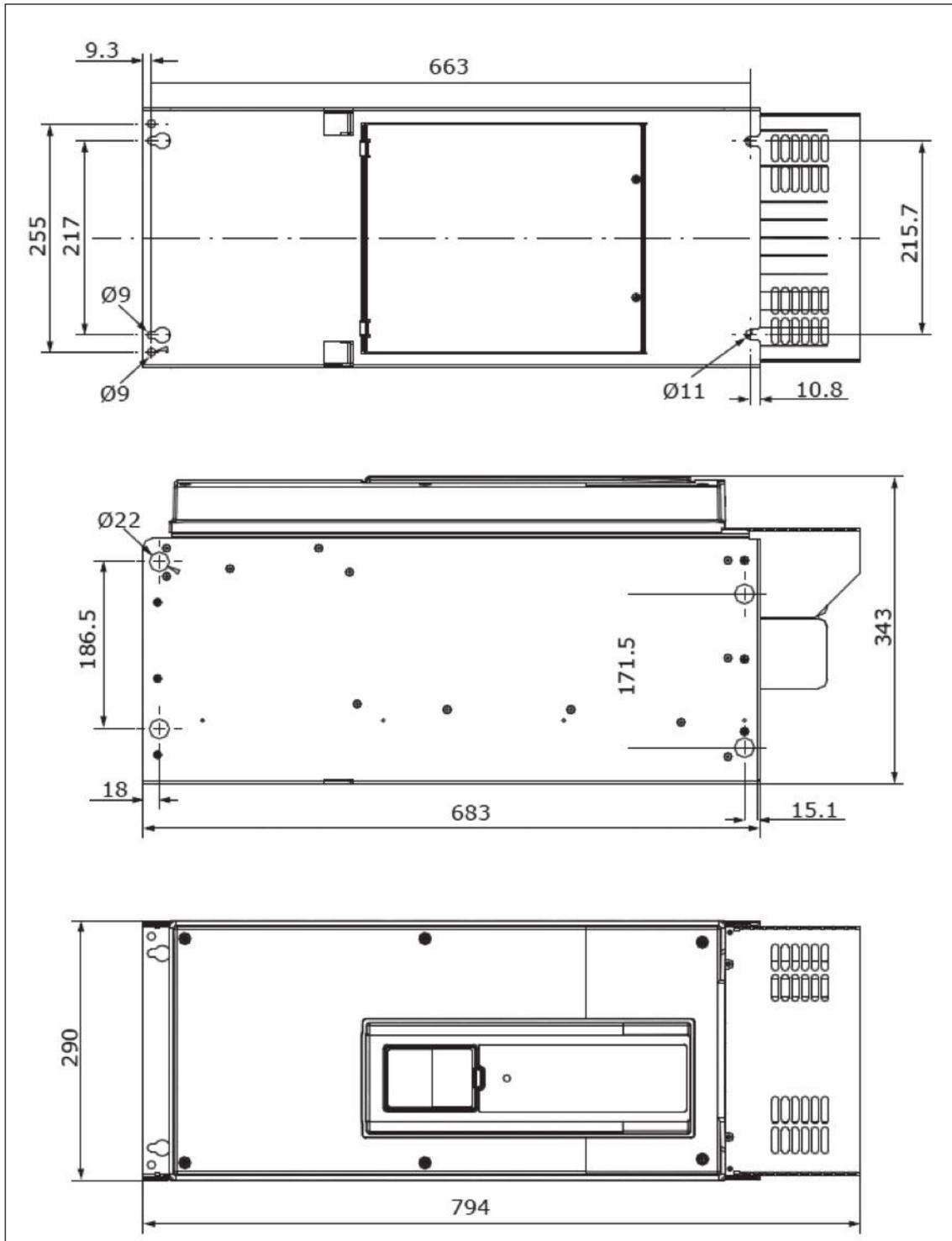


Fig. 4.3: The dimensions of the AC drive, MR8, IP00

#### 4.4.2.4   WALL MOUNTING OF MR9, IP00
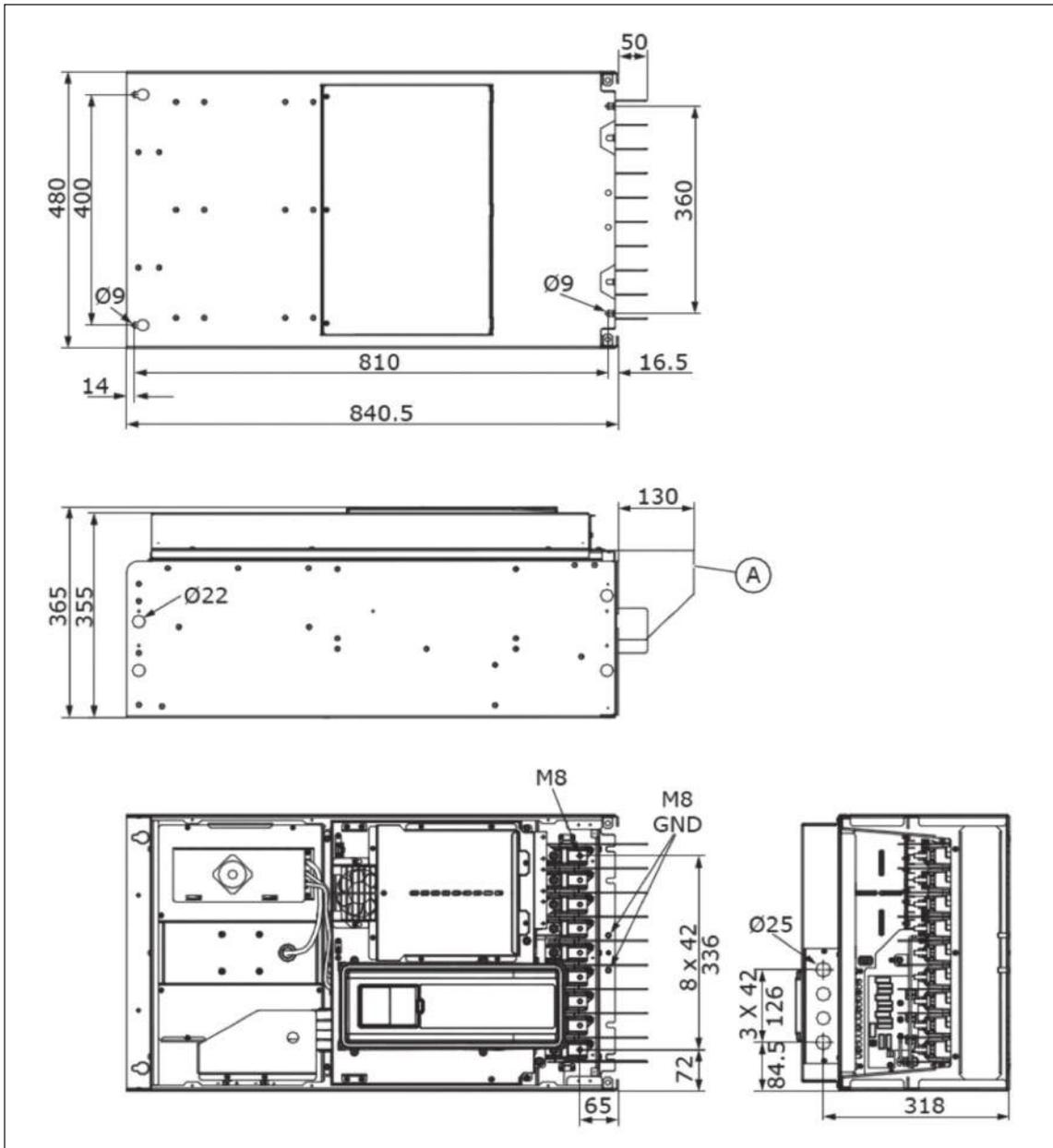


Fig. 4.4: The dimensions of the AC drive, MR9, IP00

A. An optional main connector cover for the cabinet installation

#### 4.4.3   DIMENSIONS FOR FLANGE MOUNTING

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

**NOTE!**
The protection classes are different in different sections of the drive.
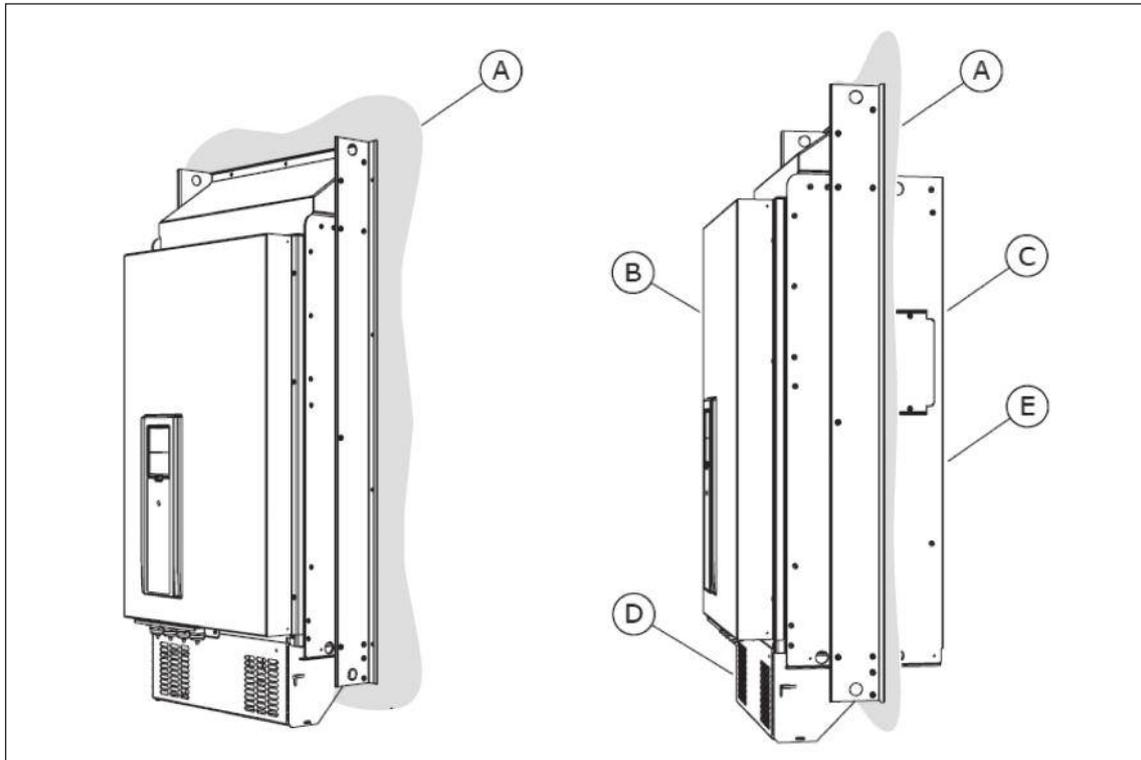


Fig. 4.5: Example of flange mounting (frame MR9)

A. The cabinet wall or other surface
B. The front
C. The rear

D. IP00 / UL Open Type
E. IP54 / UL Type 12 (Not available)
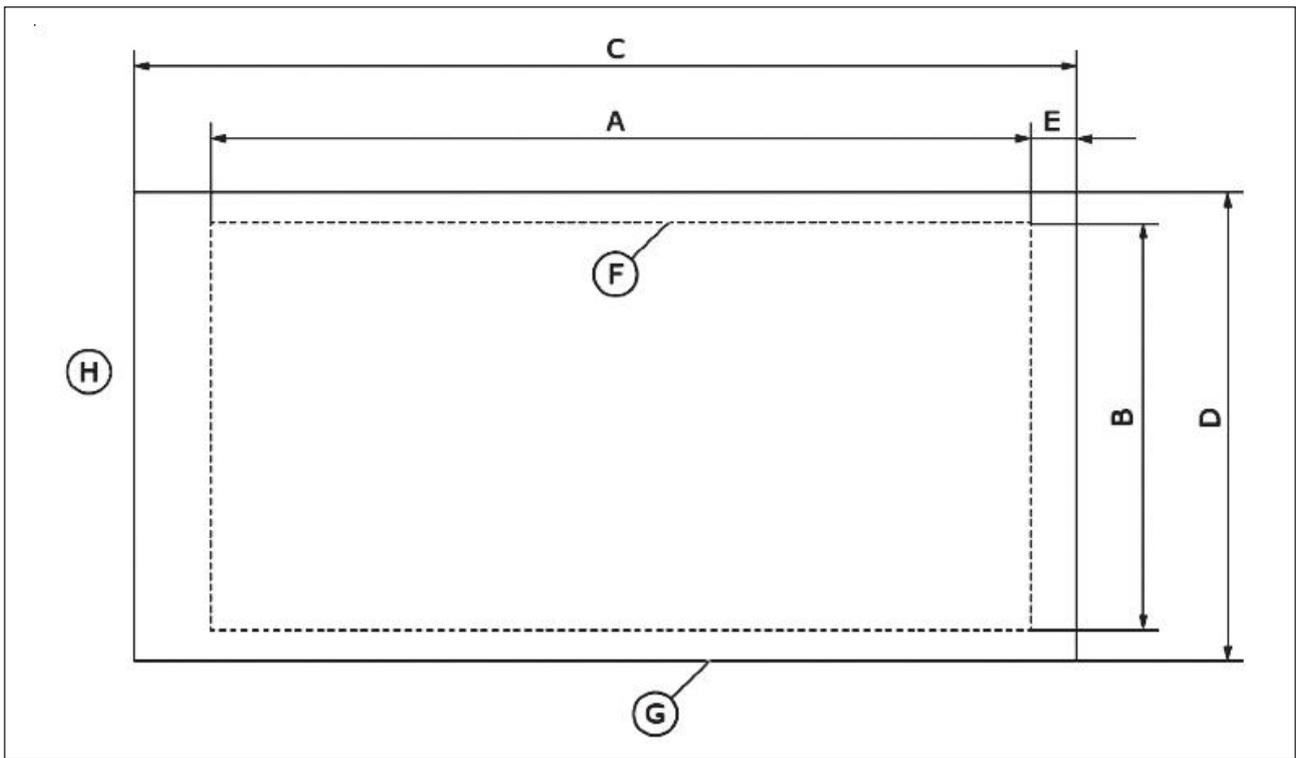
Fig. 4.6: The dimensions of the opening and drive outline with flange

A. The height of the opening for the flange mounting

B. The width of the opening

C. The height of the drive

D. The width of the drive

E. The distance between the bottom of the drive and the bottom of the opening

F. The outline of the opening

G. The outline of the drive

H. The top of the drive

Table 4.6: The dimensions of the drive, frames MR6 to MR9

| Frame | C[mm] | D[mm] | C[in] | D[in] |
|-------|-------|-------|-------|-------|
| MR6 | 580 | 220 | 22.8 | 8.7 |
| MR7 | 680 | 286 | 26.8 | 11.3 |
| MR8 | 898 | 359 | 35.4 | 14.1 |
| MR9 | 1060 | 550 | 41.7 | 21.7 |

Table 4.7: The dimensions of flange mounting MR6 to MR9

| Frame | A[mm] | B[mm] | E[mm] | A[in] | B[in] | E[in] |
|-------|-------|-------|-------|-------|-------|-------|
| MR6 | 541 | 203 | 23 | 21.3 | 8.0 | 0.9 |
| MR7 | 655 | 240 | 13 | 25.8 | 9.4 | 0.5 |
| MR8 | 859 | 298 | 18 | 33.8 | 11.7 | 0.7 |
| MR9 | 975 | 485 | 54 | 38.4 | 19.1 | 2.1 |
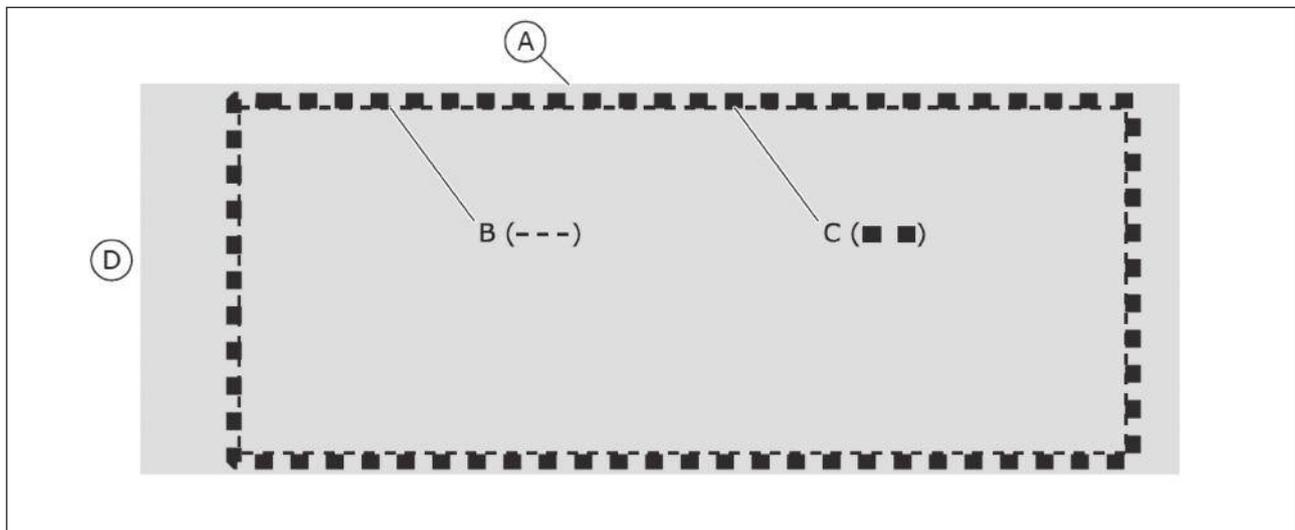


Fig. 4.7: Sealing of the opening for MR8 and MR9

A. The AC drive                     C. Gasket tape
B. The outline of the opening       D. The top of the drive

### 4.4.3.1   FLANGE MOUNTING OF MR6
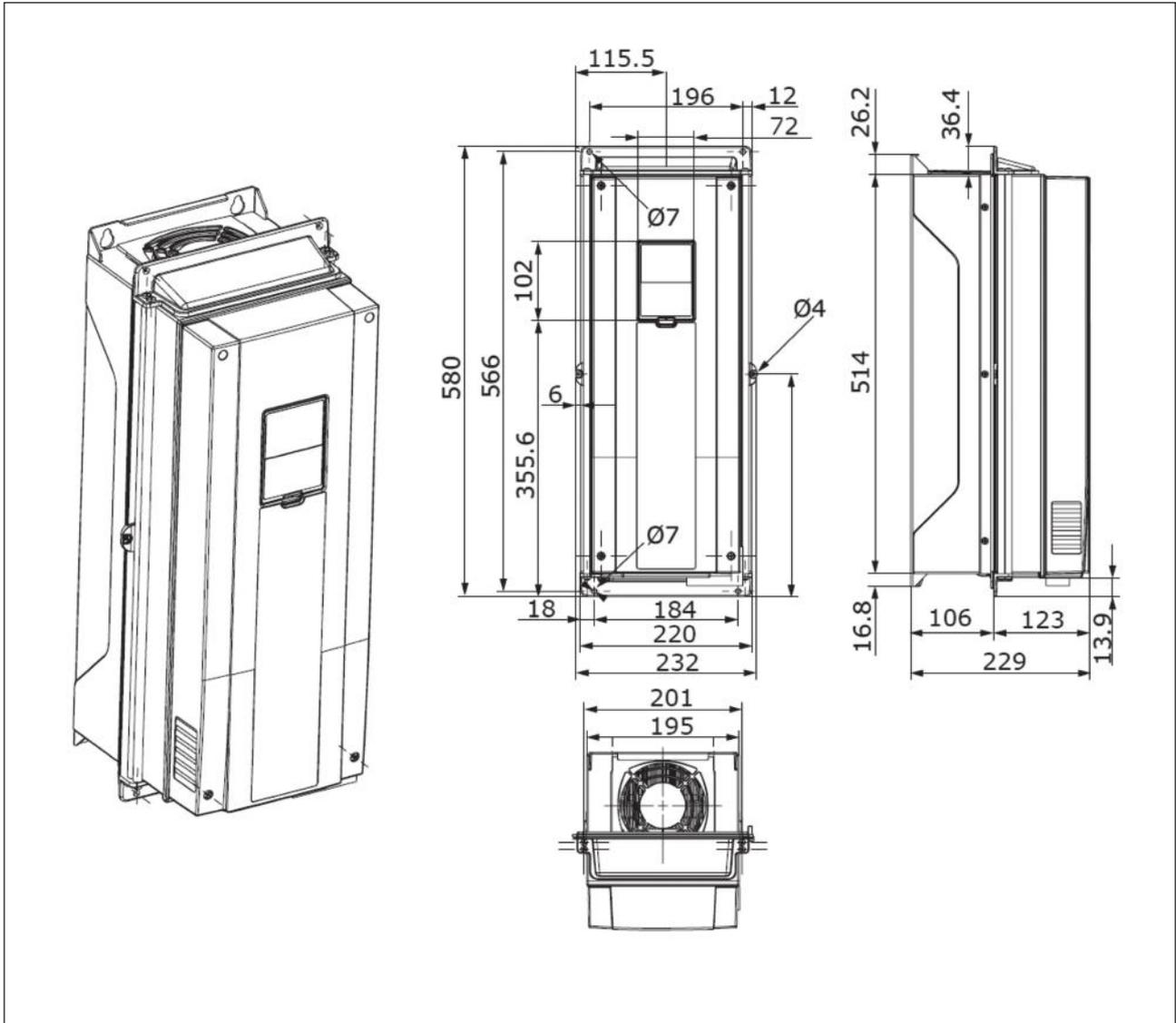


Fig. 4.8: The dimensions of the AC drive, flange mounting, MR6

### 4.4.3.2 FLANGE MOUNTING OF MR7
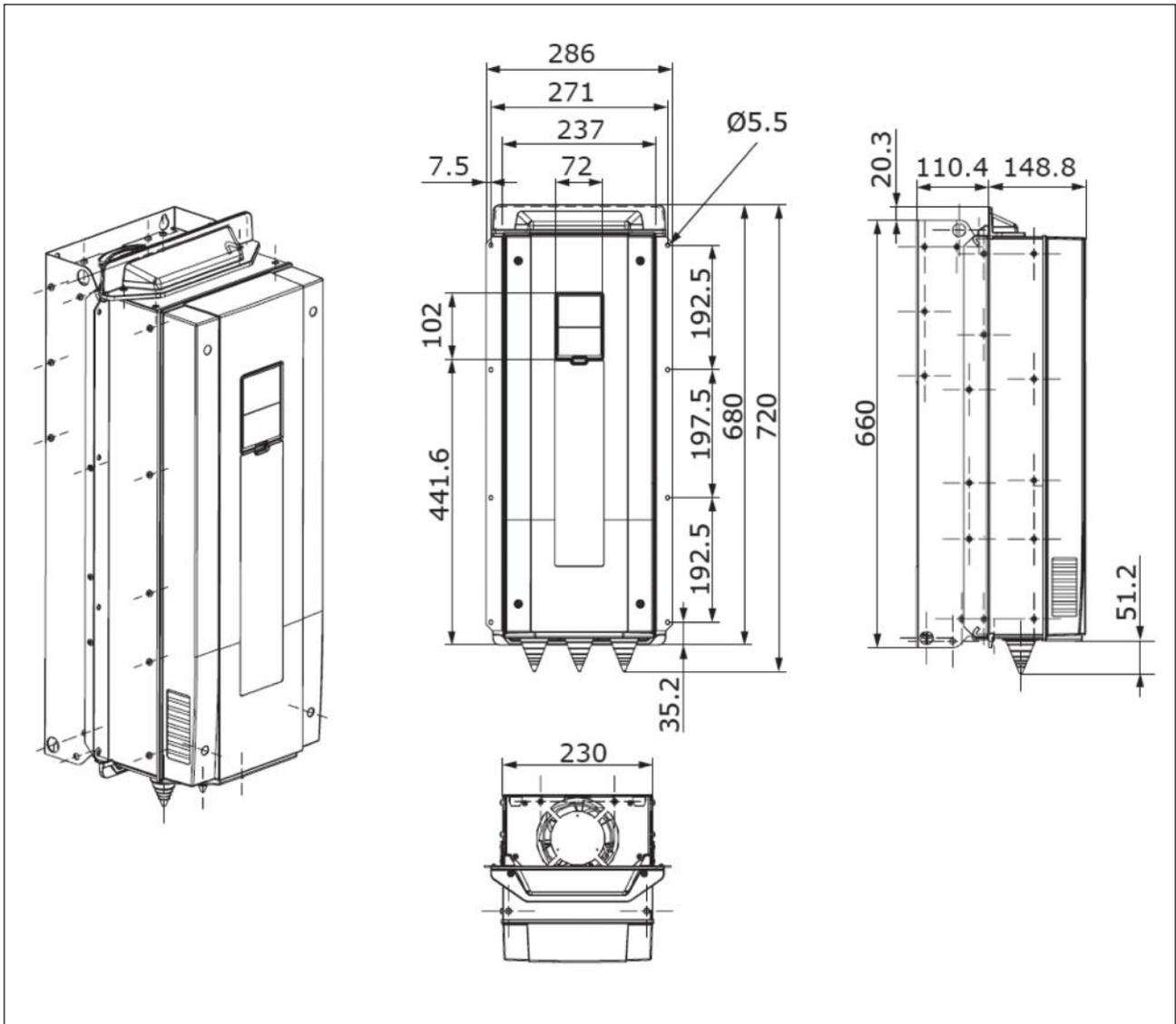


Fig. 4.9: The dimensions of the AC drive, flange mounting, MR7

### 4.4.3.3 FLANGE MOUNTING OF MR8
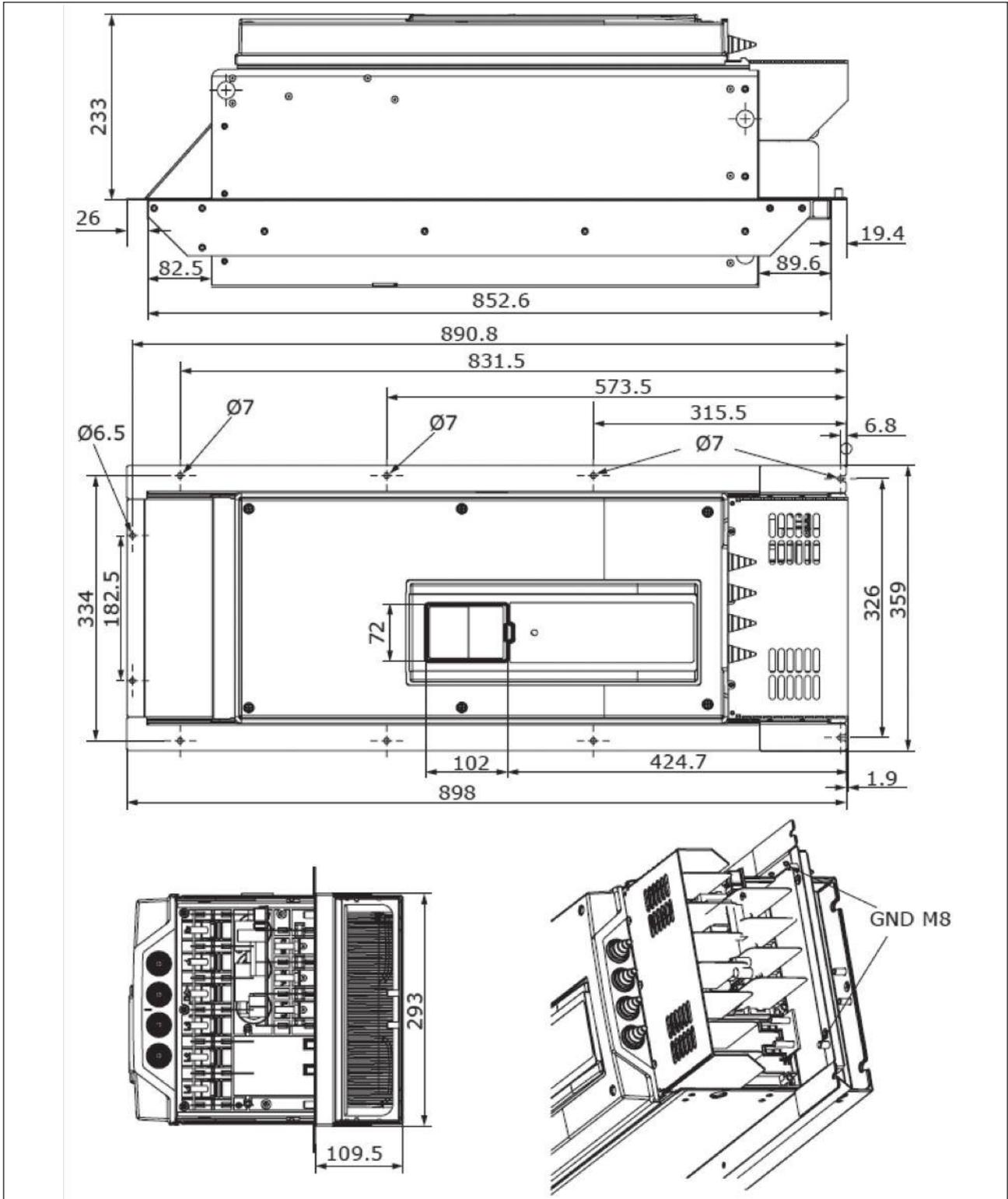
Fig. 4.10: The dimensions of the AC drive, flange mounting, MR8

#### 4.4.3.4   FLANGE MOUNTING OF MR9
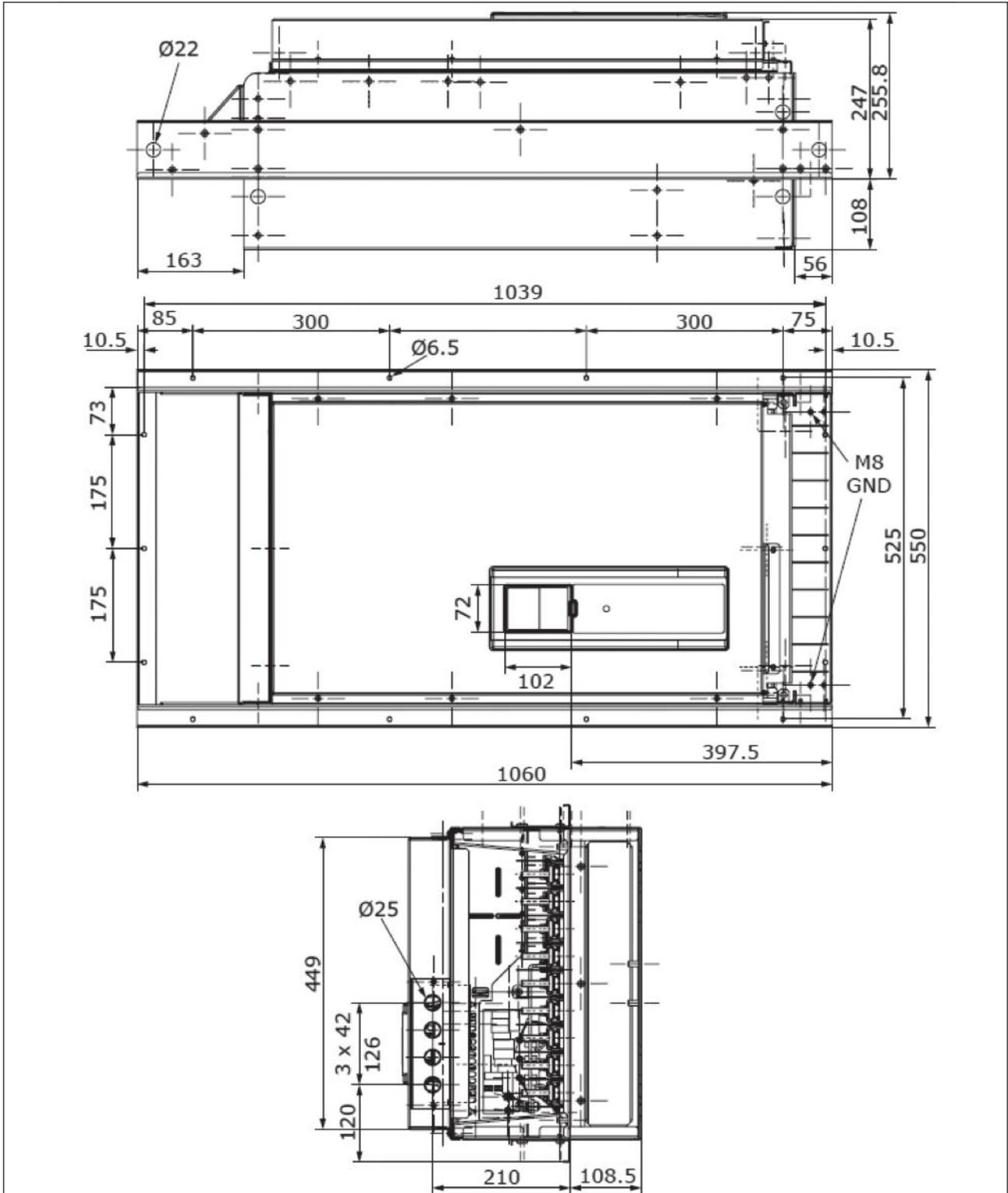


Fig. 4.11: The dimensions of the AC drive, flange mounting, MR9

## 4.5   COOLING

The AC drive produces heat in operation. The fan circulates air and decreases the temperature of the drive. Make sure that there is sufficiently free space around the drive. Some free space is also necessary for maintenance.
Make sure that the temperature of the cooling air does not become more than the maximum ambient operating temperature or less than the minimum ambient operating temperature of the drive.
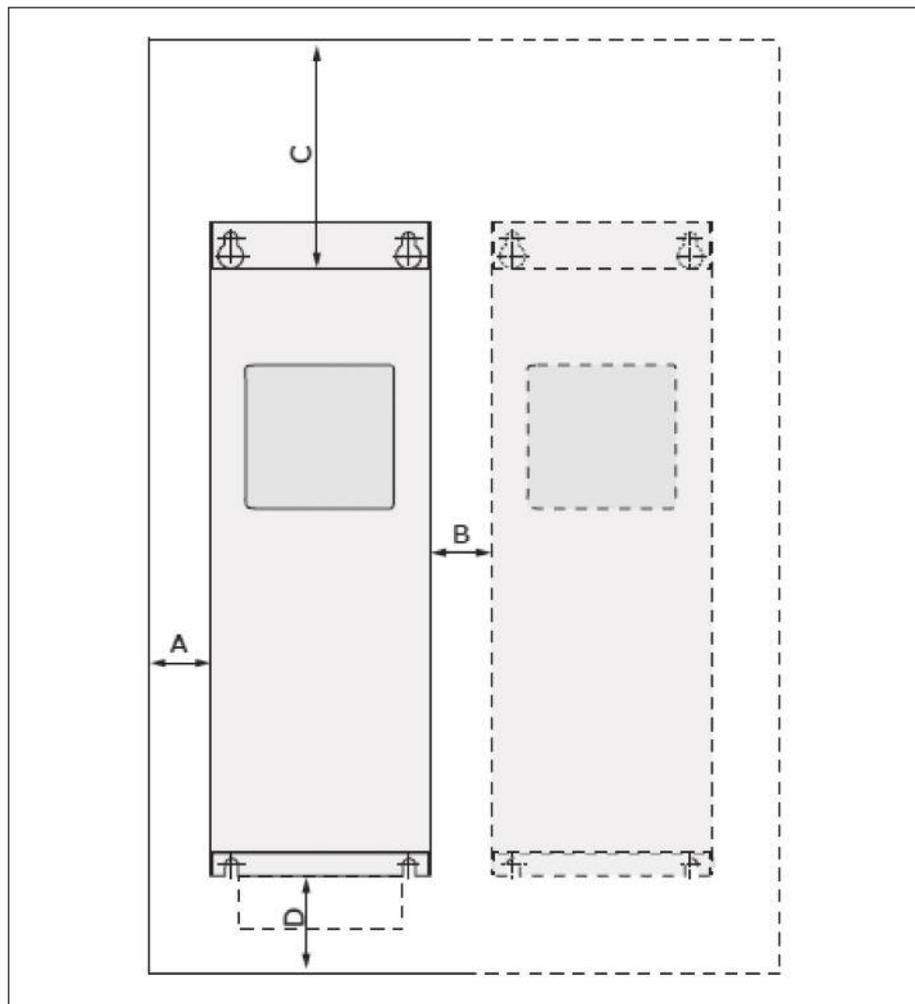


Fig. 4.12: Installation space

A. the clearance around the drive
B. the distance from a drive to a second
   drive, or the distance to the cabinet wall

C. the free space above the drive
D. the free space below the drive

Table 4.8: The minimum clearances around the AC drive

| | Minimum clearance[mm] | | | | Minimum clearance[in] | | | |
|---|---|---|---|---|---|---|---|---|
| Frame | A | B | C | D | A | B | C | D |
| MR6 | 20 | 20 | 160 | 80 | 0.8 | 0.8 | 6.3 | 3.1 |
| MR7 | 20 | 20 | 250 | 100 | 0.8 | 0.8 | 9.8 | 3.9 |
| MR8 | 20 | 20 | 300 | 150 | 0.8 | 0.8 | 11.8 | 5.9 |
| MR9 | 20 | 20 | 350 | 200 | 0.8 | 0.8 | 13.8 | 7.9 |

Table 4.9: The necessary quantity of cooling air

| Frame | The quantity of cooling air [㎥/h] | The quantity of cooling air [CFM] |
|---|---|---|
| MR6 | 190 | 111.8 |
| MR7 | 185 | 108.9 |
| MR8 | 335 | 197.2 |
| MR9 | 621 | 365.2 |
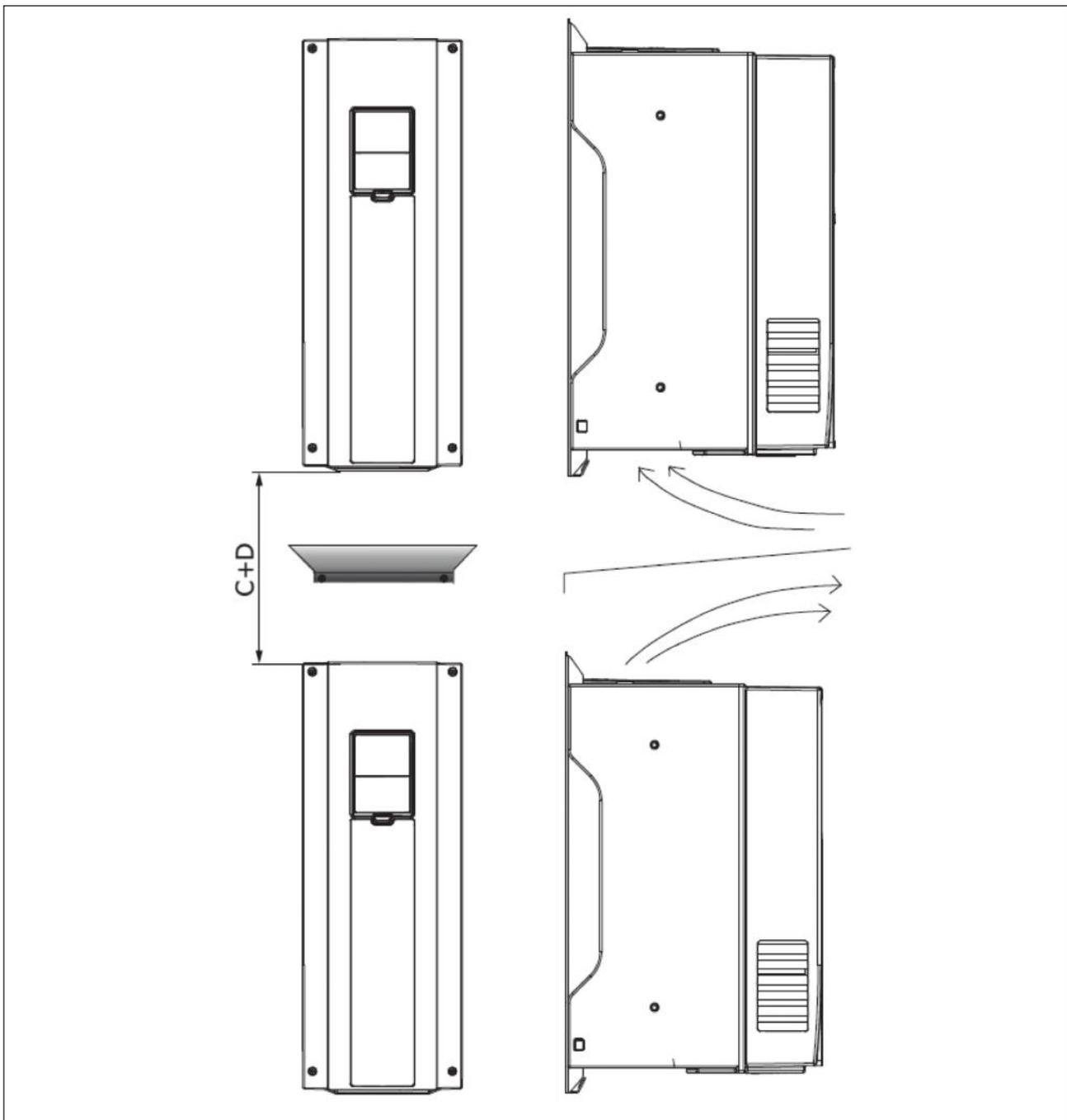
Fig. 4.13: The installation space when drives are installed on top of each other

**If you install many drives above each other**

1. The necessary free space is C + D.
2. Make the outlet air of the lower unit go away from the air intake of the upper unit. To do this, attach a metal plate to the cabinet wall between the drives.
3. When you install the drives in a cabinet, make sure that you prevent recirculation of air.

## 4.6   POWER CABLING

### 4.6.1   CABLE CONNECTIONS

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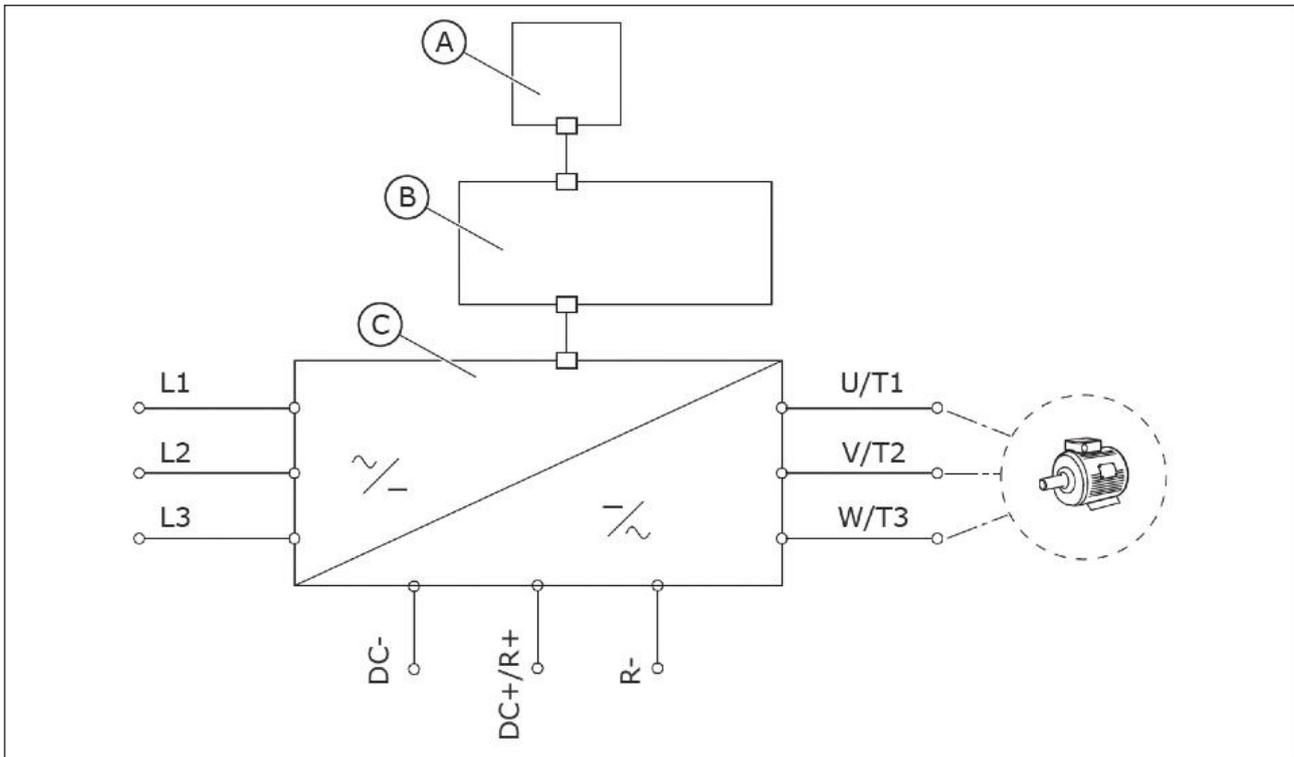


Fig. 4.14: The principal connection diagram

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

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

Table 4.10: The selection of the correct cable

| Cable type | EMC requirements | | |
| --- | --- | --- | --- |
| | 1st environment | 2nd environment | |
| | Category C2 | Category C3 | Category C4 |
| The mains cable | 1 | 1 | 1 |
| The motor cable | 3* | 2 | 2 |
| The control cable | 4 | 4 | 4 |

1 = A power cable for a fixed installation. A cable for the specified mains voltage. A shielded cable is not necessary. We recommend an MCMK cable.

2 = A symmetrical power cable with a concentric protection wire. A cable for the specified mains voltage. We recommend an MCMK cable. See Fig. 4.15.

3 = A symmetrical power cable with a compact low-impedance shield. A cable for the specified mains voltage. We recommend an MCCMK, or an EMCMK cable. We recommend that the cable transfer impedance (1...30MHz) is a maximum of 100 mΩ/m.
   See Fig. 4.15.
* For the EMC level C2, it is necessary to have a 360º earthing of the shield with cable glands in the motor end.

4 = A screened cable with a compact low-impedance shield, for example a JAMAK, or an SAB/ÖZCuY-O cable.
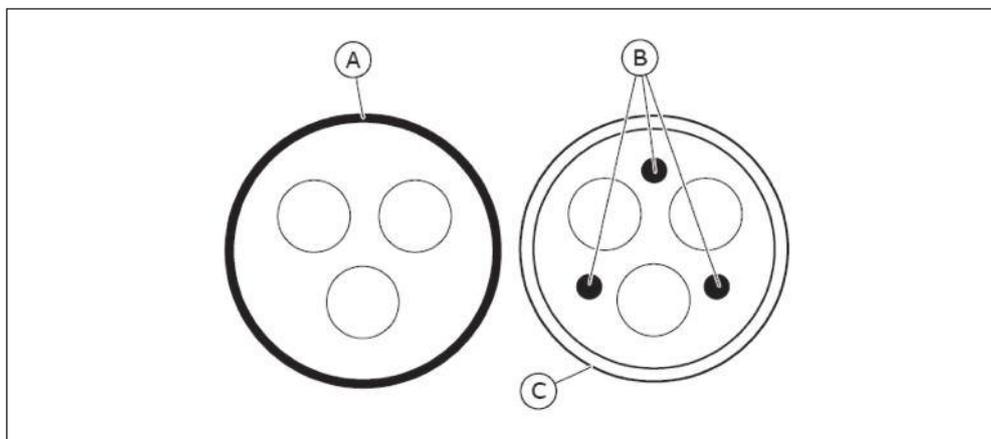


Fig. 4.15: Cables with PE conductors

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

In all the frames, to obey the EMC requirements, use the default values of the switching frequencies.
If you installed a safety switch, make sure that the EMC protection continues from the start of the cables until their ends.

### 4.6.2   UL STANDARDS ON CABLING

To obey the UL (Underwriters Laboratories) regulations, use a UL-approved Class 1 copper wire with a minimum heat resistance of 60 or 75 °C (140 or 167 °F).
You can use the drive on a circuit that gives a maximum of 100 000 rms symmetrical amperes, and a maximum of 600 V, when the drive is protected by Class T and J fuses.

### 4.6.3   CABLE DIMENSIONING AND SELECTION

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

### 4.6.3.1   CABLE AND FUSE SIZES

We recommend the fuse type gG/gL (IEC 60269-1). To make a selection of the fuse voltage rating, refer to the mains. Do not use larger fuses than what is recommended Table 4.11.

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

The table also shows the typical sizes and types of cables that can be used with the AC drive. In the selection of cables, refer to local regulations, cable installation conditions and cable specification.

Table 4.11: The cable and fuse sizes for N800S

| Frame | Type | IL [A] | Fuse (gG/gL) [A] | Mains, motor and brake resistor* cable Cu [mm²] | Terminal cable size | |
|---|---|---|---|---|---|---|
| | | | | | Main terminal [mm²] | Earth terminal [mm²] |
| MR6 | 0038 4 | 38.0 | 40 | 3*10+10 | 2.5—50 Cu/Al | 2.5—35 |
| | 0048 2 | 48.0 | 50 | 3*16+16 (Cu) | 2.5—50 Cu/Al | 2.5—35 |
| | 0046 4 | 46.0 | | 3*25+16 (Al) | | |
| | 0062 2 | 62.0 | 63 | 3*25+16 (Cu) | 2.5—50 Cu/Al | 2.5—35 |
| | 0061 4 | 61.0 | | 3*35+10 (Al) | | |
| MR7 | 0075 2 | 75.0 | 80 | 3*35+16 (Cu) | 6-70 mm² Cu/Al | 6-70 mm² |
| | 0072 4 | 72.0 | | 3*50+16 (Al) | | |
| | 0088 2 | 88.0 | 100 | 3*35+16 (Cu) | 6-70 mm² Cu/Al | 6-70 mm² |
| | 0087 4 | 87.0 | | 3*70+21 (Al) | | |
| | 0105 2 | 105.0 | 125 | 3*50+25 (Cu) | 6-70 mm² Cu/Al | 6-70 mm² |
| | 0105 4 | | | 3*70+21 (Al) | | |
| MR8 | 0140 2 | 140.0 | 160 | 3*70+35 (Cu) | Bolt size M8 | Bolt size M8 |
| | 0140 4 | | | 3*95+29 (Al) | | |
| | 0170 2 | 170.0 | 200 | 3*95+50 (Cu) | Bolt size M8 | Bolt size M8 |
| | 0170 4 | | | 3*150+41 (Al) | | |
| | 0205 2 | 205.0 | 250 | 3*120+70 (Cu) | Bolt size M8 | Bolt size M8 |
| | 0205 4 | | | 3*185+57 (Al) | | |

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

- The cables must be PVC-isolated.
- The maximum ambient temperature is +30 °C (86 °F).
- The maximum temperature of the cable surface is +70 °C (158 °F).
- Use only cables with a concentric copper shield.
- The maximum number of parallel cables is 9.

When you use parallel cables, make sure that you obey the requirements of the crosssectional area and the maximum number of cables.

For important information on the requirements of the earth conductor, see chapter 1.3 Earthing and earth fault protection.

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

### 4.6.3.2    CABLE AND FUSE SIZES, NORTH AMERICA

We recommend the fuse class T (UL & CSA). To make a selection of the fuse voltage rating, refer to the mains. Refer also to local regulations, cable installation conditions and cable specification. Do not use larger fuses than what is recommended Table 4.12.

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

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

Table 4.12: The cable and fuse sizes in North America

| Frame | Type | IL [A] | Fuse (Class T/J) [A] | Mains, motor and brake resistor* cable Cu [AWG] | Terminal cable size | |
|---|---|---|---|---|---|---|
| | | | | | Main terminal [AWG | Earth terminal [AWG] |
| MR6 | 0038 4 | 38.0 | 50 | AWG4 | AWG13-AWG0 | AWG13-AWG2 |
| | 0048 2 | 48.0 | 60 | AWG4 | AWG13-AWG0 | AWG13-AWG2 |
| | 0046 4 | 46.0 | | | | |
| | 0062 2 | 62.0 | 80 | AWG4 | AWG13-AWG0 | AWG13-AWG2 |
| | 0061 4* | 61.0 | | | | |
| MR7 | 0075 2 | 75.0 | 100 | AWG2 | AWG9-AWG2/0 | AWG9-AWG2/0 |
| | 0072 4 | 72.0 | | | | |
| | 0088 2 | 88.0 | 110 | AWG1 | AWG9-AWG2/0 | AWG9-AWG2/0 |
| | 0087 4 | 87.0 | | | | |
| | 0105 2 | 105.0 | 150 | AWG1/0 | AWG9-AWG2/0 | AWG9-AWG2/0 |
| | 0105 4 | | | | | |
| MR8 | 0140 2 | 140.0 | 200 | AWG3/0 | AWG1-350 kcmil | AWG1-350 kcmil |
| | 0140 4 | | | | | |
| | 0170 2 | 170.0 | 225 | 250 kcmil | AWG1-350 kcmil | AWG1-350 kcmil |
| | 0170 4 | | | | | |
| | 0205 2 | 205.0 | 250 | 350 kcmil | AWG1-350 kcmil | AWG1-350 kcmil |
| | 0205 4 | | | | | |
| MR9 | 0261 2 | 261.0 | 350 | 2*250 kcmil | AWG1-350 kcmil | AWG1-350 kcmil |
| | 0261 4 | | | | | |
| | 0310 2 | 310.0 | 400 | 2*350 kcmil | AWG1-350 kcmil | AWG1-350 kcmil |
| | 0310 4 | | | | | |

* To obey the UL regulations with the 500 V drive, it is necessary to have cables with a +90˚C (194 ˚F) heat resistance.

**The dimensions of the cables must agree with the requirements of the Underwriters Laboratories UL508C.**

- The cables must be PVC-isolated.
- The maximum ambient temperature is +30 °C (86 °F).
- The maximum temperature of the cable surface is +70 °C (158 °F).
- Use only cables with a concentric copper shield.
- The maximum number of parallel cables is 9.

When you use parallel cables, make sure that you obey the requirements of the crosssectional area and the maximum number of cables.

For important information on the requirements of the earth conductor, see the Underwriters Laboratories standard UL508C. For the correction factors for each temperature, see the instructions of the Underwriters Laboratories UL508C.

### 4.6.4  BRAKE RESISTOR CABLES

The inverter has terminals for an optional external brake resistor. These terminals are identified with R+ and R- (in MR6) or DC+/R+ and R- (in MR7, MR8, MR9). You can find the dimensions that we recommend for the brake resistor cables in the tables in chapters 4.6.3.1 cable and fuse sizes and 4.6.3.2 cable and sizes, North America. See brake resistor ratings in chapter 10.1.4.

**NOTE!**
The frames MR7, MR8 and MR9 have the brake chopper, only if their type designation code has the code +DBIN. The frame MR6 has the brake chopper as standard.

### 4.6.5  PREPARING FOR THE CABLE INSTALLATION

- Before you start, make sure that none of the components of the AC drive is live. Read carefully the warnings in chapter 1 Safety.
- Make sure that the motor cables are sufficiently far from other cables.
- If it is possible, do not put the motor cables in long parallel lines with other cables.
- If the motor cables are in parallel with other cables, obey the minimum distances.
- The distances are also valid between the motor cables and the signal cables of other systems.
- The maximum lengths of shielded motor cables are 150 m (for MR6), and 200 m (for MR7, MR8, and MR9).
- The motor cables must cross other cables at an angle of 90°.
- If the cable insulation checks are necessary, see chapter 4.8.3 Measuring the cable and motor insulation for instructions.

Table 4.13: The minimum distances between cables

| The distance between cables[w] | The length of the shielded cable[m] |
|---|---|
| 0.3 | ≤ 50 |
| 1 | ≤ 200 |

### 4.6.6  CABLE INSTALLATION

#### 4.6.6.1  FRAMES MR6 TO MR7

Table 4.14: The cable stripping lengths [mm]. See the figure in step 1.

| Frame | A | B | C | D | E | F | E |
|---|---|---|---|---|---|---|---|
| MR6 | 20 | 90 | 15 | 60 | 15 | 60 | As short as possible. |
| MR7 | 20 | 80 | 20 | 80 | 20 | 80 | |

Table 4.15: The cable stripping lengths [in]. See the figure in step 1.

| Frame | A | B | C | D | E | F | E |
|---|---|---|---|---|---|---|---|
| MR6 | 0.8 | 3.6 | 0.6 | 2.4 | 0.6 | 2.4 | As short as possible. |
| MR7 | 0.8 | 3.1 | 0.8 | 3.1 | 0.8 | 3.1 | |

1) Strip the motor cable, the mains cable, and the
   brake resistor cable.
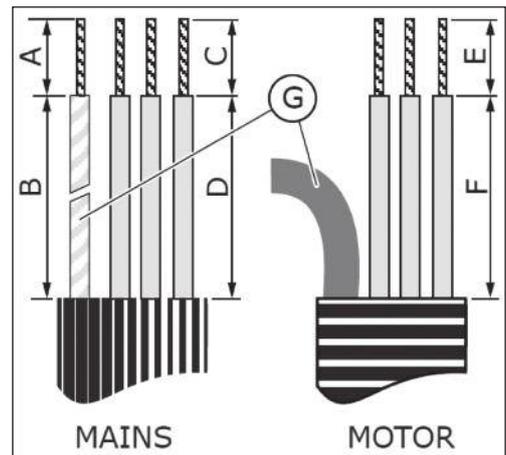


G. The earth conductor

2) Open the cover of the AC drive.
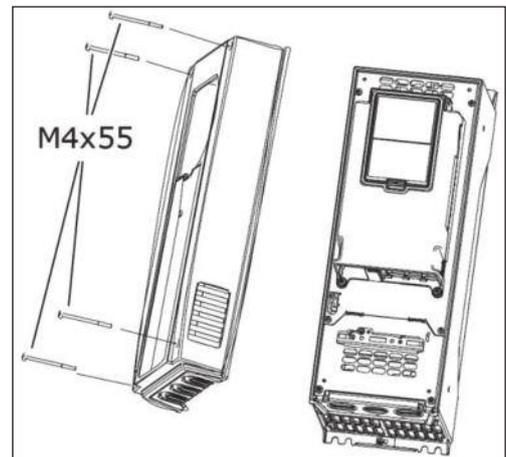


3) Remove the screws of the cable cover. Remove the
   cable cover. Do not open the cover of the power unit.
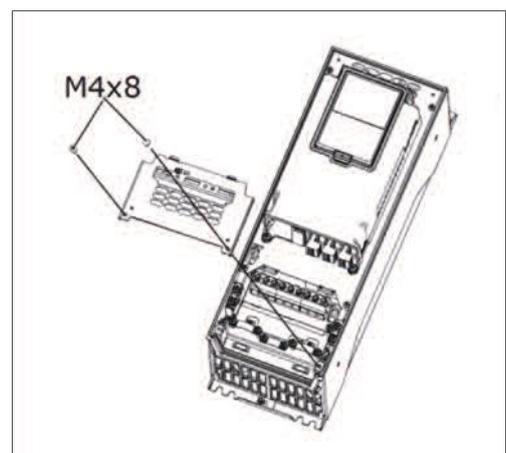
4) Put the grommets in the openings of the cable
   entry plate. These parts are included in the package.
   The picture shows the grommets in IP21 in the EU version.
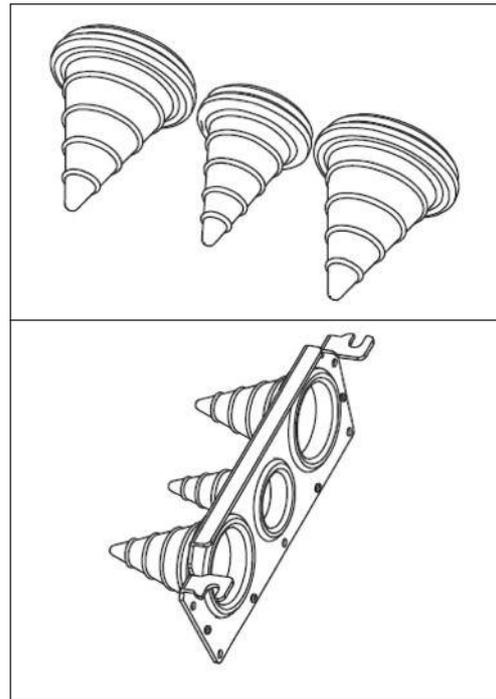
5) Put the cables - the mains cable, the motor cable and the optional brake cable - in the openings of the cable entry plate.

   a) Cut the grommets open to move the cables through them. If the grommets fold in when you put the cable, pull the cable back to make the grommets straight.

   b) Do not cut the grommet openings wider than what is necessary for the cables that you use.
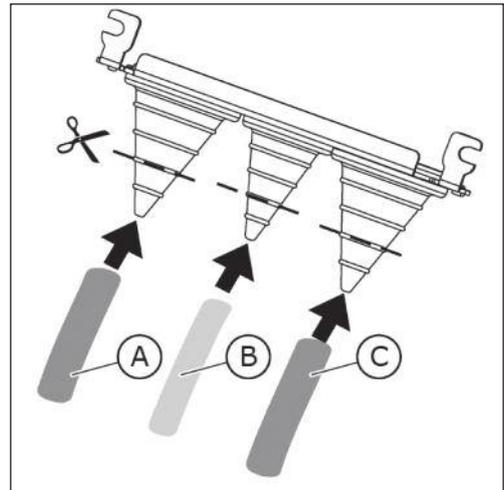


A. The mains cable          C. The motor cable
B. The brake cable
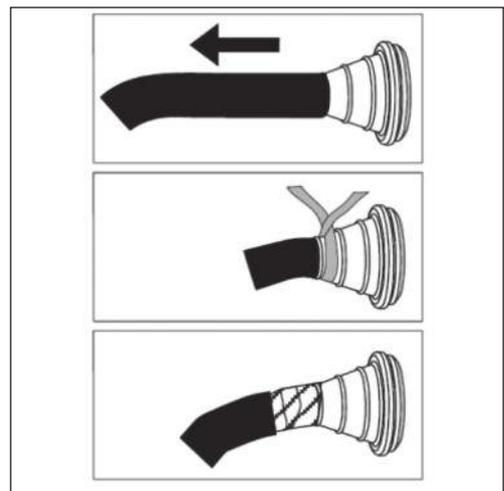


6) Remove the cable clamps and the grounding clamps.
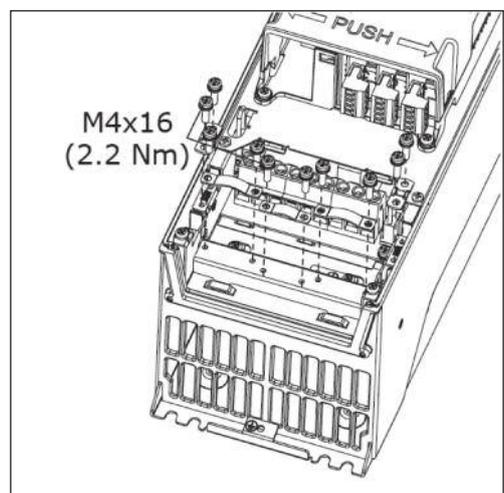
7) Put the cable entry plate with the cables into the groove on the frame of the drive.
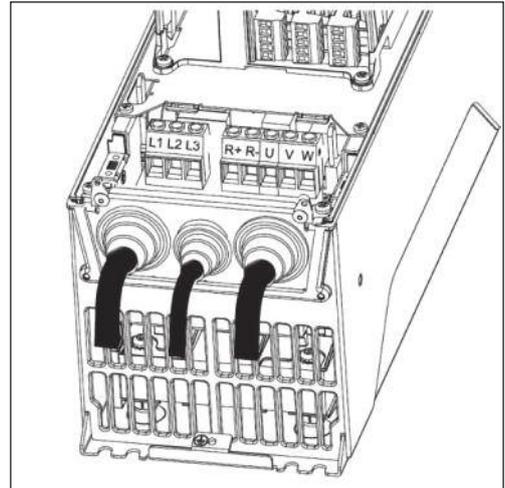


8) Connect the stripped cables.

  a) Expose the shield of all the 3 cables to make a 360-degree connection with the cable clamp.

  b) Connect the phase conductors of the mains cable and of the motor cable, and the conductors of the the brake resistor cable into the correct terminals.

  c) Attach the earth conductor of each cable to an earth terminal with a clamp.

  d) See the correct tightening torques in Table 4.16.
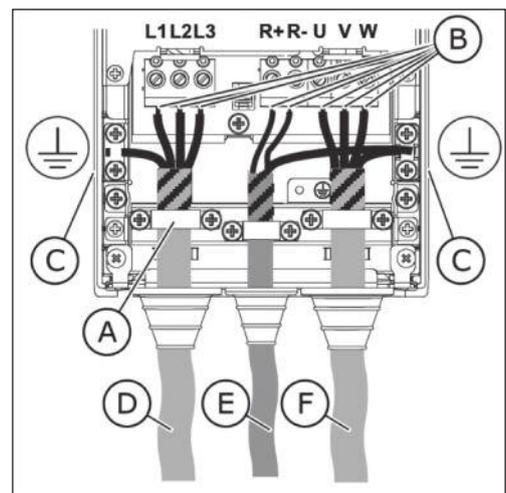


A. The cable clamp    D. The mains cable
B. The terminals    E. The brake resistor cable
C. The earth terminal    F. The motor cable

9) Make sure that the earth conductor is connected to
   the motor and also to the terminals that are identified with.

   a) To obey the requirements of the standard EN61800-5-1,
      obey the instructions in chapter 1.3 Earthing and earth fault
      protection.
   b) If a double earthing is necessary, use the earth terminal
      under the drive. Use an M5 screw and tighten it to 2.0 Nm
      or 17.7 lb-in.
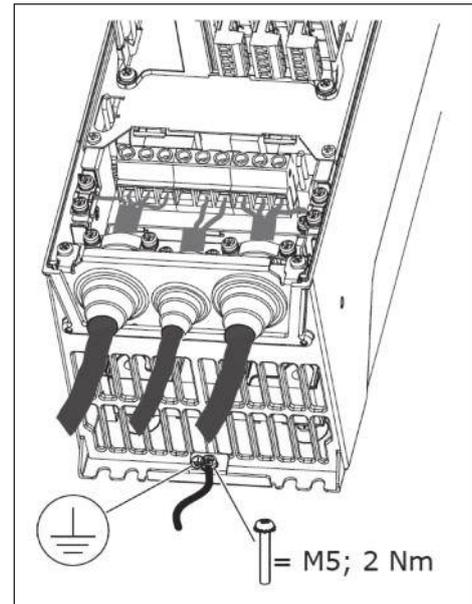
10) Attach again the cable cover and the cover of the drive.
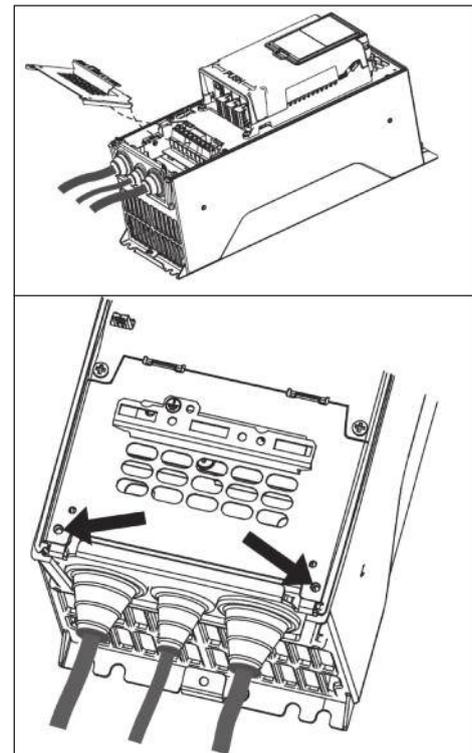
Table 4.16: Tightening torques of the terminals

| Frame | Type | Tightening torque: the power and motor terminals | | Tightening torque: the EMC grounding clamps | | Tightening torque: the earth terminals | |
|---|---|---|---|---|---|---|---|
| | | [Nm] | lb–in. | [Nm] | lb–in. | [Nm] | lb–in. |
| MR6 | 0048 2—0062 2 0038 4—0061 4 | 10 | 88.5 | 1.5 | 13.3 | 2.0 | 17.7 |
| MR7 | 0075 2—0105 2 0072 4—0105 4 | 8*/5.6** | 70.8*/49.6** | 1.5 | 13.3 | 8*/5.6** | 70.8*/49.6** |

\* The tightening torque for a torx screw.

\*\* The tightening torque for an Allen screw.
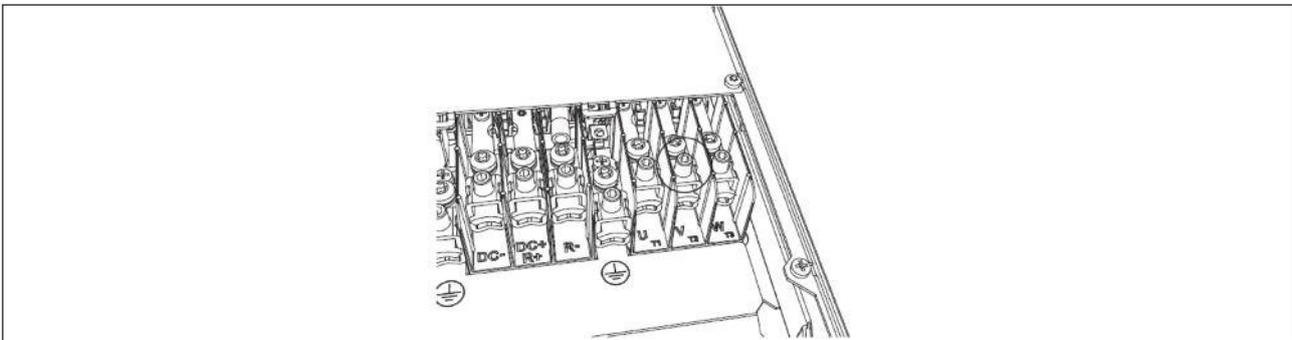


Fig. 4.16: The tightening torque for the Allen screw in MR7 is 5.6 Nm

#### 4.6.6.2 FRAMES MR8 TO MR9

Table 4.17: The cable stripping lengths [mm]. See the figure in step 1.

| Frame | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| MR8 | 40 | 180 | 25 | 300 | 25 | 300 | As short as possible. |
| MR9 | 40 | 180 | 25 | 300 | 25 | 300 | |

Table 4.18: The cable stripping lengths [in]. See the figure in step 1.

| Frame | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| MR8 | 1.6 | 7.1 | 1 | 11.8 | 1 | 11.8 | As short as possible. |
| MR9 | 1.6 | 7.1 | 1 | 11.8 | 1 | 11.8 | |

1) Strip the motor cable, the mains cable, and the brake resistor cable.
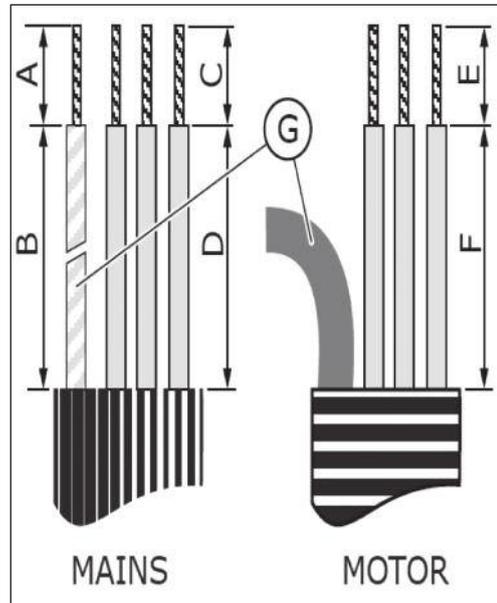
G. The earth conductor

2) MR9 only: Open the cover of the AC drive.
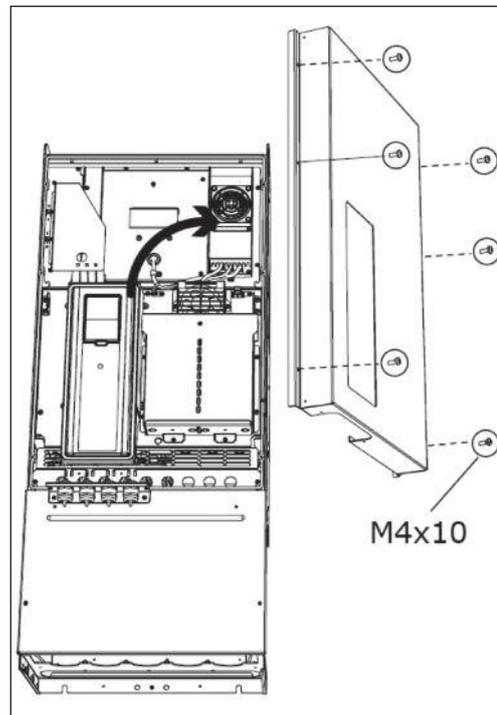
3) Remove the cable cover.
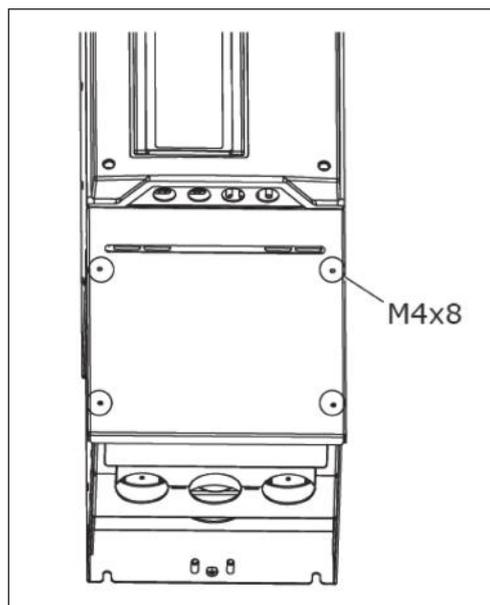


MR8
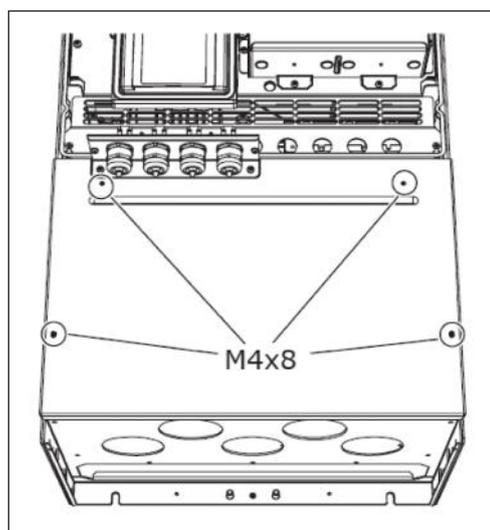


MR9

4) Remove the cable entry plate.



M4x8

MR8



M5x10
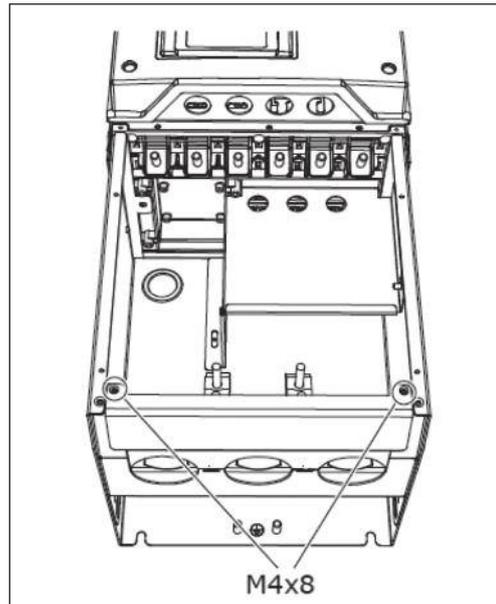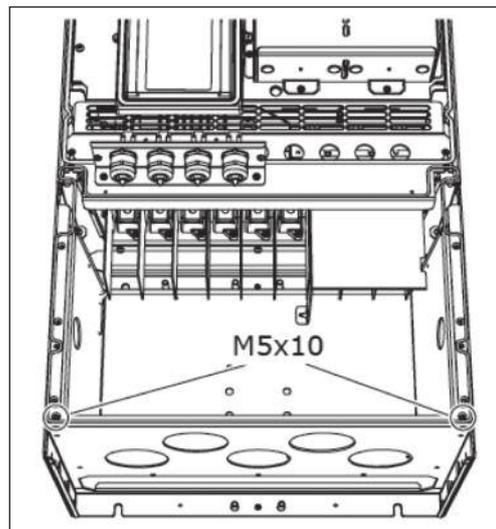
MR9

5) MR9 only: Loosen the screws and remove the sealing plate.
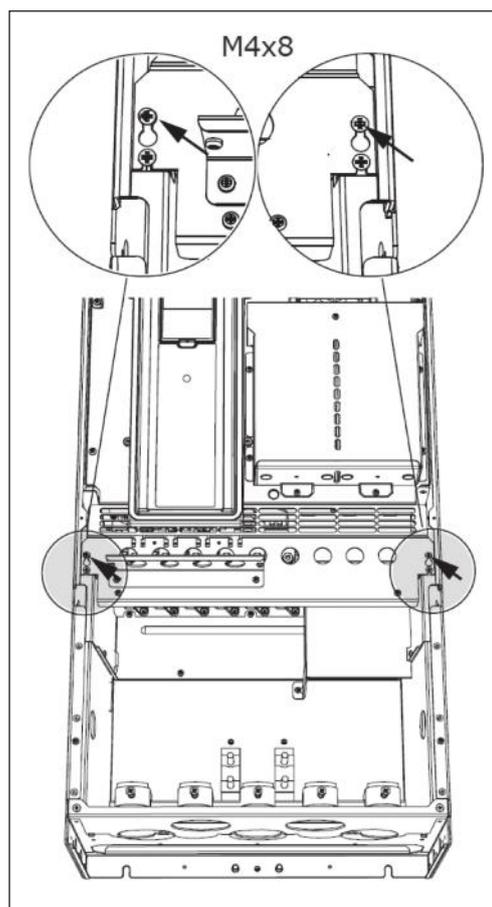
6) Remove the EMC shield plate
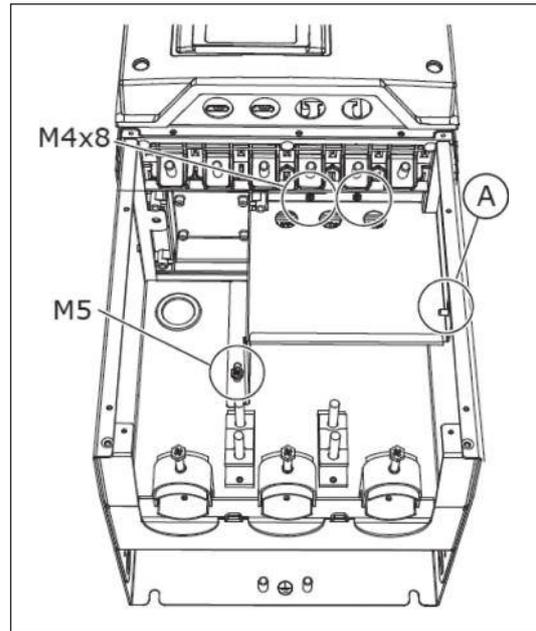


A. The wing nut in MR8
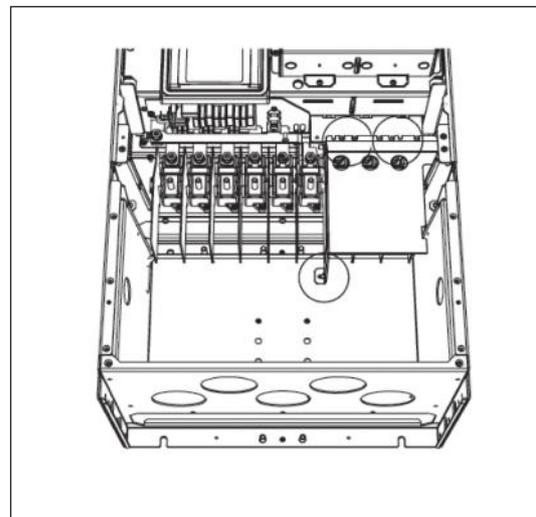


A. MR9

7) Find the terminals of the motor cables. The location of the terminals is unusual, especially in MR8.
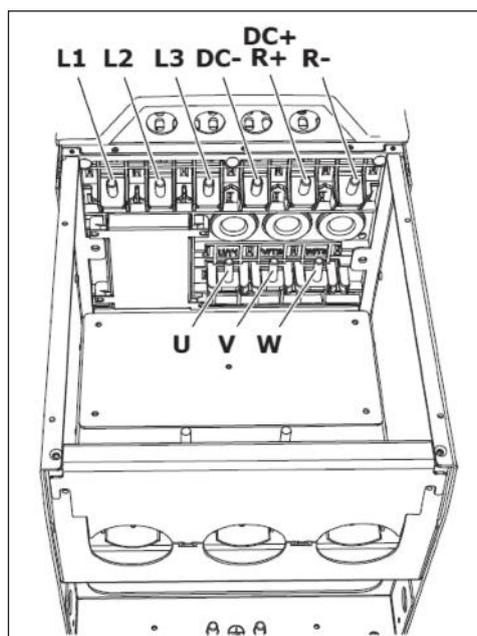


MR8
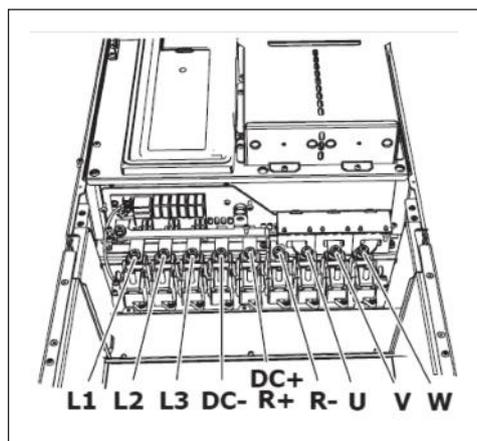


MR9

8) Cut the grommets open to move the cables through them.

   a) Do not cut the grommet openings wider than what is necessary for the cables that you use.

   b) If the grommets fold in when you put the cable, pull the cable back to make the grommets straight.
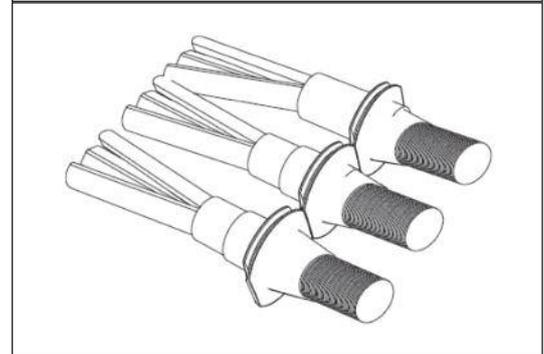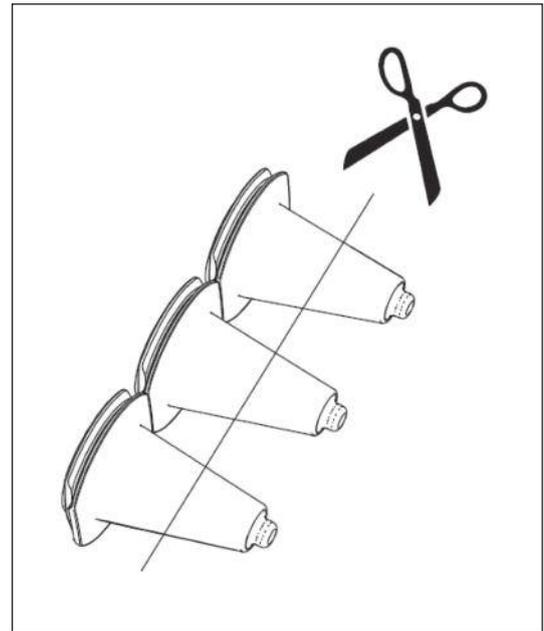
9) Attach the grommet and the cable so that the frame of the drive goes into the groove of the grommet.
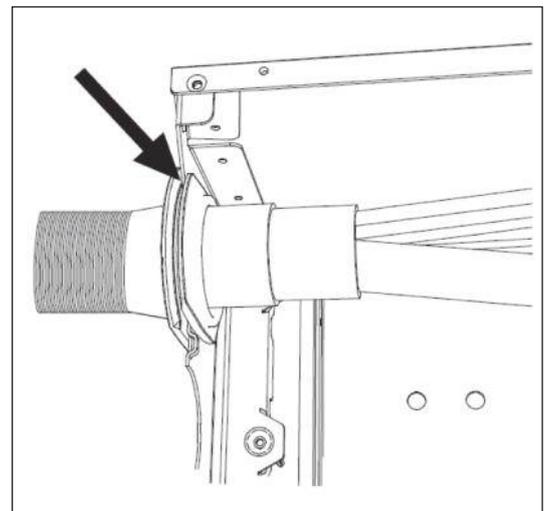
10) If you use thick cables, put the cable insulators in between the terminals to prevent contact between the cables.
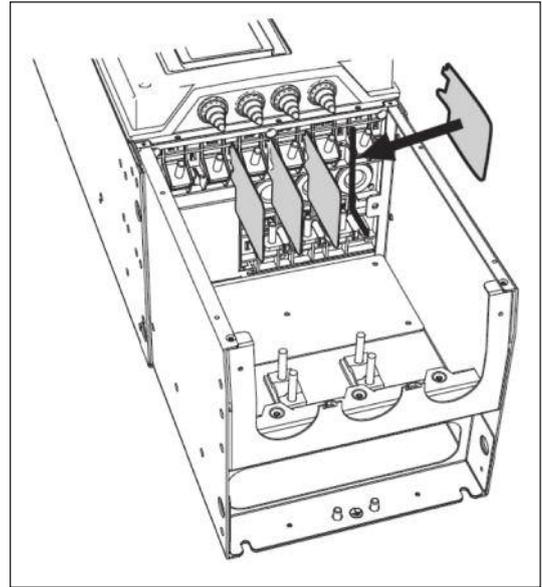
11) Connect the stripped cables.

a) Connect the phase conductors of the mains cable and of the motor cable into the correct terminals. If you use a brake resistor cable, connect its conductors into the correct terminals.

b) Attach the earth conductor of each cable to an earth terminal with a clamp.

c) See the correct tightening torques in Table 4.19.
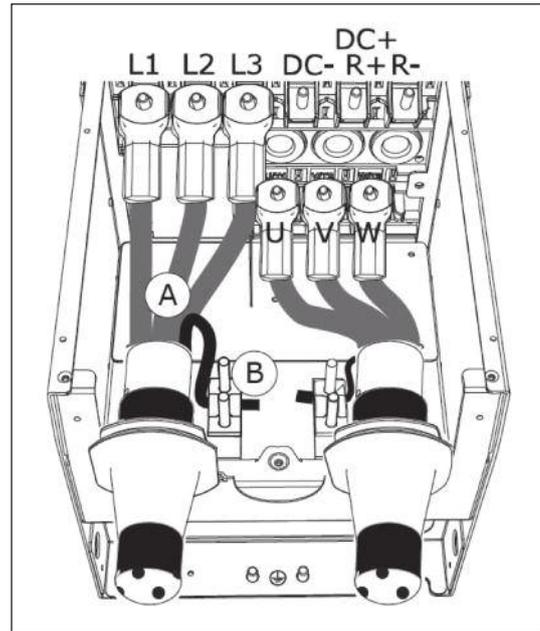
A. Connection of the cables

B. Make a grounding connection in MR8
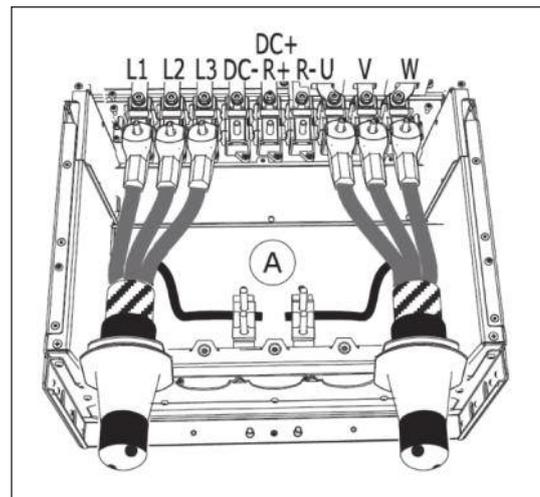
A. Make a grounding connection in MR9

12) If you use many cables on one connector, put the cable lugs on top of each other.
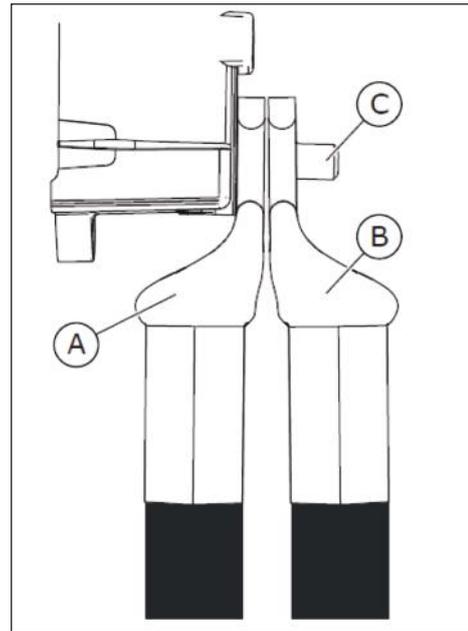


A. The first cable lug
B. The second cable lug
C. The connector

13) Expose the shield of all 3 cables to make a 360–degree connection with the cable clamp.
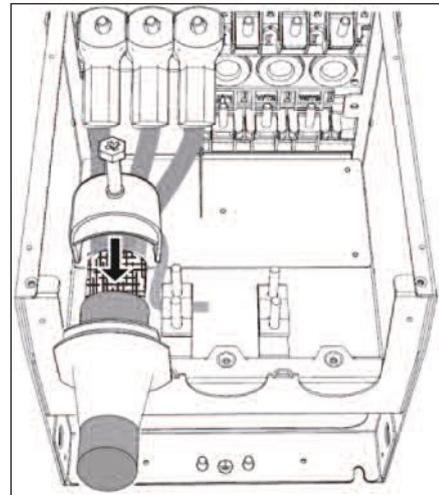


14) Attach again the EMC shield plate. For MR9, attach the sealing plate.

15) Attach the cable entry plate, and then the cable cover.
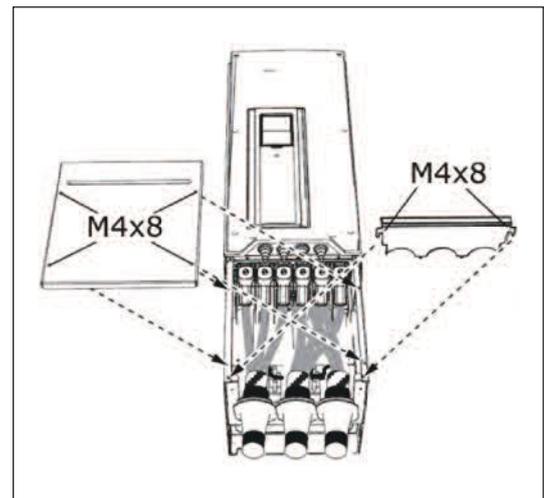


16) For MR9, attach the cover of the drive (unless you want to make the control connections first).
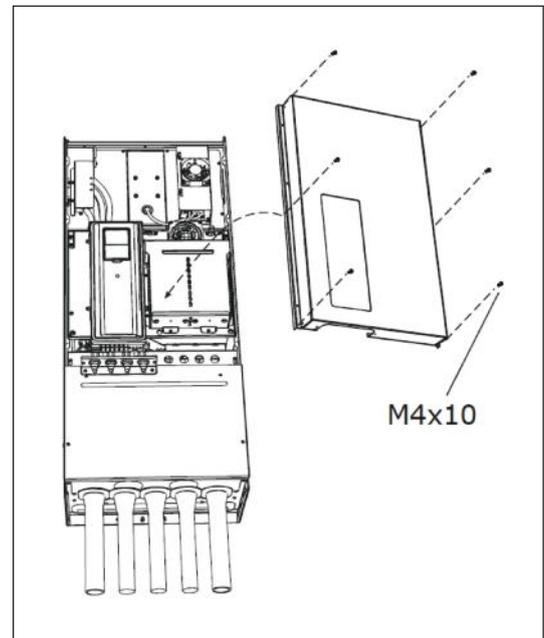


17) Make sure that the earth conductor is connected to the motor and also to the terminals that are identified with ⏚ .

  a) To obey the requirements of the standard EN61800-5-1, obey the instructions in chapter 1.3 Earthing and earth fault protection.

  b) Connect the protective conductor to 1 of the screw connectors with a cable shoe and an M8 screw.
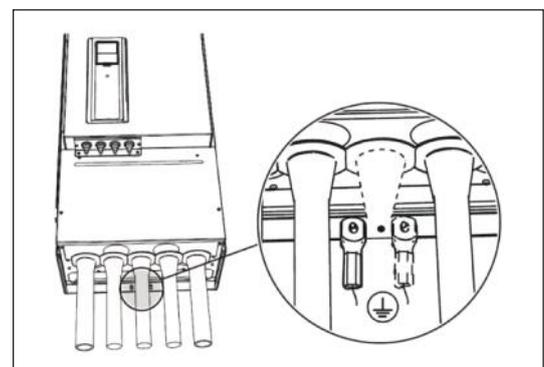
Table 4.19: Tightening torques of the terminals

| Frame | Type | Tightening torque: the power and motor terminals | | Tightening torque: the EMC grounding clamps | | Tightening torque: the earth terminals | |
|---|---|---|---|---|---|---|---|
| | | [Nm] | lb-in. | [Nm] | lb-in. | [Nm] | lb-in. |
| MR8 | 0140 2—0205 2<br>0140 5—0205 5 | 20 | 177 | 1.5 | 13.3 | 20 | 177 |
| MR9 | 0261 5—0310 5 | 20 | 177 | 1.5 | 13.3 | 20 | 177 |

### 4.6.7 INSTALLATION IN A CORNER-GROUNDED NETWORK

You can use corner grounding with the drive types (MR7 to MR9) with a rating of 72-310 A with a 380-480 V mains, and 75-310 A with a 208-240 V mains.

In these conditions, you must change the EMC protection level to C4. See the instructions in 4.8.4 Installation in an IT system.

Do not use corner grounding with the drive types (MR6) with a rating of 3.4-61 A with a 380-480 V mains, or 3.7-62 A with a 208-240 V mains.

## 4.7 CONTROL UNIT

### 4.7.1 CONTROL UNIT COMPONENTS

The control unit of the AC drive contains the standard boards and the option boards. The option boards are connected to the slots of the control board (see 4.7.5 Installation of option boards).
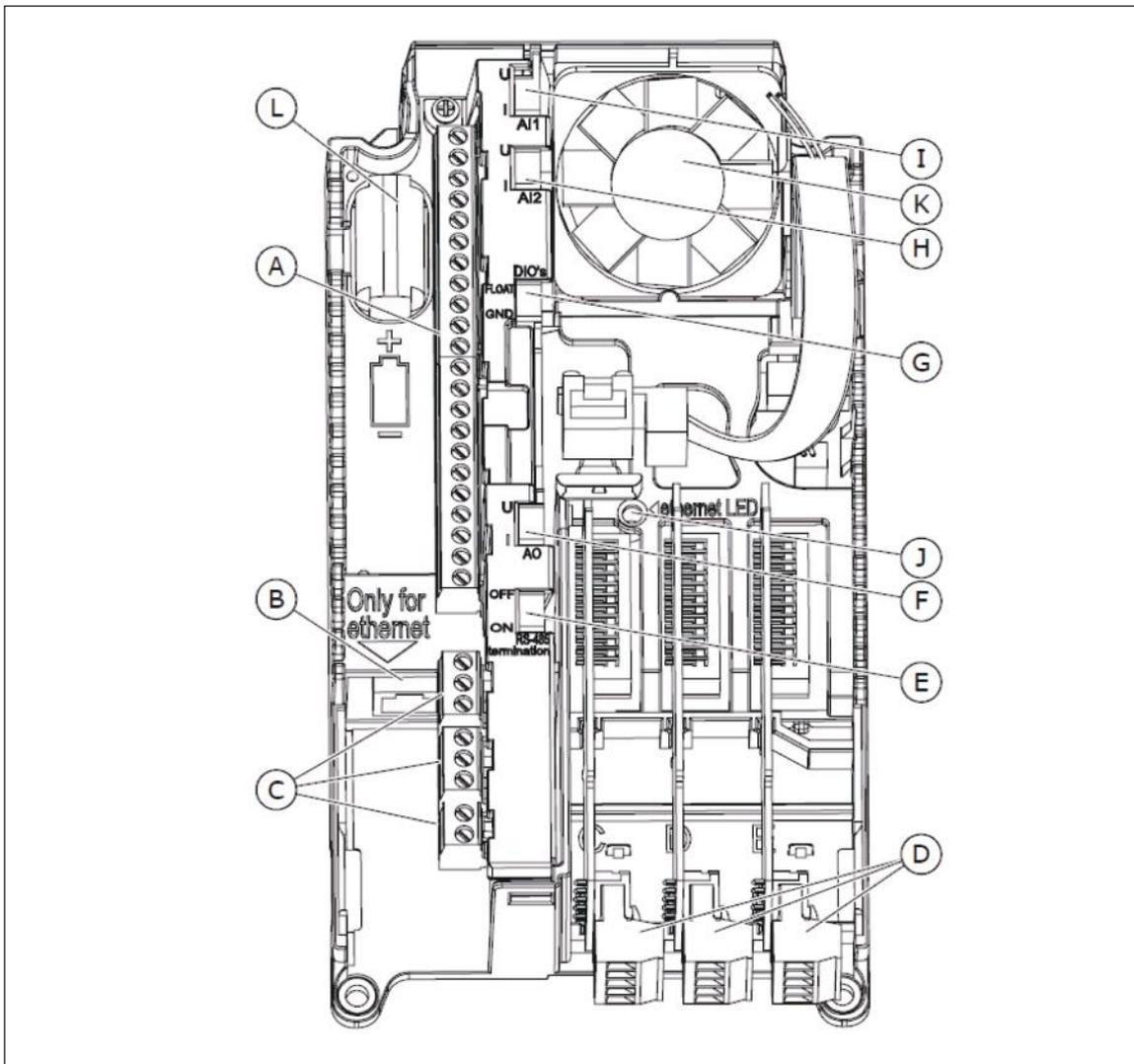


Fig. 4.17: The components of the control unit

A. The terminals for the standard I/O connections
B. The Ethernet connection
C. The terminals for 3 relay outputs or 2 relay outputs and a thermistor
D. The option boards
E. A DIP switch for the RS485 bus termination

F. A DIP switch for the signal selection of Analogue Output
G. A DIP switch for the isolation of the digital inputs from ground
H. A DIP switch for the signal selection of Analogue Input 2
I. A DIP switch for the signal selection of Analogue Input 1

J.  Using PC tool

K.  A fan

L.  The battery for the RTC

When you receive the AC drive, the control unit contains the standard control interface. If you included special options in your order, the AC drive will be as in your order. On the next pages, you will find information on the terminals and general wiring examples.

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

### 4.7.2  CONTROL UNIT CABLING

The control board has 22 fixed I/O terminals, and the relay board has 8. You can see the standard connections of the control unit and the descriptions of signals in Fig. 4.18.

#### 4.7.2.1  SELECTION OF THE CONTROL CABLES

The control cables must be a minimum of 0.5 ㎟ screened multicore cables. See more on the cable types in Table 4.10 The selection of the correct cable. The terminal wires must be a maximum of 2.5 ㎟ for the terminals of the relay board and other terminals.

Table 4.20: The tightening torques of the control cables

| The terminal | The terminal screw | The tightening torque |
| --- | --- | --- |
| | | Nm |
| All the terminals of the I/O board and the relay board | M3 | 0.5 |

#### 4.7.2.2  CONTROL TERMINALS AND DIP SWITCHES

Here you see the basic description of the terminals of the I/O board and the relay board. For more information, see Chapter 4.7.3 Technical data on control connections.

Some terminals are assigned for signals that have optional functions that you can use with the DIP switches. See more in 4.7.3.1.1 Selection of terminal functions with DIP switches.

## Standard I/O board

| | Terminal | | Signal | Description |
|---|---|---|---|---|
| 1 | +10 Vref | | Reference output | |
| 2 | AI1+ | | Analogue input, voltage or current | Frequency reference |
| 3 | AI1- | | Analogue input common, (current) | |
| 4 | AI2+ | | Analogue input, voltage or current | Frequency reference |
| 5 | AI2- | | Analogue input common, (current) | |
| 6 | 24Vout | | 24V auxiliary voltage | |
| 7 | GND | | I/O ground | |
| 8 | DI1 | | Digital input 1 | Start forward |
| 9 | DI2 | | Digital input 2 | Start reverse |
| 10 | DI3 | | Digital input 3 | External fault |
| 11 | CM | | DI1~DI6COMMON | * |
| 12 | 24Vout | | 24V auxiliary voltage | |
| 13 | GND | | I/O ground | |
| 14 | DI4 | | Digital input 4 | |
| 15 | DI5 | | Digital input 5 | |
| 16 | DI6 | | Digital input 6 | Fault reset |
| 17 | CM | | DI1~DI6COMMON | * |
| 18 | AO1+ | | Analogue signal (+output) | Output frequency |
| 19 | AO1-/GND | | Analogue output common / I/O ground | |
| 30 | +24Vin | | 24V auxiliary input voltage | |
| A | RS485 | | Serial bus, negative | Modbus RTU BACnet, N2 |
| B | RS485 | | Serial bus, positive | |
| 21 | RO1 NC | | Relay output 1 | RUN |
| 22 | RO1 CM | | | |
| 23 | RO1 NO | | | |
| 24 | RO2 NC | | Relay output 2 | FAULT |
| 25 | RO2 CM | | | |
| 26 | RO2NO | | | |
| 32 | RO3 CM | | Relay output 3 | READY |
| 33 | RO3 NO | | | |

Reference potentiometer 1...10kΩ

2-wire transmitter

Actual value I=(0) 4...20mA

| DI4 | DI5 | Freq. ref. |
|---|---|---|
| Open | Open | Analog input 1 |
| Closed | Open | Preset Freq. 1 |
| Open | Closed | Preset Freq. 2 |
| Closed | Closed | Preset Freq. 3 |

mA

RUN

Fig. 4.18: The signals of the I/O terminals on the standard I/O board, and a connection example.

*You can isolate digital inputs from ground with a DIP switch. See 4.7.3.1.2 Isolation of digital input from ground.

### 4.7.3 TECHNICAL DATA ON CONTROL CONNECTIONS

### 4.7.3.1 TECHNICAL DATA ON CONTROL CONNECTIONS

Table 4.21: The standard I/O board

| Standard I/O board | | |
|---|---|---|
| Terminal | Signal | Technical information |
| 1 | Reference output | +10 V, +3%, maximum current: 10 mA |
| 2 | Analogue input, voltage or current | Analogue input channel 1<br>0...+10 V (Ri = 200 kΩ)<br>4...20 mA (Ri =250 Ω)<br>Resolution 0.1 %, accuracy ±1 %<br>Selection V/mA with dip-switches (see chapter 4.7.3.1.1 Selection of terminal functions with DIP switches) Short-circuit protected |
| 3 | Analogue input common (current) | Differential input if not connected to ground<br>Allows ±20 V common mode voltage to GND |
| 4 | Analogue input, voltage or current (current) | Analogue input channel 2<br>Default: 4-20 mA (Ri =250 Ω)<br>0-10 V (Ri=200 kΩ)<br>Resolution 0.1 %, accuracy ±1 %<br>Selection V/mA with dip-switches (see chapter 4.7.3.1.1 Selection of terminal functions with DIP switches)<br>Short-circuit protected |
| 5 | Analogue input common (current) | Differential input if not connected to ground<br>Allows ±20 V common mode voltage to GND |
| 6 | 24 V aux. voltage | +24 V, ±10%, max volt. ripple ‹ 100 mVrms<br>max. 250 mA<br>Short–circuit protected |
| 7 | I/O ground | Ground for reference and controls (connected internally to frame earth through 1 MΩ) |
| 8 | Digital input 1 | Positive or negative logic<br>Ri = min. 5 kΩ<br>0...5 V = 0<br>15...30 V = 1 |
| 9 | Digital input 2 | |
| 10 | Digital input 3 | |
| 11 | Common A for DIN1-DIN6 | Digital inputs can be disconnected from ground, see chapter 4.7.3.1.2 Isolation of digital inputs from ground. |
| 12 | 24 V aux. voltage | +24 V, ±10%, max volt. ripple ‹ 100mVrmsmax. : 250 mA<br>Short-circuit protected |
| 13 | I/O ground | Ground for reference and controls (connected internally to frame earth through 1 MΩ) |
| 14 | Digital input 4 | Positive or negative logic<br>Ri = min. 5 kΩ<br>0...5 V = 0<br>15...30 V = 1 |
| 15 | Digital input 5 | |
| 16 | Digital input 6 | |

| Standard I/O board | | |
|---|---|---|
| Terminal | Signal | Technical information |
| 17 | Common A for DIN1-DIN6 | Digital inputs can be isolated from ground, see chapter 4.7.3.1.2 Isolation of digital inputs from ground. |
| 18 | Analogue signal (+output) | Analogue output channel 1, selection 0 -20 mA, load ‹500 Ω Default: 0-20 mA |
| 19 | Analogue output common | 0-10 V Resolution 0.1 %, accuracy ±2 % Selection V/mA with dip-switches (see chapter 4.7.3.1.1 Selection of terminal functions with DIP switches) Short-circuit protected |
| 30 | 24V auxiliary input voltage | Can be used as external power backup for the control unit |
| A | RS485 | Differential receiver/transmitter Set bus termination with dip switches (see chapter 4.7.3.1.1 |
| B | RS485 | Selection of terminal functions with DIP switches). Termination resistance = 220 Ω |

| Relay board | | | | 기본설정 |
|---|---|---|---|---|
| | **Terminal** | | **Signal** | |
| 21 | RO1 NC | | | |
| 22 | RO1 CM | | Relay output 1 | RUN |
| 23 | RO1 NO | | | |
| 24 | RO2 NC | | | |
| 25 | RO2 CM | | Relay output 2 | FAULT |
| 26 | RO2 NO | | | |
| 27 | RO3 CM | | Relay output 3 | READY |
| 28 | RO3 NC | | | |
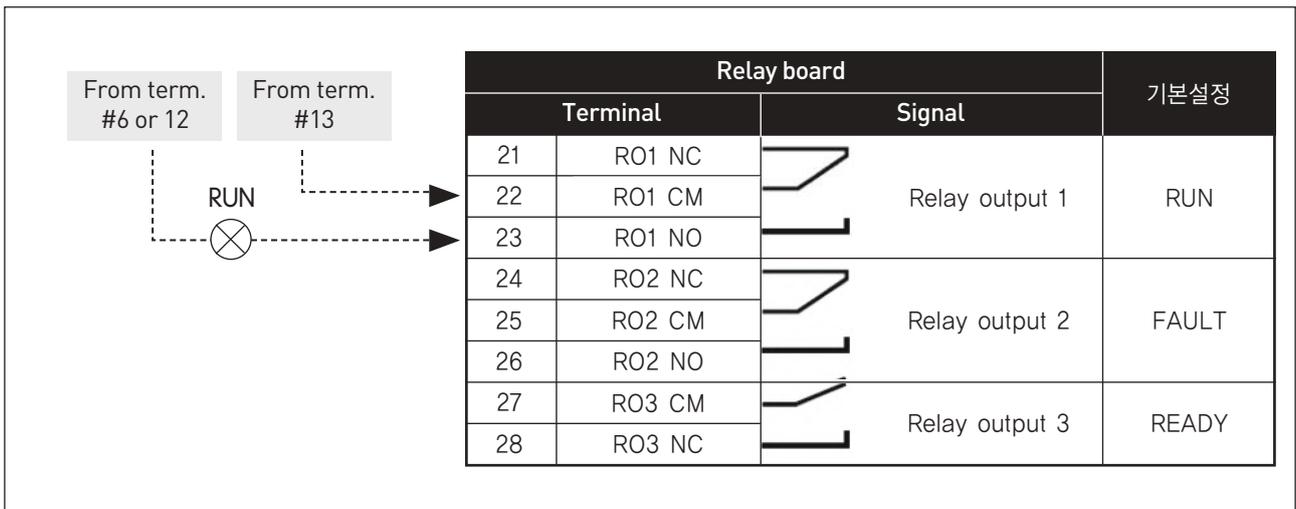
Fig. 4.19: The standard relay board (+SBF3)

#### 4.7.3.1.1 Selection of terminal functions with DIP switches

You can make 2 selections with the DIP switches for specified terminals. The switches have 2 positions: up and down. You can see the location of the DIP switches and the possible selections in Fig. 4.20.
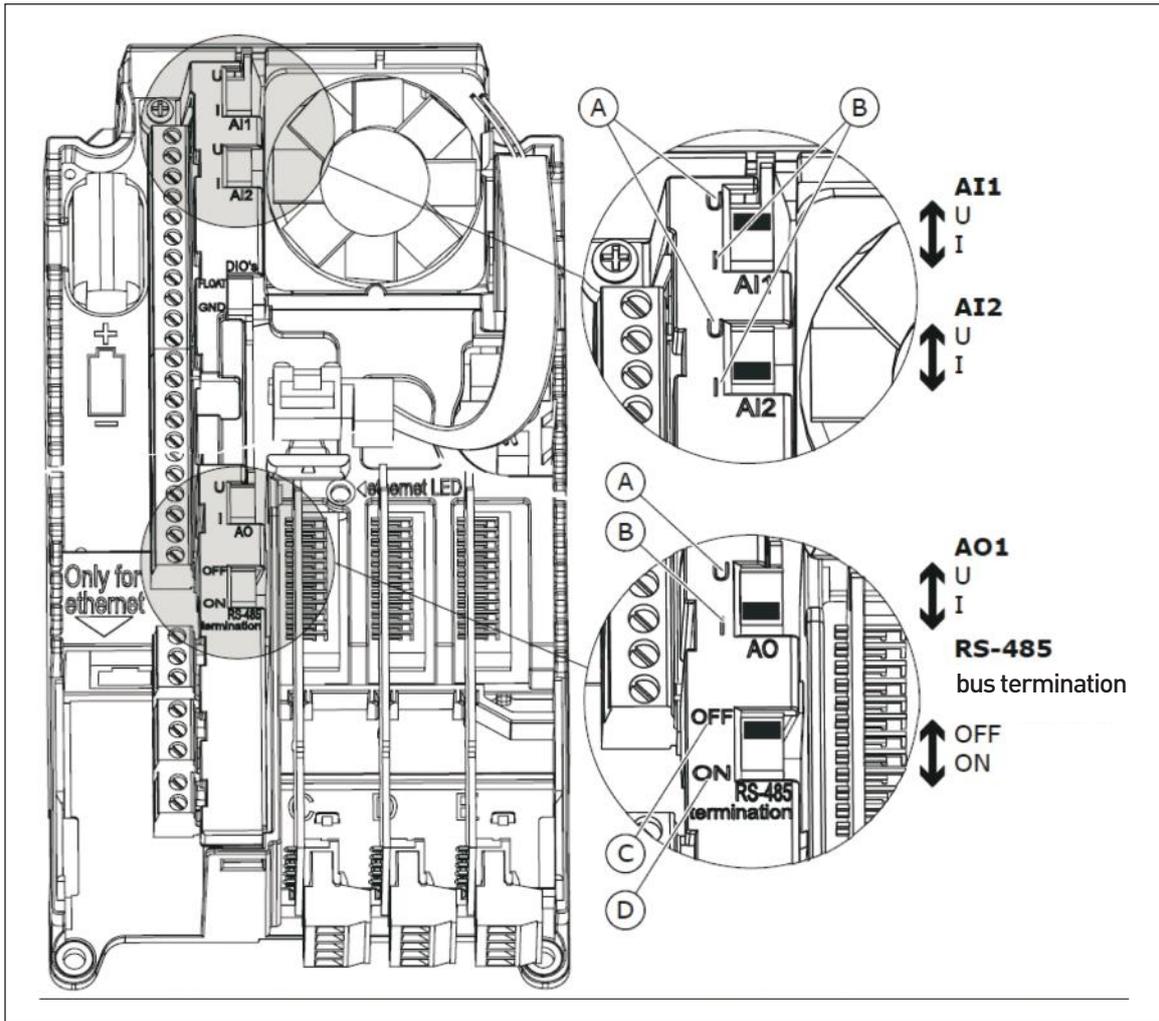
Fig. 4.20: The selections of the DIP switches

A. The voltage signal, 0-10 V input
B. The current signal, 0-20 mA input

C. OFF
D. ON

Table 4.22: The default positions of the DIP switches

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

#### 4.7.3.1.2 Isolation of digital inputs from ground

It is possible to isolate from ground the digital inputs (terminals 8-10 and 14-16) on the standard I/O board. To do this, change the position of a DIP switch on the control board.
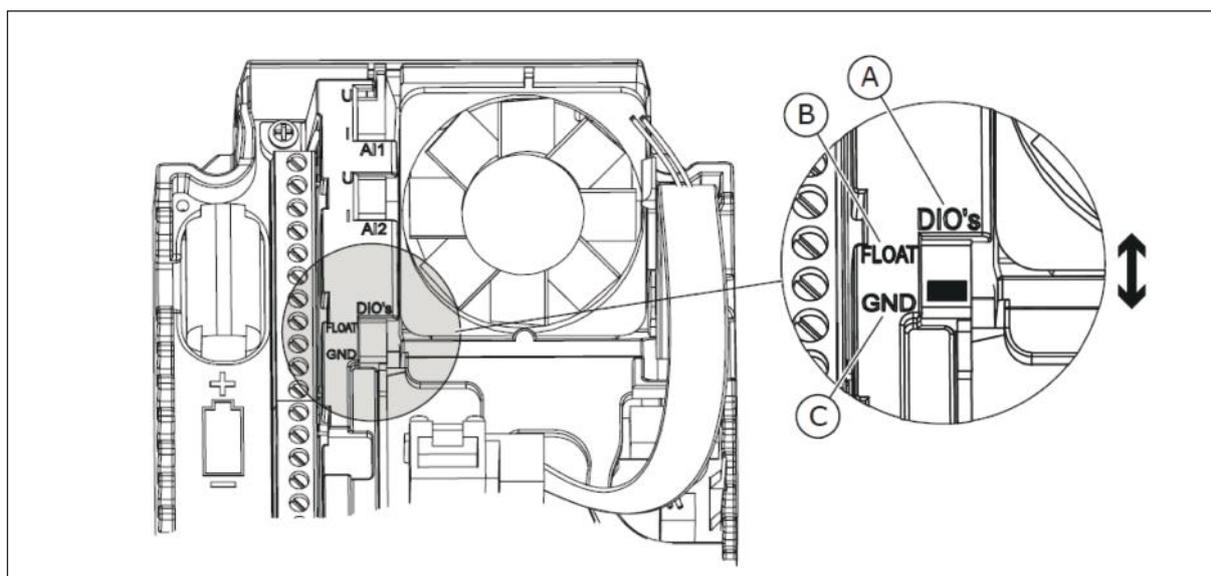
Fig. 4.21: Change the position of this switch to isolate the digital inputs from ground

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

### 4.7.4  FIELDBUS CONNECTION

You can connect the drive to fieldbus with an RS485. If you use an RS485 cable, connect it to terminal A or B of the standard I/O board.
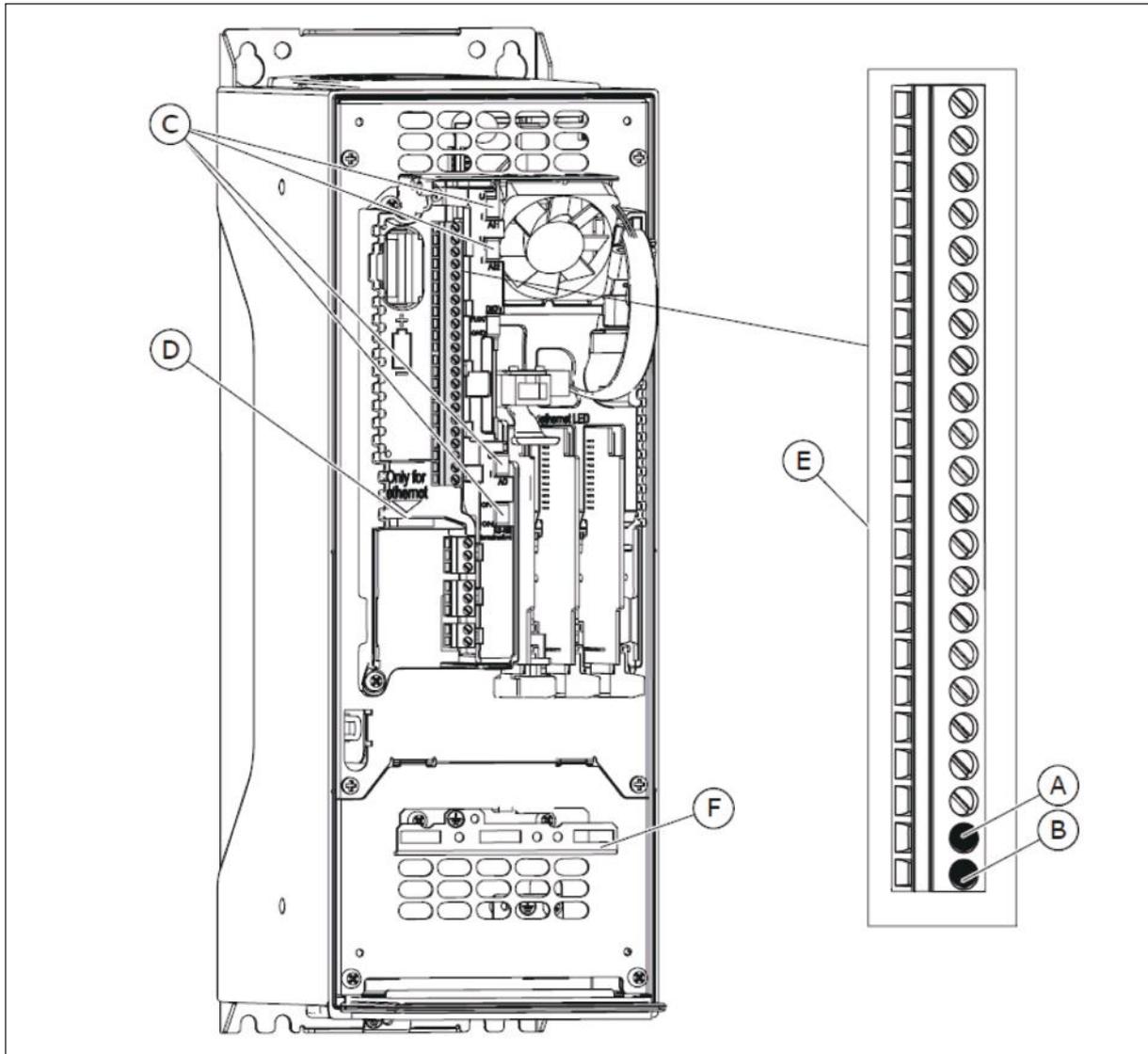
Fig. 4.22: The RS485 connection

A.  RS485 A=Data -                          D.  PC tool terminal
B.  RS485 B=Data+                           E.  The I/O terminals
C.  The DIP switches                        F.  The grounding bar

#### 4.7.4.1 USING FIELDBUS THROUGH AN RS485 CABLE

Table 4.23: RS485 cable data

| The plug type | 2.5 ㎟ |
|---|---|
| The cable type | STP (shielded twisted pair), Belden 9841 or almost the same |
| The cable length | So that it agrees with the fieldbus. See the fieldbus manual. |

1) Remove approximately 15 mm of the grey shield of the RS485 cable. Do this for the 2 fieldbus cables.

    a) Strip the cables for approximately 5 mm to put them in the terminals. Do not keep more than 10 mm of the cable outside the terminals.

    b) Strip the cable at such a distance from the terminal that you can attach it to the frame with the cable clamp. Strip the cable at a maximum length of 15 mm. Do not remove the aluminium shield of the cable.
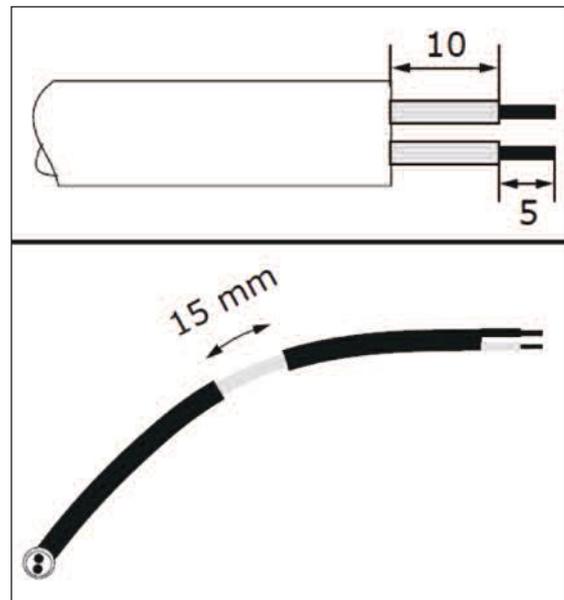
2) Connect the cable to the standard I/O board of the drive, in terminals
   A and B.

   - A = negative
   - B = positive
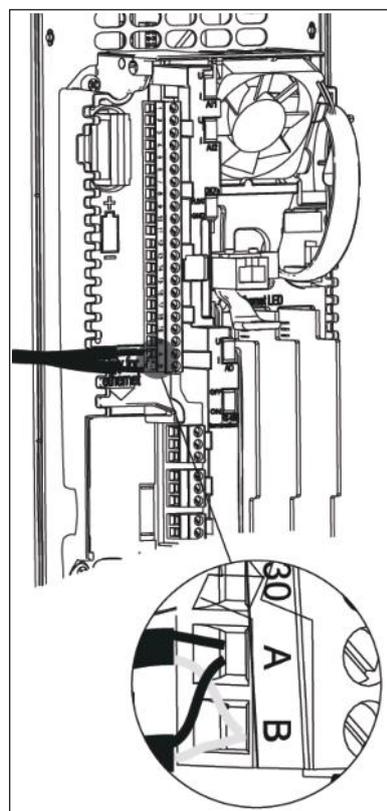


3) Attach the shield of the cable to the frame of the drive with a cable
   clamp to make a grounding connection.
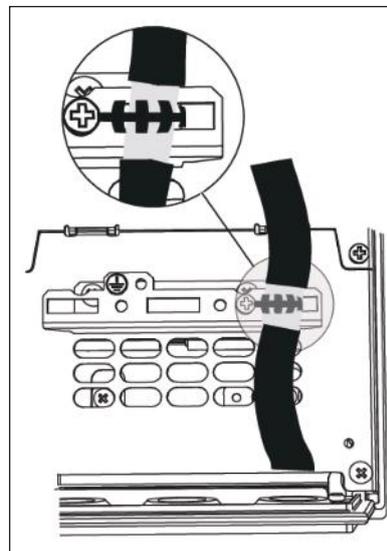
4)  If the drive is the last device on the fieldbus line, set the bus termination.

    a)  Find the DIP switches on the right side of the control panel of the drive.

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

    c)  Biasing is built in the bus termination resistor. The resistance is 220 Ω.
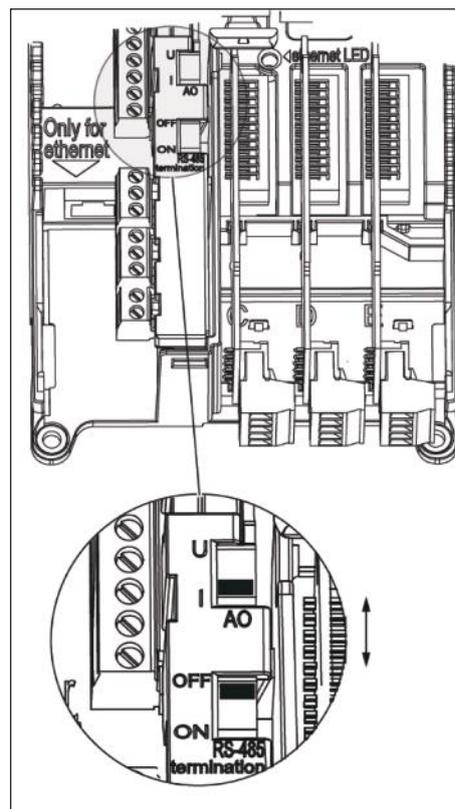
5)  In IP21, unless you have cut the openings for other cables, cut an opening on the cover of the drive for the RS485 cable.
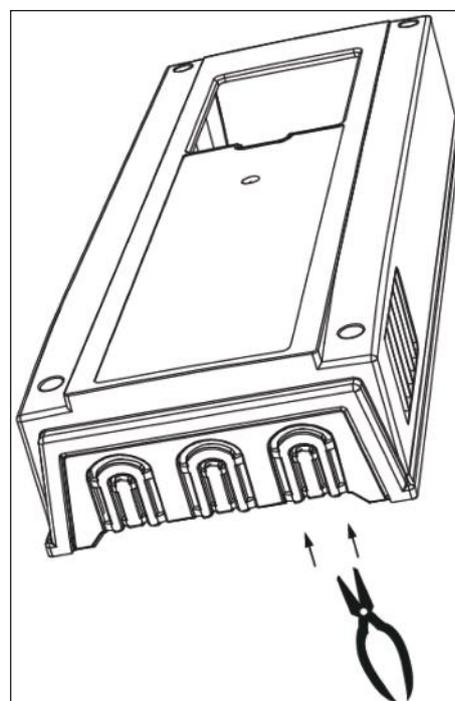
6) Put the cover of the drive back. Pull the RS485 cables to the side.

  a) Keep the distance of the I/O and Fieldbus cables from
     the motor cable at a minimum of 30 cm.
  b) Move the fieldbus cables away from the motor cable.
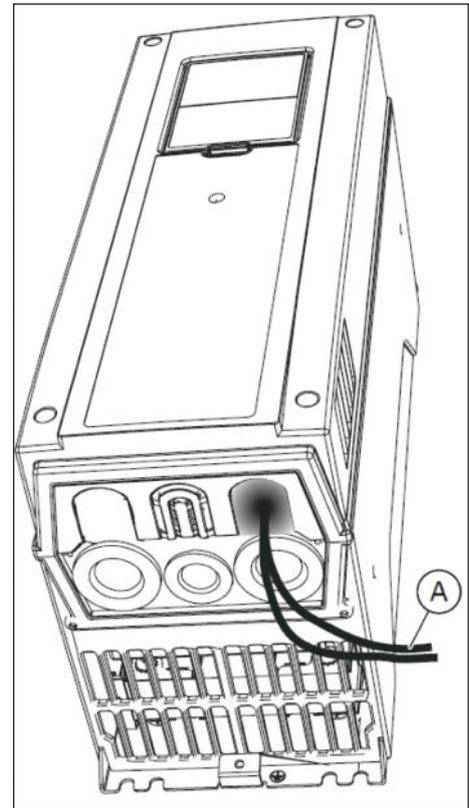


A. The fieldbus cables

7) Set the bus termination for the first and the last device of the fieldbus line. We recommend that the first device on the fieldbus is the master device.
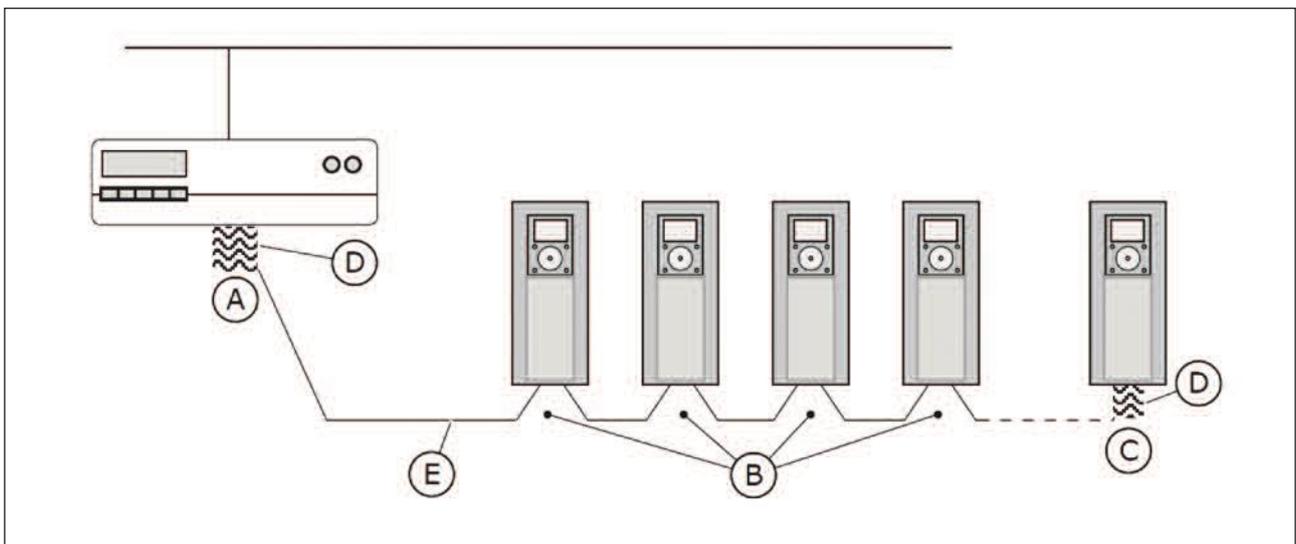


A.  The termination is activated          C.  The termination is activated with a DIP switch
B.  The termination is deactivated        D.  The bus termination. The resistance is 220 Ω.

E.  The fieldbus

**NOTE!**

If you do power-down to the last device, there is no bus termination.


### 4.7.5  INSTALLATION OF OPTION BOARDS

**CAUTION!**

Do not install, remove, or replace option boards on the drive when the power is on.
Doing this can cause damage to the boards.
Install the option boards into the option board slots of the drive. Refer to Table 4.24.

Table 4.24: The option boards and their correct option board slots

| Type of the option board | Description of the option board | The correct slot or slots |
|---|---|---|
| OPTB1 | The I/O expander board | E |
| OPTB2 | The Thermistor relay board | E |
| OPTB4 | The I/O expander board | E |
| OPTB5 | The Relay board | E |
| OPTB9 | The I/O expander board | E |
| OPTBF | The I/O expander board | E |
| OPTBH | The Temperature measurement board | E |
| OPTBJ | The Safe Torque Off board | E |
| OPTC4 | The LonWorks fieldbus board | E |
| OPTE3 | The Profibus DPV1 fieldbus board | E |
| OPTE5 | The Profibus DPV1 fieldbus board (with a type D connector) | E<br>E |
| OPTE6 | The CanOpen fieldbus board | E |
| OPTE7 | The DeviceNet fieldbus board | E |

## THE INSTALLATION PROCEDURE

1) Open the cover of the AC drive.

⚠️ **WARNING!**
Do not touch the relay outputs or the I/O terminals without measuring that there is no voltage in the terminals. They can have a dangerous voltage also when the drive is disconnected from mains.
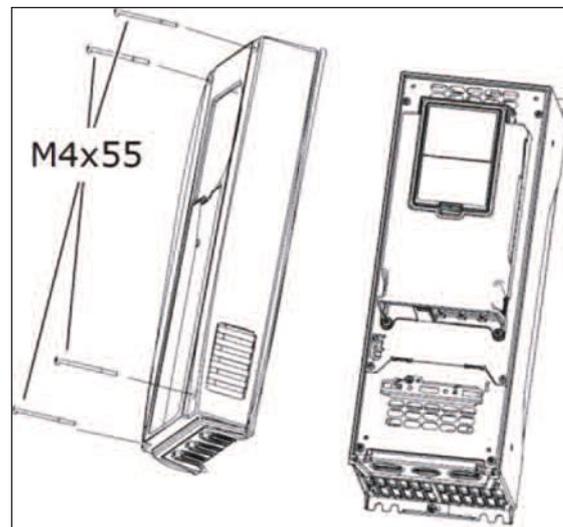
2) If you have an OPTB or an OPTC option board, make sure that the label on it says "dv" (dual voltage). This shows that the option board is compatible with the drive.

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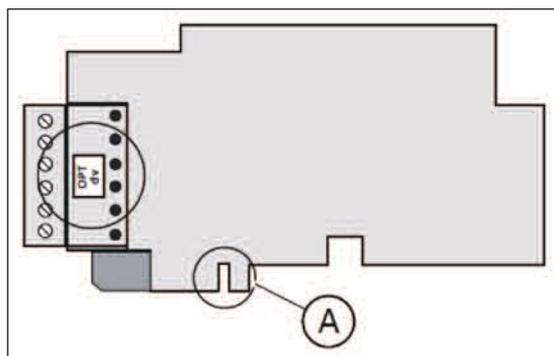


A. The slot coding

3) To get access to the option board slots, open the cover of the control unit.
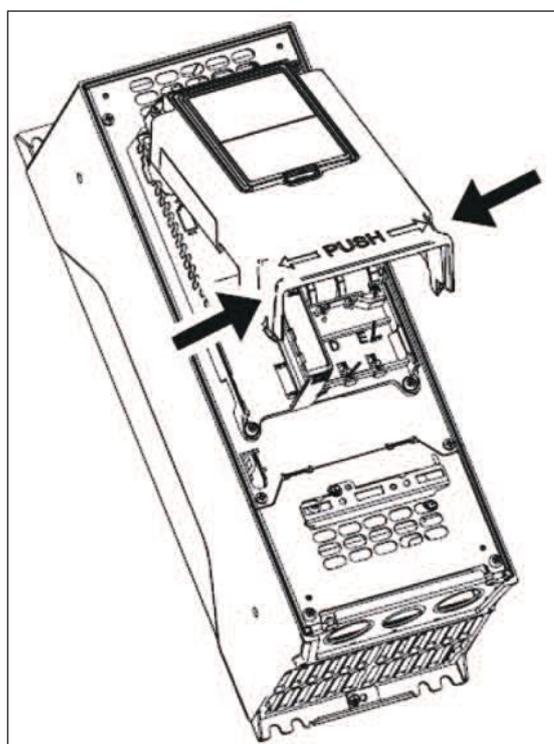
4) Install the option board into the correct slot: C, D or E. See
   Table 4.24.

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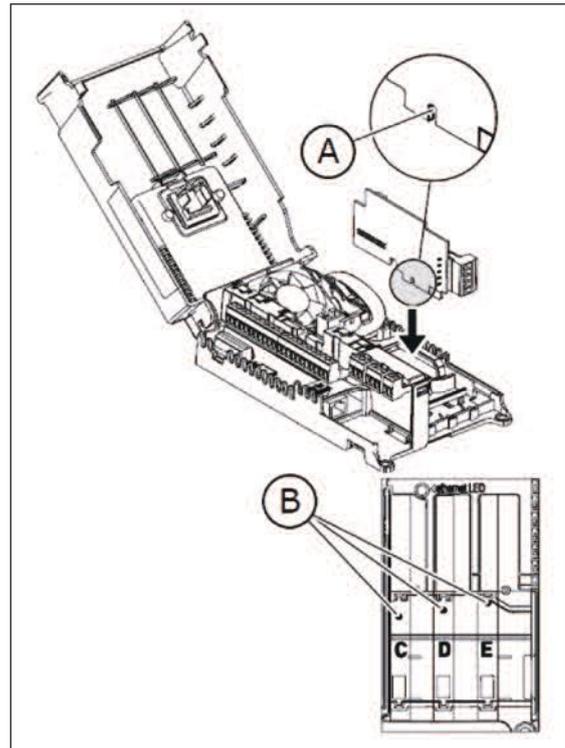


A. The slot coding        B. The option board slots

5) Close the cover of the control unit. Put the cover of the AC drive back.

### 4.7.6   GALVANIC ISOLATION BARRIERS

The control connections are isolated from mains. The GND terminals are permanently connected to I/O ground.
The digital inputs on the standard I/O board can be galvanically isolated from the I/O ground. To isolate the digital inputs, use
the DIP switch that has the positions FLOAT and GND.
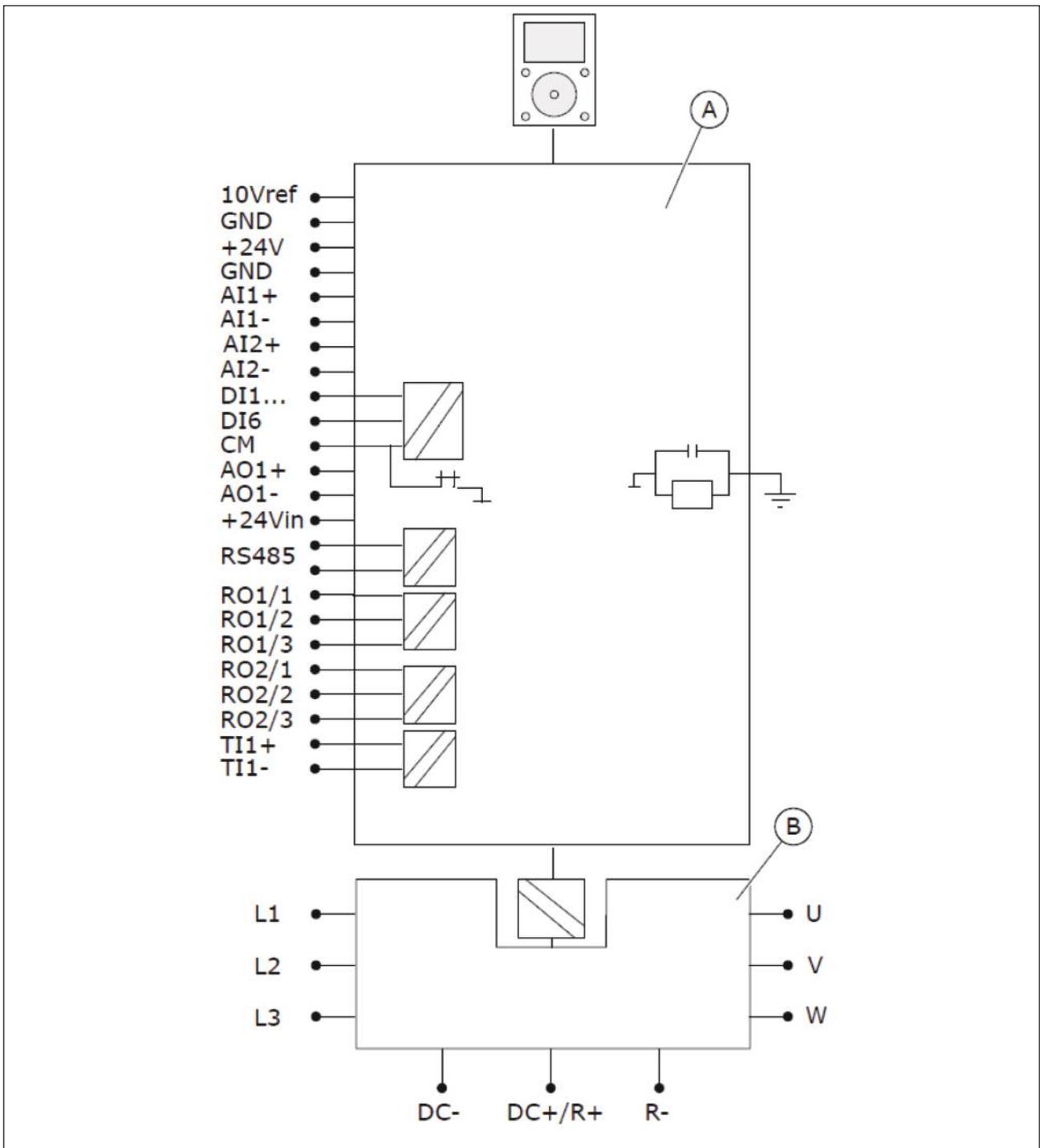
Fig. 4.23: The galvanic isolation barriers

A. The control unit            B. The power unit

## 4.8  COMMISSIONING AND ADDITIONAL INSTRUCTIONS

### 4.8.1  COMMISSIONING SAFETY

Before you start the commissioning, read these warnings.

> **WARNING!**
> Do not touch the internal components or the circuit boards of the drive when the drive is connected to mains. These components are live. A contact with this voltage is very dangerous. The galvanically isolated I/O terminals are not live.

> **WARNING!**
> Do not touch the motor terminals U, V, W or the brake resistor terminals when the drive is connected to mains. These terminals are live when the drive is connected to mains, also when the motor does not operate.

> **WARNING!**
> Do not make connections to or from the AC drive when it is connected to mains. There is a dangerous voltage.

> **WARNING!**
> To do work on the connections of the drive, disconnect the drive from mains. Wait 5 minutes before you open the cover of the drive. Then use a measuring device to make sure that there is no voltage. The connections of the drive are live 5 minutes after it is disconnected from mains.

> **WARNING!**
> Do not touch the relay outputs or other I/O terminals than the control I/O terminals. They can have a dangerous voltage also when the drive is disconnected from mains.

> **WARNING!**
> Before you connect the drive to mains, make sure that the front cover and the cable cover of the drive are closed. The connections of the AC drive are live when the drive is connected to mains.

### 4.8.2  COMMISSIONING OF THE DRIVE

Read the safety instructions in chapters 1 Safety and 4.8.1 Commissioning safety and obey them.

**After the installation:**

- Make sure that the motor is installed correctly.
- Make sure that the motor terminals are not connected to mains.
- Make sure that the AC drive and the motor are grounded.
- Make sure that you select the mains cable, the brake cable, and the motor cable correctly (see chapter 4.6.3 Cable dimensioning and selection).
- Make sure that the control cables are as far as possible from the power cables. See chapter 4.6.6 Cable installation.
- Make sure that the shields of the shielded cables are connected to an earth terminal that is identified with   .
- Do a check of the tightening torques of all the terminals.
- Make sure that no power correction capacitors are connected to the motor cable.
- Make sure that the cables do not touch the electrical components of the drive.
- Make sure that the common inputs of the digital input groups are connected to +24 V or ground of the I/O terminal or the external power source.
- Do a check of the quality and quantity of the cooling air. See chapter 4.5 Cooling and Table 4.9 The necessary quantity of cooling air.
- Make sure that there is no condensation on the inner surfaces of the AC drive.
- Make sure that there are no unwanted objects in the installation space.
- Before you connect the drive to mains, do a check of the installation and the condition of all the fuses and other protective devices.

### 4.8.3 OPERATION OF THE MOTOR

#### 4.8.3.1 MEASURING THE CABLE AND MOTOR INSULATION

The insulation checks of the motor cable

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

### The insulation checks of the mains cable

1) Disconnect the mains cable from the terminals L1, L2, and L3 and from mains.
2) Measure the insulation resistance of the mains cable between phase conductors 1 and 2, between phase conductors 1 and 3, and between phase conductors 2 and 3.
3) Measure the insulation resistance between each phase conductor and the earth conductor.
4) The insulation resistance must be >1 MΩ at the ambient temperature of 20 °C (68 °F).

### The insulation checks of the motor

1) Disconnect the motor cable from the motor.
2) Open the bridging connections in the motor connection box.
3) Measure the insulation resistance of each motor winding. The voltage must be the same or higher than the motor nominal voltage, but not higher than 1000 V.
4) The insulation resistance must be >1 MΩ at the ambient temperature of 20 °C (68 °F).
5) Obey the instructions of the motor manufacturer.

### 4.8.4 INSTALLATION IN AN IT SYSTEM

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

**WARNING!**
Do not make changes in the AC drive when it is connected to mains. The components of the drive are live when the drive is connected to mains.

**CAUTION!**
Before you connect the AC drive to mains, make sure that the EMC level of the drive is correct. An incorrect EMC level can cause damage to the drive.

#### 4.8.4.1 FRAME MR6

Change the EMC protection of the AC drive to level C4.

1) Open the cover of the AC drive.

2) Find the EMC jumpers that connect the RFI filters to ground.

MR6
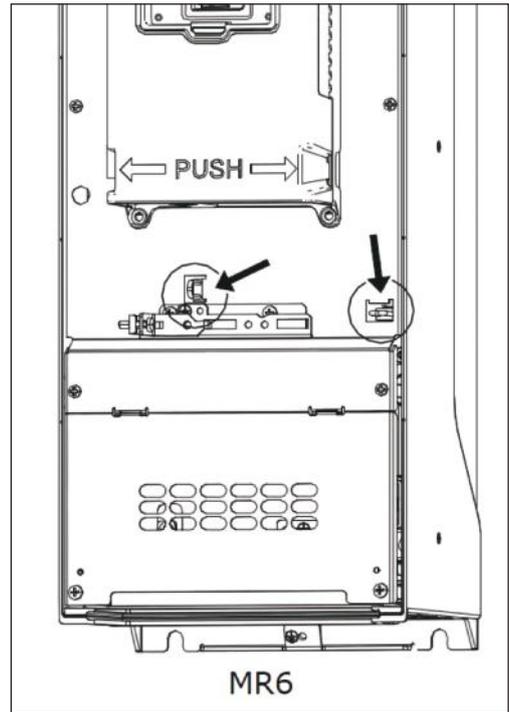
3) To disconnect the RFI filters from ground, remove the EMC jumpers.
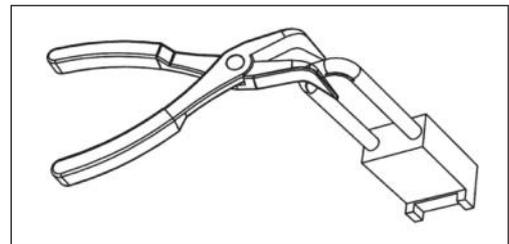
4) After the change, write "The EMC level was changed" and the date on the "product changed" label. If the label is not attached at this time, attach it on the drive near the name plate.

**Product modified**
Date: ...............
Date: ...............
Date: ...............
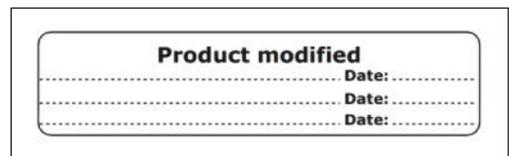
#### 4.8.4.2    FRAMES MR7 AND MR8

Change the EMC protection of the AC drive to level C4.

1) Open the cover of the AC drive.

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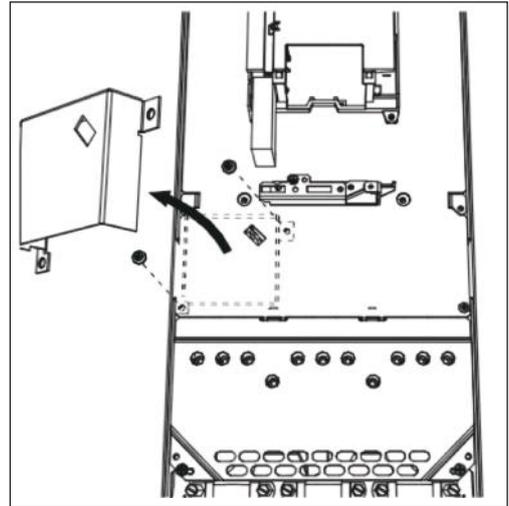


3) Remove the EMC jumper. Attach the cover of the EMC box again.
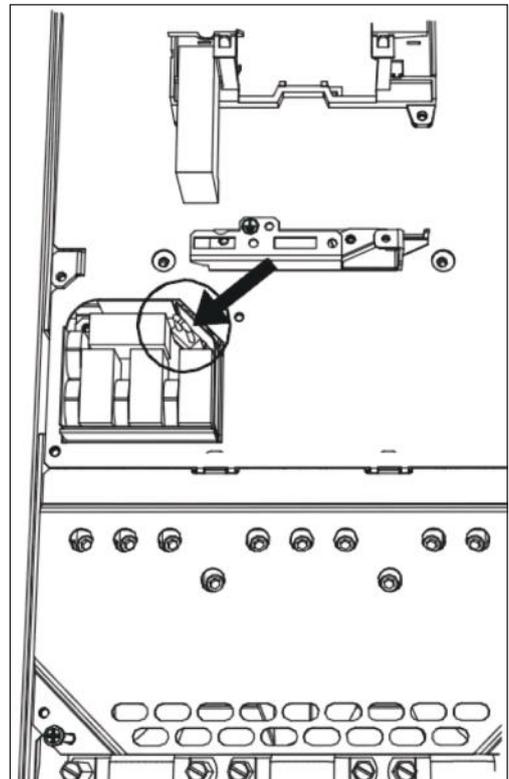
4) In MR7, find the DC grounding busbar between the connectors
   R - and U. To remove the busbar from the frame, remove the M4 screw.
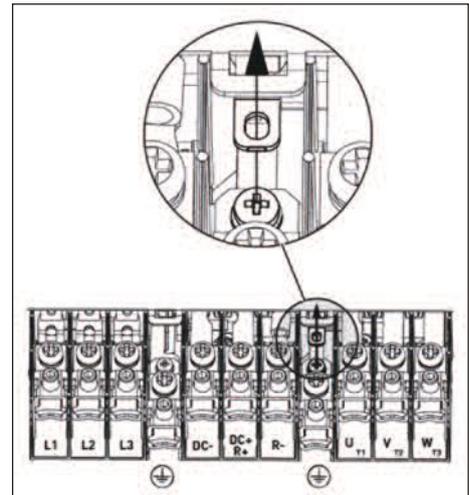
5) In MR8, find the grounding arm and push it down.
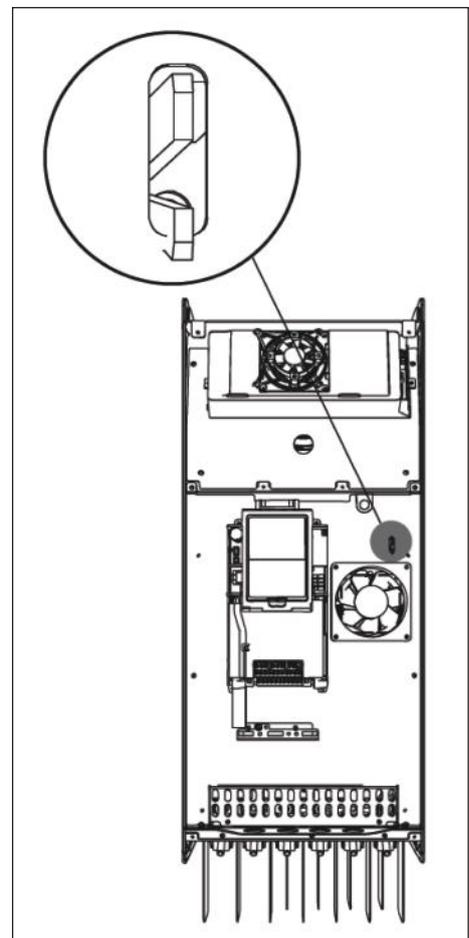
6) After the change, write "The EMC level was changed" and the date
   on the "product changed" label. If the label is not attached at this time,
   attach it on the drive near the name plate.

**Product modified**

Date:
Date:
Date:

### 4.8.4.3 FRAME MR9

To make a change in the EMC protection of the AC drive, you must find the 3 EMC jumpers. To change the EMC level from C2 to C4, remove the EMC jumpers. To change the EMC level from C4 to C2, install the EMC jumpers. You can find the EMC jumpers, which are not installed, in the accessories bag.

### HOW TO FIND THE EMC JUMPER 1

1) Open the cover of the AC drive.
2) Remove the cover of the fan.
3) In IP54, also remove the fan.
4) Find the place of the jumper behind the fan.
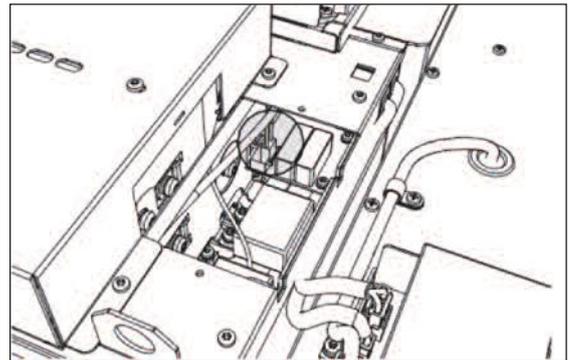


5) If you change the EMC level, write "The EMC level was changed" and the date on the "product changed" label. If the label is not attached at this time, attach it on the drive near the name plate.
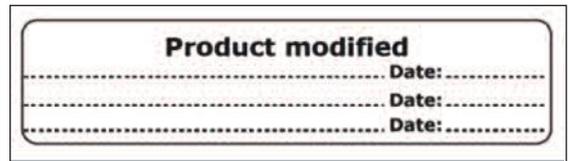


### HOW TO FIND THE EMC JUMPERS 2 AND 3

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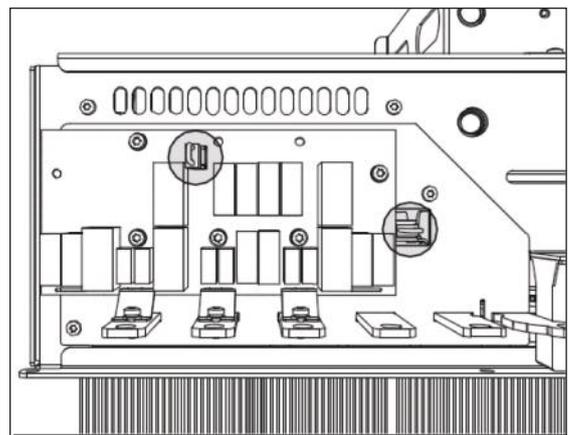


3) If you change the EMC level, write "The EMC level was changed" and the date on the "product changed" label. If the label is not attached at this time, attach it on the drive near the name plate.
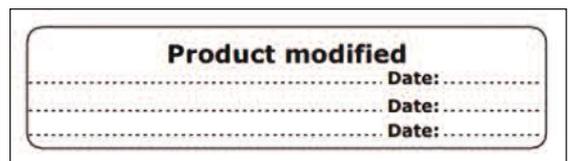
# 5. FAULT TRACING

When a fatal fault is detected by the frequency converter control electronics, the drive will stop and the symbol FT and the fault code blinked on the display are in the following format, e.g.:

FT 2

Fault code (2 = over voltage)

The active fault can be reset by pressing BACK / RESET button when the API is in active fault menu level (FT XX), or pressing BACK / RESET button with long time (〉 2 s) when the API is in active fault submenu level (F5.x ), or via the I / O terminal or field bus. Reset fault history (long push 〉 5 s), when the API is in fault history submenu level (F6.x). The faults with subcode and time labels are stored in the Fault history submenu which can be browsed. The different fault codes, their causes and correcting
actions are presented in the table below.

| Fault code | Fault ID | Fault name | Possible cause | How to correct the fault |
|---|---|---|---|---|
| 1 | 1 | Overcurrent (Hardware fault) | There is too high a current (〉4*I H) in the motor cable. Its cause can be 1 of these. • a sudden heavy load increase • a short circuit in the motor cables • the motor is not the correct type • the parameter settings are not properly made | Do a check of the loading. Do a check of the motor. Do a check of the cables and connections. Make an identification run. Set the acceleration time longer |
| | 2 | Overcurrent (Software fault) | | |
| 2 | 10 | Overvoltage (hardware fault) | The DC-link voltage is higher than the limits. • too short a deceleration time • high overvoltage spikes in the supply | Set the deceleration time longer. Use the brake chopper or the brake resistor. They are available as options. Activate the over-voltage controller. Do a check of the input voltage. |
| | 11 | Overvoltage (software fault) | | |
| 3 | 20 | Earth fault (hardware fault) | The measurement of current tells that the sum of the motor phase current is not zero. • an insulation malfunction in the cables or the motor • a filter (du/dt, sinus) malfunction | Do a check of the motor cables and the motor. Do a check of the filters. |
| | 21 | Earth fault (software fault) | | |

Table 5.1: Fault codes

| Fault code | Fault ID | Fault name | Possible cause | How to correct the fault |
|---|---|---|---|---|
| 5 | 40 | Charging switch | The charging switch is closed and the feed-back information is OPEN.<br>• operation malfunction<br>• defective component | Reset the fault and restart the drive. Do a check of the feedback signal and the cable connection between the control board and the power board. If the fault occurs again, ask instructions from the distributor near to you. |
| 7 | 60 | Saturation | • Defective IGBT<br>• de-saturation short circuit in the IGBT<br>• a short circuit or an overload in the brake resistor | This fault cannot be reset from the control panel. Switch off the power. DO NOT RESTART THE DRIVE or CONNECT THE POWER! Ask instructions from the factory. |
| 8 | 600 | System fault | There is no communication between the control board and the power. | Reset the fault and restart the drive. Update the drive with the latest software. If the fault occurs again, ask instructions from the distributor near to you. |
|  | 601 |  |  |  |
|  | 602 |  | Defective component.<br>Operation malfunction. |  |
|  | 603 |  | Defective component.<br>Operation malfunction.<br>The voltage of auxiliary power in the power unit is too low. |  |
|  | 604 |  | Defective component.<br>Operation malfunction.<br>Output phase voltage does not agree to the reference.<br>Feedback fault. |  |
|  | 605 |  | Defective component.<br>Operation malfunction. |  |
|  | 606 |  | The software of the control unit is not compatible with the software of the power unit. |  |
|  | 607 |  | The software version cannot be read.<br>There is no software in the power unit.<br>Defective component.<br>Operation malfunction (a problem in the power board or the measurement board). |  |
|  | 608 |  | A CPU overload. |  |
|  | 609 |  | Defective component<br>Operation malfunction. | Reset the fault and make a power down of the drive twice. Update the drive with the latest software. |

Table 5.1: Fault codes

| Fault code | Fault ID | Fault name | Possible cause | How to correct the fault |
|---|---|---|---|---|
| 8 | 610 | System fault | Defective component. Operation malfunction. | Reset the fault and restart. Update the drive with the latest software. If the fault occurs again, ask instructions from the distributor near to you. |
| | 614 | | Configuration error. Software error. Defective component (a defective control board). Operation malfunction. | |
| | 647 | | Defective component. Operation malfunction. | |
| | 648 | | Operation malfunction. The system software is not compatible with the application. | |
| | 649 | | A resource overload. A parameter loading, restoring or saving malfunction. | Load the factory default settings. |
| 9 | 80 | Undervoltage (fault) | The DC-link voltage is lower than the limits. • too low a supply voltage • defective component • a defective input fuse • the external charge switch is not closed  **NOTE!** This fault becomes active only if the drive is in Run state. | If there is a temporary supply voltage break, reset the fault and restart the drive. Do a check of the supply voltage. If the supply voltage is sufficient, there is an internal fault. Examine the electrical network for fault. Ask instructions from the distributor near to you. |
| 10 | 91 | Input phase | • supply voltage malfunction • a defective fuse or malfunction in the supply cables  The load must be a minimum of 10-20% for the supervision to work. | Do a check of the supply voltage, the fuses and supply cable, the rectifying bridge and the gate control of the thyristor (MR6->). |
| 11 | 100 | Output phase supervision | The measurement of current tells that there is no current in 1 motor phase. • a motor or motor cables malfunction • filter (du/dt, sinus) malfunction | Do a check of the motor cable and the motor. Do a check of the du/dt or sinus filter. |

Table 5.1: Fault codes

| Fault code | Fault ID | Fault name | Possible cause | How to correct the fault |
|---|---|---|---|---|
| 12 | 110 | Brake chopper supervision (hardware fault) | There is no brake resistor. The brake resistor is broken. A defective brake chopper. | Do a check of the brake resistor and the cabling. If they are in good condition, there is a fault in the resistor or the chopper. Ask instructions from the distributor near to you. |
| | 111 | Brake chopper saturation alarm | | |
| 13 | 120 | AC drive undertemperature (fault) | Too low a temperature in the heatsink of the power unit or in the power board. | The ambient temperature is too low for the drive. Move the drive in a warmer position. |
| 14 | 130 | AC drive overtemperature (fault, heatsink) | Too high a temperature in the heatsink of the power unit or in the power board. The temperature limits of the heatsink are different in all the frames. | Do a check of the actual amount and flow of cooling air. Examine the heatsink for dust. Do a check of the ambient temperature. Make sure that the switching frequency is not too high in relation to the ambient temperature and the motor load. Do a check of the cooling fan. |
| | 131 | AC drive overtemperature (alarm, heatsink) | | |
| | 132 | AC drive overtemperature (fault, board) | | |
| | 133 | AC drive overtemperature (alarm, board) | | |
| 15 | 140 | Motor stall | The motor stalled. | Do a check of the motor and the load. |
| 16 | 150 | Motor overtemperature | There is too heavy a load on the motor. | Decrease the motor load. If there is no motor overload, do a check of the motor thermal protection parameters. |
| 17 | 160 | Motor underload | There is not a sufficient load on the motor. | Check motor and load. e.g. for broken belts or dry pumps. |
| 19 | 180 | Power overload (short-time supervision) | The power of the drive is too high. | Decrease the load. Examine the dimensions of drive. Examine if it is too small for the load. |
| | 181 | Power overload (long-time supervision) | | |

Table 5.1: Fault codes

| Fault code | Fault ID | Fault name | Possible cause | How to correct the fault |
|---|---|---|---|---|
| 22 | - | EEPROM checksum fault | Parameter save error<br>- faulty operation<br>- componenet failure | Contact the distributor near to you. |
| 25 | 240 | Motor control fault) | This fault is available only if you use a customer-specific application. A malfunction in the start angle identification.<br>• The rotor moves during identification.<br>• The new angle does not agree with the old value. | Reset the fault and restart the drive. Increase the identification current. See the fault history source for more information. |
|  | 241 |  |  |  |
| 26 | 250 | Start-up prevented | It is not possible to do a start-up of the drive. When the Run request is ON, a new software (a firmware or an application), a parameter setting or other file that effects the operation of the drive, is loaded to drive. | Reset the fault and stop the drive.<br>Load the software and start the drive. |
| 27 | - | Back EMF protection | Drive has detected that the magnetized motor is running in start situation.<br>- A rotating PM-motor | Make sure that there is no rotating PM-motor when the start command is given. |
| 29 | 280 | Thermistor fault | The thermistor input of option board has detected increase of the motor temperature. | Check motor cooling and loading. Check thermistor connection (if thermistor input of the option board is not in use it has to be short circuit). |
| 32 | 311 | Fan cooling | The fan speed does not agree to the speed reference accurately, but the drive operates correctly.This fault shows only in the MR7 and in the drives that bigger than MR7. | Reset the fault and restart the drive. Clean or replace the fan. |
|  | 312 | Fan cooling | The fan life time (that is, 50,000h) is complete. | Replace the fan and reset the life time counter of the fan. |
| 34 | - | Internal bus communication | Ambient interference or defective hardware | If the fault re-occur, contact the distributor near to you. |
| 35 | - | Application fault | Application is not working correctly. | Contact the distributor near to you. |

Table 5.1: Fault codes

| Fault code | Fault ID | Fault name | Possible cause | How to correct the fault |
|---|---|---|---|---|
| 37 | 361 | Device changed | The power unit was replaced by a new one that has the same size. The device is ready to be used. The parameters are available in the drive. | Reset the fault. The drive reboots after you reset the fault. |
| | 362 | Device changed | The option board in slot B was replaced by a new one that you have used before in the same slot. The device is ready to be used. | Reset the fault. The drive starts to use the old parameter settings. |
| | 363 | Device changed | The same cause as in ID362, but refers to Slot C. | |
| | 364 | Device changed | The same cause as in ID362, but refers to Slot D. | |
| | 365 | Device changed | The same cause as in ID362, but refers to Slot E. | |
| 38 | 372 | Device added | An option board was put into slot B. You have used the option board before in the same slot. The device is ready to be used. | The device is ready for use. The drive starts to use the old parameter settings. |
| | 373 | Device added | The same cause as in ID372, but refers to Slot C. | |
| | 374 | Device added | The same cause as in ID372, but refers to Slot D. | |
| | 375 | Device added | The same cause as in ID372, but refers to Slot E. | |
| 39 | 382 | Device removed | An option board was removed from slot A or B. | The device is not available. Reset the fault. |
| | 383 | Device removed | The same cause as in ID382, but refers to Slot C. | |
| | 384 | Device removed | The same cause as in ID382, but refers to Slot D. | |
| | 385 | Device removed | The same cause as in ID382, but refers to Slot E. | |

Table 5.1: Fault codes

| Fault code | Fault ID | Fault name | Possible cause | How to correct the fault |
|---|---|---|---|---|
| 40 | 390 | Device unknown | An unknown device was connected (the power unit/option board) | The device is not available. If the fault occurs again, ask instructions from your nearest distributor. |
| 41 | 400 | IGBT temperature | The calculated IGBT temperature is too high.<br><br>• too high a motor load<br>• too high an ambient temperature<br>• hardware malfunction | Do a check of the parameter settings. Examine the actual amount and flow of cooling air. Do a check of the ambient temperature. Examine the heatsink for dust. Make sure that the switching frequency is not too high in relation to the ambient temperature and the motor load. Do a check of the cooling fan. Make an identification run. |
| 44 | 431 | Device changed | There is a new power unit of a different type. Parameters are not available in the settings. | Reset the fault. The drive reboots after you reset the fault. Set the power unit parameters again. |
| | 433 | Device changed | The option board in slot C was replaced by a new one that you have not used before in the same slot. No parameter settings are saved. | Reset the fault. Set the option board parameters again. |
| | 434 | Device changed | The same cause as in ID433, but refers to Slot D. | |
| | 435 | Device changed | The same cause as in ID433, but refers to Slot E. | |
| 45 | 441 | Device added | There is a new power unit of a different type. Parameters are not available in the settings. | Reset the fault. The drive reboots after you reset the fault. Set the power unit parameters again. |
| | 443 | Device added | A new option board, that you have not used before in the same slot, was put in slot C. No parameter settings are saved. | Set the option board parameters again. |
| | 444 | Device added | The same cause as in ID443, but refers to Slot D. | |
| | 445 | Device added | The same cause as in ID443, but refers to Slot E. | |

Table 5.1: Fault codes

| Fault code | Fault ID | Fault name | Possible cause | How to correct the fault |
|---|---|---|---|---|
| 47 | 663 | Software updated | The software of the drive was updated, the full software package or an application. | No steps are necessary. |
| 50 | 1050 | AI low fault | 1 or more of the available analogue input signals is below 50% of the minimum signal range. A control cable is defective or loose. A malfunction in a signal source. | Replace the defective parts. Do a check of the analogue input circuit. Make sure that parameter AI1 Signal Range is set correctly. |
| 51 | 1051 | Device external fault | The digital input signal that is set with external fault was activated. | This is a user-defined fault. Do a check of the digital inputs and schematics. |
| 52 | 1052 | Keypad communication fault | The connection between the control panel and the drive is defective. | Do a check of the control panel connection and the control panel cable. |
| | 1352 | | | |
| 53 | 1053 | Fieldbus communication fault | The data connection between the fieldbus master and the fieldbus board is defective. | Do a check of the installation and fieldbus master. |
| 54 | 1354 | Slot A fault | A defective option board or slot | Do a check of the board and the slot. Ask instructions you're your nearest distributor. |
| | 1454 | Slot B fault | | |
| | 1554 | Slot C fault | | |
| | 1654 | Slot D fault | | |
| | 1754 | Slot E fault | | |
| 55 | - | Wrong run fault | Run forward and backward are high at the same time. | Check I/O control signal 1 and I/O control signal 2 |
| 57 | 1057 | Identification | There was a failure in the identification run. | Make sure that the motor is connected to the drive. Make sure that there is no load on the motor shaft. Make sure that the start command is not removed before the identification run is complete. |
| 58 | 1058 | Mechanical brake | The actual status of the mechanical brake is different from the control signal for longer than the value of P3.20.6. | Do a check of the status and connections of the mechanical brake. See parameter P3.5.1.44 and parameter Group 3.20: Mechanical brake. |
| 63 | 1063 | Quick Stop fault | The Quick stop function is activated | Find the cause for the quick stop activation. After you find it, correct it. Reset the fault and restart the drive. |
| | 1363 | Quick Stop alarm | | |

Table 5.1: Fault codes

| Fault code | Fault ID | Fault name | Possible cause | How to correct the fault |
|---|---|---|---|---|
| 65 | 1065 | PC communication fault | The data connection between the PC and the drive is defective | Do a check of the installation, cable and terminals between the PC and the drive. |
| 66 | 1366 | Thermistor input 1 fault | The motor temperature increased. | Do a check of the motor cooling and the load. Do a check of the thermistor connection. If the thermistor input is not used, you have to short-circuit it. Ask instructions from your nearest distributor |
| | 1466 | Thermistor input 2 fault | | |
| | 1566 | Thermistor input 3 fault | | |
| 68 | 1301 | Maintenance counter 1 alarm | The value of the maintenance counter is higher than the alarm limit. | Do the necessary maintenance. Reset the counter. |
| | 1302 | Maintenance counter 1 fault | The value of the maintenance counter is higher than the fault limit. | |
| | 1303 | Maintenance counter 2 alarm | The value of the maintenance counter is higher than the alarm limit. | |
| | 1304 | Maintenance counter 2 fault | The value of the maintenance counter is higher than the fault limit. | |
| 69 | 1310 | Fieldbus communication fault | The ID number that is used to map the values to Fieldbus Process Data Out is not valid. | Do a check of the parameters in the Fieldbus Data Mapping menu. |
| | 1311 | | It is not possible to convert 1 or more values for Fieldbus Process Data Out. | The type of the value is undefined. Do a check of the parameters in the Fieldbus Data Mapping menu. |
| | 1312 | | There is an overflow when the values for Fieldbus Process Data Out (16-bit) are mapped and converted. | Do a check of the parameters in the Fieldbus Data Mapping menu. |
| 76 | 1076 | Start prevented | The start command is blocked to prevent the accidental rotation of the motor during the first power-up. | Reset the drive to start the correct operation. The parameter settings tell if it is necessary to restart the drive. |
| 77 | 1077 | ⟩5 connections | There are more than 5 active fieldbus or PC tool connections. You can use only 5 connections at the same time. | Leave 5 active connections. Remove the other connections. |

Table 5.1: Fault codes

| Fault code | Fault ID | Fault name | Possible cause | How to correct the fault |
|---|---|---|---|---|
| 100 | 1100 | Soft fill timeout | There is a timeout in the Soft fill function in the PID controller. The process value was not achieved in the time limit. A pipe that broke can be the cause. | Do a check of the process. Do a check of the parameters for the soft fill timeout |
| 101 | 1101 | Feedback supervision fault (PID1) | The PID controller: the feedback value is not in the supervision limits and the delay. | Do a check of the process. Do a check of the parameter settings, the supervision limits and the delay. |
| 105 | 1105 | Feedback supervision fault (ExtPID) | The external PID controller: the feedback value is not in the supervision limits and the delay. | |
| 109 | 1109 | Input pressure supervision | The supervision signal of the input pressure is lower than the alarm limit. | Do a check of the process. Do a check of the parameters for input pressure. Do a check of the input pressure sensor and connections. |
| | 1409 | | The supervision signal of the input pressure is lower than the fault limit. | |
| 111 | 1315 | Temperature fault 1 | 1 or more of the temperature input signals is higher than the alarm limit. | Find the cause of the temperature rise. Do a check of the temperature sensor and connections. If no sensor is connected, make sure that the temperature input is hardwired. See the option board manual for more data. |
| | 1316 | | 1 or more of the temperature input signals is higher than the fault limit. | |
| 112 | 1317 | Temperature fault 2 | 1 or more of the temperature input signals is higher than the fault limit.. | |
| | 1318 | | 1 or more of the temperature input signals is higher than the fault limit. | |
| 300 | 700 | Unsupported | The application is not compatible (it is unsupported).. | Replace the application. |
| | 701 | | The option board or the slot is not compatible (it is unsupported) | Remove the option board. |

Table 5.1: Fault codes

| F08 SubCode | Fault |
|---|---|
| 60 | Watchdog reset |
| 61 | SW stack overflow |
| 62 | HW stack overflow |
| 63 | Misalignment |
| 64 | Illegal op |
| 65 | PLL lost lock / Low CPU voltage |
| 66 | EEPROM Device |
| 67 | EEPROM Queue full |
| 68 | MPI communication (dead or CRC errors) |
| 70 | CPU load |

Table 5.2: Fault subcodes from power

| F08 SubCode | Fault |
|---|---|
| 71 | External oscillator |
| 72 | Fault in Power triggered by user |

Table 5.2: Fault subcodes from power

| F08 SubCode | Fault |
|---|---|
| 84 | MPI CRC |
| 86 | MPI2 CRC |
| 89 | HMI receive buffer overflow |
| 90 | MODBUS receive buffer overflow |
| 93 | Power source cannot be recognized (triggered as alarm) |
| 96 | MPI queue full |
| 97 | MPI off line error |
| 98 | MPI driver error |
| 99 | Option Board Driver Error |
| 100 | Option Board Configure Error |
| 104 | OBI channel full |
| 105 | OBI memory allocate fail |
| 106 | OBI object Queue full |
| 107 | OBI HMI queue full |
| 108 | OBI SPI queue full |
| 111 | Parameter copy error |
| 113 | Frequency detective timer overflow |
| 114 | PC control time out error |
| 115 | Device Property data format tree too deep exceed 3 |
| 120 | Task stack overflow |

Table 5.3: Fault Subcodes from control API

| F22 SubCode | Fault |
|---|---|
| 1 | DA_CN, Power down data counter error |
| 2 | DA_PD, Power down data restore fail |
| 3 | DA_FH, Fault history data error |

Table 5.4: Fault subcodes

| F22 SubCode | Fault |
|:---:|---|
| 4 | DA_PA, Restore parameter CRC error |
| 5 | Reserved |
| 6 | DA_PER_CN, Persist data counter error |
| 7 | DA_PER_PD, Persist data restore fail |

Table 5.5: Fault subcodes

| F35 SubCode | Fault |
|:---:|---|
| 1 | Application software flash error |
| 2 | Application header error |

Table 5.6: Fault subcodes

# 6. CONTROL PANEL

## 6.1 General

The panel is an irremovable part of the drive consisting of corresponding control board; The overlay with display status on the cover and the button are in clarifications in the user language.
The User Panel consists of an alphanumeric LCD display with backlight and a keypad with the 9 push buttons (see Figure 6.1).

## 6.2 Display

### 6.2.1 MI frame

The display includes 14-segment and 7-segment blocks, arrowheads and clear text unit symbols. The arrowheads, when visible, indicate some information about the drive, which is printed in clear text in user language on the overlay (numbers 1...14 in the figure below). The arrowheads are grouped in 3 groups with the following meanings and English overlay texts (see Figure 6.1-1):

Group 1 - 5; Drive status

   1= Drive is ready to start (READY)
   2= Drive is running (RUN)
   3= Drive has stopped (STOP)
   4= Alarm condition is active (ALARM)
   5= Drive has stopped due to a fault (FAULT)

Group 6 - 10; Control selections
When API is operated by PC control, there are no arrowhead at I / O, KEYPAD and BUS.

   6= Motor is rotating forward (FWD)
   7= Motor is rotating reverse (REV)
   8= I/O terminal block is the selected control place (I / O)
   9= Keypad is the selected control place (KEYPAD)
   10= Fieldbus is the selected control place (BUS)

Group 11 - 14; Navigation main menu

   11= Reference main menu (REF)
   12= Monitoring main menu (MON)
   13= Parameter main menu (PAR)
   14= System main menu (SYS)

### 6.2.2 MR frame

The display includes 10-segment, two text line, arrowheads and general text unit symbols. The arrowheads indicate some information about the drive. The arrowheads are grouped in 3 groups as follows (see Figure 6.1-2):

Group 1 - 5; Drive status

   1 = Drive is ready to start (READY)
   2 = Drive is running (RUN)
   3 = Drive has stopped (STOP)
   4 = Alarm condition is active (ALARM)
   5 = Drive has stopped due to a fault (FAULT)

Group 6 - 10; Control selections

When the drive's controller is operated by PC control, there is no arrowhead on KEYPAD.

    6 = Motor is rotating forward (FWD)
    7 = Motor is rotating reverse (REV)
    8 = I/O terminal block is the selected control place (I / O)
    9 = Keypad is the selected control place (KEYPAD)
    10 = Fieldbus is the selected control place (BUS)

Text display Group ; Navigation main menu

    M1 = Monitoring menu (MONITOR)
    M2 = Parameters menu (PARAMETERS)
    M3 = Diagonostics menu (DIAGNOSTICS)
    M4 = I/O and hardware menu (I/O AND HARDWARE)
    M5 = User settings (USER SETTING)
    M7 = User Levels
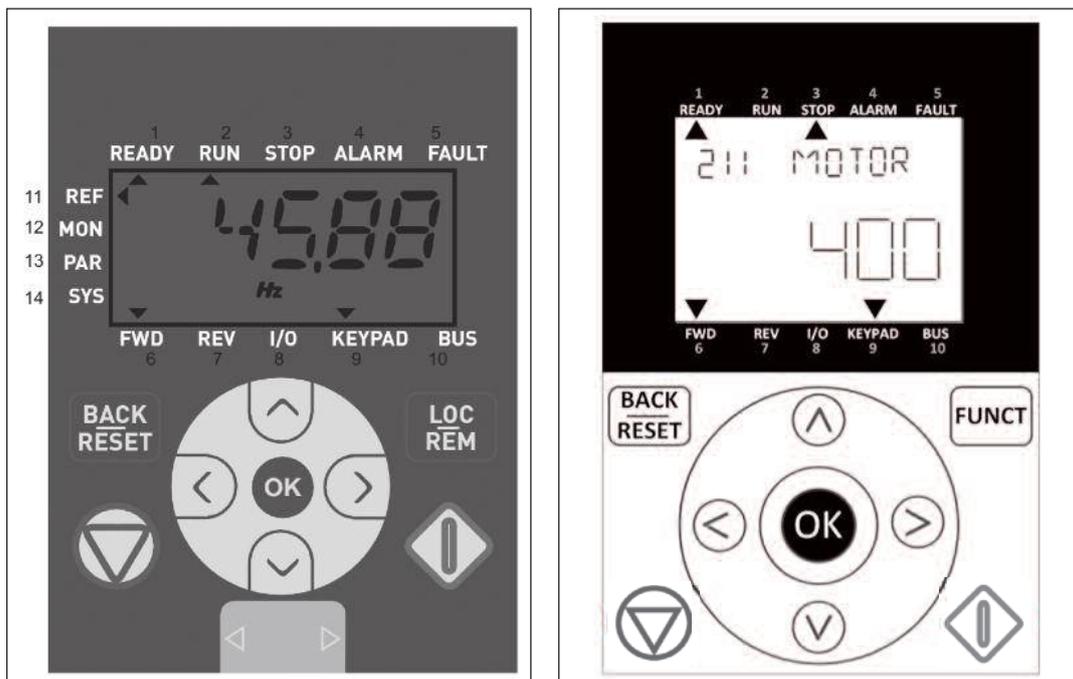


Figure 6.1–1 Control panel for the MI frame   Figure 6.1–2  Control nale for the MR frame

## 6.3  Keypad

The keypad section of the control panel consists of 9 buttons (see Figure 6.1–1 and 6.1–2). The buttons and their functions are described as Table 6.1.

The drive stops by pressing the keypad STOP button, regardless of the selected control place when Par. 2.7 (Keypad stop button) is 1 in the MI frame, and Par. 2.2.7 (Keypad stop button) is 1 in the MR frame. If Par. 2.7 is 0 in the MI frame, and Par. 2.2.7 is 0 in the MR frame, the drive stops by keypad STOP button only when control place is keypad. The drive starts by pressing the keypad START button when the selected control place is KEYPAD or LOCAL control.

| Symbol | Button Name | Function Description |
|--------|-------------|---------------------|
| ◇ | START | Motor START from the panel |
| ▽ | STOP | Motor STOP from the panel |
| OK | OK | Used for confirmation.Enter edit mode for parameter. Alternate in display between the parameter value and parameter code.<br>Reference frequency value adjusting no need to press OK-button to confirm. |
| BACK RESET | Back / Reset | Cancels edited parameter Move backwards in menu levels Reset fault indication. |
| ∧ ∨ | UP and Down | Select root parameter number on rootparameter list, Up decrease / Down increase parameter number, Up increase / Down decrease parameter value change. |
| ‹ › | Left and Right | Available in REF,PAR and SYS menu parameter digit setting when changing value.<br>MON,PAR and SYS can also use left and right button to navigate the parameter group, like e.g.,in MON menu use right button from V1.x to V2.x to V3.x.<br>Can be used to change direction in REF menu in local mode:<br>-Right arrow would mean reverse (REV)<br>-Left arrow would mean forward (FWD) |
| LOC REM | Loc / Rem<br>(There is only on the MI frame) | Change control place |
| FUNCT | FUNCTION<br>(There is only on the MR frame) | - LOCAL/REMOTE: Changing control palce<br>- CONTROL PAGE: frequency command<br>- CHANGE DIRECTION: Changing motor rotating direction |

Table 6.1: Keypad Function

⚠ NOTE! The status of all the 9 buttons are available for application program!

## 6.4 Navigation on the N800S MI frame

This chapter provides you with information on navigating the menus on N800S and editing the values of the parameters.

### 6.4.1 Main menu

The menu structure of N800S control software consists of a main menu and several submenus. Navigation in the main menu is shown below:

**REFERENCE MENU**
Dispalys the keypad reference value regardless of the selected control place.

**MONITORING MENU**
In this menu you can browse the monitoring values.

**PARAMETER MENU**
In this menu you can browse and edit the parameters.

**SYSTEM MENU**
Here you will be able to browse system parameter and fault submenu.



Figure 6.2: The main menu navigation on N800S MI frame
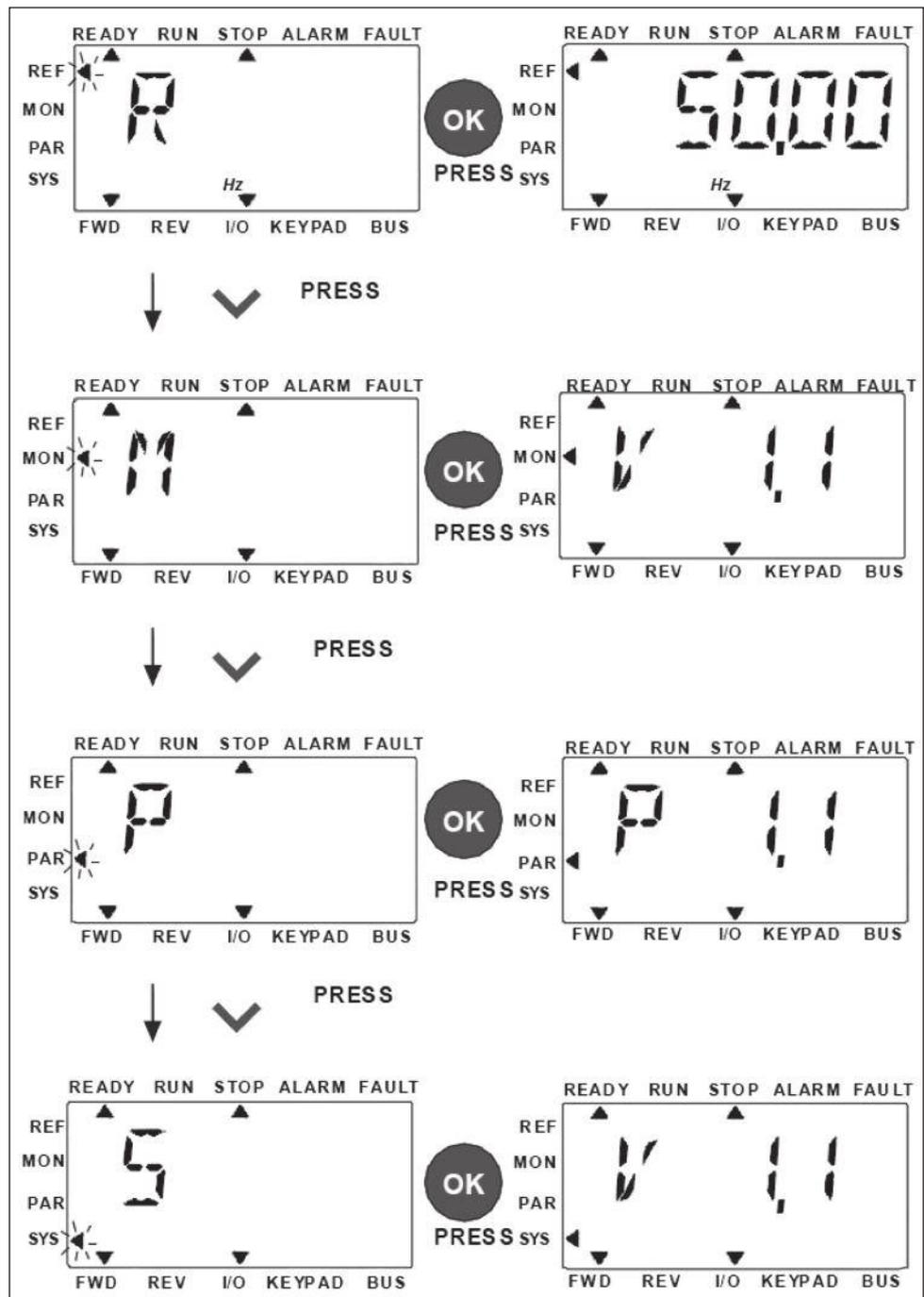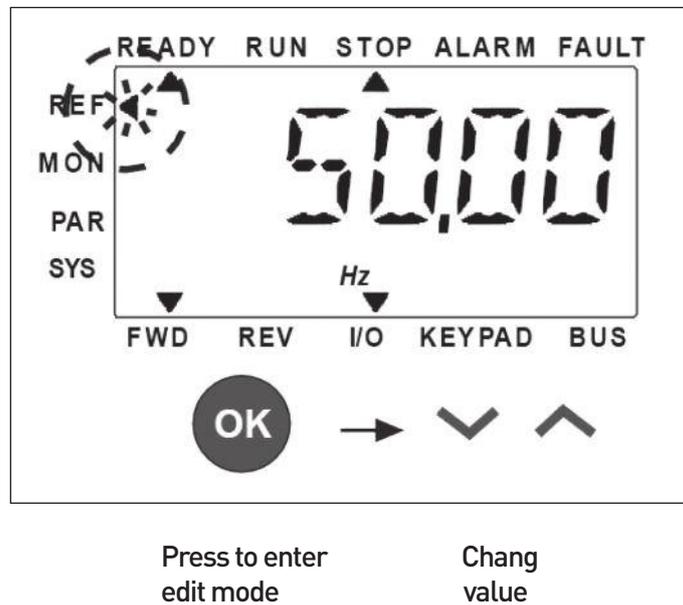
### 6.4.2   Reference menu



Figure 6.3: Reference menu display

Move to the reference menu with the UP / DOWN button (see Figure 6.2). The reference value can be changed with UP / DOWN button as shown in Figure 6.3.

If the value has big change, first press Left and Right buttons to select the digit which has to be changed, then press Up button to increase and Down button to decreases the value in the selected digit . The changing reference frequency will be taken into use immediately without pressing OK.

**Note!** LEFT and RIGHT buttons can be used to change the direction in Ref menu in local control mode.

### 6.4.3 Monitoring menu



1) Press OK to enter, Monitoring menu
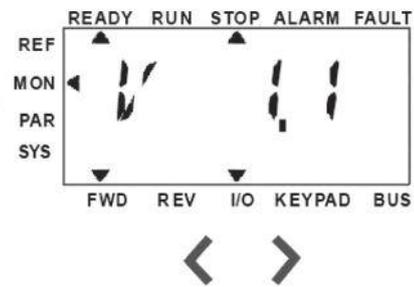


2) Press Left/Right to browse other Monitoring groups
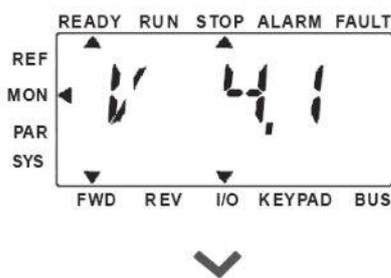


3) Press Down to browse V4.5



4) Press OK the value is displayed



5) Press OK V4.5 is display

Figure 6.4: Monitoring menu display

Monitoring values are actual values of measured signals as well as status of some control settings. It is visible in N800S display, but it can not be edited. The monitoring values are listed in Table 6.2.

Pressing Left/Right button to change the actual parameter to the first parameter of the next group, to browse monitor menu from V1.x to V2.1 to V3.1 to V4.1. After entering the desired group, the monitoring values can be browsed by pressing UP / DOWN button, as shown in Figure 6.4. In MON menu the selected signal and its value are alternateing in the display by pressing OK button.

**Note!** Turn on drive power, arrowhead of main menu is at MON, V x.x or monitor parameter value of Vx.x is displayed in Panel. Display Vx.x or monitor parameter value of Vx.x is determined by the last show status before power shut down. E.g., it was V4.5, and it is also V4.5 when restart.

| Code | Monitoring signal | Unit | ID | Description |
|------|-------------------|------|-----|-------------|
| V1.1 | Output frequency | Hz | 1 | Output frequency to motor |
| V1.2 | Frequency reference | Hz | 25 | Frequency reference to motor control |
| V1.3 | Motor speed | rpm | 2 | Calculated motor speed |
| V1.4 | Motor current | A | 3 | Measured motor current |
| V1.5 | Motor torque | % | 4 | Calculated actual / nominal torque of the motor |
| V1.6 | Motor shaft power | % | 5 | Calculated actual / nominal power of the motor |
| V1.7 | Motor voltage | V | 6 | Motor voltage |
| V1.8 | DC-link voltage | V | 7 | Measured DC-link voltage |
| V1.9 | Unit temperature | °C | 8 | Heatsink temperature |
| V1.10 | Motor temperature | % | 9 | Calculated motor temperature |
| V1.11 | Output Power | KW | 79 | Output power from drive to motor |
| V2.1 | Analog input 1 | % | 59 | AI1 signal range in percent of used range |
| V2.2 | Analog input 2 | % | 60 | AI2 signal range in percent of used range |
| V2.3 | Analog output | % | 81 | AO signal range in percent of used range |
| V2.4 | Digital input status DI1, DI2, DI3 | | 15 | Digital input status |
| V2.5 | Digital input status DI4, DI5, DI6 | | 16 | Digital input status |
| V2.6 | RO1, RO2, DO | | 17 | Relay / digital output status |
| V2.7 | Pulse train / encoder input | % | 1234 | 0 - 100% scale value |
| V2.8 | Encoder rpm | rpm | 1235 | Scaled according to Encoder pulses / revolution parameter |
| V2.11 | Analog input E1 | % | 61 | Analogue input signal 1 in % from option board, hidden until an option board is connected |
| V2.12 | Analog output E1 | % | 31 | Analogue output signal 1 in % from option board, hidden until an option board is connected |

Table 6.2: Monitoring values

| Code | Monitoring signal | Unit | ID | Description |
|------|-------------------|------|----|-------------|
| V2.13 | Analog output E2 | % | 32 | Analogue output signal 2 in % from option board, hidden until an option board is connected |
| V2.14 | DIE1, DIE2, DIE3 | | 33 | This monitor value shows status of the digital inputs 1-3 from option board, hidden until an option board is connected |
| V2.15 | DIE4, DIE5, DIE6 | | 34 | This monitor value shows status of the digital inputs 4-6 from option board, hidden until an option board is connected |
| V2.16 | DOE1, DOE2, DOE3 | | 35 | This monitor value shows status of the relay outputs 1-3 from option board, hidden until an option board is connected |
| V2.17 | DOE4, DOE5, DOE6 | | 36 | This monitor value shows status of the relay outputs 4-6 from option board, hidden until an option board is connected |
| V2.18 | Temperature input 1 | | 50 | Measured value of Temperature input 1 in temperature unit (Celsius or Kelvins) by parameter setting, hidden until an option board is connected |
| V2.19 | Temperature input 2 | | 51 | Measured value of Temperature input 2 in temperature unit (Celsius or Kelvins) by parameter setting, hidden until an option board is connected |
| V2.20 | Temperature input 3 | | 52 | Measured value of Temperature input 3 in temperature unit (Celsius or Kelvins) by parameter setting, hidden until an option board is connected |
| V3.1 | Drive status word | | 43 | Bit codes status of drive<br>**B0** = Ready<br>**B1** = Run<br>**B2** = Reverse<br>**B3** = Fault<br>**B6** = RunEnable<br>**B7** = AlarmActive<br>**B12** = RunRequest<br>**B13** = MotorRegulatorActive |

Table 6.2: Monitoring values

| Code | Monitoring signal | Unit | ID | Description |
|------|-------------------|------|-----|-------------|
| V3.2 | Application status word | | 89 | Bit codes status of application:<br>**B3** = Ramp 2 Active<br>**B5** = Remote CTRL Place 1 active<br>**B6** = Remote CTRL Place 2 active<br>**B7** = Fieldbus Control Active<br>**B8** = Local Control Active<br>**B9** = PC Control Active<br>**B10** = Preset Frequencies Active |
| V3.3 | DIN status word | | 56 | **B0** = DI1<br>**B1** = DI2<br>**B2** = DI3<br>**B3** = DI4<br>**B4** = DI5<br>**B5** = DI6<br>**B6** = DIE1<br>**B7** = DIE2<br>**B8** = DIE3<br>**B9** = DIE4<br>**B10** = DIE5<br>**B11** = DIE6 |
| V4.1 | PID setpoint | % | 20 | Regulator setpoint |
| V4.2 | PID feedback value | % | 21 | Regulator actual value |
| V4.3 | PID error | % | 22 | Regulator error |
| V4.4 | PID output | % | 23 | Regulator output |
| V4.5 | Process | | 29 | Scaled process variable see par. 15.18 |

Table 6.2: Monitoring values

### 6.4.4   Parameter menu

In Parameter menu only the Quick setup parameter list is shown as default. By giving the value 0 to the parameter 17.2, it is possible to open other advanced parameter groups. The parameter lists and descriptions can be found in chapters 7 and 8.

The following figure shows the parameter menu view:

1)  Press OK to enter Pa r. menu

2)  Press Right to browse otherPar. group

3)  Press down button to browse P3.4

4)  Press OK button to enter edit mode

6)  Press OK to confirm

5)  Press Up / Down to change value
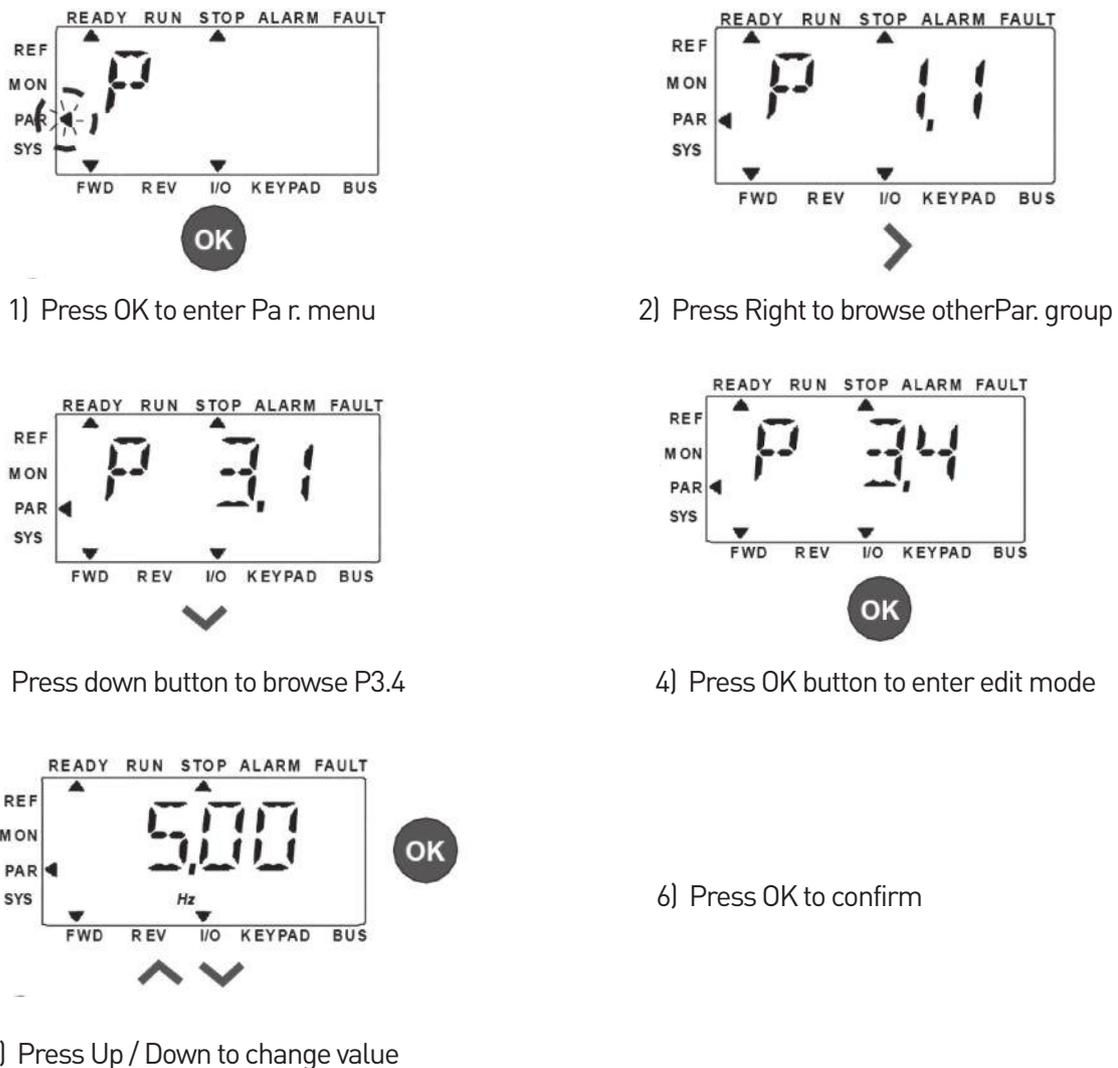
Figure 6.5: Parameter menu

The parameter can be changed as the Figure 6.5.
Left / Right button is available inside Parameter menu. Pressing Left / Right button to change the actual parameter to the first parameter of the next group (Example:
any parameter of P1... is displayed -> RIGHT button -> P2.1 is displayed -> RIGHT button -> P3.1 is displayed ...).
After entering the desired group, pressing UP / DOWN button to select root parameter number, and then press OK button to display the value of the parameter and also enter edit mode.

In edit mode, Left and Right buttons are used to select the digit which has to be changed, and Up increases / Down decreases parameter value.

In edit mode, the value of Px.x is displayed blinkingly in the panel. After about 10 s, Px.x is displayed in the panel again if you don't press any button.

> **Note!** In edit mode, if you edit the value and don't press OK button, the value isn't changed successfully. In edit mode, if you don't edit the value, you can press Reset / Back button to display Px.x again.

### 6.4.5  System menu

SYS menu including fault submenu, field bus submenu and system parameter submenu, and the display and operation of the system parameter submenu is similar to PAR menu or MON menu. In system parameter submenu, there are some editable parameter (P) and some uneditable parameter (V).
The Fault submenu of SYS menu includes active fault submenu and fault history submenu.
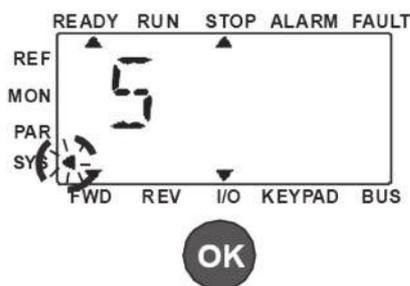


1) Press OK to enter V1.1
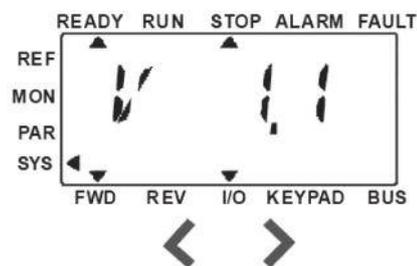


2) Press Left/Right button to browse other groups



3) Press down to browse other active faults



4) Press OK to select one fault to browse its time
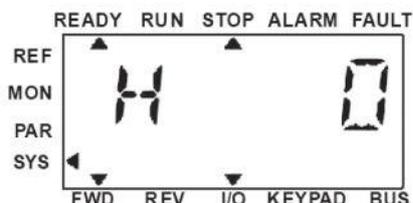


5) Browse for fault code(C xx), subcode(Id xx), days(d xx), hours(H xx), minutes(M xx)

Figure 6.6: Fault menu

In active fault situation, FAULT arrow is blinking and the display is blinking active fault menu item with fault code. If there are several active faults, you can check it by entering the active fault submenu F5.x. F5.1 is always the latest active fault code. The active faults can be reset by pressing BACK / RESET button with long time (>2 s), when the API is in active fault submenu level (F5.x). If the fault cannot be reset, the blinking continues. It is possible to select other display menus during active fault, but in this case the display returns automatically to the fault menu if no button is pressed in 10 seconds. The fault code, subcode and the operating day, hour and minute values at the fault instant are shown in the value menu (operating hours = displayed reading).

> ⚠ **Note!** Fault History can be reset by long pressing the BACK / RESET button for 5 second time,when the API is in fault history submenu level (F6.x), it will also clear all active faults.

See Chapter 5 for fault descriptions.

## 6.5   Navigation on the N800S MR frame

This chapter provides you with information on navigating the menus on the MR frame and editing the values of the parameters.

### 6.5.1   Main menu

The menu structure of the control software for N800S MR frame consists of a main menu and several submenus. Navigation in the main menu is shown below:
If the text is too long for display, the text scrolls to show the full text string.

**Monitoring Menu**
Display for monitoring values
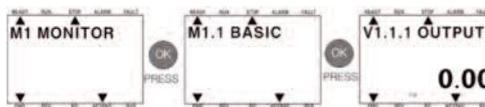
**Parameters Menu**
Setting values of parameters

**Diagonostics Menu**
Checking for faults and a reset

**I/O and hardware menu**
Checking setting values of options
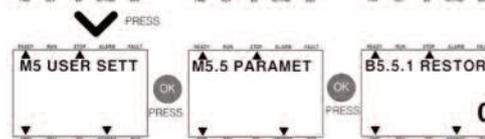
**User settings**
Parameters backup, comparison, etc
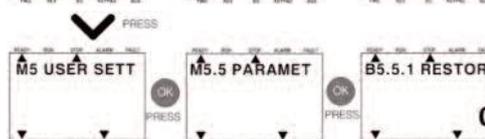
**User levels**
Acess level setting for user

Figure 6.7: main menu

### 6.5.2 Menu for changing control place
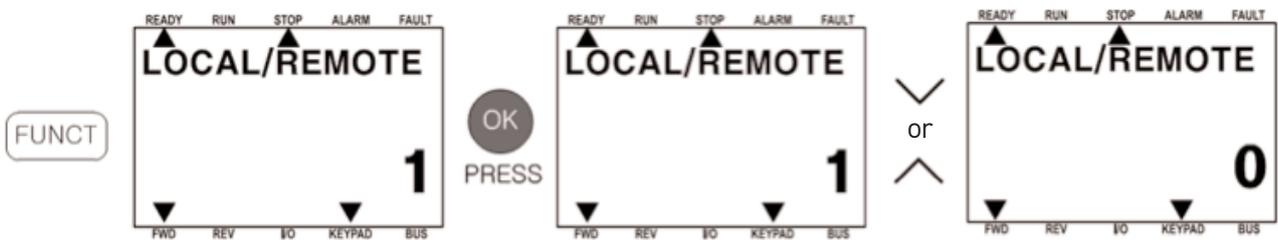


Figure 6.8: Menu for changing control place

Move to LOCAL/REMOTE menu using the FUCNTION button. And, you can select your control place using UP/DOWN button. "0"=I/O Control place, "1"=Keyped control place

### 6.5.3 Frequency reference menu
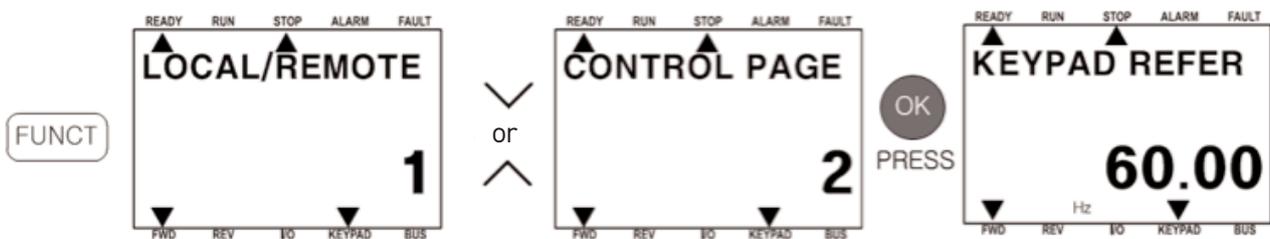


Figure 6.9: Menu for frequency reference menu

Move to CONTROL PAGE -> frequency reference menu using the FUNCT button and the UP/DOWN button. The frequency reference value can be changed with the UP/DOWN button. If you want to change the digits in the frequency reference value, it can be adjusted the digits using Left/Right button.

### 6.5.4 Menu for changing of motor rotating direction
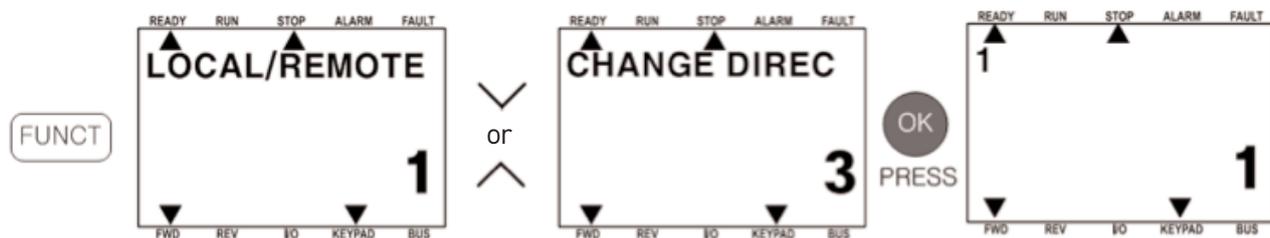


Figure 6.10: Menu for changing of motor rotating direction

Move to CONTROL PAGE -> CHANGE DIRECTION menu using the FUNCT button and the UP/DOWN button. It can be selected a forward direction("0") and a reverse direction("1").

### 6.5.5   Monitoring menu
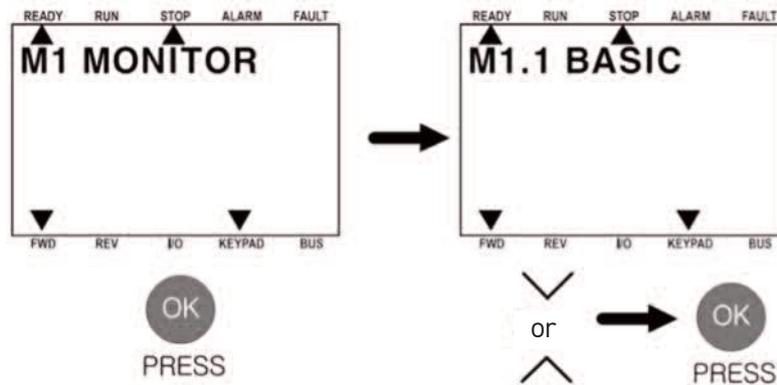


① Press OK button to enter,          ② Press UP/DOWN and OK button
   Monitoring menu                        to browse other Monitoring groups.
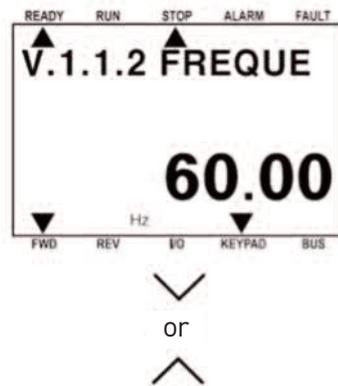


③ Select a monitoring value
   using the UP/DOWN button

Figure 6.11: Moniting menu display

Monitoring values are actual values of measured signals as well as status of some control settings. It is visible in N800S display, but it can not be edited. The monitoring values consist of 4 groups - BASIC, I/O, ADVANCED, PID CONTROL.

The monitoring values are listed in Table 6.3.

| Group | Code | Monitoring signal | Unit | ID | Description |
|-------|------|-------------------|------|----|-------------|
| BASIC | V1.1.1 | Output frequency | Hz | 1 | Output frequency to motor |
| | V1.1.2 | Frequency reference | Hz | 25 | Frequency reference to motor control |
| | V1.1.3 | Motor speed | rpm | 2 | Calculated motor speed [rpm] |
| | V1.1.4 | Motor current | A | 3 | Measured motor current |
| | V1.1.5 | Motor torque | % | 4 | Calculated actual / nominal torque of the motor |
| | V1.1.6 | Motor shaft power | % | 5 | Calculated actual / nominal power of the motor |
| | V1.1.7 | Motor voltage | V | 6 | Motor voltage |
| | V1.1.8 | DC-link voltage | V | 7 | Measured DC-link voltage |
| | V1.1.9 | Unit temperature | °C | 8 | Heatsink temperature |
| | V1.1.10 | Motor temperature | % | 9 | Calculated motor temperature |
| | V1.1.11 | Output Power | KW | 73 | Output power from drive to motor |
| I/O | V1.2.1 | Analog input 1 | % | 59 | AI1 signal range in percent of used range |
| | V1.2.2 | Analog input 2 | % | 60 | AI2 signal range in percent of used range |
| | V1.2.3 | Analog output | % | 81 | AO signal range in percent of used range |
| | V1.2.4 | Digital input status DI1, DI2, DI3 | | 15 | Digital input status |
| | V1.2.5 | Digital input status DI4, DI5, DI6 | | 16 | Digital input status |
| | V1.2.6 | RO1, RO2, DO | | 17 | Relay / digital output status |
| | V1.2.11 | Analog input E1 | % | 61 | Analogue input signal 1 in % from option board, hidden until an option board is connected |
| | V1.2.12 | Analog output E1 | % | 31 | Analogue input signal 1 in % from option board, hidden until an option board is connected |
| | V1.2.13 | Analog output E2 | % | 32 | Analogue output signal 2 in % from option board, hidden until an option board is connected |
| | V1.2.14 | DIE1, DIE2, DIE3 | | 33 | This monitor value shows status of the digital input 1-3 from option board, hidden until an option board is connected |

Table 6.3: Mitoring values

| Group | Code | Monitoring signal | Unit | ID | Description |
|-------|------|-------------------|------|----|-------------|
| I/O | V1.2.15 | DIE4, DIE5, DIE6 | | 34 | This monitor value shows status of the digital inputs 4-6 from option board, hidden until an option board is connected |
| | V1.2.16 | DOE1, DOE2, DOE3 | | 35 | This monitor value shows status of the relay outputs 1-3 from option board, hidden until an option board is connected |
| | V1.2.17 | DOE4, DOE5, DOE6 | | 36 | This monitor value shows status of the relay outputs 4-6 from option board, hidden until an option board is connected |
| | V1.2.18 | Temperature input 1 | | 50 | Measured value of Temperature input 1 in temperature unit (Celsius or Kelvins) by parameter setting, hidden until an option board is connected |
| | V1.2.19 | Temperature input 2 | | 51 | Measured value of Temperature input 2 in temperature unit (Celsius or Kelvins) by parameter setting, hidden until an option board is connected |
| | V1.2.20 | Temperature input 3 | | 52 | Measured value of Temperature input 3 in temperature unit (Celsius or Kelvins) by parameter setting, hidden until an option board is connected |
| ADVANCED | V1.3.1 | Drive status word | | 43 | Bit codes status of drive<br>B0 = Ready<br>B1 = Run<br>B2 = Reverse<br>B3 = Fault<br>B6 = Run Enable<br>B7 = Alarm Active<br>B12 = Run Request<br>B13 = Motor Regulator Active |
| | V1.3.2 | Application status word | | 89 | Bit codes status of application:<br>B3 = Ramp 2 Active<br>B5 = Remote CTRL Place 1 active<br>B6 = Remote CTRL Place 2 active<br>B7 = Fieldbus Control Active<br>B8 = Local Control Active<br>B9 = PC Control Active<br>B10 = Preset Frequencies Active |
| | V1.3.3 | DIN status word | | 56 | B0 = DI1<br>B1 = DI2<br>B2 = DI3<br>B3 = DI4<br>B4 = DI5<br>B5 = DI6<br>B6 = DIE1<br>B7 = DIE2<br>B8 = DIE3<br>B9 = DIE4<br>B10 = DIE5<br>B11 = DIE6 |

Table 6.3: Mitoring values

| Group | Code | Monitoring signal | Unit | ID | Description |
|-------|------|-------------------|------|-----|-------------|
| PID CONTROL | V1.4.1 | PID setpoint | % | 20 | Regulator setpoint |
| | V1.4.2 | PID feedback value | % | 21 | Regulator actual value |
| | V1.4.3 | PID error | % | 22 | Regulator error |
| | V1.4.4 | PID output | % | 23 | Regulator output |
| | V1.4.5 | Process | | 29 | Scaled process variable |

Table 6.3: Mitoring values

### 6.5.6 Parameter menu

In Parameter menu only the Quick setup parameter list is shown as default. By giving the value 0 to the parameter 2.17.2, it is possible to open other advanced parameter groups. The parameter lists and descriptions can be found in chapters 7 and 8.

The following figure shows the parameter menu view:

① Press OK to enter Parameter menu

② Press UP/DOWN to browse a desired parameter group, and push OK button

③ Press UP/DOWN to select a parameter, and push OK button

④ Select a parameter value using UP/DOWN button
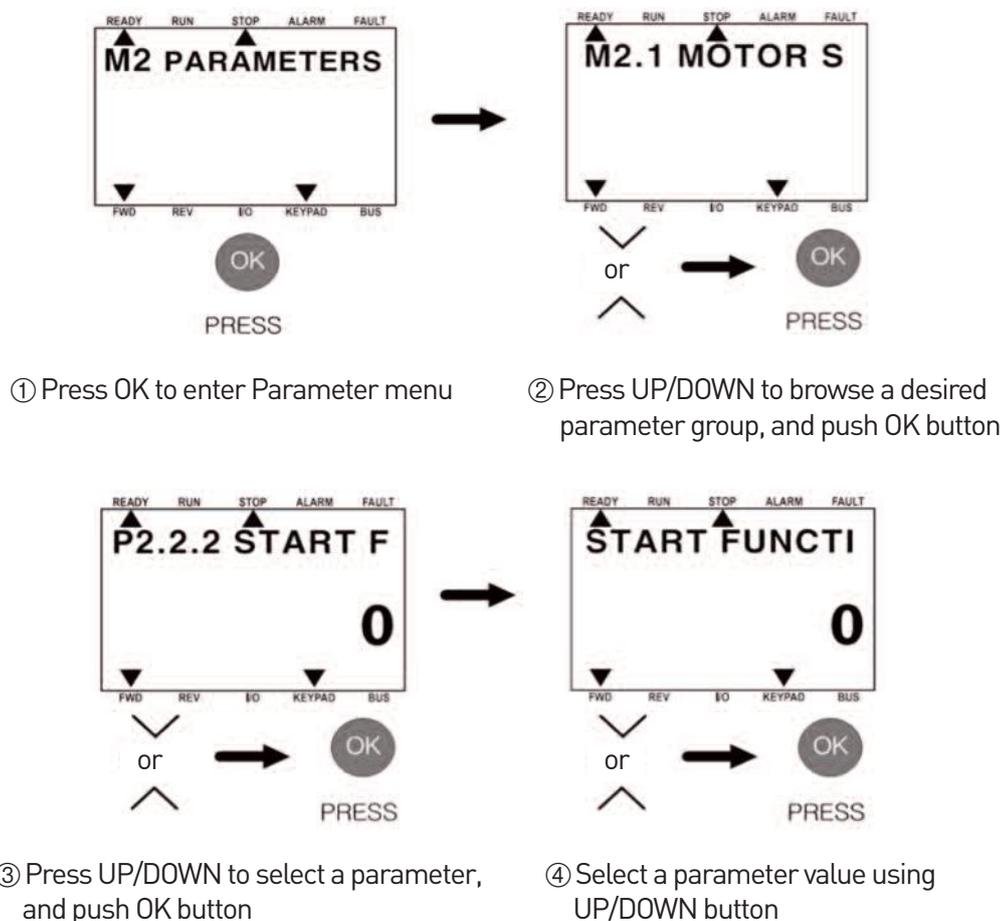
Figure 6.12: Parameter menu display

The parameter can be changed as the Figure 6.12.

Press the OK button after selecting the desired parameter group using UP/DOWN button, and then it will move to the parameter group. Press the OK button after selecting a parameter using UP/DOWN button, and then it will move to the parameter edit display.
In this edit mode, you can increase or decrease the value using UP/DOWN button. Also, if you want to change the digits in the value, use the Left/Right button.

### 6.5.7  Diagnostics menu

**The diagnostics menu shows faluts, reset, counter and software infomation.**
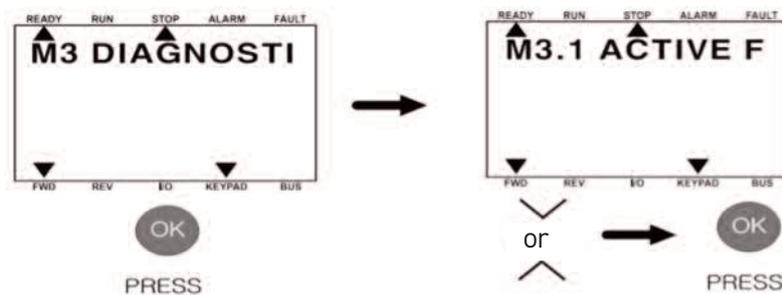


① Press OK to enter diagnostics menu          ② Press UP/DOWN button to browse
                                                                                 other diagnostics group and push OK
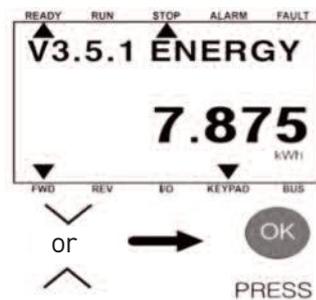


③ Search a diagnostics parameter or monitoing
   using UP/DOWN button, and then push OK

Figure 6.13: Diagnostics menu dispaly

### 6.5.7.1  Active faults

When there is a fault, the display shows the name of the fault and blinks. Push OK to go back to the Diagnostics menu. The submenu Active faults shows the number of faults. To see the fault-time data, make a selection of a fault and push OK.

The fault stays active until you reset it. There are 4 ways to reset a fault.
- Push the Reset button for 2 s.
- Go into the submenu Reset faults and use the parameter Reset Faults.
- Give a reset signal in the I/O terminal.
- Give a reset signal with the fieldbus.

The Active faults submenu can keep a storage of maximum 10 faults. The submenu shows the faults in the sequence in which they occurred.

### 6.5.7.2   Reset faults

In this menu, you can reset faults. See instructions in Chapter 5. Fault tracing.

⚠️ **CAUTION!**
Before you reset the fault, remove the external Control signal to prevent  that you restart the drive.

### 6.5.7.3   Faults history

You can see 40 faults in the Fault history.
To see the details of a fault, go into Fault history, find the fault and push OK

### 6.5.7.4   Total Counters

If you read a counter value through fieldbus, see Chapter 8.18 Total and trip counters.

| Code | Parameter | Min | Max | Unit | Default | ID | Description |
|------|-----------|-----|-----|------|---------|-----|-------------|
| V3.5.1 | Energy Counter | | | Varies | | 2291 | The quantity of energy taken from the supply net-work. You cannot reset the counter. In the text display: the highest energy unit that the display shows is MW. If the counted energy becomes more than 999.9 MW, no unit shows on the dis-play. |
| V3.5.4 | Operating Time | | | a | | | The operating time of the control unit in total years. |
| V3.5.5 | Operating Time | | | d | | | The operating time of the control unit in total days. |
| V3.5.6 | Operating Time | | | hh:min:ss | | | The operating time of the control unit in hours, minutes and seconds. |
| V3.5.8 | Run Time | | | a | | | The motor run time in total years. |
| V3.5.9 | Run Time | | | d | | | The motor run time in total days. |
| V3.5.10 | Run Time | | | hh:min:ss | | | The motor run time in hours, minutes and sec-onds. |
| V3.5.12 | Power On Time | | | a | | | The power on time in total years. |
| V3.5.13 | Power On Time | | | d | | | The power on time in total days. |
| V3.5.14 | Power On Time | | | hh:min:ss | | | The power on time in hours, minutes and sec-onds. |
| V3.5.15 | Start Command Counter | | | | | 2295 | The number of times that the power unit has been started. |

Table 6.4: The total counter parameters in the diagnostics menu

### 6.5.7.5  Trip counters

If you read a counter value through fieldbus, see Chapter 8.18 Total and trip counters.

| Code | Parameter | Min | Max | Unit | Default | ID | Description |
|------|-----------|-----|-----|------|---------|-----|-------------|
| P3.6.1 | Energy Trip Counter | | | | Varies | 2296 | You can reset this counter.<br>In the text display: the highest energy unit that the display shows is MW. If the counted energy becomes more than 999.9 MW, no unit shows on the display.<br>Resetting the counter<br>• In the text display: Push the OK button for 4 s.<br>• In the graphical display: Push OK. A Reset counter page shows. Push OK again. |
| P3.6.4 | Operating Time | | | a | | | The operating time in total years. |
| P3.6.5 | Operating Time | | | d | | | The operating time in total days. |
| P3.6.6 | Operating Time | | | hh:mm:ss | | | The operating time in hours, minutes and seconds. |

Table 6.5: The trip counter parameters in the diagnostics menu

### 6.5.7.6  Software info

| Code | Parameter | Min | Max | Unit | Default | ID | Description |
|------|-----------|-----|-----|------|---------|-----|-------------|
| V3.7.2 | Software Package ID | | | | | | The code for the software identification. |
| V3.7.3 | Software Package Version | | | | | | The code for the software identification |
| V3.7.4 | System Load | 0 | 100 | % | | 2300 | The load on the control unit CPU |
| V3.7.6 | Application ID | | | | | | The code of the application. |
| V3.7.7 | Application Version | | | | | | |

Table 6.5: The software info parameters in the diagnostics menu

### 6.5.8  I/O AND HARDWARE MENU

In this menu, there are different settings that are related to the options. The values in this menu are raw values, that is, they are not scaled by the application.
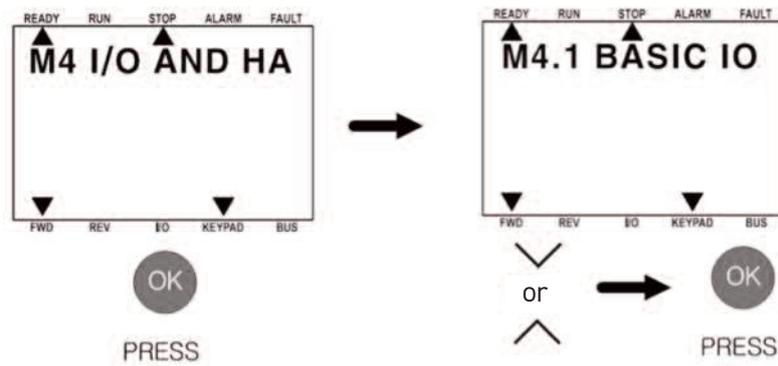
① Press OK to enter I/O          ② Press UP/DOWN button to browse other
   and hardware menu                 I/O and hardware group and than push OK



③ Search a parameter using UP/DOWN button,
   and then push OK

Figure 6.14: I/O and hardware menu display

### 6.5.8.1  Basic I/O

In the Basic I/O menu, you can monitor the statuses of the inputs and the outputs.

| Code | Parameter | Min | Max | Unit | Default | ID | Description |
|------|-----------|-----|-----|------|---------|------|-------------|
| V4.1.1 | Digital Input 1 | 0 | 1 | | 0 | 2502 | Status of the digital input signal |
| V4.1.2 | Digital Input 2 | 0 | 1 | | 0 | 2503 | Status of the digital input signal |
| V4.1.3 | Digital Input 3 | 0 | 1 | | 0 | 2504 | Status of the digital input signal |
| V4.1.4 | Digital Input 4 | 0 | 1 | | 0 | 2505 | Status of the digital input signal |
| V4.1.5 | Digital Input 5 | 0 | 1 | | 0 | 2506 | Status of the digital input signal |

Table 6.7: The basic I/O parameters in the I/O and Hardware

| Code | Parameter | Min | Max | Unit | Default | ID | Description |
|------|-----------|-----|-----|------|---------|-----|-------------|
| V4.1.6 | Digital Input 6 | 0 | 1 | | 0 | 2507 | Status of the digital input signal |
| V4.1.7 | Analogue Input 1 Mode | 1 | 3 | | 3 | 2508 | Shows the mode that is set for the analogue input signal. The selection is made with a DIP switch on the control board.<br>1 = 0...20mA<br>3 = 0...10V |
| V4.1.8 | Analogue Input 1 | 0 | 100 | % | 0.00 | 2509 | Status of the analogue input signal |
| V4.1.9 | Analogue Input 2 Mode | 1 | 3 | | 3 | 2510 | Shows the mode that is set for the analogue input signal. The selection is made with a DIP switch on the control board.<br>1 = 0...20mA<br>3 = 0...10V |
| V4.1.10 | Analogue Input 2 | 0 | 100 | % | 0.00 | 2511 | Status of the analogue input signal |
| V4.1.11 | Analogue Output 1 Mode | 1 | 3 | | 1 | 2512 | Shows the mode that is set for the analogue output signal. The selection is made with a DIP switch on the control board.<br>1 = 0...20mA<br>3 = 0...10V |
| V4.1.12 | Analogue Output 1 | 0 | 100 | % | 0.00 | 2513 | Status of the analogue output signal |
| V4.1.13 | Relay Output 1 | 0 | 1 | | 0 | 2514 | Status of the relay output signal |
| V4.1.14 | Relay Output 2 | 0 | 1 | | 0 | 2515 | Status of the relay output signal |
| V4.1.15 | Relay Output 3 | 0 | 1 | | 0 | 2516 | Status of the relay output signal |

Table 6.7: The basic I/O parameters in the I/O and Hardware

### 6.5.8.2  Option board slot

The parameters in this menu are different for all the option boards. You see the parameters of the option board that you installed. If there is no option board in the slot E, you do not see parameters.

When you remove an option board, the fault code 39 and the fault name ¨Device removed¨ show on the display. See Chapter 5. Fault tracing.

| Menu | Function | Description |
|------|----------|-------------|
| Slot E | Settings | The settings that are related to the option board |
| | Monitoring | Monitor the data that is related to the option board |

Table 6.8: Option board related parameters

### 6.5.8.3   Real time clock

| Code | Parameter | Min | Max | Unit | Default | ID | Description |
|------|-----------|-----|-----|------|---------|----|-------------|
| V4.5.1 | Battery State | 1 | 3 | | 2 | 2205 | Status of the battery.<br>1 = Not installed<br>2 = Installed (Not available)<br>3 = Replace the battery |
| V4.5.2 | Time | | | hh:mm<br>:ss | | 2201 | The current time of the day |
| V4.5.3 | Date | | | dd.mm. | | 2202 | The current date |
| V4.5.4 | Year | | | yyyy | | 2203 | The current year |
| V4.5.5 | Daylight Saving | 1 | 4 | | 1 | 2204 | The daylight saving rule<br>1 = Off<br>2 = Eu : starts on the last Sunday in March, ends on the last Sunday in October<br>3 = Us : starts on the 2nd Sunday in March, ends on the 1st Sunday in November<br>4 = Russia (permanent) |

Table 6.9: The real time clock parameters in the I/O and Hardware menu

### 6.5.8.4   Power unit settings

In this menu, you can change the settings of the fan, the brake chopper and the sine filter. The fan operates in the optimised or the always on mode. In the optimised mode, the internal logic of the drive receives data about the temperature and controls the fan speed. After the drive goes in the Ready state, the fan stops in 5 minutes. In the always on mode, the fan operates in full speed, and does not stop. The Sine filter keeps the overmodulation depth in limits and does not let the thermal management functions decrease the switching frequency.

| Code | Parameter | Min | Max | Unit | Default | ID | Description |
|------|-----------|-----|-----|------|---------|----|-------------|
| P4.6.1.1 | Fan Control Mode | 0 | 1 | | 1 | 2377 | 0 = Always on<br>1 = Optimised |
| P.4.6.2.1 | Brake Chopper Mode | 0 | 3 | | 0 | 2526 | 0 = Disabled<br>1 = Enabled (Run)<br>2 = Enabled (Run & Stop)<br>3 = Enabled (Run, no testing) |
| P4.6.4.1 | Sine Filter | 0 | 1 | | 0 | 2527 | 1 = Enabled |

Table 6.10: Power unit settings

### 6.5.8.5 Keypad

| Code | Parameter | Min | Max | Unit | Default | ID | Description |
|------|-----------|-----|-----|------|---------|-----|-------------|
| P4.7.1 | Timeout Time | 0 | 60 | min | 0 | | The time after which the display goes back to the page that is set with parameter P4.7.2. 0 = Not used |
| P4.7.2 | Default Page | 0 | 4 | | 0 | | The page that the display shows when the drive is powered up, or when the time that is set with P4.7.1 is expired. If the value is set to 0, the display shows the last page that it showed. 0 = None 1 = A menu index 2 = Main menu 3 = Control page 4 = Multimonitor |
| P4.7.3 | Menu Index | | | | | | Set a page to be the menu index. (The selection 1 in P4.7.2.) |
| P4.7.5 | Backlight Time | 0 | 60 | min | 5 | | Set the time after which the blacklight of the display turns off. If the value is set to 0, the blacklight is always on. |

Table 6.11: The keypad settings

### 6.5.8.6 Fieldbus

In the I/O and Hardware menu, there are the parameters that are related to fieldbus boards. You can find the instructions on how to use these parameters in the related fieldbus manual.

(P4.8.1.1 PROTOCOL, "0" = NO PROTOCOL, "4"=MODBUS RTU)

| Submenu level 1 | Submenu level 2 | Submenu level 3 | Submenu level 4 |
|-----------------|-----------------|-----------------|-----------------|
| RS-485 | Common settings | Protocol | Modbus RTU |
| RS-485 | Modbus RTU | Parameters | Slave address |
| | | | Baud rate |
| | | | Parity type |
| | | | Stop bits |
| | | | Communication timeout |
| | | | Operate mode |

Table 6.12: Fieldbus settings

| Submenu level 1 | Submenu level 2 | Submenu level 3 | Submenu level 4 |
|---|---|---|---|
| RS-485 | Modbus RTU | Monitoring | Fieldbus protocol status |
| | | | Communication status |
| | | | Illegal functions |
| | | | Illegal data addresses |
| | | | Illegal data values |
| | | | Slave device busy |
| | | | Memory parity error |
| | | | Slave device failure |
| | | | Last fault response |
| | | | Control Word |
| | | | Status Word |

Table 6.12: Fieldbus settings

### 6.5.9 User settings
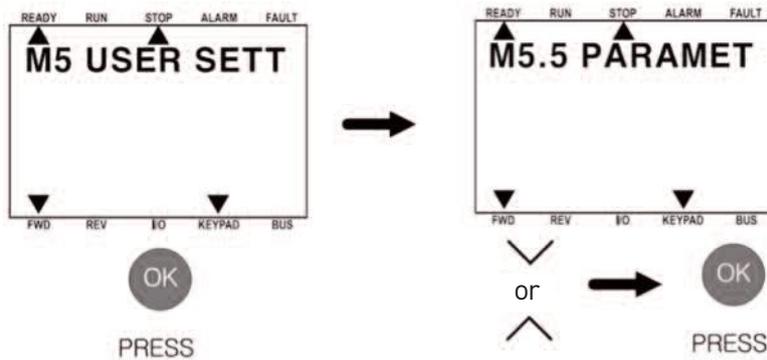


① Press OK to enter Uesr settings

② Press UP/DOWN button to browse other user settings and push OK
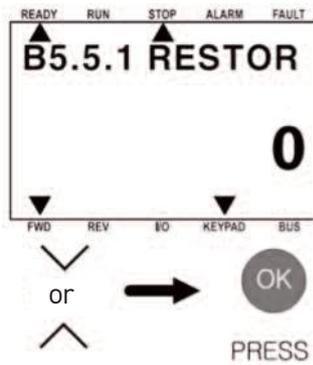
③ Search a parameter using UP/DOWN button,
and then push OK

Figure 6.15: User settings menu display

The user settings menu shows language selection, parameter backup, paramenter comparison and drive name.

| Code | Parameter | Min | Max | Unit | Default | ID | Description |
|------|-----------|-----|-----|------|---------|-----|-------------|
| P5.1 | Language selection | Varies | Varies | | Varies | 802 | The selection is different in all the language packages. |
| M5.5 | Parameter backup | | | | | | See Table 6.14 Parameter backup. |
| M5.6 | Parameter compare | | | | | | |
| P5.7 | Drive name | | | | | 2528 | necessary. |

Table 6.13: General settings in the user settings menu

| Code | Parameter | Min | Max | Unit | Default | ID | Description |
|------|-----------|-----|-----|------|---------|-----|-------------|
| B5.5.1 | Restore Factory Defaults | | | | | 831 | Restores the default parameter values and starts the Startup wizard. |
| B5.5.4 | Save to Set 1 | | | | | 2489 | Saves the parameter values to the user parameter set 1. |
| B5.5.5 | Restore from Set 1 | | | | | 2490 | Loads the parameter values in the user parameter set 1 to the drive. |
| B5.5.6 | Save to Set 2 | | | | | 2491 | Saves the parameter values to the user parameter set 2. |
| B5.5.7 | Restore from Set 2 | | | | | 2492 | Loads the parameter values in the user parameter set 2 to the drive. |

Table 6.14: The parameter backup parameters in the user settings menu

### 6.5.10  User levels

Use the User level parameters to keep the personnel who are not approved from making changes in the parameters. You can also prevent accidental changes in the parameters.

When you make a selection of a user level, the user cannot see all the parameters on the display of the control panel.
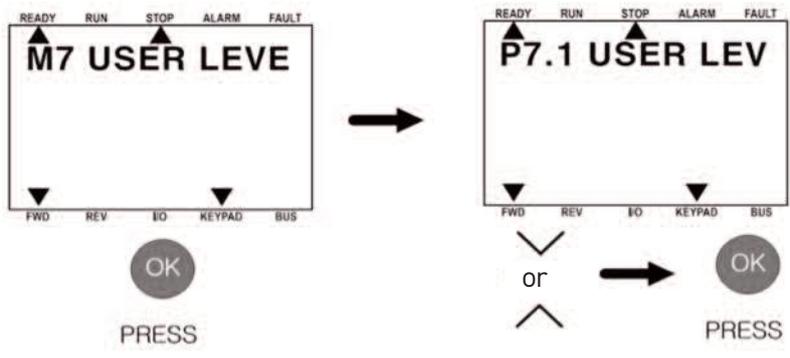


① Press OK to enter Uesr levels

② Press UP/DOWN button to browse other user levels and push OK
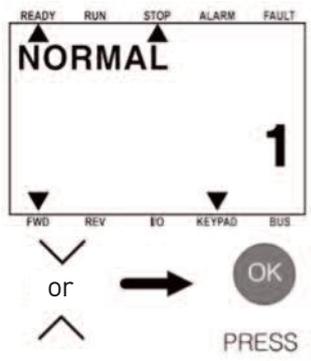
③ Search a parameter using UP/DOWN button, and then push OK

Figure 6.16: User levels menu display

| Code | Parameter | Min | Max | Unit | Default | ID | Description |
|------|-----------|-----|-----|------|---------|-----|-------------|
| P7.1 | User Level | 1 | 3 | | 1 | 1194 | 1 = Normal : All the menus are visible in the main menu<br>2 = Monitoruing : Only the monitoring and user level menus are visible in the main menu<br>3 = Favourites : Not available |
| P7.2 | Access Code | 0 | 99999 | | 0 | 2362 | If you set value to be to other than 0 before you go to Monitoring from, for example, Normal, you have to give the access code when you go back to Normal. This prevents personnel who are not approved from making changes in the parameters on the control panel. |

Table 6.15: The user level parameters

⚠ **CAUTION!**
Do not lose the access code. If the access code is lost, contact your nearest Service center or partner.

### 6.5.10.1 Change the access code of the user levels

1 ) Go to the item Acess code in the User levels.
2 ) Press OK button.
3 ) To change the digits of the acess code, use the Right/Left button, and you can edit values in a digit of access code with the UP/DOWN button.
4) Accept the change with the OK button.

# 7. STANDARD APPLICATION PARAMETERS

On the next pages you can find the lists of parameters within the respective parameter groups. For the N800S MI frame and the MR frame. The parameter descriptions are given in Chapter 8 .

Explanations:

| Code | Location indication on the keypad; Shows the operator the present Monitoring value number or Parameter number |
|------|--------------------------------------------------------------------------------------------|
| Parameter | Name of monitoring value or parameter |
| Min | Minimum value of parameter |
| Max | Maximum value of parameter |
| Unit | Unit of parameter value; given if available |
| Default | Factory preset value |
| ID | ID number of the parameter (used with fieldbus control) |
| Px.x | Modifiable only in stop state |

⚠️ **NOTE!** This manual is for N800S standard application only.

As the parameters are divided into below groups in case of the MR frame, the parameters are setted after a group as follows has been selected in keypad.

M2.1 Motor setting                          M2.10 FieldBus

M2.2 Start/Stop setup                       M2.11 Prohibited Frequencys

M2.3 Reference                              M2.12 Limit Supervisions

M2.4 Ramps and Brakes                       M2.13 Protections

M2.5 Digital Inputs                         M2.14 Automatic Reset

M2.6 Analog Inputs                          M2.15 PID Control

M2.8 Digital Outputs                        M2.16 Motor Preheat

M2.9 Analog outputs                         M2.17 Application Setting

## 7.1 Quick setup parameters (Virtual menu, shows P17.2 = 1(MIframe), P2.17.2 = 1 (MRframe) )

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P1.1 | P2.1.1 | Motor nominal voltage | 180 | 690 | V | Varies | 110 | Check rating plate on the motor. |
| P1.2 | P2.1.2 | Motor nominal frequency | 30.00 | 320.00 | Hz | 50.00/ 60.00 | 111 | Check rating plate on the motor. |
| P1.3 | P2.1.3 | Motor nominal speed | 30 | 20000 | rpm | 1440/ 1720 | 112 | Default applies for a 4-pole motor. |
| P1.4 | P2.1.4 | Motor nominal current | 0.2 x INunit | 2.0 xINunit | A | INunit | 113 | Check rating plate on the motor. |
| P1.5 | P2.1.5 | Motor cos$\phi$ (Power Factor) | 0.30 | 1.00 | | 0.85 | 120 | Check rating plate on the motor. |
| P1.7 | P2.1.7 | Current limit | 0.2 x INunit | 2.0 x INunit | A | 1.5 x INunit | 107 | Maximum motor current |
| P1.15 | P2.1.15 | Torque boost | 0 | 1 | | 0 | 109 | **0** = Not used<br>**1** = Used |
| P2.1 | P2.2.1 | Remote control place 1 selection | 0 | 2 | | 0 | 172 | **0** = I / O terminal<br>**1** = Fieldbus<br>**2** = Keypad |
| P2.2 | P2.2.2 | Start function | 0 | 1 | | 0 | 505 | **0** = Ramp<br>**1** = Flying start |
| P2.3 | P2.2.3 | Stop function | 0 | 1 | | 0 | 506 | **0** = Coasting<br>**1** = Ramp |
| P3.1 | P2.3.1 | Min frequency | 0,00 | MI=P3.2<br>MR=P2.3.2 | Hz | 0.00 | 101 | Minimum freq reference |
| P3.2 | P2.3.2 | Max frequency | MI=P3.1<br>MR=P2.3.1 | 320.00 | Hz | 50.00/ 60.00 | 102 | Maximum freq reference |
| P3.3 | P2.3.3 | Remote Control Place 1 frequency reference seclection | 1 | Varies | | 7 | 117 | **1** = Preset speed 0<br>**2** = Keypad<br>**3** = Fieldbus<br>**4** = AI1<br>**5** = AI2<br>**6** = PID<br>**7** = AI1+ AI2<br>**8** = Motor potentiometer<br>**9** = Pulse train / Encoder<br>**10** = AIE1<br>**11** = Temperature input 1<br>**12** = Temperature input 2<br>**13** = Temperature input 3 |

Table 7.1: Quick setup parameters

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
| MI frame | MR frame | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| P3.4 | P2.3.4 | Preset speed 0 | MI=P3.1<br>MR=P2.3.1 | MI=P3.2<br>MR=P2.3.2 | Hz | 5.00 | 180 | Preset speed 0 is used as frequency refer ence when P3.3 = 1 |
| P3.5 | P2.3.5 | Preset speed 1 | MI=P3.1<br>MR=P2.3.1 | MI=P3.2<br>MR=P2.3.2 | Hz | 10.00 | 105 | Activated by digital inputs |
| P.3.6 | P2.3.6 | Preset speed 2 | MI=P3.1<br>MR=P2.3.1 | MI=P3.2<br>MR=P2.3.2 | Hz | 15.00 | 106 | Activated by digital inputs |
| P3.7 | P2.3.7 | Preset speed 3 | MI=P3.1<br>MR=P2.3.1 | MI=P3.2<br>MR=P2.3.2 | Hz | 20.00 | 126 | Activated by digital inputs |
| P4.2 | P2.4.2 | Acceleration time 1 | 0.1 | 3000.0 | s | 3.0 | 103 | Acceleration time from 0 Hz to maximum frequency. |
| P4.3 | P2.4.3 | Deceleration time 1 | 0.1 | 3000.0 | s | 3.0 | 104 | Deceleration time from maximum frequency to 0 Hz. |
| P6.1 | P2.6.1 | AI1 Signal range | 0 | 1 | | 0 | 379 | 0 = 0 - 100%<br>1 = 20% - 100%<br>20% is the same as 2 V minimum signal level. |
| P6.5 | P2.6.5 | AI2 Signal range | 0 | 1 | | 0 | 390 | 0 = 0 - 100%<br>1 = 20% - 100%<br>20% is the same as 2 V or 4 mA minimum signal level. |
| P14.1 | P2.14.1 | Automatic reset | 0 | 1 | | 0 | 731 | 0 = Disable<br>1 = Enable |
| P17.2 | P2.17.2 | Parameter conceal | 0 | 1 | | 1 | 115 | 0 = All parameters visible<br>1 = Only quick setup parameter group visible |

Table 7.1: Quick setup parameters

## 7.2   Motor settings (Control panel: Menu PAR -> P1)

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P1.1 | P2.1.1 | Motor nominal voltage | 180 | 690 | V | Varies | 110 | Check rating plate on the motor |
| P1.2 | P2.1.2 | Motor nominal frequency | 30.00 | 320.00 | Hz | 50.00/ 60.00 | 111 | Check rating plate on the motor |
| P1.3 | P2.1.3 | Motor nominal speed | 30 | 20000 | rpm | 1440/1720 | 112 | Default applies for a 4-pole motor. |
| P1.4 | P2.1.4 | Motor nominal current | 0.2 x INunit | 2.0 x INunit | A | INunit | 113 | Check rating plate on the motor |
| P1.5 | P2.1.5 | Motor cos$\phi$ (Power Factor) | 0.30 | 1.00 | | 0.85 | 120 | Check rating plate on the motor |
| P1.6 | P2.1.6 | Motor type | 0 | 1 | | 0 | 650 | **0** = Induction motor<br>**1** = PM motor |
| P1.7 | P2.1.7 | Current limit | 0.2 x INunit | 2.0 x INunit | A | 1.5 x INunit | 107 | Maximum motor current |
| P1.8 | P2.1.8 | Motor control mode | 0 | 1 | | 0 | 600 | **0** = Frequency control<br>**1** = Open loop speed control |
| P1.9 | P2.1.9 | U / f ratio | 0 | 2 | | 0 | 108 | **0** = Linear<br>**1** = Square<br>**2** = Programmable |
| P1.10 | P2.1.10 | Field weakening point | 8.00 | 320.00 | Hz | 50.00/60.00 | 602 | Field weakening point frequency |
| P1.11 | P2.1.11 | Field weakening point voltage | 10.00 | 200.00 | % | 100.00 | 603 | Voltage at field weakening point as % of UNMOT |
| P1.12 | P2.1.12 | U / f mid point frequency | 0.00 | MI=P1.10 MR=P2.1.10 | Hz | 50.00/60.00 | 604 | Mid point frequency for programmable U / f |
| P1.13 | P2.1.13 | U / f mid point voltage | 0.00 | MI=P1.11 MR=P2.1.11 | % | 100.00 | 605 | Mid point voltage for programmable U / f as % of UNMOT |
| P1.14 | P2.1.14 | Zero freq voltage | 0.00 | 40.00 | % | 0.00 | 606 | Voltage at 0 Hz as % of UNMOT |
| P1.15 | P2.1.15 | Torque Boost | 0 | 1 | | 0 | 109 | **0** = Disabled<br>**1** = Enabled |
| P1.16 | P2.1.16 | Switching frequency | 1.5 | 16.0 | kHz | 4.0/ 2.0 | 601 | **PWM** frequency. If values are higher than default, reduce the current capacity |

Table 7.2: Motor settings

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|------|------|-----------|-----|-----|------|---------|-----|------|
| MI frame | MR frame | | | | | | | |
| P1.17 | Not available | Brake Chopper | 0 | 2 | | 0 | 504 | **0** = Disabled<br>**1** = Enabled: Always<br>**2** = Run state |
| P1.18 | P2.1.18 | Brake chopper level | 0 | 911 | V | varies | 631 | Brake chopper control activation level in volt. For 240V Supply: 240*1.35*1.18 = 382V For 400V Supply: 400*1.35*1.18 = 638V Please note that when brake chopper is used the overvoltage controller can be switched off or the overvoltage reference level can be set above the brake chopper level. |
| P1.19 | P2.1.19 | Motor identification | 0 | 2 | | 0 | 631 | **0** = Not active<br>**1** = Standstill identification (need run command within 20 s to activate)<br>**2** = Identification with run (need run command within 20 s to active. Only available in power.) |
| P1.20 | P2.1.20 | Rs voltage drop | 0.00 | 100.00 | % | 0.00 | 662 | Voltage drop over motor windings as % of U<sub>NMOT</sub> at nominal current. |
| P1.21 | P2.1.21 | Overvoltage controller | 0 | 2 | | 1 | 607 | **0** = Disabled<br>**1** = Enabled, Standard mode<br>**2** = Enabled, Shock load mode |
| P1.22 | P2.1.22 | Undervoltage controller | 0 | 1 | | 1 | 608 | **0** = Disable<br>**1** = Enable |
| P1.23 | Not available | Sine filter | 0 | 1 | | 0 | 522 | **0** = Not in use<br>**1** = In use |

Table 7.2: Motor settings

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P1.24 | Not available | Modulator type | 0 | 65535 | | 28928 | 648 | Modulator configuration word: <br> **B1** = Discontinuous modulation (DPWMMIN) <br> **B2** = Pulse dropping in overmodulation <br> **B6** = Under modulation <br> **B8** = Instantaneous DC voltage compensation <br> **B11** = Low noise <br> **B12** = Dead time compensation <br> **B13** = Flux error compensation |
| P1.25 | P2.1.25 | Efficiency optimization * | 0 | 1 | | 1 | 666 | Energy optimization, the frequency converte seach for the minimum cuuren in order to save energy and lower motor noise <br> **0** = disabled <br> **1** = enable |
| P1.26 | P2.1.26 | I/f start enable * | 0 | 1 | | 0 | 534 | **0** = disabled <br> **1** = enable |
| P1.27 | P2.1.27 | I/f start frequency reference limit * | 1 | 100 | % | 10 | 535 | Output frequency limit below which the defined I/f start current is fed to motor. |
| P1.28 | P2.1.28 | I/f start current reference * | 0 | 100.0 | % | 80.0 | 536 | Current reference in percent of motor nominal current [1 = 0.1%] |
| P1.29 | Not available | Voltage limiter enable * | 0 | 1 | | 1 | 1079 | Select voltage limiter mode: <br> **0** = Disabled <br> **1** = Enabled |
| P1.30 | P2.1.30 | Start Delay Time | 0 | 16 | | 0 | 1499 | **0** = Disabled |

Table 7.2: Motor settings

**NOTE!** These parameters are shown, when P17.2=0(MI frame), P2.17.2=0(MR frame).

## 7.3   Start / stop setup (Control panel: Menu PAR -> P2)

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P2.1 | P2.2.1 | Remote Control Place Selection | 0 | 2 | | 0 | 172 | **0** = I / O terminals<br>**1** = Fieldbus<br>**2** = Keypad |
| P2.2 | P2.2.2 | Start function | 0 | 1 | | 0 | 505 | **0** = Ramp<br>**1** = Flying start |
| P2.3 | P2.2.3 | Stop function | 0 | 1 | | 0 | 506 | **0** = Coasting<br>**1** = Ramp |
| P2.4 | P2.2.4 | I / O Start / Stop logic | 0 | 4 | | 2 | 300 | **I / O control signal 1**   **I / O control signal 2**<br>**0** Forward          Reverse<br>**1** Fwd (edge)       Inverted Stop<br>**2** Fwd (edge)       Bev (edge)<br>**3** Start             Reverse<br>**4** Start (edge)      Reverse |
| P2.5 | P2.2.5 | Local / Remote | 0 | 1 | | 0 | 211 | **0** = Remote control<br>**1** = Local control |
| P2.6 | P2.2.6 | Keypad control direction | 0 | 1 | | 0 | 123 | **0** = Forward<br>**1** = Reverse |
| P2.7 | P2.2.7 | Keypad stop button | 0 | 1 | | 1 | 114 | **0** = Keypad control only<br>**1** = Always |
| P2.8 | P2.2.8 | Remote Control Place 2 Selection | 0 | 2 | | 0 | 173 | **0** = I / O terminals<br>**1** = Fieldbus<br>**2** = Keypad |
| P2.9 | P2.2.9 | keypad button lock | 0 | 1 | | 0 | 15520 | **0** = unlock all keypad button<br>**1** = Loc/Rem button locked |

Table 7.3: Start / stop setup

## 7.4 Frequency references (Control panel: Menu PAR -> P3)

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P3.1 | P2.3.1 | Min frequency | 0.00 | MI=P3.2 MR=P2.3.2 | Hz | 0.00 | 101 | Minimum allowed frequency reference |
| P3.2 | P2.3.2 | Max frequency | MI=P3.1 MR=P2.3.1 | 320.00 | Hz | 50.00 /60.00 | 102 | Maximum allowed frequency reference |
| P3.3 | P2.3.3 | Remote Control Place 1 frequency reference seclection | 1 | Varies | | 7 | 117 | **1** = Preset speed 0<br>**2** = Keypad<br>**3** = Fieldbus<br>**4** = AI1<br>**5** = AI2<br>**6** = PID<br>**7** = AI1+ AI2<br>**8** = Motor potentiometer<br>**9** = Pulse train / Encoder<br>**10** = AIE1<br>**11** = Temperature input 1<br>**12** = Temperature input 2<br>**13** = Temperature input 3 |
| P3.4 | P2.3.4 | Preset speed 0 | MI=P3.1 MR=P2.3.1 | MI=P3.2 MR=P2.3.2 | Hz | 5.00 | 180 | Preset speed 0 is used as frequency reference when P3.3 = 1 |
| P3.5 | P2.3.5 | Preset speed 1 | | | Hz | 10.00 | 105 | Activated by digital inputs |
| P3.6 | P2.3.6 | Preset speed 2 | | | Hz | 15.00 | 106 | Activated by digital inputs |
| P3.7 | P2.3.7 | Preset speed 3 | | | Hz | 20.00 | 126 | Activated by digital inputs |
| P3.8 | P2.3.8 | Preset speed 4 | | | Hz | 25.00 | 127 | Activated by digital inputs |
| P3.9 | P2.3.9 | Preset speed 5 | | | Hz | 30.00 | 128 | Activated by digital inputs |
| P3.10 | P2.3.10 | Preset speed 6 | | | Hz | 40.00 | 129 | Activated by digital inputs |
| P3.11 | P2.3.11 | Preset speed 7 | | | Hz | 50.00 | 130 | Activated by digital inputs |
| P3.12 | P2.3.12 | Remote Control Place 2 frequency reference selection | 1 | Varies | | 5 | 131 | As parameter P3.3 for MI frame, and P2.3.3 for MR frame |
| P3.13 | P2.3.13 | Motor Potentiometer Ramp | 1 | 50 | Hz/s | 5 | 331 | Speed variation rate |
| P3.14 | P2.3.14 | Motor Potentiometer Reset | 0 | 2 | | 2 | 367 | **0** = No Reset<br>**1** = Reset if stopped<br>**2** = Reset if powered down |

Table 7.4: Frequency references

**NOTE!** These parameters are shown, when P17.2=0(MI frame), P2.17.2=0(MR frame).

## 7.5   Ramps and brakes setup (Control panel: Menu PAR -〉 P4)

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P4.1 | P2.4.1 | Ramp S-shape 1 | 0.0 | 10.0 | s | 0.0 | 500 | **0** = Linear<br>**〉0** = S-curve ramp time |
| P4.2 | P2.4.2 | Acceleration time 1 | 0.1 | 3000.0 | s | 3.0 | 103 | Defines the time required for the output frequency to increase from zero frequency to maximum frequency. |
| P4.3 | P2.4.3 | Deceleration time 1 | 0.1 | 3000.0 | s | 3.0 | 104 | Defines the time required for the output frequency to decrease from maximum frequency to zero frequency. |
| P4.4 | P2.4.4 | Ramp S-shape 2 | 0.0 | 10.0 | s | 0.0 | 501 | See the parameter P4.1 for MI frame and P2.4.1 for MR frame |
| P4.5 | P2.4.5 | Acceleration time 2 | 0.1 | 3000.0 | s | 10.0 | 502 | See the parameter P4.1 for MI frame and P2.4.2 for MR frame |
| P4.6 | P2.4.6 | Deceleration time 2 | 0.1 | 3000.0 | s | 10.0 | 503 | See the parameter P4.1 for MI frame and P2.4.3 for MR frame |
| P4.7 | P2.4.7 | Flux Braking | 0 | 3 | | 0 | 520 | **0** = Off<br>**1** = Deceleration<br>**2** = Chopper<br>**3** = Full Mode |
| P4.8 | P2.4.8 | Flux Braking Current | 0.5 x INunit | 2.0 x INunit | A | INunit | 519 | Defines the current level for flux braking. |
| P4.9 | P2.4.9 | DC Braking Current | 0.3 x INunit | 2.0 x INunit | A | INunit | 507 | Defines the current injected into the motor during DC brakeing. |
| P4.10 | P2.4.10 | Stop DC current time | 0.00 | 600.00 | s | 0.00 | 508 | Determines if braking is ON or OFF and the braking time of the DC-brake when the motor is stopping.<br>**0** = Not active |
| P4.11 | P2.4.11 | Stop DC current frequency | 0.10 | 10.00 | Hz | 1.50 | 515 | The output frequency at which the DC-braking is applied. |
| P4.12 | P2.4.12 | Start DC current time | 0.00 | 600.00 | s | 0.00 | 516 | **0** = Not active |

Table 7.5: Ramps and brake setup

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P4.13 | P2.4.13 | Accel2 Frequency Threshold | 0.00 | MI=P3.2 MR=P2.3.2 | Hz | 0.00 | 527 | 0.00 = disabled |
| P4.14 | P2.4.14 | Decel2 Frequency Threshold | 0.00 | MI=P3.2 MR=P2.3.2 | Hz | 0.00 | 528 | 0.00 = disabled |
| P4.15 | P2.4.15 | External Brake: Open Delay | 0.00 | 320.00 | s | 0.20 | 1544 | Delay to open brake after Open frequency limit is reached |
| P4.16 | P2.4.16 | External Brake: Open Frequency limit | 0.00 | MI=P3.2 MR=P2.3.2 | Hz | 1.50 | 1535 | Opening frequency from forward and reverse direction. |
| P4.17 | P2.4.17 | External Brake : Close Frequency limit | 0.00 | MI=P3.2 MR=P2.3.2 | Hz | 1.00 | 1539 | Close frequency from positive direction if no run command active. |
| P4.18 | P2.4.18 | External Brake : Close Frequency limit in Reverse | 0.00 | MI=P3.2 MR=P2.3.2 | Hz | 1.50 | 1540 | Close frequency from negative direction if no run command active. |
| P4.19 | P2.4.19 | External Brake : Open/Close Current limit | 0.0 | 200.0 | % | 20.0 | 1585 | The brake is not opened if the current does not exceed this value, and is closed immediately if current goes below. This parameter is set as a percent of Motor nominal current. |

Table 7.5: Ramps and brakes setup

## 7.6 Digital inputs (Control panel: Menu PAR -⟩ P5)

| Code | | Parameter | Min | Max | Unit | Default | ID | Note | |
|---|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | MI frame | MR frame |
| P5.1 | P2.5.1 | I / O control signal 1 | 0 | Varies | | 1 | 403 | **0** = Not used<br>**1** = DI1<br>**2** = DI2<br>**3** = DI3<br>**4** = DI4<br>**5** = DI5<br>**6** = DI6<br>**7** = DIE1<br>**8** = DIE2<br>**9** = DIE3<br>**10** = DIE4<br>**11** = DIE5<br>**12** = DIE6 | dI 0.1 = Not used<br>dI A.1 = DI1<br>dI A.2 = DI2<br>dI A.3 = DI3<br>dI A.4 = DI4<br>dI A.5 = DI5<br>dI A.6 = DI6<br>dI E.1 = DIE1<br>dI E.2 = DIE2<br>dI E.3 = DIE3<br>dI E.4 = DIE4<br>dI E.5 = DIE5<br>dI E.6 = DIE6 |
| P5.2 | P2.5.2 | I / O control signal 2 | 0 | Varies | | 2 | 404 | As parameter P5.1 for MI frame and P2.5.1 for MR frame | |
| P5.3 | P2.5.3 | Reverse | 0 | Varies | | 0 | 412 | | |
| P5.4 | P2.5.4 | Ext. fault Close | 0 | Varies | | 6 | 405 | | |
| P5.5 | P2.5.5 | Ext. fault Open | 0 | Varies | | 0 | 406 | | |
| P5.6 | P2.5.6 | Fault reset | 0 | Varies | | 3 | 414 | | |
| P5.7 | P2.5.7 | Run enable | 0 | Varies | | 0 | 407 | | |
| P5.8 | P2.5.8 | Preset speed B0 | 0 | Varies | | 4 | 419 | | |
| P5.9 | P2.5.9 | Preset speed B1 | 0 | Varies | | 5 | 420 | | |
| P5.10 | P2.5.10 | Preset speed B2 | 0 | Varies | | 0 | 421 | | |
| P5.11 | P2.5.11 | Ramp time 2 selection | 0 | Varies | | 0 | 408 | | |
| P5.12 | P2.5.12 | Motor potentiometer up | 0 | Varies | | 0 | 418 | | |
| P5.13 | P2.5.13 | Motor potentiometer down | 0 | Varies | | 0 | 417 | | |
| P5.14 | P2.5.14 | Remote control place 2 | 0 | Varies | | 0 | 425 | Activates control place 2<br>As parameter P5.1 for MI frame and P2.5.1 for MR frame | |
| P5.15 | P2.5.15 | Remote control place freq reference 2 | 0 | Varies | | 0 | 343 | Activates control reference 2<br>As parameter P5.1 for MI frame and P2.5.1 for MR frame | |
| P5.16 | P2.5.16 | PID setpoint 2 | 0 | Varies | | 0 | 1047 | Activates PID setpoint 2<br>As parameter P5.1 for MI frame and P2.5.1 for MR frame | |
| P5.17 | P2.5.17 | Motor PreHeat Active | 0 | Varies | | 0 | 1044 | Activates the Motor Pre- Heat (DC-Current) in stop state when parameter Motor Preheat function is set to 2 As parameter P5.1 for MI frame and P2.5.1 for MR frame | |

Table 7.6: Digital inputs

- PROGRAMMING OF DIGITAL AND ANALOGUE INPUTS

1) Setting to "not used" :
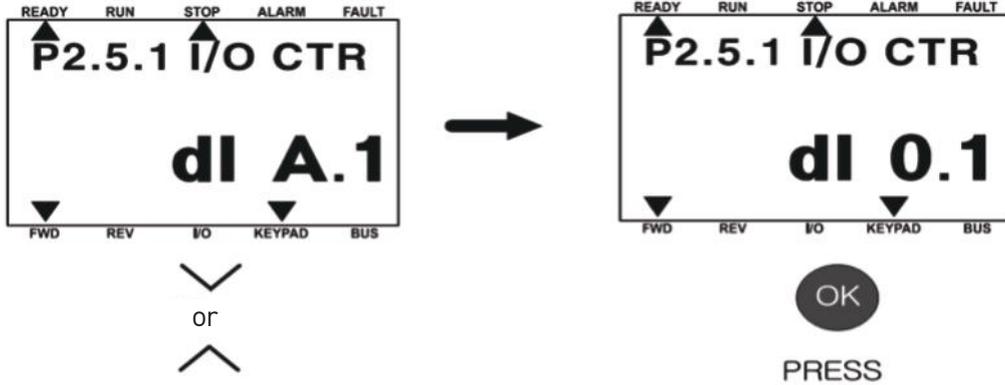


① In the edit mode, The letter "d" blinks.
   Press the UP/DOWN button

② Change to"dl 0.1",
   Press the OK button

2) Setting the digital output (for setting P2.5.1 to DIE2)
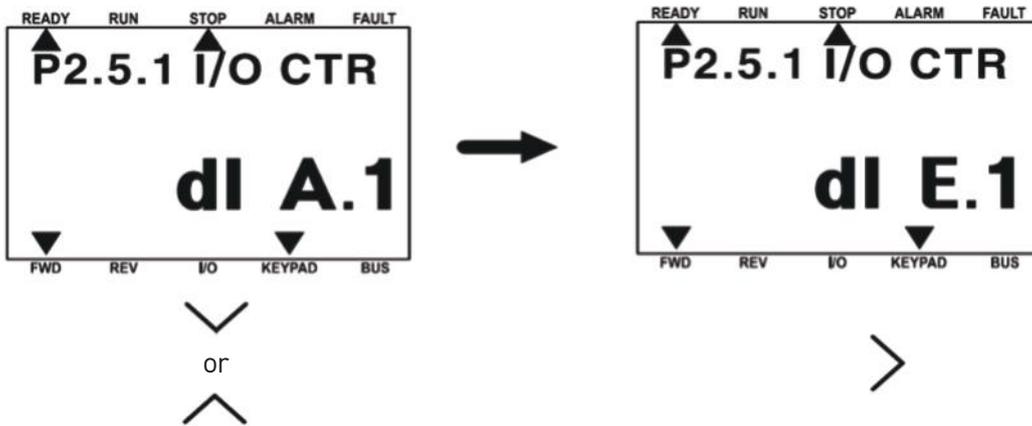


① In the edit mode, press the UP/DOWN

② Move to slot E, and press the
   Right button. Then, "1" blinks



③ Change 1 to 2 using UP button, then press OK button

## 7.7 Analogue inputs (Control panel: Menu PAR -> P6)

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P6.1 | P2.6.1 | AI1 Signal range | 0 | 1 | | 0 | 379 | **0** =0-100% (0-10V)<br>**1** =20-100% (2-10V) |
| P6.2 | P2.6.2 | AI1 Custom min | -100.00 | 100.00 | % | 0.00 | 380 | 0,00 = no min scaling |
| P6.3 | P2.6.3 | AI1 Custom max | -100.00 | 300.00 | % | 100.00 | 381 | 100.00 = no max scaling |
| P6.4 | P2.6.4 | AI1 filter time | 0.0 | 10.0 | s | 0.1 | 378 | 0 = no filtering |
| P6.5 | P2.6.5 | AI2 signal range | 0 | 1 | | 0 | 390 | As parameter P6.1 for MI frame and P2.6.1 for MR frame |
| P6.6 | P2.6.6 | AI2 Custom min | -100.00 | 100.00 | % | 0.00 | 391 | As parameter P6.2 for MI frame and P2.6.2 for MR frame |
| P6.7 | P2.6.7 | AI2 Custom max | -100.00 | 300.00 | % | 100.00 | 392 | As parameter P6.3 for MI frame and P2.6.3 for MR frame |
| P6.8 | P2.6.8 | AI2 filter time | 0.0 | 10.0 | s | 0.1 | 389 | As parameter P6.4 for MI frame and P2.6.4 for MR frame |
| P6.9 | P2.6.9 | AIE1 Signal range | 0 | 1 | | 0 | 143 | As parameter P6.1 for MI frame and P2.6.1 for MR-frame, hidden until an option board is connected |
| P6.10 | P2.6.10 | AIE1 Custom Min | -100.00 | 100.00 | % | 0.00 | 144 | As parameter P6.2 for MI frame and P2.6.2 for MR-frame, hidden until an option board is connected |
| P6.11 | P2.6.11 | AIE1 Custom Max | -100.00 | 300.00 | % | 100.00 | 145 | As parameter P6.3 for MI frame and P2.6.3 for MR-frame, hidden until an option board is connected |
| P6.12 | P2.6.12 | AIE1 Filter time | 0.0 | 10.0 | s | 0.1 | 142 | As parameter P6.4, for MI frame and P2.6.4 for MR frame, hidden until an option board is connected |

Table 7.7: Analogue inputs

## 7.8 Pulse train / Encoder (Only MI frame, Control panel : Menu PAR -→ P7)

| Code | Parameter | Min | Max | Unit | Default | ID | Note |
|------|-----------|-----|-----|------|---------|-----|------|
| P7.1 | Min pulse frequency | 0 | 10000 | Hz | 0 | 1229 | Pulse frequency to be interpreted as a 0% signal. |
| P7.2 | Max pulse frequency | 0.0 | 10000 | Hz | 10000 | 1230 | Pulse frequency to be interpreted as a 100% signal. |
| P7.3 | Freq. ref. at min pulse freq. | 0.00 | P3.2 | Hz | 0.00 | 1231 | Frequency corresponding to 0% if used as frequency reference. |
| P7.4 | Freq. ref. at max pulse freq. | 0.00 | P3.2 | Hz | 50.00 /60.00 | 1232 | Frequency corresponding to 0% if used as frequency reference. |

Table 7.8: Pulse train/Encoder

| Code | Parameter | Min | Max | Unit | Default | ID | Note |
|------|-----------|-----|-----|------|---------|-----|------|
| P7.5 | Encoder direction | 0 | 2 | | 0 | 1233 | **0** = Disable<br>**1** = Enable / Normal<br>**2** = Enable / Inverted |
| P7.6 | Encoder pulses / revolution | 1 | 65535 | ppr | 256 | 629 | Pulse count of encoder per round. Used for scaling encoder rpm monitor value only. |
| P7.7 | Config DI5 and DI6 | 0 | 2 | | 0 | 1165 | **0** = DI5 and DI6 are for normal digital input<br>**1** = DI6 is for pulse train<br>**2** = DI5 and DI6 are for encoder frequence mode |

Table 7.8: Pulse train/Encoder

## 7.9   Digital Outputs(Control panel: Menu PAR -> P8)

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P8.1 | P2.8.1 | RO1 signal selection | 0 | Varies | | 2 | 313 | **0** = Not used<br>**1** = Ready<br>**2** = Run<br>**3** = Fault<br>**4** = Fault Inverted<br>**5** = Warning<br>**6** = Reversed<br>**7** = At Speed<br>**8** = Motor regulator active<br>**9** = FB Control Word.B13<br>**10** = FB Control Word.B14<br>**11** = FB Control Word.B15<br>**12** = Output freq superv.<br>**13** = Output torque superv.<br>**14** = Unit temperature superv.<br>**15** = Analogue input superv.<br>**16** = Preset Speed Active<br>**17** = External Brake ctrl<br>**18** = Keypad control active<br>**19** = I / O control active<br>**20** = Temperature supervision |
| P8.2 | P2.8.2 | RO2 signal selcetion | 0 | Varies | | 3 | 314 | As parameter P8.1 for MI frame and P2.8.2 for MR frame |
| P8.3 | P2.8.3 | DO1 signal selcetion for MI frame / RO3 signal selection for MR frame | 0 | Varies | | 1 | 312 | As parameter P8.1 for MI frame and P2.8.2 for MR frame |

Table 7.9: Digital outputs

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P8.4 | P2.8.4 | RO2 inversion | 0 | 1 | | 0 | 1588 | **0** = No inversion<br>**1** = Inverted |
| P8.5 | P2.8.5 | RO2 ON delay | 0.00 | 320.00 | s | 0.00 | 460 | 0,00 = No delay |
| P8.6 | P2.8.6 | RO2 OFF delay | 0.00 | 320.00 | s | 0.00 | 461 | 0,00 = No delay |
| P8.7 | P2.8.7 | RO1 inversion | 0 | 1 | | 0 | 1587 | **0** = No inversion<br>**1** = Inverted |
| P8.8 | P2.8.8 | RO1 ON delay | 0.00 | 320.00 | s | 0.00 | 458 | 0,00 = No delay |
| P8.9 | P2.8.9 | RO1 OFF delay | 0.00 | 320.00 | s | 0.00 | 459 | 0,00 = No delay |
| P8.10 | P2.8.10 | DOE1 signal selection | 0 | Varies | | 0 | 317 | As parameter P8.1 for MI frame and P2.8.2 for MRframe, hidden until an option board is connected |
| P8.11 | P2.8.11 | DOE2 signal selection | 0 | Varies | | 0 | 318 | As parameter P8.1 for MI frame and P2.8.2 for MRframe, hidden until an option board is connected |
| P8.12 | P2.8.12 | DOE3 signal selection | 0 | Varies | | 0 | 1386 | As parameter P8.1 for MI frame and P2.8.2 for MRframe, hidden until an option board is connected |
| P8.13 | P2.8.13 | DOE4 signal selection | 0 | Varies | | 0 | 1390 | As parameter P8.1 for MI frame and P2.8.2 for MRframe, hidden until an option board is connected |
| P8.14 | P2.8.14 | DOE5 signal selection | 0 | Varies | | 0 | 1391 | As parameter P8.1 for MI frame and P2.8.2 for MRframe, hidden until an option board is connected |
| P8.15 | P2.8.15 | DOE6 signal selection | 0 | Varies | | 0 | 1395 | As parameter P8.1 for MI frame and P2.8.2 for MRframe, hidden until an option board is connected |

Table 7.9: Digital outputs

## 7.10   Analogue outputs (Control panel: Menu PAR -> P9)

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P9.1 | P2.9.1 | Analog output signal selection | 0 | 14 | | 1 | 307 | **0** = Not used<br>**1** = Output freq. (0-fMAX)<br>**2** = Output current (0-INMOTOR)<br>**3** = Motor torque (0-TNMOTOR)<br>**4** = PID output (0 - 100%)<br>**5** = Freq. refer. (0-fMAX)<br>**6** = Motor speed (0-nMAX)<br>**7** = Motor power (0-PNMOTOR)<br>**8** = Motor Voltage (0-UNMOTOR)<br>**9** = DC-link Voltage (0 - 1000 V)<br>**10** = Process Data In1 (0 - 10000)<br>**11** = Process Data In2 (0 - 10000)<br>**12** = Process Data In3 (0 - 10000)<br>**13** = Process Data In4 (0 - 10000)<br>**14** = Test 100% |
| P9.2 | P2.9.2 | Analog output minimum | 0 | 1 | | 0 | 310 | **0** = 0 V / 0 mA<br>**1** = 2 V / 4 mA |
| P9.3 | P2.9.3 | Analog output scaling | 0.0 | 1000.0 | % | 100.0 | 311 | Scaling factor |
| P9.4 | P2.9.4 | Analog output filter time | 0.00 | 10.00 | s | 0.10 | 308 | Filter time |
| P9.5 | P2.9.5 | Analog output E1 signal selection | 0 | 14 | | 0 | 472 | As parameter P9.1 for MI frame and P2.9.1 for MR frame, hidden until an option board is connected |
| P9.6 | P2.9.6 | Analog output E1 minimum | 0 | 1 | | 0 | 475 | As parameter P9.2 for MI frame and P2.9.2 for MR frame, hidden until an option board is connected |
| P9.7 | P2.9.7 | Analog output E1 scaling | 0.0 | 1000.0 | % | 100.0 | 476 | As parameter P9.3 for MI frame and P2.9.3 for MR frame, hidden until an option board is connected |
| P9.8 | P2.9.8 | Analog output E1 filter time | 0.00 | 10.00 | s | 0.10 | 473 | As parameter P9.3 for MI frame and P2.9.4 for MR frame, hidden until an option board is connected |

Table 7.10: Analogue outputs

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P9.9 | P2.9.9 | Analog output E2 signal selection | 0 | 14 | | 0 | 479 | As parameter P9.1 for MI frame and P2.9.1 for MR frame, hidden until an option board is connected |
| P9.10 | P2.9.10 | Analog output E2 minimum | 0 | 1 | | 0 | 482 | As parameter P9.2 for MI frame and P2.9.2 for MR frame, hidden until an option board is connected |
| P9.11 | P2.9.11 | Analog output E2 scaling | 0.0 | 1000.0 | % | 100.0 | 483 | As parameter P9.3 for MI frame and P2.9.3 for MR frame, hidden until an option board is connected |
| P9.12 | P2.9.12 | Analog output E2 filter time | 0.00 | 10.00 | s | 0.10 | 480 | As parameter P9.3 for MI frame and P2.9.3 for MR frame, hidden until an option board is connected |

Table 7.10: Analogue outputs

## 7.11 Fieldbus Data-Mapping (Control panel: Menu PAR -> P10)

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P10.1 | P2.10.1 | FB Data Output 1 selection | 0 | Varies | | 0 | 852 | 0 = Frequency reference<br>1 = Output reference<br>2 = Motor speed<br>3 = Motor current<br>4 = Motor voltage<br>5 = Motor torque<br>6 = Motor power<br>7 = DC link voltage<br>8 = Active fault code<br>9 = Analogue AI1<br>10 = Analogue AI2<br>11 = Digital input state<br>12 = PID feedback value<br>13 = PID setpoint<br>14 = Pulse train / encoder input (%)<br>15 = Pulse train / encoder pulse()<br>16 = AIE1 |
| P10.2 | P2.10.2 | FB Data Output 2 selection | 0 | Varies | | 1 | 853 | Variable mapped on PD2 |
| P10.3 | P2.10.3 | FB Data Output 3 selection | 0 | Varies | | 2 | 854 | Variable mapped on PD3 |
| P10.4 | P2.10.4 | FB Data Output 4 selection | 0 | Varies | | 4 | 855 | Variable mapped on PD4 |

Table 7.11: Fieldbus Data-Mapping

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P10.5 | P2.10.5 | FB Data Output 5 selection | 0 | Varies | | 5 | 856 | Variable mapped on PD5 |
| P10.6 | P2.10.6 | FB Data Output 6 selection | 0 | Varies | | 3 | 857 | Variable mapped on PD6 |
| P10.7 | P2.10.7 | FB Data Output 7 selection | 0 | Varies | | 6 | 858 | Variable mapped on PD7 |
| P10.8 | P2.10.8 | FB Data Output 8 selection | 0 | Varies | | 7 | 859 | Variable mapped on PD8 |
| P10.9 | P2.10.9 | Aux CW Data In selection | 0 | 5 | | 0 | 1167 | PDI for Aux CW<br>**0** = Not used<br>**1** = PDI1<br>**2** = PDI2<br>**3** = PDI3<br>**4** = PDI4<br>**5** = PDI5 |

Table 7.11: Fieldbus Data-Mapping

## 7.12    Prohibited Frequencies (Control panel: Menu PAR -> P11)

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P11.1 | P2.11.1 | Prohibit Frequency Range 1 Low Limit | 0.00 | MI=P3.2 MR=P2.3.2 | Hz | 0.00 | 509 | Low Limit<br>**0** = Not used |
| P11.2 | P2.11.2 | Prohibit Frequency Range 1 High Limit | 0.00 | MI=P3.2 MR=P2.3.2 | Hz | 0.00 | 510 | High Limit<br>**0** = Not used |
| P11.3 | P2.11.3 | Prohibit Frequency Range 2 Low Limit | 0.00 | MI=P3.2 MR=P2.3.2 | Hz | 0.00 | 511 | Low Limit<br>**0** = Not used |
| P11.4 | P2.11.4 | Prohibit Frequency Range 2 High Limit | 0.00 | MI=P3.2 MR=P2.3.2 | Hz | 0.00 | 512 | High Limit<br>**0** = Not used |

Table 7.12: Prohibited Frequencies

## 7.13 Limit Supervisions (Control panel: Menu PAR -〉 P12)

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P12.1 | P2.12.1 | Output freq. supervision function | 0 | 2 | | 0 | 315 | **0** = Not used<br>**1** = Low limit<br>**2** = High limit |
| P12.2 | P2.12.2 | Output freq. supervision limit | 0.00 | MI=P3.2 MR=P2.3.2 | Hz | 0.00 | 316 | Output frequency supervision threshold |
| P12.3 | P2.12.3 | Torque supervision function | 0 | 2 | | 0 | 348 | **0** = Not used<br>**1** = Low limit<br>**2** = High limit |
| P12.4 | P2.12.4 | Torque supervision limit | 0.00 | 300.0 | % | 0.0 | 349 | Torque supervision Threshold |
| P12.5 | P2.12.5 | Unit Temperature Supervision | 0 | 2 | | 0 | 354 | **0** = Not used<br>**1** = Low limit<br>**2** = High limit |
| P12.6 | P2.12.6 | Unit Temperature Supervision Limit | -10 | 100 | °C | 40 | 355 | Unit temperature supervision threshold |
| P12.7 | P2.12.7 | Analogue input superv signal | 0 | Varies | | 0 | 356 | **0** = AI1<br>**1** = AI2<br>**2** = AIE1 |
| P12.8 | P2.12.8 | AI superv ON level | 0.00 | 100.00 | % | 80.00 | 357 | ON threshold AI superv. |
| P12.9 | P2.12.9 | AI superv OFF level | 0.00 | 100.00 | % | 40.00 | 358 | OFF threshold AI superv. |
| P12.10 | P2.12.10 | Temperature supervision input | 1 | 7 | | 1 | 1431 | Binary-coded selection of signals to use for temperature supervision<br>**B0** = Temperature input 1<br>**B1** = Temperature input 2<br>**B2** = Temperature input 3<br>**NOTE!** Hidden until an option board is connected |
| P12.11 | P2.12.11 | Temperature supervision function | 0 | 2 | | 2 | 1432 | As parameter P12.5 for MI frame and P2.12.5 for MR frame, hidden until an option board is connected |
| P12.12 | P2.12.12 | Temperature supervision limit | -50.0 /223.2 | 200.0 /473.2 | | 80.0 | 1433 | Temperature supervision threshold, hidden until an option board is connected |

Table 7.13: Limit Supervisions

## 7.14   Protections (Control panel: Menu PAR -> P13)

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P13.1 | P2.13.1 | Analog Input low fault | 0 | 4 | | 1 | 700 | **0** = No action<br>**1** = Alarm<br>**2** = Alarm, preset alarm frequency<br>**3** = Fault: Stop function<br>**4** = Fault: Coast |
| P13.2 | P2.13.2 | Under voltage fault | 1 | 2 | | 2 | 727 | **1** = No response (no fault generated but drive still stops modulation)<br>**2** = Fault:Coast |
| P13.3 | P2.13.3 | Earth fault | 0 | 3 | | 2 | 703 | **0** = No action<br>**1** = Alarm<br>**2** = Fault:Stop function<br>**3** = Fault:Coast |
| P13.4 | P2.13.4 | Output Phase Fault | 0 | 3 | | 2 | 702 | As parameter P13.3 for MI frame and P2.13.3 for MR frame |
| P13.5 | P2.13.5 | Stall protection | 0 | 3 | | 0 | 709 | As parameter P13.3 for MI frame and P2.13.3 for MR frame |
| P13.6 | P2.13.6 | Under load protection | 0 | 3 | | 0 | 713 | As parameter P13.3 for MI frame and P2.13.3 for MR frame |
| P13.7 | P2.13.7 | Motor thermal protection | 0 | 3 | | 2 | 704 | As parameter P13.3 for MI frame and P2.13.3 for MR frame |
| P13.8 | P2.13.8 | Mtp:Ambient temperature | -20 | 100 | °C | 40 | 705 | Environment temperation |
| P13.9 | P2.13.9 | Mtp: Zero speed cooling | 0.0 | 150.0 | % | 40.0 | 706 | Cooling as % at 0 speed |
| P13.10 | P2.13.10 | Mtp:Thermal time constant | 1 | 200 | min | Varies | 707 | Motor thermal time constant |
| P13.11 | P2.13.11 | Stall Current | 0.00 | 2.0 x INunit | A | INunit | 710 | For a stall stage to occur, the current must have exceeded this limit |
| P13.12 | P2.13.12 | Stall time | 0.00 | 300.00 | s | 15.00 | 711 | Stall time limited |
| P13.13 | P2.13.13 | Stall frequency | 0.10 | 320.00 | Hz | 25.00 | 712 | Stall min. frequency |
| P13.14 | P2.13.14 | UL:Field weakening load | 10.0 | 150.0 | % | 50.0 | 714 | Minimum torque at field weakening |
| P13.15 | P2.13.15 | UL:Zero freq load | 5.0 | 150.0 | % | 10.0 | 715 | Minimum torque at 0HZ |

Table 7.14: Protections

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P13.16 | P2.13.16 | UL:Time limit | 1.0 | 300.0 | s | 20.0 | 716 | This is the maximum time allowed for an underload state to exist |
| P13.17 | P2.13.17 | Analog Input low fault delay | 0.0 | 10.0 | s | 0.5 | 1430 | Delay time for analog input low fault |
| P13.18 | P2.13.18 | External fault | 0 | 3 | | 2 | 701 | As parameter P13.3 for MI frame and P2.13.3 for MR frame |
| P13.19 | P2.13.19 | Fieldbus fault | 0 | 4 | | 3 | 733 | As parameter P13.1 for MI frame and P2.13.1 for MR frame |
| P13.20 | P2.13.20 | Preset alarm frequency | MI=P3.1 MR=P2.3.1 | MI=P3.2 MR=P2.3.2 | Hz | 25.00 | 183 | Frequency used when fault response is Alarm + preset Frequency. |
| P13.21 | P2.13.21 | Parameters edit lock | 0 | 1 | | 0 | 819 | **0** = Edit enabled<br>**1** = Edit disabled |
| P13.22 | P2.13.22 | Thermistor Fault | 0 | 3 | | 2 | 732 | **0** = No action<br>**1** = Alarm<br>**2** = Fault: Stop function<br>**3** = Fault: Coast<br>Hidden until an option board is connected. |
| P13.23 | P2.13.23 | FWD/REV conflict supervision | 0 | 3 | | 1 | 1463 | As parameter P13.3 for MI frame and P2.13.3 for MR frame |
| P13.24 | P2.13.24 | Temperature fault | 0 | 3 | | 0 | 740 | As parameter P13.3, hidden until an OPTBH board is connected |
| P13.25 | P2.13.25 | Temperature fault input | 1 | 7 | | 1 | 739 | Binary-coded selection of signals to use for alarm and fault triggering<br>**B0** = Temperature input 1<br>**B1** = Temperature input 2<br>**B2** = Temperature input 3<br>**NOTE!** Hidden until an OPTBH board is connected |
| P13.26 | P2.13.26 | Temperature fault mode | 0 | 2 | | 2 | 743 | **0** = Not used<br>**1** = Low limit<br>**2** = High limit |
| P13.27 | P2.13.27 | Temperature fault limit | -50.0 /223.2 | 200.0 /473.2 | | 100.0 | 742 | Temperature fault threshold, hidden until an OPTBH board is connected |

Table 7.14: Protections

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P13.28 | Not available | Input phase fault | 0 | 3 | | 3 | 730 | As parameter P13.3 |
| P13.29 | P2.13.29 | Motor temperature memory mode | 0 | 2 | | 2 | 15521 | 0 = Disabled<br>1 = Constant mode<br>2 = Last value mode |

Table 7.14: Protections

NOTE! These parameters are shown, when P17.2=0(MI frame), P2.17.2=0(MR frame).

## 7.15   Fault autoreset parameters (Control panel: Menu PAR -> P14)

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P14.1 | P2.14.1 | Automatic Reset | 0 | 1 | | 0 | 731 | **0** = Disabled<br>**1** = Enable |
| P14.2 | P2.14.2 | Wait time | 0.10 | 10.00 | s | 0.50 | 717 | Waiting time after fault |
| P14.3 | P2.14.3 | Trial time | 0.00 | 60.00 | s | 30.00 | 718 | Maximum time for trials |
| P14.4 | P2.14.4 | Trials number | 1 | 10 | | 3 | 759 | Maximum trials |
| P14.5 | P2.14.5 | Restart Function | 0 | 2 | | 2 | 719 | **0** = Ramping<br>**1** = Flying<br>**2** = From Start Function |

Table 7.15: Fault autoreset parameters

NOTE! These parameters are shown, when P17.2=0(MI frame), P2.17.2=0(MR frame).

## 7.16 PID control parameters (Control panel: Menu PAR -> P15)

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P15.1 | P2.15.1 | Setpoint source selection | 0 | Varies | | 0 | 332 | **0** = Fixed setpoint %<br>**1** = AI1<br>**2** = AI2<br>**3** = ProcessDataIn1 (0 -100%)<br>**4** = ProcessDataIn2 (0 -100%)<br>**5** = ProcessDataIn3 (0 -100%)<br>**6** = ProcessDataIn4 (0 -100%)<br>**7** = Pulse train/encoder (except MR frame)<br>**8** = AIE1<br>**9** = Temperature input 1<br>**10** = Temperature input 2<br>**11** = Temperature input 3 |
| P15.2 | P2.15.2 | Fixed setpoint | 0.0 | 100.0 | % | 50.0 | 167 | Fixed setpoint |
| P15.3 | P2.15.3 | Fixed setpoint 2 | 0.0 | 100.0 | % | 50.0 | 168 | Alternative fixed setpoint, selectable with DI |
| P15.4 | P2.15.4 | Feedback source selection | 0 | Varies | | 1 | 334 | **0** = AI1<br>**1** = AI2<br>**2** = ProcessDataIn1 (0 -100%)<br>**3** = ProcessDataIn2 (0 -100%)<br>**4** = ProcessDataIn3 (0 -100%)<br>**5** = ProcessDataIn4 (0 -100%)<br>**6** = AI2-AI1<br>**7** = Pulse train / encoder<br>**8** = AIE1<br>**9** = Temperature input 1<br>**10** = Temperature input 2<br>**11** = Temperature input 3 |
| P15.5 | P2.15.5 | Feedback value minumum | 0.0 | 50.0 | % | 0.0 | 336 | Value at minimum signal |
| P15.6 | P2.15.6 | Feedback value maximum | 10.0 | 300.0 | % | 100.0 | 337 | Value at maximum signal |
| P15.7 | P2.15.7 | P gain | 0.0 | 1000.0 | % | 100.0 | 118 | Proportional gain |

Table 7.16: PID control parameters

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P15.8 | P2.15.8 | I time | 0.00 | 320.00 | s | 10.00 | 119 | Integrative time |
| P15.9 | P2.15.9 | D time | 0.00 | 10.00 | s | 0.00 | 132 | Derivative time |
| P15.10 | P2.15.10 | Error inversion | 0 | 1 | | 0 | 340 | **0** = Direct (Feedback ⟨ Setpoint -⟩ Increase PID output) **1** = Inverted (Feedback ⟩ Setpoint -⟩ Decrease PID output) |
| P15.11 | P2.15.11 | Sleep minimum frequency | 0.00 | MI=P3.2 MR=P2.3.2 | Hz | 25.00 | 1016 | Drive goes to sleep mode when the output frequency stays below this limit for a time greater than that defined by parameter Sleep delay |
| P15.12 | P2.15.12 | Sleep delay | 0 | 3600 | s | 30 | 1017 | Delay for enter sleep |
| P15.13 | P2.15.13 | Wake up error | 0.0 | 100.0 | % | 5.0 | 1018 | Threshold for exit sleep |
| P15.14 | P2.15.14 | Sleep setpoint boost | 0.0 | 50.0 | % | 10.00 | 1071 | Referred to setpoint |
| P15.15 | P2.15.15 | Setpoint boost time | 0 | 60 | s | 10 | 1072 | Boost time after MI = P15.12, MR = P2.15.2 |
| P15.16 | P2.15.16 | Sleep maximum loss | 0.0 | 50.0 | % | 5.0 | 1509 | Referred to feedback value after boost |
| P15.17 | P2.15.17 | Sleep loss check time | 1 | 300 | s | 30 | 1510 | After boost time MI = P15.15, MR = P2.15.15 |
| P15.18 | P2.15.18 | Process unit source select | 0 | 6 | | 0 | 1513 | **0** = PID feedback value **1** = Output frequency **2** = Motor speed **3** = Motor torque **4** = Motor power **5** = Motor current **6** = Pulse Train / Encoder (except MR frame) |
| P15.19 | P2.15.19 | Process unit decimal digits | 0 | 3 | | 1 | 1035 | Decimals on display |
| P15.20 | P2.15.20 | Process unit minimum value | 0.0 | MI=P15.21 MR=P2.15.21 | | 0.0 | 1033 | Process min value |
| P15.21 | P2.15.21 | Process unit maximum value | MI=P15.20 MR=P2.15.20 | 3200.0 | | 100.0 | 1034 | Process max value |

Table 7.16: PID control parameters

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
| MI frame | MR frame | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| P15.22 | P2.15.22 | Temperature min value | -50.0 /223.2 | MI=P15.23 MR=P2.15.23 | | 0.0 | 1706 | Temperature min value for PID and frequency reference scale, hidden until an OPTBH board is connected |
| P15.23 | P2.15.23 | Temperature max value | MI=P15.22 MR=P2.15.22 | 200.0 /473.2 | | 100.0 | 1707 | Temperature max value for PID and frequency reference scale, hidden until an OPTBH board is connected |

Table 7.16: PID control parameters

⚠️ **NOTE!** These parameters are shown, when P17.2=0(MI frame), P2.17.2=0(MR frame).

### 7.17  Motor Pre-heat (Control panel: Menu PAR -> P16)

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P16.1 | P2.16.1 | Motor Pre-heat Function | 0 | 2 | | 0 | 1225 | **0** = Not used<br>**1** = Always in stop state<br>**2** = Controlled by digital input |
| P16.2 | P2.16.2 | Motor Pre-heat Current | 0 | 0.5 x INUNIT | A | 0 | 1227 | DC current for Pre-heating of motor and drive in stop state. Active in stop state or by digital input while in stop state. |

Table 7.17: Motor Pre-heat

### 7.18  Easy usage menu (Control panel: Menu PAR -> P17)

| Code | | Parameter | Min | Max | Unit | Default | ID | Note |
|---|---|---|---|---|---|---|---|---|
| MI frame | MR frame | | | | | | | |
| P17.1 | P2.17.1 | Application Type | 0 | 3 | | 0 | 540 | **0** = Basic<br>**1** = Pump<br>**2** = Fan drive<br>**3** = High Torque<br>**NOTE!** Visible only when Startup wizard is active. |
| P17.2 | P2.17.2 | Parameter conceal | 0 | 1 | | 1 | 115 | **0** = All parameters visible<br>**1** = Only quick setup parameter group visible |
| P17.3 | P2.17.3 | Temperature unit | 0 | 1 | | 0 | 1197 | **0** = Celsius<br>**1** = Kelvins<br>**NOTE!** Hidden until an OPTBH board is connected. |
| P17.4 | Not available | Application access password | 0 | 30000 | | 0 | 2362 | Input the right password could review parameter group 18. |

Table 7.18: Easy usage menu parameters

## 7.19   System parameters(supported by only MI frame)

| Code | Parameter | Min | Max | Default | ID | Note |
|------|-----------|-----|-----|---------|-----|------|
| | Software information (MENU PAR -> V1) | | | | | |
| V1.1 | API SW ID | | | | 2314 | |
| V1.2 | API SW version | | | | 835 | |
| V1.3 | Power SW ID | | | | 2315 | |
| V1.4 | Power SW version | | | | 834 | |
| V1.5 | Application ID | | | | 837 | |
| V1.6 | Application revision | | | | 838 | |
| V1.7 | System load | | | | 839 | |
| When no field bus Option Board or no OPT-BH Board has been installed, the Modbus comm. Parameters are as follows | | | | | | |
| V2.1 | Communication status | | | | 808 | Status of Modbus communication. Format: xx.yyy where xx = 0 - 64 (Number of error messages) yyy = 0 - 999 (Number of good messages) |
| P2.2 | Fieldbus protocol | 0 | 1 | | 809 | **0** = Not used  **1** = Modbus used |
| P2.3 | Slave address | 1 | 255 | 1 | 810 | |
| P2.4 | Baud rate | 0 | 8 | 5 | 811 | **0** = 300  **1** = 600  **2** = 1200  **3** = 2400  **4** = 4800  **5** = 9600  **6** = 19200  **7** = 38400  **8** = 57600 |
| P2.6 | Parity type | 0 | 2 | 0 | 813 | **0** = None  **1** = Even  **2** = Odd  The Stop Bit is 2-bit When Parity type is **0** = None;  The Stop Bit is 1-bit When Parity type is **1** = Even or **2** = Odd |

Table 7.19: System parameters

| Code | Parameter | Min | Max | Default | ID | Note |
|------|-----------|-----|-----|---------|-----|------|
| P2.7 | Communication time out | 0 | 255 | 10 | 814 | **0** = Not used<br>**1** = 1 sec<br>**2** = 2 secs, etc |
| P2.8 | Reset communication status | 0 | 1 | 0 | 815 | |
| **When Canopen E6 board has been installed, the comm. Parameters are as follows** | | | | | | |
| V2.1 | Canopen communication status | | | | 14004 | **0** = Initialising<br>**4** = Stopped<br>**5** = Operational<br>**6** = Pre_Operational<br>**7** = Reset_Application<br>**8** = Reset_Comm<br>**9** = Unknown |
| P2.2 | Canopen operation mode | 1 | 2 | 1 | 14003 | **1** = Driver Profile<br>**2** = Bypass |
| P2.3 | Canopen Node ID | 1 | 127 | 1 | 14001 | |
| P2.4 | Canopen baud rate | 1 | 8 | 6 | 14002 | **1** = 10 kBaud<br>**2** = 20 kBaud<br>**3** = 50 kBaud<br>**4** = 100 kBaud<br>**5** = 125 kBaud<br>**6** = 250 kBaud<br>**7** = 500 kBaud<br>**8** = 1000 kBaud |
| **When DeviceNet E7 board has been installed, the comm. Parameters are as follows** | | | | | | |
| V2.1 | Communication status | | | | 14014 | Format: **XXXX.Y**<br>**XXXX** = DeviceNet msg counter<br>**Y** = DeviceNet status.<br>**0** = Non-existent or no bus power.<br>**1** = Configuring state<br>**2** = Established<br>**3** = Timeout |
| P2.2 | Output assembly type | 20 | 111 | 21 | 14012 | 20, 21, 23, 25, 101, 111 |
| P2.3 | MAC ID | 0 | 63 | 63 | 14010 | |
| P2.4 | Baud rate | 1 | 3 | 1 | 14011 | **1** = 125 kbit/s<br>**2** = 250 kbit/s<br>**3** = 500 kbit/s |
| P2.5 | Input assembly type | 70 | 117 | 71 | 14013 | 70, 71, 73, 75, 107, 117 |

| Code | Parameter | Min | Max | Default | ID | Note |
|------|-----------|-----|-----|---------|-----|------|
| When Profibus E3/E5 board has been installed, the comm. Parameters are as follows | | | | | | |
| V2.1 | Communication status | | | | 14022 | |
| V2.2 | Fieldbus protocol status | | | | 14023 | |
| V2.3 | Active protocol | | | | 14024 | |
| V2.4 | Active buad rate | | | | 14025 | |
| V2.5 | Telegram type | | | | 14027 | |
| V2.6 | Operate mode | 1 | 3 | 1 | 14021 | **1** = Profidrive<br>**2** = Bypass<br>**3** = Echo |
| V2.7 | Slave address | 2 | 126 | 126 | 14020 | |
| When OPT-BH board has been installed, the comm. Parameters are as follows | | | | | | |
| P2.1 | Sensor 1 type | 0 | 6 | 0 | 14072 | **0** = No Sensor<br>**1** = PT100<br>**2** = PT1000<br>**3** = Ni1000<br>**4** = KTY84<br>**5** = 2 x PT100<br>**6** = 3 x PT100 |
| P2.2 | Sensor 2 type | 0 | 6 | 0 | 14073 | **0** = No Sensor<br>**1** = PT100<br>**2** = PT1000<br>**3** = Ni1000<br>**4** = KTY84<br>**5** = 2 x PT100<br>**6** = 3 x PT100 |
| P2.3 | Sensor 3 type | 0 | 6 | 0 | 14074 | **0** = No Sensor<br>**1** = PT100<br>**2** = PT1000<br>**3** = Ni1000<br>**4** = KTY84<br>**5** = 2 x PT100<br>**6** = 3 x PT100 |
| When OPT-EC board has been installed the comm. Parameters are as follows | | | | | | |
| V2.1 | Version number | | | 0 | | Version numbers of the board software |
| V2.2 | Board status | | | 0 | | State of the OPTEC board application |

Table 7.19: System parameters

| Code | Parameter | Min | Max | Default | ID | Note |
|------|-----------|-----|-----|---------|-----|------|
| Other information | | | | | | |
| V3.1 | MWh counter | | | | 827 | Million Watt Hour |
| V3.2 | Power on days | | | | 828 | |
| V3.3 | Power on hours | | | | 829 | |
| V3.4 | Run counter: Days | | | | 840 | |
| V3.5 | Run counter: Hours | | | | 841 | |
| V3.6 | Fault counter | | | | 842 | |
| V3.7 | Panel parameter set status monitor | | | | | Hidden when connect with PC. |
| P4.2 | Restore factory defaults | 0 | 1 | 0 | 831 | **1** = Restores factory defaults for all parameters |
| P4.3 | Password | 0000 | 9999 | 0000 | 832 | |
| P4.4 | Time for panel and lcd backlight active | 0 | 99 | 5 | 833 | |
| P4.5 | Save parameter set to panel | 0 | 1 | 0 | | Hidden when connect with PC. |
| P4.6 | Restore parameter set from panel | 0 | 1 | 0 | | Hidden when connect with PC. |
| F5.x | Active Fault menu | | | | | |
| F6.x | Fault History menu | | | | | |

Table 7.19: System parameters

# 8. PARAMETER DESCRIPTIONS

On the next pages you can find the descriptions of certain parameters. The descriptions have been arranged according to parameter group and number.

Note! The parameter groups and numbers in this chapter are written with the MI frame base, in case of the MR frame, the parameters are added with P2.

example) MI=P1.7 --→ MR=P2.1.7

## 8.1 Motor settings (Control panel: Menu PAR -〉 P1)

### 1.7 CURRENT LIMIT

This parameter determines the maximum motor current from the frequency converter. To avoid motor overload, set this parameter according to the rated current of the motor. The current limit is equal to (1.5 x In) by default.

### 1.8 MOTOR CONTROL MODE

With this parameter the user can select the motor control mode. The selections are:

#### 0 = Frequency control:

Drive frequency reference is set to output frequency without slip compensation. Motor actual speed is finally defined by motor load.

#### 1 = Open loop speed control:

Drive frequency reference is set to motor speed reference. The motor speed remains the same regardless of motor load. Slip is compensated.

### 1.9 U / F RATIO

There are three selections for this parameter:

#### 0 = Linear:

The voltage of the motor changes linearly with the frequency in the constant flux area from 0 Hz to the field weakening point where the field weakening point voltage is supplied to the motor. Linear U / f ratio should be used in constant torque applications. See Figure 8.1.
This default setting should be used if there is no special need for another setting.

**1 = Square:**

The voltage of the motor changes following a squared curve form with the frequency in the area from 0 Hz to the field weakening point where the field weakening point voltage is also supplied to the motor. The motor runs under magnetised below the field weakening point and produces less torque, power losses and electromechanical noise.
Squared U / f ratio can be used in applications where torque demand of the load is proportional to the square of the speed, e.g. in centrifugal fans and pumps.
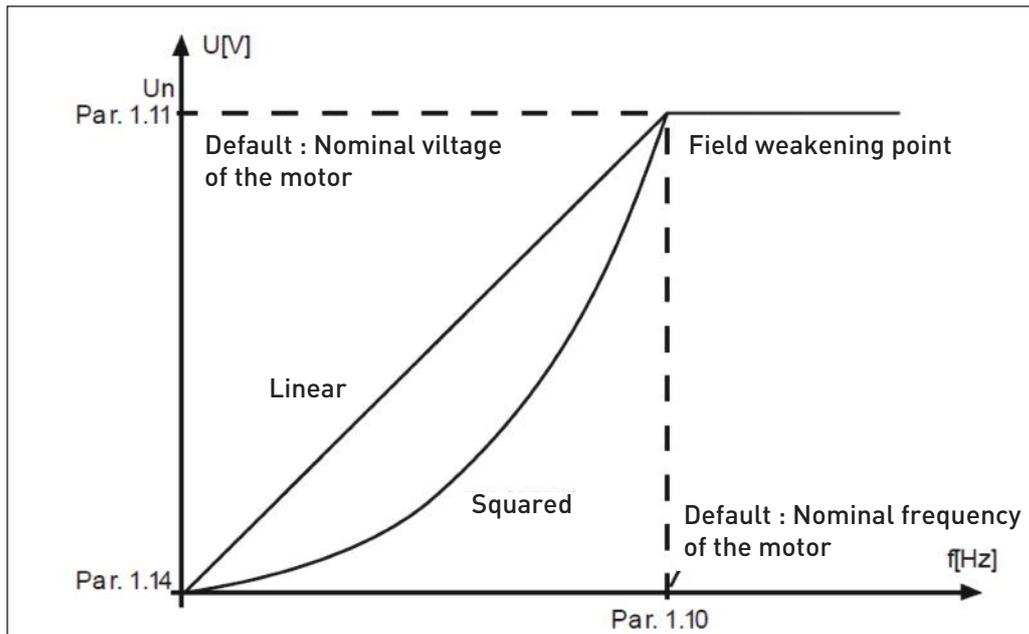


Figure 8.1: Linear and squared change of motor voltage

**2 = Programmable U / f curve:**

Drive frequency reference is set to output frequency without slip compensation. Motor actual speed is finally defined by motor load.
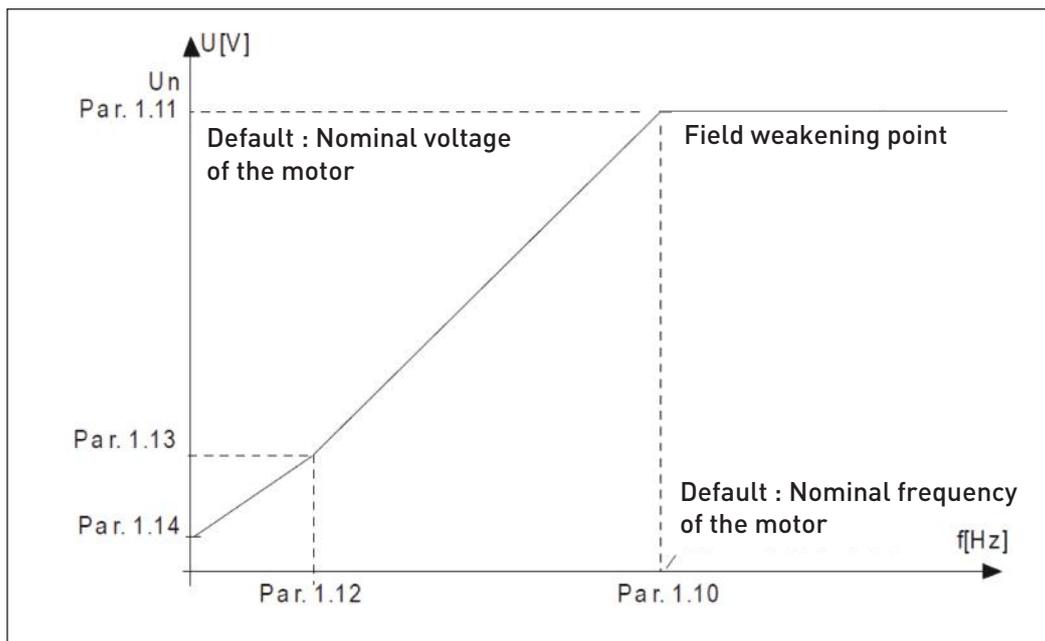
Figure 8.2: Programmable U / f curve

### 1.10    FIELD WEAKENING POINT

The field weakening point is the output frequency at which the output voltage reaches the value set with par. 1.11.

### 1.11    FIELD WEAKENING POINT VOLTAGE

Above the frequency at the field weakening point, the output voltage remains at the value set with this parameter. Below the frequency at the field weakening point, the output voltage depends on the setting of the U / f curve parameters. See parameters 1.9-1.14 and Figures 8.1 and 8.2.

When the parameters 1.1 and 1.2 (nominal voltage and nominal frequency of the motor) are set, the parameters 1.10 and 1.11 are automatically given the corresponding values. If you need different values for the field weak ening point and the voltage, change these parameters after setting the parameters 1.1 and 1.2.

### 1.12    U / F MIDDLE POINT FREQUENCY

If the programmable U / f curve has been selected with the parameter 1.9, this parameter defines the middle point frequency of the curve. See Figure 8.2.

### 1.13    U / F MIDDLE POINT VOLTAGE

If the programmable U / f curve has been selected with the parameter 1.9, this parameter defines the middle point voltage of the curve. See Figure 8.2.

### 1.14    ZERO FREQUENCY VOLTAGE

This parameter defines the zero frequency voltage of the curve. See Figures 8.1 and 8.2.

### 1.15   TORQUE BOOST

When this parameter has been activated, the voltage to the motor changes automatically with high load torque which makes the motor produce sufficient torque to start and run at low frequencies. The voltage increase de pends on the motor type and power. Automatic torque boost can be used in applications with high load torque, e.g. in conveyors.

**0** = Disabled
**1** = Enabled

**Note:** In high torque - low speed applications - it is likely that the motor will overheat. If the motor has to run a prolonged time under these conditions, special attention must be paid to cooling the motor. Use external cooling for the motor if the temperature tends to rise too high.

**Note:** The best performance can be reached by running motor identification,see par. 1.18.

### 1.16   SWITCHING FREQUENCY

Motor noise can be minimised using a high switching frequency. Increasing the switching frequency reduces the capacity of the frequency converter unit.

Switching frequency for N800S: 1.5...16 kHz.

### 1.17   BRAKE CHOPPE

**0 = Disable** (No brake chopper used)
**1 = Enable: Always** (Used in Run and Stop state)
**2 = Enable: Run state** (Brake chopper used in Run state)

WHEN THE FREQUENCY CONVERTER IS DECELERATING THE MOTOR, THE ENERGY STORED TO THE IN ERTIA OF THE MOTOR AND THE LOAD ARE FED INTO AN EXTERNAL BRAKE RESISTOR, IF THE BRAKE CHOPPER HAS BEEN ACTIVATED. THIS ENABLES THE FREQUENCY CONVERTER TO DECELERATE THE LOAD WITH A TORQUE EQUAL TO THAT OF ACCELERATION (PROVIDED THAT THE CORRECT BRAKE RESIS TOR HAS BEEN SELECTED). SEE SEPARATE BRAKE RESISTOR INSTALLATION MANUAL.

### 1.19   MOTOR IDENTIFICATION

**0** = Not active
**1** = Standstill identification

When Standstill identification is selected, the drive will perform an ID-run when it is started from selected control place. Drive has to be started within 20 seconds, otherwise identification is aborted.

The drive does not rotate the motor during Standstill identification. When ID run is ready the drive is stopped. Drive will start normally, when the next start command is given.

After end the identification, the drive need stop the start command. If control place is Keypad, user need press stop button. If control place is IO,user need put DI(Control signal) inactivate. If control place is fieldbus, user need set the control bit to 0.

The ID run improves the torque calculations and the automatic torque boost function. It will also result in a better slip compensation in speed control (more accurate RPM).

The parameters below will change after ID run successfully,

a. P1.8 Motor control mode
b. P1.9 U / f ratio
c. P1.12 U / f mid point frequency
d. P1.13 U / f mid point voltage
e. P1.14 Zero freq voltage
f. P1.19 Motor identification (1-→0)
g. P1.20 Rs voltage drop

**Note!**The nameplate data of the motor has to be set BEFORE doing ID run.

### 1.21    OVERVOLTAGE CONTROLLER

**0 = Disabled**

**1** = Enabled, Standard mode (Minor adjustments of OP frequency are made)
**2** = Enabled, Shock load mode (Controller adjusts OP freq. up to max.freq.)

### 1.22    UNDERVOLTAGE CONTROLLER

**0** = Disable
**1** = Enable

These parameters allow the under-/overvoltage controllers to be switched out of operation. This may be useful, for example, if the mains supply voltage varies more than –15% to +10% and the application will not tolerate this over- /undervoltage. In this case, the regulator controls the output frequency taking the supply fluctuations into account.

When a value other than 0 is selected also the Closed Loop overvoltage controller becomes active (in Multi-Purpose Control application).

**Note!** Over-/undervoltage trips may occur when controllers are switched out of operation.

## 1.25   EFFICIENCY OPTIMIZATION

Energy optimization, the frequency converter search for the minimum current in order to save energy and lower motor noise, **0** = disabled, **1** = enable.

## 1.26   I/F START ENABLE

The I/f Start function is typically used with permanent magnet motors (PM) to start the motor with constant current control. This is useful with high power motors in which the resistance is low and the tuning of the U/f curve difficult. Applying the I/f Start function may also prove useful in providing sufficient torque for the motor at startup.
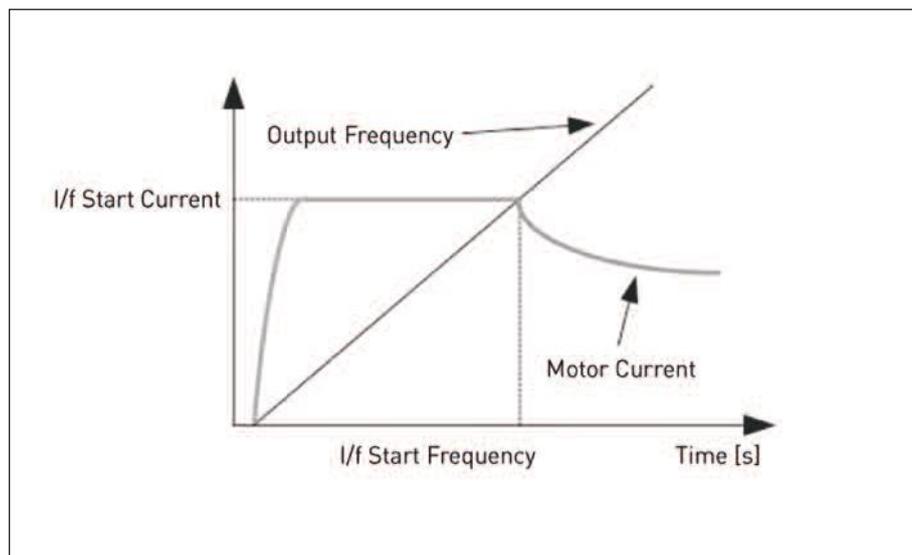


Figure 8.3: I/f Start

## 1.26   I/F START FREQUENCY REFERENCE LIMIT

Output frequency limit below which the defined I/f start current is fed to motor.

## 1.26   I/F START CURRENT REFERENCE

The current fed to the motor when the I/f start function is activated.

## 1.26   VOLTAGE LIMITER ENABLE

Voltage limiter function addresses problem with very high DC-link voltage ripple with 1-phase drives when fully loaded. Very high ripple in DC-link voltage will transform to high current and torque ripple, which can disturb some users. Voltage limiter function limits maximum output voltage to bottom of DCvoltage ripple. This reduces current and torque ripple, but decreases maximum output power since voltage is limited and more current is needed.

**0** = disable, **1** = enable.

## 8.2 Start / stop setup (Control panel: Menu PAR -> P2)

### 2.1 REMOTE CONTROL PLACE SELECTION

With this parameter, the user can select the active control place, frequency reference can be selected with P3.3/P3.12. The selections are:

**0** = I / O terminal
**1** = Fieldbus
**2** = Keypad

**Note:** You can select control place by pressing Loc / Rem button or with par. 2.5(Local / Remote), P2.1 will have no effect in local mode.

**Local** = Keypad is the control place
**Remote** = Control place determined by P2.1

### 2.2 START FUNCTION

The user can select two start functions for N800S with this parameter:

**0 = Ramp start**

The frequency converter starts from 0 Hz and accelerates to the set frequency reference within the set accel eration time (See detailed description: ID103). (Load inertia, torque or starting friction may cause prolonged acceleration times).

**1 = Flying start**

The frequency converter is able to start into a running motor by applying small current pulses to motor and searching for the frequency corresponding to the speed the motor is running at. Searching starts from the maximum frequency towards the actual frequency until the correct value is detected. Thereafter, the output frequency will be increased/ decreased to the set reference value according to the set acceleration/deceleration parameters. Use this mode if the motor is coasting when the start command is given. With the flying start it is possible to start the motor from actual speed without forcing the speed to zero before ramping to reference.

### 2.3 STOP FUNCTION

Two stop functions can be selected in this application:

**0 = Coasting**

The motor coasts to a halt without control from the frequency converter after the Stop command.

**1 = Ramping**

After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters.

If the regenerated energy is high it may be necessary to use an external braking resistor for to be able to decelerate the motor in acceptable time.

## 2.4  I / O START STOP LOGIC

Values 0...4 offer possibilities to control the starting and stopping of the AC drive with digital signal connected to digital inputs. CS = Control signal.

The selections including the text 'edge' shall be used to exclude the possibility of an unintentional start when, for example, power is connected, re-connected after a power failure, after a fault reset, after the drive is stopped by Run Enable (Run Enable = False) or when the control place is changed to I / O control.
**The Start / Stop contact must be opened before the motor can be started.**

I/O stop logic uses accurate stop mode.Accurate stop mode is that the stop time is fixed from falling edge of DI to power stopping the drive.

| Selection number | Selection name | Note |
|---|---|---|
| 0 | CS1:Forward<br><br>CS2:Backward | The functions take place when the contacts are closed. |
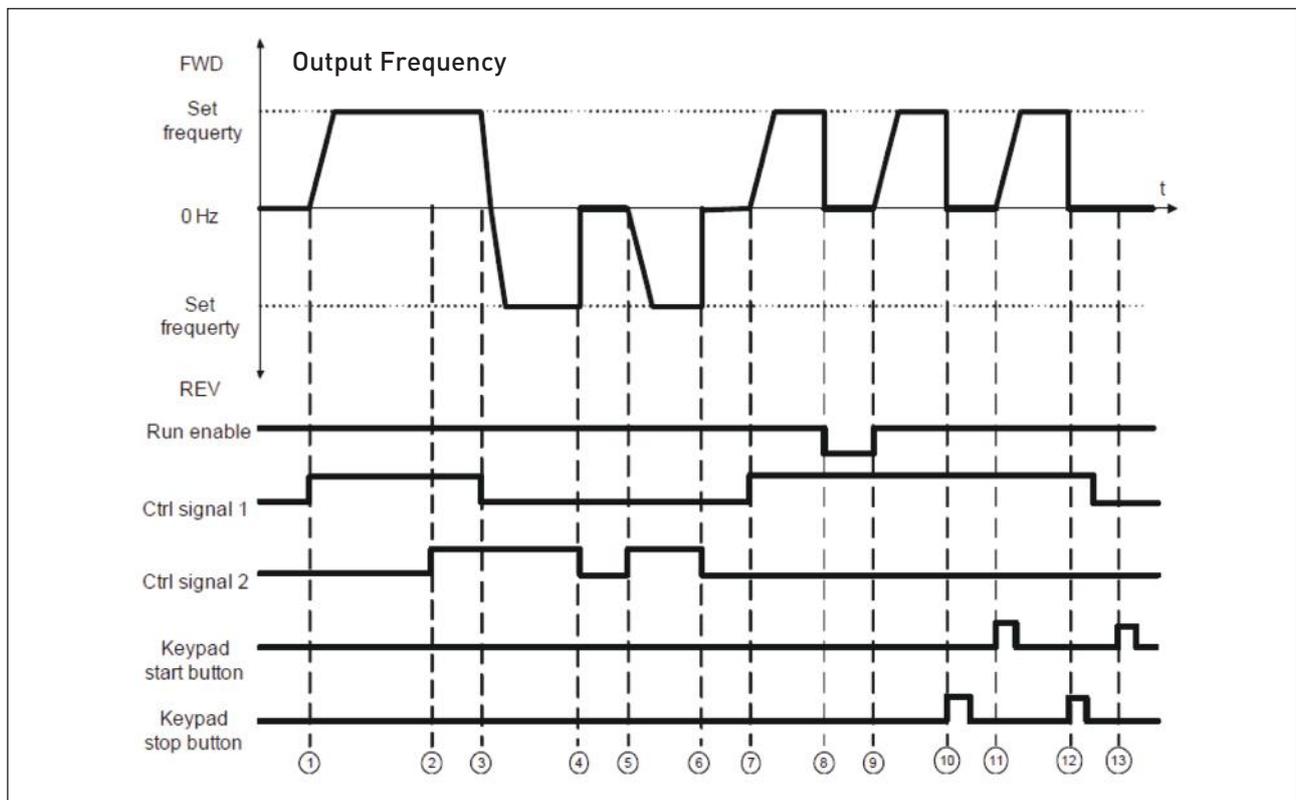


Figure 8.4: Start/Stop logic, selection 0

| | Explanations | | |
|---|---|---|---|
| ① | Control signal (CS) 1 actives causing the output frequency to rise. The motor runs forward. | ⑧ | Run enable signal is set to FALSE, which drops the frequency to 0.The run enable signal is configured with par. 5.7. |
| ② | If start forward signal [CS1] and start reverse signal [CS2] are active simultaneously, there is alarm 55 in LCD panel when P13.23 FWD/REV conflict supervision=1. | ⑨ | Run enable signal is set to TRUE, which causes the frequency to rise towards the set frequency because CS1 is still active. |
| ③ | CS1 is inactivated which caused the direction to start changing (FWD to REV) because CS2 is still active, and alarm 55 should be disappeared in a while time. | ⑩ | Keypad stop button is pressed and the frequency fed to the motor drops to 0.(This signal only works if Par. 2.7 [Keypad stop button] = 1) |
| ④ | CS2 inactivates and the frequency fed to the motor drops to 0. | ⑪ | The drive starts through pushing the Start button on the keypad. |
| ⑤ | CS2 actives again causing the motor to accelerate (REV) towards the set frequency. | ⑫ | The keypad stop button is pushed again to stop the drive. (This signal only works if Par. 2.7 [Keypad stop button] = 1) |
| ⑥ | CS2 inactivates and the frequency fed to the motor drops to 0. | ⑬ | The attempt to start the drive through pushing the Start button is not successful because CS1 is inactive. |
| ⑦ | CS1 actives and the motor accelerates (FWD) towards the set frequency. | | |

| Selection number | Selection name | Note |
|---|---|---|
| 1 | CS1:Forward(edge) <br><br> CS2:Inverted stop | |
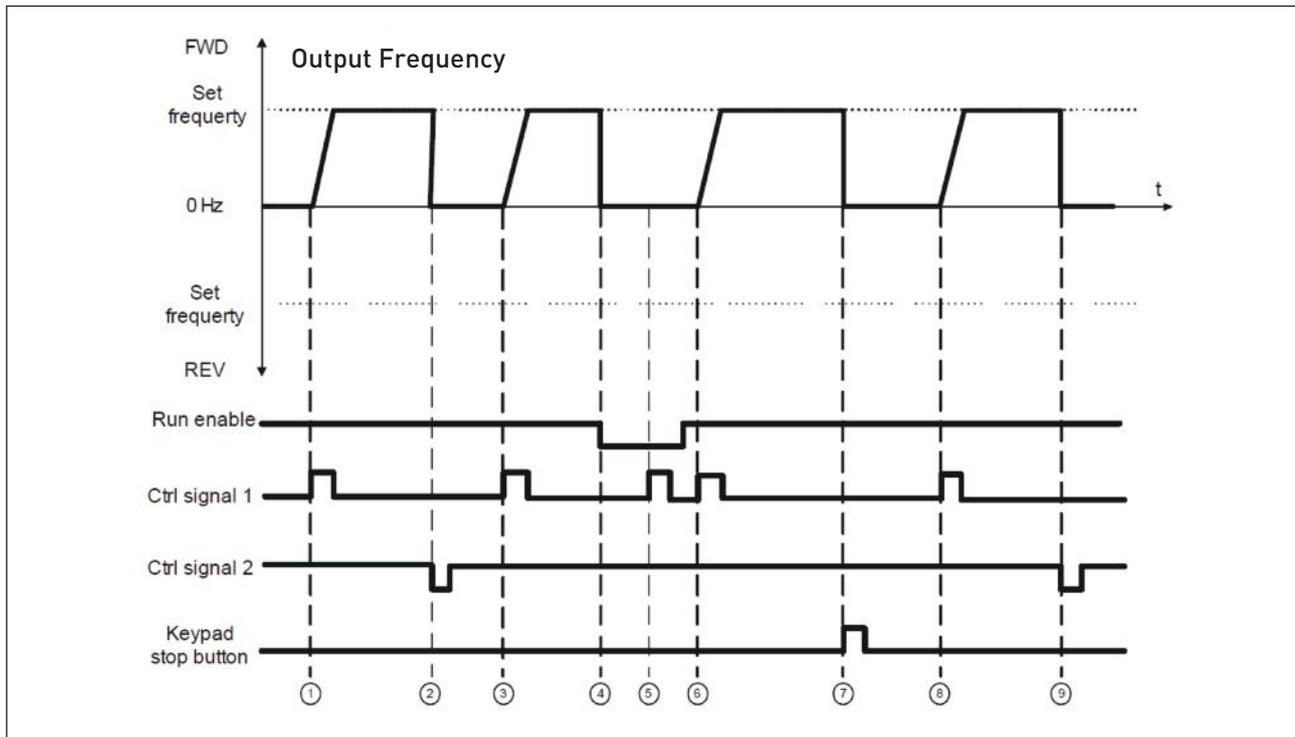


Figure 8.5: Start/Stop logic, selection 1

| Explanations | | | |
|---|---|---|---|
| ① | Control signal (CS) 1 actives causing the output frequency to rise. The motor runs forward. | ⑥ | CS1 activates and the motor accelerates (FWD) towards the set frequency because the Run enable signal has been set to TRUE. |
| ② | CS2 inactivates causing the frequency to drop to 0. | ⑦ | Keypad stop button is pressed and the frequency fed to the motor drops to 0.(This signal only works if Par.2.7 [Keypad stop button] = 1) |
| ③ | CS1 activates causing the output frequency to rise again. The motor runs forward. | ⑧ | CS1 activates causing the output frequency to rise again. The motor runs forward. |
| ④ | Run enable signal is set to FALSE, which drops the frequency to 0. The run enable signal is configured with par. 5.7. | ⑨ | CS2 inactivates causing the frequency to drop to 0. |
| ⑤ | Start attempt with CS1 is not successful because Run enable signal is still FALSE. | | |

| Selection number | Selection name | Note |
|---|---|---|
| 2 | CS1:Forward(edge) <br> CS2:Backward(edge) | Shall be used to exclude the possibility of an unintentional start. The Start / Stop contact must be opened before the motor can be restarted. |



Figure 8.6: Start/Stop logic, selection 2

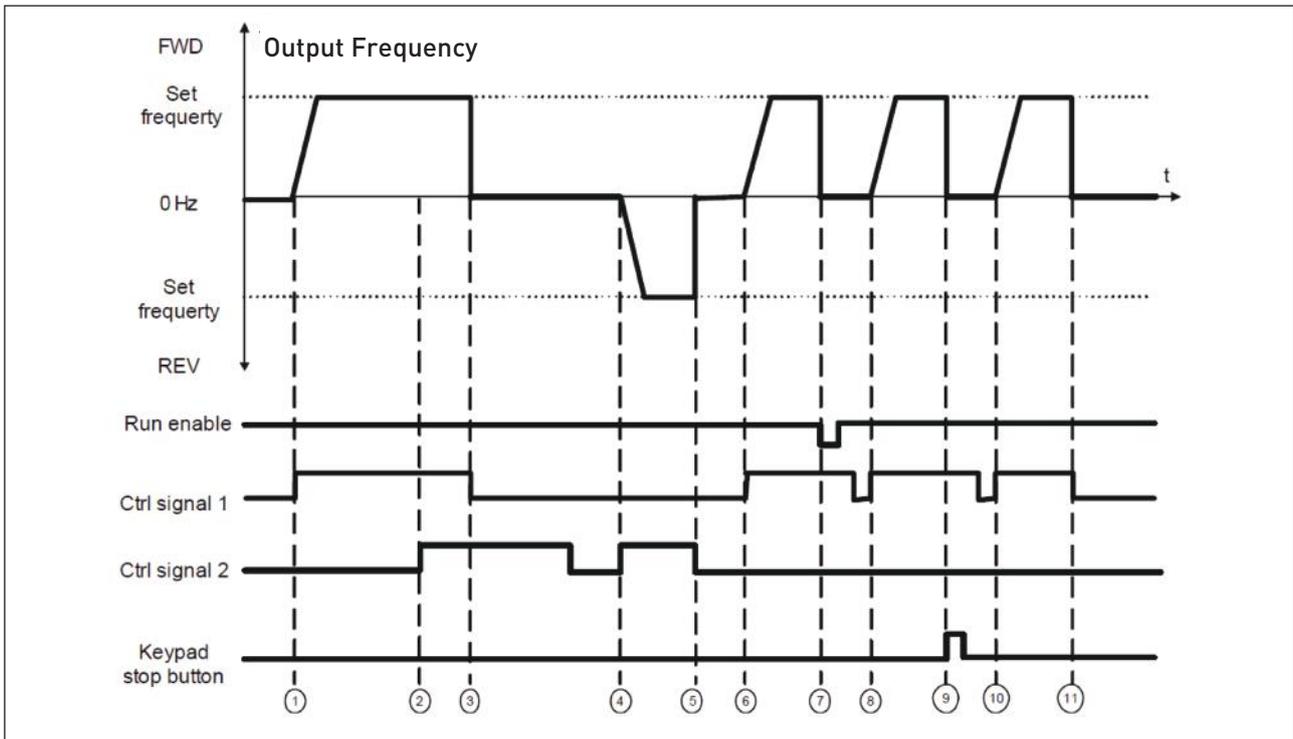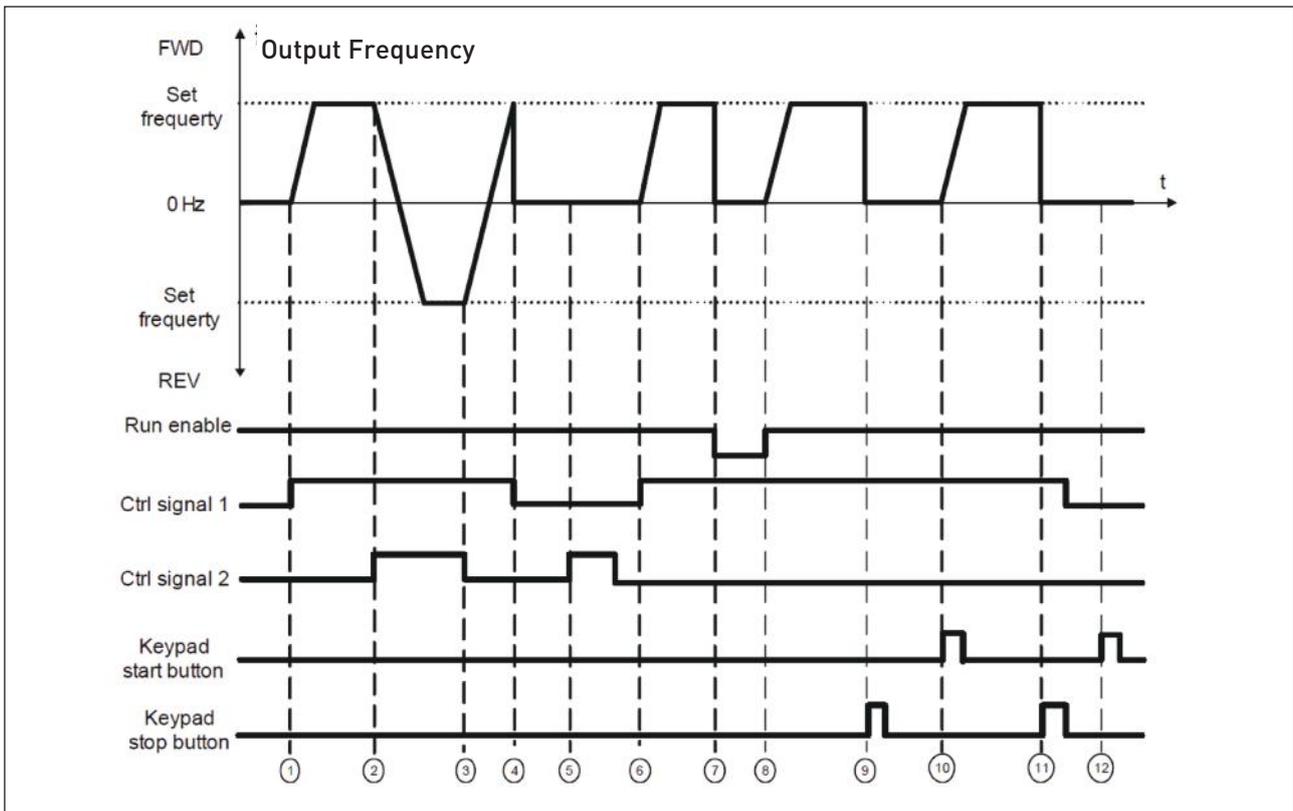| Explanations: | | | |
|---|---|---|---|
| ① | Control signal (CS) 1 actives causing the output frequency to rise. The motor runs forward. | ⑦ | Run enable signal is set to FALSE, which drops the frequency to 0.The run enable signal is configured with par. 5.7. |
| ② | If start forward signal [CS1] and start reverse signal [CS2] are active simultaneously, there is alarm 55 in LCD panel when P13.23 FWD/REV conflict supervision=1. | ⑧ | CS1 activates and the motor accelerates (FWD) towards the set frequency because the Run enable signal has been set to TRUE. |
| ③ | CS1 is inactivated the motor is still stopped though CS2 is still active, and alarm 55 should be disappeared in a while time. | ⑨ | Keypad stop button is pressed and the frequency fed to the motor drops to 0.(This signal only works if Par.2.7 [Keypad stop button] = 1) |
| ④ | CS2 activates again causing the motor to accelerate (REV) towards the set frequency. | ⑩ | CS1 is opened and closed again which causes the motor to start. |
| ⑤ | CS2 inactivates and the frequency fed to the motor drops to 0. | ⑪ | CS1 inactivates and the frequency fed to the motor drops to 0. |
| ⑥ | CS1 activates and the motor accelerates (FWD) towards the set frequency. | | |

| Selection number | Selection name | Note |
|---|---|---|
| 3 | CS1:Start<br><br>CS2:Reverse | |



Figure 8.7: Start/Stop logic, selection 3

| Explanations: | | | |
|---|---|---|---|
| ① | Control signal (CS) 1 actives causing the output frequency to rise. The motor runs forward. | ⑦ | Run enable signal is set to FALSE, which drops the frequency to 0.The run enable signal is configured with par. 5.7. |
| ② | CS2 activates which causes the direction to start changing (FWD to REV). | ⑧ | Run enable signal is set to TRUE, which causes the frequency to rise towards the set frequency because CS1 is still active. |
| ③ | CS2 is inactivated which causes the direction to start changing (REV to FWD) because CS1 is still active. | ⑨ | Keypad stop button is pressed and the frequency fed to the motor drops to 0.(This signal only works if Par.2.7 [Keypad stop button] = 1) |
| ④ | Also CS1 inactivates and the frequency drops to 0. | ⑩ | The drive starts through pushing the Start button on the keypad. |
| ⑤ | Despite the activates of CS2,the motor does not start because CS1 is inactive. | ⑪ | The drive is stopped again with the Stop button on the Keypad. |
| ⑥ | CS1 activates causing the output frequency to rise again. The motor runs forward because CS2 is inactive | ⑫ | The attempt to start the drive through pushing the Start button is not successful because CS1 is inactive. |

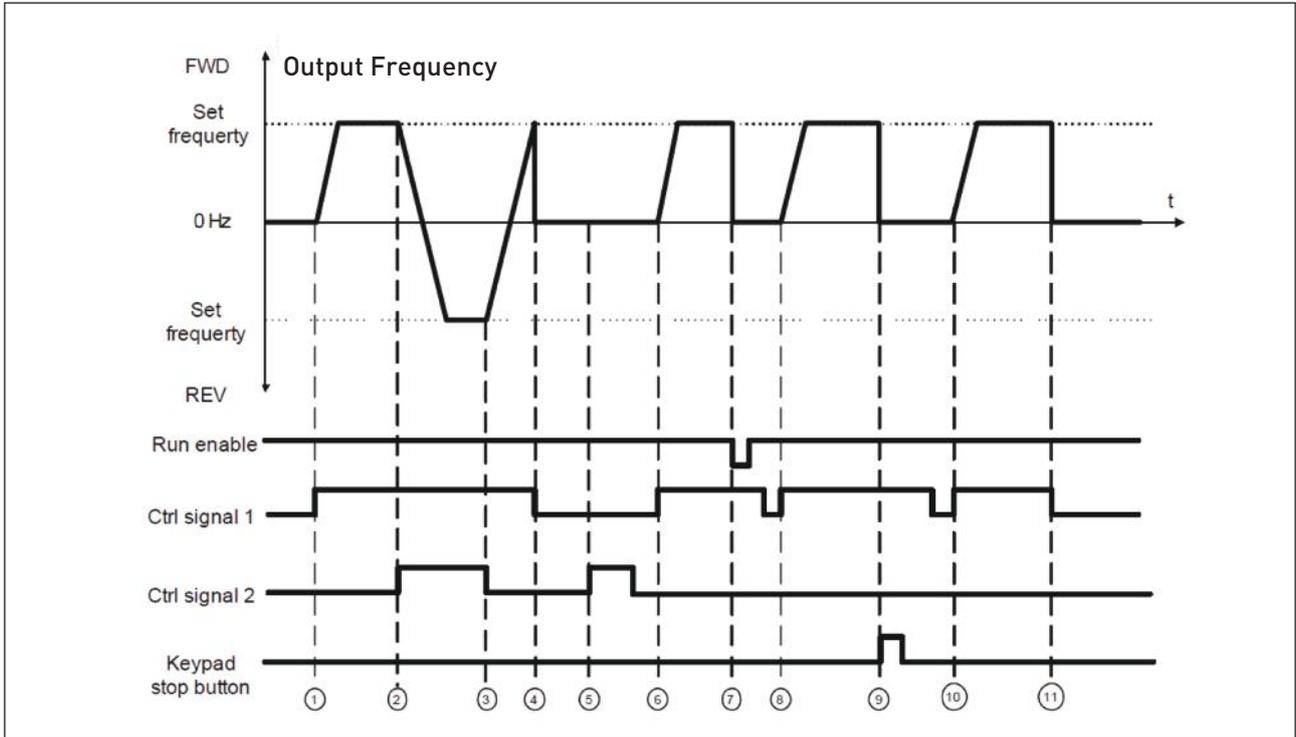| Selection number | Selection name | Note |
|---|---|---|
| 4 | CS1:Start(edge)<br><br>CS2:Reverse | Shall be used to exclude the possibility of an unintentional start. The Start / Stop contact must be opened before the motor can be restarted. |



Figure 8.8: Start/Stop logic, selection 4

| Explanations: | | |
|---|---|---|
| ① Control signal (CS) 1 actives causing the output frequency to rise. The motor runs forward because CS2 is inactive.. | ⑦ | Run enable signal is set to FALSE, which drops the frequency to 0.The run enable signal is configured with par. 5.7. |
| ② CS2 activates which causes the direction to start changing (FWD to REV). | ⑧ | Before a successful start can take place, CS1 must be opened and closed again. |
| ③ CS2 is inactivated which causes the direction to start changing (REV to FWD) because CS1 is still active. | ⑨ | Keypad stop button is pressed and the frequency fed to the motor drops to 0.(This signal only works if Par.2.7 [Keypad stop button] = 1) |
| ④ Also CS1 inactivates and the frequency drops to 0. | ⑩ | Before a successful start can take place, CS1 must be opened and closed again. |
| ⑤ Despite the activation of CS2, the motor does not start because CS1 is inactive. | ⑪ | CS1 inactivates and the frequency drops to 0. |
| ⑥ CS1 activates causing the output frequency to rise again. The motor runs forward because CS2 is inactive. | | |

## 2.5   LOCAL/REMOTE

This parameter defines whether the control place of the drive is remote (I / O or FieldBus) or local.

**0** = Remote Control
**1** = Local Control

The priority order of selecting control place is

1. PC control by N800 HIMS
2. Loc / Rem button
3. Forced from I / O terminal

## 8.3   Frequency references (Control panel: Menu PAR -> P3)

### 3.3   REMOTE CONTROL PLACE FREQUENCY REFERENCE SELECTION

It defines the selected frequency reference source when the drive is remote control. A second reference source is programmable in par. 3.12.

**1** = Preset speed 0

**2** = Keypad reference

**3** = Fieldbus Reference

**4** = AI1

**5** = AI2

**6** = PID

**7** = AI1+AI2

**8** = Motor potentiometer

**9** = Pulse train / Encoder

### 3.4 - 3.11   PRESET SPEEDS 0 - 7

Preset speed 0 is used as frequency reference when P3.3 = 1.

Preset speeds 1 - 7 can be used to determine frequency references that are applied when appropriate combinations of digital inputs are activated. Preset speeds can be activated from digital inputs despite of the active control place.

Parameter values are automatically limited between the minimum and maximum frequencies. (par. 3.1, 3.2).

| Speed | Preset speed B2 | Preset speed B1 | Preset speed B0 |
|---|---|---|---|
| Preset speed 1 | | | x |
| Preset speed 2 | | x | |
| Preset speed 3 | | x | x |
| Preset speed 4 | x | | |
| Preset speed 5 | x | | x |
| Preset speed 6 | x | x | |
| Preset speed 7 | x | x | x |

Table 8.1: Preset speeds 1 - 7

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### 3.13   MOTOR POTENTIOMETER RAMP

P3.13 is the speed variation ramp when motor potentiometer reference is increased or decreased.

### 3.14   MOTOR POTENTIOMETER RESET

P3.14 tells under which circumstances the potentiometers reference should be reset and start over from 0 Hz.

0 = No Reset
1 = Reset if stopped
2 = Reset if powered down

P5.12 and P5.13 sets which digital inputs increase and decrease the motor potentiometers reference.
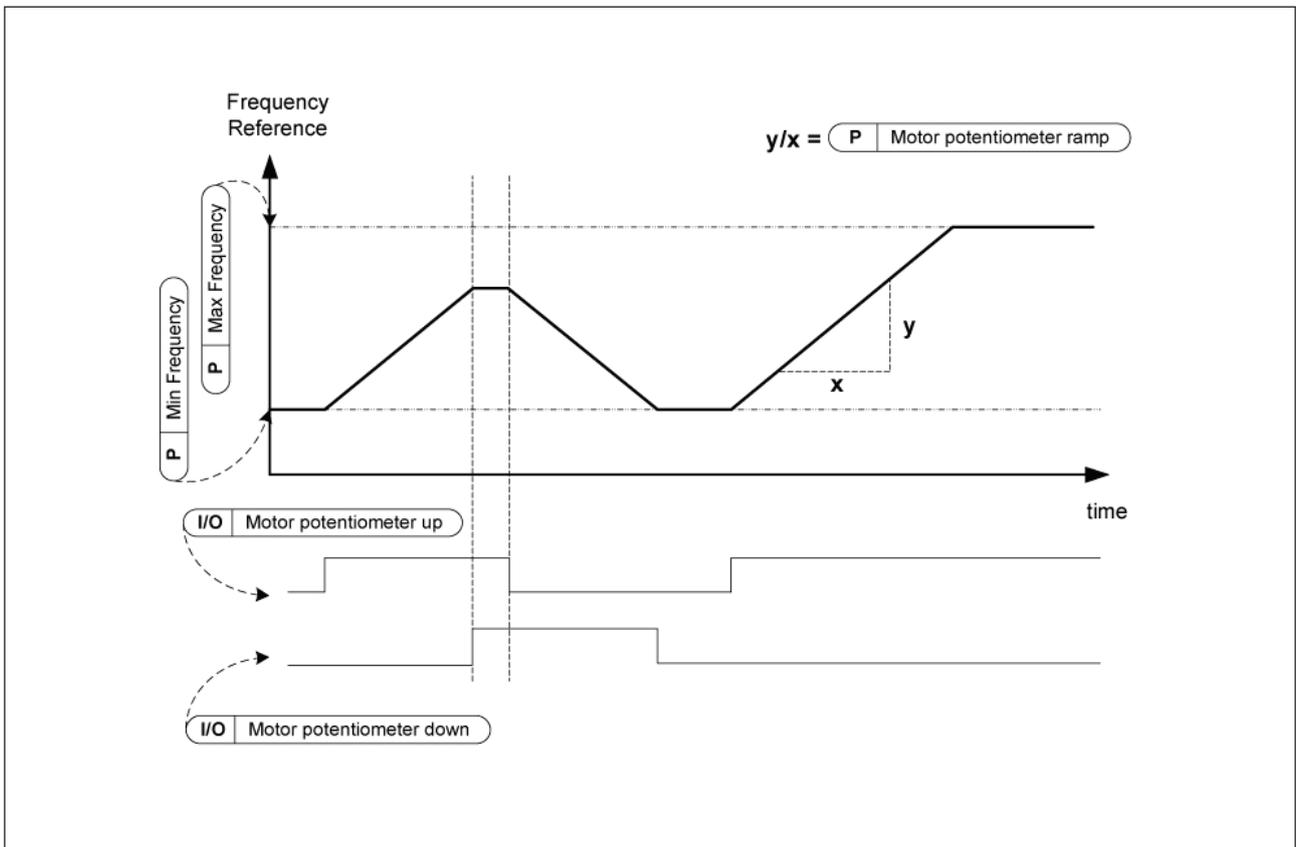


Figure 8.9: The change of motor potentiometers reference

## 8.4   Ramps & brakes setup (Control panel: Menu PAR -> P4)

### 4.1   RAMP S-SHAPE

The start and end of the acceleration and deceleration ramp can be smoothed with this parameter. Setting value 0 gives a linear ramp shape which causes acceleration and deceleration to act immediately to the changes in the reference signal.

Setting value 0.1...10 seconds for this parameter produces an S-shaped acceleration/ deceleration. The acceleration and deceleration times are determined with parameters 4.2 and 4.3.
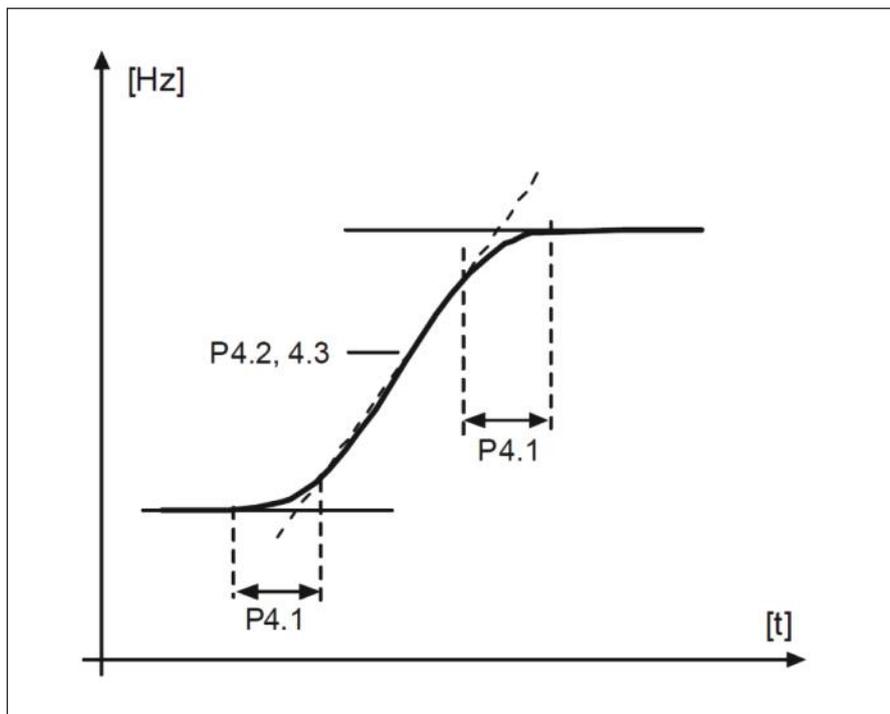


Figure 8.10: S-shaped acceleration/deceleration

### 4.2 ACCELERATION TIME 1

### 4.3 DECELERATION TIME 1

### 4.4 RAMP S-SHAPE 2

### 4.5 ACCELERATION TIME 2

### 4.6 DECELERATION TIME 2

These limits correspond to the time required for the output frequency to accelerate from the zero frequency to the set maximum frequency, or to decelerate from the set maximum frequency to zero frequency.

The user can set two different acceleration/deceleration time and set two different ramp s-shape for one ap plication.The active set can be selected with the selected digital input (par. 5.11).

### 4.7 FLUX BRAKING

Instead of DC braking, flux braking is a useful form of braking with motors of max. 15 kW.

When braking is needed, the frequency is reduced and the flux in the motor is increased, which in turn increases the motor's capability to brake. Unlike DC braking, the motor speed remains controlled during braking.

**0** = Off

**1** = Deceleration

**2** = Chopper

**3** = Full Mode

**Note!** Flux braking converts the energy into heat at the motor, and should be used intermittently to avoid motor damage.

### 4.10 STOP DC CURRENT TIME

Determines if braking is ON or OFF and the braking time of the DC-brake when the motor is stopping. The function of the DC-brake depends on the stop function, par. 2.3.

**0** = DC brake is not active
**〉0** = DC brake is active and its function depends on the Stop function, (par. 2.3). The DC braking time is determined with this parameter.

**Par. 2.3 = 0 (Stop function = Coasting):**

After the stop command, the motor coasts to a stop without control from the frequency converter.

With the DC injection, the motor can be electrically stopped in the shortest possible time, without using an optional external braking resistor.

The braking time is scaled by the frequency when the DC-braking starts. If the frequency is greater, or equal to the nominal frequency of the motor, the set value of parameter 4.10 determines the braking time. When the frequency is 10% of the nominal, the braking time is 10% of the set value of parameter 4.10.
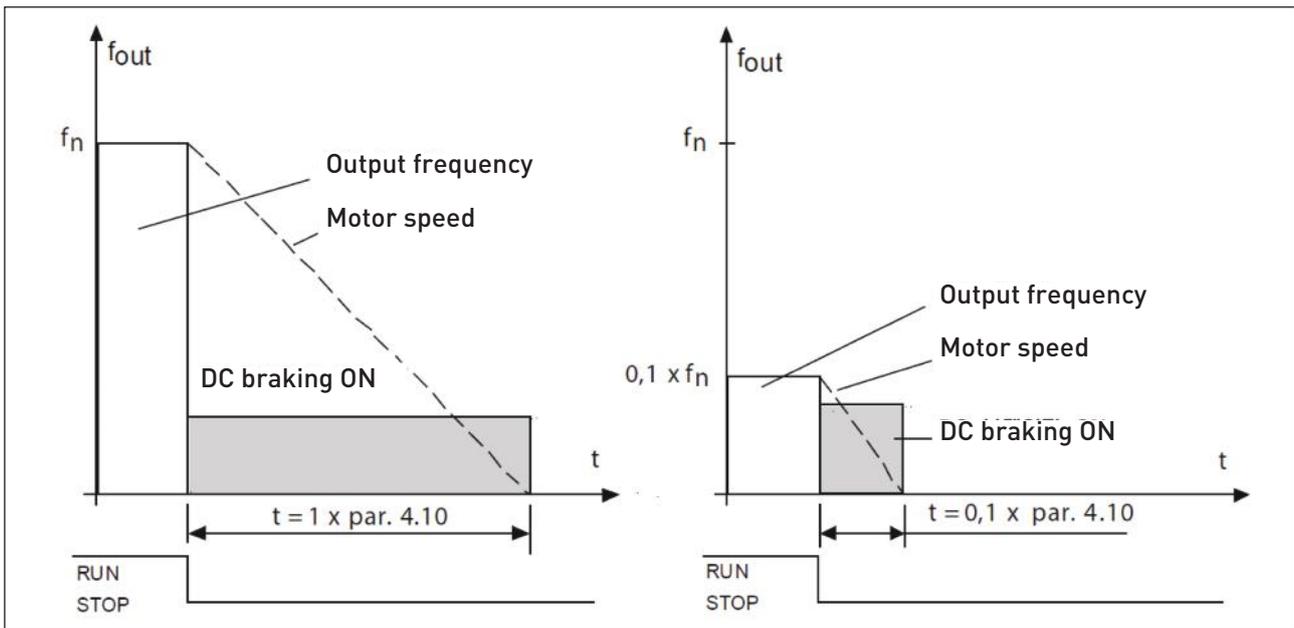
Figure 8.11: DC-braking time when Stop mode = Coasting

**Par. 2.3 = 1 (Stop function = Ramp):**

After the Stop command, the speed of the motor is reduced according to the set deceleration parameters, if the inertia of the motor and load allows that, to the speed defined with parameter 4.11, where the DC-braking starts. The braking time is defined with parameter 4.10. See Figure 8.12.
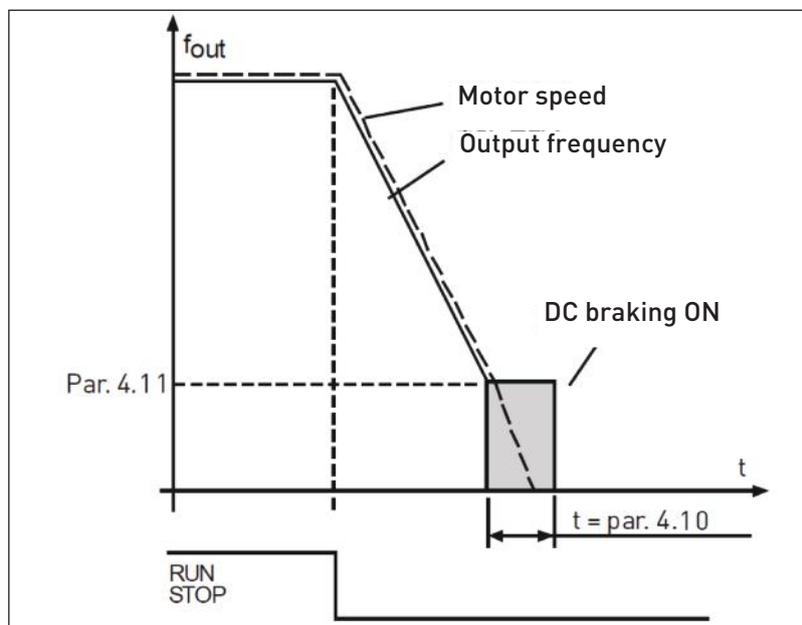


Figure 8.12: DC-braking time when Stop mode = Ramp

### 4.11  STOP DC CURRENT FREQUENCY

It is the output frequency at which the DC-braking is applied.

### 4.12  START DC CURRENT TIME

DC-brake is activated when the start command is given. This parameter de fines the time for how long DC current is fed to motor before acceleration starts. After the brake is released, the output frequency increases according to the set start function by par. 2.2.
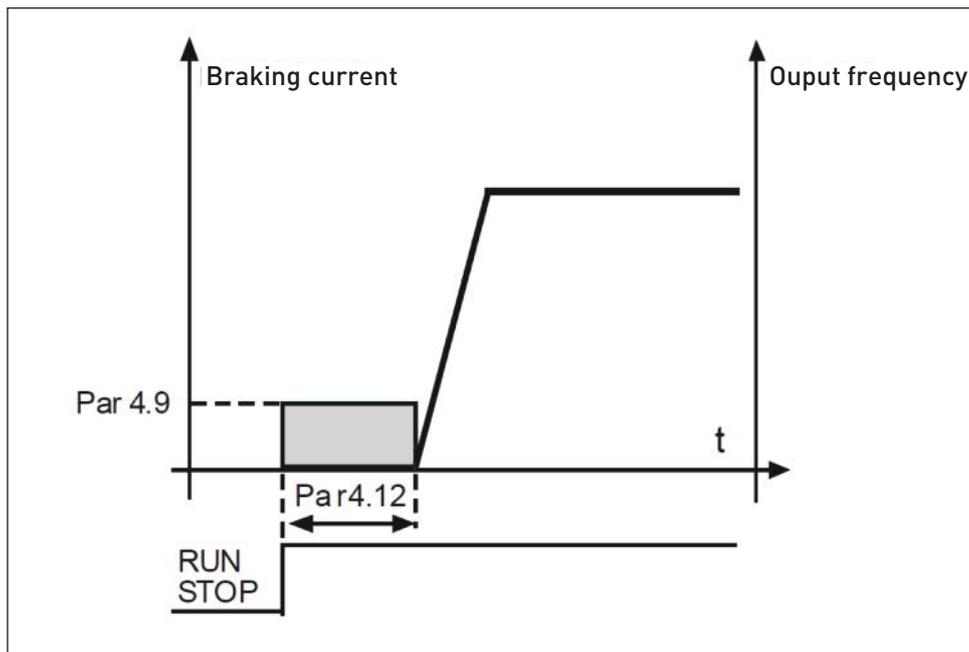


Figure 8.13: DC braking time at start

4.15 EXTERNAL BRAKE: OPEN DELAY

4.16 EXTERNAL BRAKE: OPEN FREQUENCY LIMIT

4.17 EXTERNAL BRAKE: CLOSE FREQUENCY LIMIT

4.18 EXTERNAL BRAKE: CLOSE FREQUENCY LIMIT IN REVERSE

4.19 EXTERNAL BRAKE: OPEN / CLOSE CURRENT LIMIT

External brake control is used for controlling a mechanical brake on the motor by digital / relay output by selecting value 17 for parameters P8.1, P8.2 or P8.3. Brake is closed while relay is open and vice versa.

**Opening brake conditions:**

There are three different conditions for opening the brake, all must be true, if used.

1. The Open frequency limit (P4.16) must be reached.

2. When the Opening frequency limit has been reached the Open delay (P4.15) must also elapse. **Note!** The output frequency is held at the Open frequency limit until this.

3. When the two previous conditions are reached. The brake will open if the output current is higher than the current limit.(P4.19)

**Notice that any of the previous conditions can be left out by setting their values to zero.**
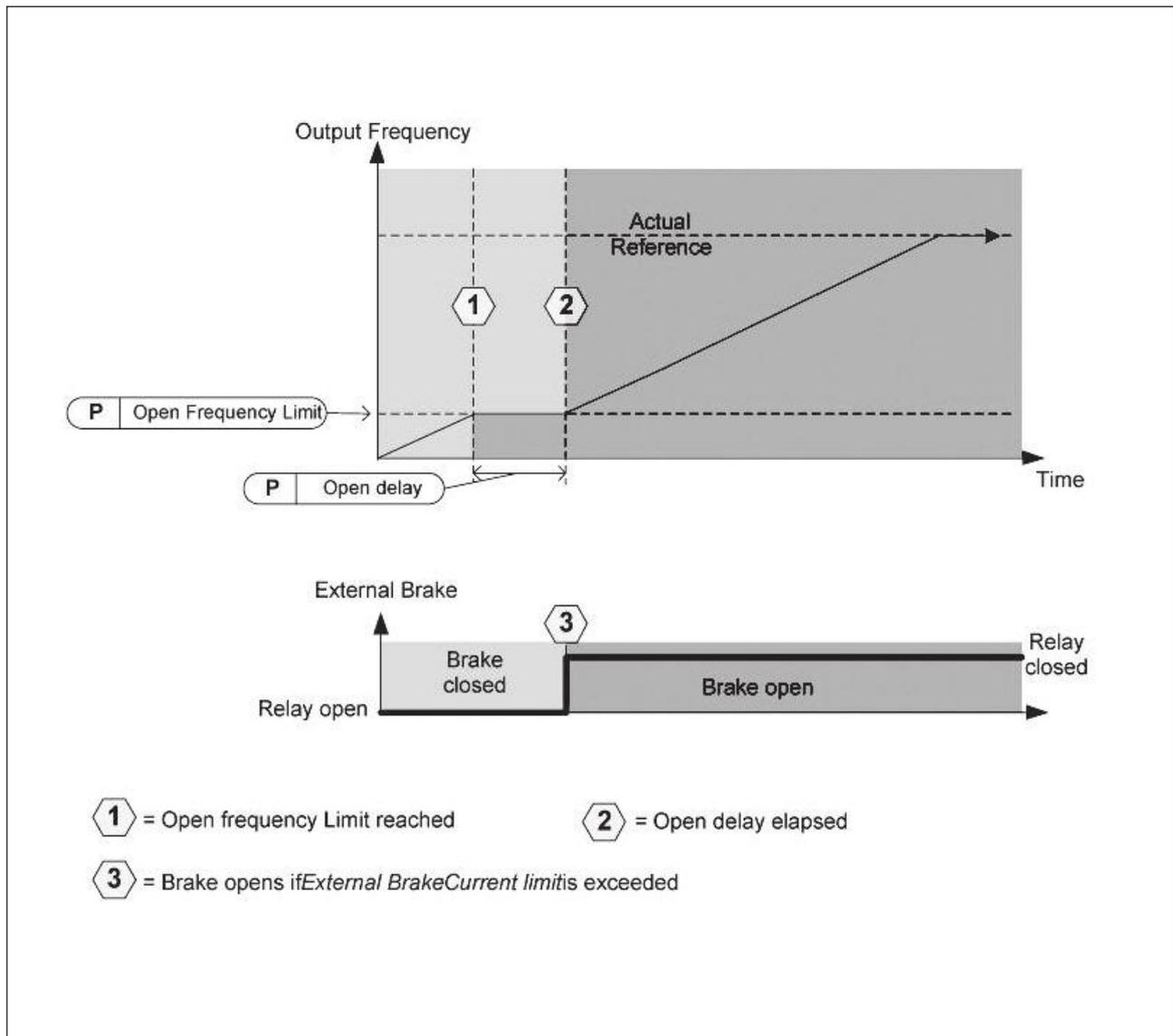


Figure 8.14: Starting / opening sequence with external brake

**Closing brake conditions:**

There are 2 conditions for closing the brake again. It's enough that one is true for the brake to close.
1. If there is no run command active and output frequency goes below Close frequency limit (P4.17) or Close frequency limit in reverse (P4.18), depending on direction of rotation.
OR
2. Output current has gone below Current limit.(P4.19)

## 8.5   Digital inputs (Control panel: Menu PAR -> P5)

These parameters are programmed using the FTT-method (Function To Terminal), where you have a fixed input or output that you define a certain function for. You can also define more than one function to a digital input, e.g. Start signal 1 and Preset Speed B1 to DI1.

The selections for these parameters are:
**0** = Not used
**1** = DI1
**2** = DI2
**3** = DI3
**4** = DI4
**5** = DI5
**6** = DI6

### 5.1   I / O CTRL SIGNAL 1

### 5.2   I / O CTRL SIGNAL 2

P5.1 and P5.2 : See P2.4 (I/O start stop logic) for function

### 5.3   REVERSE

The digital input only active when P2.4 (I/O Start stop logic) =1

The motor will run in reverse when the rising edge of P5.3 is happened.

### 5.11   RAMP TIME 2 SELECTION

Contact open: Acceleration / Deceleration time 1 and Ramp S-shape selected
Contact closed: Acceleration / Deceleration time 2 and Ramp S-shape2 selected

Set Acceleration / Deceleration time with parameters 4.2 and 4.3 and the alternative Acceleration / Deceleration time with 4.4 and 4.5.

Set Ramp S-shape with Par. 4.1 and the alternative Ramp S-shape2 with Par. 4.4

### 5.16   PID SETPOINT 2

Digital input high activates setpoint 2 (P15.3), when P15.1=0.

### 5.17   MOTOR PREHEAT ACTIVE

Digital input high activates the Motor preheat function (if P16.1 = 2) which feeds DC-Current to the motor in stop state.

## 8.6   Analogue inputs (Control panel: Menu PAR -> P6)

### 6.4   AI1 FILTER TIME

### 6.8   AI2 FILTER TIME

This parameter, given a value greater than 0, activates the function that filters out disturbances from the in coming analogue signal.

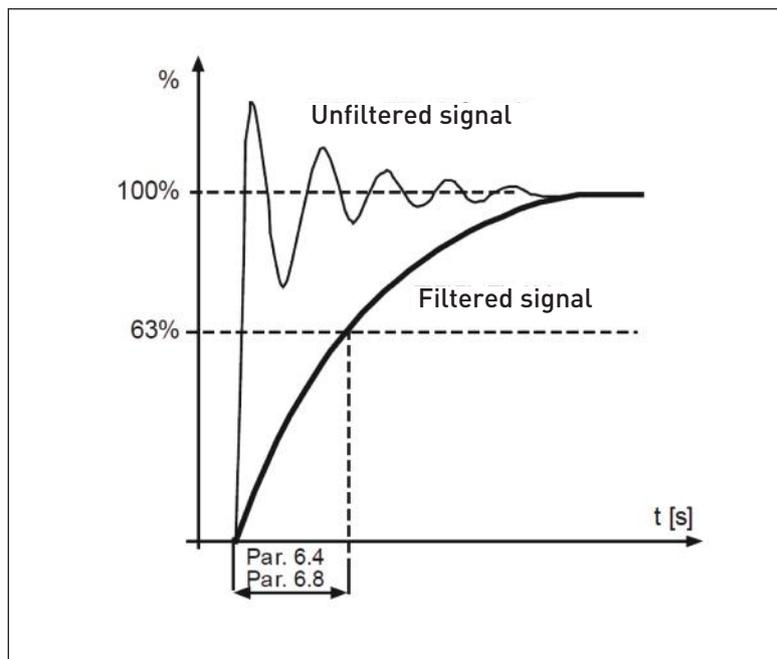Long filtering time makes the regulation response slower. See Figure 8.15.



Figure 8.15: AI1 and AI2 signal filtering

### 6.2   AI1 CUSTOM MINIMUM

### 6.3   AI1 CUSTOM MAXIMUM

### 6.6   AI2 CUSTOM MINIMUM

### 6.7   AI2 CUSTOM MAXIMUM

These parameters set the analogue input signal for any input signal span from minimum to maximum.

### 8.7   Pulse train / Encoder (Control panel: Menu PAR -〉 P7)

#### 7.1   MIN PULSE FREQUENCY

#### 7.2   MAX PULSE FREQUENCY

Minimum and maximum pulse frequency correspond to a signal value of 0% and 100% respectively.

Frequencies over Max pulse frequency are handled as constant 100% and below Min pulse frequency as constant 0%. The signal value of range 0 - 100% is shown in monitor value V2.7 and can be used as PID Controller feedback, or scaled to frequency with parameters P7.3 and P7.4, and used as frequency reference.

#### 7.3   FREQ REF AT MIN PULSE FREQUENCY

#### 7.4   FREQ REF AT MAX PULSE FREQUENCY

Pulse train/Encoder signal with range 0-100% and scaled by parameter P7.1 and P7.2, which can be used as frequency reference by telling what frequency corresponds to 0% and 100% with parameters P7.3 and P7.4 re spectively. Then it can be selected as frequency reference for Remote control place.

#### 7.5   ENCODER DIRECTION

It is possible to also take direction information from the encoder.

**0** = Disable
**1**= Enable/Normal
**2** = Enable/Inverted

#### 7.6   ENCODER PULSES / REVOLUTION

Encoder pulses per revolution can be set in case an encoder is used, which is used to record the count of encoder per round. In this case monitor value V2.8 will show the actual rpm of the encoder.

Maximum pulse frequency is 10 kHz. It means that a 256 pulse per round encoder would allow shaft speeds up to 2300 rpm. (60*10000/256 = 2343)

#### 7.7   CONFIG DI5 AND DI6

**0** = DI5 and DI6 are for normal digital input
**1** = DI6 is for pulse train
**2** = DI5 and DI6 are for encoder frequency mode

⚠️      When using pulse train / encoder input, the DI5 and DI6 has to be set to - Not Used

**Note!** If use the encoder function have to do 2 steps:

1) Set the parameter to change normal DI to Encoder in menu firstly.
2) Then push down the DI switch for encoder function. otherwise F51 occur.

## 8.8   Digital outputs (Control panel: Menu PAR -> P8)

### 8.1   RO1 SIGNAL SELECTION

### 8.2   RO2 SIGNAL SELCETION

### 8.3   DO1 SIGNAL SELCETION

| Setting | Signal content |
|---|---|
| **0** = Not used | Output is not in operation. |
| **1** = Ready | The frequency converter is ready to operate. |
| **2** = Run | The frequency converter operates (motor is running). |
| **3** = Fault | A fault trip has occurred. |
| **4** = Fault inverted | A fault trip has not occurred. |
| **5** = Warning | A warning is active. |
| **6** = Reversed | The reverse command has been selected, output frequency to the motor is negative. |
| **7** = At speed | The output frequency has reached the set reference. |
| **8** = Motor regulator active | Each of Motor regulator is active (e.g., over current regulator, over voltage regulator, under voltage regulator, etc.) |
| **9** = FB Control Word.B13 | Output can be controlled with B13 in the fieldbus control word. |
| **10** = FB Control Word.B14 | Output can be controlled with B14 in the fieldbus control word. |
| **11** = FB Control Word.B15 | Output can be controlled with B15 in the fieldbus control word. |
| **12** = Output frequency superv. | Output frequency is over / under the limits, set with parameters P12.1 and P12.2. |
| **13** = Output torque superv. | Motor torque is over/under the limit, set with parameter P12.3 and P12.4 |
| **14** = Unit temperature superv. | Unit temperature is over / under the limits, set with parameters P12.5 and P12.6. |
| **15** = Analogue input superv. | Analogue inputs set with parameter P12.7 is over / under the limits, set in P12.8 and P12.9. |
| **16** = Preset Speed Active | Each of preset speeds are activated. |
| **17** = External Brake control | External Brake control. Closed = Brake open, Open = Brake closed. |
| **18** = Keypad control active | Keypad is set as the current control place. |
| **19** = I / O control active | I / O is set as the current control place. |

Table 8.2: Output signals via RO1, RO2 and DO1

## 8.9   Analogue outputs (Control panel: Menu PAR -〉 P9)

### 9.1   ANALOG OUTPUT SIGNAL SELECTION

**0** = Not used

**1** = Output frequency (0 - fmax)

**2** = Output current (0 - Inmotor)

**3** = Motor torque (0 - Tnmotor)

**4** = PID output (0 - 100%)

**5** = Frequency reference (0 - fmax)

**6** = Motor speed (0 - nmax)

**7** = Motor power (0 - Pnmotor)

**8** = Voltage (0 - Unmotor)

**9** = DC-link Voltage (0 - 1000V)

**10** = Process Data In1 (0 - 10000)

**11** = Process Data In2 (0 - 10000)

**12** = Process Data In3 (0 - 10000)

**13** = Process Data In4 (0 - 10000)

**14** = Test 100%

### 9.2   ANALOG OUTPUT MINIMUM

**0** = 0 V / 0 mA

**1** = 2 V / 4 mA

## 8.10   Fieldbus Data-Mapping (Control panel: Menu PAR -> P10)

### 10.1   FB DATA OUT 1 SELECTION

Parameter couples read only variables to output process data 1.

   0 = Frequency reference
   1 = Output reference
   2 = Motor speed
   3 = Motor current
   4 = Motor voltage
   5 = Motor torque
   6 = Motor power
   7 = DC link voltage
   8 = Active fault code
   9 = Analogue AI1
  10 = Analogue AI2
  11 = Digital input state
  12 = PID feedback value
  13 = PID setpoint
  14 = Pulse train / encoder input(%)
  15 = Pulse train / encoder pulse()


### 10.9   AUX CW DATA IN SELECTION

Parameter defines the input process data coupled to Aux Control Word.

   0 = Not used
   1 = PDI1
   2 = PDI2
   3 = PDI3
   4 = PDI4
   5 = PDI5

## 8.11 Prohibited Frequencies (Control panel: Menu PAR -〉 P11)

### 11.1 PROHIBIT FREQUENCY RANGE 1: LOW LIMIT

### 11.2 PROHIBIT FREQUENCY RANGE 1: HIGH LIMIT

### 11.3 PROHIBIT FREQUENCY RANGE 2: LOW LIMIT

### 11.4 PROHIBIT FREQUENCY RANGE 2: HIGH LIMIT

Two skip frequency regions are available if there is a need to avoid certain frequencies because of e.g. mechanical resonance. In this case the actual frequency reference sent to the motor control will be kept out of these ranges according to the example below, where one range is in use.
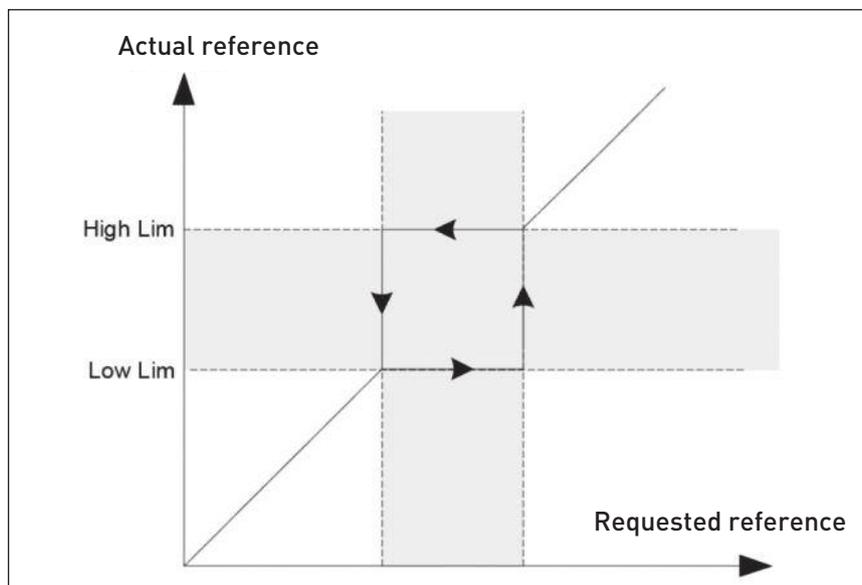


Figure 8.16: Frequency Range

## 8.12   Protections (Control panel:Menu Par->P13)

### 13.5   STALL PROTECTION

**0** = No action
**1** = Alarm
**2** = Fault, stop function
**3** = Fault, coast

The motor stall protection protects the motor from short time overload situations such as one caused by a stalled shaft. The reaction time of the stall protection can be set shorter than that of motor thermal protection. The stall state is defined with two parameters, P13.11 (Stall current) and P13.13 (Stall frequency limit). If the current is higher than the set limit and the output frequency is lower than the set limit the stall state is true. There is actually no real indication of the shaft rotation. Stall protection **is a type of over current protection.**

### 13.6   UNDER LOAD PROTECTION

**0** = No action
**1** = Alarm
**2** = Fault, stop function
**3** = Fault, coast

The purpose of the motor underload protection is to ensure that there is load on the motor when the drive is running. If the motor loses its load there might be a problem in the process, e.g. a broken belt or a dry pump.

Motor underload protection can be adjusted by setting the underload curve with parameters P13.14 (Underload protection: Field weakening area load) and P13.15 (Underload protection: Zero frequency load), see the figure below. The underload curve is a squared curve set between the zero frequency and the field weakening point. The protection is not active below 5Hz (the underload time counter is stopped).

The torque values for setting the underload curve are set in percentage which refers to the nominal torque of the motor. The motor's name plate data, parameter motor nominal current and the drive's nominal current IL are used to find the scaling ratio for the internal torque value. If other than nominal motor is used with the drive, the accuracy of the torque calculation decreases.

**The default parameter value of the underload protection time limit** is 20 seconds, which is the maximum time allowed for an underload state to exist before causing a trip according to this parameter.
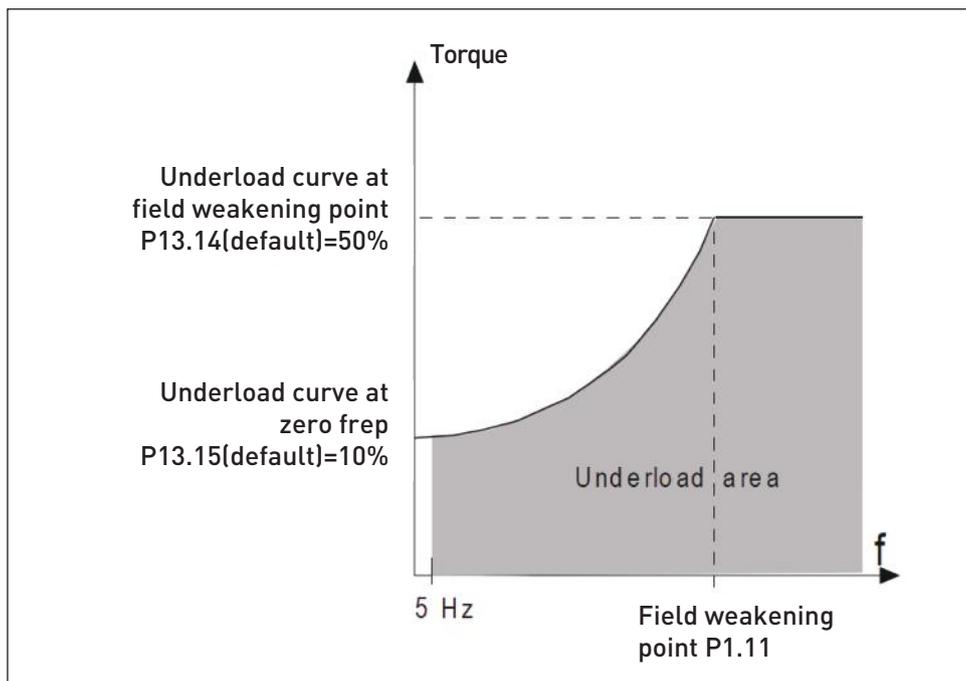
Figure 8.17: Underload protection

### 13.7  MOTOR THERMAL PROTECTION

**0** = No action
**1** = Alarm
**2** = Fault, stop function
**3** = Fault, coast

If tripping is selected the drive will stop and activate the fault stage, if the temperature of the motor becomes too high. Deactivating the protection, i.e. setting parameter to 0, will reset the thermal model of the motor to 0%.

capable of supplying higher than nominal current to the motor. If the load requires this high current there is a risk that the motor will be thermally overloaded. This is the case especially at low frequencies. At low frequencies the cooling effect of the motor is reduced as well as its capacity. If the motor is equipped with an external fan the load reduction at low speeds is small.
The motor thermal protection is based on a calculated model and it uses the output current of the drive to determine the load on the motor.
The motor thermal protection can be adjusted with parameters. The thermal current IT specifies the load current above which the motor is overloaded. This current limit is a function of the output frequency.
The thermal stage of the motor can be monitored on the control keypad display.

⚠️ **CAUTION!** The calculated model does not protect the motor if the airflow to the motor is reduced by blocked air intake grill.

**NOTE!** To comply with UL 508C requirements motor over-temperature sensing is required at installation if the parameter is set to 0.

**Note:** If you use long motor cables (max. 100m) together with small drives (⟨=1.5 kW) the motor current measured by the drive can be much higher than the actual motor current due to capacitive currents in the motor cable. Consider this when setting up the motor thermal protection functions.

### 13.8   MTP:AMBIENT TEMPERATURE

When the motor ambient temperature must be taken into consideration, it is recommended to set a value for this parameter. The value can be set between -20 and 100 degrees Celsius.

### 13.9   MTP:ZERO SPEED COOLING

Defines the cooling factor at zero speed in relation to the point where the motor is running at nominal speed without external cooling. The default value is set assuming that there is no external fan cooling the motor. If an external fan is used this parameter can be set to 90% (or even higher).

If you change the parameter P1.4 (Motor nominal current), this parameter is automatically restored to the default value.Setting this parameter does not affect the maximum output current of the drive which is deter mined by parameter P1.7 alone.

The corner frequency for the thermal protection is 70% of the motor nominal frequency(P1.2).

The cooling power can be set between 0 - 150.0% x cooling power at nominal frequency. See Figure 8.18.
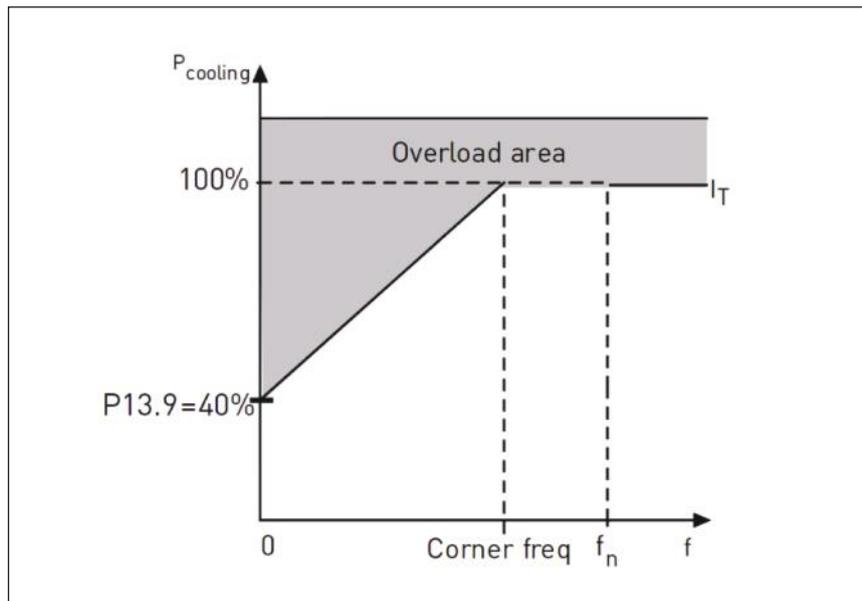
Figure 8.18: Motor thermal current IT curve

### 13.10   MTP:THERMAL TIME CONSTANT

This time can be set between 1 and 200 minutes.

This is the thermal time constant of the motor. The bigger the frame and/or slower the speed of the motor, the longer the time constants. The time constant is the time within which the calculated thermal model has reached 63% of its final value.

The motor thermal time is specific to the motor design and it varies between different motor manufacturers.

If the motor's t6-time (t6 is the time in seconds the motor can safely operate at six times the rated current) is known (given by the motor manufacturer) the time constant parameter can be set basing on it. As a rule of thumb, the motor thermal time constant in minutes equals to 2 X t6. If the drive is in stop state the time constant is internally increased to three times the set parameter value. See also Figure 8.19.

The cooling in stop stage is based on convection and the time constant is increased.
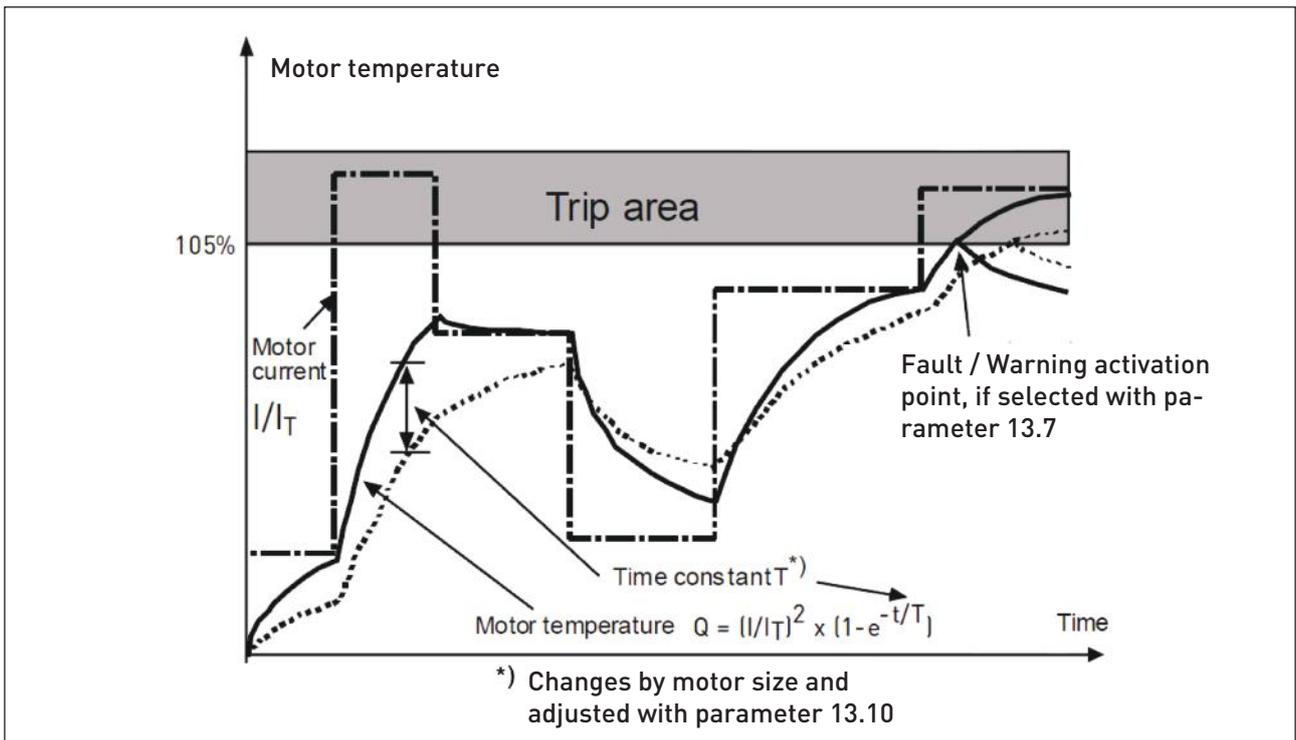
Figure 8.19: Motor temperature calculation

P13.11  STALL CURRENT

The current can be set to 0.0...2xINunit.For a stall stage to occur, the current must have exceeded this limit. If parameter P1.7 Motor current limit is changed, this parameter is automatically calculated to 90% of the current limit. See Figure 8.20.

NOTE! In order to guarantee desired operation, this limit must be set below the current limit.
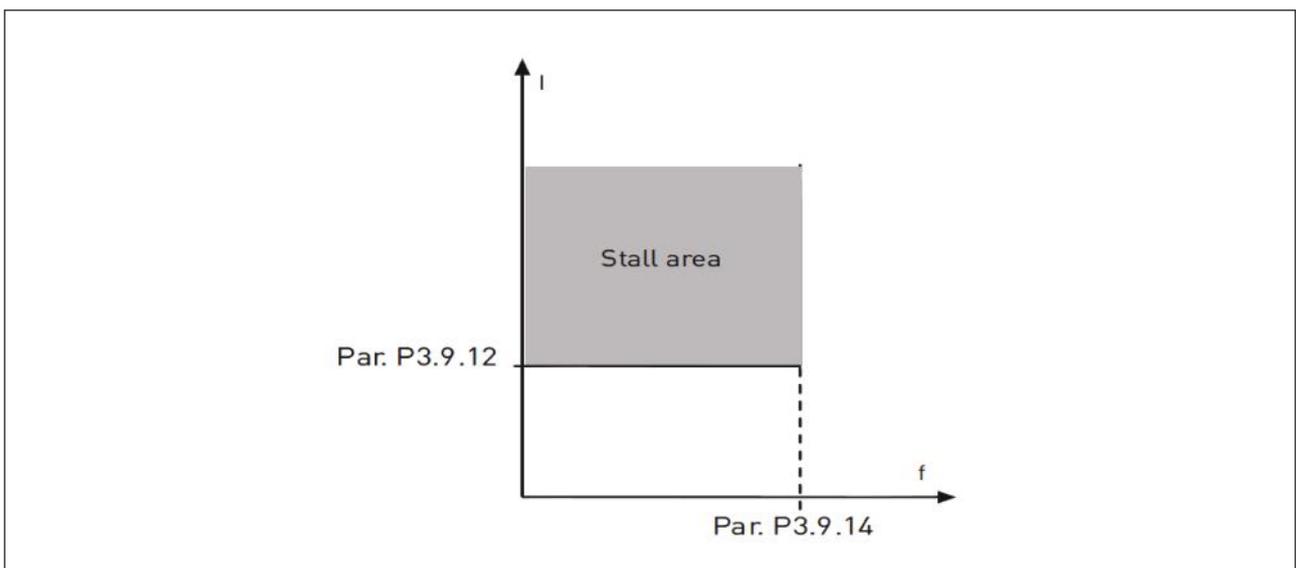


Figure 8.20: Stall current

### P13.12 STALL TIME

This time can be set between 0.00 and 300.00s.

This is the maximum time allowed for a stall stage. The stall time is counted by an internal up/down counter.

If the stall time counter value goes above this limit the protection will cause a trip (see P13.5).See Figure 8.21.
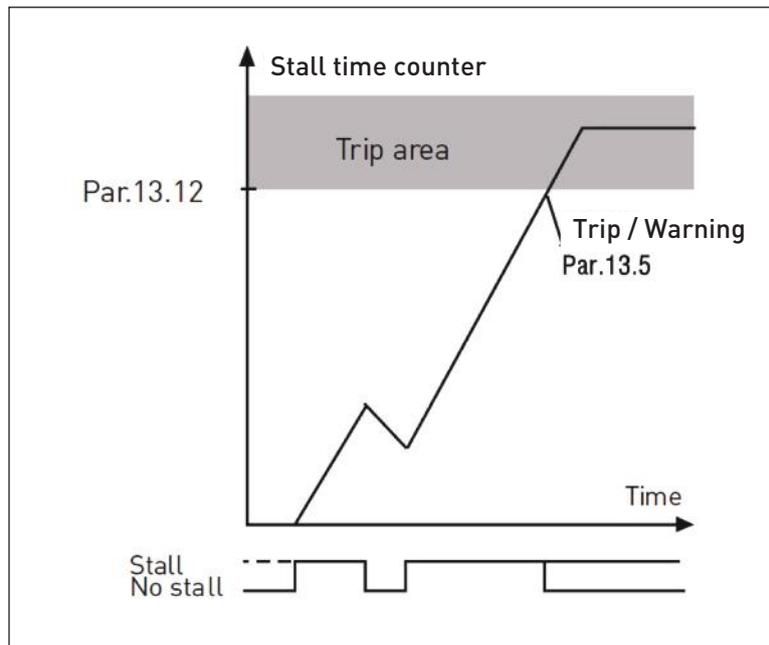


Figure 8.21: Stall time calculation

### P13.14 UNDERLOAD PROTECTION: FIELD WEAKENING AREA LOAD

The torque limit can be set between 10.0-150.0 % X Tnmotor.

This parameter gives the value for the minimum torque allowed when the output frequency is above the field weakening point. If you change parameter P1.4 (Motor nominal current) this parameter is automatically restored to the default value.

### P13.16 UNDERLOAD PROTECTION : TIME LIMIT

This time can be set between 2.0 and 600.0 s.

This is the maximum time allowed for an underload state to exist. An internal up/down counter counts the accumulated underload time. If the underload counter value goes above this limit the protection will cause a trip according to parameter P13.6). If the drive is stopped the underload counter is reset to zero. See Figure 8.22.
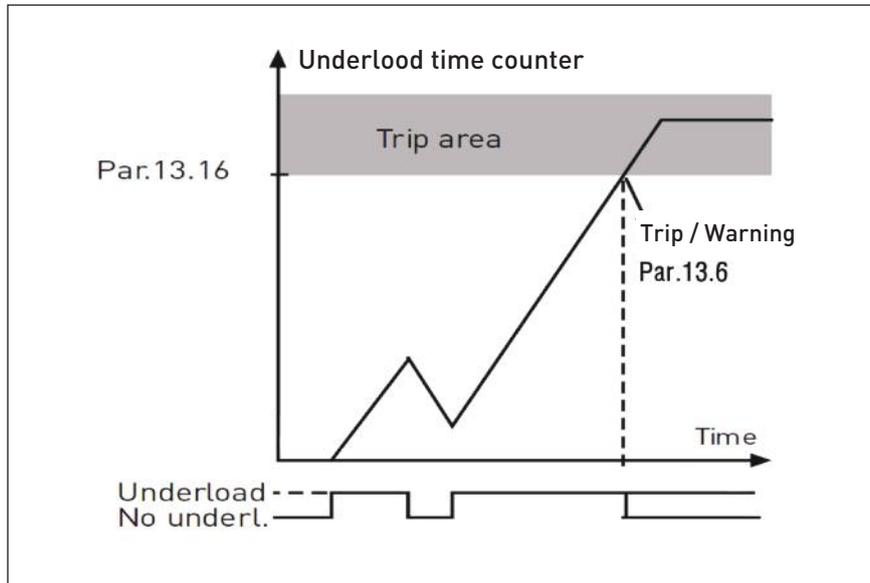


Figure 8.22: underload counter

### 13.28   Input phase fault

0 = No action
1 = Alarm
2 = Fault : Stop function
3 = Fault : Coast

### 13.29   Motor temperature memory mode

0 = Disabled
1 = Constant mode
2 = Last value mode

### 8.13   Automatic reset (Control panel: Menu PAR -> P14)

#### 14.1   AUTOMATIC RESET

Activate the Automatic reset after fault with this parameter.

**NOTE!** Automatic reset is allowed for certain faults only.

Fault : **1.** Under voltage
**2.** Over voltage
**3.** Over current
**4.** Motor over temperature
**5.** Under load

#### 14.3   TRIAL TIME

The Automatic restart function restarts the frequency converter when the faults have disappeared and the waiting time has elapsed.

The time count starts from the first auto reset. If the number of faults occurring during the trial time exceeds trail number (the value of P14.4), the fault state becomes active. Otherwise the fault is cleared after the trial time has elapsed and the next fault starts the trial time count again. See Figure 8.23.
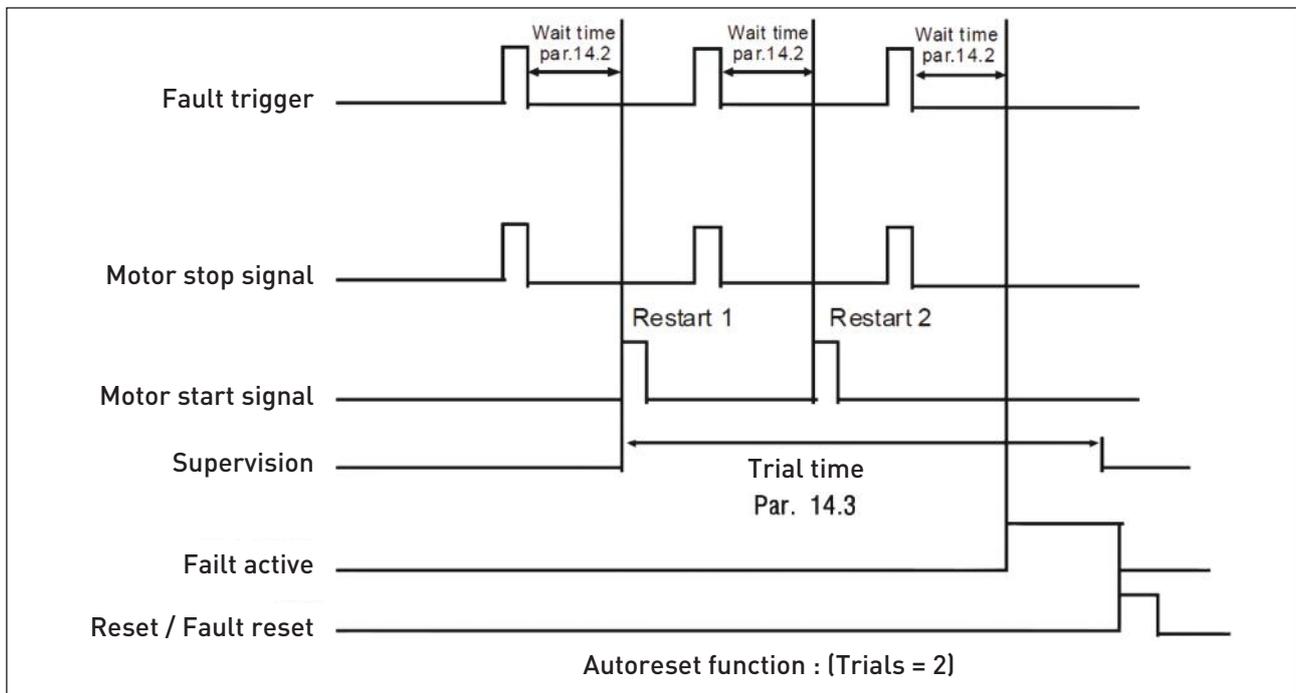


Figure 8.23: Example of Automatic restarts with two restarts

## 8.14   PID control parameters (Control panel: Menu PAR -〉 P15)

### 15.5 FEEDBACK VALUE MINIMUM

### 15.6 FEEDBACK VALUE MAXIMUM

This parameter sets the minimum and maximum scaling points for feedback value.
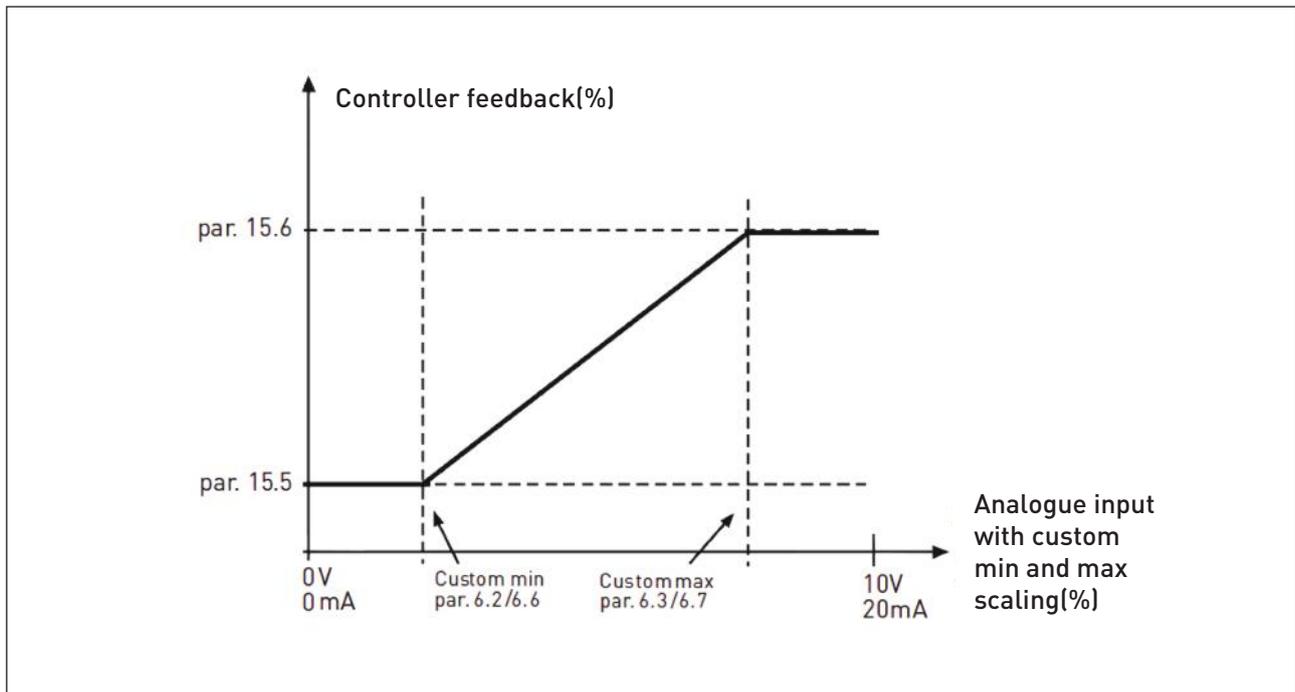


Figure 8.24: Feedback minimum and maximum

### 15.7   P GAIN

This parameter defines the gain of the PID controller. If the value of the parameter is set to 100%, a change of 10% in the error value causes the controller output to change by 10%.

### 15.8   PID CONTROLLER I-TIME

This parameter defines the integration time of the PID controller. If this parameter is set to 1,00 second, the controller output is changed by a value corresponding to the output caused from the gain every second. (Gain*Error)/s.

### 15.9   PID CONTROLLER D-TIME

This parameter defines the derivative time of the PID controller. If this parameter is set to 1,00 second, a change of 10% in the error value causes the controller output to change by 10%.

### 15.11   SLEEP MIN FREQUENCY

### 15.12   SLEEP DELAY

### 15.13   WAKE-UP ERROR

This function will put the drive into sleep mode if the frequency stays below the sleep limit for a longer time than that set with the Sleep Delay (P15.12). This means that the start command remains on, but the run request is turned off. When the actual value goes below, or above, the wake-up error depending on the set actingmode the drive will activate the run request again if the start command is still on.
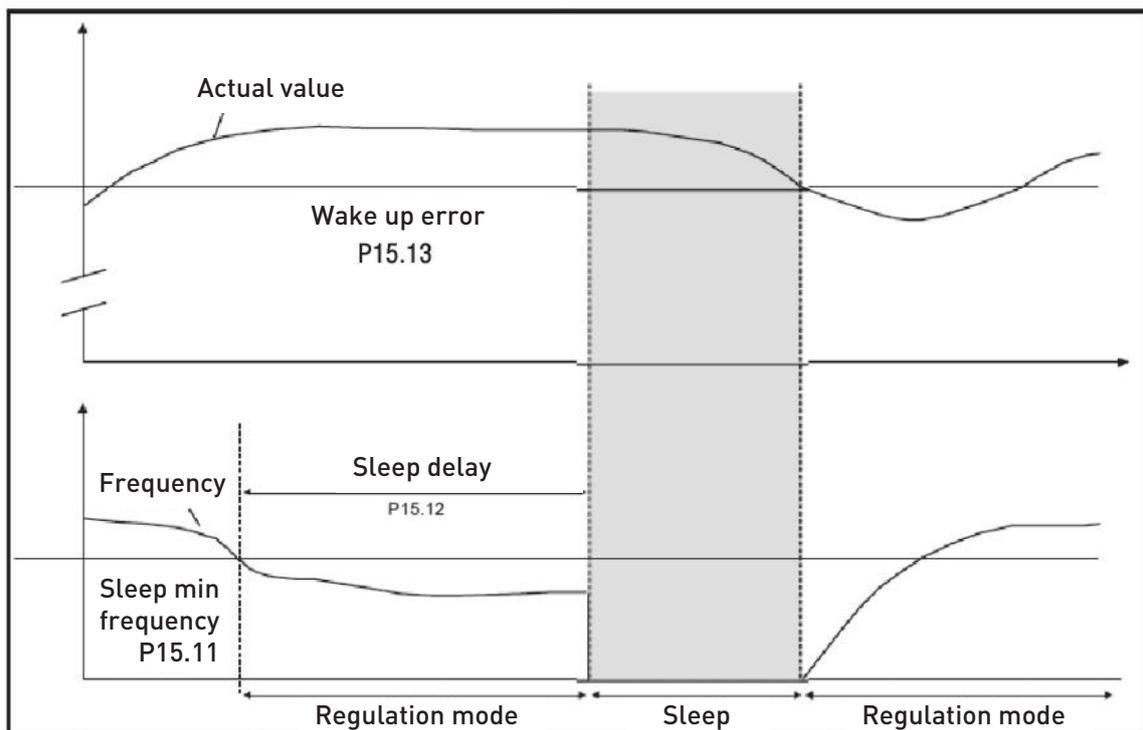


Figure 8.25: Sleep min frequency, Sleep delay,Wake-up error

### 15.14 SLEEP SETPOINT BOOST

### 15.15 SETPOINT BOOST TIME

### 15.16 SLEEP MAX LOSS

### 15.17 SLEEP LOSS CHECK TIME

These parameters manage a more complex sleep sequence. After the time in P15.12, the setpoint is increased of the term in P15.14, for the time in P15.15. This will cause a higher output frequency.

Frequency reference is then forced at minimum frequency and the feedback value is sampled.

If the variation on the feedback value stays then lower than P15.16 for the time in P15.17, the drive will enter sleep condition.

If this sequence is not needed, then program P15.14 = 0%, P15.15 = 0 s, P15.16 = 50%, P15.17 = 1 s.

### 15.18   PROCESS UNIT SOURCE SELECTION

Monitor V4.5 can show a process value, proportional to a variable measured by the drive. Source variables are:

**0** = PID feedback value (max: 100%)
**1** = Output frequency (max: fmax)
**2** = Motor speed (max: nmax)
**3** = Motor torque (max: Tnom)
**4** = Motor power (max: Pnom)
**5** = Motor current (max: Inom)
**6** = Pulse train/ Encoder (max: 100%)

### 15.19   PROCESS UNIT DECIMAL DIGITS

Number of decimals shown on monitor V4.5.

### 15.20   PROCESS UNIT MIN VALUE

Value shown on V4.5 when source variable is at its minimum.Proportionality is kept if source overtakes the minimum.

### 15.21   PROCESS UNIT MAX VALUE

Value shown on V4.5 when source variable is at its maximum. Proportionality is kept if source overtakes the maximum.

### 8.15   Application setting (Control panel: Menu PAR->P17)

#### 17.1   DRIVE SETUP

With this parameter you can easily set up your drive for four different applications.

**NOTE!** This parameter is only visible when the Startup Wizard is active. The startup wizard will start in first power-up. It can also be started by setting SYS P4.2=1. See the figures below.

**NOTE!** Running the startup wizard will always return all parameter settings to their factory defaults!

**NOTE!** Start Up-Wizard  can be skipped after pressing stop button continuously for 30 seconds.
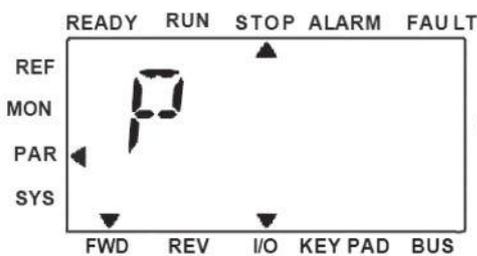
1) Enter Pa r. menu, select  P1.3 motor nominal speed
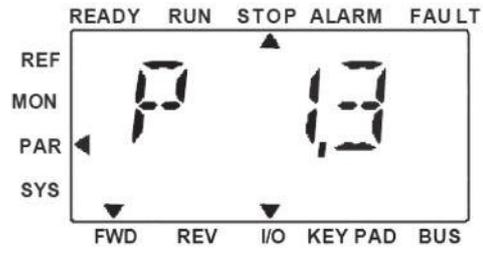
2) Press OK enter edit mode
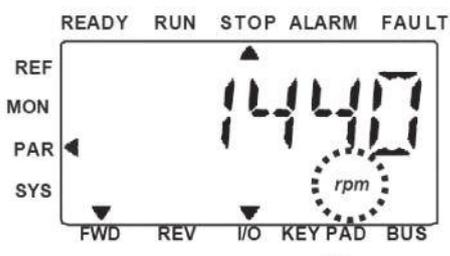
3) Change P1.3 value with Up/Down button and press OK to comfirm
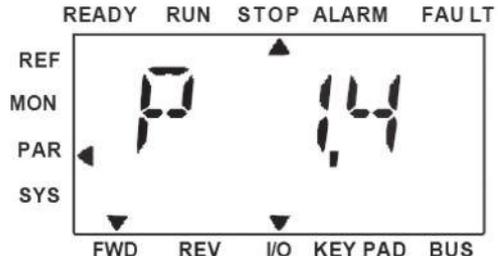
4) Perform the same procedure for P1.4, motor nominal current

Figure 8.26: Startup wizard

| 1) Startup wizard showns par 17.1 number. | 2) Press OK to enter edit mode. | 3) Select between 0-3, see below! |

Selections:

|  | P1.7 | P1.8 | P1.15 | P2.2 | P2.3 | P3.1 | P4.2 | P4.3 |
|---|---|---|---|---|---|---|---|---|
| 0 = Basic | 1.5 x INMOT | 0= Frequecny control | 0= Not used | 0=Ramp | 0=Coast | 0Hz | 3s | 3s |
| 1 = Pump drive | 1,1 x INMOT | 0= Frequecny control | 0= Not used | 0=Ramp | 1=Ramp | 20 Hz | 5s | 5s |
| 2 = Fan drive | 1,1 x INMOT | 0= Frequecny control | 0= Not used | 1=Flying | 0=Coast | 20 Hz | 20s | 20s |
| 3 = High Torque drive | 1.5 x INMOT | 1=Open loop speed ontrol | 1=used | 0=Ramp | 0=Coast | 0Hz | 1s | 1s |

P1.7 Current limit (A)        P2.3 Stop function

P1.8 Motor control mode       P3.1 Min frequency

P1.15 Torque boost            P4.2 Acc. time (s)

P2.2 Start function           P4.3 Dec time (s)
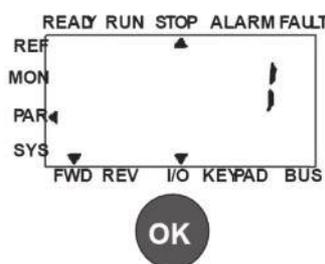


4) Press OK to confirm drive setup

Figure 8.27: Drive setup

## 17.4   APPLICATION ACCESS PASSWORD

Input the right password could review parameter group 18.

## 8.16   System parameter

### 4.3   PASSWORD

N800S API provides password function that is used when changing parameter value.

Inside PAR or SYS menu the selected parameter symbol and its value are alternating in the display. The single OK button pressing causes entering to the parameter value change mode.

If password protection is ON, user is asked to enter the right password (defined with parameter P4.3) and press OK button before editing value is possible. The password consists of four digit numbers, factory default value is 0000 = Password Disabled. Editing of all the parameters (including System parameters) is prohibited if the correct  password has not been entered. If wrong password is entered, pressing OK button causes return to the main level.

**Password Parameters:**

N800S API has one password parameter P4.3 "Password";
Parameter P4.3 is a 4 digit number. Factory default will be 0000 = Password disabled;
Any other value than 0000 will enable the password and it is not possible to change parameters. In this status all parameters are visible;
When navigate to Parameter P4.3, show "PPPP" as a parameter value if password has been set.

**Activating a password:**

Navigate to Parameter P4.3;
Press OK button;
Cursor (lowest horizontal segment) of the very left digit flashes;
Select first digit of password by using UP and DOWN key;
Press RIGHT button;
Cursor of the second digit flashes;
Select second digit of password by using UP and DOWN key;
Press RIGHT button;
Cursor of the third digit flashes;
Select third digit of password by using UP and DOWN key;
Press RIGHT button;
Cursor of the fourth digit flashes;
Select fourth digit by using UP and DOWN key;
Press OK button --→ the cursor of the first digit flashes;

Repeat insertion of password;
Press OK button → password is locked;
In case of different values for the two passwords: display Fault;
Press OK button → repeat password a second time;
To interrupt insertion of Password → Press BACK / RES.

**Disabling a password:**

Insert the actual password → Press OK → Password is automatically set to 0000;
All parameters can then freely be changed;
To enable password again → see 'Activating a password' procedure.

**Change of one parameter:**

User tries to change a parameter value when password is enabled → display PW;
Press OK button;
Cursor (lowest horizontal segment) of the very left digit flashes;
Select first digit of password by using UP and DOWN key;
Press RIGHT button;
Cursor of the second digit flashes;
Select second digit of password by using UP and DOWN key;
Press RIGHT button;
Cursor of the third digit flashes;
Select third digit of password by using UP and DOWN key;
Press RIGHT button;
Cursor of the fourth digit flashes;
Select fourth digit by using UP and DOWN key;
Press OK button;
Current value of parameter to be changed will be display;
Change parameter value as normal;
Press OK → New parameter value will be stored and Password is enabled again;
For changing another parameter the procedure has to be repeated;
In the case of wanting to change multiple parameters it is of advantage to set P4.3 to 0000,
After the change of the parameter values password has to be activated again;

**Forgotten password:**

Follow procedure "Disabling a password" and select 6020 as actual password.

## 8.17   Modbus RTU

N800S has a built-in Modbus RTU bus interface. The signal level of the interface is in accordance with the RS-485 standard.

The built-in Modbus connection of N800S supports the following function codes:

| Function code | Function name | Address | Broadcast messages |
|:---:|:---:|:---:|:---:|
| 03 | Read Holding Registers | All ID numbers | No |
| 04 | Read Input Registers | All ID numbers | No |
| 06 | Write Single Registers | All ID numbers | Yes |
| 16 | Write multiple registers | All ID numbers | Yes |

Table 8.3: Modbus RTU

### 8.17.1   Termination resistor

The RS-485 bus is terminated with termination resistors of 220 ohms in both ends. The inverter has a built-in termination resistor which is switched off as a default (presented below). The termination resistor can be switched on and off with the right hand dip switch located above IO-terminals in the front of the drive (see below).
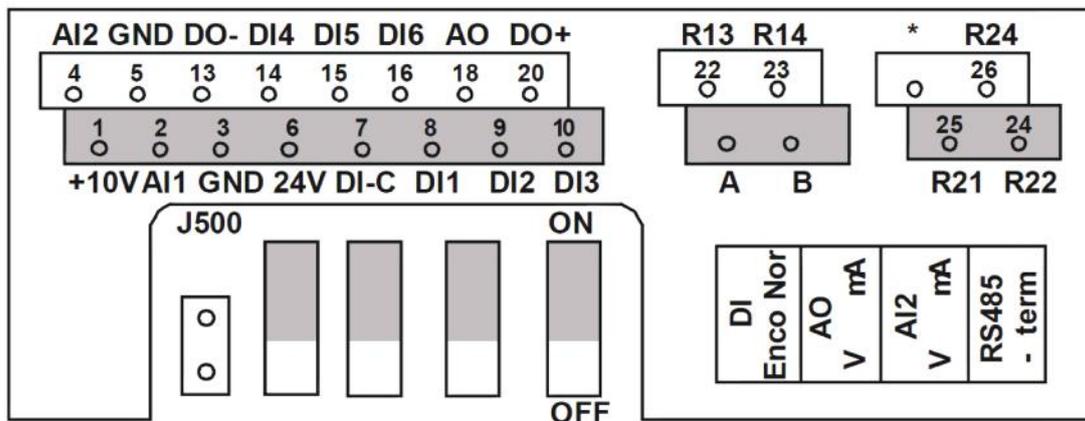


Figure 8.28: MI frame I/O

See the chapter 4.7.3.1 to setup the termination resistor for N800S MR frames.

### 8.17.2   Modbus address area

The Modbus interface of N800S uses the ID numbers of the application parameters as addresses. The ID numbers can be found in the parameter tables in chapter 8.

When several parameters / monitoring values are read at a time, they must be consecutive. 11 addresses can be read and the addresses can be parameters or monitoring values.

**Note:** With some PLC manufacturers, the interface driver for Modbus RTU communication may contain an offset of 1 (the ID number to be used would then subtract 1).

### 8.17.3  Modbus process data

Process data is an address area for fieldbus control. Fieldbus control is active when the value of parameter 2.1 (Control place) is 1 (= fieldbus). The content of the process data can be programmed in the application.The following tables present the process data contents in N800S Application.

| ID | Modbus register | Name | Scale | Type |
|----|----|----|----|----|
| 2101 | 32101, 42101 | FB Status Word | - | Binary coded |
| 2102 | 32102, 42102 | FB General Status Word | - | Binary coded |
| 2103 | 32103, 42103 | FB Actual Speed | 0.01 | % |
| 2104 | 32104, 42104 | Programmable by P10.1 (Default: Frequency reference) | - | - |
| 2105 | 32105, 42105 | Programmable by P10.2 (Default: Output frequency)) | 0.01 | +/- Hz |
| 2106 | 32106, 42106 | Programmable by P10.3 (Default: Motor speed) | 1 | +/- Rpm |
| 2107 | 32107, 42107 | Programmable by P10.4 (Default: Motor voltage) | 0.1 | V |
| 2108 | 32108, 42108 | Programmable by P10.5 (Default: Motor torque) | 0.1 | +/- % (of nominal) |
| 2109 | 32109, 42109 | Programmable by P10.6 (Default: Motor current) | 0.01 | A |
| 2110 | 32110, 42110 | Programmable by P10.7 (Default: Motor power) | 0.1 | +/- % (of nominal) |
| 2111 | 32111, 42111 | Programmable by P10.8 (Default: DC link voltage) | 1 | V |

Table 8.4: Output process data

| ID | Modbus register | Name | Scale | Type |
|----|----|----|----|----|
| 2001 | 32001, 42001 | FB Control Word | - | Binary coded |
| 2002 | 32002, 42002 | FB General Control Word | - | Binary coded |
| 2003 | 32003, 42003 | FB Speed Reference | 0.01 | % |
| 2004 | 32004, 42004 | Programmable by P10.9 | | |
| 2005 | 32005, 42005 | Programmable by P10.9 | | |
| 2006 | 32006, 42006 | Programmable by P10.9 | | |
| 2007 | 32007, 42007 | Programmable by P10.9 | | |
| 2008 | 32008, 42008 | Programmable by P10.9 | | |

Table 8.5: Input process data

| ID | Modbus register | Name | Scale | Type |
|------|------------------|------|-------|------|
| 2009 | 32009, 42009 | - | - | - |
| 2010 | 32010, 42010 | - | - | - |
| 2011 | 32011, 42011 | - | - | - |

Table 8.5: Input process data

**Note!** 2004 - 2007 can set as PID Control Reference by setting P15.1(Setpoint selection) or PID Actual value by setting P15.4(Feedback value selection)!

2004 - 2007 can be set as the Analogue Output by P9.1, P9.5, P9.9.
2004 - 2008 can set as Aux Control Word with P10.9:
b0: Run enable
b1: acc / dec ramp 2 selection
b2: freq reference 2 selection

**Note!**- AUX CW is active when configured, even if control place is not the fieldbus
- b0 Run enable is computed in AND with a possible Run enable signal from digital input. Fall of enable will cause coasting stop.

Status word (output process data)
Information about the status of the device and messages is indicated in the Status word. The Status word is composed of 16 bits the meanings of which are described in the table below:

| Bit | Description | |
|-----|-------------|---|
| | Value = 0 | Value = 1 |
| B0, RDY | Drive not ready | Drive ready |
| B1, RUN | Stop | Run |
| B2, DIR | Clockwise | Counter-clockwise |
| B3, FLT | No fault | Fault active |
| B4, W | No alarm | Alarm active |
| B5, AREF | Ramping | Speed reference reached |
| B6, Z | - | Drive is running at zero speed |
| B7 - B15 | - | - |

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Table 8.6: Status word (output process data)

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General status word (output process data)

Information about the status of the device and messages is indicated in the General status word. The General status word is composed of 16 bits the meanings of which are described in the table below:

| Bit | Description | |
|---|---|---|
| | Value = 0 | Value = 1 |
| B0, RDY | Drive not ready | Drive ready |
| B1, RUN | Stop | Run |
| B2, DIR | Clockwise | Counter-clockwise |
| B3, FLT | No fault | Fault active |
| B4, W | No alarm | Alarm active |
| B5, AREF | Ramping | Speed reference reached |
| B6, Z | - | Drive is running at zero speed |
| B7, F | - | Fieldbus control active |
| B8 - B12 | - | |

| Bit | Control place | | | |
|---|---|---|---|---|
| | I/O | PC tool | Keypad | Fieldbus |
| B13 | 1 | 0 | 0 | 0 |
| B14 | 0 | 1 | 1 | 0 |
| B15 | 0 | 1 | 0 | 1 |

Table 8.7: General status word (output process data)

Actual speed (output process data)

This is actual speed of the frequency converter. The scaling is -10000...10000. The value is scaled in percentage of the frequency area between set minimum and maximum frequency.

Control word (input process data)

The three first bits of the control word are used to control the frequency converter. By using control word it is possible to control the operation of the drive. The meanings of the bits of control word are explained in the table below:

| Bit | Description | |
|---|---|---|
| | Value = 0 | Value = 1 |
| B0, RUN | Stop | Run |
| B1, DIR | Clockwise | Counter-clockwise |
| B2, RST | Rising edge of this bit will reset active fault | |
| B5, Quick | Normal deceleration ramp time | Quick deceleration ramp time |

Table 8.8: Control word (input process data)

Speed reference (input process data)

This is the Reference 1 to the frequency converter. Used normally as Speed reference.The allowed scaling is 0...10000. The value is scaled in percentage of the frequency area between the set minimum and maximum frequencies.

## 8.18 TOTAL AND TRIP COUNTERS

The N800S has different counters based on the operation time of the drive and theenergy consumption. Some of the counters measure total values and some can be reset.

The energy counters measure the energy that is taken from the supply network. The other counters are used to measure, for example, the operation time of the drive or the run time ofthe motor.

It is possible to monitor all the counter values from the PC, keypad or fieldbus. If you use thekeypad or the PC, you can monitor the counter values in the Diagnostics menu. If you usefieldbus, you can read the counter values with the ID numbers. In this chapter, you find dataon these ID numbers.

### 8.18.1 OPERATING TIME COUNTER

It is not possible to reset the operating time counter of the control unit. The counter is in thesubmenu Total counters. The value of the counter has 5 different 16-bit values. To read the value of the counter through fieldbus, use these ID numbers.

- ID 1754 Operating Time Counter (years)
- ID 1755 Operating Time Counter (days)
- ID 1756 Operating Time Counter (hours)
- ID 1757 Operating Time Counter (minutes)
- ID 1758 Operating Time Counter (seconds)

Example) You receive the value 1a 143d 02:21 of the operating time counter from the fieldbus.

- ID1754: 1 (years)
- ID1755: 143 (days)
- ID1756: 2 (hours)
- ID1757: 21 (minutes)
- ID1758: 0 (seconds)

### 8.18.2 OPERATING TIME TRIP COUNTER

The operating time trip counter of the control unit can be reset. It is in the submenu Trip counters. It is possible to reset the counter with the PC, the control panel, or the fieldbus.The value of the counter has 5 different 16-bit values. To read the value of the counterthrough fieldbus, use these ID numbers.

- ID 1766 Operating Time Trip Counter (years)
- ID 1767 Operating Time Trip Counter (days)
- ID 1768 Operating Time Trip Counter (hours)
- ID 1769 Operating Time Trip Counter (minutes)
- ID 1770 Operating Time Trip Counter (seconds)

Example) You receive the value 1a 143d 02:21 of the operating time trip counter from the fieldbus.

- ID1766: 1 (years)
- ID1767: 143 (days)
- ID1768: 2 (hours)
- ID1769: 21 (minutes)
- ID1770: 0 (seconds)

**ID 2311 OPERATING TIME TRIP COUNTER RESET**

You can reset the operating time trip counter with the PC, the control panel, or the fieldbus. If you use the PC or the control panel, reset the counter in the Diagnostics menu.If you use the fieldbus, to reset the counter, set a rising edge (0 → 1) to ID2311 OperatingTime Trip Counter Reset.

### 8.18.3 RUN TIME COUNTER

The run time counter of the motor cannot be reset. It is in the submenu Total counters. The value of the counter has 5 different 16-bit values. To read the value of the counter throughfieldbus, use these ID numbers.

- ID 1772 Run Time Counter (years)
- ID 1773 Run Time Counter (days)
- ID 1774 Run Time Counter (hours)
- ID 1775 Run Time Counter (minutes)
- ID 1776 Run Time Counter (seconds)

Example) You receive the value '1a 143d 02:21' of the run time counter from the fieldbus.

- ID1772: 1 (years)
- ID1773: 143 (days)
- ID1774: 2 (hours)
- ID1775: 21 (minutes)
- ID1776: 0 (seconds)

### 8.18.4 POWER ON TIME COUNTER

The power on time counter of the power unit is in the submenu Total counters. It is notpossible to reset the counter. The value of the counter has 5 different 16-bit values. To read the value of the counter through fieldbus, use these ID numbers.

- ID 1777 Power On Time Counter (years)
- ID 1778 Power On Time Counter (days)
- ID 1779 Power On Time Counter (hours)
- ID 1780 Power On Time Counter (minutes)
- ID 1781 Power On Time Counter (seconds)

Example) You receive the value '1a 240d 02:18' of the power on time counter from the fieldbus.

- ID1777: 1 (years)
- ID1778: 240 (days)
- ID1779: 2 (hours)
- ID1780: 18 (minutes)
- ID1781: 0 (seconds)

### 8.18.5 ENERGY COUNTER

The energy counter counts the total quantity of energy that the drive gets from the supply network. The counter cannot be reset. To read the value of the counter through fieldbus, usethese ID numbers.

**ID 2291 Energy Counter**

The value has always 4 digits. The format and the unit of the counter change to agree with the energy counter value. See the example below.

Example)
• 0.001 kWh
• 0.010 kWh
• 0.100 kWh
• 1.000 kWh
• 10.00 kWh
• 100.0 kWh
• 1.000 MWh
• 10.00 MWh
• 100.0 MWh
• 1.000 GWh
• etc~

**ID2303 Energy Counter Format**

The energy counter format gives the position of the decimal point in the value of the Energy Counter.

• 40=4 digits, 0 fractional digit
• 41=4 digits, 1 fractional digit
• 42=4 digits, 2 fractional digits
• 43=4 digits, 3 fractional digits

Example)
• 0.001 kWh (Format=43)
• 100.0 kWh (Format=41)
• 10.00 MWh (Format=42)

**ID2305 Energy Counter Unit**

The energy counter unit gives the unit for the value of the Energy Counter.

• 0=kWh
• 1=MWh
• 2=GWh
• 3=TWh
• 4=PWh

Example) If you receive the value 4500 from ID2291, the value 42 from ID2303, and the value 0 from ID2305, the result is 45.00 kWh.

**8.18.6 ENERGY TRIP COUNTER**

The energy trip counter counts the quantity of energy that the drive gets from the supply network. The counter is in the submenu Trip counters. You can reset the counter with the PC, the control panel, or the fieldbus. To read the value of the counter through fieldbus, use these ID numbers.

**ID 2296 Energy Trip Counter**

The value has always 4 digits. The format and the unit of the counter change to agree with the energy trip counter value. See the example below. You can monitor the energy counter format and unit with ID2307 Energy Trip Counter Format and ID2309 Energy trip Counter unit.

• 0.001 kWh
• 0.010 kWh
• 0.100 kWh
• 1.000 kWh
• 10.00 kWh
• 100.0 kWh
• 1.000 MWh
• 10.00 MWh
• 100.0 MWh
• 1.000 GWh
• etc...

ID2307 Energy Trip Counter Format

The energy trip counter format gives the position of the decimal point in the value of the Energy Trip Counter.

• 40 = 4 digits, 0 fractional digit
• 41 = 4 digits, 1 fractional digit
• 42 = 4 digits, 2 fractional digits
• 43 = 4 digits, 3 fractional digits

Example)
• 0.001 kWh (Formet=43)
• 100.0 kWh (Formet=41)
• 10.00 MWh (Formet=42)

**ID2309 Energy Trip Counter Unit**

The energy trip counter unit gives the unit for the value of the Energy Trip Counter.

• 0=kWh
• 1=MWh
• 2=GWh
• 3=TWh
• 4=PWh

**ID2312 Energy Trip Counter Reset**

To reset the energy trip counter, use the PC, the control panel, or the fieldbus. If you use the PC or the control panel, reset the counter in the Diagnostics menu. If you use the fieldbus, set a rising edge(0-→1) to ID2312 Energy Trip Counter Reset.

# 9. TECHNICAL DATA OF MI FRAMES

## 9.1 AC drive technical data

| | | |
|---|---|---|
| **Mains connection** | Input voltage Uin | 208...240 V, -15%...+10% 1~<br>208...240 V, -15%...+10% 3~<br>380 - 480 V, -15%...+10% 3~ |
| | Input frequency | 45...66 Hz |
| | Connection to mains | Once per minute or less (normal case). |
| **Supply network** | Networks | N800S (400 V) cannot be used with corner grounded networks |
| | Short circuit current | Maximum short circuit current has to be 〈 50 kA, For MI4 without DC-choke, maximum short circuit current has to be 〈 2.3 kA, for MI5 without DC-choke, maximum short circuit current has to be 〈 3.8 kA |
| **Motor connection** | Output voltage | 0 - Uin |
| | Output current | Continuous rated current IN at ambient temperature max. +50 ºC (depends on the unit size),<br>overload 1.5 x IN MAX 1 min / 10 min |
| | Starting current / torque | Current 2 x IN for 2 sec in every 20 sec period.<br>Torque depends on motor |
| | Output frequency | 0...320 Hz |
| | Frequency resolution | 0.01 Hz |
| **Control connection** | Digital input | Positive, Logic1: 18...+30V, Logic0: 0...5V; Negative, Logic1: 0...10V, Logic0: 18...30V; Ri = 10KΩ (floating) |
| | Analogue input voltage | 0....+10V,Ri = 250KΩ |
| | Analogue input current | 0(4)...20mA, Ri ≤ 250Ω |
| | Analogue output | 0...10V, RL ≥ 1KΩ; 0(4)...20mA,RL ≤ 500Ω |
| | Digital output | Open collector, max. load 35V/50mA (floating) |
| | Relay output | Switching load: 250Vac/3A |
| | Auxiliary voltage | ±20%,max.load 50mA |

Table 9.1: MI frame technical data

| | Control method | Frequency Control U / f <br> Open Loop Sensorless Vector Control |
|---|---|---|
| **Control characteristics** | Switching frequency | 1...16 kHz; Factory default 4 kHz |
| | Frequency reference | Resolution 0.01 Hz |
| | Field weakening point | 30...320 Hz |
| | Acceleration time | 0.1...3000 sec |
| | Deceleration time | 0.1...3000 sec |
| | Braking torque | 100%*TN with brake option (only in 3~ drives sizes MI2-5 ) <br> 30%*TN without brake option |
| **Ambient conditions** | Ambient operating temperature | -10 °C (no frost)...+40 / 50 °C (depends on the unit size): rated loadability $I_N$ <br> Side by side installation for MI1-3 it is always 40 °C; For IP21/ <br> Nema1 option in MI1-3 the maximum temparture is also 40 °C |
| | Storage temperature | -40°C ...+70°C |
| | Relative humidity | 0...95% RH, non-condensing, non-corrosive, no dripping water |
| | Air quality: <br> - chemical vapours <br> - mech. particles | IEC 721-3-3, unit in operation, class 3C2 <br> IEC 721-3-3, unit in operation, class 3S2 |
| | Altitude | 100% load capacity (no derating) up to 1000 m. 1% derating for <br> each 100 m above 1000 m; max. 2000 m |
| | Vibration: <br> EN60068-2-6 | 3...150 Hz <br> Displacement amplitude 1(peak) mm at 3...15.8 Hz <br> Max acceleration amplitude 1 G at 15.8...150 Hz |
| | Shock <br> IEC 68-2-27 | UPS Drop Test (for applicable UPS weights) <br> Storage and shipping: max 15 G, 11 ms (in package) |
| | Enclosure class | IP20/IP21/Nema1 for MI1-3, IP21/Nema 1 for MI4-5 |
| | Pollution degree | PD2 |
| **EMC** | Immunity | Complies with EN61800-3 |
| | Emissions | Complies with EN61800-3, category C4 |
| **Standards** | | For EMC: EN61800-3, For safety: UL508C, EN61800-5 |
| **Certificates and manu-facturer's declarations of conformity** | | For safety: CE, UL, cUL, <br> For EMC: CE <br> (see unit nameplate for more detailed approvals) |

Table 9.1: MI frame technical data

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## 9.2   Power ratings

### 9.2.1   Mains voltage 208-240 V

| Mains voltage 208-240 V, 50/60 Hz, 1~ series | | | | | | | |
|---|---|---|---|---|---|---|---|
| Freq. converter type | Rated loadability | | Motor shaft power | | Nominal input current | Mechani-cal size | Weight (kg) |
| | 100% contin. current $I_N$ [A] | 150% overload current[A] | P [HP] | P [KW] | [A] | | |
| 0001 | 1.7 | 2.6 | 0.33 | 0.25 | 4.2 | MI1 | 0.55 |
| 0002 | 2.4 | 3.6 | 0.5 | 0.37 | 5.7 | MI1 | 0.55 |
| 0003 | 2.8 | 4.2 | 0.75 | 0.55 | 6.6 | MI1 | 0.55 |
| 0004 | 3.7 | 5.6 | 1 | 0.75 | 8.3 | MI2 | 0.7 |
| 0005 | 4.8 | 7.2 | 1.5 | 1.1 | 11.2 | MI2 | 0.7 |
| 0007 | 7 | 10.5 | 2 | 1.5 | 14.1 | MI2 | 0.7 |
| 0009* | 9.6 | 14.4 | 3 | 2.2 | 22.1 | MI3 | 0.99 |

Table 9.2: MI frame power ratings, 208-240 V, 1~

* The maximum ambient operating temperature of this drive is 40 °C!

| Mains voltage 208 - 240 V, 50/60 Hz, 3~ series | | | | | | | |
|---|---|---|---|---|---|---|---|
| Freq. converter type | Rated loadability | | Motor shaft power | | Nominal input current | Mechani-cal size | Weight (kg) |
| | 100% contin. current $I_N$ [A] | 150% overload current[A] | P [HP] | P [KW] | [A] | | |
| 0001 | 1.7 | 2.6 | 0.33 | 0.25 | 2.7 | MI1 | 0.55 |
| 0002 | 2.4 | 3.6 | 0.5 | 0.37 | 3.5 | MI1 | 0.55 |
| 0003 | 2.8 | 4.2 | 0.75 | 0.55 | 3.8 | MI1 | 0.55 |
| 0004 | 3.7 | 5.6 | 1 | 0.75 | 4.3 | MI2 | 0.7 |
| 0005 | 4.8 | 7.2 | 1.5 | 1.1 | 6.8 | MI2 | 0.7 |
| 0007* | 7 | 10.5 | 2 | 1.5 | 8.4 | MI2 | 0.7 |
| 0011* | 11 | 16.5 | 3 | 2.2 | 13.4 | MI3 | 0.99 |
| 0012 | 12.5 | 18.8 | 4 | 3 | 14.2 | MI4 | 9 |
| 0017 | 17.5 | 26.3 | 5 | 4 | 20.6 | MI4 | 9 |
| 0025 | 25 | 37.5 | 7.5 | 5.5 | 30.3 | MI4 | 9 |
| 0031 | 31 | 46.5 | 10 | 7.5 | 36.6 | MI5 | 11 |
| 0038 | 38 | 57 | 15 | 11 | 44.6 | MI5 | 11 |

Table 9.3: MI frame power ratings, 208-240 V, 3~

* The maximum ambient operating temperature of these drives is +40 °C.

### 9.2.2   Mains voltage 380-480 V

| Freq. converter type | Rated loadability | | Motor shaft power | | Nominal input current | Mechanical size | Weight (kg) |
|---|---|---|---|---|---|---|---|
| | 100% contin. current Iℕ [A] | 150% overload current[A] | P [HP] | P [KW] | [A] | | |
| 0001 | 1.3 | 2 | 0.5 | 0.37 | 2.2 | MI1 | 0.55 |
| 0002 | 1.9 | 2.9 | 0.75 | 0.55 | 2.8 | MI1 | 0.55 |
| 0003 | 2.4 | 3.6 | 1 | 0.75 | 3.2 | MI1 | 0.55 |
| 0004 | 3.3 | 5 | 1.5 | 1.1 | 4 | MI2 | 0.7 |
| 0005 | 4.3 | 6.5 | 2 | 1.5 | 5.6 | MI2 | 0.7 |
| 0006 | 5.6 | 8.4 | 3 | 2.2 | 7.3 | MI2 | 0.7 |
| 0008 | 7.6 | 11.4 | 4 | 3 | 9.6 | MI3 | 0,99 |
| 0009 | 9 | 13.5 | 5 | 4 | 11.5 | MI3 | 0.99 |
| 0012 | 12 | 18 | 7.5 | 5.5 | 14.9 | MI3 | 0.99 |
| 0016 | 16 | 24 | 10 | 7.5 | 17.1 | MI4 | 9 |
| 0023 | 23 | 34.5 | 15 | 11 | 25.5 | MI4 | 9 |
| 0031 | 31 | 46.5 | 20 | 15 | 33 | MI5 | 11 |
| 0038 | 38 | 57 | 25 | 18.5 | 41.7 | MI5 | 11 |

The table's title row reads: **Mains voltage 380-480 V, 50/60 Hz, 3~ series**

Table 9.4: MI frame power ratings, 380-480 V, 3～

**Note 1:** The input currents are calculated values with 100KVA line transformer supply.

**Note 1:** The mechanical dimensions of the units are given in chapter 3.1.1.

**Note 1:** For PM motor, please select the drive power rating according to motor draft power, not rated current.

## 9.3 Brake resistors

| N800S type | Minimum braking resistance |
|---|---|
| MI2 204-240V,3~ | 50 Ohm |
| MI2 380-480V,3~ | 118 Ohm |
| MI3 204-240V, 3~ | 31 Ohm |
| MI3 380-480V, 3~ | 55 Ohm |
| MI4 204-240V, 3~ | 14 Ohm |
| MI4 380-480V, 3~ | 28 Ohm |
| MI5 204-240V, 3~ | 9 Ohm |
| MI5 380-480V, 3~ | 17 Ohm |

# 10. TECHNICAL DATA OF MR FRAMES

## 10.1 AC DRIVE POWER RATINGS

### 10.1.1 MAINS VOLTAGE 208-240 V

Table 10.1: The power ratings of MR frame in mains voltage 208-240V, 50-60 Hz, 3~

| Frame | Drive type | Loadability | | | | | Motor shaft power | | | |
| | | Low * | | High * | | | 230 V mains | | 230 V mains | |
| | | Continuous current I_L [A] | 10% overload current [A] | Continuous current I_H [A] | 50% overload current [A] | Max current Is 2s | 10% overload 40°C [kW] | 50% overload 50°C [kW] | 10% overload 40°C [hp] | 50% overload 50°C [hp] |
|---|---|---|---|---|---|---|---|---|---|---|
| MR6 | 0048 | 48 | 52.8 | 31 | 46.5 | 62 | 11 | 7.5 | 15 | 10 |
| | 0062 | 62 | 68.2 | 48 | 72 | 96 | 15 | 11 | 20 | 15 |
| MR7 | 0075 | 75 | 82.5 | 62 | 93 | 124 | 18.5 | 15 | 25 | 20 |
| | 0088 | 88 | 96.8 | 75 | 112.5 | 150 | 22 | 18.5 | 30 | 25 |
| | 0105 | 105 | 115.5 | 88 | 132 | 176 | 30 | 22 | 40 | 30 |
| MR8 | 0140 | 143 | 154 | 114 | 171 | 210 | 37 | 30 | 50 | 40 |
| | 0170 | 170 | 187 | 140 | 210 | 280 | 45 | 37 | 60 | 50 |
| | 0205 | 208 | 225.5 | 170 | 255 | 340 | 55 | 45 | 75 | 60 |
| MR9 | 0261 | 261 | 287.1 | 211 | 316.5 | 410 | 75 | 55 | 100 | 75 |
| | 0310 | 310 | 341 | 251 | 376.5 | 502 | 90 | 75 | 125 | 100 |

* See chapter 10.1.3 Overload capability.

**NOTE!**

The rated currents in given ambient temperatures (in Table 10.6 The technical data of the N800S AC drive) are achieved only when the switching frequency $\leq$ the factory default.

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

### 10.1.2 MAINS VOLTAGE 380-500 V

Table 10.2: The power ratings of MR frame in mains voltage 380-500V, 50-60 Hz, 3~

| Frame | Drive type | Loadability | | | | | Motor shaft power | | | |
| | | Low * | | High * | | | 400 V mains | | 480 V mains | |
| | | Continuous current $I_L$ [A] | 10% overload current [A] | Continuous current $I_H$ [A] | 50% overload current [A] | Max current Is 2s | 10% overload 40°C [kW] | 50% overload 50°C [kW] | 10% overload 40°C [hp] | 50% overload 50°C [hp] |
|---|---|---|---|---|---|---|---|---|---|---|
| MR6 | 0038 | 38 | 41.8 | 31 | 46.5 | 62 | 18.5 | 15 | 25 | 20 |
| | 0046 | 46 | 50.6 | 38 | 57 | 76 | 22 | 18.5 | 30 | 25 |
| | 0061 | 61 | 67.1 | 46 | 69 | 92 | 30 | 22 | 40 | 30 |
| MR7 | 0072 | 72 | 79.2 | 61 | 91.5 | 122 | 37 | 30 | 50 | 40 |
| | 0087 | 87 | 95.7 | 72 | 108 | 144 | 45 | 37 | 60 | 50 |
| | 0105 | 105 | 115.5 | 87 | 130.5 | 174 | 55 | 45 | 75 | 60 |
| MR8 | 0140 | 140 | 154 | 105 | 157.5 | 210 | 75 | 55 | 100 | 75 |
| | 0170 | 170 | 187 | 140 | 210 | 280 | 90 | 75 | 125 | 100 |
| | 0205 | 205 | 225.5 | 170 | 255 | 340 | 110 | 90 | 150 | 125 |
| MR9 | 0261 | 261 | 287.1 | 205 | 307.5 | 410 | 132 | 110 | 200 | 150 |
| | 0310 | 310 | 341 | 251 | 376.5 | 502 | 160 | 132 | 250 | 200 |

* See chapter 10.1.3 Overload capability.

**NOTE!**

The rated currents in given ambient temperatures (in Table 10.6 The technical data of the N800S AC drive) are achieved only when the switching frequency ≤ the factory default.

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

### 10.1.3   OVERLOAD CAPABILITY

The **low overload** means that if 110% of the rated continuous current ($I_L$) is required for 1 minute every 10 minutes, the remaining 9 minutes must be approximately 98% of $I_L$ or less.

This is to make sure that the output current is not more than $I_L$ during the duty cycle.
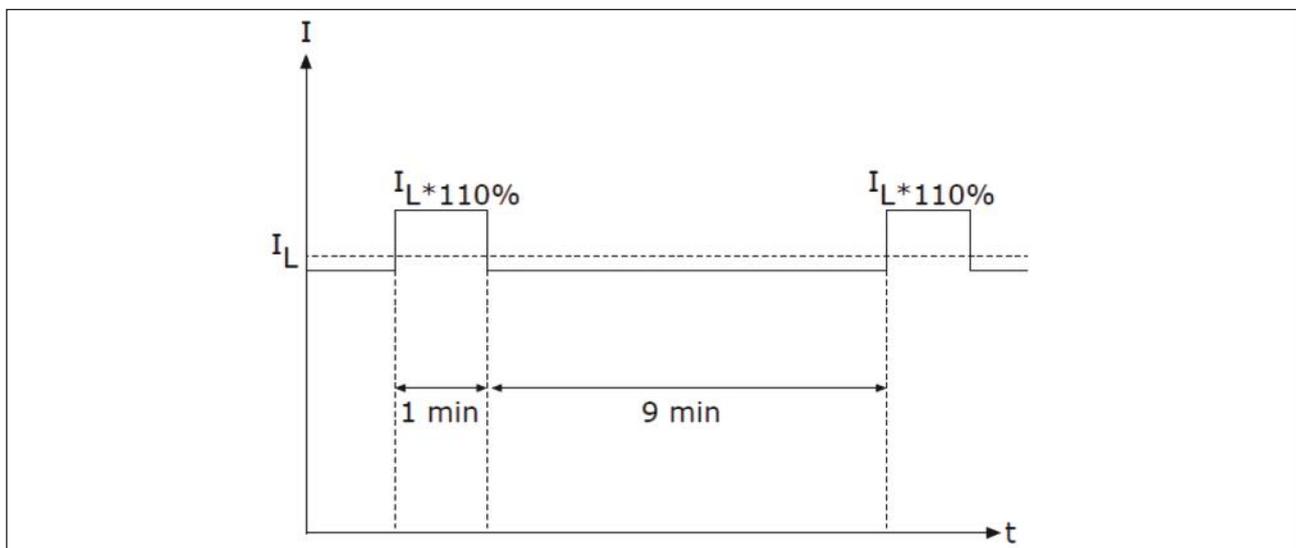


Fig. 10.1: Low overload

The **high overload** means that if 150% of the rated continuous current ($I_H$) is required for 1 minute every 10 minutes, the remaining 9 minutes must be approximately 92% of $I_H$ or less.

This is to make sure that the output current is not more than $I_H$ during the duty cycle.
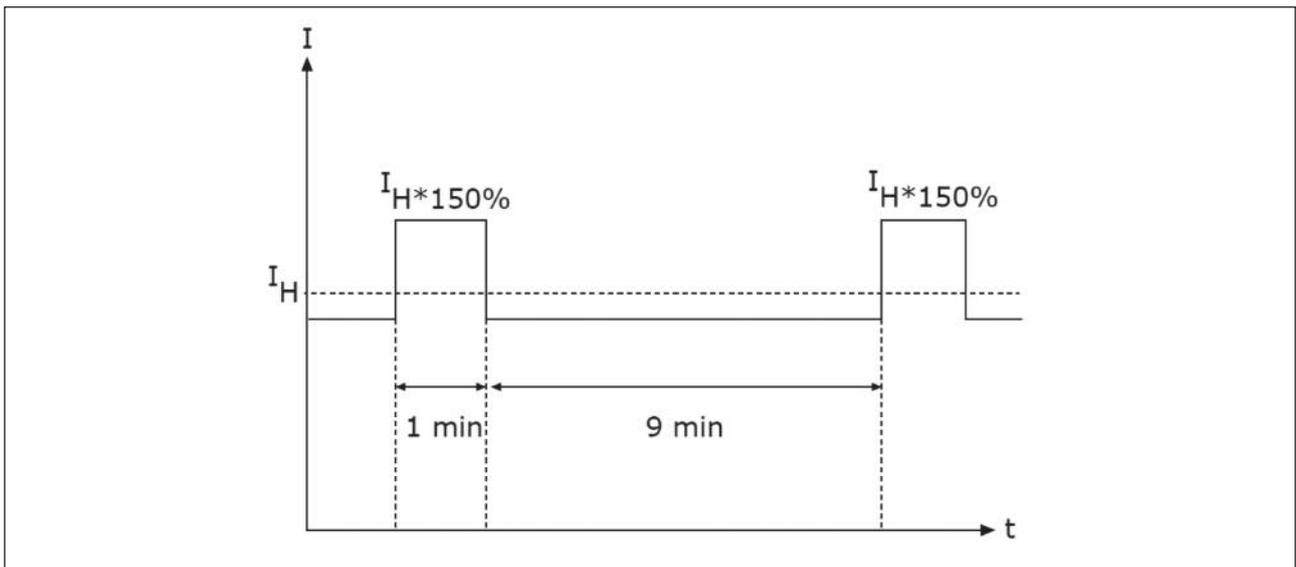
Fig. 10.2: High overload

**NOTE!** For more information, refer to the standard IEC61800-2 (IEC:1998).

### 10.1.4  BRAKE RESISTOR RATINGS

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

| Frame | Duty cycle | Minimum braking resistance ($\Omega$) |
|---|---|---|
| MR6 | Light Duty* | 21.0 |
|  | Heavy Duty* | 21.0 |
| MR7 | Light Duty* | 14.0 |
|  | Heavy Duty* | 14.0 |
| MR8 | Light Duty* | 6.5 |
|  | Heavy Duty* | 6.5 |
| MR9 | Light Duty* | 3.3 |
|  | Heavy Duty* | 3.3 |

Table 10.3: The recommended brake resistor types and the calculated resistance of the drive

• The light duty cycle is for brake resistor cyclic use (1 LD pulse in a 120-second period).
  The light duty resistor is rated for a 5-second ramp from full power to 0.
• The heavy duty cycle is for brake resistor cyclic use (1 HD pulse in a 120-second period).
  The heavy duty resistor is rated for a 3-second full power braking with a 7-second ramp to 0.
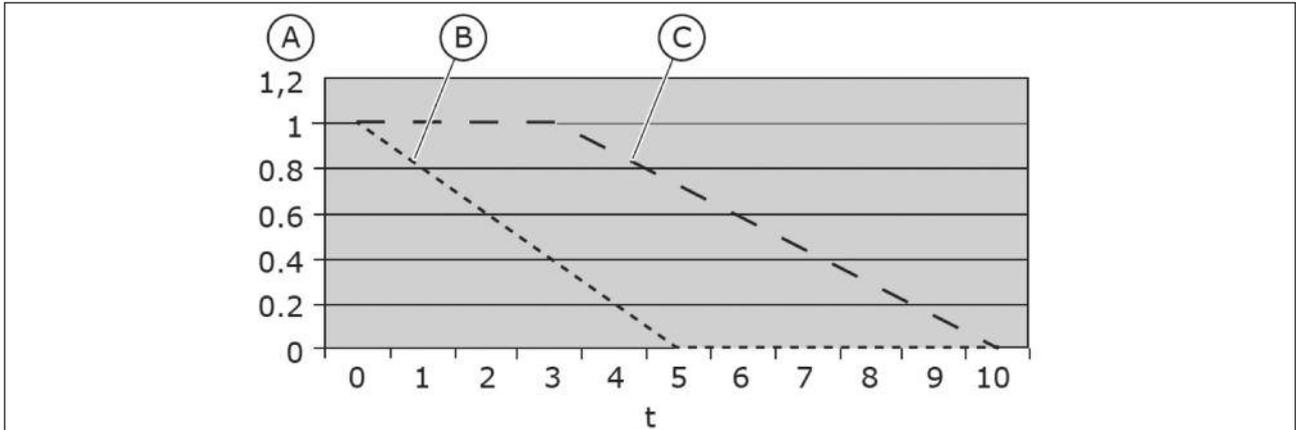


Fig. 10.3: The LD and HD pulses

A.  Relative power                              C.  Heavy duty
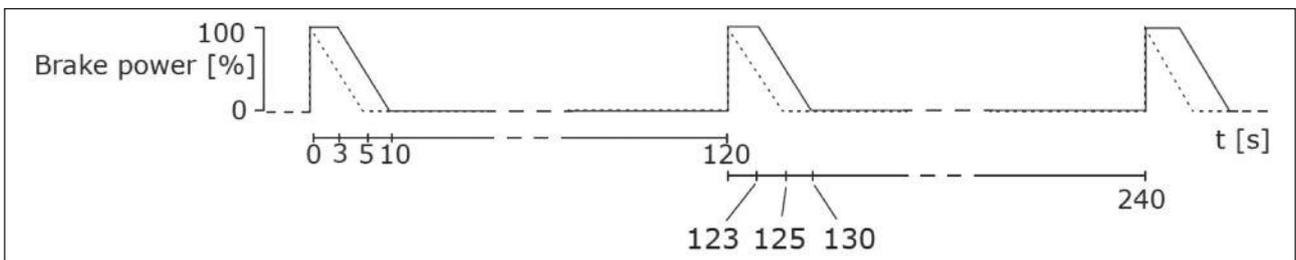B.  Light duty



Fig. 10.4: The duty cycles of the LD and HD pulses

Table 10.4: The minimum resistance and the brake power, mains voltage 208-240V

| Mains voltage 208-240 V, 50/60 Hz, 3~ | | |
|---|---|---|
| Frame | The minimum brake resistance [Ω] | Brake power* @ 405 VDC [kW] |
| MR6 | 10.0 | 7.8 |
| MR7 | 5.5 | 11.7 |
| MR8 | 3.0 | 25.2 |
| MR9 | 1.4 | 49.7 |

\* = When you use recommended resistor types.

Table 10.5: The minimum resistance and the brake power, mains voltage 380-500V

| Mains voltage 380-500 V, 50/60 Hz, 3~ | | |
|---|---|---|
| Frame | The minimum brake resistance [Ω] | Brake power* @ 845 VDC [kW] |
| MR6 | 21.0 | 34.0 |
| MR7 | 14.0 | 51.0 |
| MR8 | 6.5 | 109.9 |
| MR9 | 3.3 | 216.4 |

* When you use recommended resistor types.

## 10.2   AC drive - TECHNICAL DATA

Table 10.6: The technical data of the MR frame

| | | |
|---|---|---|
| Mains connection | Input voltage Uin | 208...240 V; 380...500 V; -10%...+10% |
| | Input frequency | 50...60 Hz -5...+10% |
| | Connection to mains | Once per minute or less |
| | Starting delay | 6s (MR6); 8s (MR7 - MR9) |
| Motor connection | Output voltage | 0-Uin |
| | Continuous output current | IL: Ambient temperature max. +40 °C overload 1.1 x IL (1 min/10 min) IH: Ambient temperature max. +50 °C overload 1.5 x IH (1 min/10 min) |
| | Output frequency | 0-320 Hz (standard) |
| | Frequency resolution | 0.01 Hz |
| Control qualities | Switching frequency | MR6: 1.5-10 kHz Defaults: 4 kHz<br><br>MR7 to MR9: 1.5-6 kHz Defaults <br>• MR7: 4 kHz <br>• MR8: 3 kHz <br>• MR9: 2 kHz <br>Automatic switching frequency derating in case of overload. |
| | Frequency reference | Analogue input: Resolution 0.1% (10-bit), accuracy ±1% Keypad: 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 | IL current: -10°C (no frost)...+40 °C IH current: -10°C (no frost)...+50 °C Maximum operating temperature: +50 °C |
| | Storage temperature | -40 °C...+70 °C |
| | Relative humidity | 0-95% RH, non-condensing, non-corrosive |
| | Air quality: • chemical vapours • mechanical particles | Tested according to IEC 60068-2-60 Test Ke: Flowing mixed gas corrosion test, Method 1 (H2S [hydrogen sulfide] and SO2 [sulfur dioxide]) Designed according to • IEC 60721-3-3, unit in operation, class 3C3 (IP21/UL Type 1 Models 3C2) • IEC 60721-3-3, unit in operation, class 3S2 |

| | | |
|---|---|---|
| **Ambient conditions** | Altitude | 100% load capacity (no derating) up to 1000 m<br>1% derating for each 100m above 1000 m<br>Maximum altitudes:<br>• 208-240 V: 4000 m (TN and IT systems)<br>• 380-500 V: 4000 m (TN and IT systems)<br>Voltage for relay outputs:<br>• Up to 3000 m : Allowed up to 240 V<br>• 3000-4000 m: Allowed up to 120 V<br>Corner-grounding: up to 2,000 m only (see chapter 4.6.7 Installation in a corner-grounded network) |
| | **Vibration**<br>EN61800-5-1/<br>EN60068-2-6 | 5-150 Hz<br>Displacement amplitude 1 mm (peak) at 5-15.8 Hz<br>(MR6-MR9)<br>Maximum acceleration amplitude 1 G at 15.8-150 Hz<br>(MR6-MR9) |
| | **Shock**<br>EN60068-2-27 | UPS Drop Test (for applicable UPS weights)<br>Storage and shipping: maximum 15 G, 11 ms<br>(in package) |
| | Enclosure class | MR6 ～ MR7: IP21 standard<br>MR8 ～ MR9: IP00 standard |
| **EMC (at default settings)** | Immunity | Fulfils EN61800−3 (2004) |
| | Emissions | Fulfills EN61800−3 (2004), category C4 |
| **Noise level** | Average noise level (min…max) sound pressure level in dB(A) | The sound pressure depends on the cooling fan speed, which is controlled in accordance with the drive temperature.<br><br>MR6: 63…72  MR7: 43…73<br>MR8: 58…73  MR9: 54…75 |
| **Safety** | | EN 61800-5-1 (2007), CE (See the nameplate of the drive for more approvals.) |
| **Protections** | Overvoltage trip limit | The 240-volt drives: 456 VDC<br>The 500-volt drives: 911 VDC |
| | Undervoltage trip limit | Depends on mains voltage (0.8775 X mains voltage):<br>Mains voltage 240 V: trip limit 211 VDC<br>Mains voltage 400 V: trip limit 351 VDC<br>Mains voltage 500 V: trip limit 421 VDC |
| | ETC | Earth fault protection, Mains supervision, Motor phase supervision, Overcurrent protection, Unit overtemperature protection, Motor overload protection, Motor stall protection, Motor underload protection, Short-circuit protection of +24 V and +10 V reference voltages |

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