

# VSA Series III Variable Speed Drive

## Installation manual

Effective July 2017



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## **Danger!** **Dangerous electrical voltage!**

### **Before commencing the installation**

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit the device.
- Cover or enclose any adjacent live components.
- Follow the engineering instructions (AWA/IL) for the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE, PES) must be connected to the protective earth (PE) or the potential equalisation. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that an open circuit on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the extra-low voltage of the 24 V supply. Only use power supply units complying with IEC 60364-4-41 (VDE 0100 Part 410) or HD384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause a restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed and with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause injury or material damage, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).
- Depending on their degree of protection, frequency inverters may contain live bright metal parts, moving or rotating components or hot surfaces during and immediately after operation.
- Removal of the required covers, improper installation or incorrect operation of motor or frequency inverter may cause the failure of the device and may lead to serious injury or damage.
- The applicable national accident prevention and safety regulations apply to all work carried on live frequency inverters.
- The electrical installation must be carried out in accordance with the relevant regulations (e. g. with regard to cable cross sections, fuses, PE).
- Transport, installation, commissioning and maintenance work must be carried out only by qualified personnel (IEC 60364, HD 384 and national occupational safety regulations).
- Installations containing frequency inverters must be provided with additional monitoring and protective devices in accordance with the applicable safety regulations. Modifications to the frequency inverters using the operating software are permitted.
- All covers and doors must be kept closed during operation.
- To reduce the hazards for people or equipment, the user must include in the machine design measures that restrict the consequences of a malfunction or failure of the drive (increased motor speed or sudden standstill of motor).

These measures include:

- Other independent devices for monitoring safety-related variables (speed, travel, end positions etc.).
- Electrical or non-electrical system-wide measures (electrical or mechanical interlocks).
- Never touch live parts or cable connections of the frequency inverter after it has been disconnected from the power supply. Due to the charge in the capacitors, these parts may still be live after disconnection. Fit appropriate warning signs.

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## 0 About this Manual

This manual (LIT-XXXXXXXX) is used in the installation and programming of the Series III VSA variable speed drives.

### 0.1 Target group

This LIT-XXXXXXXX manual is intended for engineers and electricians. Electrical engineering and physics-related knowledge and skills will be required in order to be able to commission the corresponding devices.

We assume that you have a good knowledge of engineering basics and that you are familiar with handling electrical systems and machines, as well as with reading technical drawings.

### 0.2 List of revisions

The following significant amendments have been introduced since previous issues:

| Publication date | Page    | Keyword   | New | Modified | Deleted |
|------------------|---------|---|-----|----------|---------|
| 11/16            | 66      | P1-12 = 12  |     |          | ✓       |
| 01/16            | –       | Manual split into this installation manual (= MN04020005Z-EN) and a parameter configuration manual (= MN04020006Z-EN) as well as revised in general |     | ✓        |         |
|                  | various | Performance expansion up to 250 kW (400 V)  | ✓   |          |         |
|                  | various | Rated operating voltages up to 600 V  | ✓   |          |         |
|                  | 59      | STO function (Safe Torque Off)  | ✓   |          |         |
| 10/12            |         | Initial Issue   |     |          |         |

### 0.3 Writing conventions

Symbols with the following meaning are used in this manual:

- ▶ Indicates instructions to be followed.

#### 0.3.1 Hazard warnings of material damages

**NOTICE**

Warns about the possibility of material damage.

#### 0.3.2 Hazard warnings of personal injury



**CAUTION**

Warns of the possibility of hazardous situations that may possibly cause slight injury.



**WARNING**

Warns of the possibility of hazardous situations that could result in serious injury or even death.



**DANGER**

Warns of hazardous situations that result in serious injury or death.

#### 0.3.3 Tips



Indicates useful tips.



In order to make it easier to understand some of the images included in this manual, the variable frequency drive housing, as well as other safety-relevant parts, has been left out. However, it is important to note that the variable frequency drive must always be operated with its housing in its proper place, as well as with all required safety-relevant parts.



All the specifications in this manual refer to the hardware and software versions documented in it.

## 0.4 Documents with additional information



More information on the devices described here can be found on the Internet under:

[www.johnsoncontrols.com](http://www.johnsoncontrols.com)

## 0.5 Abbreviations

The following abbreviations are used in this manual.

|      |   |
|------|---|
| DS   | Default settings                                  |
| EMC  | Electromagnetic compatibility                     |
| FE   | Functional earth                                  |
| FS   | Frame Size  |
| FWD  | Forward run (clockwise rotating field)            |
| GND  | Ground (0-V-potential)                            |
| IGBT | Insulated gate bipolar transistor                 |
| LED  | Light Emitting Diode (LED)                        |
| OLED | Organic Light Emitting Diode                      |
| PC   | Personal Computer                                 |
| PDS  | Power Drive System (magnet system)                |
| PE   | Protective earth (⊕)                              |
| PES  | EMC connection to PE for screened lines           |
| PNU  | Parameter number                                  |
| REV  | Reverse run (anticlockwise rotation field active) |
| SCCR | Short Circuit Current Rating                      |
| UL   | Underwriters Laboratories                         |

## 0.6 Mains supply voltages

The rated operating voltages stated in the following table are based on the nominal values for networks with a grounded star point.

In ring networks (as found in Europe) the rated operating voltage at the transfer point of the power supply companies is the same as the value in the consumer networks (e.g. 230 V, 400 V).

In star networks (as found in North America), the rated operating voltage at the transfer point of the utility companies is higher than in the consumer network.

Example: 240 V → 230 V, 480 V → 460 V, 600 V → 575 V.

The VSA variable frequency drive's wide tolerance range takes into account a permissible voltage drop of 10% (i.e.  $U_{LN} - 10\%$ ) while, in the 400-V category, it takes into account the North American mains voltage of 480 V + 10% (60 Hz).

0 About this Manual  
 0.7 Unit of measurement

The permissible power supplies for the VSA series are listed in the technical data section in the appendix.

The rated mains voltage operational data is always based on mains frequencies of 50/60 Hz within a range of 48 to 62 Hz.

**0.7 Unit of measurement**

Every physical dimension included in this manual uses international metric system units, otherwise known as SI (Système International d’Unités) units. For the purpose of the equipment’s UL certification, some of these dimensions are accompanied by their equivalents in imperial units.

**Table 1: Unit conversion examples**

| Designation | US-American designation | US-American value      | SI value                     | Conversion value                           |
|-------------|-------------------------|------------------------|------------------------------|--|
| Length      | inch                    | 1 in (")               | 25.4 mm                      | 0.0394                                     |
| Power       | horsepower              | 1 HP = 1.014 PS        | 0.7457 kW                    | 1.341                                      |
| Torque      | pound-force inches      | 1 lbf in               | 0.113 Nm                     | 8.851                                      |
| Temperature | Fahrenheit              | 1 °F (T <sub>F</sub> ) | -17.222 °C (T <sub>C</sub> ) | T <sub>F</sub> = T <sub>C</sub> × 9/5 + 32 |
| Speed       | Revolutions per minute  | 1 rpm                  | 1 min <sup>-1</sup>          | 1  |
| Weight      | pound                   | 1 lb                   | 0.4536 kg                    | 2.205                                      |
| Flow rate   | cubic feed per minute   | 1 cfm                  | 1.698 m <sup>3</sup> /min    | 0.5889                                     |

# 1 VSA device series

## 1.1 Introduction

Due to their comprehensive functionality and high reliability, PowerXL™ VSA variable frequency drives are ideal for sophisticated applications involving synchronous or asynchronous three-phase motors.

In fact, VSA variable frequency drives are characterized by innovative technology and unrivalled reliability that meet the needs of the machine and system-building industry and enable companies to optimize their production and manufacturing processes.

All VSA variable frequency drives feature an internal brake chopper. In addition, devices belonging to the 230 V (VSA 32...) and 400 V (VSA 34...) voltage classes come with an integrated radio interference suppression filter (EMC).

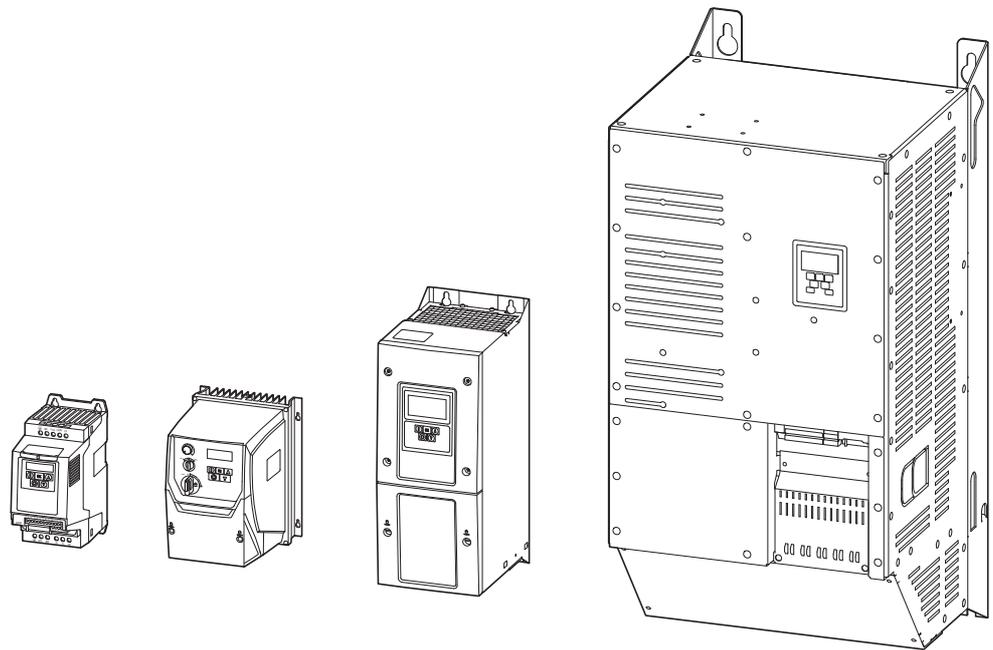
Moreover, the devices' printed circuit boards are coated in order to provide greater protection against environmental factors.

VSA devices are characterized by compact and rugged construction, are available in seven frame sizes (FS2 to FS8), and are designed for the following motor output ratings:

- 0.75 (with 230 V) to 11 kW (with 400 V and 500 V) with an IP20 degree of protection and a 7-segment digital display assembly
- 0.75 kW (with 230 V) to 7.5 kW (with 400 V and 500 V) with an IP66 degree of protection and an OLED display – also available in a version with a mains switch and controls for local control
- 5.5 kW (with 230 V) to 90 kW (with 500 V) and 132 kW (with 400 V) with an IP55 degree of protection, an OLED display, and an internal DC link choke in frame sizes FS5, FS6, and FS7
- 200 kW to 250 kW (with 400 V) with an IP20 degree of protection and an OLED display (frame size FS8)

# 1 VSA device series

## 1.1 Introduction



Degree of protection IP20

VSA...-A20C

Degree of protection IP66, with local controls

VSA...-B6SC  
VSA...-B66C – without controls)

Degree of protection IP55

VSA...-B55C

Degree of protection IP20 (200 kW, 250 kW)

VSA...-B20C

Figure 1: Models and enclosure versions

## 1.2 System overview

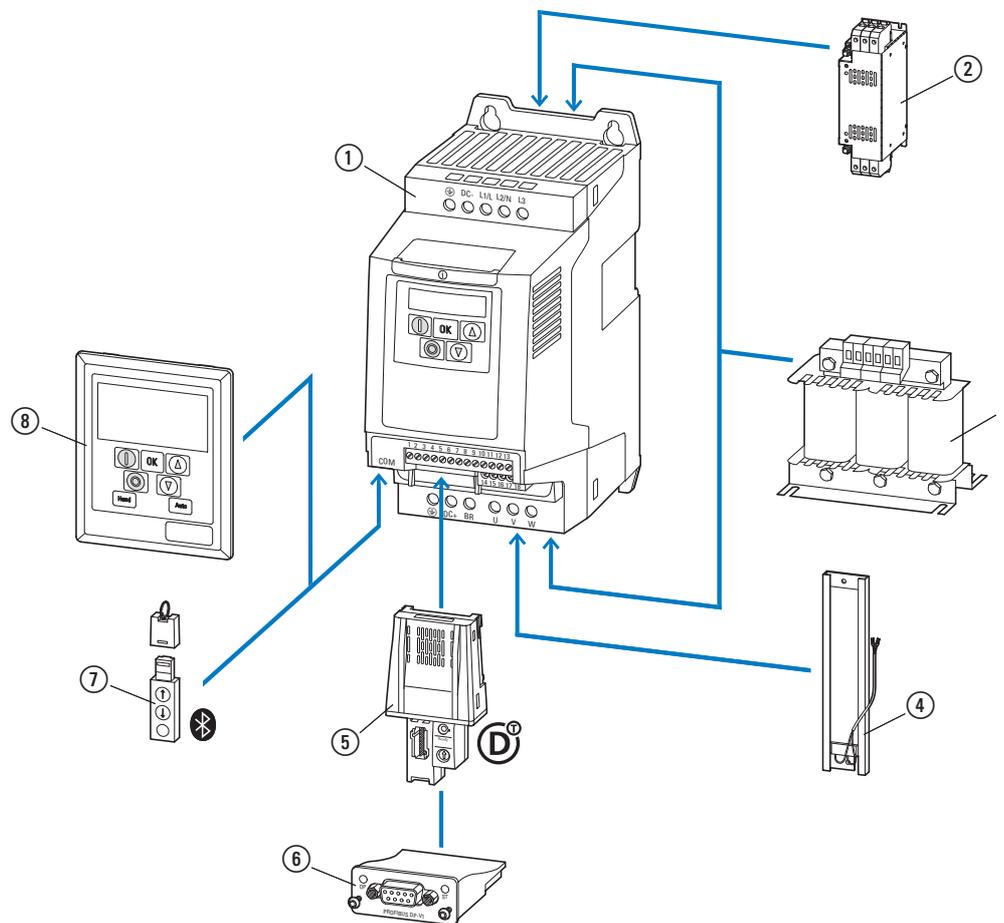


Figure 2: System overview (example: frame size FS2, degree of protection IP20)

- ① VSA... variable frequency drives
- ② DX-LN... mains choke, DX-LM3-... motor choke, DX-SIN3-... sine filter
- ③ DX-BR... braking resistance
- ④ DX-NET... fieldbus connection and DXA-EXT... expansion group
- ⑤ DX-COM-STICK communication module and accessories (e. g. DX-CBL-... connection cable)
- ⑥ DX-KEY-... keypad (external)

### 1.3 Checking the Delivery



Before opening the package, please check the nameplate on it to make sure that you received the correct variable speed drive.

The VSC series variable speed drives are carefully packaged and prepared for delivery. The devices should be shipped only in their original packaging with suitable transportation materials. Please take note of the labels and instructions on the packaging, as well as of those meant for the unpacked device.

Open the packaging with adequate tools and inspect the contents immediately after receipt in order to ensure that they are complete and undamaged.

The packaging must contain the following parts:

- VSC series variable speed drive
- an instructional leaflet

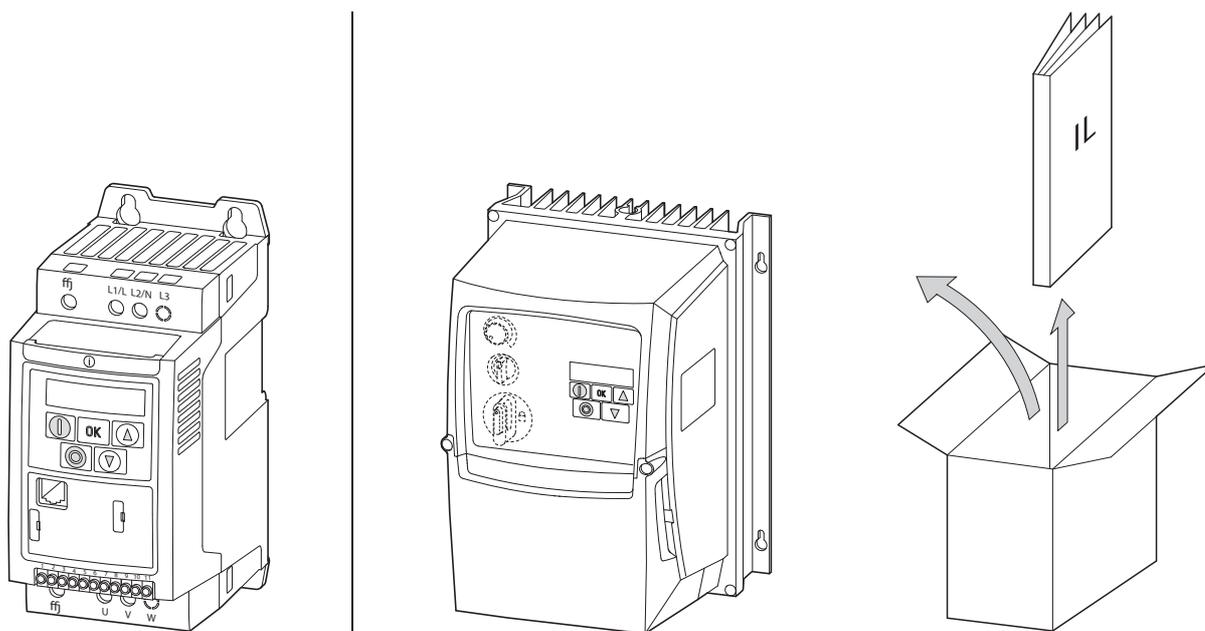


Figure 3: Equipment supplied (example: devices with IP20 / IP66 degree of protection with instruction leaflet)

## 1.4 Rated operational data

### 1.4.1 Rating data on the nameplate

The device-specific rated operational data for the VSA variable frequency drive is listed on the nameplate of the device.

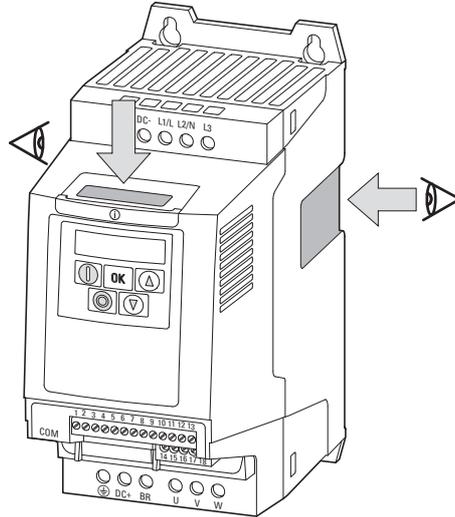


Figure 4: Nameplate on the device (example: frame size FS2, IP20 degree of protection)

The nameplate on top (nameplate ②) is a simplified version that can be used to clearly identify the device if the main nameplate (nameplate ①) is blocked by other devices.

# 1 VSA device series

## 1.4 Rated operational data

The inscription of the nameplate has the following meaning (example):

| Inscription   | Meaning  |
|---|--|
| VSA 124D3FB-A20C  | Part no.:<br>VSA = VSA series variable frequency drive<br>1 = Single-phase mains connection / three-phase motor connection<br>2 = 230 V mains voltage category<br>4D3 = 4.3 A rated operational current (4-decimal-1, output current)<br>F = Integrated radio interference suppression filter<br>B = Integrated brake chopper<br>A = LED display (7-segment text display)<br>20 = IP20 degree of protection<br>C = PCB protection (coated board) |
| Input   | Main terminal rating:<br>Single-phase AC voltage ( $U_e$ 1~ AC)<br>Voltage 200 - 240 V, frequency 50/60 Hz, input phase current (11 A)   |
| Output  | Load side (motor) rating:<br>Three-phase AC voltage (0 - $U_e$ ), output phase current (4.3 A),<br>Output frequency (0 - 500 Hz)<br>Assigned motor output:<br>0.75 kW with 230 V/1 HP with 230 V for a four-pole, internally cooled or<br>surface-cooled three-phase motor (1500 min <sup>-1</sup> at 50 Hz/1800 rpm at 60 Hz)   |
| Serial No.:   | Serial number  |
| IP20  | Degree of protection of the housing: IP 20, UL (cUL) Open type   |
| Software  | Software version (1.20)  |
| 08112013  | Manufacturing date: 11-08-2013   |
| Max amb. 50 °C  | Maximum permissible ambient air temperature (50 °C)  |
|  | Variable speed drive is an electrical apparatus.<br>Read the manual (in this case LIT-XXXXXXX) before making any electrical<br>connections and commissioning.  |

### 1.4.2 Catalog number selection

The catalog number selection/part no. for VSA variable frequency drives is subdivided into three groups

Series – Power section – Model

The following figure shows it in greater detail:

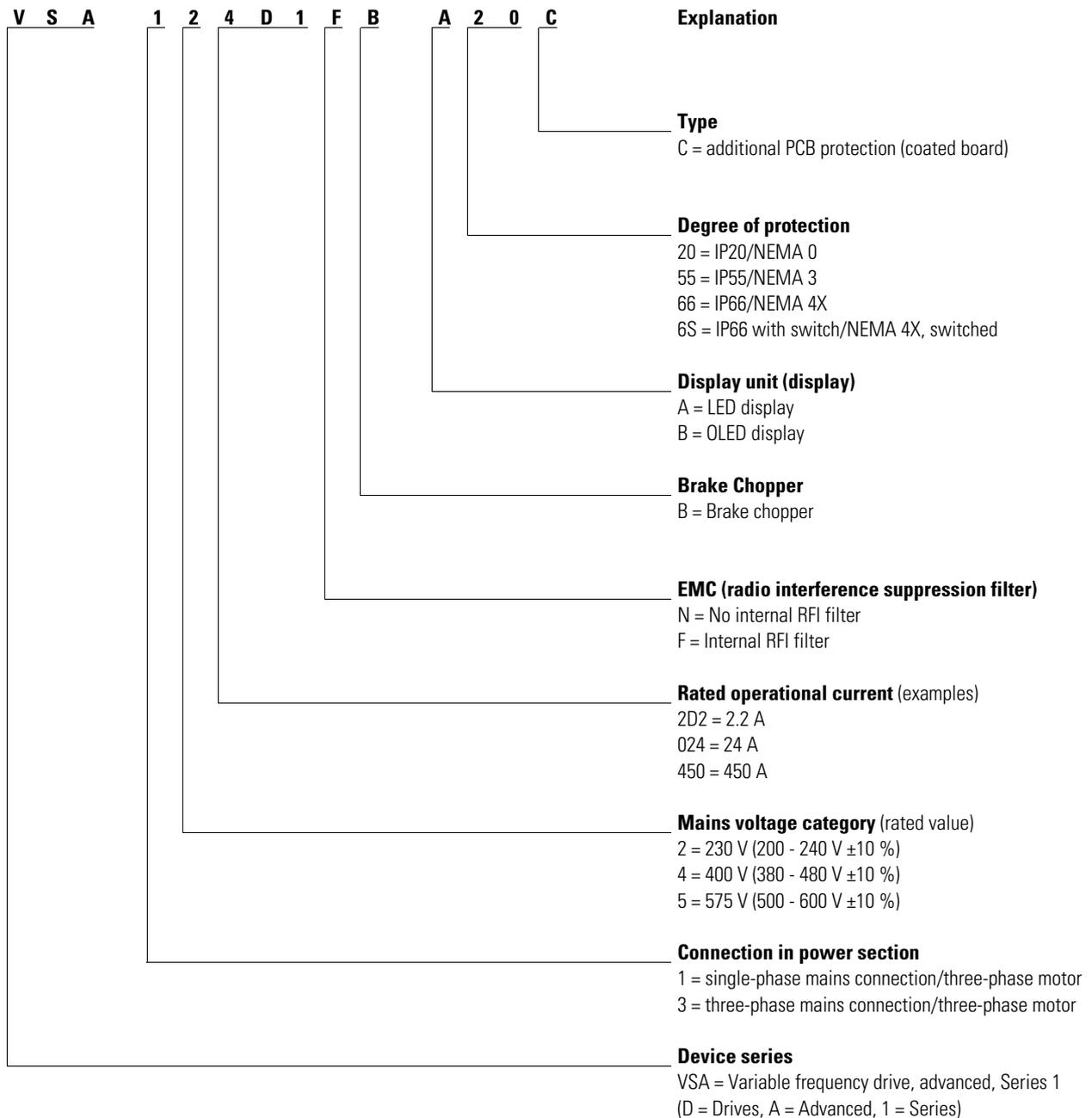


Figure 5: Catalog number selection

# 1 VSA device series

## 1.4 Rated operational data

### Catalog number selection

| Inscription      | Meaning   |
|------------------|---|
| VSA 124D3FB-A20C | VSA = VSA series variable frequency drive<br>1 = Single-phase main terminal<br>2 = Mains voltage category: 230 V (200 V - 240 V ±10 %)<br>4D3 = Rated operational current: 4.3 A<br>N = Internal radio interference suppression filter<br>B = Internal brake chopper<br>A = LED display<br>20 = IP20 degree of protection<br>C = PCB protection (coated board)                |
| VSA 327D0FB-A20C | VSA = VSA series variable frequency drive<br>3 = Three-phase main terminal<br>2 = Mains voltage category: 230 V (200 V - 240 V ±10 %)<br>7D0 = Rated operational current: 7.0 A<br>N = Internal radio interference suppression filter<br>B = Internal brake chopper<br>A = LED display<br>20 = IP20 degree of protection<br>C = PCB protection (coated board)                 |
| VSA 34014FB-B66C | VSA = VSA series variable frequency drive<br>3 = Three-phase main terminal<br>4 = Mains voltage category: 400 V (380 V - 480 V ±10 %)<br>014 = Rated operational current: 14 A<br>N = Internal radio interference suppression filter<br>B = Internal brake chopper<br>B = OLED display<br>66 = IP66 degree of protection<br>C = PCB protection (coated board)                 |
| VSA 35043NB-B55C | VSA= VSA series variable frequency drive<br>3 = Three-phase main terminal<br>5 = Mains voltage category: 575 V (500 V - 600 V ±10 %)<br>043 = Rated operational current: 43 A<br>N = No internal radio interference suppression filter <sup>1)</sup><br>B = Internal brake chopper<br>B = OLED display<br>55 = IP55 degree of protection<br>C = PCB protection (coated board) |

1) See following note



For VSA 35...**NB**-... devices, an external radio interference suppression filter is required for operation as per IEC/EN 61800-3.

### 1.4.3 Features

**Mains supply voltage: 1 AC 230 V**

**Motor connection voltage: 3 AC 230 V, 50/60 Hz**

| Type             | Rated operational current<br>$I_e$<br>A | Assigned motor power (induction motor) |                                | Display (operating unit) | Local controls | Radio interference suppression filter | DC link choke | Degree of protection<br>IP | Frame size<br>FS | Brake chopper<br>B = Yes |
|------------------|---|--|--------------------------------|--------------------------|----------------|---------------------------------------|---------------|----------------------------|------------------|--------------------------|
|                  |   | P1)<br>(230 V,<br>50 Hz)               | P2)<br>(220 - 240 V,<br>60 Hz) |                          |                |                                       |               |                            |                  |                          |
|                  |   | kW                                     | HP                             |                          |                |                                       |               |                            |                  |                          |
| VSA 124D3FB-A20C | 4.3                                     | 0.75                                   | 1                              | LED                      | –              | ✓                                     | –             | IP20                       | FS2              | B                        |
| VSA 124D3FB-B66C | 4.3                                     | 0.75                                   | 1                              | OLED                     | –              | ✓                                     | –             | IP66                       | FS2              | B                        |
| VSA 124D3FB-B6SC | 4.3                                     | 0.75                                   | 1                              | OLED                     | ✓              | ✓                                     | –             | IP66                       | FS2              | B                        |
| VSA 127D0FB-A20C | 7                                       | 1.5                                    | 2                              | LED                      | –              | ✓                                     | –             | IP20                       | FS2              | B                        |
| VSA 127D0FB-B66C | 7                                       | 1.5                                    | 2                              | OLED                     | –              | ✓                                     | –             | IP66                       | FS2              | B                        |
| VSA 127D0FB-B6SC | 7                                       | 1.5                                    | 2                              | OLED                     | ✓              | ✓                                     | –             | IP66                       | FS2              | B                        |
| VSA 12011FB-A20C | 10.5                                    | 2.2                                    | 3                              | LED                      | –              | ✓                                     | –             | IP20                       | FS2              | B                        |
| VSA 12011FB-B66C | 10.5                                    | 2.2                                    | 3                              | OLED                     | –              | ✓                                     | –             | IP66                       | FS2              | B                        |
| VSA 12011FB-B6SC | 10.5                                    | 2.2                                    | 3                              | OLED                     | ✓              | ✓                                     | –             | IP66                       | FS2              | B                        |

1) As per IEC standards

2) Quote from "Power Conversion Equipment - UL 508C, May 3, 2002".

# I VSA device series

## 1.4 Rated operational data

**Mains supply voltage: 3 AC 230 V, 50/60 Hz**

**Motor connection voltage: 3 AC 230 V, 50/60 Hz**

| Type             | Rated operational current<br>$I_e$<br>A | Assigned motor power (induction motor) |                                | Display (operating unit) | Local controls | Radio interference suppression filter | DC link choke | Degree of protection<br>IP | Frame size<br>FS | Brake chopper<br>B = Yes |
|------------------|---|--|--------------------------------|--------------------------|----------------|---------------------------------------|---------------|----------------------------|------------------|--------------------------|
|                  |   | P1)<br>(230 V,<br>50 Hz)               | P2)<br>(220 - 240 V,<br>60 Hz) |                          |                |                                       |               |                            |                  |                          |
|                  |   | kW                                     | HP                             |                          |                |                                       |               |                            |                  |                          |
| VSA 324D3FB-A20C | 4.3                                     | 0.75                                   | 1                              | LED                      | –              | ✓                                     | –             | IP20                       | FS2              | B                        |
| VSA 324D3FB-B66C | 4.3                                     | 0.75                                   | 1                              | OLED                     | –              | ✓                                     | –             | IP66                       | FS2              | B                        |
| VSA 324D3FB-B6SC | 4.3                                     | 0.75                                   | 1                              | OLED                     | ✓              | ✓                                     | –             | IP66                       | FS2              | B                        |
| VSA 327D0FB-A20C | 7                                       | 1.5                                    | 2                              | LED                      | –              | ✓                                     | –             | IP20                       | FS2              | B                        |
| VSA 327D0FB-B66C | 7                                       | 1.5                                    | 2                              | OLED                     | –              | ✓                                     | –             | IP66                       | FS2              | B                        |
| VSA 327D0FB-B6SC | 7                                       | 1.5                                    | 2                              | OLED                     | ✓              | ✓                                     | –             | IP66                       | FS2              | B                        |
| VSA 32011FB-A20C | 10.5                                    | 2.2                                    | 3                              | LED                      | –              | ✓                                     | –             | IP20                       | FS2              | B                        |
| VSA 32011FB-B66C | 10.5                                    | 2.2                                    | 3                              | OLED                     | –              | ✓                                     | –             | IP66                       | FS2              | B                        |
| VSA 32011FB-B6SC | 10.5                                    | 2.2                                    | 3                              | OLED                     | ✓              | ✓                                     | –             | IP66                       | FS2              | B                        |
| VSA 32018FB-A20C | 18                                      | 4                                      | 5                              | LED                      | –              | ✓                                     | –             | IP20                       | FS3              | B                        |
| VSA 32018FB-B66C | 18                                      | 4                                      | 5                              | OLED                     | –              | ✓                                     | –             | IP66                       | FS3              | B                        |
| VSA 32018FB-B6SC | 18                                      | 4                                      | 5                              | OLED                     | ✓              | ✓                                     | –             | IP66                       | FS3              | B                        |
| VSA 32024FB-A20C | 24                                      | 5.5                                    | 7.5                            | LED                      | –              | ✓                                     | –             | IP20                       | FS3              | B                        |
| VSA 32024FB-B55C | 24                                      | 5.5                                    | 7.5                            | OLED                     | –              | ✓                                     | –             | IP55                       | FS4              | B                        |
| VSA 32030FB-B55C | 30                                      | 7.5                                    | 10                             | OLED                     | –              | ✓                                     | –             | IP55                       | FS4              | B                        |
| VSA 32046FB-B55C | 46                                      | 11                                     | 15                             | OLED                     | –              | ✓                                     | –             | IP55                       | FS4              | B                        |
| VSA 32061FB-B55C | 61                                      | 15                                     | 20                             | OLED                     | –              | ✓                                     | ✓             | IP55                       | FS5              | B                        |
| VSA 32072FB-B55C | 72                                      | 18.5                                   | 25                             | OLED                     | –              | ✓                                     | ✓             | IP55                       | FS5              | B                        |
| VSA 32090FB-B55C | 90                                      | 22                                     | 30                             | OLED                     | –              | ✓                                     | ✓             | IP55                       | FS6              | B                        |
| VSA 32110FB-B55C | 110                                     | 30                                     | 40                             | OLED                     | –              | ✓                                     | ✓             | IP55                       | FS6              | B                        |
| VSA 32150FB-B55C | 150                                     | 37                                     | 50                             | OLED                     | –              | ✓                                     | ✓             | IP55                       | FS6              | B                        |
| VSA 32180FB-B55C | 180                                     | 45                                     | 60                             | OLED                     | –              | ✓                                     | ✓             | IP55                       | FS6              | B                        |
| VSA 32202FB-B55C | 202                                     | 55                                     | 75                             | OLED                     | –              | ✓                                     | ✓             | IP55                       | FS7              | B                        |
| VSA 32248FB-B55C | 248                                     | 75                                     | 100                            | OLED                     | –              | ✓                                     | ✓             | IP55                       | FS7              | B                        |

1) As per IEC standards

2) Quote from "Power Conversion Equipment - UL 508C, May 3, 2002".

**Mains supply voltage: 3 AC 400 V, 50 Hz/480 V, 60 Hz**  
**Output voltage: 3 AC 400 V, 50 Hz/440 - 480 V, 60 Hz**

| Type             | Rated operational current<br><b>I<sub>e</sub></b><br><b>A</b> | Assigned motor power (induction motor) <sup>1</sup> |   | Display (operating unit) | Local controls | Radio interference suppression filter | DC link choke | Degree of protection<br><b>IP</b> | Frame size<br><b>FS</b> | Brake chopper<br><b>B = Yes</b> |
|------------------|---|---|---|--------------------------|----------------|---------------------------------------|---------------|-----------------------------------|-------------------------|---------------------------------|
|                  |   | <b>P1)</b><br><b>(400 V, 50 Hz)</b>                 | <b>P2)</b><br><b>(440 - 480 V, 60 Hz)</b> |                          |                |                                       |               |                                   |                         |                                 |
|                  |   | <b>kW</b>   | <b>HP</b>                                 |                          |                |                                       |               |                                   |                         |                                 |
| VSA 342D2FB-A20C | 2.2   | 0.75  | 1   | LED                      | –              | ✓                                     | –             | IP20                              | FS2                     | B                               |
| VSA 342D2FB-B66C | 2.2   | 0.75  | 1   | OLED                     | –              | ✓                                     | –             | IP66                              | FS2                     | B                               |
| VSA 342D2FB-B6SC | 2.2   | 0.75  | 1   | OLED                     | ✓              | ✓                                     | –             | IP66                              | FS2                     | B                               |
| VSA 344D1FB-A20C | 4.1   | 1.5   | 2   | LED                      | –              | ✓                                     | –             | IP20                              | FS2                     | B                               |
| VSA 344D1FB-B66C | 4.1   | 1.5   | 2   | OLED                     | –              | ✓                                     | –             | IP66                              | FS2                     | B                               |
| VSA 344D1FB-B6SC | 4.1   | 1.5   | 2   | OLED                     | ✓              | ✓                                     | –             | IP66                              | FS2                     | B                               |
| VSA 345D8FB-A20C | 5.8   | 2.2   | 3   | LED                      | –              | ✓                                     | –             | IP20                              | FS2                     | B                               |
| VSA 345D8FB-B66C | 5.8   | 2.2   | 3   | OLED                     | –              | ✓                                     | –             | IP66                              | FS2                     | B                               |
| VSA 345D8FB-B6SC | 5.8   | 2.2   | 3   | OLED                     | ✓              | ✓                                     | –             | IP66                              | FS2                     | B                               |
| VSA 349D5FB-A20C | 9.5   | 4   | 5   | LED                      | –              | ✓                                     | –             | IP20                              | FS2                     | B                               |
| VSA 349D5FB-B66C | 9.5   | 4   | 5   | OLED                     | –              | ✓                                     | –             | IP66                              | FS2                     | B                               |
| VSA 349D5FB-B6SC | 9.5   | 4   | 5   | OLED                     | ✓              | ✓                                     | –             | IP66                              | FS2                     | B                               |
| VSA 34014FB-A20C | 14  | 5.5   | 7.5                                       | LED                      | –              | ✓                                     | –             | IP20                              | FS3                     | B                               |
| VSA 34014FB-B66C | 14  | 5.5   | 7.5                                       | OLED                     | –              | ✓                                     | –             | IP66                              | FS3                     | B                               |
| VSA 34014FB-B6SC | 14  | 5.5   | 7.5                                       | OLED                     | ✓              | ✓                                     | –             | IP66                              | FS3                     | B                               |
| VSA 34018FB-A20C | 18  | 7.5   | 10  | LED                      | –              | ✓                                     | –             | IP20                              | FS3                     | B                               |
| VSA 34018FB-B66C | 18  | 7.5   | 10  | OLED                     | –              | ✓                                     | –             | IP66                              | FS3                     | B                               |
| VSA 34018FB-B6SC | 18  | 7.5   | 10  | OLED                     | ✓              | ✓                                     | –             | IP66                              | FS3                     | B                               |
| VSA 34024FB-A20C | 24  | 11  | 15  | LED                      | –              | ✓                                     | –             | IP20                              | FS3                     | B                               |
| VSA 34024FB-B55C | 24  | 11  | 15  | OLED                     | –              | ✓                                     | –             | IP55                              | FS4                     | B                               |
| VSA 34030FB-B55C | 30  | 15  | 20  | OLED                     | –              | ✓                                     | –             | IP55                              | FS4                     | B                               |
| VSA 34039FB-B55C | 39  | 18.5  | 25  | OLED                     | –              | ✓                                     | –             | IP55                              | FS4                     | B                               |
| VSA 34046FB-B55C | 46  | 22  | 30  | OLED                     | –              | ✓                                     | –             | IP55                              | FS4                     | B                               |
| VSA 34061FB-B55C | 61  | 30  | 40  | OLED                     | –              | ✓                                     | ✓             | IP55                              | FS5                     | B                               |
| VSA 34072FB-B55C | 72  | 37  | 50  | OLED                     | –              | ✓                                     | ✓             | IP55                              | FS5                     | B                               |
| VSA 34090FB-B55C | 90  | 45  | 60  | OLED                     | –              | ✓                                     | ✓             | IP55                              | FS6                     | B                               |
| VSA 34110FB-B55C | 110   | 55  | 75  | OLED                     | –              | ✓                                     | ✓             | IP55                              | FS6                     | B                               |
| VSA 34150FB-B55C | 150   | 75  | 100                                       | OLED                     | –              | ✓                                     | ✓             | IP55                              | FS6                     | B                               |
| VSA 34180FB-B55C | 180   | 90  | 125                                       | OLED                     | –              | ✓                                     | ✓             | IP55                              | FS6                     | B                               |
| VSA 34202FB-B55C | 202   | 110   | 150                                       | OLED                     | –              | ✓                                     | ✓             | IP55                              | FS7                     | B                               |
| VSA 34240FB-B55C | 240   | 132   | 200                                       | OLED                     | –              | ✓                                     | ✓             | IP55                              | FS7                     | B                               |

# 1 VSA device series

## 1.4 Rated operational data

| Type                           | Rated operational current<br><b>I<sub>e</sub></b><br><b>A</b> | Assigned motor power (induction motor) <sup>1</sup> |                                       | Display (operating unit) | Local controls | Radio interference suppression filter | DC link choke | Degree of protection<br><b>IP</b> | Frame size<br><b>FS</b> | Brake chopper<br><b>B = Yes</b> |
|--------------------------------|---|---|---------------------------------------|--------------------------|----------------|---------------------------------------|---------------|-----------------------------------|-------------------------|---------------------------------|
|                                |   | <b>P1)</b><br>(400 V,<br>50 Hz)                     | <b>P2)</b><br>(440 - 480 V,<br>60 Hz) |                          |                |                                       |               |                                   |                         |                                 |
|                                |   | <b>kW</b>   | <b>HP</b>                             |                          |                |                                       |               |                                   |                         |                                 |
| VSA 34302FB-B55C               | 302   | 160   | 250                                   | OLED                     | –              | ✓                                     | ✓             | IP55                              | FS7                     | B                               |
| VSA 34370FB-B20C <sup>3)</sup> | 370   | 200   | 300                                   | OLED                     | –              | ✓                                     | –             | IP20                              | FS8                     | B                               |
| VSA 34450FB-B20C <sup>3)</sup> | 450   | 250   | 350                                   | OLED                     | –              | ✓                                     | –             | IP20                              | FS8                     | B                               |

1) As per IEC standards

2) Quote from "Power Conversion Equipment - UL 508C, May 3, 2002".

3) If it is not guaranteed that the system percentage impedance is greater than or equal to 1 %, a mains choke must be connected. Your  $u_k$  value should fall between 1 and 4 %.

Examples:

VSA 34370FB-B20C → DX-LN3-370

VSA 34450FB-B20C → DX-LN3-450

**Mains supply voltage: 3 AC 500 V, 50 Hz/575 V, 60 Hz**  
**Output voltage: 3 AC 500 V, 50 Hz/550 - 600 V, 60 Hz**

| Type             | Rated operational current<br><b>I<sub>e</sub></b><br><b>A</b> | Assigned motor power (induction motor) |   | Display (operating unit) | Local controls | Radio interference suppression filter | DC link choke | Degree of protection<br><b>IP</b> | Frame size<br><b>FS</b> | Brake chopper<br><b>B = Yes</b> |
|------------------|---|--|---|--------------------------|----------------|---------------------------------------|---------------|-----------------------------------|-------------------------|---------------------------------|
|                  |   | <b>P (500 V, 50 Hz)</b><br><b>kW</b>   | <b>P<sup>1)</sup> (550 - 600 V, 60 Hz)</b><br><b>HP</b> |                          |                |                                       |               |                                   |                         |                                 |
| VSA 352D1NB-A20C | 2.1   | 0.75                                   | 1   | LED                      | –              | –                                     | –             | IP20                              | FS2                     | B                               |
| VSA 352D1NB-B66C | 2.1   | 0.75                                   | 1   | OLED                     | –              | –                                     | –             | IP66                              | FS2                     | B                               |
| VSA 352D1NB-B6SC | 2.1   | 0.75                                   | 1   | OLED                     | ✓              | –                                     | –             | IP66                              | FS2                     | B                               |
| VSA 353D1NB-A20C | 3.1   | 1.5                                    | 2   | LED                      | –              | –                                     | –             | IP20                              | FS2                     | B                               |
| VSA 353D1NB-B66C | 3.1   | 1.5                                    | 2   | OLED                     | –              | –                                     | –             | IP66                              | FS2                     | B                               |
| VSA 353D1NB-B6SC | 3.1   | 1.5                                    | 2   | OLED                     | ✓              | –                                     | –             | IP66                              | FS2                     | B                               |
| VSA 354D1NB-A20C | 4.1   | 2.2                                    | 3   | LED                      | –              | –                                     | –             | IP20                              | FS2                     | B                               |
| VSA 354D1NB-B66C | 4.1   | 2.2                                    | 3   | OLED                     | –              | –                                     | –             | IP66                              | FS2                     | B                               |
| VSA 354D1NB-B6SC | 4.1   | 2.2                                    | 3   | OLED                     | ✓              | –                                     | –             | IP66                              | FS2                     | B                               |
| VSA 356D5NB-A20C | 6.5   | 4                                      | 5   | LED                      | –              | –                                     | –             | IP20                              | FS2                     | B                               |
| VSA 356D5NB-B66C | 6.5   | 4                                      | 5   | OLED                     | –              | –                                     | –             | IP66                              | FS2                     | B                               |
| VSA 356D5NB-B6SC | 6.5   | 4                                      | 5   | OLED                     | ✓              | –                                     | –             | IP66                              | FS2                     | B                               |
| VSA 359D0NB-A20C | 9   | 5.5                                    | 7.5   | LED                      | –              | –                                     | –             | IP20                              | FS2                     | B                               |
| VSA 359D0NB-B66C | 9   | 5.5                                    | 7.5   | OLED                     | –              | –                                     | –             | IP66                              | FS2                     | B                               |
| VSA 359D0NB-B6SC | 9   | 5.5                                    | 7.5   | OLED                     | ✓              | –                                     | –             | IP66                              | FS2                     | B                               |
| VSA 35012NB-A20C | 12  | 7.5                                    | 10  | LED                      | –              | –                                     | –             | IP20                              | FS3                     | B                               |
| VSA 35012NB-B66C | 12  | 7.5                                    | 10  | OLED                     | –              | –                                     | –             | IP66                              | FS3                     | B                               |
| VSA 35012NB-B6SC | 12  | 7.5                                    | 10  | OLED                     | ✓              | –                                     | –             | IP66                              | FS3                     | B                               |
| VSA 35017NB-A20C | 17  | 11                                     | 15  | LED                      | –              | –                                     | –             | IP20                              | FS3                     | B                               |
| VSA 35017NB-B66C | 17  | 11                                     | 15  | OLED                     | –              | –                                     | –             | IP66                              | FS3                     | B                               |
| VSA 35017NB-B6SC | 17  | 11                                     | 15  | OLED                     | ✓              | –                                     | –             | IP66                              | FS3                     | B                               |
| VSA 35022NB-A20C | 22  | 15                                     | 20  | LED                      | –              | –                                     | –             | IP20                              | FS3                     | B                               |
| VSA 35022NB-B55C | 22  | 15                                     | 20  | OLED                     | –              | –                                     | –             | IP55                              | FS4                     | B                               |
| VSA 35028NB-B55C | 28  | 18.5                                   | 25  | OLED                     | –              | –                                     | –             | IP55                              | FS4                     | B                               |
| VSA 35034NB-B55C | 34  | 22                                     | 30  | OLED                     | –              | –                                     | –             | IP55                              | FS4                     | B                               |
| VSA 35043NB-B55C | 43  | 30                                     | 40  | OLED                     | –              | –                                     | ✓             | IP55                              | FS5                     | B                               |
| VSA 35054NB-B55C | 54  | 37                                     | 50  | OLED                     | –              | –                                     | ✓             | IP55                              | FS5                     | B                               |
| VSA 35065NB-B55C | 65  | 45                                     | 60  | OLED                     | –              | –                                     | ✓             | IP55                              | FS5                     | B                               |
| VSA 35078NB-B55C | 78  | 55                                     | 75  | OLED                     | –              | –                                     | ✓             | IP55                              | FS6                     | B                               |
| VSA 35105NB-B55C | 105   | 75                                     | 100   | OLED                     | –              | –                                     | ✓             | IP55                              | FS7                     | B                               |
| VSA 35130NB-B55C | 130   | 90                                     | 125   | OLED                     | –              | –                                     | ✓             | IP55                              | FS6                     | B                               |
| VSA 35150NB-B55C | 150   | 110                                    | 150   | OLED                     | –              | –                                     | ✓             | IP55                              | FS7                     | B                               |

1) Quote from "Power Conversion Equipment - UL 508C, May 3, 2002".

## 1 VSA device series

### 1.5 Description

#### 1.5 Description

##### 1.5.1 Degree of protection IP20 (FS2, FS3)

The following drawing serves as an example showing the designations used for the elements in VSA variable frequency drives with a frame size of FS2 and an IP20 degree of protection.

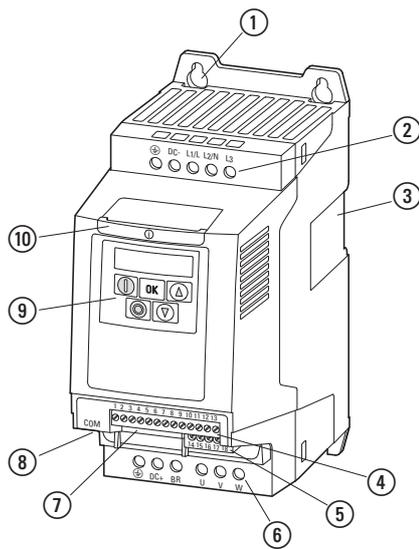


Figure 6: VSA designations (FS2, IP20)

- ① Fixing holes (screw fastening)
- ② Connection terminals in power section (mains side)
- ③ Cutout for mounting on mounting rail
- ④ Control terminals (plug-in)
- ⑤ Relay terminals (plug-in)
- ⑥ Connection terminals in power section (motor feeder)
- ⑦ Slot for fieldbus connection or expansion module
- ⑧ Communication interface (RJ45)
- ⑨ Operating unit with 5 control buttons and LED display
- ⑩ Info card

### 1.5.2 Degree of protection IP20 (FS8)

The following drawing serves as an example showing the designations used for the elements in VSA variable frequency drives with a frame size of FS8 and an IP20 degree of protection.

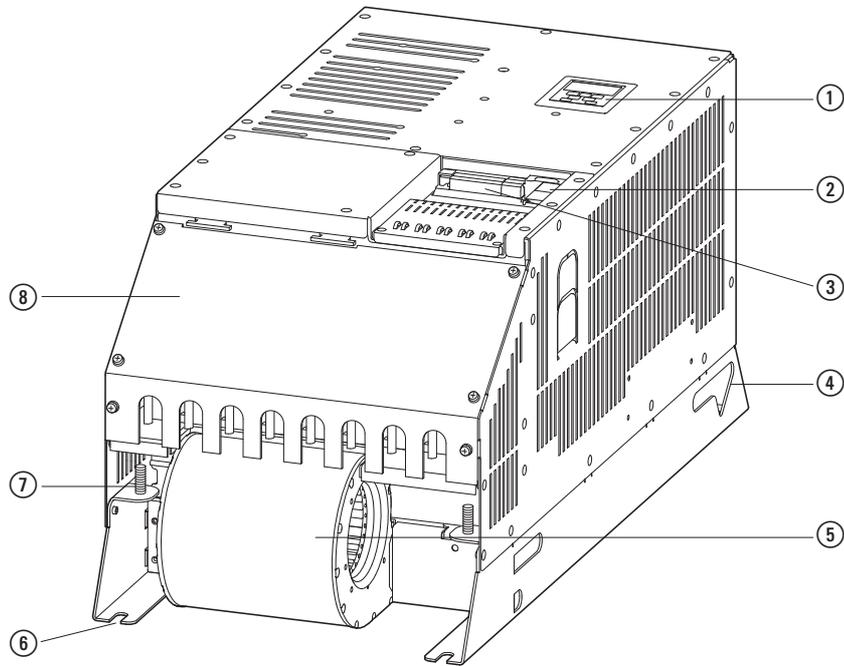


Figure 7: VSA designations (FS8, IP20)

- ① Operating unit with 5 control buttons and OLED display
- ② Slot for fieldbus connection or expansion module
- ③ Control signal terminals and relay terminals (plug-in)
- ④ Eyebolts
- ⑤ Device fan
- ⑥ Fixing holes
- ⑦ PE terminal bolt
- ⑧ Enclosure cover for the connection terminals in the power section

The info cards are located at the back of the enclosure cover.

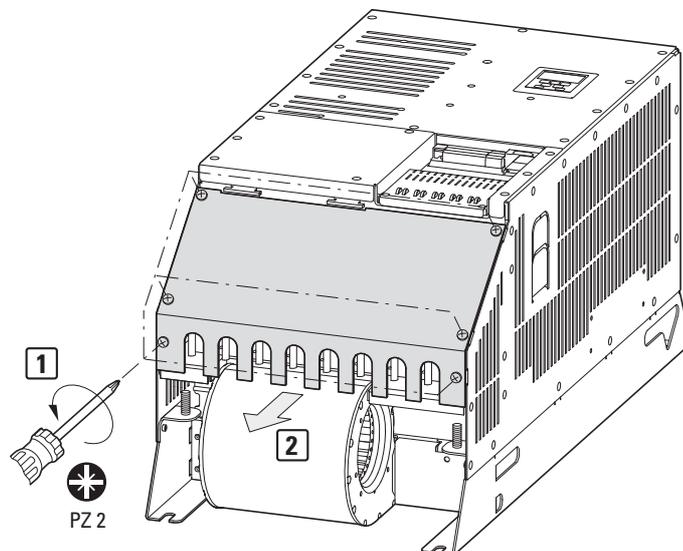


Figure 8: Info cards (back of enclosure cover ⑧)

**1.5.3 Degree of protection IP55 (FS4, FS5, FS6, FS7)**

The following drawing serves as an example showing the designations used for the elements in VSA variable frequency drives with a frame size of FS4 and an IP55 degree of protection.

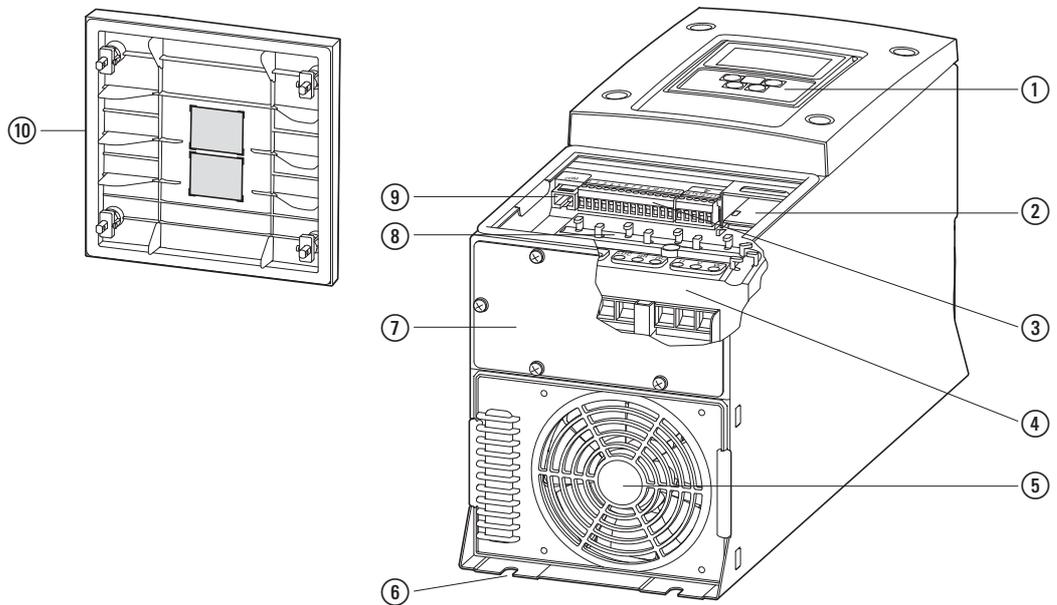


Figure 9: VSA designations (FS4, IP55)

- ① Operating unit with 5 control buttons and OLED display
- ② Slot for fieldbus connection or expansion module
- ③ Control signal terminals and relay terminals (plug-in)
- ④ Connection terminals in power section
- ⑤ Device fan
- ⑥ Fixing holes
- ⑦ Blanking plate for installing cable glands for an IP55 degree of protection (without blanking plate: IP40 degree of protection)
- ⑧ Retainer for the control section connection cables
- ⑨ Communication interface (RJ45)
- ⑩ Enclosure cover (connection terminals)

The info card is located inside the lower enclosure cover ⑩ (removed in the figure above).

**Blanking plate**

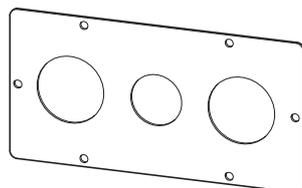


Figure 10: Blanking plate with holes for cable glands (FS4, FS5)



The equipment supplied with frame sizes FS4 and FS5 includes an additional blanking plate ⑦ that already has holes for the cable glands.

### 1.5.4 Degree of protection IP66 (FS2, FS3)

The following drawing serves as an example showing the designations used for the elements in VSA variable frequency drives with a frame size of FS2 and an IP66 degree of protection.

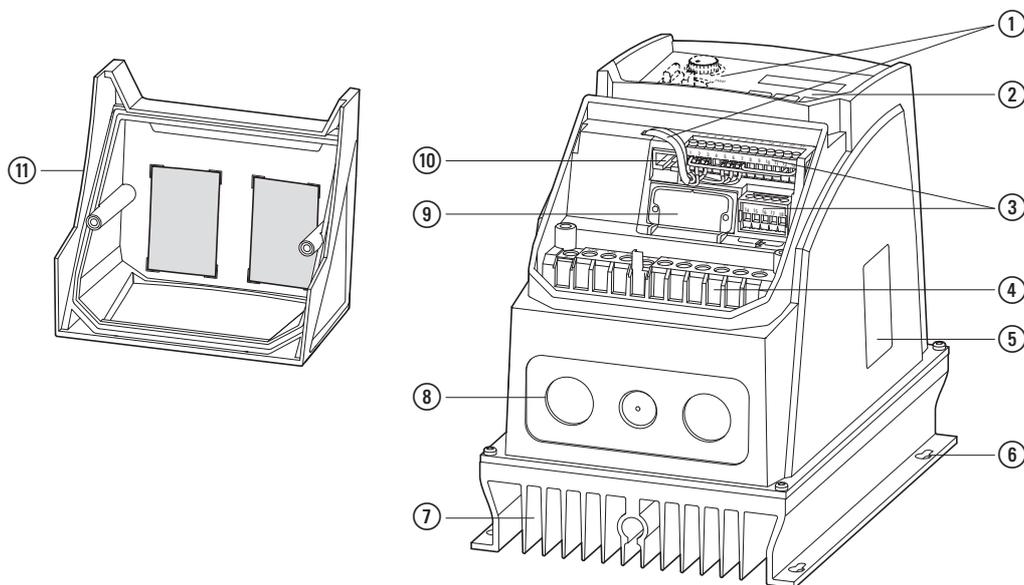


Figure 11:VSA descriptions (FS2, IP66)

- ① Local controls on VSA...-B6SC
- ② Operating unit with 5 control buttons and OLED display
- ③ Control and relay terminals (plug-in)
- ④ Connection terminals in power section  
Cableway for EMC cable gland
- ⑤ Rating plate
- ⑥ Fixing holes
- ⑦ Heat sink
- ⑧ Connection terminals in power section and  
Cableway for cable gland
- ⑨ Slot for fieldbus connection or expansion module
- ⑩ Communication interface (RJ45)
- ⑪ Cover

The info cards ⑪ are located inside the lower enclosure cover, which features three knockouts for cable glands to the control section.

### 1.6 Voltage categories

VSA variable frequency drives are divided into three voltage categories:

- 200 V: 200 – 240 V  $\pm 10$  % → VSA **12**..., VSA **32**...
  - 400 V: 380 – 480 V  $\pm 10$  % → VSA **34**...
  - 575 V: 500 – 600 V  $\pm 10$  % → VSA **35**...
- VSA **12**...
    - Single-phase mains connection, rated operating voltage 230 V
    - $U_{LN} = 1\sim$ , 200 - 240 V  $\pm 10$  %, 50/60 Hz
    - $I_e = 4.3 - 11$  A
    - Motor: 0.75 - 2.2 kW (230 V, 50 Hz), 1 - 3 HP (230 V, 60 Hz)

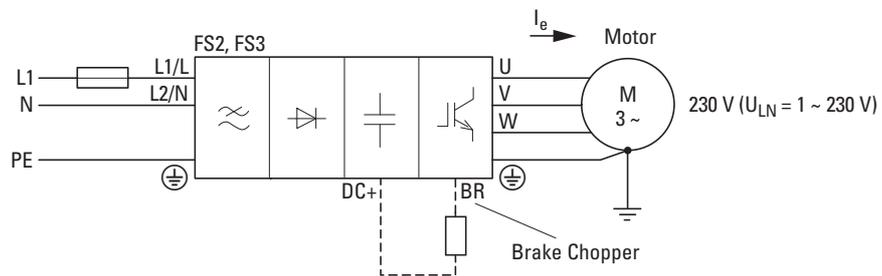


Figure 12:VSA 12...FB-...

- VSA **32**...
  - Three-phase power supply, rated operating voltage 230 V
  - $U_{LN} = 3\sim$ , 200 - 240 V  $\pm 10$  %, 50/60 Hz
  - $I_e = 4.3 - 46$  A
  - Motor: 0.75 - 11 kW (230 V, 50 Hz), 1 - 15 HP (230 V, 60 Hz)

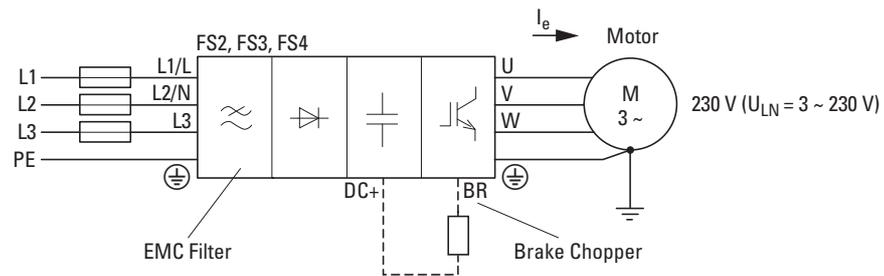


Figure 13:VSA 32...FB-...

- $I_e = 61 - 248 \text{ A}$
- Motor: 15 - 75 kW (230 V, 50 Hz), 20 - 100 HP (230 V, 60 Hz)

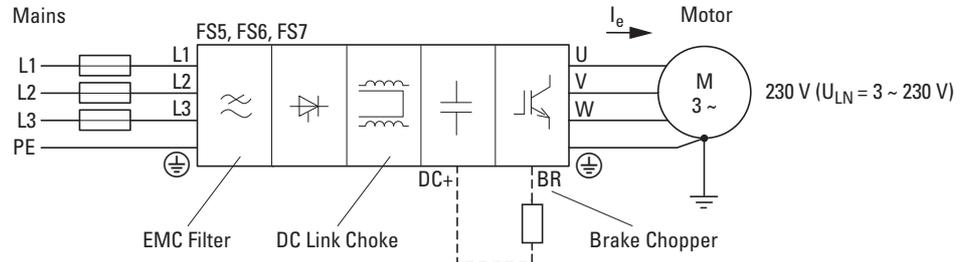


Figure 14:VSA 32...FB-B55C with DC link choke

- VSA **34**...
  - Three-phase power supply, rated operating voltage 400/480 V
  - $U_{LN} = 3\sim, 380 - 480 \text{ V} \pm 10 \%$ , 50/60 Hz
  - $I_e = 2.2 - 46 \text{ A}$
  - Motor: 0.75 - 22 kW (400 V, 50 Hz), 1 - 30 HP (460 V, 60 Hz)

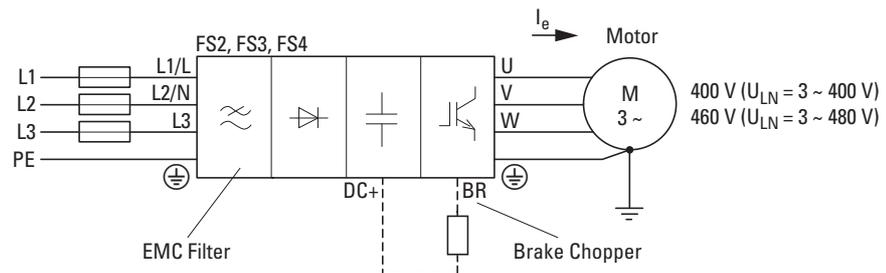


Figure 15:VSA 34...FB-...

- $I_e = 61 - 302 \text{ A}$
- Motor: 30 - 160 kW (230 V, 50 Hz), 40 - 250 HP (460 V, 60 Hz)

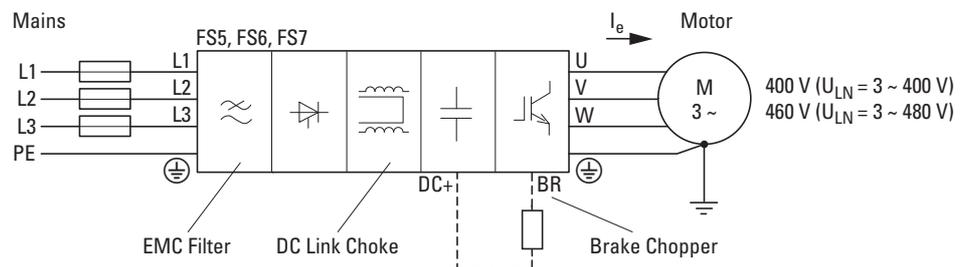


Figure 16:VSA 34...FB-B55C with DC link choke

# 1 VSA device series

## 1.6 Voltage categories

- $I_e = 370 - 450 \text{ A}$
- Motor: 200 - 250 kW (400 V, 50 Hz), 300 - 350 HP (460 V, 60 Hz)

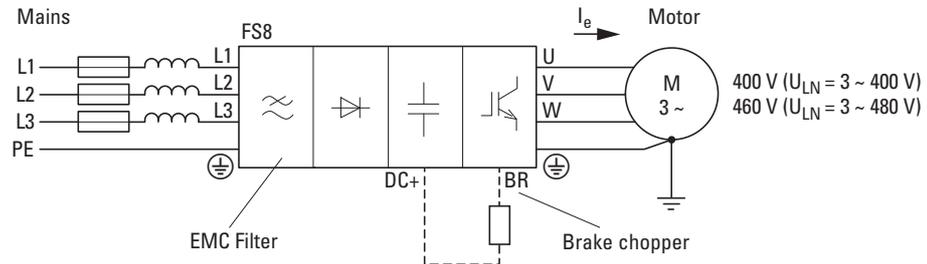


Figure 17:VSA 34...FB-B20C (external mains choke required)

- **VSA 35...**
  - Three-phase power supply, rated operating voltage 500/575 V
  - $U_{LN} = 3\sim, 500 - 600 \text{ V} \pm 10 \%$ , 50/60 Hz
  - $I_e = 2.1 - 34 \text{ A}$
  - Motor: 1.1 - 22 kW (500 V, 50 Hz), 1.5 - 30 HP (575 V, 60 Hz)

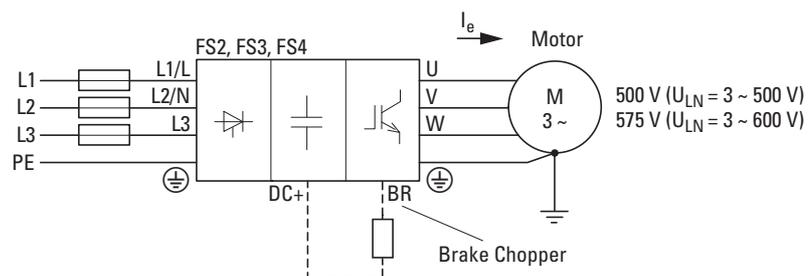


Figure 18:VSA 35...NB-... (without radio interference suppression filter)

- $I_e = 43 - 150 \text{ A}$
- Motor: 30 - 110 kW (500 V, 50 Hz), 40 - 150 HP (575 V, 60 Hz)

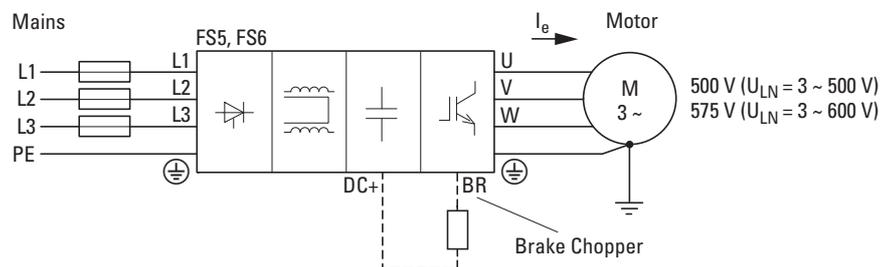


Figure 19:VSA 34...NB-B55C with DC link choke (without radio interference suppression filter)

## 1.7 Selection criteria

Select the variable frequency drive according to the supply voltage  $U_{LN}$  of the supply system and the rated operational current of the assigned motor. The circuit type ( $\Delta/Y$ ) of the motor must be selected according to the supply voltage.

The variable frequency drive's rated output current  $I_e$  must be greater than or equal to the rated motor current.

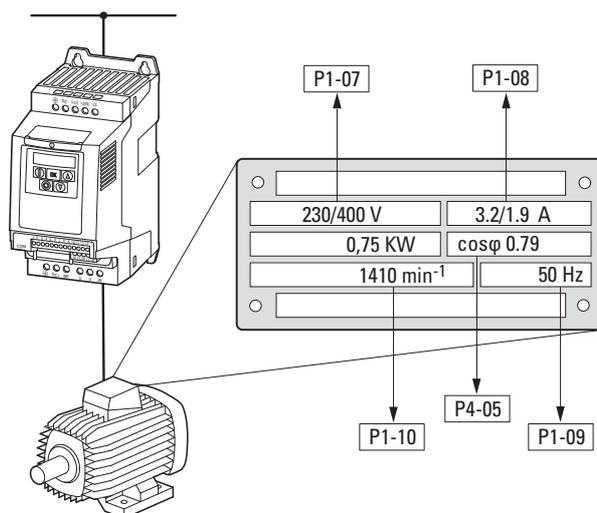


Figure 20: Selection criteria – Rating plate data

When selecting the drive, the following criteria must be known:

- Mains voltage = motor supply voltage (e.g. 3~ 400 V),
- Type of motor (e.g., three-phase asynchronous motor),
- The rated motor current (recommended value – depends on the motor's configuration and on the power supply)
- Ambient conditions: ambient temperature, control cabinet installation with IP20 degree of protection or direct local installation with IP66 degree of protection.

### Example based on figure 20

- Mains voltage: 3~ 400 V, 50 Hz
  - Star-connected circuit (400 V)
  - Rated operational current: 1.9 A (400 V)
  - Control panel installation → IP20 degree of protection
  - Ambient air temperature max. 50 °C without output reduction, IP20
- Variable frequency drive that should be selected: VSA 342D2FB-B20C
- VSA **34**...: 3-phase main terminal, rated operating voltage: 400 V
  - VSA...**2D2**...: 2.2 A – The variable frequency drive's rated operational current (output current) guarantees that the motor will be supplied with the required rated operational current (1.9 A).

## 1 VSA device series

### 1.7 Selection criteria



When connecting multiple motors in parallel to the output of a variable frequency drive, the motor currents are added geometrically – separated by effective and idle current components.

Accordingly, when selecting a variable frequency drive, make sure to size it in such a way that it will be able to supply the total resulting current. It may be necessary to install motor chokes or sine filters between the variable frequency drive and the motor in order to dampen and compensate for deviating current values.

## 1.8 Output reduction (derating)

Derating the VSA variable frequency drive / limiting the maximum continuous output current ( $I_2$ ) will generally be necessary if, during operation:

- The ambient temperature is higher than 40 °C
- An installation altitude of 1,000 m is exceeded
- The effective switching frequency is higher than the minimum value

The following tables specify the factors that need to be applied when selecting a VSA variable frequency drive if the drive will be run outside these conditions:

### Derating for ambient temperature

| Enclosure degree of protection | Maximum ambient temperature without derating | Derate      | Maximum permissible ambient air temperature |
|--------------------------------|--|-------------|---|
| IP20                           | 50 °C  | none        | 50 °C                                       |
| IP40 <sup>1)</sup>             | 40 °C  | none        | 40 °C                                       |
| IP5                            | 40 °C  | 1.5 % per K | 50 °C                                       |
| IP66                           | 40 °C  | 2.5 % per K | 50 °C                                       |

### Derating for installation altitude

| Enclosure degree of protection        | Maximum height without derating | Derate        | Maximum permissible altitude as per IEC (UL) |
|---------------------------------------|---------------------------------|---------------|--|
| IP20, IP40 <sup>1)</sup> , IP55, IP66 | 1000 m                          | 1 % per 100 m | 4000 m (2000 m)                              |

### Derating for switching frequency

| Enclosure degree of protection | Switching frequency (P2-24), setting (audible) <sup>2)</sup> |       |        |        |        |            |
|--------------------------------|--|-------|--------|--------|--------|------------|
|                                | 4 kHz  | 8 kHz | 12 kHz | 16 kHz | 24 kHz | 32 kHz     |
| IP20                           | none   | none  | 20 %   | 30 %   | 40 %   | 50 %       |
| IP40 <sup>1)</sup>             | none   | none  | 10 %   | 15 %   | 25 %   | Do not set |
| IP55                           | none   | 10 %  | 10 %   | 15 %   | 25 %   | Do not set |
| IP66                           | none   | 10 %  | 25 %   | 35 %   | 50 %   | 50 %       |

1) VSA variable frequency drive with IP55 enclosure and connection area open from below (without blanking plate and cable glands).

2) The pulse frequency's effective rms value will be approximately half the value set with parameter P2-24 (double modulation).



For more information on the subject of derating, please refer to Application Note "VSC Variable Speed Drives – Dependency of the output current on switching frequency and ambient air temperature".

## 1 VSA device series

### 1.8 Output reduction (derating)

#### Examples showing how to apply derating factors

4 kW motor (400 V, 8.5 A), installation altitude of 2,000 m above sea level, ambient temperature of 42 °C, switching frequency of 12 kHz.

##### a)

Selected variable frequency drive: VSA 349D5FB-A20C, rated operational current of 9.5 A, switching frequency of 8 kHz (default setting).

Required derating factors:

- For the 12 kHz switching frequency: **20%**
- For the 2,000 m installation altitude: **10%** (1% per 100 m above 1,000 m, 2,000 m - 1,000 m = 1,000 m, 1,000 m/100 m = 10)
- For the 42 °C ambient temperature: **None**  
(not needed for VSA 349D5FB-A20C, IP20 degree of protection)

$$9.5 \text{ A} - 20 \% - 10 \% = (9.5 \times 0.8 \times 0.9) \text{ A} = \mathbf{6.84 \text{ A}}$$

The VSA's permissible continuous rated operational current of 6.84 A is lower than the motor's required rated operational current (8.5 A).

Reducing the pulse frequency to 8 kHz will make it possible to operate the motor continuously at an altitude of 2,000 m (9.5 A - 10% = 8.55 A).



Use a variable frequency drive belonging to a higher output class and repeat the calculations in order to ensure that a sufficiently high output current will be available continuously.

##### b)

Selected variable frequency drive: VSA 34014FB-B55C, rated operational current of 14 A.

Required derating factors:

- For the 12 kHz switching frequency: **10 %**
- For the 2,000 m installation altitude: **10 %** (1 % per 100 m above 1,000 m, 2,000 m - 1,000 m = 1,000 m, 1,000 m/100 m = 10)
- For the 42 °C ambient temperature: **3 %**  
(1.5 % per kelvin, 42 °C - 40 °C = 2 K, IP55 degree of protection).

$$14 \text{ A} - 10 \% - 10 \% - 3 \% = (14 \times 0.9 \times 0.9 \times 0.97) \text{ A} = \text{approx. } \mathbf{11 \text{ A}}$$

The VSA 34014FB-B55C variable frequency drive meets the necessary operating conditions.

## 1.9 Proper use

The VSA variable frequency drives are electrical devices for controlling variable speed drives with three-phase motors. They are designed for installation in machines or for use in combination with other components within a machine or system.

The VSA variable frequency drives are not domestic appliances. They are designed only for industrial use as system components.

If the variable speed starter is installed in a machine, it is prohibited to place it into operation until it has been determined that the corresponding machine meets the safety and protection requirements set forth in Machinery Safety Directive 2006/42/EC (e.g., by complying with EN 60204). The user of the equipment is responsible for ensuring that the machine use complies with the relevant EU Directives.

The CE markings on VSA variable frequency drives confirm that the devices meet the requirements set forth in the European Union's Low Voltage and EMC Directives (Directives 2006/95/EC, EMC 2004/108/EC and ROHS 2011/65/EU) when used in their typical drive configuration.

In the described system configurations, VSA variable frequency drives are suitable for use in public and non-public networks.

A connection of a VSA variable frequency drive to IT networks (networks without reference to earth potential) is permissible only to a limited extent, since the device's built-in filter capacitors connect the network with the earth potential (enclosure).

In unearthed networks, this can result in hazardous situations or damage to the device (insulation monitoring is required!).



To the output (terminals U, V, W) of the VSA variable frequency drive you must not:

- connect a voltage or capacitive loads (e.g. phase compensation capacitors),
- connect multiple variable frequency drives in parallel
- make a direct connection to the input (bypass).



Always observe the technical data and connection conditions! For additional information, refer to the equipment nameplate or label at the frequency inverter and the documentation. Any other use will be considered to be an improper use of the device.

## 1 VSA device series

### 1.10 Maintenance and inspection

#### 1.10 Maintenance and inspection

VSA variable speed starters are maintenance-free, provided that the general rating data, as well as the technical data for the specific models in use, is observed. Please note, however, that external influences may affect the operation and lifespan of a VSA variable frequency drive.

We therefore recommend that the devices are checked regularly and the following maintenance measures are carried out at the specified intervals.

**Table 2: Recommended maintenance**

| Maintenance measures  | Maintenance interval  |
|---|---|
| Clean cooling vents (cooling slits)   | Please enquire  |
| Check that the fan is working properly  | 6 - 24 months (depending on the environment)  |
| Check the filters in the control panel door (see the manufacturer's specifications)       | 6 - 24 months (depending on the environment)  |
| Check all earth connections to make sure they are intact                                  | On a regular basis, at periodic intervals   |
| Check the tightening torques of the terminals (control signal terminals, power terminals) | On a regular basis, at periodic intervals   |
| Check connection terminals and all metallic surfaces for corrosion                        | 6 - 24 months; when stored, no more than 12 months later (depending on the environment) |
| Motor cables and shield connection (EMC)  | According to manufacturer specifications, no later than 5 years                         |
| Charge capacitors   | 12 months<br>(→ Section 1.12, „Charging the internal DC link capacitors“)               |

There are no plans for replacing or repairing individual components of VSA variable frequency drives.

If an FS2 or FS3 (IP20, IP66) VSA variable frequency drive is damaged or ruined by external factors, it will not be possible to repair it.

In the case of frame sizes FS4 to FS8, it may be possible for a qualified and certified service center to repair it (→ Section 1.13, „Service and warranty“).

Dispose of the device according to the applicable environmental laws and provisions for the disposal of electrical or electronic devices.

## 1.11 Storage

If the VSA variable frequency drive is stored before use, suitable ambient conditions must be ensured at the site of storage:

- Storage temperature: -40 - +60 °C,
- Relative average air humidity: < 95 %, non condensing (EN 50178),
- To prevent damage to the variable speed starter's internal DC link capacitors, it is not recommended to store the variable frequency drive for more than 12 months (→ Section 1.12, „Charging the internal DC link capacitors“).

## 1.12 Charging the internal DC link capacitors

After extended storage times or extended downtimes during which no power is supplied (> 12 months), the capacitors in the internal DC link must be recharged in a controlled manner in order to prevent damage. To do this, the VSA variable frequency drive must be supplied with power, with a controlled DC power supply unit, via two mains connection terminals (e.g. L1 and L2).

In order to prevent the capacitors from having excessively high leakage currents, the inrush current should be limited to approximately 300 to 800 mA (depending on the relevant rating). The variable frequency drive must not be enabled during this time (i.e. no start signal). After this, the DC voltage must be set to the magnitudes for the corresponding DC link voltage ( $U_{DC} \sim 1.41 \times U_e$ ) and applied for one hour at least (regeneration time).

- VSA 12..., VSA 32...: about 324 V DC at  $U_e = 230$  V AC
- VSA 34...: about 560 V DC at  $U_e = 400$  V AC
- VSA 35...: about 705 V DC at  $U_e = 500$  V AC

## 1.13 Service and warranty

In the unlikely event that you have a problem with your VSA variable frequency drive, please contact your local sales office.

When you call, have the following data ready:

- The exact variable frequency drive part number (see nameplate),
- the date of purchase,
- a detailed description of the problem which has occurred with the variable frequency drive.

If some of the information printed on the rating plate is not legible, please state only the data which are clearly legible.

Information concerning the guarantee can be found in the Terms and Conditions.

## 1 VSA device series

### 1.13 Service and warranty

**Please contact your local office:**

Voice: 1-800-ASK-JNSN [275-5676] (US); 1-800-321-4023 (CA)

FAX: 1-800-356-1191 (US); 1-800-321-4024 (CA)

Support Hours of Operation: Monday–Friday, 6:30 a.m.–5:30 p.m. CST  
(No evening or weekend Customer Service hours).

If you are in the U.S. or Canada, you can take advantage of our toll-free line for technical assistance. Technical support engineers are available for calls during regular business hours.

Johnson Controls Field Support Center

1-888-281-3792 Monday–Friday, 7:30 a.m.–5:30 p.m. CST

email: [CGFieldSupportCenter@jci.com](mailto:CGFieldSupportCenter@jci.com)

## 2 Engineering

### 2.1 Introduction

This chapter describes the most important features in the energy circuit of a magnet system (PDS = Power Drive System), which you should take into consideration in your project planning.

It contains instructions that must be followed when determining which device to use with which rated motor output, as well as when selecting protection devices and switchgear, selecting cables, cable entries, and operating the VSA variable frequency drive.

All applicable laws and local standards must be complied with when planning and carrying out the installation. Not following the recommendations provided may result in problems what will not be covered by the warranty.

### An example for a magnet system

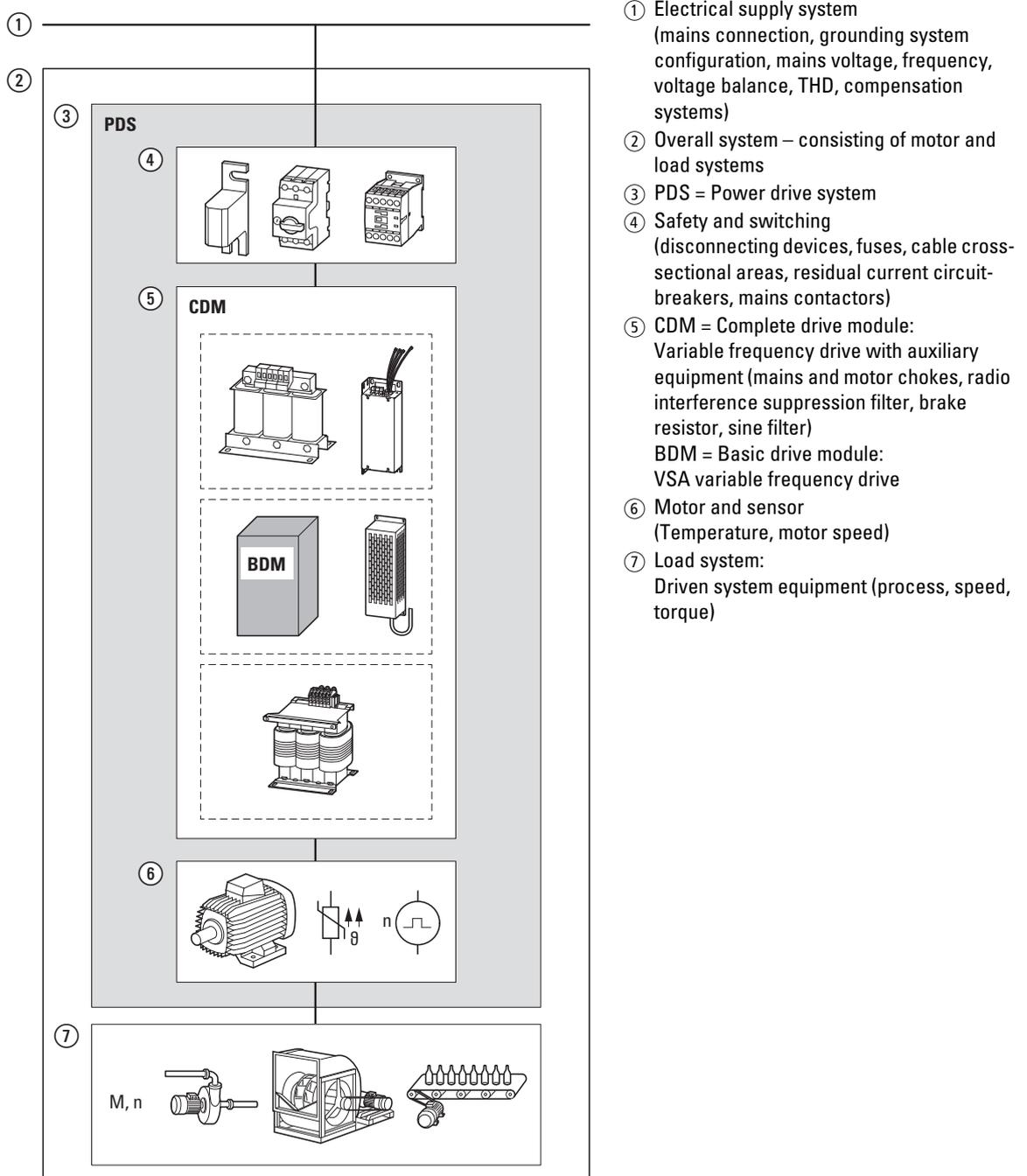


Figure 21: Magnet system example (overall system as its own system or as part of a larger system)

## 2.2 Electrical power network

### 2.2.1 Mains connection and network configuration

VSA variable frequency drives can be connected to and run on all neutral point-grounded AC supply systems (TN-S, TN-C, TT grounding systems – please refer to IEC 60364) without any limitations.

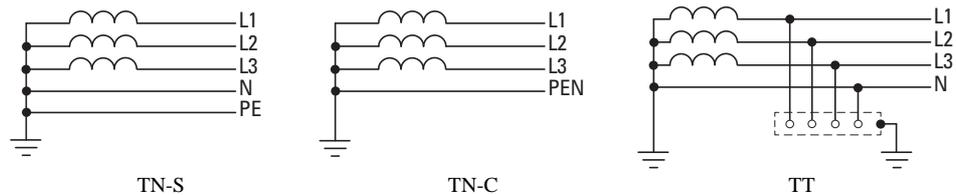


Figure 22: AC supply systems with earthed center point

- ➔ While planning the project, consider a symmetrical distribution to the three main phase conductors, if multiple variable frequency drives with single-phase supplies are to be connected.  
The total current of all single-phase consumers is not to cause an overload of the neutral conductor (N-conductor).

The connection and operation of variable frequency drives to asymmetrically grounded TN networks (phase-grounded delta network "Grounded Delta", USA) or non-grounded or high-resistance grounded (over 30 Ω) IT networks is only conditionally permissible (internal radio interference suppression filters).

- ➔ Operation on non-earthed networks (IT) requires the use of suitable insulation monitors (e.g. pulse-code measurement method).
- ➔ In networks with an earthed main pole, the maximum phase-earth voltage must not exceed 300 V AC.

VSA...-A20C variable frequency drives with an FS2 or FS3 frame size can be connected to corner-grounded systems or IT grounding systems (not grounded, insulated). The internal radio interference suppression filter must be disabled in these cases.

- ➔ Generally speaking, measures designed to ensure electromagnetic compatibility are required in drive systems in order to ensure compliance with the applicable regulations in the EMC and Low Voltage Directives.  
Good earthing measures are a prerequisite for the effective insert of further measures such as screen earth kit or filters here. Without respective grounding measures, further steps are superfluous.

## 2 Engineering

### 2.2 Electrical power network

VSA 35... (500 - 600 V) devices do not feature a radio interference suppression filter and can be connected to corner-grounded systems and IT grounding systems.

#### 2.2.2 Mains voltage and frequency

The standardized rated operating voltages (IEC 60038, VDE 017-1) of power utilities guarantee the following conditions at the connection point:

- Deviation from the rated value of voltage:  
maximum  $\pm 10$  %
- Deviation in voltage phase balance:  
maximum  $\pm 3$  %
- Deviation from rated value of the frequency:  
maximum  $\pm 4$  %

The broad tolerance band of the VSA variable frequency drive considers the rated value for

European as (EU:  $U_{LN} = 230$  V/400 V, 50 Hz) and

American as (USA:  $U_{LN} = 240$  V/480 V, 60 Hz) standard voltages:

- 230 V, 50 Hz (EU) and 240 V, 60 Hz (USA) at VSA 12..., VSA 32...  
200 V -10 % - 240 V +10 % (180 V -0 % - 264 V +0 %)
- 400 V, 50 Hz (EU) and 480 V, 60 Hz (USA) at VSA 34...  
380 V -10 % - 480 V +10 % (342 V -0 % - 528 V +0 %)
- 500 V, 50 Hz (EU) and 575 V, 60 Hz (USA) at VSA 35...  
500 V -10 % - 600 V +10 % (450 V -0 % - 660 V +0 %)

The permissible frequency range for all voltage categories is 50/60 Hz (48 Hz - 0 % - 62 Hz + 0 %).

#### 2.2.3 Voltage balance

Unbalanced voltages and deviations from the ideal voltage shape may occur in three-phase AC supply systems if the conductors are loaded unevenly and if large output loads are connected directly. These supply voltage unbalances may cause the diodes in the variable frequency drive's rectifier bridge converter to be loaded unevenly, resulting in premature diode failure.



In the project planning for the connection of three-phase supplied variable frequency drives (VSA 3...), consider only AC supply systems that handle permitted asymmetric divergences in the mains voltage  $\leq +3$  %.

If this condition is not fulfilled, or symmetry at the connection location is not known, the use of an assigned main choke is recommended.

### 2.2.4 Total Harmonic Distortion (THD)

The THD value (THD = Total Harmonic Distortion) is defined in standard IEC/EN 61800-3 as the ratio of the rms value of all harmonic components to the rms value of the fundamental frequency.



In order to reduce the THD value (up to 30 %), it is recommended to use a DX-LN... mains choke (→ Section 2.4, „Mains chokes“, page 47).



FS5, FS6, and FS7 VSA variable frequency drives feature chokes in their DC link. Using mains chokes in order to reduce current harmonics is not necessary in this case.



Only for FS8 VSA variable frequency drives:  
VSA 34370FB-B20C, VSA 34450FB-B20C

If it is not guaranteed that the system percentage impedance is greater than or equal to 1 %, a mains choke must be connected. Your  $u_k$  value should fall between 1 and 4 %.

Examples:

VSA 34370FB-B20C → DX-LN3-370

VSA 34450FB-B20C → DX-LN3-450

### 2.2.5 Idle power compensation devices

Compensation on the power supply side is not required for the variable frequency drives of the VSA series. From the AC supply system they only take on very little reactive power of the fundamental harmonics ( $\cos \varphi \sim 0.98$ ).



In the AC supply systems with non-choked reactive current compensation devices, current deviations can enable parallel resonance and undefinable circumstances.

In the project planning for the connection of variable frequency drives to AC supply systems with undefined circumstances, consider using main chokes.

## 2.3 Safety and switching

### 2.3.1 Disconnecting device

- Install a manual disconnecting device between the mains connection and the VSA variable frequency drive. This disconnecting device must be designed in such a way that it can be interlocked in its open position for installation and maintenance work.

In the European Union, this disconnecting device must be one of the following devices in order to comply with European Directives as per standard EN 60204-1, "Safety of machinery":

- An AC-23B utilization category disconnecter (EN 60947-3)
- A disconnecter with an auxiliary contact that in all cases will disconnect the load circuit before the disconnecter's main contacts open (EN 60947-3)
- A circuit-breaker designed to disconnect the circuit as per EN 60947-2

In all other regions, the applicable national and local safety regulations must be complied with.

### 2.3.2 Fuses

The VSA variable frequency drive and the corresponding supply cables must be protected from thermal overload and short-circuits.

- The fuse ratings and cable cross-sectional areas (wire gauges) for the connection on the mains side will depend on the VSA variable frequency drive's input current  $I_{LN}$ .

- For the recommended fuse sizing and assignments, please refer to → Section 6.5, „Fuses“, page 164.

The fuses will protect the supply cable in the event of a short-circuit, limit any damage to the variable frequency drive, and prevent damage to upstream devices in the event of a short-circuit in the variable frequency drive.

### 2.3.3 Cable cross-sections

The mains cables and motor cables must be sized as required by local standards and by the load currents that will be involved.

The PE conductor's cross-sectional area must be the same as the phase conductors' cross-sectional area. The connection terminals marked with ⊕ must be connected to the earth-current circuit.

**NOTICE**

The specified minimum PE conductor cross-sections (EN 61800-5-1) must be maintained.

If there are leakage currents greater than 3.5 mA, a reinforced earthing (PE) must be connected, as required by standard EN 61800-5-1. The cable cross-section must be at least 10 mm<sup>2</sup>, or the earthing system must consist of two separately connected earthing cables.

→ → Section 6.2, „Specific rated operational data“, page 147 provides the leakage currents for the individual models.

→ → Section 3.5, „EMC installation“, page 83 goes over the EMC requirements for the motor cables.

A symmetrical, fully screened (360°), low-impedance motor cable must be used. The length of the motor cable depends on the RFI class and the environment.

For US installations, UL-listed fuses, fuse bases, and cables (AWG) should be used exclusively. These cables must have a temperature rating of 70 °C (158 °F), and will often require installation inside a metal conduit (please consult the applicable local standards).

→ For the rated cable cross-sectional areas for VSA variable frequency drives, please refer to the technical data chapter in → Section 6.4, „Cable cross-sections“, page 161.

## 2 Engineering

### 2.3 Safety and switching

#### 2.3.4 Residual current circuit-breaker

When using variable frequency drives (VSA 3...) that work with a three-phase power supply (L1, L2, L3), make sure to use type B AC/DC sensitive residual current devices exclusively.

When using variable frequency drives that work with a single-phase power supply (L, N) (VSA 12...), you may use type A and type B residual current devices (RCD).

#### **NOTICE**

Residual current circuit-breakers (RCD = residual current device) should only be installed between the power feed system (the AC supply system supplying power) and the VSA variable frequency drive – not at the output to the motor!

The leakage currents' magnitude will generally depend on:

- length of the motor cable,
- shielding of the motor cable,
- height of the pulse frequency (switching frequency of the inverter),
- Design of the radio interference suppression filter
- grounding measures at the site of the motor.

Other protective measures against direct and indirect contact can be used for VSA variable frequency drives, including isolating them from the supply system with the use of a transformer.

### 2.3.5 Mains contactors

The mains contactor enables an operational switching on and off of the supply voltage for the variable frequency drive and switching off in case of a fault. The mains contactor is designed based on the mains-side input current  $I_{LN}$  of the VSA variable frequency drive for utilization category AC-1 (IEC 60947) and the ambient air temperature at the location of use.

- The mains contactors listed here are based on the variable frequency drive's rated input-side mains current  $I_{LN}$  without an external mains choke.  
The contactor should be selected based on thermal current  $I_{th} = I_e$  (AC-1) at the specified ambient air temperature.

**NOTICE**

The inching operation is not permissible via the mains contactor (Pause time  $\geq 30$  s between switching off and on).

- For UL-compliant installation and operation, the mains side switching devices must allow for a 1.25 times higher input current.

- For the rated mains contactors for VSA variable frequency drives, please refer to the technical data chapter in → Section 6.6, „Mains contactors“, page 168.

### 2.3.6 Using a bypass connection



**WARNING**

Never connect the VSA variable frequency drive's output terminals U, V, and W to the power feed system (L1, L2, L3)! Connecting the mains voltage to the output terminals can result in the variable frequency drive being irreparably damaged.

If a bypass is required, use mechanically linked switches or contactors or electrically interlocked contactors in order to ensure that the motor terminals will not be simultaneously connected to the mains connection and to the variable frequency drive's output terminals.

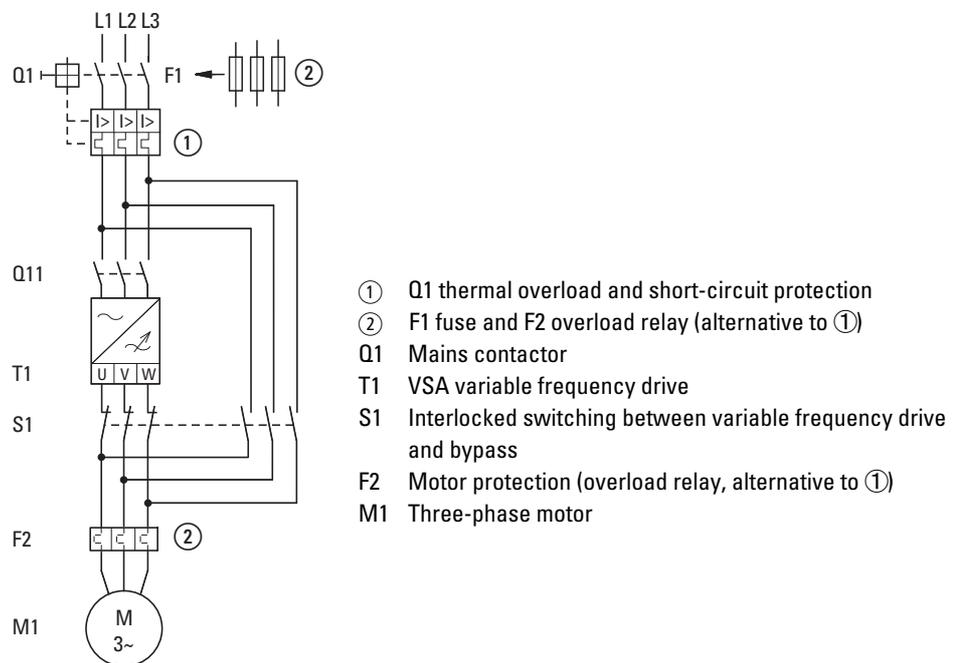


Figure 23: Bypass motor control (example)

## 2.4 Mains chokes

Mains chokes reduce the total harmonic distortion, the mains feedback and improve the power factor. The apparent current on the mains side is then reduced by around 30 %.

Towards the variable frequency drive, the main chokes dampen the interference from the supply network. This increases the electric strength of the variable frequency drive and lengthens the lifespan (diodes of the mains power rectifier, internal DC link capacitors).

→ It is not necessary to use mains chokes in order to run the VSA variable frequency drive. However, we recommend using a mains choke if the electrical supply system's quality is not known.

While planning the project, consider that a main choke is only assigned to a single variable frequency drive for decoupling.

When using an adapting transformer (assigned to a single variable frequency drive), a main choke is not necessary.

Main chokes are designed based on the mains-side input current ( $I_{LN}$ ) of the variable frequency drive.

→ FS5, FS6, and FS7 VSA variable frequency drives feature mains chokes in their DC link. Using chokes in order to reduce current harmonics is not necessary in this case.

→ Only for FS8 VSA variable frequency drives:  
VSA 34370FB-B20C, VSA 34450FB-B20C

If it is not guaranteed that the system percentage impedance is greater than or equal to 1%, a mains choke must be connected. Your  $u_K$  value should fall between 1 and 4%.

Examples:

VSA 34370FB-B20C → DX-LN3-370

VSA 34450FB-B20C → DX-LN3-450

→ When the frequency inverter is operating at its rated current limit, the mains choke with a  $u_K$  value of around 4 % causes a reduction of the frequency inverter's maximum possible output voltage ( $U_2$ ) to about 96 % of the mains voltage ( $U_{LN}$ ).

→ For the rated mains contactors for VSA variable frequency drives, please refer to the technical data chapter in → Section 6.7, „Mains chokes“, page 172.

#### 2.5 Radio interference suppression filter

VSA 12...FB-..., VSA 32...FB-..., and VSA 34...FB-... variable frequency drives feature an internal radio interference suppression filter. In combination with a motor cable that is earthed and screened 360° on both ends, they make it possible to comply with the sensitive EMC limits of category C1 in the 1st environment (IEC/EN 61800-3) when there is conducted interference. This requires installation in accordance with EMC requirements, as well as not exceeding permissible motor cable lengths.

The standard motor cable lengths are as follows:

- 1 m for category C1 in the 1st environment
- 5 m for category C2 in the 1st and 2nd environments
- 25 m for category C3 in the 2nd environment

Longer motor cable lengths can be used if additional, external radio interference suppression filters (DX-EMC...) are used. For more information, please refer to the following tables.

Additional measures used to reduce EMC limits and use longer motor cable lengths are possible in combination with motor chokes and sine filters.

VSA 35...NB-... devices do not feature an internal radio interference suppression filter. DX-EMC34... radio interference suppression filters can be connected upstream in order to run these devices on a three-phase mains voltage of 500 V.

Please enquire for radio interference suppression filters for higher mains voltages.



In the case of power drive systems (PDS) with variable frequency drives, electromagnetic compatibility (EMC) measures must already be taken into account during the engineering stage, as making changes during assembly and installation and retroactively fixing things will be more expensive.



The maximum unscreened cable length between the radio interference suppression filter and the variable frequency drive should not exceed 300 to 500 mm (depending on the VSA variable frequency drive's frame size).



For the rated radio interference suppression filters for VSA variable frequency drives, please refer to the technical data chapter in → Section 6.8, „Radio interference suppression filter“, page 176.

## 2.6 Braking resistances

In certain operating states, the motor may run as a generator in certain applications (regenerative braking operation).

Examples include:

- Lowering in hoisting gear and conveyor applications
- Controlled speed reduction in the case of large load inertias (flywheels)
- A fast speed reduction in dynamic travel drives

When the motor operates as a generator, its braking energy will be fed into the variable frequency drive's DC link via the inverter. DC link voltage  $U_{DC}$  will be increased as a result. If the voltage value is too high, the VSA variable frequency drive will disable its inverter, after which the motor will coast uncontrolled.

If there is a braking chopper and a connected braking resistance  $R_B$ , the braking energy fed back into the variable frequency drive can be dissipated in order to limit the DC link voltage.

VSA...B-... variable frequency drives feature an integrated braking chopper. The brake resistors are connected to the internal braking transistor with terminals DC+ and BR so that they will be connected in parallel to the DC link. In addition to this, the braking chopper must be enabled using parameter P1-05 (= 2 or = 3). The braking chopper will be switched on automatically if the braking energy being fed back causes the DC link voltage to increase to the switch-on voltage's magnitude.

| Device series | Main terminal | Voltage class | Braking chopper on | Braking chopper off |
|---------------|---------------|---------------|--------------------|---------------------|
| VSA 12...     | Single-phase  | 230 V         | 390 V              | 378 V               |
| VSA 32...     | Three-phase   | 230 V         | 390 V              | 378 V               |
| VSA 34...     | Three-phase   | 400 V         | 780 V              | 756 V               |
| VSA 35...     | Three-phase   | 575 V         | 975 V              | 945 V               |

For example, in the case of VSA 34... variable frequency drives, the braking chopper will be switched on at a DC link voltage of approximately 780 VDC and then back off at 756 VDC. During this stage, the braking transistor and the brake resistor will be active continuously. In order to protect against a thermal overload, parameter P6-19 can be used to set resistance value  $R_B$  and parameter P6-20 can be used to set rated power  $P_{DB}$  for the brake resistor.

It is often difficult to specify a suitable brake resistor for specific applications. This is due to the fact that not all of the application conditions required for sizing will be available when the engineering stage starts. Because of this, and as a simplification, brake resistors are instead usually classified for two load groups:

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### 2.6 Braking resistances

- **Low duty:** Low load with short braking duration and low duty factor (up to about 25 %), e.g., for horizontal conveyors and handling equipment for bulk cargo and general cargo, end carriages, sliding doors, and turbomachinery (centrifugal pumps, fans).
- **High duty:** High load with long braking duration and high duty factor (at least 30 %), e.g., for elevators, downhill conveyors, winders, centrifuges, flywheel motors, and large fans.

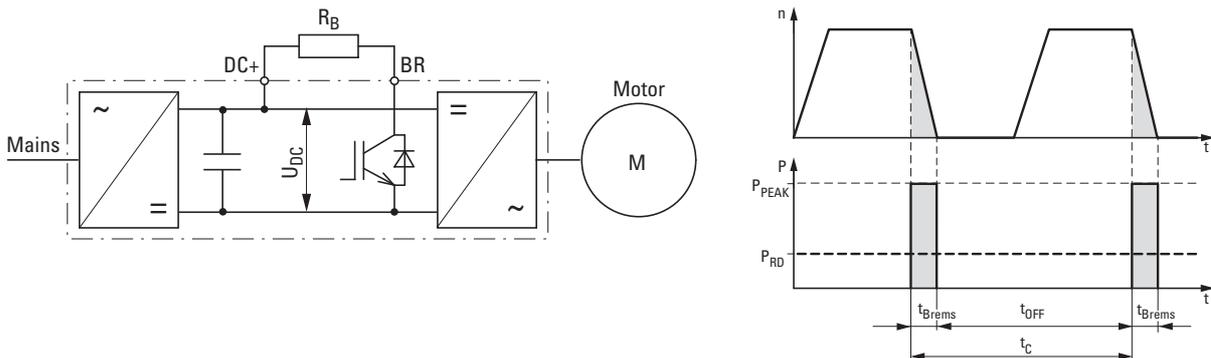


Figure 24: Braking cycle, fast motor stop with external brake resistor

#### Selecting brake resistors

Brake resistors are selected based on continuous power dissipation  $P_{DB}$  and maximum peak pulse power  $P_{Peak}$ . The brake resistor must be adequate for both powers.

The maximum pulse power is defined by the braking torque – kinetic energy  $W_{kin}$  during braking – that is fed back by the motor during braking. A simplified method that can be used is to take the variable frequency drive's braking power  $P_{max}$  or the rated motor output and use it as peak pulse power  $P_{Peak}$  for sizing purposes, since the mechanical braking power will be reduced by the motor's and inverter's efficiency.

$$P_{Peak} \sim P_{max} = \frac{1}{2} \times \frac{W_{kin}}{t_{Brakin}} \times g$$

The required rated power / continuous rating for braking resistance  $P_{DB}$  is calculated using braking energy  $W_{kin}$  and cycle time  $t_C$ :

$$P_{DB} = \frac{W_{kin}}{t_C}$$

If the kinetic energy is not known, you will need the ratio of braking time  $t_{Brakin}$  to cycle time  $t_C$ :

$$DF[\%] = \frac{t_{Brakin}}{t_C} \times 100 \%$$

The required continuous rating for a duty factor of 10 % (= DF[%]), for example, can be calculated as follows:

$$P_{DB} = P_{Peak} \times 10 \%$$

This means that the brake resistor's continuous rating  $P_{DB}$  will always be lower than maximum pulse power  $P_{Peak}$  by the DF[%] factor.

Resistance  $R_B$  must be at least as high as the braking transistor's minimum permissible resistance  $R_{min}$ .



Use brake resistors with the recommended  $R_{Brec}$  resistance values for the VSA variable frequency drives' ratings.



For the rated brake resistors for VSA variable frequency drives, please refer to the technical data chapter in  
→ Section 6.9, „Braking resistances“, page 182.

## 2.7 Motor chokes

It is recommended to use a motor choke if using long cable lengths and/or connecting several motors in parallel. The motor reactor is in the output of the variable frequency drive. Its rated operational current must always be greater than/equal to the rated operational current of variable frequency drive.

For VSA variable frequency drives, it is recommended to use a motor choke for motor cable lengths of 50 meters or more. Doing so may result in the following improvements:

- Longer maximum permissible screened motor cable length, up to 200 m  
Longer maximum permissible motor cable length without screening, up to 300 m
- Current smoothing and  $du/dt$  value ( $kV/\mu s$ ) attenuation, providing additional protection for the winding insulation inside the motor,
- Motor noise and heat build-up will be reduced.

➔ Take into account the maximum permissible motor cable lengths for the relevant EMC interference category.

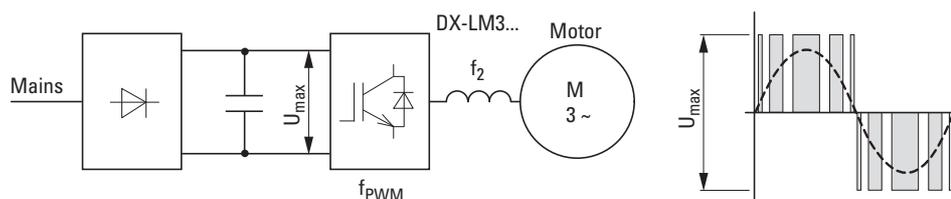


Figure 25:DX-LM3... rated operational data:

$$U_{\max} = 750 \text{ V}, f_2 = 0 - 400 \text{ Hz}, f_{\text{PWM}} = 8 - 24 \text{ kHz (P2-24 setting on VSA)}$$

It is also recommended to use a motor choke at the variable frequency drive's output if several motors with identical or different rated operational data are being run in parallel (V/Hz control only). In this case, the motor choke will compensate for the total resistance and total inductance decreases caused by the parallel circuit and will attenuate the cables' higher stray capacitance.

➔ For the rated motor chokes for VSA variable frequency drives, please refer to the technical data chapter in  
➔ Section 6.10, „Motor chokes“, page 188.

## 2.8 Sine filter

The DX-SIN3... sine filter removes high-frequency components from the variable frequency drive's output voltage ( $U_2$ ) reducing conducted and emitted interference as a result. The sine filter's output voltage will have a sinusoidal shape with a small superimposed ripple voltage. The sinusoidal voltage's total harmonic distortion is typically 5 to 10 %. This will reduce noise and losses in the motor.

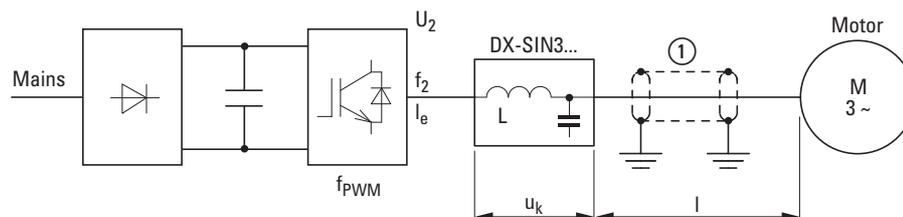


Figure 26: Maximum permissible motor cable lengths

Screened motor cable:  $U_2 \leq 230 \text{ V} \rightarrow l \leq 200 \text{ m}$ ;  $U_2 \leq 500 \text{ V} \rightarrow l \leq 150 \text{ m}$   
 Unscreened motor cable:  $U_2 \leq 230 \text{ V} \rightarrow l \leq 300 \text{ m}$ ;  $U_2 \leq 500 \text{ V} \rightarrow l \leq 200 \text{ m}$



Sine filter DX-SIN3... should only be operated with fixed switching frequencies. Accordingly, the carrier frequency (P2-24) must be set to the value set in parameter P6-02 (auto temperature management) (P2-24 = P6-02).

Permissible carrier frequencies for VSA with DX-SIN3...:  
 1  $\triangleq$  8 kHz; 2  $\triangleq$  12 kHz

As a result of double modulation, the value set on the VSA variable frequency drive will be twice the effective value on the sine filter (1  $\triangleq$  8 kHz  $\rightarrow$  4 kHz; 2  $\triangleq$  12 kHz  $\rightarrow$  6 kHz).



For the rated sine filters for VSA variable frequency drives, please refer to the technical data chapter in  $\rightarrow$  Section 6.11, „Sine filter“, page 190.

## 2.9 Three-phase motor

### 2.9.1 Motor selection



Check whether the VSA variable frequency drive you selected and the AC motor you will be using are compatible with each other as per the corresponding voltage (mains and motor voltage) and rated operational current.

General recommendations for motor selection:

- Use three-phase induction motors with squirrel-cage rotors and surface cooling – also referred to as three-phase asynchronous motors or standard motors. Other types of motors, such as external rotor motors, wound rotor motors, reluctance motors, permanent magnet motors, synchronous motors, and servomotors can also be run with VSA variable frequency drives, but will normally require additional engineering, modifying the various parameters, and detailed information from the motor manufacturer.
- Only use motors that have insulation class F (maximum steady state temperature of 155 °C ) at least.
- Choose 4 pole motors preferably (synchronous speed: 1500 min<sup>-1</sup> at 50 Hz and 1800 min<sup>-1</sup> at 60 Hz).
- Take the operating conditions into account for S1 operation (IEC 60034-1).
- Do not oversize the motor, i.e., the motor should not be more than one rating level higher than the rated motor output.
- In the case of undersized motors, the motor output should not be more than one rating level lower than the rated rating level (in order to ensure that the motor will be protected).  
For significantly lower motor outputs, the "frequency control (V/Hz)" operating mode must be set (P4-01 = 2).

### 2.9.2 Circuit types with three-phase motors

A three-phase motor's stator winding can be connected in a star connection or delta circuit as per the mains voltage ( $U_{LN}$  = output voltage  $U_2$ ) and the rated operational data on the motor's nameplate (rating plate).

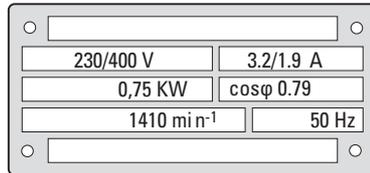


Figure 27: Example of a motor rating plate

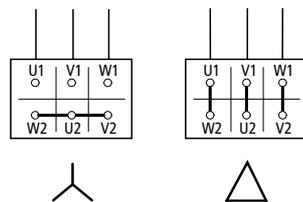


Figure 28: Configuration types:  
Star-connected circuit (left), delta circuit (right)

#### Examples based on figures 27 and 28

Motor in star connection,  
mains voltage: three-phase 400 V; output voltage: three-phase 400 V  
→ VSA 342D2...

Motor in delta circuit,  
mains voltage: single-phase 230 V; output voltage: three-phase 230 V  
→ VSA 124D3...

#### Motor connection

| VSA variable frequency drives | according to IEC | according to UL |
|-------------------------------|------------------|-----------------|
| U                             | U1 (-U2)         | T1 (-T4)        |
| V                             | V1 (-V2)         | T2 (-T5)        |
| W                             | W1 (-W2)         | T3 (-T6)        |

#### 2.9.3 Connecting Motors in Parallel

When in V/Hz control mode (default setting, P4-01 = 2), VSA variable frequency drives can be used to run multiple motors simultaneously.



If multiple motors are connected in parallel, the total of their motor currents must be lower than the VSA variable frequency drive's rated operational current.

Connecting motors in parallel reduces the load resistance at the variable frequency drive output. The total stator inductance will be reduced and the cables' stray capacitance will be increased. The result will be greater harmonic distortion when compared to a single-motor connection. A motor choke or a sine filter should be used at the variable frequency drive's output in order to reduce this harmonic distortion.



When running multiple motors in parallel with a single variable frequency drive, the individual motors' outputs should not be more than three output classes apart.



If several motors are being run in parallel, you will not be able to use the variable frequency drive's electronic motor protection. As a result, each individual motor must be protected with thermistors and/or an overload relay. Within a frequency range of 20 to 120 Hz, the PKE electronic motor-protective circuit-breaker can be used for motor protection at a VSA variable frequency drive's output as well.

#### **NOTICE**

If multiple motors are being run simultaneously using a single variable frequency drive, make sure to size the individual motors' contactors as required for utilization category AC-3. The motor contactors must be selected according to the rated operational currents of the motors that will be connected.



The total of the motor currents in operation, plus one motor's inrush current, must be less than the rated operational current of the variable frequency drive.

In applications with motors that will be connected and disconnected, we recommend using a motor choke.

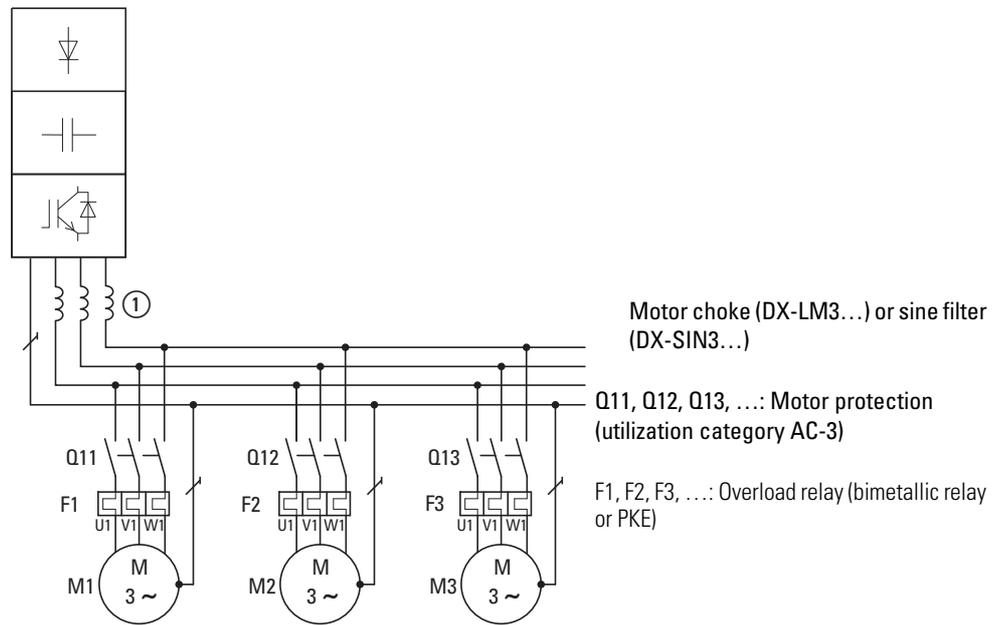


Figure 29: Example: Parallel connection of several motors to one frequency inverter

#### 2.9.4 Single-phase AC motors

It is not permitted to run VSA variable frequency drives with single-phase AC motors (induction motors), single-phase asynchronous motors (capacitor motors), shaded-pole motors, etc.

#### 2.9.5 Connecting EX motors

The following aspects must be taken into account when connecting hazardous location motors:

- A VSA variable frequency drive can be installed in an explosion-proof enclosure within the hazardous location or in a control panel outside the hazardous location.
- All applicable industry-specific and country-specific regulations for hazardous locations (ATEX 100a) must be complied with.
- The specifications and instructions provided by the motor's manufacturer with regard to operation with a variable frequency drive – e.g., whether motor reactors (dV/dt limiting) or sine filters are required – must be taken into account.
- Temperature monitors in the motor windings (thermistor, Thermo-Click) must not be connected directly to the variable frequency drive, but instead must be connected through a relay approved for the hazardous location (e.g. EMT6).

#### 2.9.6 Synchronous, reluctance, and PM motors

VSA variable frequency drives can be used to run premium efficiency three-phase motors, such as:

- IE3 and IE4 efficiency classes – as defined in IEC/EN 60034-30, EU No. 4/2014
- Permanent magnet motors (PM motor),
- Synchronous reluctance motors (SynRM)
- Brushless DC motors.

These motor technologies have comparable efficiencies at their rated operating point and identical efficiency classes, but also have significant differences when it comes to their startup behavior and partial-load operation.

Moreover, the corresponding nameplate specifications (315 V,  $R_{20^*} = 2.1 \Omega$ ,  $L^* = 20 \text{ mH}$ , and  $U_{Pol} = 195 \text{ V}/1000 \text{ rpm}$ , for example) will deviate significantly from the usual specifications.

## 2.10 STO function

### 2.10.1 Overview

VSA variable frequency drives include the STO function (STO = Safe Torque Off) as part of their standard range of functionalities. This function meets the requirements for variable-speed drive systems defined in Part 5-2 of the IEC 61800 standard and ensures that torque-generating energy is no longer able to act on the motor shaft and that unintended starting is prevented. Moreover, this state is monitored internally in the drive.

The STO function can be used anywhere where the corresponding motor will come to a stop by itself in a sufficiently short amount of time as a result of the corresponding load torque or friction, as well as in cases in which coasting has no safety implications.

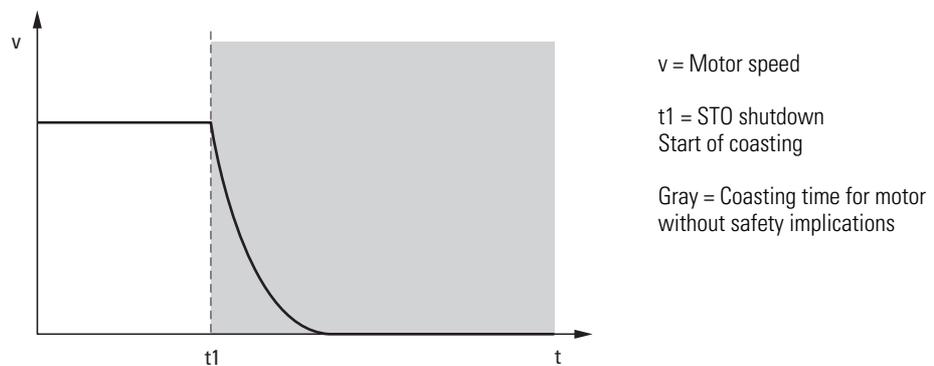


Figure 30:: STO conforming to Stop Category 0



This safety function corresponds to uncontrolled stopping as defined in IEC 60204-1, Stop Category 0. It can be used if it is necessary to switch off the power in order to prevent unexpected starts.

Additional measures (such as mechanical brakes) may be required in order to prevent hazards in which external factors are involved (e.g., suspended loads falling down).



#### CAUTION

When used in conjunction with permanent magnet motors and in the unlikely case of multiple output semiconductors (IGBTs) failing, having the STO function activated may result in a motor shaft rotational movement of  $180 \text{ degrees}/p$  ( $p$  = Number of motor pole pairs).



**DANGER**

The STO function is an electronic mechanism that does not provide sufficient protection against electric shock. Additional potential isolation measures may be accordingly required (e.g., switch-disconnector).

**2.10.2 TÜV certification**

VSA variable frequency drives with a TÜV logo on their nameplate feature an STO function that complies with the following standards:

| Standard               | Classification   |
|------------------------|--|
| EN 61800-5-2:2007      | Type 2: "Safely removed torque"  |
| EN ISO 13849-1:2006    | PL d   |
| EN 61508 (Part 1 to 7) | SIL 2  |
| EN60204-1              | Stop category 0:<br>"Uncontrolled stopping by means of immediately cutting the power supply to the machine drive elements" |
| EN 62061               | SIL CL 2   |



The following information and descriptions for the STO function are translations of the original description in English (TÜV specification).

**2.10.3 Safety relay specification**

Safety component monitoring requires an approved safety relay.

When used together with a VSA variable frequency drive, the following minimum requirements must be met for the STO function:

|                           |   |
|---------------------------|---|
| Standard requirement      | SIL 2 or PL d SC 3 or better with interlocked opposing contacts |
| Number of output contacts | Two independent   |
| Rated switching voltage   | 30 V DC   |
| Current carrying capacity | 100 mA (at least)   |

### 2.10.4 STO-compatible installation



#### **DANGER**

Make sure to use proper earthing and select cables based on local regulations or standards.

The variable frequency drive may have a leakage current greater than 3.5 mA AC or 10 mA DC. In addition, the grounding cable must be sized for the maximum mains fault current, which is normally limited by fuses or miniature circuit-breakers.

Appropriately sized fuses or miniature circuit-breakers should be installed at the mains supply for the variable frequency drive in line with local regulations or standards.



#### **DANGER**

The "STO wiring" must be protected against unintended short-circuits and unintended tampering and modifications. It must be ensured that the "STO input signal" (control signal terminals 12/13) has a safe operating state.



#### **CAUTION**

Variable frequency drives with an IP 20 degree of protection that are used in environments with a pollution degree of 2 must be installed in a control panel with a degree of protection of IP 54 or better.



In order to prevent damage to the variable frequency drive, the devices should remain in their original packaging until right before they are installed.

They must be stored in a dry and clean area with a temperature range of -40 °C to 60 °C.



The conductor cross-section used for the STO installation should be between 0.05 and 2.5 mm<sup>2</sup> (AWG 30-12).

The length of the cable connected to the control signal terminals should not exceed 25 meters.



In addition to the wiring guidelines for an installation meeting EMC requirements (→ Section 3.5, „EMC installation“, page 83), the following requirements must be observed as well for the “STO wiring”:

- The STO-compatible installation must be protected against short-circuits and tampering. The cables in the STO circuit can be mechanically protected with a closed cable duct or with a conduit (eks = ground and short-circuit-safe installation).
- The 24 VDC power supply for the STO inputs can be supplied from the VSA's internal 24 VDC voltage or from an external 24 VDC power supply.
- Accordingly, the VSA variable frequency drive should be wired as described below:

### STO installation with internal VSA supply voltage (24 V DC)

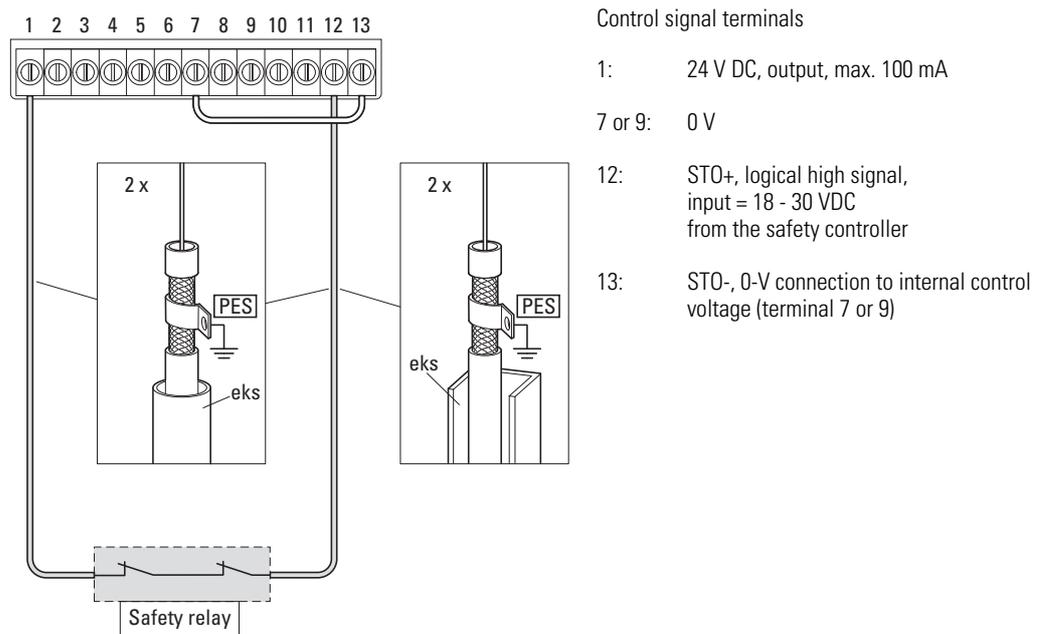


Figure 31: STO installation with internal control voltage

The connecting cable from control signal terminal 1 (+24 V) to the safety relay's contact and the connecting cable from the safety relay's contact to control signal terminal 12 (STO+) must be wired individually and installed separately (eks, separate mechanical protection with two closed cable ducts or two conduits). These two separately wired single cables must be screened, and the corresponding cable screen must be earthed (PES).

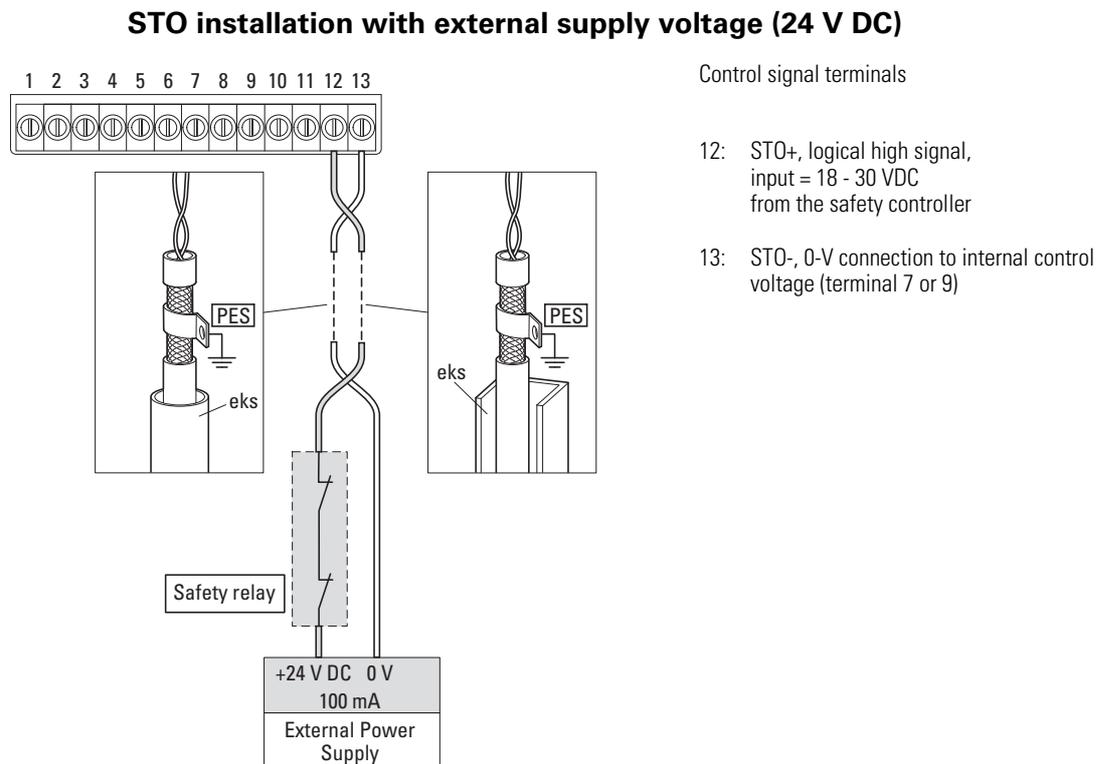


Figure 32:: STO installation with external control voltage

The two connecting cables going from the external control voltage and the safety relay to control signal terminals 12 (STO+) and 13 (STO-) must be twisted.

This twisted pair must be routed inside a closed cable duct or conduit (eks) and must also be screened, with the corresponding cable screen being earthed (PES).

The external control voltage should meet the following specifications:

|   |              |
|---|--------------|
| Rated control voltage                   | 24 V DC      |
| Voltage for the logical STO high signal | 18 - 30 V DC |
| Current carrying capacity               | 100 mA       |

### 2.10.5 STO function pick-up time

The total pick-up time for the STO function is the time that elapses from the moment a safety-relevant event occurs on the system's components (aggregate) to the moment a safe state is reached (in this case: Stop category 0 as defined in IEC 60204-1):

- The pick-up time from the moment the STO inputs (control signal terminals 12 and 13) become de-energized to the moment when the outputs in the power section (U, V, W) are in a state in which no torque is produced in the motor (STO function activated) is less than 1 ms.

## 2 Engineering

### 2.10 STO function

- The pick-up time from the moment the STO inputs (control signal terminals 12 and 13) become de-energized to the moment the STO monitoring status changes is less than 20 ms.
- The pick-up time from the moment a fault is detected in the STO circuit to the moment *Sto-F* is signaled (fault indicator, digital output) is less than 20 ms.

#### 2.10.6 STO function parameters



The STO function is always activated and enabled in VSA variable frequency drives – regardless of the operating mode or of parameter changes made by the user.

During normal operation (supply voltage present), there are various options for monitoring the STO inputs' (control signal terminals 12 and 13) state.

If the STO inputs are de-energized:

- The corresponding operating unit will display *! nH Ib It*.  
Exception: If the VSA variable frequency drive detects a fault, the corresponding fault code will be displayed (not: *! nH Ib It*)
- Relay RO1 will be switched off if parameter P2-15 is set to 13 (changeover contact: 14-16 = open, 14-15 = closed)
- Relay RO2 will be switched off if parameter P2-18 is set to 13 (N/O: 17-18 = open).

**Table 3: STO-relevant parameters**

| PNU   | Modbus ID | Access right |       | Type name    | Value  | Description   | DS |
|-------|-----------|--------------|-------|--------------|--------|---|----|
|       |           | RUN/ STOP    | ro/rw |              |        |   |    |
| P2-15 | 237       | RUN          | rw    | RO1 function | 0 - 13 | <p>Used to select the function for output relay RO1</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> RUN, enable (FWD/REV)</li> <li>• <b>1:</b> READY, variable frequency drive ready for operation</li> <li>• <b>2:</b> Speed = speed reference value</li> <li>• <b>3:</b> Speed &gt; 0</li> <li>• <b>4:</b> Speed ≥ limit value: ON: ≥ P2-16; OFF: &lt; P2-17</li> <li>• <b>5:</b> Motor current ≥ limit value: ON: ≥ P2-16; OFF: &lt; P2-17</li> <li>• <b>6:</b> Torque ≥ limit value: ON: ≥ P2-16; OFF: &lt; P2-17</li> <li>• <b>7:</b> Analog input AI2 ≥ limit value: ON: &gt; P2-16; OFF: &lt; P2-17</li> <li>• <b>8:</b> reserved</li> <li>• <b>9:</b> reserved</li> <li>• <b>9:</b> reserved</li> <li>• <b>10:</b> reserved</li> <li>• <b>11:</b> reserved</li> <li>• <b>12:</b> reserved</li> <li>• <b>13:</b> STO status (STO = Safe Torque OFF)</li> </ul>  | 1  |
| P2-18 | 240       | RUN          | rw    | RO2 function | 0 - 13 | <p>Used to select the function for output relay RO2</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> RUN, enable (FWD/REV)</li> <li>• <b>1:</b> READY, variable frequency drive ready for operation</li> <li>• <b>2:</b> Speed = speed reference value</li> <li>• <b>3:</b> Speed &gt; 0</li> <li>• <b>4:</b> Speed ≥ limit value: ON: ≥ P2-19; OFF: &lt; P2-20</li> <li>• <b>5:</b> Motor current ≥ limit value: ON: ≥ P2-19; OFF: &lt; P2-20</li> <li>• <b>6:</b> Torque ≥ limit value: ON: ≥ P2-19; OFF: &lt; P2-20</li> <li>• <b>7:</b> Analog input AI2 ≥ limit value: ON: &gt; P2-19; OFF: &lt; P2-20</li> <li>• <b>8:</b> Control signal for the external brake of a hoist drive (enables the “hoisting gear” mode). ON: Output frequency ≥ P2-07 while there is a START command present (FWD/REV). OFF: Output frequency ≤ P2-08 if there is no START command present (FWD/REV).</li> <li>• <b>9:</b> reserved</li> <li>• <b>9:</b> reserved</li> <li>• <b>10:</b> reserved</li> <li>• <b>11:</b> reserved</li> <li>• <b>12:</b> reserved</li> <li>• <b>13:</b> STO status (STO = Safe Torque OFF)</li> </ul> | 0  |

## 2 Engineering

### 2.10 STO function

| PNU   | Modbus ID | Access right |       | Type name  | Value                             | Description  | DS     |
|-------|-----------|--------------|-------|------------|-----------------------------------|--|--------|
|       |           | RUN/ STOP    | ro/rw |            |                                   |  |        |
| P2-36 | 258       | RUN          | rw    | Start Mode | Edge-r<br>Auto-0<br>...<br>Auto-5 | <p>Used to define the drive's behavior in relation to the enable signal and to configure automatic restarting after a fault.</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> Edge-r: If the enable signal is already active before the supply voltage is switched on or before a RESET, the drive will not start. Instead, the drive will wait for a rising edge before starting.</li> <li>• <b>1:</b> Auto-0: If the enable signal is already active before the supply voltage is switched on or before a RESET, the drive will start automatically.</li> <li>• <b>2 to 6:</b> Auto-1 to Auto-5: If the device is switched off due to a fault, the drive will automatically try to start again. The drive can make up to 5 start attempts, with an interval of P6-03 between each attempt. As long as the supply voltage is not switched off, the counter's contents will be retained, i.e., the contents of the counter used to count the number of start attempts. If the drive fails to start automatically on the last attempt, it will be switched off with a fault message, after which a manual RESET will be required.</li> </ul> <p><b>Notice:</b><br/>Automatic starting is only possible if the control commands are received via the terminals (P1-12 = 0, P1-12 = 11, if the unit automatically switches to terminal-based operation after a loss of communication).</p> <p><b>Observe the following warning!</b></p> | Auto-0 |



#### **DANGER**

For the automatic start mode (*Auto-0* to *Auto-5*), personnel protection and the impact on the drive system must be analyzed separately.

### 2.10.7 Fault messages

The following table lists the error messages relevant to the STO function, as well as potential causes and fixes.

**Table 4: Fault messages**

| Display <sup>1)</sup> | Fault code <sup>2)</sup><br>Modbus RTU [hex] | Designation                | Potential causes and fixes   |
|-----------------------|--|----------------------------|--|
| PS-trP                | 05   | Power section fault        | <ul style="list-style-type: none"> <li>• Fault message from the power section's output.</li> <li>• Check the connection to the motor (short-circuit, earth fault).</li> <li>• Disconnect the cable from terminals U, V, W. If the fault message cannot be reset, please contact your nearest Johnson Controls representative.</li> </ul> |
| Sto-F                 | 29   | Internal STO circuit fault | Please contact your closest Johnson Controls representative.   |

1) Display = Error code on the 7-digital display assembly or on the optional DX-KEY-LED keypad

2) Modbus RTU [hex] = Hexadecimal fault code via Modbus

### 2.10.8 STO function checklist

A drive's STO function should always be checked before initial commissioning, after maintenance, and at regular maintenance intervals. This check should include the following tests:

| No. | Occupation   | Note |
|-----|--|------|
| 1   | The STO inputs (control signal terminals 12, 13) are de-energized. <i>! rH Ib It</i> is displayed when the motor is stopped and there is a stop command on the VSA variable frequency drive.   |      |
| 2   | The STO inputs (control signal terminals 12, 13) are de-energized and the VSA variable frequency drive receives a start command (depends on the mode selected in P1-13, Config Select DI). <i>! rH Ib It</i> is displayed. The motor does not start.                               |      |
| 3   | The STO inputs (control signal terminals 12, 13) are powered with 24 VDC and the VSA variable frequency drive receives a start command (depends on the mode selected in P1-13, DI Config Select). The motor starts normally and is controlled by the VSA variable frequency drive. |      |
| 4   | The motor is running while being controlled by the VSA variable frequency drive and an STO input (control signal terminal 12 or 13) is de-energized. <i>! rH Ib It</i> is displayed and the motor coasts,  |      |

### 2.10.9 Regular maintenance

The STO function should always be included in a scheduled maintenance process (at least once per year) so that the function will be tested on a regular basis to make sure it is intact and complete – especially after changes are made to the safety system and after repairs are made.

During the corresponding inspection and testing, the variable frequency drive's installation and operating environment must be checked:

- The ambient temperature must fall within the admissible range.
- The heat sink and fan must be free of dust and other foreign particles. The fan must be able to rotate freely.
- The enclosure in which the variable frequency drive is installed must be free of dust and condensate.
- The enclosure fan and air filter must provide the required airflow.
- All electrical connections must be checked:  
The screw terminals must be properly tightened and the power cables must not show any signs of heat damage.

### 2.10.10 "Safe stop" function

The purpose of the STO function is to prevent the drive from making the motor produce a torque when there is no input signal at terminals 12 and 13. This makes it possible to integrate the drive into a complete safety system in which the "safe stop" function needs to be fully implemented.



#### **DANGER**

The STO function cannot prevent unexpected restarting or automatic restarting (if the corresponding parameters are configured for this type of restarting). Accordingly, it must not be used to perform maintenance or cleaning work on the machine.

The STO function eliminates the need to use electro-mechanical contactors with self-monitoring auxiliary contacts in order to implement safety functions.



#### **DANGER**

In certain applications, additional measuring and monitoring equipment may be needed in order to meet the requirements for the system's safety function.  
The STO function does not include motor braking, and the VSA's braking function cannot be considered a fail-safe method by itself.  
If a motor braking function is required, an appropriate safety relay and/or a mechanical braking system or a similar method must be used.

The STO function integrated into VSA variable frequency drives meets the definition of a “safe stop” as specified in IEC 61800-5-2 and of a non-controlled stop as per Category 0 (emergency switching off) as specified in IEC 60204-1. This means that the motor will coast when the STO function is activated. The method used for stopping must be appropriate for the system being driven by the motor.

The STO function is approved for use as a fail-safe method even in cases in which the STO signal is not present and a single fault has occurred in the drive. The drive was accordingly tested in accordance with the following security standards:

|                       | <b>SIL</b><br>(Safety Integrity Level) | <b>PFH<sub>d</sub></b><br>(Probability of dangerous Failures per Hour) | <b>SFF (%)</b><br>(Safe Failure Fraction) | <b>Lifetime assumed</b> |
|-----------------------|--|--|---|-------------------------|
| <b>EN 61800-5-2</b>   | 2                                      | 1.23E-09 1/h (0.12 % of SIL 2)   | 50  | 20 Yrs                  |
|                       | <b>PL</b><br>(Performance Level)       | <b>CCF (%)</b><br>(Common Cause Failure)                               |   |                         |
| <b>EN ISO 13849-1</b> | PL d                                   | 1  |   |                         |
|                       | <b>SIL CL</b>                          |  |   |                         |
| <b>EN 62061_x</b>     | SIL CL 2                               |  |   |                         |

The values provided here can only be ensured if the VSA variable frequency drive is installed in an environment that stays within the permissible limits:

- Ambient temperature range: -10 to +50 °C, taking into account any limits that depend on frame size and degree of protection
- Maximum altitude for rated operation: 1000 m above sea level, with altitude derating of 1% for every 100 m above 1000 m (up to max. 4000 m for IEC / 2000 m for UL)
- Relative humidity: < 95% (non-condensing). The VSA variable frequency drive must always be free of frost and moisture.

2 Engineering  
2.10 STO function

## 3 Installation

### 3.1 Introduction

This chapter provides a description of the mounting and the electrical connection for the VSA variable frequency drive.



While mounting and/or assembling the variable frequency drive, cover all ventilation slots in order to ensure that no foreign bodies can enter the device.



Perform all installation work with the specified tools and without the use of excessive force.

### 3.2 Mounting position

VSA variable frequency drives are available with three enclosure versions:

- IP20/NEMA 0 degree of protection for use in control panels,
- IP55/NEMA 12 degree of protection,
- IP66/NEMA 4X degree of protection.

The IP55 and IP66 enclosure versions provide protection against moisture and dust, allowing them to be used under harsh conditions indoors.

Without the required additional measures, using the device in the following environments is strictly prohibited:

- Explosion-proof Ranges
- Environments with damaging substances:
  - Oils and acids
  - Gases and fumes
  - Dust
  - Radiated noise
- Environments with mechanical vibration and impact loads that go beyond the requirements in EN 50178.
- Areas in which the variable frequency drive takes care of safety functions that must guarantee machine and personnel protection.

### 3.3 Mounting

The engineering instructions in this section are meant to show how to install the device in a suitable enclosure for devices with degree of protection IP20 and IP55 in compliance with standard EN 60529 and/or any other applicable local regulations.

- The enclosures must be made of a material with high thermal conductivity.
- If a control panel with ventilation openings is used, the openings must be located above and below the variable frequency drive in order to allow for proper air circulation. Air should be delivered from the bottom and conveyed outwards through the top.
- If the environment outside the control panel contains dirt particles (e.g., dust), a suitable particulate filter must be placed on the ventilation openings and forced ventilation must be used. The filters must be maintained and cleaned if necessary.
- An appropriate enclosed control panel (without ventilation openings) must be used in environments containing large percentages or amounts of humidity, salt, or chemicals.



Install the VSA variable frequency drive only on a nonflammable mounting base (e.g., on a metal plate).

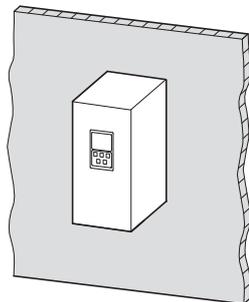


Figure 33: Surface mounting on metal plate

IP66 VSA variable frequency drives must be installed as required by the local conditions for this degree of protection.

### 3.3.1 Mounting position

VSA series variable frequency drives are designed to be mounted vertically. The maximum permissible inclination is 30°.

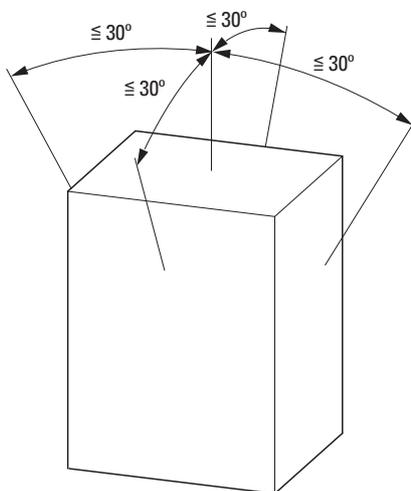


Figure 34: Mounting position

### 3.3.2 Cooling measures

In order to guarantee sufficient air circulation, enough thermal clearance must be ensured according to the frame size (rating) of the frequency inverter.

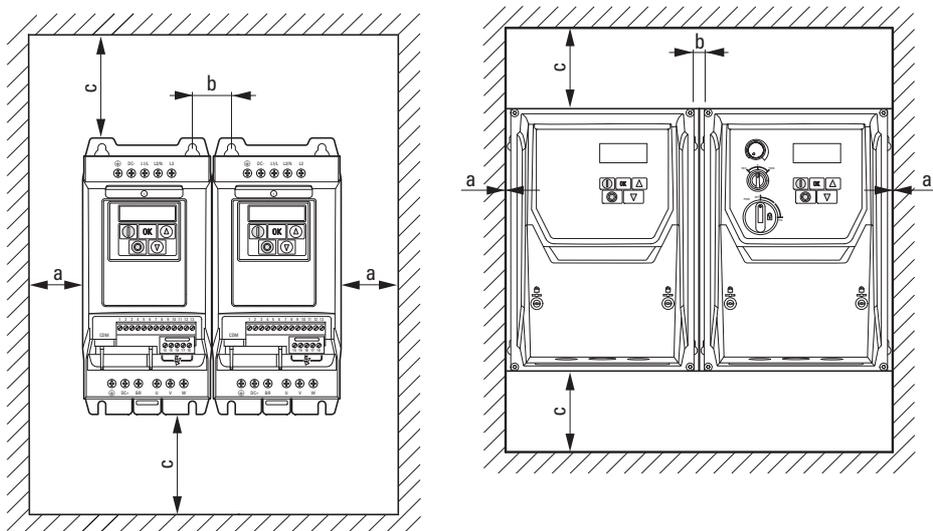


Figure 35: Clearances for air cooling (left: IP20; right: IP66)



The variable frequency drives can be mounted side by side without any lateral clearance between them.

### 3 Installation

#### 3.3 Mounting

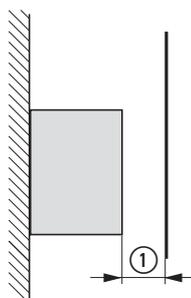
**Table 5: Minimum clearances and required cooling airflow**

| Frame size<br>(degree of<br>protection) | a  |      | b   |             | c   |             | Required airflow  |     |
|---|----|------|-----|-------------|-----|-------------|-------------------|-----|
|   | MM | in   | MM  | Occur<br>in | mm  | Occur<br>in | m <sup>3</sup> /h | cfm |
| FS2 (IP20)                              | 50 | 1.97 | 31  | 1.22        | 75  | 2.95        | 70                | 41  |
| FS2 (IP66)                              | 0  | 0    | 12  | 0.47        | 150 | 5.91        | 0                 | 0   |
| FS3 (IP20)                              | 50 | 1.97 | 31  | 1.22        | 100 | 3.94        | 190               | 112 |
| FS3 (IP66)                              | 0  | 0    | 13  | 0.51        | 150 | 5.91        | 0                 | 0   |
| FS4 (IP 55)                             | 10 | 0.39 | 71  | 2.8         | 200 | 7.87        | 425               | 250 |
| FS5 (IP 55)                             | 10 | 0.39 | 70  | 2.76        | 200 | 7.87        | 425               | 250 |
| FS6 (IP 55)                             | 10 | 0.39 | 140 | 5.52        | 200 | 7.87        | 650               | 383 |
| FS7 (IP 55)                             | 10 | 0.39 | 140 | 5.52        | 200 | 7.87        | 650               | 383 |
| FS8 (IP20)                              | 50 | 1.97 | 162 | 6.38        | 350 | 13.78       | 825               | 485 |

The values in 5 are recommended values for an ambient air temperature of up to +50 °C for IP20 and +40 °C for IP55 and +40 °C in FS8 (IP20), an installation altitude of up to 1000 m, and a switching frequency of up to 8 kHz.



Typical heat loss makes up about 3 % of the operational load conditions.



| Frame size    | Minimum clearance<br>① |
|---------------|------------------------|
| FS2, ..., FS7 | ≥ 15 mm (≥ 0.59 inch)  |
| FS8           | ≥ 50 mm (≥ 1.97 inch)  |

Figure 36: Minimum required clearance ① in front of the variable frequency drive when installed in an enclosure (control panel)



Please note that the mounting makes it possible to open and close the control signal terminal covers without any problems.

When variable frequency drives with internal fans are installed vertically over each other, an air baffle must be placed between the devices. Failure to do so may expose the device on top to a thermal overload caused by the guided air flow (device fan).

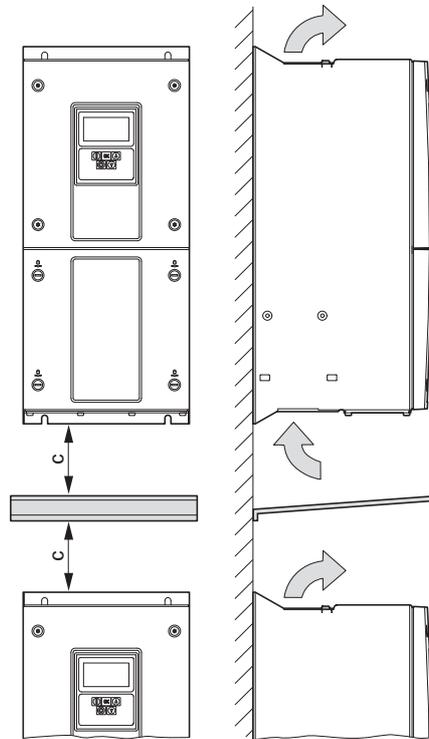


Figure 37: Deflector due to increased circulation caused by device fan

### 3 Installation

#### 3.3 Mounting

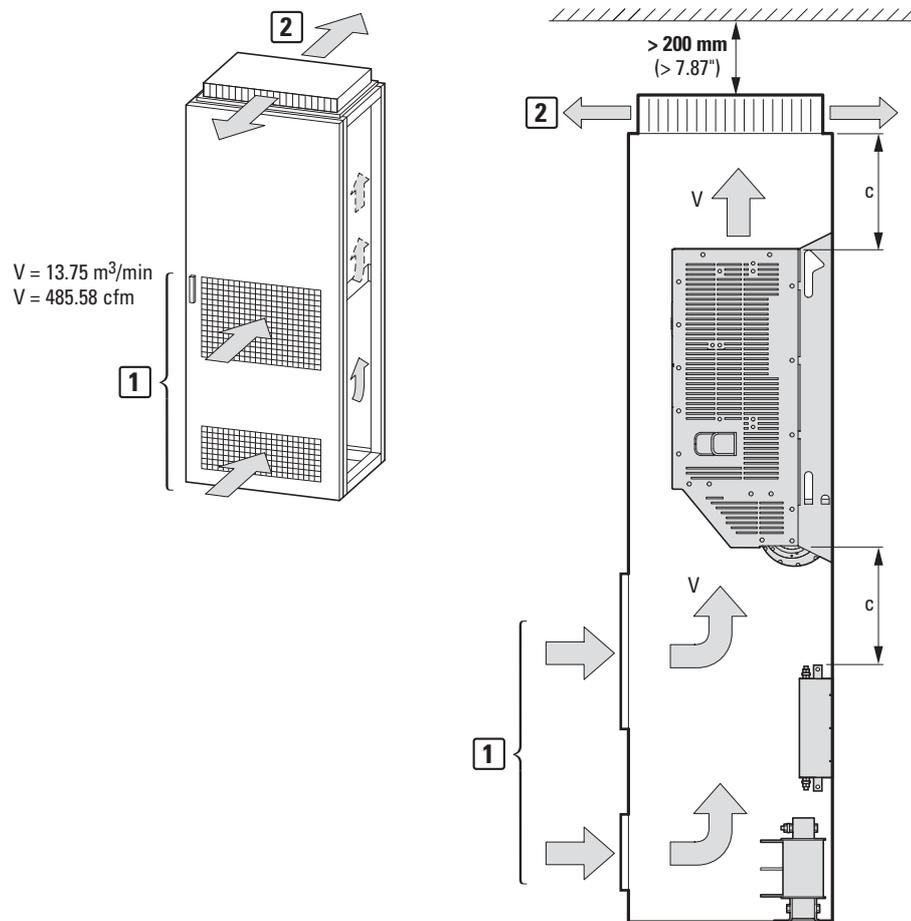


Figure 38: Air circulation in frame size FS8

There must be enough clearance above and in front of the control panel in order to ensure that there will be adequate cooling and space for any required maintenance work. The required volume of cooling air [1] and the required cooling air temperature must ensure that the variable frequency drive's maximum permissible ambient temperature will not be exceeded.

It must be possible for the hot exhaust air [2] to be channeled away unobstructed. Residual heat may cause the variable frequency drive's maximum permissible ambient temperature to be exceeded.

The heat dissipation of the variable frequency drive and of the accessories in the power branch (mains choke, motor choke, sine filter) will vary significantly depending on the load, the output frequency, and the carrier frequency being used.



→ Section 6.2, „Specific rated operational data“, page 147 lists the variable frequency drives' heat dissipation at the rated operational current.

The following formula provides a good reference value for estimating heat dissipation at target conditions, and can be used to size cooling and ventilation equipment for electrical rooms:

$$P_{\text{Dissipated}} [\text{kW}] = P_{\text{Motor}} [\text{kW}] \times 0.025$$

### 3.3.3 Fixing

All VSA variable frequency drive frame sizes can be mounted with screws. Moreover, frame sizes FS2 to FS3 with an IP20 degree of protection can be mounted on a mounting rail as well.

→ Install the VSA variable frequency drive only on a nonflammable mounting base (e.g., on a metal plate).

→ Dimension and weight specifications for the VSA variable frequency drive can be found in the  
→ Section 6.3, „Dimensions“, page157.

#### 3.3.3.1 Fixing with screws

→ Use screws with a washer and split washer with the permissible tightening torque in order to protect the enclosure and safely and reliably mount the device.

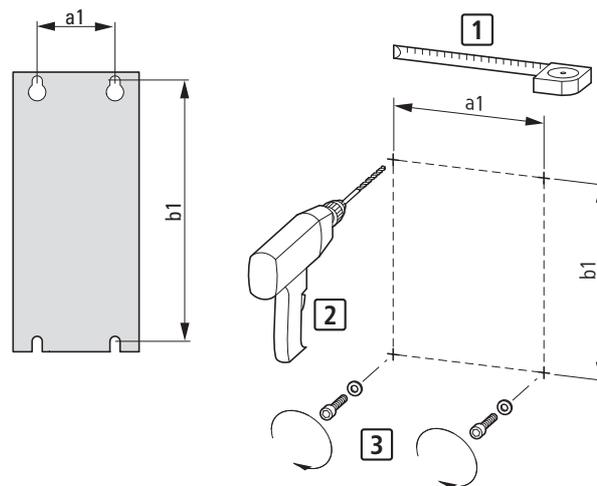


Figure 39: Mounting dimensions

- ▶ First fit the screws at the specified positions, mount the variable frequency drive and then fully tighten all screws.

### 3 Installation

#### 3.3 Mounting

**Table 6: Installation dimensions, screws, tightening torques**

| Frame size | Degree of protection |         | a1   |       | b1       |       | Screw    |          | Tightening torque |               |
|------------|----------------------|---------|------|-------|----------|-------|----------|----------|-------------------|---------------|
|            | FS                   | IP      | NEMA | mm    | Occur in | mm    | Occur in | Quantity | Size              | N/m           |
| FS2        | IP20                 | NEMA 0  | 75   | 2.95  | 215      | 8.46  | 4        | M4       | 1                 | 8.85          |
| FS2        | IP66                 | NEMA 4X | 176  | 6.93  | 200      | 7.87  | 4        | M4       | 1.2 - 1.5         | 10.62 - 13.27 |
| FS3        | IP20                 | NEMA 0  | 100  | 3.94  | 255      | 10.04 | 4        | M4       | 1                 | 8.85          |
| FS3        | IP66                 | NEMA 4X | 198  | 7.78  | 252      | 9.9   | 4        | M4       | 1.2 - 1.5         | 10.62 - 13.27 |
| FS4        | IP55                 | NEMA 12 | 110  | 4.33  | 428      | 16.85 | 4        | M8       | 4                 | 35.4          |
| FS5        | IP55                 | NEMA 12 | 175  | 6.89  | 515      | 20.28 | 4        | M8       | 15                | 132.76        |
| FS6        | IP55                 | NEMA 12 | 200  | 7.87  | 840      | 33.07 | 4        | M10      | 20                | 177           |
| FS7        | IP55                 | NEMA 12 | 200  | 7.87  | 1255     | 44.41 | 4        | M10      | 20                | 177           |
| FS8        | IP20                 | NEMA 0  | 420  | 16.54 | 942      | 37.09 | 4        | M12      | 57                | 504.5         |

1 in = 1" = 25.4 mm; 1 mm = 0.0394 in

#### 3.3.3.2 Fixing on a mounting rail

As an alternative to screw fixing, VSA variable frequency drives (sizes FS2 and FS3) and a degree of protection of IP20 can also be mounted on a mounting rail as per IEC/EN 60715.



If you use EMC mounting adapters (DX-EMC-MNT-...), use a tall mounting rail (15 mm) preferably.

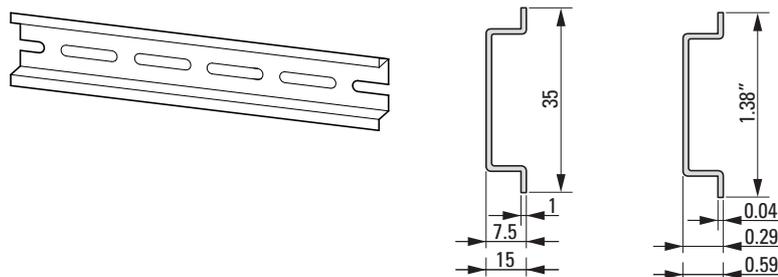


Figure 40: Mounting rail conforming with IEC/EN 60715

- ▶ To do this, place the variable frequency drive on the mounting rail from above [1] and press it down until it snaps into place [2].

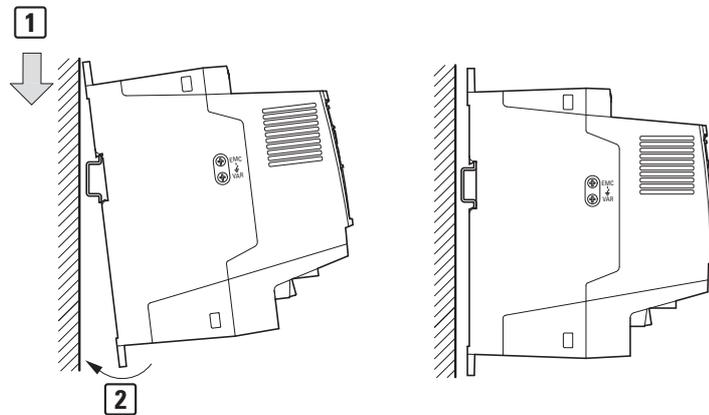


Figure 41: Fixing on mounting rails

#### Dismantling from mounting rails

- ▶ To remove the device, push down [2] on the clip being held by a spring force [1]. There is a marked recess at the bottom edge of the device that is intended for this purpose. A flat-bladed screwdriver (blade width 5 mm) is recommended for pushing down the clip.

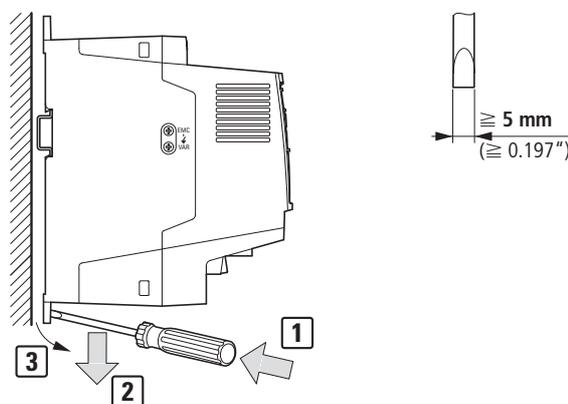


Figure 42: Dismantling from mounting rails

- ▶ Now pull the lower edge away from the mounting surface (towards you) [3] before lifting the variable frequency drive off the mounting rail.

### 3 Installation

#### 3.3 Mounting

#### 3.3.4 Control panel installation

If you install the VSA variable frequency drive in a control panel, make sure that the cabinet is installed in such a way that it is stable. The best option is to install it with the back panel lying against a wall. Moreover, the top of the cabinet should be fastened to the wall and the two front corners should be fastened to the floor. If the cabinet is set up in a freestanding configuration, all four corners must be fastened to the floor.

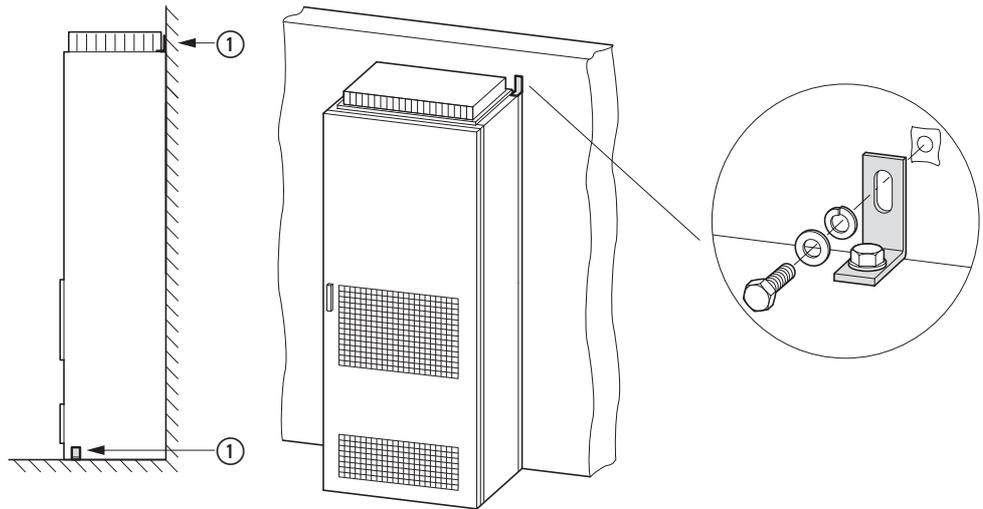


Figure 43: Stable control panel setup



Heavy accessories such as motor chokes and sine filters should always be installed on the control panel's base plate.

### 3.4 IP66/NEMA4X degree of protection

IP66 VSA variable frequency drives are available in two versions:

- VSA...-A66C: Activation via control signal terminals
- VSA...-A66SC: Controlled with controls on the front and/or control signal terminals

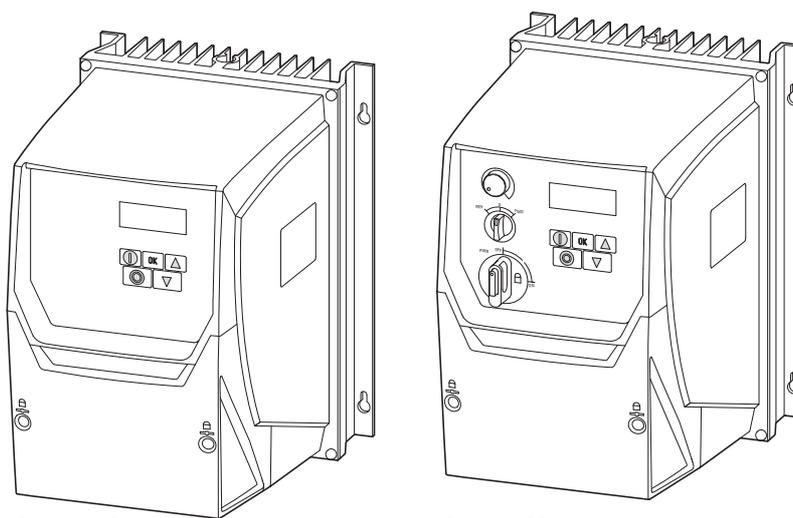


Figure 44:IP66 variants

The units must be mounted, with four screws and in a vertical position, on a wall or panel that is made of nonflammable material and is stable enough to hold the variable frequency drive’s weight.

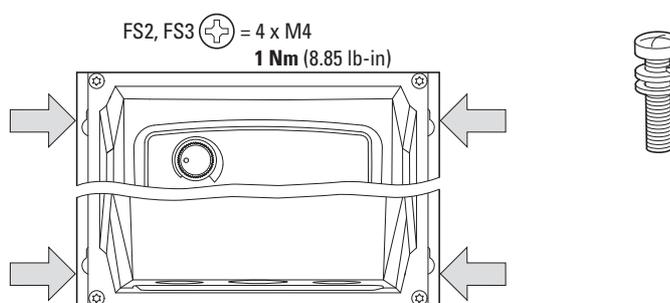


Figure 45:Openings for fixing screws

### 3 Installation

#### 3.4 IP66/NEMA4X degree of protection

On the VSA...-A6SC version, the main disconnect switch can be locked in the OFF position with a standard padlock.

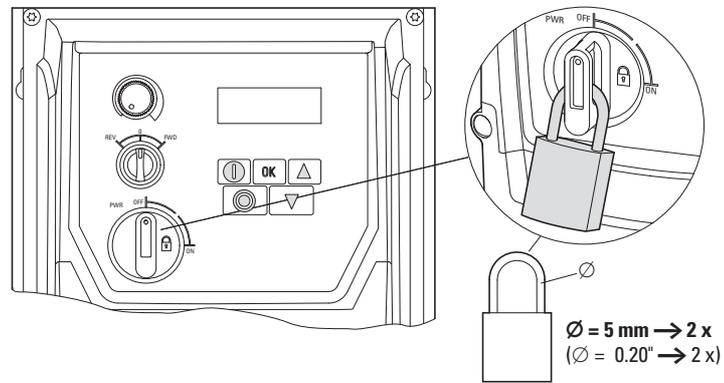


Figure 46:VSA...-A6SC with padlock

- ▶ Push on the center of the switch in order to open the opening for the padlock.

### 3.5 EMC installation

The responsibility to comply with the legally stipulated limit values and thus the provision of electromagnetic compatibility is the responsibility of the end user or system operator. This operator must also take measures to minimize or remove emission in the environment concerned. He must also utilize means to increase the interference immunity of the devices of the system.



In a magnet system (PDS) with frequency inverters, you should take measures for electromagnetic compatibility (EMC) while doing your engineering, since changes or improvements to the installation site, which are required in the installation or while mounting, are normally associated with additional higher costs as well.

The technology and system of a variable frequency drive cause the flow of high frequency leakage current during operation. Because of this, all earthing elements must be low-impedance elements connected in such a way as to establish an electrical contact across a large surface area.

With leakage currents greater than 3.5 mA, in accordance with VDE 0160 or EN 60335, either

- the cross-sectional area of the protective conductor must be  $\geq 10 \text{ mm}^2$ ,
- The protective conductor must be open-circuit monitored, or
- the second protective conductor must be fitted.

For an EMC-compliant installation, we recommend the following measures:

- Installation of the variable frequency drive in a metallically conductive housing with a good connection to ground,
- screened motor cables (short cables).



Ground all conductive components and housings in a drive system using as short a line as possible with the greatest possible cross-section (Cu-braid).

#### 3.5.1 EMC compliance in the control panel

In order to have an installation that meets EMC requirements, make sure to connect all the metallic parts in the devices and in the control panel to each other across a large area and in a way that will make it possible to conduct high frequencies. Mounting plates and control panel doors should be connected to the panel by means of short drain wires with an electrical contact established across a large surface area.



Do not make connections to painted surfaces (electrolytic oxidation, yellow chromated).



Install the variable frequency drive as directly as possible (without spacers) on a metal plate (mounting plate).

### 3 Installation

#### 3.5 EMC installation



Route mains and motor cables in the control panel as close to the ground potential as possible. This is because free moving cables act as antennas.



If routed in parallel, cables carrying high frequencies (e.g., screened motor cables) and clean cables (e.g., mains supply cable, control and signal cables) should be installed at a distance of at least 100 mm from each other in order to avoid electromagnetic interference. You should also use separate cable entries if there is a great difference in voltage potentials. If control cables and power cables need to cross, they should always do so at a right angle (90°).

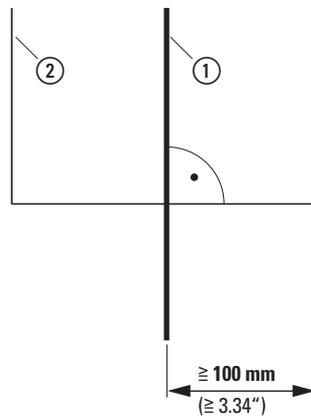


Figure 47: Cable routing



Do not route the control and signal cables ② in the same conduit as the power cables ①. Analog signal cables (measured values, setpoints, and correction values) must be routed inside screened conduit.

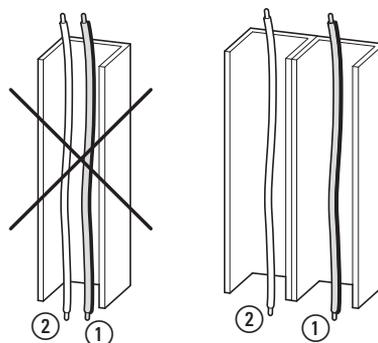


Figure 48: Separate routing

- ① Power cable: mains voltage, motor connection
- ② Control and signal lines, fieldbus connections

## 3.5.2 Earthing

The protective earth (PE) in the control panel should be connected from the mains supply to a central earth point (mounting plate, system earth). The PE conductor's cross-sectional area must be at least as large as that of the incoming mains supply cable.

Every variable frequency drive must be individually connected to the power supply system's protective earth directly at the location of installation (system earthing). This protective earth must not pass through any other devices.

All protective conductors should be routed in a star topology starting from the central earth point, and all of the magnet system's conductive components (e.g. variable frequency drive, sine filter) should be connected.

The earth-fault loop impedance must comply with all locally applicable industrial safety regulations. In order to meet UL requirements, UL-listed ring cable lugs must be used for all earth wiring connections.



Avoid ground loops when installing multiple variable frequency drives in one control panel. Make sure that all metallic devices that are to be grounded have a broad area connection with the mounting plate.

### 3.5.2.1 Protective earth

This refers to the legally required protective earth for a variable frequency drive. An earthing terminal on the variable frequency drive, or the system earth, must be connected to a neighboring steel element in the building (beam, ceiling joist), an earth electrode in the ground, or a mains earth bus. The earth points must meet the requirements set forth by the applicable national and local industrial safety regulations and/or regulations for electrical systems.

### 3.5.2.2 Motor earthing

The motor earth must be connected to one of the earthing terminals on the variable frequency drive and to a neighboring steel element in the building (beam, ceiling joist), an earth electrode in the ground, or a mains earth bus.

### 3.5.2.3 Earth-fault protection

A fault current to earth can be produced by variable frequency drives due to their system characteristics. VSA series variable frequency drives have been designed in such a way that the smallest possible fault current will be produced in compliance with standards applicable worldwide. In the case of devices powered with a three-phase supply (VSA 3...), this fault current must be monitored by a residual current device (RCD, type B).

### 3 Installation

#### 3.5 EMC installation

### 3.5.3 Internal filters (EMC and VAR screws)

#### 3.5.3.1 EMC screw

FS2 and FS3 VSA variable frequency drives with an IP20 degree of protection feature two screws on the left side that are labeled EMC and VAR.

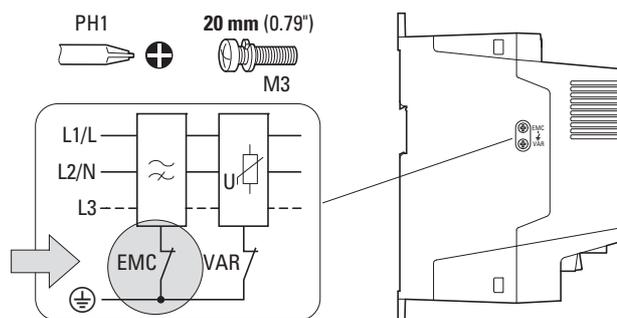


Figure 49: EMC and VAR screw

#### **NOTICE**

The screw labeled EMC must not be manipulated as long as the variable frequency drive is connected to the mains.



The EMC screw galvanically connects the EMC filter's mains-side capacitors to earth. The screw must be screwed in all the way to the stop (factory setting) in order for the variable frequency drive to comply with EMC standards.

Due to their system characteristics, variable frequency drives with an internal EMC filter will produce a larger fault current to earth than devices without a filter. For applications in which this larger leakage current may cause malfunction messages or disconnections (residual current device), the EMC filter's internal protective earth can be disconnected (remove the EMC screw to do this).

Local EMC regulations must be taken into account when doing so. If necessary, a specific low-leakage-current EMC filter (DX-EMC...-L) must be connected upstream.

In connections to isolated power sources (IT networks), the EMC and VAR screw should be removed. The earth fault monitors required for IT networks must be suitable for operation with power electronic devices (IEC 61557-8).

### 3.5.4 VAR screw

VSA series variable frequency drives are equipped with an overvoltage filter for the input supply voltage that is designed to protect the devices from noise pulses in the mains voltage. Pulse spikes are typically caused by lightning strikes or by switching operations in other high-power devices on the same supply.

If high potential tests are performed on a system, these overvoltage protection components may cause the system to fail the test. In order to make it possible to perform this type of hipot tests, the overvoltage protection components can be disconnected by removing the VAR screw. The screw must be screwed back in after the high potential tests are performed and the test must then be repeated. The system must then fail the test, indicating that the overvoltage protection components have been reconnected.

**NOTICE**

The screw labeled VAR (→ Figure 49, page 86) must not be manipulated as long as the variable frequency drive is connected to the mains.

### 3.5.5 Screen earth kit

Cables that are not screened work like antennas (sending, receiving).

→ For a proper EMC connection, cables emitting interference (e.g. motor cables) and susceptible cables (analog signal and measurement values) must be screened and laid separately from each other.

The effectiveness of the cable screen depends on a good screen connection and a low screen impedance.

→ Use only shields with tinned or nickel-plated copper braiding. Braided steel shields are unsuitable.

→ Control and signal lines (analog, digital) should always be grounded on one end, in the immediate vicinity of the supply voltage source (PES).

## 3 Installation

### 3.5 EMC installation

#### 3.5.6 EMC cable brackets

DX-EMC-MNT-... cable brackets can be used to route and secure cables in the connection area of an FS2 or FS3 variable frequency drive with an IP20 degree of protection. These cable brackets are mounted on the variable frequency drive's mains connection side (DX-EMC-MNT-...N) and motor side (DX-EMC-MNT-...M) using the corresponding mounting holes, and are then connected to the drive's earthing connection.

The cable brackets' integrated hole pattern (M4 screw thread) makes it possible to secure the cables being connected and relieve any strain on them by using the corresponding gland plates. It also makes it possible to have a 360° EMC connection (PES) in the case of screened cables.

These cable brackets are made of galvanized sheet steel.

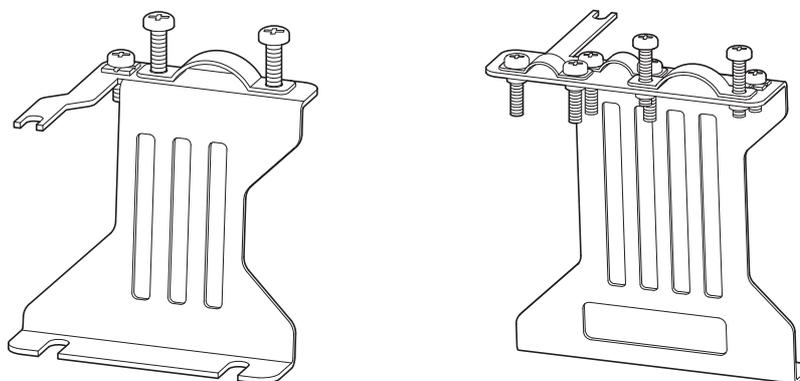


Figure 50: DX-EMC-MNT-...N (left), net and DX-EMC-MNT-...M (right), motor, cable brackets



For more information and technical data on DX-EMC-MNT-... EMC cable brackets, please refer to instructional leaflet IL040010ZU.



DX-EMC-MNT-... EMC cable brackets are sold as individual units. There are different brackets for each VSA variable frequency drive frame size (FS2 and FS3). The gland plates and their fixing screws are included in the equipment supplied with the cable brackets.

| Cable bracket | Frame size VSA | Gland plates  |
|---------------|----------------|---|
|               |                | Quantity/designation  |
| DX-EMC-MNT-2N | FS2            | 1/mains connection  |
| DX-EMC-MNT-2M | FS2            | 3/control cables, motor connection, external braking resistance |
| DX-EMC-MNT-3N | FS3            | 1/mains connection  |
| DX-EMC-MNT-3M | FS3            | 3/control cables, motor connection, external braking resistance |

### 3.5.7 General installation diagram

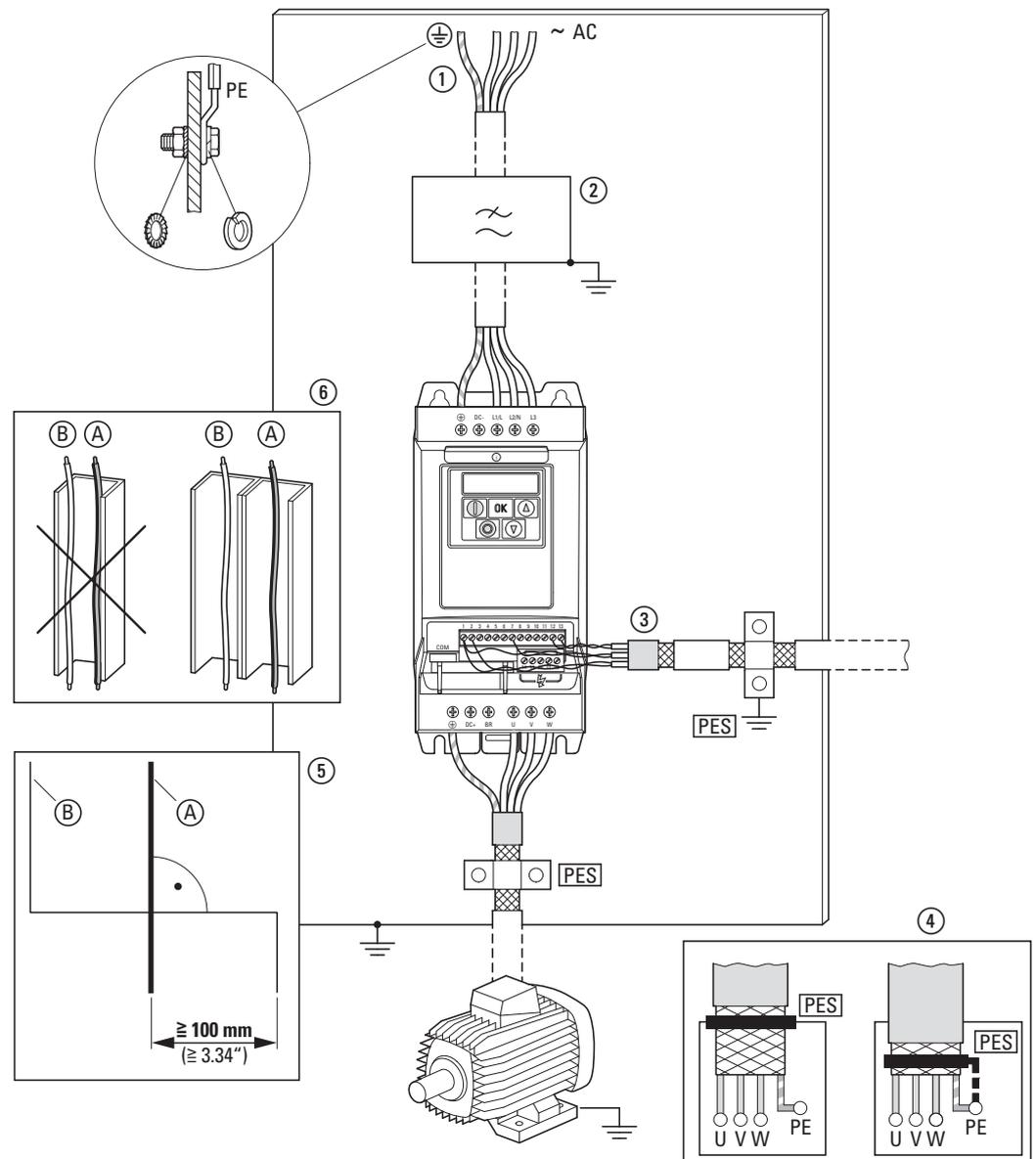


Figure 51:EMC installation

- ① Mains connection: Supply voltage, central earthing connection for control panel and machine
- ② External radio interference suppression filter: Optional DX-EMC... radio interference suppression filter for longer motor cables or use in a different EMC environment
- ③ Control connection: Connection for the digital and analog control cables, STO function, and communication via RJ45 plug-in connection
- ④ Motor connection: Connection (PES) between the screened motor cable and the motor's terminal box, made according to EMC requirements, with metal cable gland or with gland plate in the terminal box.
- ⑤ Cable routing: Power cables (A) and control cables (B) spatially routed separately from each other. If different potential levels need to cross, they should do so at a right angle as far as possible.
- ⑥ Cable routing: Do not route power cables and control cables parallel to each other in a single cable duct. If they need to be routed in parallel, they should be in separate metal cable ducts (in order to meet EMC requirements).

### 3 Installation

#### 3.6 Electrical Installation

#### 3.6 Electrical Installation



#### **CAUTION**

Carry out wiring work only after the variable frequency drive has been correctly mounted and secured.



#### **DANGER**

Electric shock hazard - risk of injuries!  
Carry out wiring work only if the unit is de-energized.

#### **NOTICE**

Fire hazard!  
Only use cables, circuit-breakers, and contactors that feature the indicated permissible nominal current value.

#### **NOTICE**

On VSA variable frequency drives, earth leakage currents can be greater than 3.5 mA (AC).  
Accordingly, as per IEC/EN 61800-5-1, an additional protective conductor must be connected or the protective conductor's cross-sectional area must be at least 10 mm<sup>2</sup>.



#### **DANGER**

The components in the variable frequency drive's power section remain energized up to five (5) minutes after the supply voltage has been switched off (intermediate circuit capacitor discharging time).

Pay attention to hazard warnings!



Complete the following steps with the specified tools and without using force.

### 3.6.1 Power section connections

The connection to the power section is normally made via the connection terminals:

- L1/L, L2/N, L3, PE for the mains-side supply voltage.  
The phase sequence does not matter.
- DC+ (or +), DC- (or -), PE for DC link coupling or if the device is being supplied with DC voltage
- U, V, W, PE for the input wiring to the motor
- BR, DC+ (or +), PE for an external braking resistance
- DC+ (or +) or DC- (or -), PE for connecting all-pole sine filters

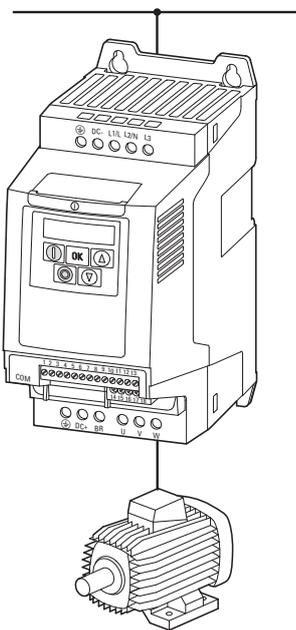


Figure 52: Connection in power section (schematic)

The number and the arrangement of the connection terminals used depend on the variable frequency drive's frame size and model.

#### **NOTICE**

The variable frequency drive must always be connected with ground potential via a grounding conductor (PE).

3.6.1.1 Connection terminals on frame sizes FS2 and FS3 with IP20

**Table 7: Connection terminals (FS2, FS3)**

| Connection terminals | Description   |
|----------------------|---|
|                      | Connection with single-phase supply voltage (230 V):<br>• VSA 12... (200 - 240 V)   |
|                      | Connection with three-phase supply voltage:<br>• VSA 32... (200 - 240 V)<br>• VSA 34... (380 - 400 V)<br>• VSA 35... (500 - 600 V)  |
|                      | Motor connection for three-phase motors:<br>(motor voltage = supply voltage)<br>• VSA 12...<br>• VSA 32...<br>• VSA 34...<br>• VSA 35...<br><br>optional: internal or external braking resistance ( $R_B$ ) |



DC+ and DC- for DC link coupling or if the device is being supplied with DC voltage.  
 To do this, the terminal screw cover needs to be knocked out.

### 3.6.1.2 Connection for frame sizes FS4 to FS7 with IP55

On enclosures with an IP55 degree of protection (frame sizes FS4 to FS7), the connection area will be located behind the lower enclosure cover.

#### Sizes FS4 and FS5

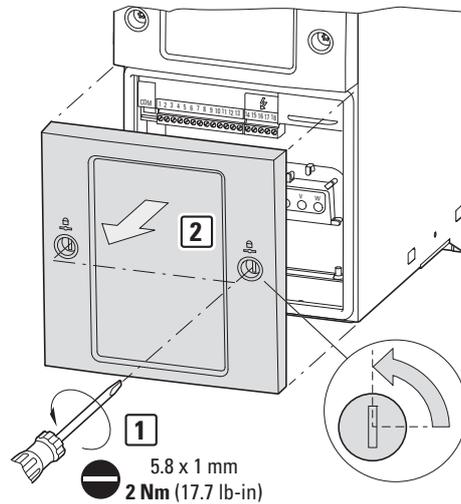


Figure 53: Removing the cover

Release the latches by turning them counterclockwise (90 degrees) so that they are in a vertical position [1] and lift the cover off towards you [2].

#### Sizes FS6 and FS7

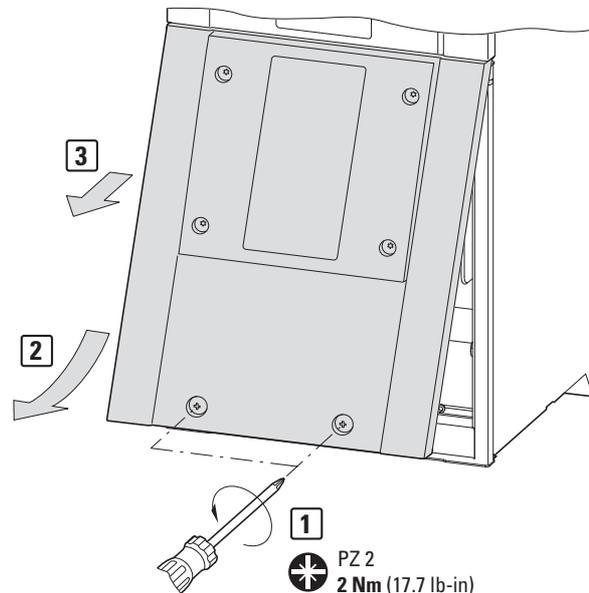


Figure 54: Removing the cover

Unscrew the two screws at the bottom [1], lift the cover from the bottom [2], and then remove it towards you

### 3 Installation

#### 3.6 Electrical Installation

➔ The upper edge of this cover is inserted into the upper enclosure cover from below.

The connection cables need to be brought in from below. To do this on these frame sizes (FS4 to FS7), the cover at the bottom (above the device fan) needs to be removed.

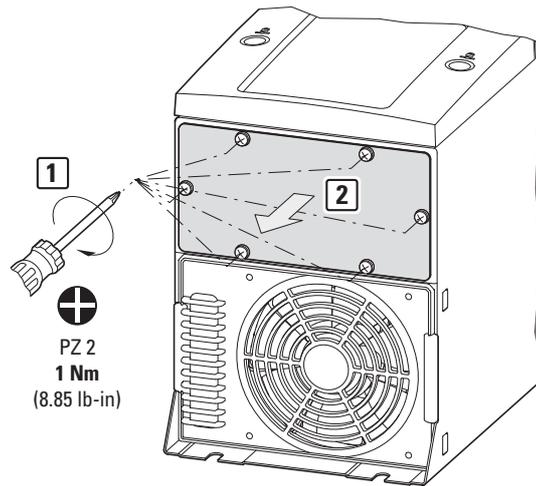


Figure 55: Remove the blanking plate

Unscrew the screws (six/eight) [1] and remove the blanking plate [2].

**Table 8: Connection terminals (FS4, FS5)**

| Description  |   |  |
|--|---|--|
| Connection with three-phase supply voltage:<br>• VSA 32... (200 - 240 V)<br>• VSA 34... (380 - 480 V)<br>• VSA 35... (500 - 600 V) | internal or external braking resistance (R <sub>B</sub> , optional) | Connection for three-phase motors (motor voltage = supply voltage) |

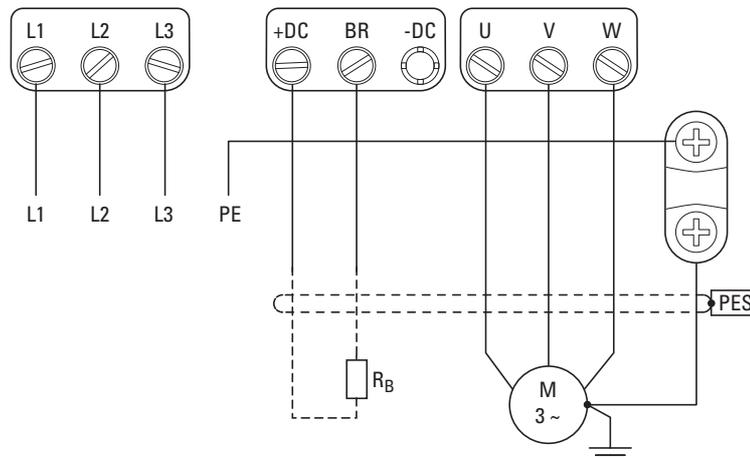


Figure 56: Connection terminals for FS4 and FS5

➔ PE earthing connection with ring terminals on the right side.

➔ Terminals +DC and -DC have the same function as terminals DC+ and DC-.

**Table 9: Terminal bolt (FS6, FS7)**

| Description  |   |  |
|--|---|--|
| Connection with three-phase supply voltage:<br>• VSA 32... (200 - 240 V)<br>• VSA 34... (380 - 480 V)<br>• VSA 35... (500 - 600 V) | external braking resistance ( $R_B$ , optional) | Connection for three-phase motors (motor voltage = supply voltage) |

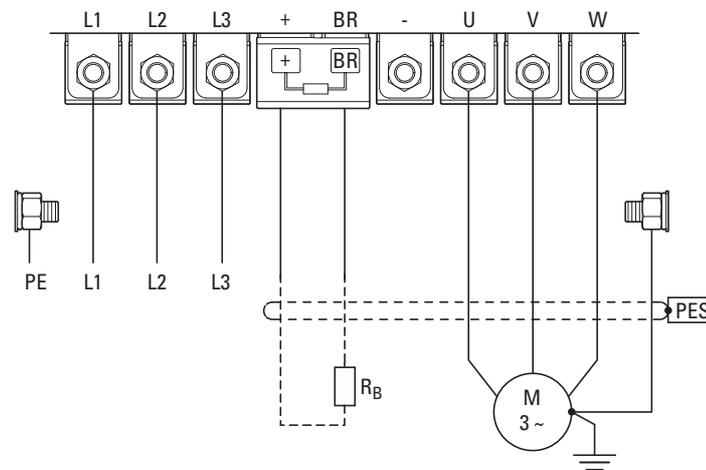


Figure 57: Terminal bolt for FS6 and FS7

The PE earthing connection is made with ring terminals and the bolts on the left and right sides of the enclosure.

The terminal bolts for an external brake resistor are located under the cover marked with + and BR.

➔ Stud terminal + has the same function as terminal DC+.

➔ If the device is installed in a control panel, the lower blanking plate and the front enclosure cover must not be installed. Without the cover, the VSA variable frequency drive will have an IP40 degree of protection.

### 3 Installation

#### 3.6 Electrical Installation

#### 3.6.1.3 Terminal bolts on frame size FS8 (IP20)

On FS8 VSA variable frequency drives, the connection area inside the power section will be covered by a blanking plate at the bottom of the enclosure. In order to open it, you will need to unscrew six screws [1].

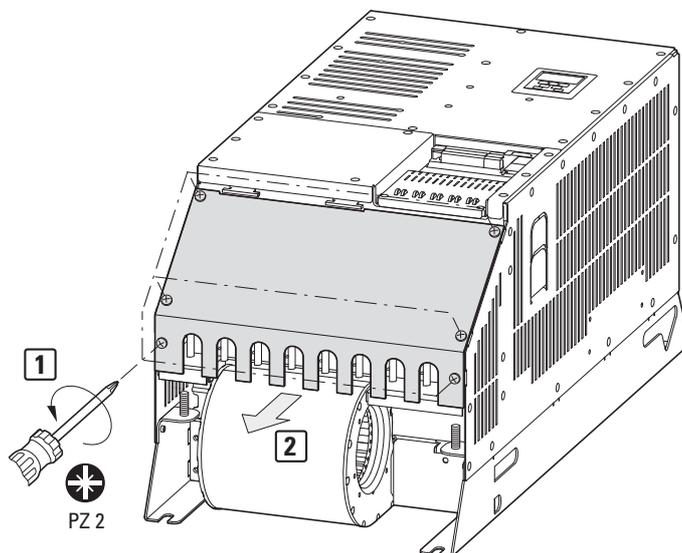


Figure 58: Remove the blanking plate

**Table 10: Terminal bolt (FS8)**

| Description  |   |  |
|--|---|--|
| Connection with three-phase supply voltage:<br>• VSA 34... (380 - 480 V) | external braking resistance ( $R_B$ , optional) | Connection for three-phase motors (motor voltage = supply voltage) |

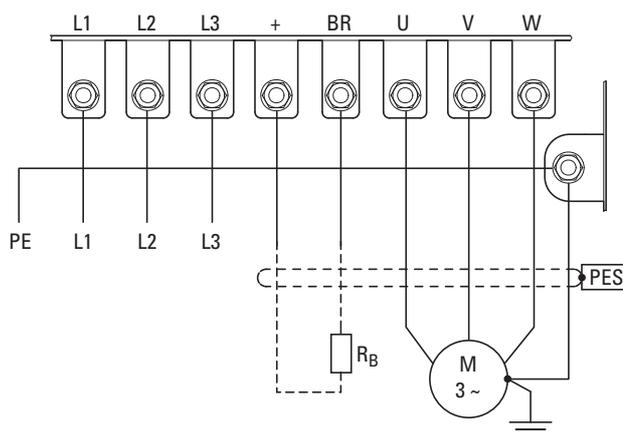


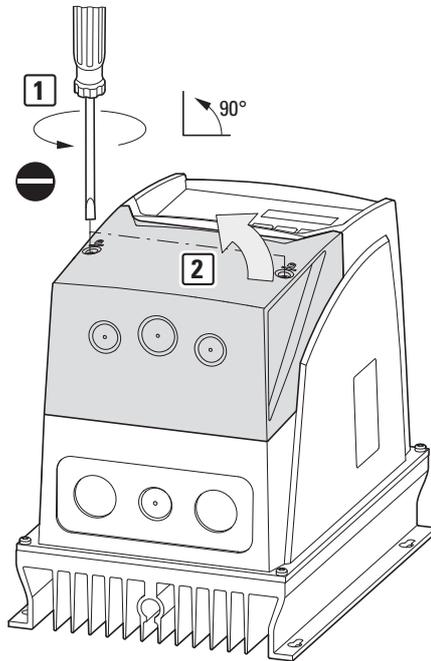
Figure 59: Terminal bolt for FS8

The PE earthing connection is made with ring terminals and the bolts on the right side.



Stud terminal + has the same function as terminal DC+.

### 3.6.1.4 Connection terminals on frame sizes FS2 and FS3 with IP66



On FS2 and FS3 frame sizes with an IP66 degree of protection, the connection area is located behind the lower enclosure cover. To open the cover, release the two latches by turning them counterclockwise (90 degrees) so that they are in a vertical position [1].

Once the latches are released, you can lift the cover off towards you [2].

Figure 60: Remove enclosure cover (IP66)

**Table 11: Connection terminals (FS2, FS3)**

| Connection terminals | Description   |
|----------------------|---|
|                      | Connection with single-phase supply voltage <ul style="list-style-type: none"> <li>VSA 12... (200 - 240 V)</li> </ul>   |
|                      | Connection with three-phase supply voltage: <ul style="list-style-type: none"> <li>VSA 32... (200 - 240 V)</li> <li>VSA 34... (380 - 480 V)</li> <li>VSA 35... (500 - 600 V)</li> </ul> |
|                      | Motor connection for three-phase motors:<br>(motor voltage = supply voltage)<br><br>optional: External braking resistance ( $R_B$ )   |



Terminal + has the same function as terminal DC+.

3 Installation  
3.6 Electrical Installation

3.6.1.5 Stripping lengths and tightening torques

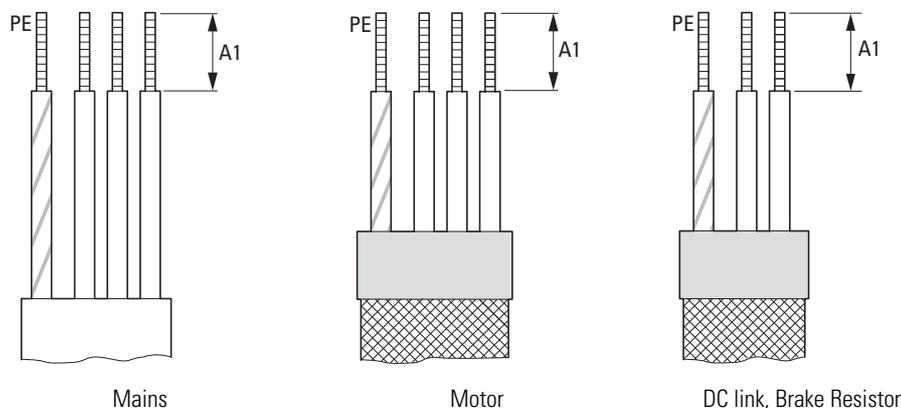


Figure 61: connection cables

Mains = Electrical supply system (mains voltage),  
Motor = Motor connection,  
DC-Link = internal DC link,  
Brake Resistor = Braking resistance

**Table 12: Stripping lengths in the power section**

| Frame size<br>(degree of protection) | A1<br>mm (in)                       | Tightening torque |
|--------------------------------------|-------------------------------------|-------------------|
|                                      | mm (in)                             | Nm (lb-in)        |
| FS2 (IP20)                           | 8 (0.3)                             | 1 (8.85)          |
| FS3 (IP20)                           | 8 (0.3)                             | 1 (8.85)          |
| FS2 (IP66)                           | 10 (0.39)                           | 1.5 (15)          |
| FS3 (IP66)                           | 10 (0.39)                           | 1.5 (15)          |
| FS4                                  | 15, space unit = ring-cable ferrule | 4 (35.4)          |
| FS5                                  | 15, space unit = ring-cable ferrule | 15 (98.2)         |
| FS6                                  | Ring-cable ferrule                  | 20 (177)          |
| FS7                                  | Ring-cable ferrule                  | 20 (177)          |
| FS8                                  | Ring-cable ferrule                  | 57 (504, 49)      |

**Table 13: Openings (FS2, FS3)**

| Frame size | Control section          | Power part                      | Metric gland for hole size         |
|------------|--------------------------|---------------------------------|------------------------------------|
| FS2        | 2 x 21 mm<br>1 x 25.5 mm | 3 x 21 mm                       | M20 with 21 mm<br>M25 with 25.5 mm |
| FS3        | 2 x 21 mm<br>1 x 25.5 mm | 1 x 21 mm<br>1 x 25.5 mm (open) | M20 with 21 mm<br>M25 with 25.5 mm |

### 3.6.1.6 Connecting the motor cable

The screened cables between the variable frequency drive and the motor should be as short as possible.

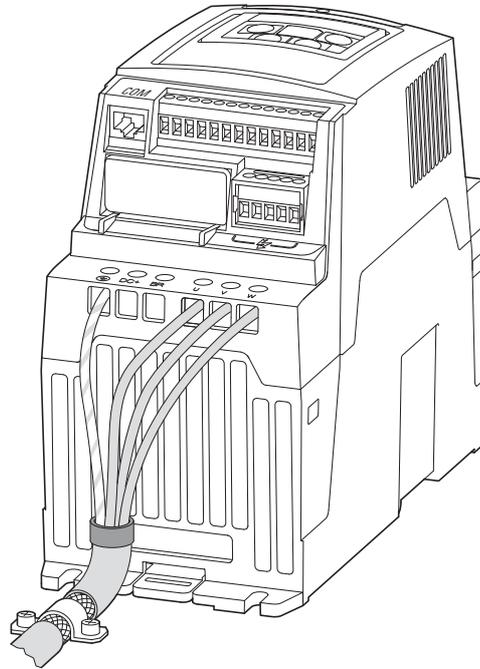


Figure 62: Connection on motor side

- ▶ Connect the screening, on both sides and across a large area (360° overlap), to the protective earth (PE) ⊕. The power screening's protective earth (PES) connection should be in the immediate proximity of the variable frequency drive and directly on the motor terminal box.
- ▶ Prevent the screen earth kit from becoming unbraided, i.e. by pushing the separated plastic covering over the end of the shielding or with a rubber grommet on the end of the shielding. Terminate the cable screen across a large area at the end (PES).

Alternatively, you can twist the screen braid and connect it to the protective earth with a cable lug. In order to prevent EMC interference, this twisted screen connection should be as short as possible (recommended value for the twisted cable screen:  $b \geq 1/5 a$ ).

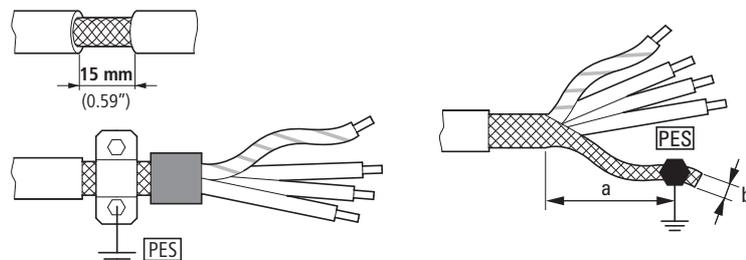


Figure 63: Screened connection cable in motor circuit

## 3 Installation

### 3.6 Electrical Installation

Screened, four-wire cable is recommended for the motor cables. The green-yellow line of this cable connects the protective ground connections from the motor and the variable frequency drive and therefore minimizes the equalizing current loads on the screen braid.

The following figure shows the construction of a four-wire, screened motor line (recommended specifications).

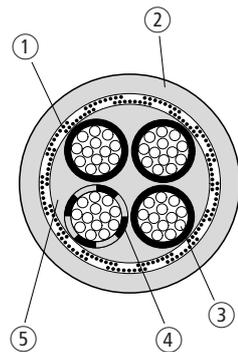


Figure 64: Four-core screened motor supply cable

- ① Cu shield braid
- ② PVC outer casing
- ③ Drain wire (copper strands)
- ④ PVC core insulation, 3 x black, 1 x green-yellow
- ⑤ Textile and PVC fillers

If there are additional subassemblies in a motor feeder (such as motor contactors, overload relays, motor chokes, sine filters or terminals), the shielding of the motor cable can be interrupted close to these subassemblies and connected to the mounting plate (PES) with a large area connection. Free or non-shielded connection cables should not be any longer than about 300 mm.

### 3.6.1.7 Cable glands on IP55 and IP66

In the case of applications requiring for a variable frequency drive to be installed inside buildings or systems but outside a control panel, cable glands can be used with VSA variable frequency drives with an IP55 or IP66 degree of protection in order to establish an optimal connection.

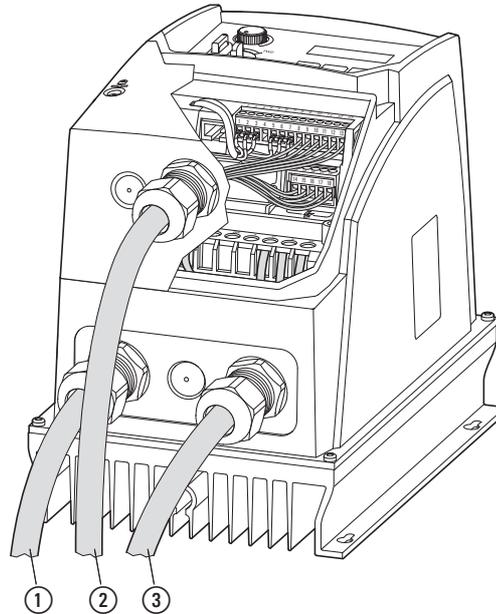


Figure 65: Openings with cable glands (IP66)

- ① Mains connection (supply voltage)
- ② Control and signal cables
- ③ Motor connection (screened cable with metal cable gland)

The lower metal section already comes with openings for the cable glands to the power section.

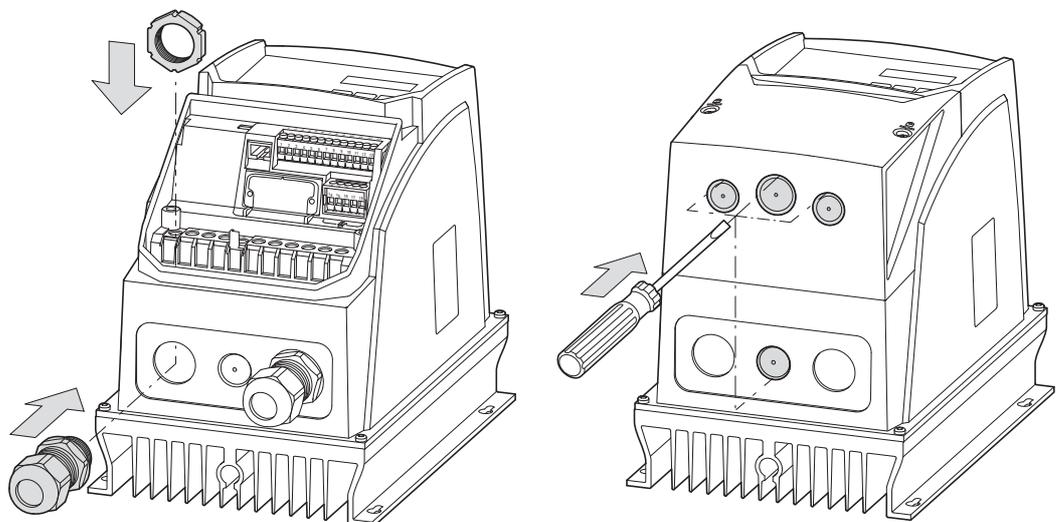


Figure 66: Openings for cable glands with IP66 degree of protection

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**Table 14: Openings for cable glands (FS2, FS3)**

| Frame size | Control section          | Power part                      | Metric gland for hole size         |
|------------|--------------------------|---------------------------------|------------------------------------|
| FS2        | 2 x 21 mm<br>1 x 25.5 mm | 3 x 21 mm                       | M20 with 21 mm<br>M25 with 25.5 mm |
| FS3        | 2 x 21 mm<br>1 x 25.5 mm | 1 x 21 mm<br>1 x 25.5 mm (open) | M20 with 21 mm<br>M25 with 25.5 mm |



Make sure that the cable glands have at least an IP66 degree of protection.

The EMC cable gland must be earthed properly – e.g., with a metal lock nut that is then connected to the PE terminal.

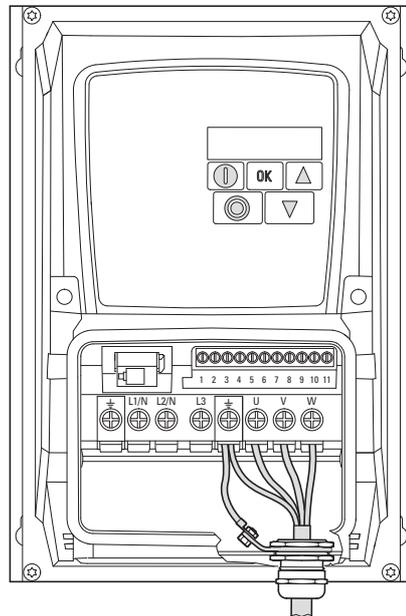


Figure 67: Grounding the EMC cable gland (IP66)

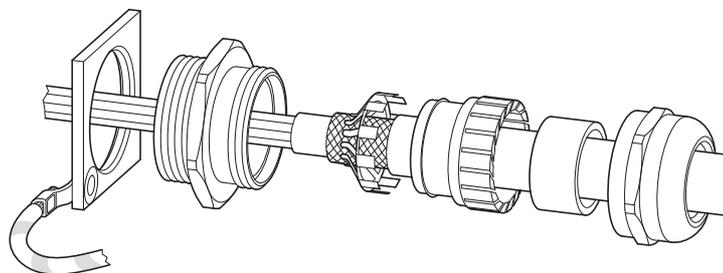


Figure 68: Example: diagram of EMC gland assembly

In devices with an IP55 degree of protection (frame sizes FS4 to FS7), the blanking plates (→ Figure 72) have three locating points for individual opening diameters. In order to have an installation that meets EMC requirements, the metal stud on this blanking plate must be connected to the enclosure's PE/earthing connection.

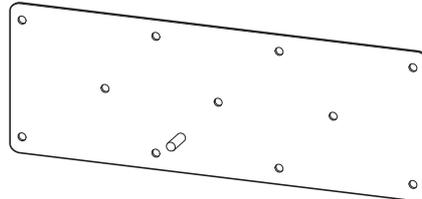


Figure 69: Blanking plate (FS6, FS7) with locating points and earthing stud



On frame sizes FS4 and FS5, the equipment supplied includes a second blanking plate with three openings in addition to the solid blanking plate that comes already installed.

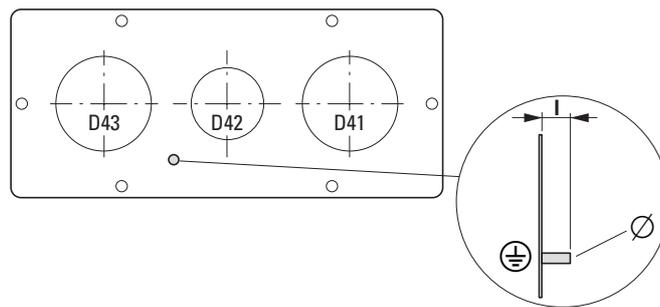


Figure 70: Blanking plate with openings and earthing stud (FS4, FS5)

**Table 15: Openings (FS4, FS5)**

| Frame size | D41<br>mm (in)     | D42<br>mm (in)  | D43<br>mm (in)     | l<br>mm (in) | Ø  |
|------------|--------------------|-----------------|--------------------|--------------|----|
| FS4        | 40.5 (1.59)<br>M40 | 25.5 (1)<br>M25 | 40.5 (1.59)<br>M40 | 10 (0.35)    | M4 |
| FS5        | 50.5 (1.99)<br>M50 | 25.5 (1)<br>M25 | 50.5 (1.99)<br>M50 | 18 (0.71)    | M6 |

### 3 Installation

#### 3.6 Electrical Installation

##### 3.6.2 Connection on control section

The connection to the control section is made using the plug-in connection terminals:

- Terminals 1, 5, 7, 9: for the internal power supply,
- Terminals 2, 3, 4, 6, 10: for digital and analog input signals,
- Terminals 8, 11: for a digital or analog output signal,
- Terminals 14, 15, 16, 17, 18: for dry relay outputs
- Terminals 12, 13: for the STO inputs

The 13-terminal and 5-terminal strips have a plug-in design.

On devices with an IP20 degree of protection (FS2, FS3, FS8), the control signal terminals are mounted on the front; on devices with an IP55 (FS4 to FS7) or IP66 degree of protection, they are mounted under the enclosure cover.

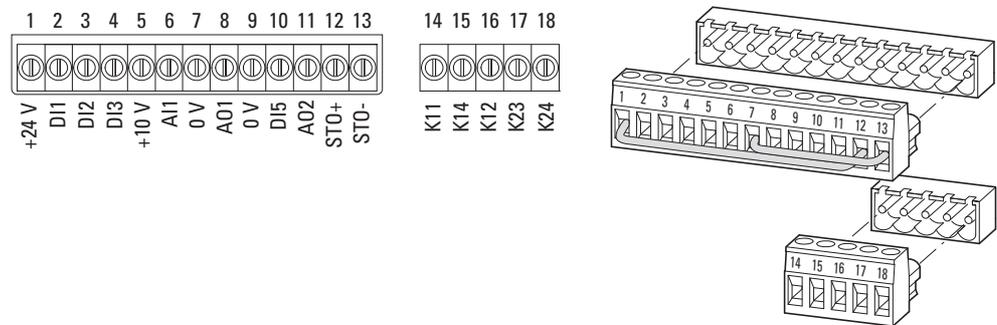


Figure 71: Plug-in control signal terminal designations



#### ESD measures

Discharge yourself on a grounded surface before touching the control signal terminals and the circuit board to prevent damage through electrostatic discharge.

##### 3.6.2.1 Terminal capacity

The connection terminals' layout depends on the size of the power section. The cross-sections to be used in the connections and the tightening torques for screws are listed in the following.

**Table 16: Control signal terminal dimensions**

| Frame size    | mm <sup>2</sup> | AWG     | mm | in   | Nm  | mm        |
|---------------|-----------------|---------|----|------|-----|-----------|
| FS2, ..., FS8 | 0.2 - 2.5       | 24 - 12 | 8  | 0.31 | 0.5 | 0.6 x 3.5 |

### 3.6.2.2 Connection data and functions

The functions that are set in the ex-factory and the electrical connection data of the control signal terminals are listed in the following table.

**Table 17: Factory-set functions of the control terminals**

| Terminal | Signal     | Description                                   | Default settings<br>(P1-12 = 0, P1-13 = 11) <sup>1)</sup>  |
|----------|------------|---|--|
| 1        | +24 V      | Control voltage for DI1 - DI5, output (+24 V) | (= Input for external control voltage, +24 VDC, reference potential at terminal 7 or 9)          |
| 2        | DI1        | Digital input 1                               | FWD (clockwise rotating field enable)  |
| 3        | DI2        | Digital Input 2                               | REV (anticlockwise rotating field enable)  |
| 4        | DI3        | Digital Input 3                               | Select AI1 REF/f-Fix (used to change the setpoint source from analog input 1 to fixed frequency) |
| 5        | +10 V      | Reference voltage, Output (+10 V)             | –  |
| 6        | AI1<br>DI4 | Analog input 1<br>Digital Input 4             | Select f-Fix Bit0 (used to select the fixed frequency setpoints for Bit0: f-Fix1 = 5 Hz (P2-01)) |
| 7        | 0 V        | Reference potential                           | –  |
| 8        | AO1<br>DO1 | Analog output 1<br>Digital output 1           | Output frequency f-Out (P2-11 = 8, AO1 function & mode)  |
| 9        | 0 V        | Reference potential                           | –  |
| 10       | DI5<br>AI2 | Digital Input 5<br>Analog input 2             | Select f-Fix Bit0  |
| 11       | AO2<br>DO2 | Analog output 2<br>Digital output 2           | Output current A-Out (P2-13 = 9, AO2 function & mode)  |
| 12       | STO+       | Safe Torque Off +                             | → Section 2.10, „STO function“, page59   |
| 13       | STO-       | Safe Torque Off -                             |  |
| 14       | K11        | Relay 1, changeover contact                   | (common connection for N/C and N/O)  |
| 15       | K14        | Relay 1, N/O (changeover contact)             | Closed = No fault message  |
| 16       | K12        | Relay 1, N/C (changeover contact)             | Closed = No 24 V control voltage or fault message (Error)  |
| 17       | K23        | Relay 2, N/O contact                          | Closed = RUN operating signal  |
| 18       | K24        | Relay 2, N/O contact                          |  |

1) Configurable function: Manual MN04020006Z-EN describes the functions and modes for the configurable control signal terminals.

3 Installation  
3.6 Electrical Installation

3.6.2.3 STO terminals

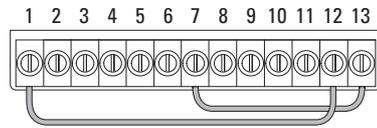


Figure 72:STO control signal terminals (direct enable)



Control signal terminal 12 (STO+) must always be connected to +24 V and control signal terminal 13 (STO-) must always be connected to 0 V (reference point for +24 V)!

If a control voltage (24 VDC) is not connected to control signal terminals 12 and 13, the control section and the inverter will remain disabled. "i nh ib t" will be displayed.

3.6.2.4 Connection example

The control cables should be screened and twisted. The screening is applied on one side in the proximity of the variable frequency drive (PES).

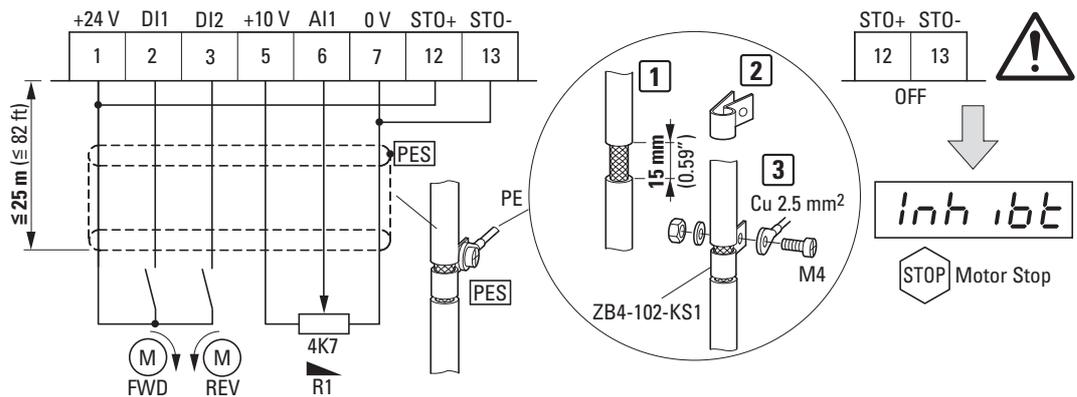


Figure 73:Simple connection example



Prevent the shielding from becoming unbraided, i.e. by pushing the separated plastic covering over the end of the shielding or with a rubber grommet on the end of the shielding.

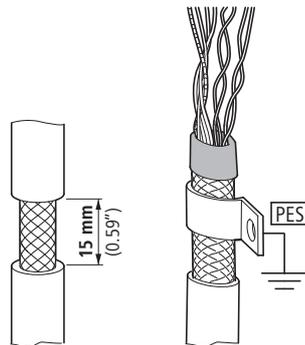


Figure 74: Preventing the screening from becoming unbraided

Alternatively, in addition to the broad area cable clip, you can also twist the shielding braid at the end and connect to the protective ground with a cable lug. To prevent EMC disturbance, this twisted shielding connection should be made as short as possible.

Prevent the screen from becoming unbraided at the other end of the control cable, e.g. by using a rubber grommet. The shield braid must not make any connection with the protective ground here because this would cause problems with an interference loop.

## 3 Installation

### 3.6 Electrical Installation

#### 3.6.2.5 Digital Input Signals

Control signal terminals 2, 3, 4, 6 and 10 all have the same function and mode of operation as digital inputs (DI1 to DI5).

A logic level of +24 V (positive logic) is used:

- 8 - +30 V = High (logic "1")
- 0 - +4 V = Low (logic "0")
- Input current: ~ 4 mA
- Signal common 0 V (control signal terminal 7 or 9)

The internal control voltage from control signal terminal 1 (+24 V) or an external voltage source (+24 V) can be used for this.

By default (with the unit as supplied), the control signal terminals for the digital input signals will be assigned as follows:

- Control signal terminal 2 as digital input 1 (DI1) = FWD (clockwise rotating field enable signal)
- Control signal terminal 3 as digital input 2 (DI2) = REV (counterclockwise rotating field enable signal)
- Control signal terminal 4 as digital input 3 (DI3) = Used to switch from f-Set to fixed frequency (f-Fix1, f-Fix2)
- Control signal terminal 6 as analog input 1 (AI1) = f-Set analog setpoint
- Control signal terminal 10 as digital input 5 (DI5), can be switched between f-Fix1 and f-Fix2.



The setting (digital/analog) for terminals 6 and 10 will be configured automatically based on the value set for P1-13.

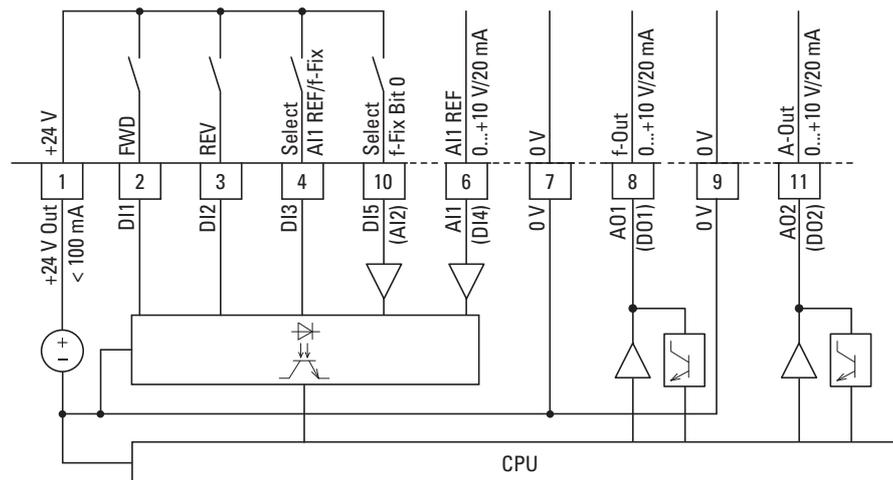


Figure 75: Control signal terminals (digital / analog)

### 3.6.2.6 Analog input signals

Depending on how parameters P1-12 and P1-13 are set, control signal terminals 6 (AI1) and 10 (AI2) can be connected to analog signals (→ Figure 78):

- 0 - +10 V
- 0 - 10 V with scaling and operating direction change
- 0 - 20 mA
- 4 - 20 mA or 20 - 4 mA with open-circuit monitoring (< 3 mA)



Control signal terminals 7 and 9 are the common 0 V reference potential for all analog and digital signals.

### 3.6.2.7 Analog output signal

Analog signals are available at control signal terminals 8 and 11 (→ Figure 78). These outputs can handle a maximum load of 20 mA. The output signals can be selected using parameters P2-11 (AO1) and P2-13 (AO2). Parameters P2-12 (AO1) and P2-14 (AO2) are used to configure the formats for the analog inputs:

| Parameter value | Output signal |
|-----------------|---------------|
| 0               | 0 - 10 V      |
| 1               | 10 - 0 V      |
| 2               | 0 - 20 mA     |
| 3               | 20 - 0 mA     |
| 4               | 4 - 20 mA     |
| 5               | 20 - 4 mA     |

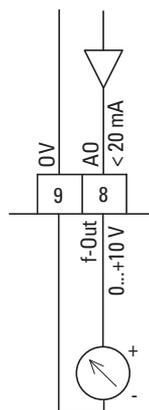


Figure 76: Analog output (AO) (connecting example)



Control signal terminals 7 and 9 are the common 0 V reference potential for all analog and digital signals.

By default, the speed/frequency (AO1) and the output current (AO2) will be displayed.

## 3 Installation

### 3.6 Electrical Installation

#### 3.6.2.8 Digital output (Transistor)

Control signal terminals 8 and 11 (→ Figure 78) are configured as analog outputs (AO) by default. Parameters P2-11 and P2-13 can be used to configure them as digital outputs (DO) instead.

Transistor outputs DO1 (terminal 8) and DO2 (terminal 11) switch the internal device control voltage (+24 V) as a digital signal. The maximum permissible load current is 20 mA.

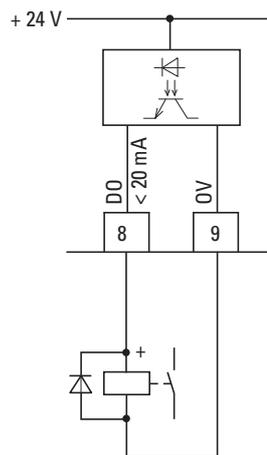


Figure 77: Connection example (interposing relay with free-wheeling diode: ETS4-VS3; article no. 083094)



Control signal terminals 7 and 9 are the common 0 V reference potential for all analog and digital output signals.

#### 3.6.2.9 Relay output

VSA variable frequency drives feature two relays with dry contacts.

Relay K1:

Control terminals 14 (changeover contact), 15 (N/O), and 16 (N/C)

Default setting: 1 = Ready for operation/fault (Error)

Relay K2:

Control signal terminals 17 and 18 (N/O)

Default setting: 0 = Drive running (RUN)

The relay function can be configured using parameters P2-15 and P2-18.

The electrical connection specifications for control signal terminals or relay contacts are:

- 250 V AC, max. 6 A
- 30 V DC, max. 5 A

We recommend connecting any connected loads as follows:

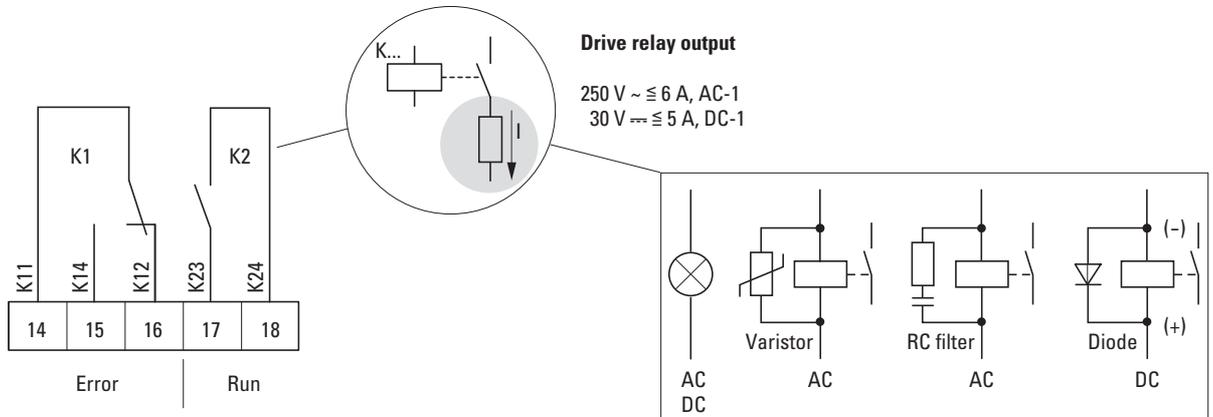


Figure 78: Connection examples with suppressor circuit

### 3.6.2.10 External control voltage

An external power supply unit can be used to supply the VSA variable frequency drive's control section with 24 V DC.

| VSA           | External control voltage |
|---------------|--------------------------|
| Terminal 1    | +24 V                    |
| Terminal 7, 9 | 0 V                      |



The external control voltage (+24 V) should be able to handle a load of at least 100 mA. This external control voltage's residual ripple must be smaller than  $\pm 5\%$  of  $\Delta U_a/U_a$ .

If the control section is powered with an external power supply unit, the control section, the control signal terminals, and the RJ45 interface will be active.

You will be able to do the following:

- Change parameters (but not save them)
- Read readings and error registers
- Address and read parameters via the RJ45 interface, the drivesConnect parameter configuration program, field buses, and SmartWire-DT.
- Control control level functions without the power section being powered.

### 3 Installation

#### 3.6 Electrical Installation

##### 3.6.2.11 RJ 45 interface

The RJ45 interface on the VSA variable frequency drive makes it possible to connect directly to communication modules and fieldbus connections.

The internal RS485 connection handles transmissions for the OP bus, Modbus RTU, and CANopen field bus systems.

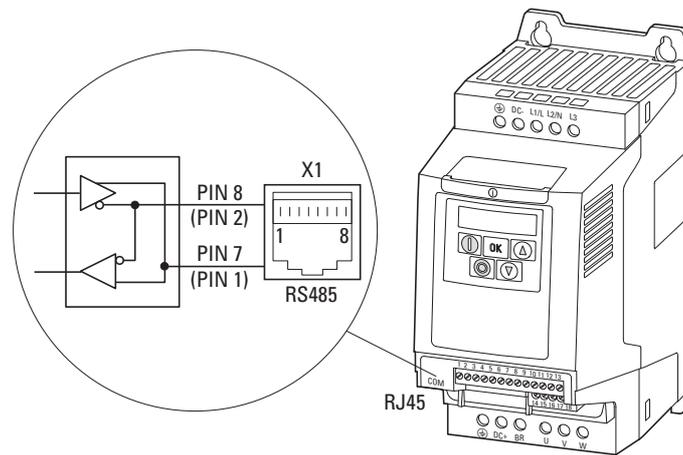


Figure 79:RJ45 interface (example: location on FS2 frame size)



VSA variable frequency drives do not have an internal bus termination resistor – use EASY-NT-R if necessary.

### 3.6.2.12 IP66, control signal terminals (VSA...A6SC)

On VSA variable frequency drives with an IP66 degree of protection and local controls (VSA...A6SC), the control signal terminals will be partially wired.

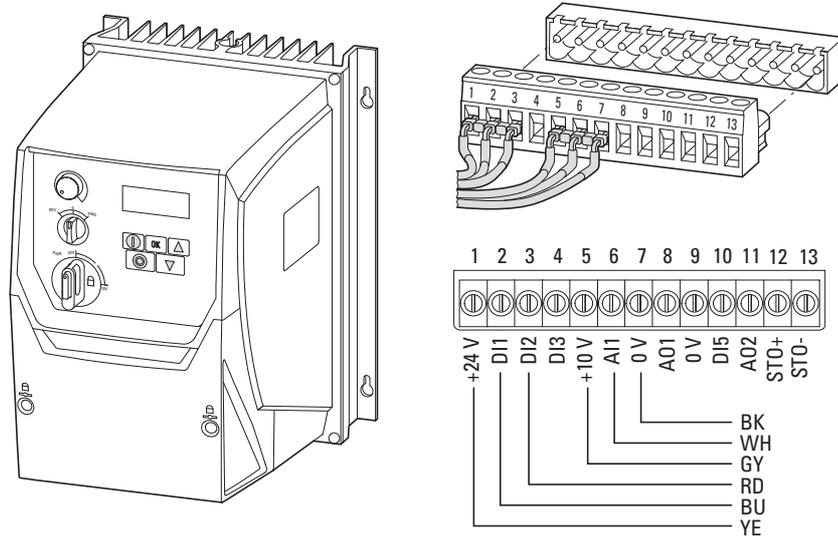


Figure 80:VSA ...A6SC (factory connection)

When supplied, the control signal terminals will be connected as follows:

**Table 18: Configuration of the control signal terminals**

| Terminal | Color       | Function                         |
|----------|-------------|----------------------------------|
| 1        | YE (yellow) | +24 V to FWD/REV selector switch |
| 2        | BU (blue)   | From selector switch = FWD       |
| 3        | RD (red)    | From selector switch = REV       |
| 5        | GY (gray)   | +10 V to potentiometer           |
| 6        | WH (white)  | From potentiometer = f-Set       |
| 7        | BK (black)  | From potentiometer = 0 V         |



For the enable signal for operation, you will also need to install an insulated wire jumper from terminal 1 to terminal 12 (STO+) and a link from terminal 13 (STO-) to terminal 9 or 7 (→ Figure 71, page 104).

## 3 Installation

### 3.7 Block diagrams

#### 3.7 Block diagrams

The following block diagrams show all the connection terminals on a VSA variable frequency drive and their functions when in their default settings.



An external 24 V power supply can be connected to control signal terminals 1 (+24 V) and 7 or 9 (0 V).

3.7.1 VSA 12...

Mains voltage  $U_{LN}$ : single-phase, 200 (-10 %) - 240 (+10 %) V, 50/60 Hz

Motor voltage  $U_2$ : 3-phase,  $U_2 = U_{LN}$ , 0 - 50/60 Hz (max. 500 Hz)

Frame size: FS2 with IP20 degree of protection

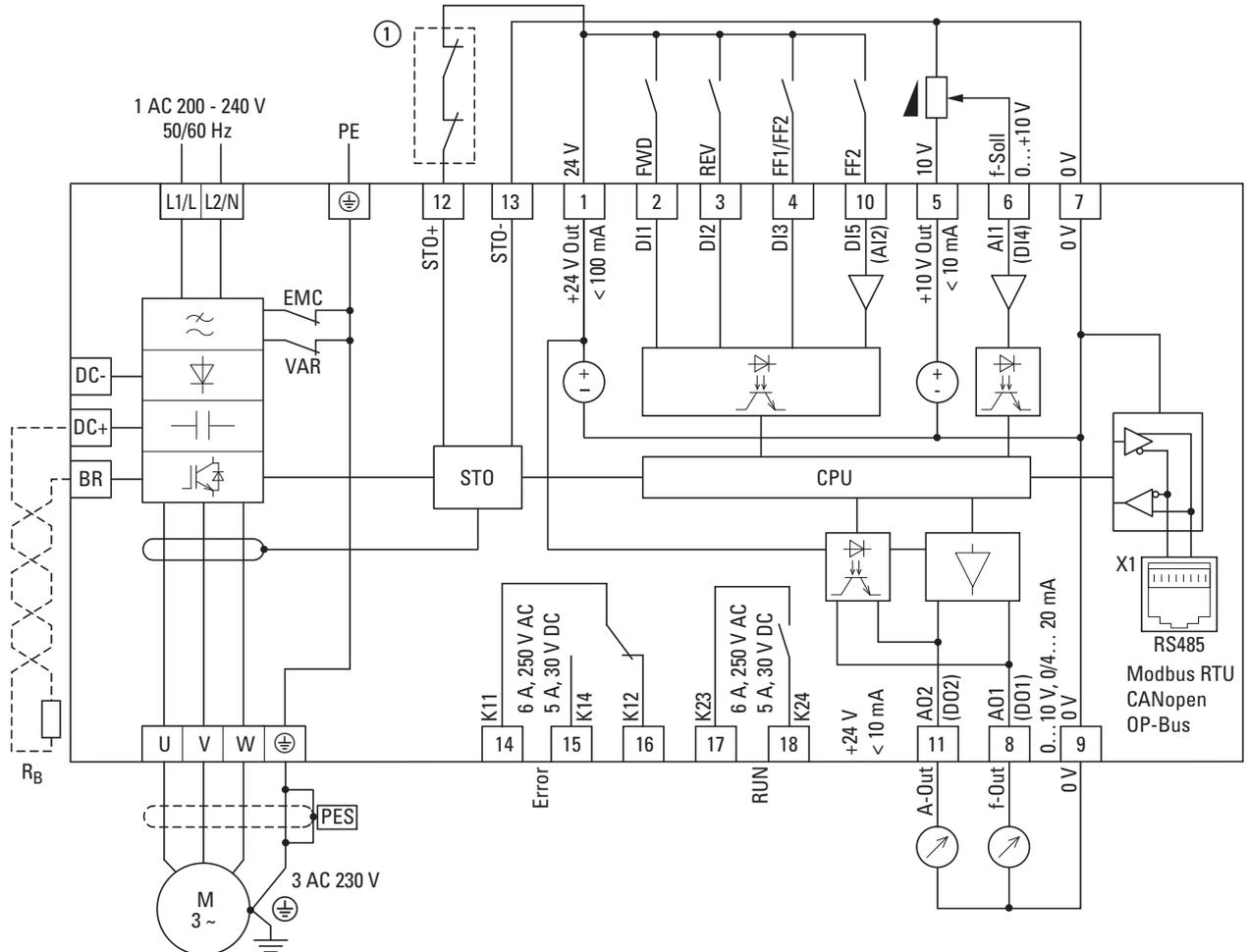


Figure 81:Block diagram VSA 12...

① Relay: Safe Torque Off (STO), SIL 2 (EN 61800-5-2)

### 3 Installation

#### 3.7 Block diagrams

##### 3.7.2 VSA 32...-A20C, VSA 34...-A20C

Mains voltage  $U_{LN}$ :

**VSA 32...**: 3-phase, 200 (-10 %) - 240 (+10 %) V, 50/60 Hz

**VSA 34...**: 3-phase, 380 (-10 %) - 480 (+10 %) V, 50/60 Hz

Motor voltage  $U_2$ : 3-phase,  $U_2 = U_{LN}$ , 0 - 50/60 Hz (max. 500 Hz)

Frame size: FS2 and FS3 with IP20 degree of protection

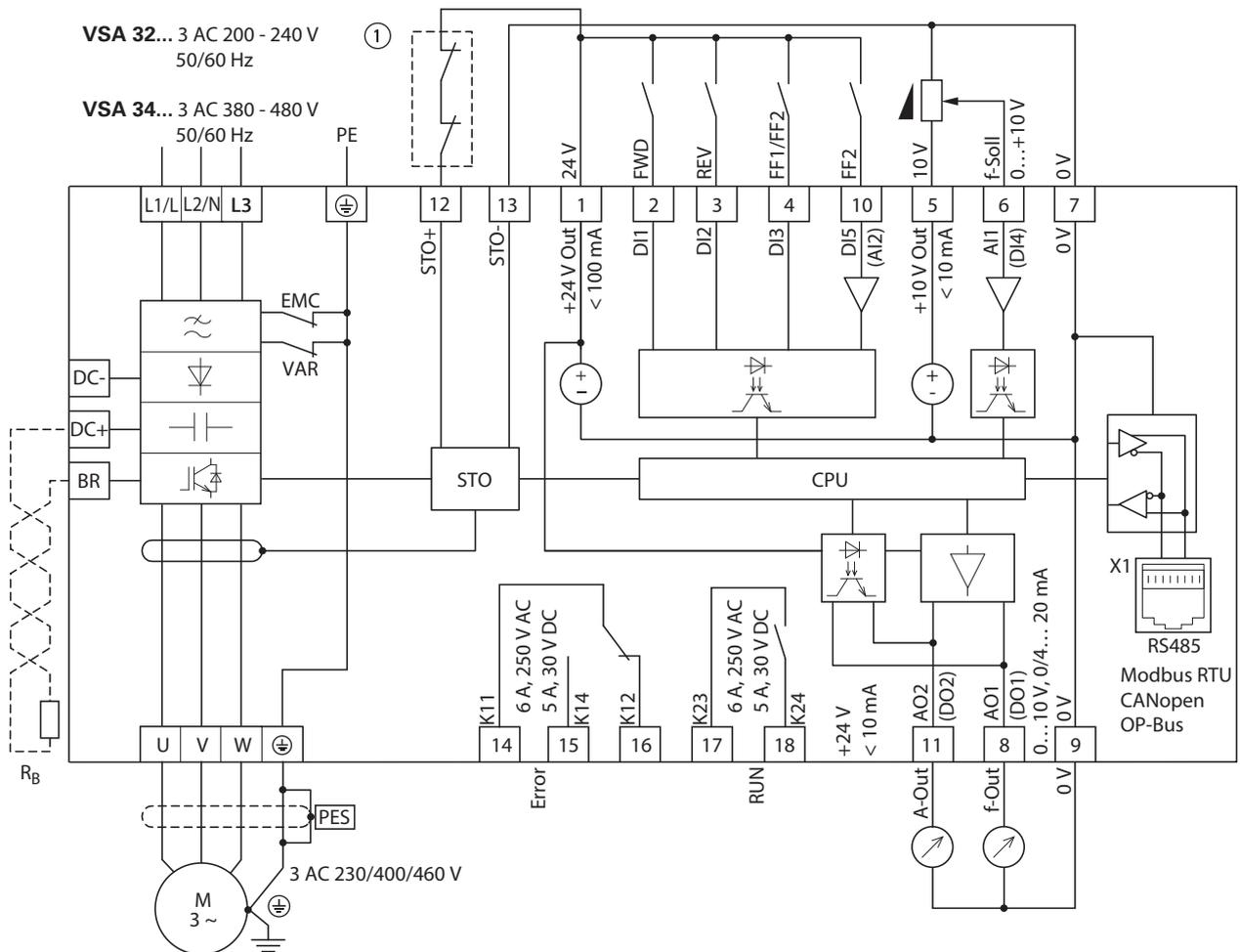


Figure 82: Block diagram for VSA 32..., VSA 34..., FS2 and FS3 frame sizes

① Relay: Safe Torque Off (STO), SIL 2 (EN 61800-5-2)

### 3.7.3 VSA 32...-B55C, VSA 34...-B55C, FS4 frame size

Mains voltage  $U_{LN}$ :

**VSA 32...**: 3-phase, 200 (-10 %) - 240 (+10 %) V, 50/60 Hz

**VSA 34...**: 3-phase, 380 (-10 %) - 480 (+10 %) V, 50/60 Hz

Motor voltage  $U_2$ : 3-phase,  $U_2 = U_{LN}$ , 0 - 50/60 Hz (max. 500 Hz)

Frame size: FS4 with IP55 degree of protection

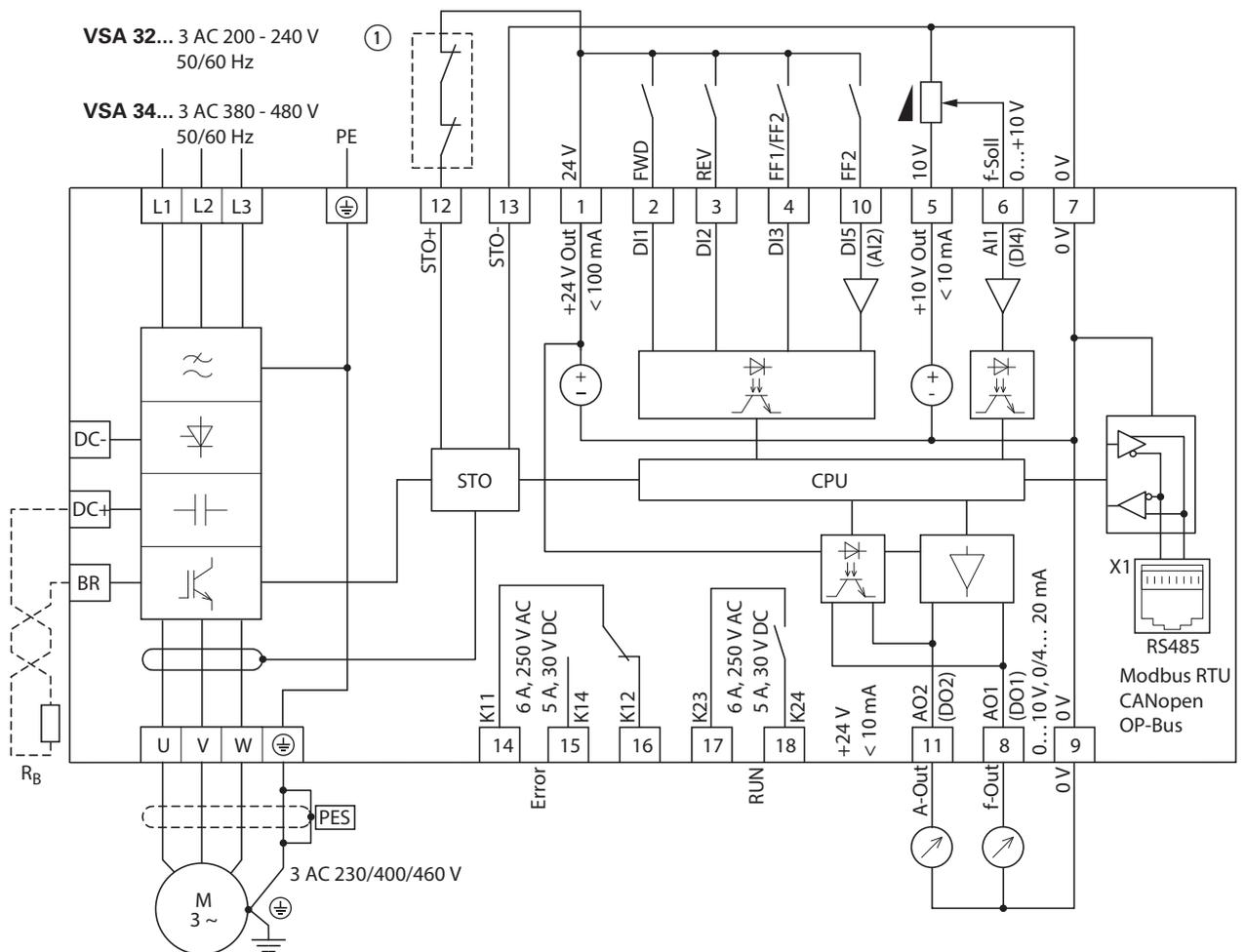


Figure 83:Block diagram for VSA 32..., VSA 34..., FS4 frame size

① Relay: Safe Torque Off (STO), SIL 2 (EN 61800-5-2)

### 3 Installation

#### 3.7 Block diagrams

##### 3.7.4 VSA 32...-B55C, VSA 34...-B55C, FS5, FS6, FS7 frame sizes

Mains voltage  $U_{LN}$ :

**VSA 32...**: 3-phase, 200 (-10 %) - 240 (+10 %) V, 50/60 Hz

**VSA 34...**: 3-phase, 380 (-10 %) - 480 (+10 %) V, 50/60 Hz

Motor voltage  $U_2$ : 3-phase,  $U_2 = U_{LN}$ , 0 - 50/60 Hz (max. 500 Hz)

Frame size: FS5, FS6 and FS7 with IP55 degree of protection

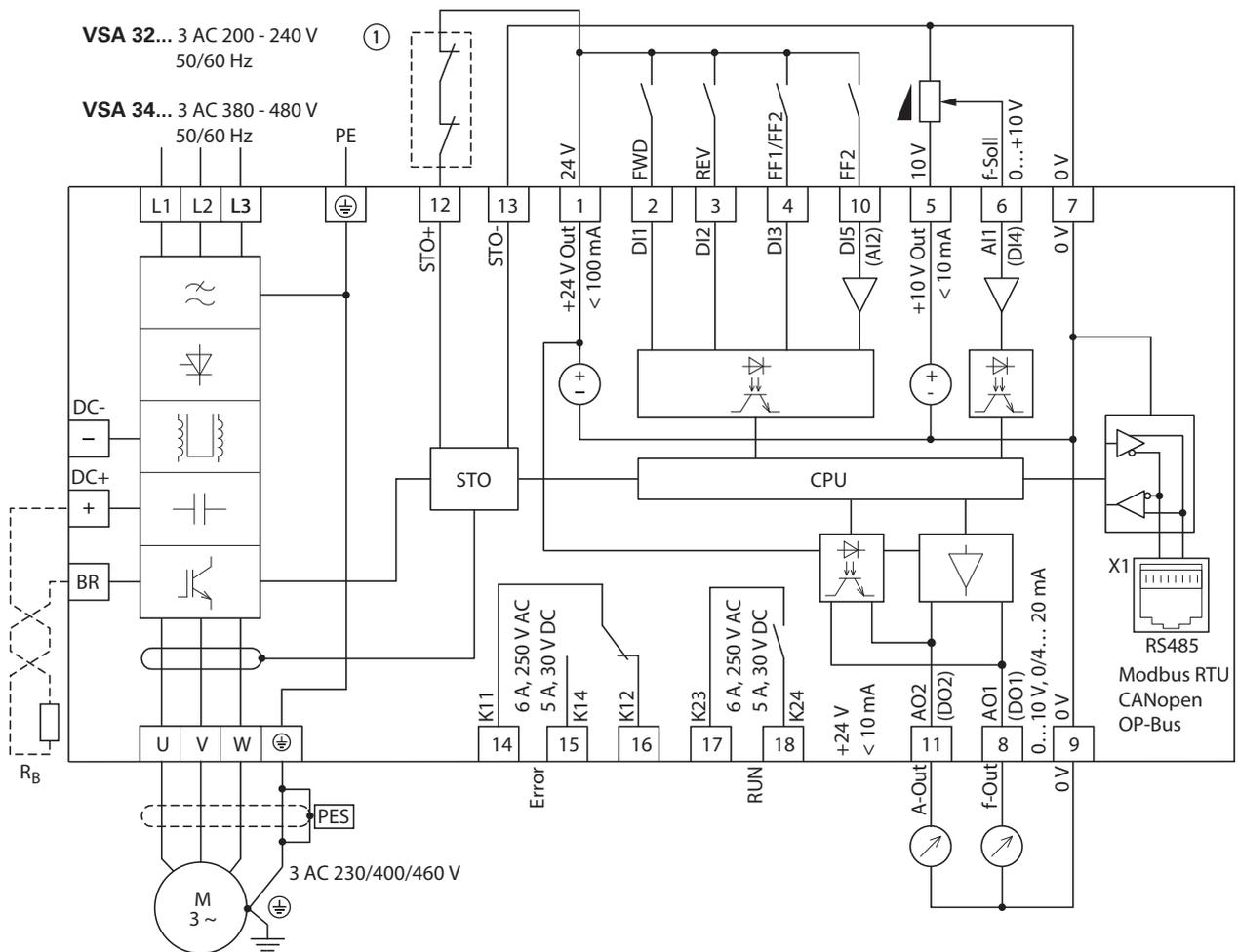


Figure 84:Block diagram VSA 32..., VSA 34...

① Relay: Safe Torque Off (STO), SIL 2 (EN 61800-5-2)

### 3.7.5 VSA 34370..., VSA 34450...

Mains voltage  $U_{LN}$ : 3-phase, 380 (-10 %) - 480 (+10 %) V, 50/60 Hz

Motor voltage  $U_2$ : 3-phase,  $U_2 = U_{LN}$ , 0 - 50/60 Hz (max. 500 Hz)

Frame size: FS8 with IP20 degree of protection

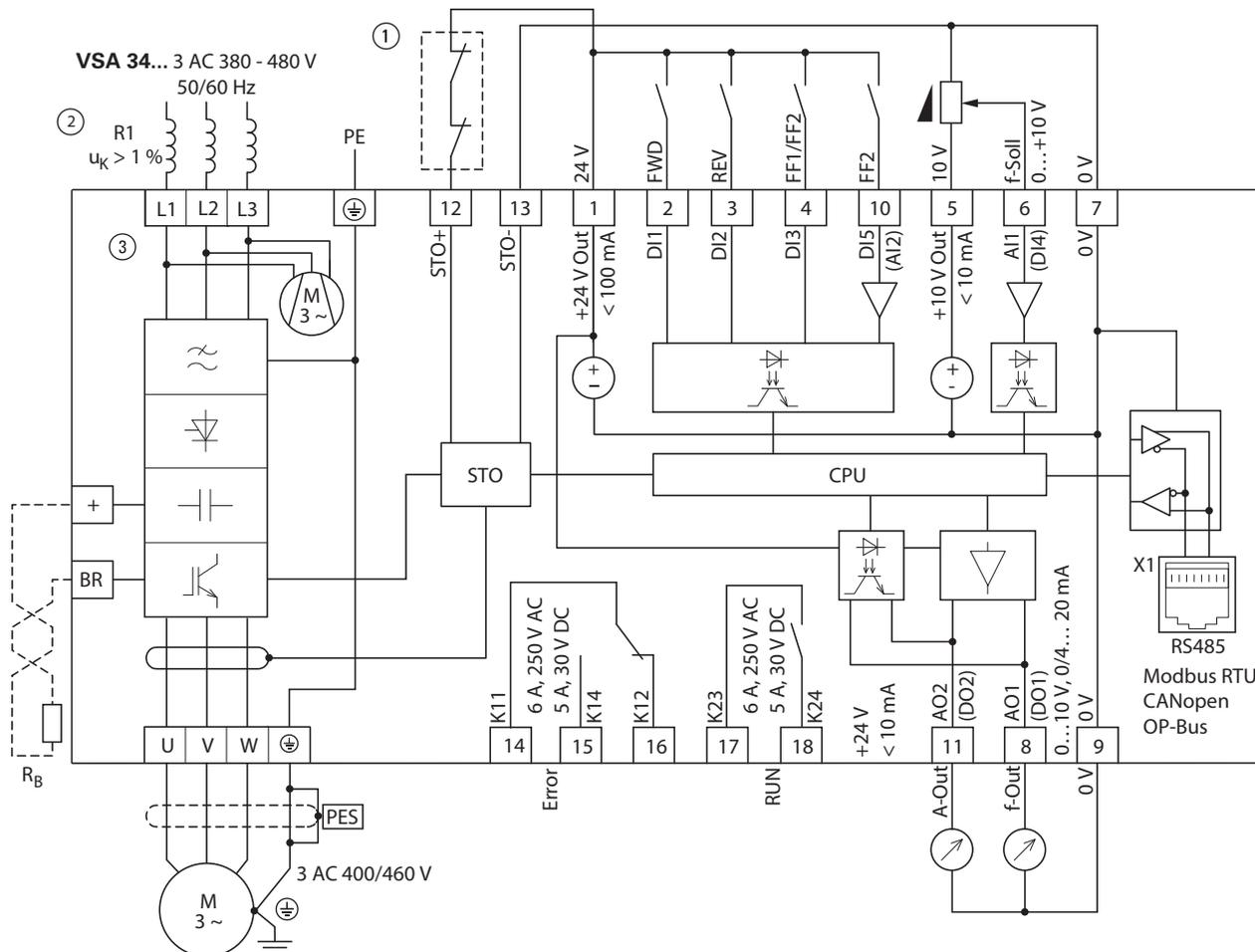


Figure 85:VSA 34... block diagram in frame size FS8

- ① Relay: Safe Torque Off (STO), SIL 2 (EN 61800-5-2)
- ② If it is not guaranteed that the system percentage impedance is greater than or equal to 1%, a mains choke must be connected. Your  $u_K$  value should fall between 1 and 4%.
- ③ Check the L1–L2–L3 phase sequence (rotating field direction). If the phase sequence is wrong, the *FA<sub>n</sub>-F* fault message will be displayed.

### 3 Installation

#### 3.7 Block diagrams

##### 3.7.6 VSA 35...-A20C

Mains voltage  $U_{LN}$ : 3-phase, 500 (-10 %) - 600 (+10 %) V, 50/60 Hz

Motor voltage  $U_2$ : 3-phase,  $U_2 = U_{LN}$ , 0 - 50/60 Hz (max. 500 Hz)

Frame size: FS2 and FS3 with IP20 degree of protection

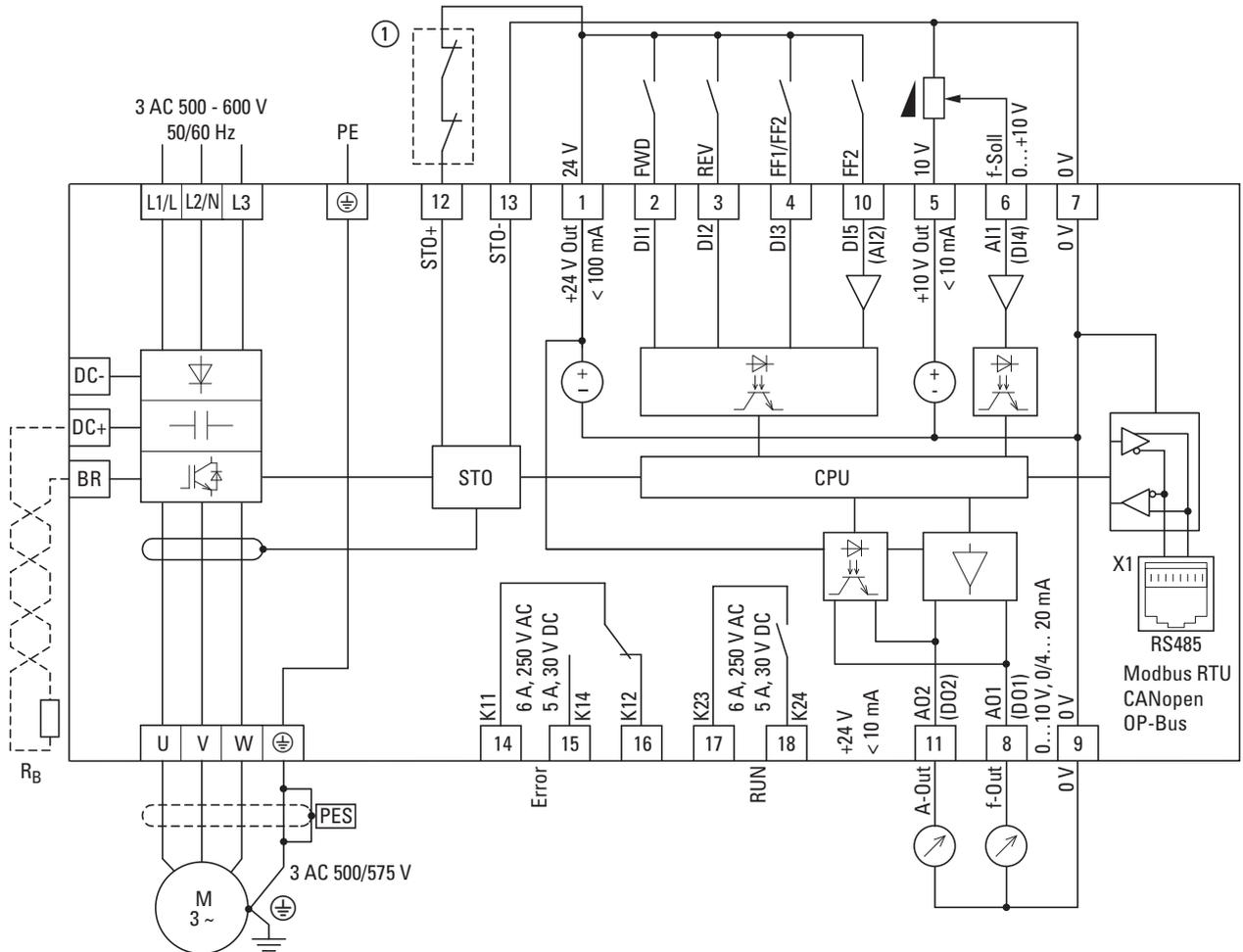


Figure 86:Block diagram VSA 35...

① Relay: Safe Torque Off (STO), SIL 2 (EN 61800-5-2)



VSA 35... devices do not feature an internal radio interference suppression filter.

### 3.7.7 VSA 35...-B55C in FS4

Mains voltage  $U_{LN}$ : 3-phase, 500 (-10 %) - 600 (+10 %) V, 50/60 Hz

Motor voltage  $U_2$ : 3-phase,  $U_2 = U_{LN}$ , 0 - 50/60 Hz (max. 500 Hz)

Frame size: FS4 with IP55 degree of protection

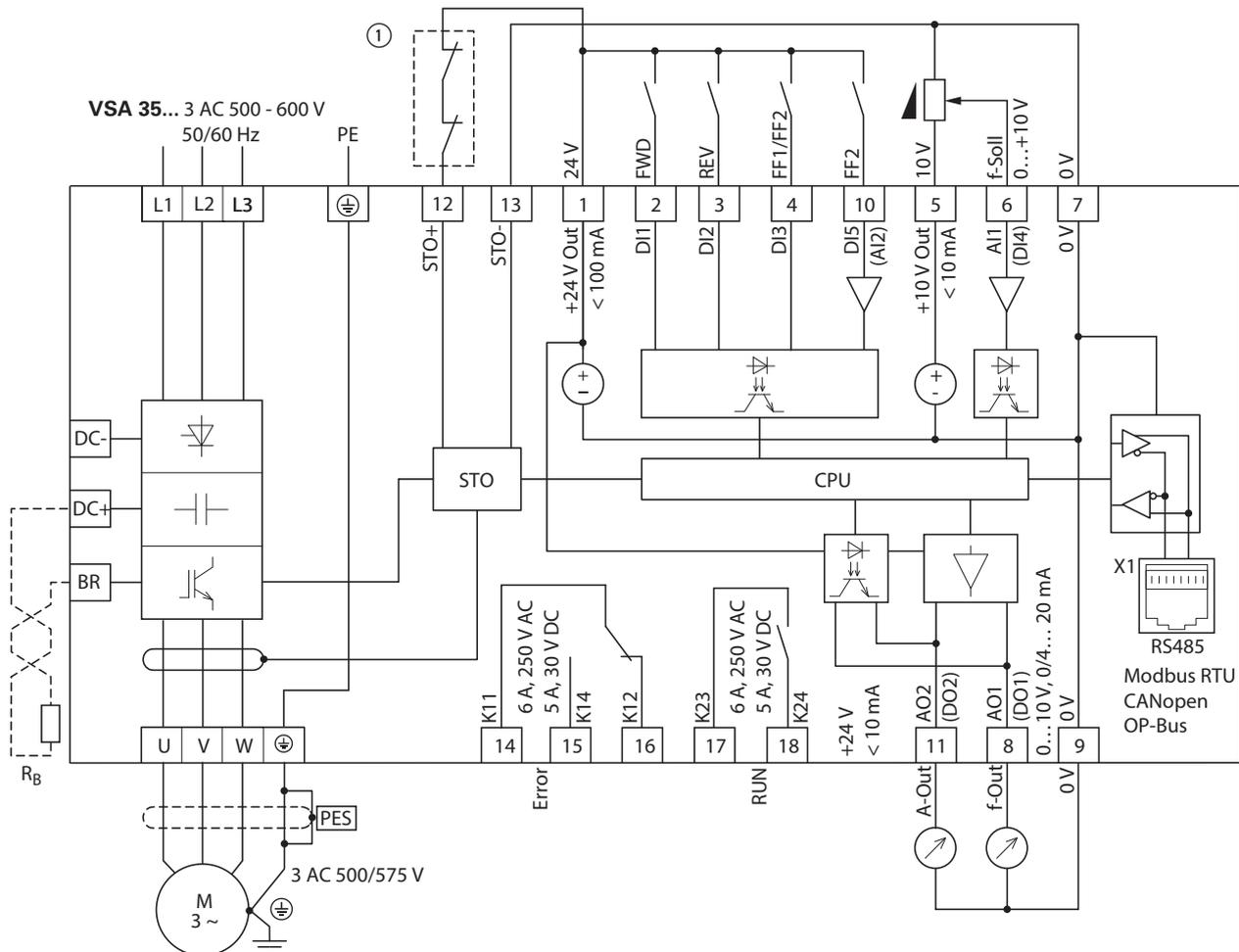


Figure 87: VSA 35... block diagram in frame size FS4

① Relay: Safe Torque Off (STO), SIL 2 (EN 61800-5-2)

### 3 Installation

#### 3.7 Block diagrams

##### 3.7.8 VSA 35...-B55C in FS5, FS6

Mains voltage  $U_{LN}$ : 3-phase, 500 (-10 %) - 600 (+10 %) V, 50/60 Hz

Motor voltage  $U_2$ : 3-phase,  $U_2 = U_{LN}$ , 0 - 50/60 Hz (max. 500 Hz)

Frame size: FS5 and FS6 with IP55 degree of protection

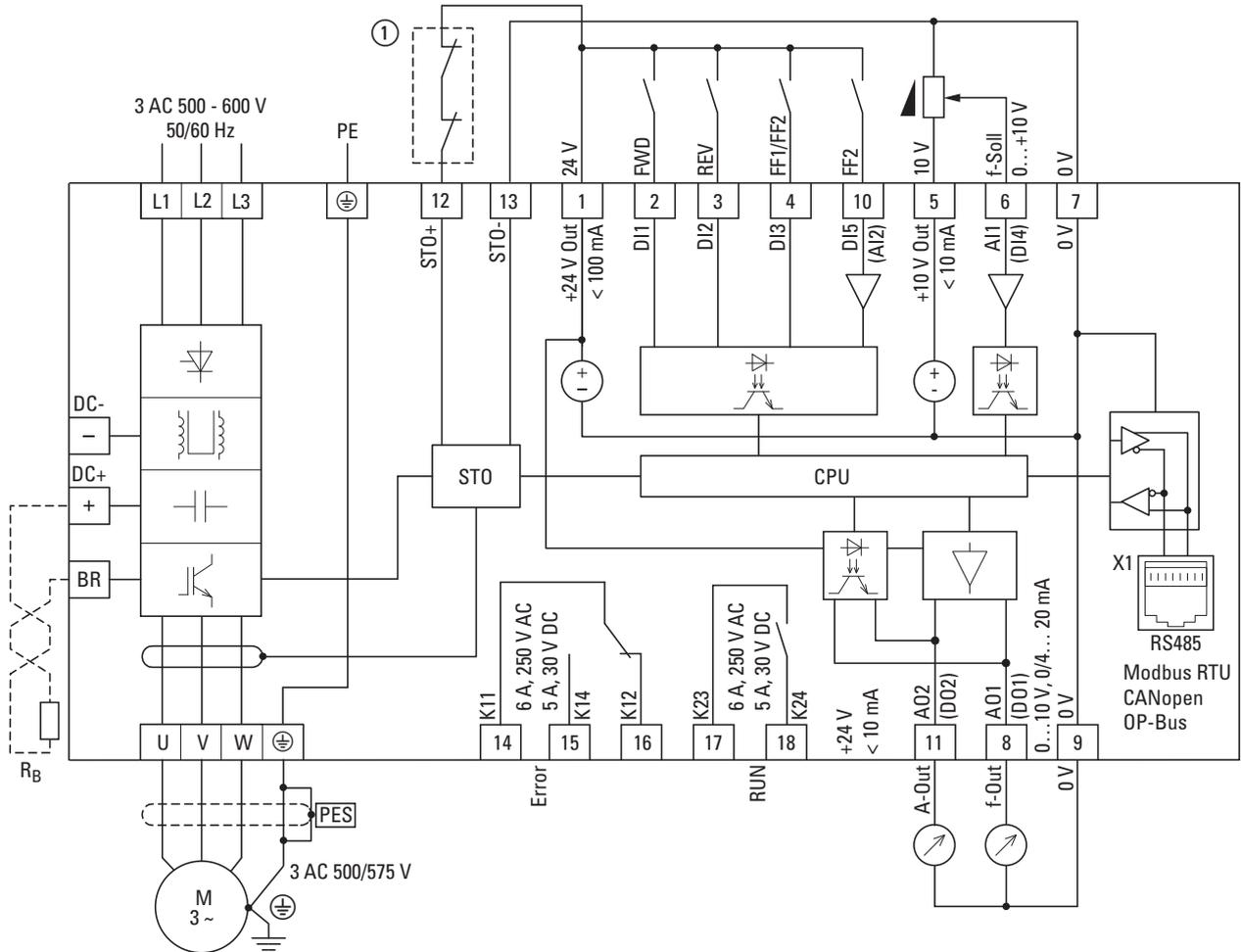


Figure 88: VSA 35... block diagram in frame size FS5 and FS6

① Relay: Safe Torque Off (STO), SIL 2 (EN 61800-5-2)



### 3 Installation

#### 3.7 Block diagrams

##### 3.7.10 VSA 32...-B6SC, VSA 34...-B6SC

Mains voltage  $U_{LN}$ :

**VSA 32...**: 3-phase, 200 (-10 %) - 240 (+10 %) V, 50/60 Hz

**VSA 34...**: 3-phase, 380 (-10 %) - 480 (+10 %) V, 50/60 Hz

Motor voltage  $U_2$ : 3-phase,  $U_2 = U_{LN}$ , 0 - 50/60 Hz (max. 500 Hz)

Frame size: FS2 and FS3 with IP66 degree of protection

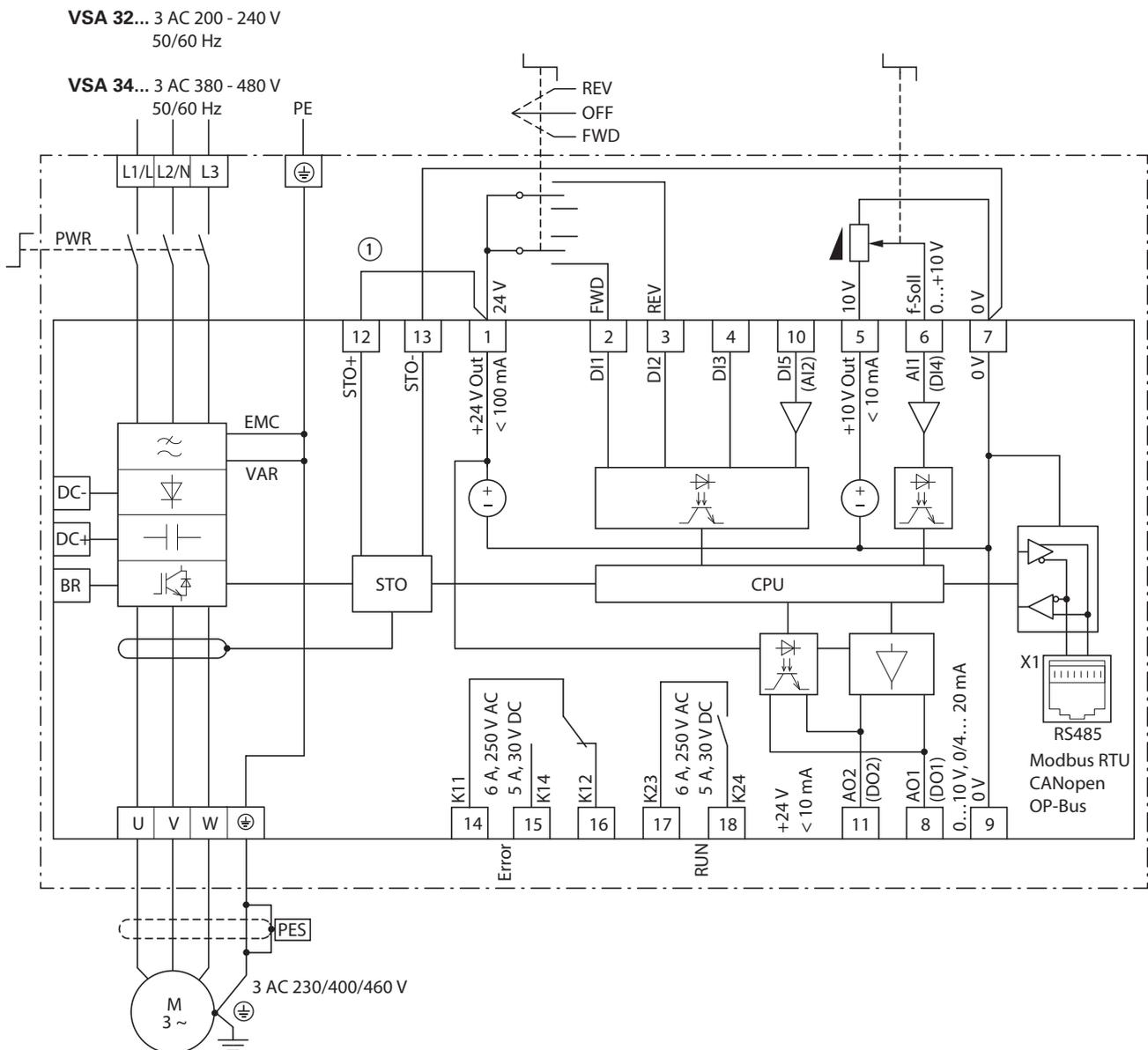


Figure 90: VSA 32...-B6SC, VSA 34...-B6SC block diagram

① Direct enable signal for STO function or relay: Safe Torque Off (STO), SIL 2 (EN 61800-5-2) as in → Figure 82, page 116.



The STO connection must be made by the user.

### 3.7.11 VSA 35...-B6SC

Mains voltage  $U_{LN}$ : 3-phase, 500 (-10 %) - 600 (+10 %) V, 50/60 Hz

Motor voltage  $U_2$ : 3-phase,  $U_2 = U_{LN}$ , 0 - 50/60 Hz (max. 500 Hz)

Frame size: FS2 and FS3 with IP66 degree of protection

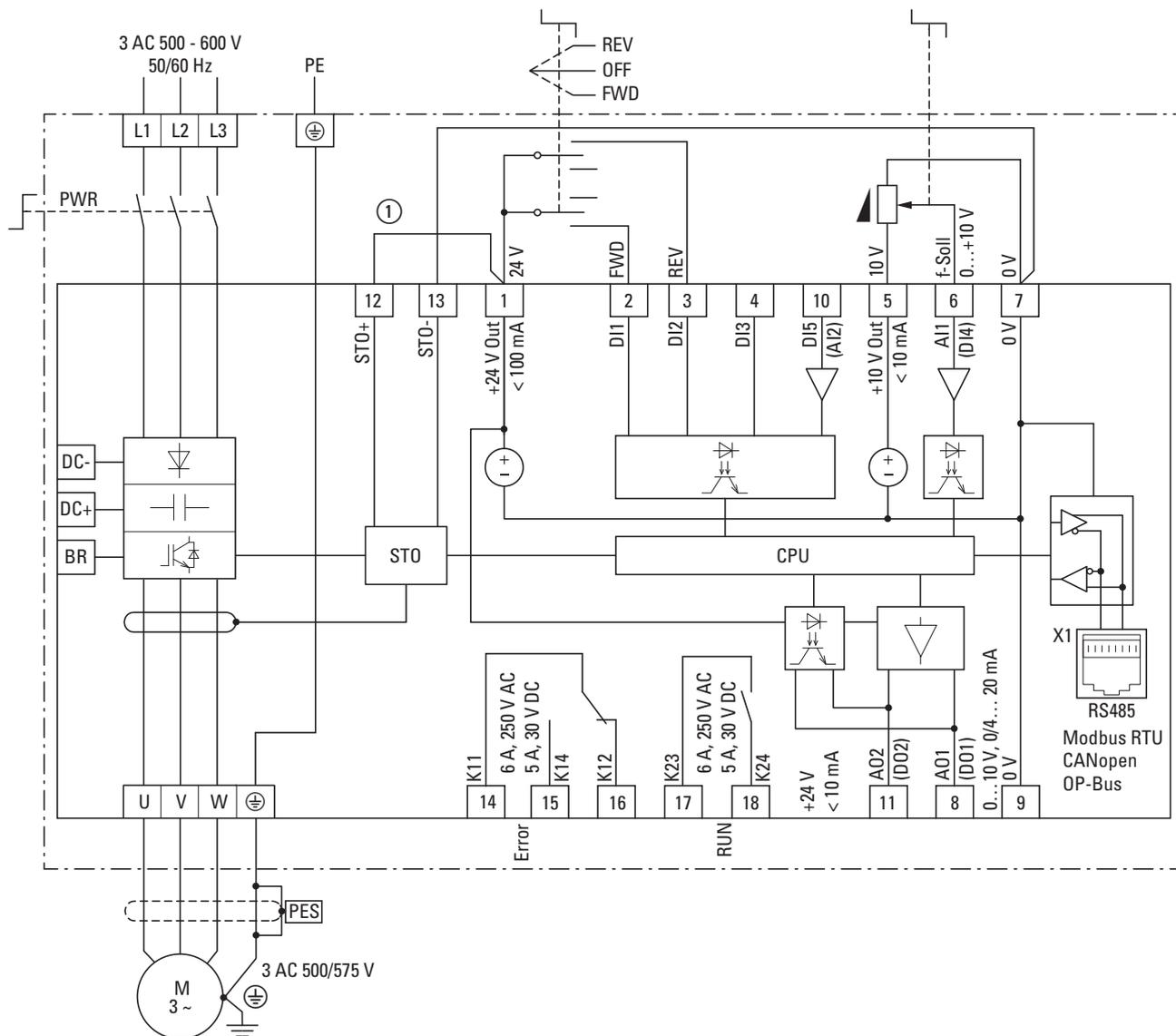


Figure 91: VSA 35...-B6SC block diagram

① Direct enable signal for STO function or relay: Safe Torque Off (STO), SIL 2 (EN 61800-5-2) as in → Figure 87, page 121.



The STO connection must be made by the user.

#### 3.8 Insulation testing

The variable frequency drive of the VSA series are tested, delivered and require no additional testing.



#### CAUTION

On the control signal and the connection terminals of the variable frequency drive, no leakage resistance tests are to be performed with an insulation tester.



#### CAUTION

Wait at least 5 minutes after switching the supply voltage off before you disconnect one of the connection terminals (L1/L, L2/N, L3, DC-, DC+, BR) of the variable frequency drive.

If insulation testing is required in the power circuit of the PDS, you must consider the following measures.

#### Testing the motor cable insulation

- ▶ Disconnect the motor cable from the connection terminals U, V and W of the variable frequency drive and from the motor (U, V, W). Measure the insulation resistance of the motor cable between the individual phase conductors and between the phase conductor and the protective conductor.

The insulation resistance must be greater than 1 M $\Omega$ .

#### Testing the mains cable insulation

- ▶ Disconnect the power cable from the mains supply network and from the connection terminals 1/L, L2/N and L3 of the variable frequency drive. Measure the insulation resistance of the mains cable between the individual phase conductors and between each phase conductor and the protective conductor.

The insulation resistance must be greater than 1 M $\Omega$ .

#### Testing the motor insulation

- ▶ Disconnect the motor cable from the motor (U, V, W) and open the bridge circuits (star or delta) in the motor terminal box. Measure the individual motor windings' insulation resistance. The measurement voltage must at least match the rated operating voltage of the motor but is not to exceed 1000 V.

The insulation resistance must be greater than 1 M $\Omega$ .



Consider the notes from the motor manufacturer in testing the insulation resistance.

### 3.9 Protection against electric shock

#### **Ensuring protection against electric shock when using VSA variable frequency drives, as per IEC/EN 61800-5-1**

#### **Manufacturer's declaration for the initial verification as per IEC/HD 60364-6 (DIN VDE 0100-600 (VDE 0100-600)) and for periodic testing as per EN 50110-1 (DIN VDE 0105-100 (VDE 0105-100))**

Fault protection in accordance with IEC/HD 60364-4-41 (DIN VDE 0100-410 (VDE 0100-410)) for the output-side circuits of the aforementioned apparatus is guaranteed provided that the following requirements are met:

- The installation instructions in this documentation have been observed.
- The applicable standards in the IEC/HD 60364 (DIN VDE 0100 (VDE 0100)) series have been observed.
- The continuity of all associated protective conductors and equipotential bonding conductors, including the corresponding connection points, has been ensured.

Provided that the above requirements are met, the aforementioned apparatus meets the requirements in IEC/HD 60364-4-41 (DIN VDE 0100-410 (VDE 0100-410):2007-06, section 411.3.2.5) when using the "automatic power supply shutdown" protective measure.

The note is based on the following information:

In the event of a short-circuit with negligible impedance to a protective conductor or to earth, the aforementioned apparatus will reduce the output voltage within a time as required in table 41.1 or within 5 seconds – depending on the applicable scenario – as per IEC/HD 60364-41 (DIN VDE 0100-410; VDE 0100-410):2007-06).

## 3 Installation

### 3.9 Protection against electric shock

## 4 Operation

### 4.1 Checklist for commissioning

Before placing the frequency converter into operation, use the checklist below to make sure that all the following requirements are met:

| No. | Activity  | Notes |
|-----|---|-------|
| 1   | Mounting and wiring have been carried out in accordance with the corresponding instructional leaflet (→ IL04020015Z, IL04020011Z, IL04020012Z, IL04020010Z).  |       |
| 2   | All wiring and line section leftovers, as well as all the tools used, have been removed from the variable frequency drive's proximity.  |       |
| 3   | All connection terminals in the power section and in the control section were tightened with the specified torque.  |       |
| 4   | The lines connected to the output terminals (U, V, W, DC+, DC-, BR) of the variable frequency drive are <b>not</b> short-circuited and are <b>not</b> connected to ground (PE).   |       |
| 5   | The variable frequency drive has been earthed properly (PE).  |       |
| 6   | All electrical connections in the power section (L1/L, L2/N, L3, U, V, W, DC+, DC-, BR, PE) have been connected properly while taking into account the degree of protection and have been dimensioned in line with the corresponding requirements.<br><br>The device fan in frame size FS8 requires a connection with the correct phase sequence (L1–L2–L3). – check the airflow's direction. |       |
| 7   | Each single phase of the supply voltage (L or L1, L2, L3) is protected with a fuse.   |       |
| 8   | The variable frequency drive and the motor are adapted to the mains voltage. (→ Section 1.4.1, „Rating data on the nameplate“, page14, connection type (star, delta) of the motor tested).  |       |
| 9   | The quality and volume of cooling air are in line with the environmental conditions required for the variable frequency drive and the motor.  |       |
| 10  | All connected control cables comply with the corresponding stop conditions (e.g., switch in OFF position and setpoint value= zero).   |       |
| 11  | The parameters that were preset at the factory have been checked with the list of parameters.   |       |
| 12  | The effective direction of a coupled machine will allow the motor to start.   |       |
| 13  | All emergency switching off functions and safety functions (→ Section 2.10, „STO function“, page59) are in an appropriate condition.  |       |

## 4 Operation

### 4.2 Hazard warnings for operation

#### 4.2 Hazard warnings for operation

Please observe the following notes.



#### **DANGER**

Commissioning is only to be completed by qualified technicians.



#### **DANGER**

Hazardous voltage!

The safety instructions on pages I and II must be followed.



#### **DANGER**

The components in the variable frequency drive's power section are energized if the supply voltage (mains voltage) is connected. For instance: L1/L, L2/N, L3, DC+, DC-, BR, U/T1, V/T2, W/T3 power terminals.

The control signal terminals are isolated from the line power potential.

There can be a dangerous voltage on the relay terminals (10, 11) even if the variable frequency drive is not being supplied with line voltage (e.g., integration of relay contacts in control systems with voltage > 48 V AC/60 V DC).



#### **DANGER**

The components in the variable frequency drive's power section remain energized up to five (5) minutes after the supply voltage has been switched off (internal DC link capacitor discharging time).

Pay attention to hazard warnings!



#### **DANGER**

Following a shutdown (fault, mains voltage off), the motor can start automatically (when the supply voltage is switched back on) if the automatic restart function has been enabled (→ parameters P2-36).

## 4.3 Commissioning with control signal terminals (default settings)

**NOTICE**

Any contactors and switchgear on the power side are not to be opened during motor operation. Inching operation using the power switch is not permitted.

Contactors and switchgear (repair and maintenance switches) on the motor side must not be opened while the motor is in operation.

Inching operation of the motor with contactors and switching devices in the output of the variable frequency drive is not permissible.

**NOTICE**

Make sure that there is no danger in starting the motor. Disconnect the driven machine if there is a danger in an incorrect operating state.



If motors are to be operated with frequencies higher than the standard 50 or 60 Hz, then these operating ranges must be approved by the motor manufacturer. The motors could be damaged otherwise.

**4.3 Commissioning with control signal terminals (default settings)**

The controls on VSA variable frequency drives are pre-wired at the factory; however, you will need to wire the STO inputs yourself. After the mains voltage and the rated motor are connected, the VSA variable frequency drive can be started with the local controls (see following connecting example).



You can skip this section if you want to set up the parameters directly for optimal operation of the variable frequency drive based on the motor data (rating plate) and the application.

The following shows a simplified connecting example of a connection with default settings.

## 4 Operation

### 4.3 Commissioning with control signal terminals (default settings)

#### Connecting example for three-phase motor

| Connecting example for three-phase motor |                           | Terminal  | Designation                             |
|--|---------------------------|---|---|
|  | L1/L                      | Single-phase main terminal (VSA 12...)                  | Three-phase mains connection (VSA 3...) |
|  | L2/N                      |   |   |
|  | L3                        | –   |   |
|  | ⊕                         | Ground connection                                       |   |
|  | 1                         | Control voltage +24 V (output, maximum 100 mA)          |   |
|  | 2                         | FWD, Start release clockwise rotating field             |   |
|  | 3                         | REV, Start release left rotating field                  |   |
|  | U                         | Connection for three-phase ac motor (three-phase motor) |   |
|  | V                         |   |   |
|  | W                         |   |   |
|  | ⊕                         |   |   |
|  | 5                         | Reference voltage +10 V (Output, maximum 10 mA)         |   |
|  | 6                         | Frequency reference value f-Set (Input 0 – +10 V)       |   |
| 7  | Reference potential (0 V) |   |   |
| 12                                       | Safe Torque Off +         |   |   |
| 13                                       | Safe Torque Off -         |   |   |

- ▶ For simple commissioning with the preset default settings, connect the variable frequency drive as shown in the connecting example above.

The potentiometer should have a fixed resistance (connection to control signal terminals 5 and 7) of at least 1 kΩ, up to a maximum of 10 kΩ. A standard fixed resistance of 4.7 kΩ is recommended.

Make sure that the enable contacts (FWD/REV) are open and the STO is connected correctly before switching on the mains voltage.



If the connections for the setpoint value potentiometer cannot be clearly allocated with terminals 5, 6 and 7, you should set the potentiometer to about 50 % before giving the start release (FWD/REV) for the first time.

When the specified supply voltage is applied at the mains connection terminals (L1/L, L2/N, L3), the switched-mode power supply unit (SMPS) in the internal DC link will be used to generate the control voltage and light up the 7-segment LED display (STOP).

At this point, the variable frequency drive will be ready for operation (correct operating status) and in Stop mode.

## 4.3 Commissioning with control signal terminals (default settings)

The start release is done by actuating one of the digital inputs with +24 V:

- Terminal 2: FWD = Clockwise rotating field (Forward Run)
- Terminal 3: REV = Counterclockwise rotating field (Reverse Run)

The FWD and REV control commands are interlocked (exclusive OR) and require a rising voltage edge.

The frequency is shown with a minus sign with a start release with a left rotating field (REV).

- You can now set the output frequency (0 - 50 Hz) and, as a result, the speed of the connected three-phase motor (0 -  $n_{Motor}$ ) by using the potentiometer via terminal 6 (0 - +10 V proportional voltage signal). The change in output frequency here is delayed based on the specified acceleration and deceleration ramps. In the default settings, these times are set to 5 seconds and to 10 seconds from a frame size FS4.

The acceleration and deceleration ramps specify the time change for the output frequency: from 0 to  $f_{max}$  (WE = 50 Hz) or from  $f_{max}$  back to 0.

Figure92 shows a good example of the process, if the release signal (FWD/REV) is switched on and the maximum setpoint voltage reference voltage (+10 V) is applied. The speed of the motor follows the output frequency depending on the load and moment of inertia (slip), from zero to  $n_{max}$ .

If the release signal (FWD, REV) is switched off during operation, the inverter is blocked immediately (STOP). The motor comes to an uncontrolled stop (see ① in Figure92).

The acceleration time is set in parameter P1-03.

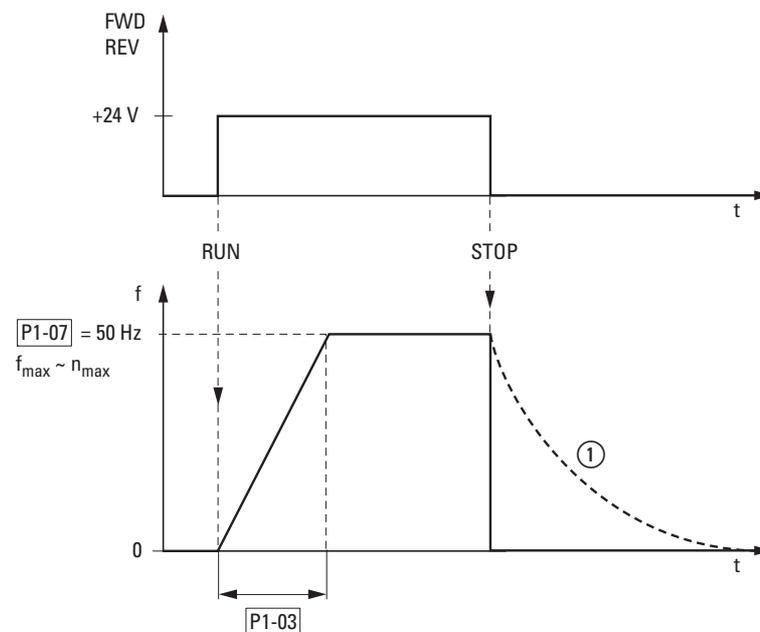


Figure 92: Start-Stop command with maximum reference voltage

## 4 Operation

### 4.4 Handling the keypad

#### 4.4 Handling the keypad

The keypad can be used to configure the VSA variable frequency drive's parameters and monitor its operation.

##### 4.4.1 Operating unit elements

The following figure shows the elements of the VSA variable frequency drive integrated operating unit.

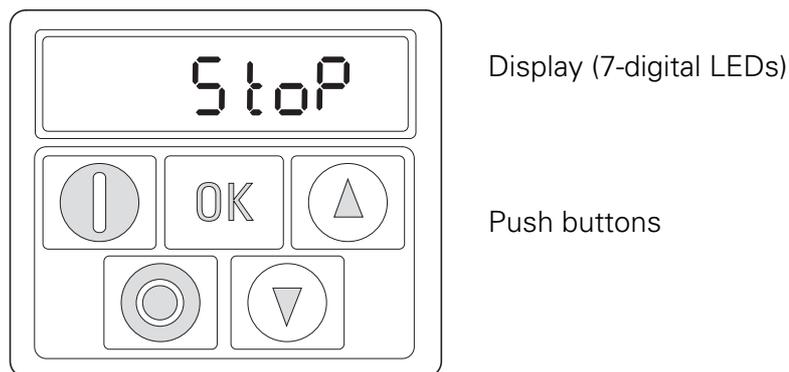
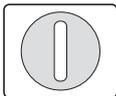
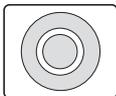
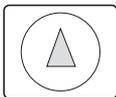


Figure 93: Operating unit view (example VSA...-A20C)

- ➔ The integrated keypad on VSA...-A20C devices and the (optional) external DX-KEY-LED keypad feature a six-digit 7-segment LED display. Meanwhile, VSA...-B20C, VSA...-B55C devices and the (optional) external DX-KEY-OLED keypad feature a multi-language cleartext display (OLED = organic light-emitting diode display). The function keys work the exact same way. The external DX-KEY-OLED keypad features two additional buttons (**Hand**, **Auto**). By default, these buttons do not do anything, and can only be configured (freely) in the PLC editor.
- ➔ On OLED displays, languages can be selected by pressing **START** + **▲** simultaneously.  
Display: **Select Language**.  
The display language can be changed with the **▲** and **▼** arrow keys.  
The selected language setting can then be saved by pressing the **OK** button.
- ➔ The **START**, **STOP**, **UP**, and **DOWN** buttons need to be enabled with parameter P1-12 (local process data source).

**Table 19: Keypad elements – Buttons**

| Button   | Attribute ID | Explanation  |
|--|--------------|--|
|   | <b>OK</b>    | <ul style="list-style-type: none"> <li>• Navigating in parameter mode</li> <li>• Opens and closes the parameter interface (press the button and hold it down for more than two seconds)</li> <li>• Saves parameter changes</li> <li>• Changes the value being displayed: A, rpm, etc. (real-time information)</li> </ul> |
|   | <b>START</b> | <ul style="list-style-type: none"> <li>• Starts the variable frequency drive<sup>1)</sup></li> <li>• Changes the operating direction<sup>2)</sup> if the motor is running</li> </ul>   |
|   | <b>STOP</b>  | <ul style="list-style-type: none"> <li>• Stops the variable frequency drive<sup>1)</sup></li> <li>• Reset – Resetting after fault message</li> </ul>   |
|   | <b>UP</b>    | <ul style="list-style-type: none"> <li>• Increases the speed<sup>1)</sup></li> <li>• Increment numeric value or parameter number</li> </ul>  |
|  | <b>DOWN</b>  | <ul style="list-style-type: none"> <li>• Decreases the speed<sup>1)</sup></li> <li>• Decrement numeric value or parameter number</li> </ul>  |

**Note:**

1) P1-12 = 1 (one operating direction) or P1-12 = 2 (two operating directions);  
The operating direction will be reversed when the START button is pressed

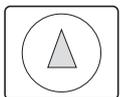
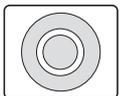
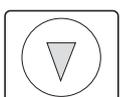
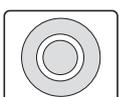
2) P1-12 = 2 only

## 4 Operation

### 4.4 Handling the keypad

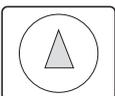
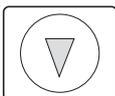
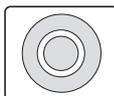
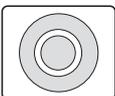
#### 4.4.2 Adjust parameters

**Table 20: Modify parameters**

| Commands  | Description   |
|---|---|
|    | Press the <b>OK</b> button and hold it down for two seconds in order to access the parameter interface.<br>→ The display will show the parameter that was last used.  |
|       | Use the ▲ and ▼ buttons to select a parameter.  |
|    | Press the <b>OK</b> button.<br>The value of the selected parameter can be changed.  |
|       | Use the ▲ and ▼ buttons to change the parameter's value.  |
|   | Press the <b>OK</b> button to confirm the parameter value change.<br>As soon as the parameter is displayed, the value will have been saved.<br><br>Press the <b>OK</b> button and hold it down for two seconds in order to exit the parameter interface (display: "StoP").  |
|   | <b>Switching between two parameter groups</b><br>The parameters are in sequential order. This means that moving forward from the last parameter in a parameter group will take you directly to the first parameter in the next parameter group and the other way around.<br><br><b>Note:</b> In order to access the extended parameter groups, you will need to enter the corresponding password in parameter P1-14 (default passwords: level 2 = 101, level 3 = 201).<br><br>Press the ▲ and <b>STOP</b> buttons to jump to the first parameter in the next parameter group. |
|   | Press the ▼ and <b>STOP</b> buttons to jump to the first parameter in the previous parameter group.   |

#### 4.4.3 Resetting Parameters (RESET)

**Table 21: Resetting parameters (RESET)**

| Commands  | Description   |
|---|---|
| <b>Reset to default settings</b>  |   |
|  +  +  | Press the ▲ and ▼ and STOP buttons and hold them down for two seconds.<br>→ <b>All parameters will be restored to their default settings.</b><br>The display will show <i>P-dEF</i> . |
| <b>Resetting after a fault</b>  |   |
|    | Press the <b>STOP</b> button to reset a fault message.<br>The display will show <i>StoP</i> .   |

## 5 Fault messages

### 5.1 Introduction

VSA series variable frequency drives come with several built-in monitoring functions. When a deviation from the correct operating state is detected, an error message will be displayed; in the inverter's default settings, the relay contact will open (control signal terminals 14 and 15).

#### 5.1.1 Fault messages

The most recent four error messages will be stored in the order in which they occurred (with the most recent one in the first place). Fault messages can be read from the monitor-parameter P0-13. The values will not be deleted if the variable frequency drive is reset to its default settings!

#### 5.1.2 Acknowledge fault (Reset)

To acknowledge and reset the current error message, you can either switch off the supply voltage or press the STOP button. Error messages can also be reset with an additional positive edge at control signal terminal 2 (DI1) or 3 (DI2) (new start signal).

If parameter P2-36 is set to a value between 2 (*Auto-1*) and 6 (*Auto-5*), the variable frequency drive will attempt to automatically start again up to five times.

## 5 Fault messages

### 5.1 Introduction

#### 5.1.3 Fault list

The following table lists the failure codes, the possible causes and indicates corrective measures.

**Table 22: Fault messages list**

| Message         | Error no. [dec] | Possible causes and fixes  |
|-----------------|-----------------|--|
| <i>StOP</i>     | –               | Ready to start. There is no drive enable signal present. There are no fault messages present.  |
| <i>no-Flt</i>   | 00              | Shown for P0-13 if there are no messages in the error register.  |
| <i>Ol-b</i>     | 01              | Excessively high braking current <ul style="list-style-type: none"> <li>• Check the brake resistor and its wiring for short-circuits and ground faults.</li> <li>• Make sure that the braking resistance value is not lower than the minimum permissible braking resistance.</li> </ul>  |
| <i>OL-br</i>    | 02              | Thermal overload on brake resistor<br>The drive has been switched off in order to prevent the brake resistor from being thermally destroyed. <ul style="list-style-type: none"> <li>• Make the P1-04 and P2-25 ramp times longer in order to have less frequent braking.</li> <li>• Reduce the load's inertia, if possible.</li> </ul>   |
| <i>O-I</i>      | 03              | Overcurrent at variable frequency drive output<br>Occurs right after switching on the unit: <ul style="list-style-type: none"> <li>• Check the cable connection between inverter and motor.</li> <li>• Check the motor for shorted turns and ground faults.</li> </ul> Occurs when starting the motor: <ul style="list-style-type: none"> <li>• Check whether the motor can rotate freely and make sure that it is not being blocked mechanically.</li> <li>• Motor with mechanical brake: Check whether the brake is being applied.</li> <li>• Check the connection configuration (star/delta).</li> <li>• Check to make sure that the motor data was entered correctly in P1-07, P1-08, and P1-09.</li> <li>• In vector control mode (P4-01 = 0 or 1): Check to make sure that the cos <math>\phi</math> (P4-05) value was entered correctly and that a motor identification run was performed correctly.</li> <li>• Increase the acceleration ramp time (t-acc, P1-03) if necessary.</li> <li>• In speed control mode (P4-01 = 2): Reduce the voltage boost with P1-11.</li> </ul> Occurs during operation at a constant speed: <ul style="list-style-type: none"> <li>• Check whether the motor is overloaded.</li> </ul> Occurs during acceleration/deceleration: <ul style="list-style-type: none"> <li>• The ramp times are too short and require too much power. If P-03 / P-04 cannot be increased, a larger device may be required.</li> </ul> |
| <i>I.Lt-trP</i> | 04              | Motor overload. The thermal protection mechanism has tripped as a result of the device being run above the rated motor current set with P1-08 longer than a specific time. <ul style="list-style-type: none"> <li>• Check to make sure that the motor data was entered correctly in P1-07, P1-08, and P1-09.</li> <li>• In vector control mode (P4-01 = 0 or 1): Check to make sure that the cos <math>\phi</math> (P4-05) value was entered correctly and that a motor identification run was performed correctly.</li> <li>• Check the motor's connection configuration (e.g., start/delta)</li> <li>• If the decimal points on the display flash during operation, this means that the unit is being run in its overload range (&gt; P1-08). In this case, use P1-03 to make the acceleration ramp longer or reduce the load.</li> <li>• Make sure that the motor is not being mechanically blocked and that there are no additional loads on the motor.</li> </ul>   |

| Message       | Error no. [dec] | Possible causes and fixes   |
|---------------|-----------------|---|
| <i>P5-trP</i> | 05              | <p>Overcurrent (Hardware)</p> <ul style="list-style-type: none"> <li>• Check the wiring to the motor and the motor itself for short-circuits and ground faults.</li> <li>• Disconnect the motor cable from the variable frequency drive and switch the variable frequency drive back on. If the fault message still appears, the device needs to be replaced. Before commissioning the new device, check the system for short-circuits or ground faults that could have caused the device to fail.</li> </ul>   |
| <i>O_Volt</i> | 06              | <p>Overvoltage in DC link</p> <p>The DC link voltage value can be viewed using parameter P0-20. P0-36 contains a fault register with the last values before the unit was switched off (scan time: 256 ms).</p> <ul style="list-style-type: none"> <li>• Check to make sure that the supply voltage falls within the range for which the variable frequency drive is sized.</li> <li>• If the fault occurs during deceleration or stopping: Make the deceleration ramp (P1-04/P2-25) longer or use the brake resistor.</li> <li>• In vector control mode (P4-01 = 0 or = 1): Reduce the speed controller's gain (P4-03).</li> <li>• If using the PID controller: Reduce P3-11 (PID1 fault ramp) to ensure that the ramps are active.</li> </ul>  |
| <i>U_Volt</i> | 07              | <p>Undervoltage in DC link</p> <p><b>Note:</b><br/>Generally, this message will appear when the supply voltage is switched off on the device and the DC link voltage dies away. In this case, there is no fault.</p> <p>If the message appears during operation:</p> <ul style="list-style-type: none"> <li>• Check whether the power supply voltage is too low.</li> <li>• Check all components/devices in the variable frequency drive's feeder circuit (circuit-breaker, contactor, choke, etc.) to make sure they are connected properly and have an adequate contact resistance.</li> </ul>  |
| <i>O-t</i>    | 08              | <p>Overtemperature at heat sink. The drive is too hot.</p> <p>The heat sink temperature can be viewed by using P0-21. P0-38 contains a fault register with the last values before the unit was switched off (scan time: 30 s).</p> <ul style="list-style-type: none"> <li>• Check to make sure that the variable frequency drive is being operated within the ambient temperature range specified for it. (IP20 devices: max. 50 °C; IP66 devices: max. 40 °C).</li> <li>• Check to make sure that the device fan is running.</li> <li>• Make sure that cooling air can circulate freely (clearances to neighboring devices above and below the variable frequency drive).</li> <li>• Improve the control cabinet's ventilation if necessary: The device's vents must not be obstructed, e.g., by dirt or as a result of devices being installed too close to each other.</li> <li>• Reduce the switching frequency with P2-24.</li> <li>• Reduce the load, if possible.</li> </ul> |
| <i>U-t</i>    | 09              | <p>Under-temperature</p> <p>The message will appear if the ambient air temperature falls below -10 °C. In order to be able to start the drive, the temperature must be higher than this.</p>  |
| <i>P-def</i>  | 10              | <p>The parameters' default settings have been loaded.</p> <ul style="list-style-type: none"> <li>• Press the STOP button: You will be able to reconfigure the drive after doing so.</li> </ul>  |

## 5 Fault messages

### 5.1 Introduction

| Message       | Error no. [dec] | Possible causes and fixes  |
|---------------|-----------------|--|
| <i>E-trIP</i> | 11              | External fault (at digital input 5, terminal 10, if P1-13 = 6/7/16/17). There must be a high-level signal at this input in order to be able to run the variable frequency drive. <ul style="list-style-type: none"> <li>If a thermistor is connected to terminal 10, check whether the motor is too hot.</li> </ul>  |
| <i>SC-ObS</i> | 12              | Communication fault with an external operating unit or with a PC. <ul style="list-style-type: none"> <li>Check connections.</li> </ul>   |
| <i>Flt-dc</i> | 13              | Excessively high DC link voltage ripple<br>The DC link voltage ripple can be viewed using P0-16.<br>P0-37 contains a fault register with the last values before the unit was switched off (scan time: 20 ms). <ul style="list-style-type: none"> <li>Check to make sure that all the mains supply phases are present and that their voltage balance falls within the permissible tolerance range (3%).</li> <li>Reduce the load if possible.</li> <li>If the fault persists, please contact your nearest Johnson Controls sales branch.</li> </ul> |
| <i>P-L0SS</i> | 14              | Incoming power phase failure (only for devices with a three-phase power supply)  |
| <i>h O-I</i>  | 15              | Overcurrent at output <ul style="list-style-type: none"> <li>See Error no. 03.</li> </ul>  |
| <i>th-Flt</i> | 16              | Malfunctioning heat sink thermistor. <ul style="list-style-type: none"> <li>Please contact your nearest Johnson Controls sales branch.</li> </ul>  |
| <i>dAtA-F</i> | 17              | Error in internal memory. The parameters have not been saved and the default settings have been loaded. <ul style="list-style-type: none"> <li>Change the parameter values (again) and save them once more.</li> <li>If the message appears again, please contact your nearest Johnson Controls sales branch.</li> </ul>   |
| <i>4-20 F</i> | 18              | The analog input's input current does not fall within the specified range. <ul style="list-style-type: none"> <li>Check the setting in P2-30 for AI1 (terminal 6) and P2-33 for AI2 (terminal 10).</li> <li>In the case of 4-20 mA: Check the setpoint connection for wire breakage.</li> </ul>  |
| <i>dAtA-E</i> | 19              | Error in internal memory. The parameters have not been saved and the default settings have been loaded. <ul style="list-style-type: none"> <li>Change the parameter values (again) and save them once more.</li> <li>If the message appears again, please contact your nearest Johnson Controls sales branch.</li> </ul>   |
| <i>U-dEF</i>  | 20              | The customer's settings for the parameters have been imported. <ul style="list-style-type: none"> <li>Press the STOP button.</li> </ul>  |
| <i>F-Ptc</i>  | 21              | Motor PTC thermistor over temperature  |
| <i>FAn-F</i>  | 22              | The device's internal fan is experiencing a fault<br>In the case of frame size FS8: Wrong device fan operating direction <ul style="list-style-type: none"> <li>Check the supply voltage phase sequence (L1-L2-L3).</li> </ul>   |
| <i>U-hEA</i>  | 23              | The measured ambient temperature exceeds the specified value. <ul style="list-style-type: none"> <li>Check the device's internal fan.</li> <li>Make sure that the required clearance around the device is being maintained and that cooling air can flow through the vents on the device unimpeded.</li> <li>Reduce the switching frequency with P2-24.</li> <li>If possible: Reduce the load.</li> </ul>  |
| <i>U-torq</i> | 24              | Maximum permissible torque exceeded. <ul style="list-style-type: none"> <li>If possible: Reduce the load or increase acceleration time t-acc.</li> </ul>   |
| <i>U-torq</i> | 25              | Only active if brake control is enabled in hoisting gear mode (P2-18 = 8). The torque produced before the hoisting gear's mechanical brake is enabled falls below the set threshold.   |

| Message                        | Error no. [dec] | Possible causes and fixes   |
|--------------------------------|-----------------|---|
| <i>Out-F</i>                   | 26              | Device output fault <ul style="list-style-type: none"> <li>• Please contact your nearest Johnson Controls sales branch.</li> </ul>  |
| <i>Sto-F</i>                   | 29              | Internal STO circuit fault <ul style="list-style-type: none"> <li>• Please contact your nearest Johnson Controls sales branch.</li> </ul>   |
| <i>Enc-01</i>                  | 30              | No communication between the encoder module and the variable frequency drive. <ul style="list-style-type: none"> <li>• Check to make sure that the module is correctly plugged in and secured.</li> </ul>   |
| <i>Enc-02</i><br><i>SP-Err</i> | 31              | The calculated motor speed is different from the measured motor speed. <ul style="list-style-type: none"> <li>• Check the encoder connection, including the corresponding shielding.</li> <li>• Increase the value of P6-07 if necessary.</li> </ul>  |
| <i>Enc-03</i>                  | 32              | The motor speed and the PPR value entered in P6-06 do not match. The PPR value in P6-06 must be at least 60. <ul style="list-style-type: none"> <li>• Check the speed entered in P1-10.</li> </ul>  |
| <i>Enc-04</i>                  | 33              | Channel A fault:<br>Usually a bad connection. <ul style="list-style-type: none"> <li>• Check wiring.</li> </ul>   |
| <i>Enc-05</i>                  | 34              | Channel B fault<br>Usually a bad connection. <ul style="list-style-type: none"> <li>• Check wiring.</li> </ul>  |
| <i>Enc-06</i>                  | 35              | Error on channels A and B<br>Usually a bad connection. <ul style="list-style-type: none"> <li>• Check wiring.</li> </ul>  |
| <i>AtF-01</i>                  | 40              | Motor identification failed:<br>The measured stator resistance varies between the phases. <ul style="list-style-type: none"> <li>• Make sure that the motor is connected properly and working correctly.</li> <li>• Check the motor windings to make sure they have the same resistance values.</li> </ul>  |
| <i>AtF-02</i>                  | 41              | Motor identification failed:<br>The measured stator resistance is too large. <ul style="list-style-type: none"> <li>• Make sure that the motor is connected properly and working correctly.</li> <li>• Check to make sure that the device's rated output matches the motor's rated output. The difference should not exceed one full output class.</li> </ul> |
| <i>AtF-03</i>                  | 42              | Motor identification failed:<br>The measured motor inductance is too low. <ul style="list-style-type: none"> <li>• Make sure that the motor is connected properly and working correctly.</li> </ul>   |
| <i>AtF-04</i>                  | 43              | Motor identification failed:<br>The measured motor inductance is too high. <ul style="list-style-type: none"> <li>• Make sure that the motor is connected properly and working correctly.</li> <li>• Check to make sure that the device's rated output matches the motor's rated output. The difference should not exceed one full output class.</li> </ul>   |
| <i>AtF-05</i>                  | 44              | Motor identification failed:<br>The measured motor parameters do not match. <ul style="list-style-type: none"> <li>• Make sure that the motor is connected properly and working correctly.</li> <li>• Check to make sure that the device's rated output matches the motor's rated output. The difference should not exceed one full output class.</li> </ul>  |
| <i>Out-Ph</i>                  | 49              | A phase in the motor cable is not connected or has a discontinuity.   |
| <i>Sc-F01</i>                  | 50              | No valid Modbus frame was received within the time specified in P5-06. <ul style="list-style-type: none"> <li>• Check to make sure that the network master is working correctly.</li> <li>• Check connecting cables.</li> <li>• Increase the value of P5-06 to an acceptable value.</li> </ul>  |

## 5 Fault messages

### 5.1 Introduction

| <b>Message</b> | <b>Error no.<br/>[dec]</b> | <b>Possible causes and fixes</b>  |
|----------------|----------------------------|---|
| <i>Sc-F02</i>  | 51                         | No valid CANopen frame was received within the time specified in P5-06. <ul style="list-style-type: none"><li>• Check to make sure that the network master is working correctly.</li><li>• Check connecting cables.</li><li>• Increase the value of P5-06 to an acceptable value.</li></ul> |
| <i>Sc-F03</i>  | 52                         | Communications between the device and the plugged-in field bus option have dropped out. <ul style="list-style-type: none"><li>• Check to make sure that the module is installed properly.</li></ul>   |
| <i>Sc-F04</i>  | 53                         | Communications between the device and the plugged-in I/O expansion have dropped out. <ul style="list-style-type: none"><li>• Check to make sure that the module is installed properly.</li></ul>  |
| <i>OF-01</i>   | 60                         | No internal connection to an optional board   |
| <i>OF-02</i>   | 61                         | Optional module in undefined operating state  |
| <i>PLC-01</i>  | 70                         | Non-supported function block from function block editor   |
| <i>PLC-02</i>  | 71                         | Program from function block editor is too big   |
| <i>PLC-03</i>  | 72                         | Division by zero  |
| <i>PLC-04</i>  | 73                         | Lower limit is higher than upper limit  |
| <i>PLC-05</i>  | 74                         | Overflow table Function block editor  |

## 6 Technical Data

### 6.1 General rating data

| Technical data   | Symbol   | Unit  | Value  |
|--|----------|-------|--|
| General  |          |       |  |
| Standards  |          |       | EMC: EN 61800-3:2004+A1-2012<br>Radio interference: EN 55011: 2010<br>Safety: EN 61800-5: 2007<br>Degree of protection: EN 60529: 1992<br><br><b>Note:</b><br>VSA 35... devices are not covered by the declaration of conformity for the EU EMC Directive. |
| Certifications and manufacturer's declarations on conformity |          |       | CE, UL, cUL, c-Tick, UkrSEPRO, Gost-R<br><br><b>Note:</b><br>Frame size FS8 is not UL or cUL listed as of this writing.  |
| Production quality   |          |       | RoHS, ISO 9001   |
| Climatic proofing  | $\rho_w$ | %     | < 95 %, mean relative humidity (RH), non-condensing (EN 50178)   |
| Ambient air temperature                                      |          |       |  |
| Operational  |          |       |  |
| IP20 (NEMA 0)  | $\theta$ | ?C    | -10 - +50 (frost-free and condensation-free)   |
| IP55 (NEMA 3)  | $\theta$ | ?C    | -10 - +40, with derating of 1.5% per °C above 40 °C on rated operational current $I_e$<br><br><b>Note:</b><br>Operation within a temperature range of 40 to 50 °C does not conform to UL listing.  |
| IP66 (NEMA 4X)   | $\theta$ | °C    | -10 - +40, with a derating of 2.5% per °C above 40 °C on rated operational current $I_e$<br><br><b>Note:</b><br>Operation within a temperature range of 40 to 50 °C does not conform to UL listing.  |
| Storage  | $\theta$ | °C    | -40 - +60  |
| MTTF <sub>d</sub>  |          | Years | 4525   |
| MTBF<br>(mean time between two failures)                     |          | Years | 50   |
| PFH <sub>D</sub>   |          |       | 1.23 - 09 1/h (0.12 % of SIL)  |
| Electrostatic discharge (ESD, EN 61000-4-2:2009)             | U        | kV    | ±4, contact discharge<br>±8, air discharge   |
| Fast transient burst (EFT/B, EN 61000-4-4: 2004)             | U        | kV    | ±1, at 5 kHz, control signal terminal<br>±2, at 5 kHz, motor connection terminals,<br>Single-phase mains connection terminals<br>±4, at 5 kHz, three-phase mains connection terminals  |

## 6 Technical Data

### 6.1 General rating data

| Technical data   | Symbol         | Unit | Value  |
|--|----------------|------|--|
| Overvoltage (surge, EN 61000-4-5: 2006)  |                |      |  |
| 110 - 115 V, 200 - 240 V   | U              | kV   | ±1, phase to phase/neutral conductor<br>±2, phase/neutral conductor to earth   |
| 380 - 480 V, 500 - 600 V   | U              | kV   | ±2, phase to phase<br>±4, phase to earth   |
| Electric strength (flash, EN 61800-5-1: 2007)  |                |      |  |
| 110 - 115 V, 200 - 240 V   | U              | kV   | 1.5  |
| 380 - 480 V, 500 - 600 V   | U              | kV   | 2.5  |
| Radio interference class (EMC)   |                |      |  |
| Category and maximum screened motor cable length with integrated radio interference suppression filter |                |      |  |
| C1   | l              | m    | 1  |
| C2   | l              | m    | 5  |
| C3   | l              | m    | 25   |
| Mounting position  |                |      | vertical   |
| Altitude   | h              | m    | 0 - 1000 above sea level,<br>> 1000 with 1% load current reduction every 100 m,<br>maximum 2000 with UL approval,<br>maximum 4000 without UL approval  |
| Degree of protection   |                |      | IP20 (NEMA 0)<br>IP55 (NEMA 3)<br>IP66 (NEMA 4X)   |
| Fan (built-in)   |                |      | yes  |
| Busbar tag shroud  |                |      | BGV A3 (VBG4, finger- and back-of-hand proof)  |
| <b>Main circuit / power section</b>  |                |      |  |
| <b>Feeder unit</b>   |                |      |  |
| Rated operating voltage  |                |      |  |
| VSA 12...  | U <sub>e</sub> | V    | 1~ 230 (200 V -10 % - 240 V +10 %)   |
| VSA 32...  | U <sub>e</sub> | V    | 3~ 230 (200 V -10 % - 240 V +10 %)   |
| VSA 34...  | U <sub>e</sub> | V    | 3~ 400 (380 V -10 % - 480 V +10 %)   |
| VSA 35...  | U <sub>e</sub> | V    | 3~ 575 (500 V - 10 % - 600 V +10 %)  |
| Mains frequency  | f              | Hz   | 50/60 ±10 %  |
| Phase Imbalance  |                | %    | max. 3   |
| Maximum short-circuit current (supply voltage)   | SCCR           | kA   | 100 (according to IEC 60439-1)   |
| Mains switch-on frequency  |                |      | Maximum of one time every 30 seconds   |
| Mains network configuration (AC power supply network)  |                |      | TN and TT earthing systems with directly earthed neutral point.<br>IT earthing systems with PCM insulation monitoring relays only.<br>Operation on phase-earthed networks is only permissible up to a maximum phase-earth voltage of 300 V AC. |

## 6 Technical Data

### 6.1 General rating data

| Technical data  | Symbol      | Unit | Value  |
|---|-------------|------|--|
| <b>Motor feeder</b>   |             |      |  |
| Output voltage  |             |      |  |
| VSA 12..., VSA 32..., VSA 34..., VSA 35...                    | $U_2$       | V    | 3~ 0 - $U_e$   |
| Assigned motor output   |             |      |  |
| at 230 V, 50 Hz   | P           | kW   | 0.75 - 75  |
| at 400 V, 50 Hz   | P           | kW   | 0.75 - 250   |
| at 500 V, 60 Hz   | P           | kW   | 0.75 - 110   |
| Output Frequency  |             |      |  |
| Range, parameterizable  | $f_2$       | Hz   | 0 - 50/60 (max. 500 Hz)  |
| resolution  | $\Delta f$  | Hz   | 0.1  |
| Rated operational current                                     | $I_e$       | A    | IP20: 4.3- 24/370 - 450<br>IP55: 24 -302<br>IP66: 4.3 -18                          |
| Overload current for 60 s every 600 s                         | $i_l$       | %    | 150  |
| Starting current for 4 s every 40 s                           | $i_l$       | %    | 200  |
| Motor cable length  |             |      |  |
| screened  | l           | m    | 100  |
| unscreened  | l           | m    | 150  |
| with motor choke  | $\Delta l$  | %    | 100 (increased maximum cable length)   |
| Switching frequency (pulse frequency)                         | $f_{PWM}$   | kHz  | 4 - 32 (double modulation) / 2 - 16 (effective)<br>Maximum value depends on rating |
| Operate Mode  |             |      | V/Hz control, slip compensation, vector control                                    |
| SLV, max. speed error   | $\Delta n$  | %    | $\pm 0.5$  |
| DC braking  |             |      |  |
| Time before start   | t           | s    | 0 - 25, in the event of a stop   |
| Motor pick-up control function (for catching spinning motors) |             |      | yes  |
| Brake chopper   |             |      | yes  |
| Braking current during continuous operation                   | $I_{BR}$    | %    | 100 ( $I_e$ )  |
| Maximum braking current                                       | $I_{BRmax}$ | %    | 150 for 60 s   |

## 6 Technical Data

### 6.1 General rating data

| Technical data  | Symbol           | Unit            | Value                                    |
|---|------------------|-----------------|--|
| <b>Control section</b>                                |                  |                 |  |
| Terminal capacity (clampable)                         | A                | mm <sup>2</sup> | 0.05 - 2.5 (30 - 12 AWG)                 |
| Control voltage                                       |                  |                 |  |
| Output voltage (control signal terminal 1)            | U <sub>c</sub>   | V DC            | 24                                       |
| Input voltage (control signal terminal 1)             | U <sub>c</sub>   | V DC            | 18 - 30                                  |
| Load rating (control signal terminal 1), maximum      | I                | mA              | 100                                      |
| Reference voltage (control signal terminal 5)         | U <sub>S</sub>   | V DC            | 10                                       |
| Load rating (control signal terminal 5), maximum      | I                | mA              | 10                                       |
| Digital Input (DI)                                    |                  |                 |  |
| Number (configurable)                                 |                  |                 | 3 - 5                                    |
| Logic (level)   |                  |                 | Increase                                 |
| Response time   | t                | ms              | < 4                                      |
| Input voltage range High (1)                          | U <sub>c</sub>   | V DC            | 8 - 30                                   |
| Input voltage range Low (0)                           | U <sub>c</sub>   | V DC            | 0 - 4                                    |
| Analog Input (AI)                                     |                  |                 |  |
| Number (configurable)                                 |                  |                 | 0 - 2                                    |
| resolution  |                  |                 | 12 bits                                  |
| accuracy  |                  | %               | < 1 to the final value                   |
| Response time   | t                | ms              | < 4                                      |
| Input voltage range                                   | U <sub>Ref</sub> | V               | 0/-10 - +10, DC (R <sub>i</sub> ~ 72 kΩ) |
| Input current range                                   | I                | mA              | 0/4 - 20 (R <sub>B</sub> ~ 500 Ω)        |
| Setpoint potentiometer (recommended fixed resistance) | R                | kΩ              | 1 - 10                                   |
| Relay output (K)                                      |                  |                 |  |
| Number of relays (contacts)                           |                  |                 | 2 (1 N/O/1 changeover contact)           |
| Switching capacity                                    |                  |                 |  |
| AC  | I                | A               | 6 (250 V)                                |
| DC current  | I                | A               | 5 (30 V)                                 |
| Digital/analog output (DO/AO)                         |                  |                 |  |
| Quantity  |                  |                 | 2 (digital/analog)                       |
| Output voltage  |                  |                 |  |
| TH  | U <sub>out</sub> | V DC            | +24                                      |
| AO  | U <sub>out</sub> | V DC            | 0/-10 - +10                              |
| Current carrying capacity DO                          | I <sub>out</sub> | mA              | < 20                                     |
| AO resolution   |                  |                 | 12 bits                                  |
| Interface (RJ45)                                      |                  |                 | OP bus, Modbus RTU, CANopen, (RS485)     |
| STO (Safe Torque Off)                                 |                  |                 |  |
| Voltage   | U                | V DC            | +24 (18 - 30)                            |
| Current   | I                | mA              | 100                                      |
| SIL category  |                  |                 | 2  |
| PL  |                  |                 | d  |

## 6.2 Specific rated operational data

### 6.2.1 VSA 12... series

| Physical quantity                                    |       | Symbol    | Unit     | 4D3  | 7D0    | 011    |
|--|-------|-----------|----------|--|--------|--------|
| Rated operational current                            |       | $I_e$     | A        | 4.3  | 7.0    | 10.5   |
| Overload current for 60 s every 600 s                |       | $i_l$     | A        | 6.45   | 10.5   | 15.75  |
| Apparent power at rated operation <sup>1)</sup>      | 230 V | S         | kVA      | 1.71   | 2.79   | 4.18   |
|  | 240 V | S         | kVA      | 1.79   | 2.91   | 4.36   |
| Assigned motor power                                 | 230 V | P         | kW       | 0.75   | 1.5    | 2.2    |
|  | 230 V | P         | HP       | 1  | 2      | 3      |
| Power side (primary side):                           |       |           |          |  |        |        |
| Number of phases                                     |       |           |          | single-phase or two-phase  |        |        |
| Rated voltage  |       | $U_{LN}$  | V        | 200 - 10 % - 240 + 10 %, 50/60 Hz<br>(180 - 264 V $\pm$ 0 %, 48 - 62 Hz $\pm$ 0 %) |        |        |
| Input current (phase current)                        |       | $I_{LN}$  | A        | 9  | 13     | 19     |
| Minimum braking resistance                           |       | $R_B$     | $\Omega$ | 100  | 50     | 35     |
| Switching frequency (pulse frequency)                |       |           |          |  |        |        |
| Default settings                                     |       | $f_{PWM}$ | kHz      | 16   | 16     | 16     |
| Setting range  |       | $f_{PWM}$ | kHz      | 4 - 32 kHz   | 4 - 32 | 4 - 32 |
| Maximum leakage current to earth (PE), without motor |       | $I_{PE}$  | mA       | 2.49   | 2.49   | 2.49   |
| Efficiency   |       | $\eta$    |          | 0.94   | 0.96   | 0.95   |
| Heat dissipation at $I_e$                            |       | $P_V$     | W        | 45.75  | 63     | 103.4  |
| Frame size   |       |           |          | FS2  | FS2    | FS2    |

## 6 Technical Data

### 6.2 Specific rated operational data

#### 6.2.2 VSA 32... series

| Physical quantity                                    | Symbol    | Unit     | 4D3   | 7D0    | 011    | 018    | 024    | 024    |      |
|--|-----------|----------|---|--------|--------|--------|--------|--------|------|
| Rated operational current                            | $I_e$     | A        | 4.3   | 7.0    | 10.5   | 18     | 24     | 24     |      |
| Overload current for 60 s every 600 s                | $i_l$     | A        | 6.45  | 10.5   | 15.75  | 27     | 36     | 36     |      |
| Apparent power at rated operation                    | 230 V     | S        | kVA   | 1.71   | 2.79   | 4.18   | 7.17   | 9.56   | 9.56 |
|  | 240 V     | S        | kVA   | 1.79   | 2.91   | 4.36   | 7.48   | 9.98   | 9.98 |
| Assigned Instance Motor Power                        | 230 V     | P        | kW  | 0.75   | 1.5    | 2.2    | 4.0    | 5.5    | 5.5  |
|  | 230 V     | P        | HP  | 1      | 2      | 3      | 5      | 7.5    | 7.5  |
| Power side (primary side):                           |           |          |   |        |        |        |        |        |      |
| Number of phases                                     |           |          | three-phase   |        |        |        |        |        |      |
| Rated operating voltage                              | $U_{LN}$  | V        | 200 V - 10 % - 240 V +10 %, 50/60 Hz<br>(180 - 264 V $\pm$ 0 %, 48 - 62 Hz $\pm$ 0 %) |        |        |        |        |        |      |
| Input current (phase current)                        | $I_{LN}$  | A        | 6   | 11     | 13     | 21     | 26     | 27     |      |
| Minimum braking resistance                           | $R_B$     | $\Omega$ | 100   | 50     | 35     | 20     | 20     | 20     |      |
| Switching frequency (pulse frequency)                |           |          |   |        |        |        |        |        |      |
| Default settings                                     | $f_{PWM}$ | kHz      | 16  | 16     | 16     | 16     | 16     | 16     |      |
| Setting range  | $f_{PWM}$ | kHz      | 4 - 32  | 4 - 32 | 4 - 32 | 4 - 32 | 4 - 16 | 4 - 16 |      |
| Maximum leakage current to earth (PE), without motor | $I_{PE}$  | mA       | 1.73  | 1.73   | 1.73   | 0.93   | 0.93   | 1.42   |      |
| Efficiency   | $\eta$    |          | 0.95  | 0.96   | 0.96   | 0.96   | 0.97   | 0.97   |      |
| Heat dissipation at $I_e$                            | $P_V$     | W        | 39.75   | 61.5   | 90.2   | 160    | 170.5  | 170.5  |      |
| Frame size   |           |          | FS2   | FS2    | FS2    | FS3    | FS3    | FS4    |      |

## 6 Technical Data

### 6.2 Specific rated operational data

| <b>VSA 32... series</b>                              |       |               |             |   |            |            |            |            |            |        |        |
|--|-------|---------------|-------------|---|------------|------------|------------|------------|------------|--------|--------|
| <b>Physical quantity</b>                             |       | <b>Symbol</b> | <b>Unit</b> | <b>030</b>  | <b>046</b> | <b>061</b> | <b>072</b> | <b>090</b> | <b>110</b> |        |        |
| Rated operational current                            |       | $I_e$         | A           | 30  | 46         | 61         | 72         | 90         | 110        |        |        |
| Overload current for 60 s every 600 s at 50 °C       |       | $i_l$         | A           | 58.5  | 69         | 91.5       | 108        | 135        | 165        |        |        |
| Apparent power at rated operation                    | 230 V | S             | kVA         | 15.5  | 18.3       | 24.3       | 28.7       | 35.9       | 43.8       |        |        |
|  | 240 V | S             | kVA         | 16.2  | 19.1       | 25.4       | 29.9       | 37.4       | 45.7       |        |        |
| Assigned Instance Motor Power                        | 230 V | P             | kW          | 7.5   | 11         | 15         | 18.5       | 22         | 30         |        |        |
|  | 230 V | P             | HP          | 10  | 15         | 20         | 25         | 30         | 40         |        |        |
| Power side (primary side):                           |       |               |             |   |            |            |            |            |            |        |        |
| Number of phases                                     |       |               |             | three-phase   |            |            |            |            |            |        |        |
| Rated operating voltage                              |       |               |             | 200 V - 10 % - 240 V +10 %, 50/60 Hz<br>(180 - 264 V ±0 %, 48 - 62 Hz ±0 %) |            |            |            |            |            |        |        |
| Input current (phase current)                        |       |               |             | $I_{LN}$  | A          | 33         | 50         | 64         | 74         | 99     | 121    |
| Minimum braking resistance                           |       |               |             | $R_B$   | Ω          | 22         | 22         | 12         | 12         | 6      | 6      |
| Pulse frequency                                      |       |               |             |   |            |            |            |            |            |        |        |
| Default settings                                     |       |               |             | $f_{PWM}$   | kHz        | 8          | 8          | 8          | 8          | 8      | 4      |
| Setting range  |       |               |             | $f_{PWM}$   | kHz        | 4 - 24     | 4 - 24     | 4 - 24     | 4 - 24     | 4 - 24 | 4 - 16 |
| Maximum leakage current to earth (PE), without motor |       |               |             | $I_{PE}$  | mA         | 1.42       | 1.42       | 0.28       | 0.28       | 1.54   | 1.54   |
| Efficiency   |       |               |             | $\eta$  |            | 0.97       | 0.97       | 0.97       | 0.97       | 0.97   | 0.97   |
| Heat dissipation at $I_e$                            |       |               |             | $P_V$   | W          | 187.5      | 264        | 345        | 518        | 550    | 720    |
| Frame size   |       |               |             |   |            | FS4        | FS4        | FS5        | FS5        | FS6    | FS6    |

## 6 Technical Data

### 6.2 Specific rated operational data

| <b>VSA 32... series</b>                              |       |               |             | <b>150</b>  | <b>180</b> | <b>202</b> | <b>248</b> |
|--|-------|---------------|-------------|---|------------|------------|------------|
| <b>Physical quantity</b>                             |       | <b>Symbol</b> | <b>Unit</b> |   |            |            |            |
| Rated operational current                            |       | $I_e$         | A           | 150   | 180        | 202        | 248        |
| Overload current for 60 s every 600 s                |       | $i_l$         | A           | 225   | 270        | 303        | 372        |
| Apparent power at rated operation                    | 230 V | S             | kVA         | 59.8  | 71.7       | 80.5       | 98.8       |
|  | 240 V | S             | kVA         | 62.4  | 74.8       | 84         | 103.1      |
| Assigned Instance Motor Power                        | 230 V | P             | kW          | 37  | 45         | 55         | 75         |
|  | 230 V | P             | HP          | 50  | 60         | 75         | 100        |
| Power side (primary side):                           |       |               |             |   |            |            |            |
| Number of phases                                     |       |               |             | three-phase   |            |            |            |
| Rated operating voltage                              |       | $U_{LN}$      | V           | 200 V - 10 % - 240 V +10 %, 50/60 Hz<br>(180 - 264 V $\pm$ 0 %, 48 - 62 Hz $\pm$ 0 %) |            |            |            |
| Input current (phase current)                        |       | $I_{LN}$      | A           | 160   | 188        | 207        | 246        |
| Minimum braking resistance                           |       | $R_B$         | $\Omega$    | 6   | 6          | 6          | 6          |
| Switching frequency (pulse frequency)                |       |               |             |   |            |            |            |
| Default settings                                     |       | $f_{PWM}$     | kHz         | 4   | 4          | 4          | 4          |
| Setting range  |       | $f_{PWM}$     | kHz         | 4 - 12  | 4 - 8      | 4 - 16     | 4 - 12     |
| Maximum leakage current to earth (PE), without motor |       | $I_{PE}$      | mA          | 1.54  | 1.54       | 2.74       | 2.74       |
| Efficiency   |       | $\eta$        |             | 0.97  | 0.98       | 0.98       | 0.98       |
| Heat dissipation at $I_e$                            |       | $P_V$         | W           | 814   | 945        | 1100       | 1425       |
| Frame size   |       |               |             | FS6   | FS6        | FS7        | FS7        |

### 6.2.3 VSA 34... series

| Physical quantity                                    | Symbol    | Unit     | 2D2   | 4D1    | 5D8    | 9D5    | 014    | 018    | 024    |      |
|--|-----------|----------|---|--------|--------|--------|--------|--------|--------|------|
| Rated operational current                            | $I_e$     | A        | 2.2   | 4.1    | 5.8    | 9.5    | 14     | 18     | 24     |      |
| Overload current for 60 s every 600 s                | $i_l$     | A        | 3.3   | 6.15   | 8.7    | 14.25  | 21     | 27     | 36     |      |
| Apparent power at rated operation                    | 400 V     | S        | kVA   | 1.52   | 2.84   | 4.02   | 6.58   | 9.7    | 12.5   | 16.6 |
|  | 480 V     | S        | kVA   | 1.83   | 3.41   | 4.8    | 7.9    | 11.6   | 15     | 20   |
| Assigned Instance Motor Power                        | 400 V     | P        | kW  | 0.75   | 1.5    | 2.2    | 4.0    | 5.5    | 7.5    | 11   |
|  | 460 V     | P        | HP  | 1      | 2      | 3      | 5      | 7.5    | 10     | 15   |
| Power side (primary side):                           |           |          |   |        |        |        |        |        |        |      |
| Number of phases                                     |           |          | three-phase   |        |        |        |        |        |        |      |
| Rated operating voltage                              | $U_{LN}$  | V        | 380 V - 10 % - 480 V +10 %, 50/60 Hz<br>(342 - 528 V $\pm$ 0 %, 48 - 62 Hz $\pm$ 0 %) |        |        |        |        |        |        |      |
| Input current (phase current)                        | $I_{LN}$  | A        | 3.5   | 6      | 7.5    | 12     | 17     | 22     | 28     |      |
| Minimum braking resistance                           | $R_B$     | $\Omega$ | 400   | 200    | 150    | 100    | 75     | 50     | 40     |      |
| Switching frequency (pulse frequency)                |           |          |   |        |        |        |        |        |        |      |
| Default settings                                     | $f_{PWM}$ | kHz      | 8   | 8      | 8      | 8      | 8      | 8      | 8      |      |
| Setting range  | $f_{PWM}$ | kHz      | 4 - 32  | 4 - 32 | 4 - 32 | 4 - 32 | 4 - 24 | 4 - 24 | 4 - 16 |      |
| Maximum leakage current to earth (PE), without motor | $I_{PE}$  | mA       | 4.65  | 4.65   | 4.65   | 4.65   | 1.55   | 1.55   | 1.55   |      |
| Efficiency   | $\eta$    |          | 0.92  | 0.95   | 0.95   | 0.96   | 0.96   | 0.97   | 0.97   |      |
| Heat dissipation at $I_e$                            | $P_V$     | W        | 63.75   | 76.5   | 101.2  | 136    | 209    | 300    | 297    |      |
| Frame size   |           |          | FS2   | FS2    | FS2    | FS2    | FS3    | FS3    | FS3    |      |

## 6 Technical Data

### 6.2 Specific rated operational data

| <b>VSA 34... series</b>                              |               |             | <b>024</b>  | <b>030</b> | <b>039</b> | <b>046</b> | <b>061</b> | <b>072</b> | <b>090</b> |
|--|---------------|-------------|---|------------|------------|------------|------------|------------|------------|
| <b>Physical quantity</b>                             | <b>Symbol</b> | <b>Unit</b> |   |            |            |            |            |            |            |
| Rated operational current                            | $I_e$         | A           | 24  | 30         | 39         | 46         | 61         | 72         | 90         |
| Overload current for 60 s every 600 s                | $i_l$         | A           | 36  | 45         | 58.5       | 69         | 91.5       | 108        | 135        |
| Apparent power at rated operation                    | 400 V         | S           | 16.6  | 20.8       | 27         | 31.9       | 42.3       | 49.9       | 62.4       |
|  | 480 V         | S           | 20  | 24.9       | 32.4       | 38.2       | 50.7       | 59.9       | 74.8       |
| Assigned Instance Motor Power                        | 400 V         | P           | 11  | 15         | 18.5       | 22         | 30         | 37         | 45         |
|  | 460 V         | P           | 15  | 20         | 25         | 30         | 40         | 50         | 60         |
| Power side (primary side):                           |               |             |   |            |            |            |            |            |            |
| Number of phases                                     |               |             | three-phase   |            |            |            |            |            |            |
| Rated operating voltage                              | $U_{LN}$      | V           | 380 V - 10 % - 480 V +10 %, 50/60 Hz<br>(342 - 528 V $\pm$ 0 %, 48 - 62 Hz $\pm$ 0 %) |            |            |            |            |            |            |
| Input current (phase current)                        | $I_{LN}$      | A           | 28  | 34         | 44         | 52         | 66         | 77         | 103        |
| Minimum braking resistance                           | $R_B$         | $\Omega$    | 40  | 22         | 22         | 22         | 12         | 12         | 6          |
| Switching frequency (pulse frequency)                |               |             |   |            |            |            |            |            |            |
| Default settings                                     | $f_{PWM}$     | kHz         | 8   | 8          | 8          | 8          | 8          | 8          | 4          |
| Setting range  | $f_{PWM}$     | kHz         | 4 - 16  | 4 - 24     | 4 - 24     | 4 - 24     | 4 - 24     | 4 - 24     | 4 - 16     |
| Maximum leakage current to earth (PE), without motor | $I_{PE}$      | mA          | 2.47  | 2.47       | 2.47       | 2.47       | 0.49       | 0.49       | 2.68       |
| Efficiency   | $\eta$        |             | 0.97  | 0.97       | 0.97       | 0.97       | 0.97       | 0.97       | 0.97       |
| Heat dissipation at $I_e$                            | $P_V$         | W           | 297   | 375        | 444        | 506        | 840        | 925        | 1080       |
| Frame size   |               |             | FS4   | FS4        | FS4        | FS4        | FS5        | FS5        | FS6        |

## 6 Technical Data

### 6.2 Specific rated operational data

| <b>VSA 34... series</b>                              |               |             |  | <b>110</b> | <b>150</b> | <b>180</b> | <b>202</b> | <b>240</b> | <b>302</b> | <b>370</b> | <b>450</b> |
|--|---------------|-------------|--|------------|------------|------------|------------|------------|------------|------------|------------|
| <b>Physical quantity</b>                             | <b>Symbol</b> | <b>Unit</b> |  |            |            |            |            |            |            |            |            |
| Rated operational current                            | $I_e$         | A           | 110  | 150        | 180        | 202        | 240        | 302        | 370        | 456        |            |
| Overload current for 60 s every 600 s                | $i_{ll}$      | A           | 165  | 225        | 270        | 303        | 360        | 453        | 555        | 675        |            |
| Apparent power at rated operation                    | 400 V         | S           | kVA  | 76.2       | 104        | 125        | 140        | 166        | 209        | 256        | 311        |
|  | 480 V         | S           | kVA  | 91.5       | 125        | 150        | 168        | 200        | 251        | 307        | 332        |
| Assigned Instance Motor Power                        | 400 V         | P           | kW   | 55         | 75         | 90         | 110        | 132        | 160        | 200        | 250        |
|  | 460 V         | P           | HP   | 75         | 120        | 150        | 175        | 200        | 250        | 300        | 350        |
| Power side (primary side):                           |               |             |  |            |            |            |            |            |            |            |            |
| Number of phases                                     |               |             | three-phase  |            |            |            |            |            |            |            |            |
| Rated operating voltage                              | $U_{LN}$      | V           | 380 V - 10 % - 480 V +10 %, 50/60 Hz (342 - 528 V $\pm$ 0 %, 48 - 62 Hz $\pm$ 0 %) |            |            |            |            |            |            |            |            |
| Input current (phase current)                        | $I_{LN}$      | A           | 126  | 165        | 192        | 211        | 241        | 299        | 377        | 459        |            |
| Minimum braking resistance                           | $R_B$         | $\Omega$    | 6  | 6          | 6          | 6          | 6          | 6          | 2          | 2          |            |
| Switching frequency (pulse frequency)                |               |             |  |            |            |            |            |            |            |            |            |
| Default settings                                     | $f_{PWM}$     | kHz         | 4  | 4          | 4          | 4          | 4          | 4          | 4          | 4          |            |
| Setting range  | $f_{PWM}$     | kHz         | 4 - 16   | 4 - 12     | 4 - 8      | 4 - 16     | 4 - 12     | 4 - 8      | 4 - 8      | 4 - 8      |            |
| Maximum leakage current to earth (PE), without motor | $I_{PE}$      | mA          | 2.68   | 2.68       | 2.68       | 4.75       | 4.75       | 4.75       | N/A        | N/A        |            |
| Efficiency   | $\eta$        |             | 0.98   | 0.98       | 0.98       | 0.98       | 0.98       | 0.98       | N/A        | N/A        |            |
| Heat dissipation at $I_e$                            | $P_V$         | W           | 1210   | 1575       | 1800       | 2090       | 2375       | 3040       | 4000       | 5000       |            |
| Frame size   |               |             | FS6  | FS6        | FS6        | FS7        | FS7        | FS7        | FS8        | FS8        |            |

## 6 Technical Data

### 6.2 Specific rated operational data

#### 6.2.4 VSA 35... series



VSA 35... devices are not covered by the declaration of conformity.  
Additional radio interference suppression filters are required for compliance.

| Physical quantity                                    | Symbol    | Unit     | 2D1                                 | 3D1    | 4D1    | 6D5    | 9D0    | 012    |
|--|-----------|----------|-------------------------------------|--------|--------|--------|--------|--------|
| Rated operational current                            | $I_e$     | A        | 2.1                                 | 3.1    | 4.1    | 6.5    | 9      | 12     |
| Overload current for 60 s every 600 s at 50 °C       | $i_l$     | A        | 3.15                                | 4.65   | 6.15   | 9.75   | 13.5   | 18     |
| Apparent power at rated operation                    | 500 V     | S        | 1.6                                 | 2.1    | 2.4    | 4.3    | 6      | 7.5    |
|  | 600 V     | S        | 2                                   | 2.5    | 2.9    | 5.1    | 7.3    | 9      |
| Assigned Instance Motor Power                        | 500 V     | P        | 0.75                                | 1.5    | 2.2    | 4      | 5.5    | 7.5    |
|  | 575 V     | P        | 1                                   | 2      | 3      | 5      | 7.5    | 10     |
| Power side (primary side):                           |           |          |                                     |        |        |        |        |        |
| Number of phases                                     |           |          | three-phase                         |        |        |        |        |        |
| Rated operating voltage                              | $U_{LN}$  | V        | 500 V -10 % - 600 V +10 %, 50/60 Hz |        |        |        |        |        |
| Input current (phase current)                        | $I_{LN}$  | A        | 3.5                                 | 4.5    | 4.5    | 9      | 12     | 15     |
| Minimum braking resistance                           | $R_B$     | $\Omega$ | 50                                  | 50     | 50     | 50     | 50     | 40     |
| Switching frequency (pulse frequency)                |           |          |                                     |        |        |        |        |        |
| Default settings                                     | $f_{PWM}$ | kHz      | 8                                   | 8      | 8      | 8      | 8      | 8      |
| Setting range  | $f_{PWM}$ | kHz      | 4 - 24                              | 4 - 24 | 4 - 24 | 4 - 24 | 4 - 24 | 4 - 24 |
| Maximum leakage current to earth (PE), without motor | $I_{PE}$  | mA       | —                                   | —      | —      | —      | —      | —      |
| Efficiency   | $\eta$    |          | 0.97                                | 0.97   | 0.97   | 0.97   | 0.97   | 0.97   |
| Heat dissipation at $I_e$                            | $P_V$     | W        | 22.5                                | 45     | 66     | 120    | 165    | 225    |
| Frame size   |           |          | FS2                                 | FS2    | FS2    | FS2    | FS2    | FS3    |

## 6 Technical Data

### 6.2 Specific rated operational data

| <b>VSA 35... series</b>                              |       |               |             |                                     |            |            |            |            |            |      |      |
|--|-------|---------------|-------------|-------------------------------------|------------|------------|------------|------------|------------|------|------|
| <b>Physical quantity</b>                             |       | <b>Symbol</b> | <b>Unit</b> | <b>017</b>                          | <b>022</b> | <b>022</b> | <b>028</b> | <b>034</b> | <b>043</b> |      |      |
| Rated operational current                            |       | $I_e$         | A           | 17                                  | 22         | 22         | 28         | 34         | 43         |      |      |
| Overload current for 60 s every 600 s                |       | $i_l$         | A           | 25.5                                | 33         | 33         | 42         | 51         | 64.5       |      |      |
| Apparent power at rated operation                    | 500 V | S             | kVA         | 10.4                                | 12.7       | 12.7       | 16         | 19.5       | 24.4       |      |      |
|  | 600 V | S             | kVA         | 12.5                                | 15.2       | 15.5       | 19.3       | 23.4       | 29.3       |      |      |
| Assigned Instance Motor Power                        | 500 V | P             | kW          | 11                                  | 15         | 15         | 18.5       | 22         | 30         |      |      |
|  | 575 V | P             | HP          | 15                                  | 20         | 20         | 25         | 30         | 40         |      |      |
| Power side (primary side):                           |       |               |             |                                     |            |            |            |            |            |      |      |
| Number of phases                                     |       |               |             | three-phase                         |            |            |            |            |            |      |      |
| Rated operating voltage                              |       |               |             | 500 V -10 % - 600 V +10 %, 50/60 Hz |            |            |            |            |            |      |      |
| Input current (phase current)                        |       |               |             | $I_{LN}$                            | A          | 21         | 26         | 26         | 33         | 40   | 49   |
| Minimum braking resistance                           |       |               |             | $R_B$                               | $\Omega$   | 40         | 40         | 22         | 22         | 22   | 22   |
| Switching frequency (pulse frequency)                |       |               |             |                                     |            |            |            |            |            |      |      |
| Default settings                                     |       |               |             | $f_{PWM}$                           | kHz        | 8          | 8          | 8          | 8          | 8    | 8    |
| Setting range  |       |               |             | $f_{PWM}$                           | kHz        | 24         | 24         | 24         | 24         | 24   | 24   |
| Maximum leakage current to earth (PE), without motor |       |               |             | $I_{PE}$                            | mA         | –          | –          | –          | –          | –    | –    |
| Efficiency   |       |               |             | $\eta$                              |            | 0.97       | 0.97       | 0.97       | 0.97       | 0.97 | 0.97 |
| Heat dissipation at $I_e$                            |       |               |             | $P_V$                               | W          | 330        | 450        | 450        | 555        | 660  | 850  |
| Frame size   |       |               |             |                                     |            | FS3        | FS3        | FS4        | FS4        | FS4  | FS4  |

## 6 Technical Data

### 6.2 Specific rated operational data

| <b>VSA 35... series</b>                              |       |               | <b>054</b>  | <b>065</b>                          | <b>078</b> | <b>105</b> | <b>130</b> | <b>150</b> |        |
|--|-------|---------------|-------------|-------------------------------------|------------|------------|------------|------------|--------|
| <b>Physical quantity</b>                             |       | <b>Symbol</b> | <b>Unit</b> |                                     |            |            |            |            |        |
| Rated operational current                            |       | $I_e$         | A           | 54                                  | 65         | 78         | 105        | 130        | 150    |
| Overload current for 60 s every 600 s                |       | $i_l$         | A           | 81                                  | 97.5       | 117        | 157.5      | 195        | 225    |
| Apparent power at rated operation                    | 500 V | S             | kVA         | 29.7                                | 35.2       | 45.2       | 60.5       | 71.5       | 79.1   |
|  | 600 V | S             | kVA         | 35.6                                | 42.2       | 54.3       | 72.6       | 85.9       | 95     |
| Assigned Instance Motor Power                        | 500 V | P             | kW          | 37                                  | 45         | 55         | 75         | 90         | 110    |
|  | 575 V | P             | HP          | 50                                  | 60         | 75         | 100        | 125        | 150    |
| Power side (primary side):                           |       |               |             |                                     |            |            |            |            |        |
| Number of phases                                     |       |               |             | three-phase                         |            |            |            |            |        |
| Rated operating voltage                              |       | $U_{LN}$      | V           | 500 V -10 % - 600 V +10 %, 50/60 Hz |            |            |            |            |        |
| Input current (phase current)                        |       | $I_{LN}$      | A           | 60                                  | 71         | 91         | 121        | 143        | 158    |
| Minimum braking resistance                           |       | $R_B$         | $\Omega$    | 12                                  | 12         | 6          | 6          | 6          | 6      |
| Switching frequency (pulse frequency)                |       |               |             |                                     |            |            |            |            |        |
| Default settings                                     |       | $f_{PWM}$     | kHz         | 8                                   | 8          | 4          | 4          | 4          | 4      |
| Setting range  |       | $f_{PWM}$     | kHz         | 4 - 24                              | 4 - 24     | 4 - 16     | 4 - 16     | 4 - 12     | 4 - 12 |
| Maximum leakage current to earth (PE), without motor |       | $I_{PE}$      | mA          | —                                   | —          | —          | —          | —          | —      |
| Efficiency   |       | $\eta$        |             | 0.97                                | 0.97       | 0.97       | 0.97       | 0.97       | 0.97   |
| Heat dissipation at $I_e$                            |       | $P_V$         | W           | 1110                                | 1350       | 1650       | 2250       | 2700       | 3300   |
| Frame size   |       |               |             | FS5                                 | FS5        | FS6        | FS6        | FS6        | FS6    |

## 6.3 Dimensions

### 6.3.1 Frame sizes FS2 and FS3 in IP20

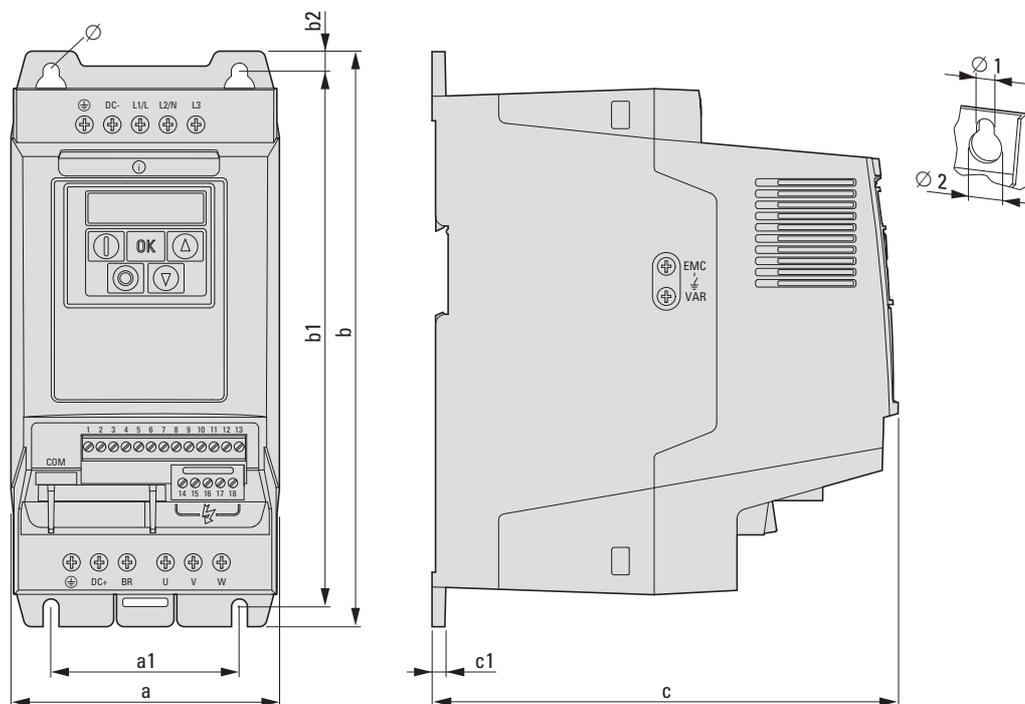


Figure 94: Sizes FS2 and FS3 in IP20 (NEMA 0)

**Table 23: Dimensions and weights for sizes FS2 and FS3 in IP20 (NEMA 0)**

| Frame size | a<br>[mm]<br>(in) | a1<br>[mm]<br>(in) | b<br>[mm]<br>(in) | b1<br>[mm]<br>(in) | b2<br>[mm]<br>(in) | c<br>[mm]<br>(in) | c1<br>[mm]<br>(in) | Ø1<br>[mm]<br>(in) | Ø2<br>[mm]<br>(in) | m<br>[kg]<br>(lbs) |
|------------|-------------------|--------------------|-------------------|--------------------|--------------------|-------------------|--------------------|--------------------|--------------------|--------------------|
| FS2        | 107<br>(4.2)      | 75<br>(3)          | 231<br>(9.1)      | 215<br>(8.5)       | 8<br>0.31          | 185.5<br>(7.3)    | 5<br>(0.2)         | 6.5<br>(0.26)      | 12.2<br>(0.48)     | 1.8<br>(3.97)      |
| FS3        | 131<br>(5.2)      | 100<br>(3.9)       | 273<br>(10.8)     | 255<br>(10)        | 8.5<br>0.33        | 204<br>(8)        | 5<br>(0.2)         | 6.5<br>(0.26)      | 12.2<br>(0.48)     | 3.5<br>(7.72)      |

1 in = 1" = 25.4 mm, 1 mm = 0.0394 in

## 6 Technical Data

### 6.3 Dimensions

#### 6.3.2 Frame sizes FS4 to FS7 in IP55

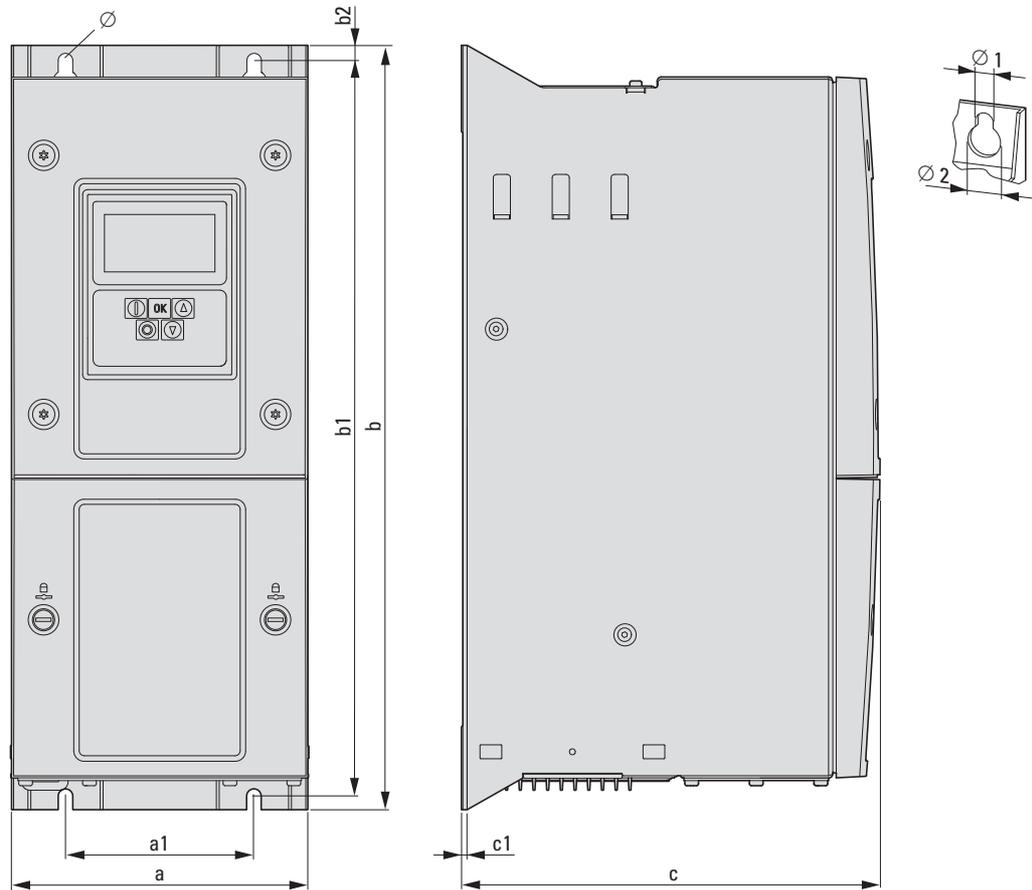


Figure 95: Sizes FS4 to FS7 in IP55 (NEMA 12)

**Table 24: Dimensions and weights for sizes FS4 to FS7 in IP55 (NEMA 12)**

| Frame size | a<br>[mm]<br>(in) | a1<br>[mm]<br>(in) | b<br>[mm]<br>(in) | b1<br>[mm]<br>(in) | b2<br>[mm]<br>(in) | c<br>[mm]<br>(in) | c1<br>[mm]<br>(in) | Ø1<br>[mm]<br>(in) | Ø2<br>[mm]<br>(in) | m<br>[kg]<br>(lbs) |
|------------|-------------------|--------------------|-------------------|--------------------|--------------------|-------------------|--------------------|--------------------|--------------------|--------------------|
| FS4        | 173<br>(6.8)      | 110<br>(4.3)       | 450<br>(17.7)     | 433<br>(17.1)      | 9<br>(0.35)        | 240<br>(9.7)      | 2<br>(0.79)        | 8<br>(0.32)        | 15<br>(0.59)       | 11.5<br>(25.35)    |
| FS5        | 235<br>(9.3)      | 175<br>(6.9)       | 540<br>(21.3)     | 520<br>(20.5)      | 12<br>(0.47)       | 270<br>(10)       | 2<br>(0.79)        | 8<br>(0.32)        | 15<br>(0.59)       | 22.5<br>(49.60)    |
| FS6        | 330<br>(13)       | 200<br>(7.9)       | 865<br>(34.1)     | 840<br>(33.1)      | 15<br>(0.59)       | 322<br>(13)       | 2<br>(0.79)        | 11<br>(0.43)       | 22<br>(0.87)       | 50<br>(110.23)     |
| FS7        | 330<br>(14.2)     | 200<br>(7.9)       | 1280<br>(50.4)    | 1255<br>(49.5)     | 15<br>(0.59)       | 348<br>(14.2)     | 2<br>(0.79)        | 11<br>(0.43)       | 22<br>(0.87)       | 80<br>(176.37)     |

1 in = 1" = 25.4 mm, 1 mm = 0.0394 in

### 6.3.3 Frame size FS8 in IP20

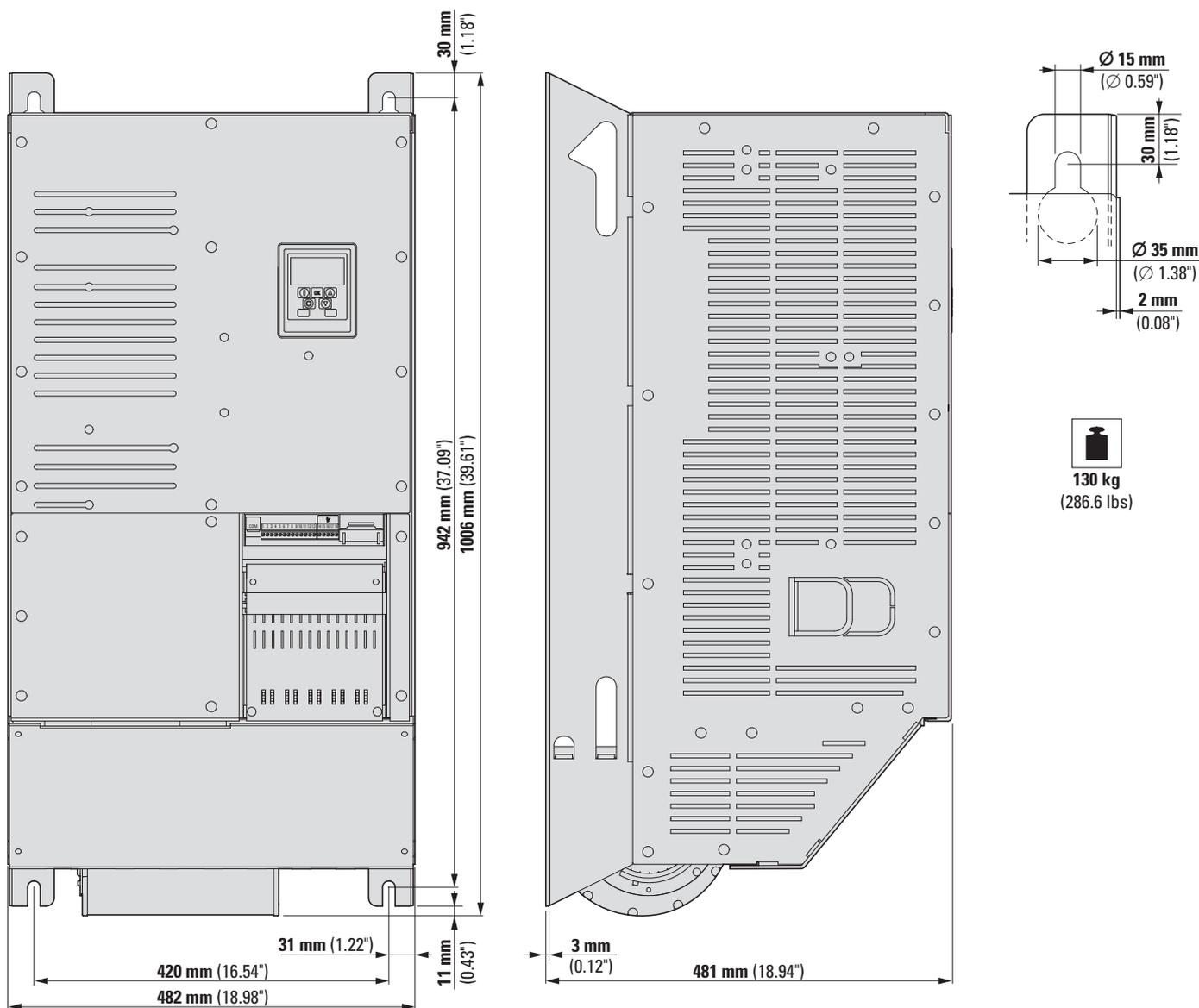


Figure 96: Frame size FS8 in IP20 (NEMA 0)

**Table 25: Dimensions and weights for frame size FS8 in IP20 (NEMA 0)**

| Frame size | a<br>[mm]<br>(in) | a1<br>[mm]<br>(in) | b<br>[mm]<br>(in) | b1<br>[mm]<br>(in) | b2<br>[mm]<br>(in) | c<br>[mm]<br>(in) | c1<br>[mm]<br>(in) | Ø 1<br>[mm]<br>(in) | Ø 2<br>[mm]<br>(in) | m<br>[kg]<br>(lbs) |
|------------|-------------------|--------------------|-------------------|--------------------|--------------------|-------------------|--------------------|---------------------|---------------------|--------------------|
| FS8        | 480<br>(18.9)     | 420<br>(16.5)      | 1005<br>(39.6)    | 944<br>(37.2)      | 30<br>(1.18)       | 480<br>(18.9)     | 3<br>(0.12)        | 15<br>(0.59)        | 35<br>(1.38)        | 130<br>(286.6)     |

1 in = 1" = 25.4 mm, 1 mm = 0.0394 in

## 6 Technical Data

### 6.3 Dimensions

#### 6.3.4 Frame sizes FS2 and FS3 in IP66

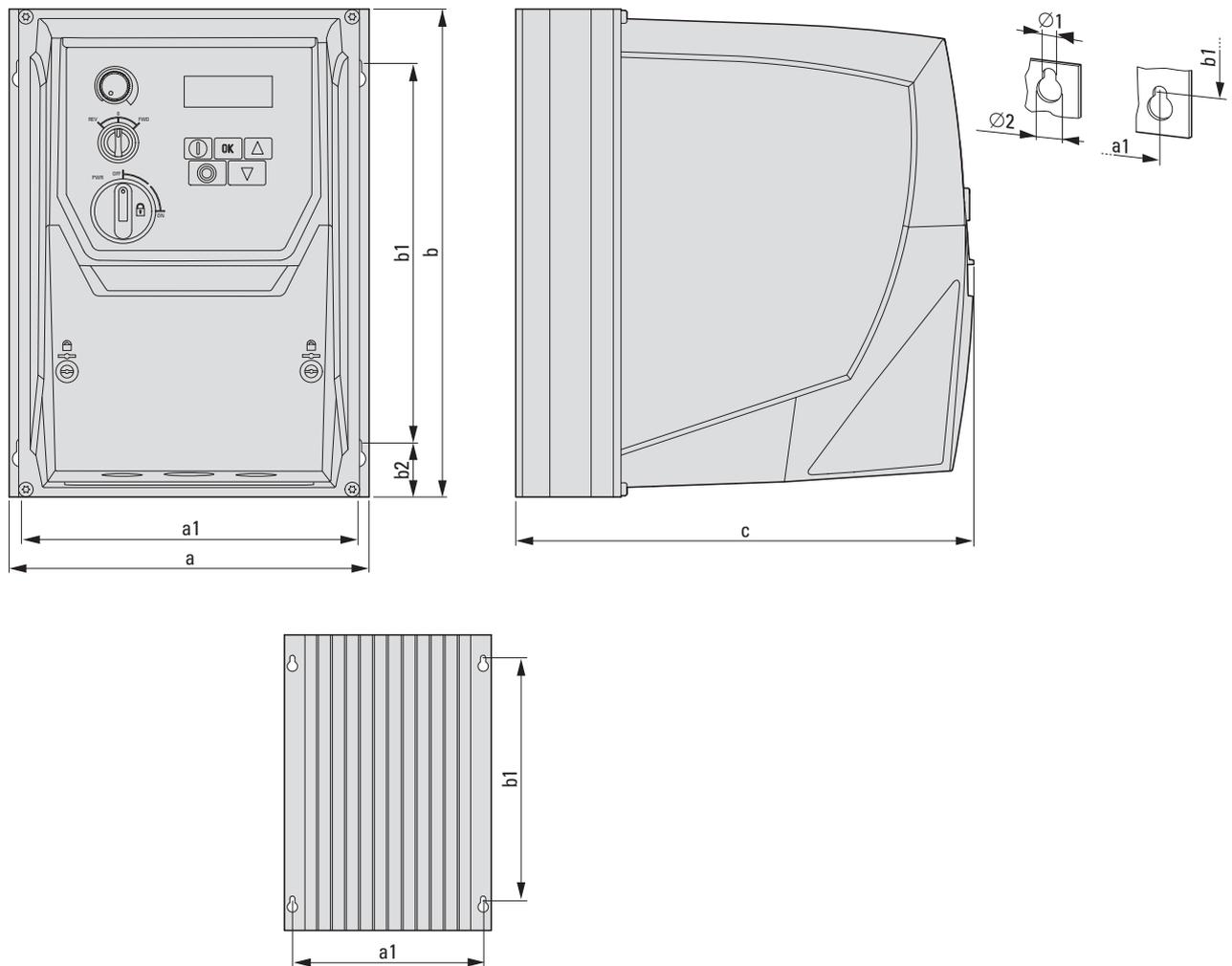


Figure 97: Frame sizes FS2 and FS3 in IP66 (NEMA 4X)

**Table 26: Dimensions and weights for sizes FS2 and FS3 in IP66 (NEMA 4X)**

| Frame size | a<br>[mm]<br>(in) | a1<br>[mm]<br>(in) | b<br>[mm]<br>(in) | b1<br>[mm]<br>(in) | b2<br>[mm]<br>(in) | c<br>[mm]<br>(in) | c1<br>[mm]<br>(in) | Ø 1<br>[mm]<br>(in) | Ø 2<br>[mm]<br>(in) | m<br>[kg]<br>(lbs) |
|------------|-------------------|--------------------|-------------------|--------------------|--------------------|-------------------|--------------------|---------------------|---------------------|--------------------|
| FS2        | 188<br>(7.4)      | 176<br>(6.93)      | 257<br>(10.12)    | 200<br>(7.87)      | 20<br>(0.79)       | 239<br>(9.42)     | 3.5<br>(0.14)      | 4.2<br>(0.16)       | 8.5<br>(0.33)       | 4.8<br>(10.6)      |
| FS3        | 211<br>(8.29)     | 198<br>(7.78)      | 310<br>(12.2)     | 252<br>(9.9)       | 25<br>(0.98)       | 266<br>(10.48)    | 3.5<br>(0.14)      | 4.2<br>(0.16)       | 8.5<br>(0.33)       | 7.3<br>(16.1)      |

1 in = 1" = 25.4 mm, 1 mm = 0.0394 in

## 6.4 Cable cross-sections

**Table 27: Cable cross-sections – voltage class 230 V**

| Device Type   | Frame size | Maximum terminal capacity |                             | Input current<br>$I_{LN}$<br>A | Feeder unit cross-sectional area      |                             | Output current<br>$I_e$<br>A | Motor connection cross-sectional area <sup>2)</sup> |                             |
|---|------------|---------------------------|-----------------------------|--------------------------------|---------------------------------------|-----------------------------|------------------------------|---|-----------------------------|
|   |            | mm <sup>2</sup>           | AWG/<br>kcmil <sup>1)</sup> |                                | L1/L, L2/N, L3, PE<br>mm <sup>2</sup> | AWG/<br>kcmil <sup>1)</sup> |                              | U, V, W, PE<br>mm <sup>2</sup>                      | AWG/<br>kcmil <sup>1)</sup> |
| <b>Mains voltage: 230 V</b>   |            |                           |                             |                                |                                       |                             |                              |   |                             |
| <b>Supply voltage (50/60 Hz) <math>U_{LN}</math> 200 (-10%) - 240 (+10 %) V</b>         |            |                           |                             |                                |                                       |                             |                              |   |                             |
| <b><math>U_e</math> 230 V AC, single-phase / <math>U_2</math> 230 V AC, three-phase</b> |            |                           |                             |                                |                                       |                             |                              |   |                             |
| VSA 124D3FB-...   | FS2        | 8                         | 8                           | 9                              | 2.5                                   | 14                          | 4.3                          | 1.5   | 14                          |
| VSA 127D0FB-...   | FS2        | 8                         | 8                           | 13                             | 4                                     | 12                          | 7                            | 1.5   | 14                          |
| VSA 2011FB-...  | FS2        | 8                         | 8                           | 19                             | 4                                     | 10                          | 10.5                         | 1.5   | 14                          |
| <b>Mains voltage: 230 V</b>   |            |                           |                             |                                |                                       |                             |                              |   |                             |
| <b>Supply voltage (50/60 Hz) <math>U_{LN}</math> 200 (-10%) - 240 (+10 %) V</b>         |            |                           |                             |                                |                                       |                             |                              |   |                             |
| <b><math>U_e</math> 230 V AC, three-phase / <math>U_2</math> 230 V AC, three-phase</b>  |            |                           |                             |                                |                                       |                             |                              |   |                             |
| VSA 324D3FB-...   | FS2        | 8                         | 8                           | 6                              | 1.5                                   | 14                          | 4.3                          | 1.5   | 14                          |
| VSA 327D0FB-...   | FS2        | 8                         | 8                           | 11                             | 2.5                                   | 14                          | 7                            | 1.5   | 14                          |
| VSA 32011FB-...   | FS2        | 8                         | 8                           | 13                             | 2.5                                   | 12                          | 10.5                         | 1.5   | 14                          |
| VSA 32018FB-...   | FS3        | 8                         | 8                           | 21                             | 6                                     | 10                          | 18                           | 2.5   | 10                          |
| VSA 32024FB-A20C  | FS3        | 8                         | 8                           | 26                             | 10                                    | 8                           | 24                           | 4   | 10                          |
| VSA 32024FB-B55C  | FS4        | 16                        | 5                           | 27                             | 10                                    | 8                           | 24                           | 4   | 10                          |
| VSA 32030FB-B55C  | FS4        | 16                        | 5                           | 33                             | 16                                    | 8                           | 30                           | 6   | 8                           |
| VSA 32046FB-B55C  | FS4        | 16                        | 5                           | 50                             | 25                                    | 4                           | 46                           | 10  | 6                           |
| VSA 32061FB-B55C  | FS5        | 35                        | 2                           | 64                             | 35                                    | 3                           | 61                           | 16  | 4                           |
| VSA 32072FB-B55C  | FS5        | 35                        | 2                           | 74                             | 50                                    | 2                           | 72                           | 25  | 3                           |
| VSA 32090FB-B55C  | FS6        | 150                       | 300                         | 99                             | 70                                    | 1                           | 90                           | 35  | 2                           |
| VSA 32110FB-B55C  | FS6        | 150                       | 300                         | 121                            | 70                                    | 2/0                         | 110                          | 50  | 1/0                         |
| VSA 32150FB-B55C  | FS6        | 150                       | 300                         | 160                            | 120                                   | 4/0                         | 150                          | 70  | 3/0                         |
| VSA 32180FB-B55C  | FS6        | 150                       | 300                         | 188                            | 120                                   | 4/0                         | 180                          | 95  | 4/0                         |
| VSA 32202FB-B55C  | FS7        | 150                       | 300                         | 207                            | 185                                   | 300                         | 202                          | 120   | 250                         |
| VSA 32248FB-B55C  | FS7        | 150                       | 300                         | 246                            | 2 x 95                                | 400                         | 248                          | 150   | 350                         |

- 1) AWG = American wire gauge  
kcmil = Thousands of circular mils (1 kcmil = 0.5067 mm<sup>2</sup>)  
2) Maximum motor cable length = 100 m (330 ft)

6 Technical Data  
6.4 Cable cross-sections

**Table 28: Cable cross-sections – voltage class 400 V**

| Device Type  | Frame size | Maximum terminal capacity |                             | Input current<br>$I_{LN}$<br>A | Feeder unit cross-sectional area |                             | Output current<br>$I_e$<br>A | Motor connection cross-sectional area <sup>2)</sup> |                             |
|--|------------|---------------------------|-----------------------------|--------------------------------|----------------------------------|-----------------------------|------------------------------|---|-----------------------------|
|  |            | mm <sup>2</sup>           | AWG/<br>kcmil <sup>1)</sup> |                                | L1/L, L2/N, L3, PE               |                             |                              | mm <sup>2</sup>                                     | AWG/<br>kcmil <sup>1)</sup> |
|  |            |                           |                             |                                | mm <sup>2</sup>                  | AWG/<br>kcmil <sup>1)</sup> |                              |   |                             |
| <b>Mains voltage: 400 V</b>  |            |                           |                             |                                |                                  |                             |                              |   |                             |
| <b>Supply voltage (50/60 Hz) <math>U_{LN}</math> 380 (-10%) - 480 (+10 %) V</b>        |            |                           |                             |                                |                                  |                             |                              |   |                             |
| <b><math>U_e</math> 400 V AC, three-phase / <math>U_2</math> 400 V AC, three-phase</b> |            |                           |                             |                                |                                  |                             |                              |   |                             |
| VSA 342D2FB-...  | FS2        | 8                         | 8                           | 3.5                            | 1.5                              | 14                          | 2.2                          | 1.5   | 14                          |
| VSA 344D1FB-...  | FS2        | 8                         | 8                           | 6                              | 1.5                              | 14                          | 4.1                          | 1.5   | 14                          |
| VSA 345D8FB-...  | FS2        | 8                         | 8                           | 7.5                            | 1.5                              | 14                          | 5.8                          | 1.5   | 14                          |
| VSA 349D5FB-...  | FS2        | 8                         | 8                           | 12                             | 2.5                              | 14                          | 9.5                          | 1.5   | 14                          |
| VSA 34014FB-...  | FS3        | 8                         | 8                           | 17                             | 4                                | 10                          | 14                           | 1.5   | 12                          |
| VSA 34018FB-...  | FS3        | 8                         | 8                           | 22                             | 6                                | 10                          | 18                           | 2.5   | 10                          |
| VSA 34024FB-A20C   | FS3        | 8                         | 8                           | 28                             | 8                                | 8                           | 24                           | 4   | 10                          |
| VSA 34024FB-B55C   | FS4        | 16                        | 5                           | 28                             | 10                               | 5                           | 24                           | 4   | 10                          |
| VSA 34030FB-B55C   | FS4        | 16                        | 5                           | 34                             | 16                               | 8                           | 30                           | 6   | 8                           |
| VSA 34039FB-B55C   | FS4        | 16                        | 5                           | 44                             | 16                               | 6                           | 39                           | 10  | 8                           |
| VSA 34046FB-B55C   | FS4        | 16                        | 5                           | 52                             | 16                               | 5                           | 46                           | 10  | 6                           |
| VSA 34061FB-B55C   | FS5        | 35                        | 2                           | 66                             | 25                               | 4                           | 61                           | 16  | 4                           |
| VSA 34072FB-B55C   | FS5        | 35                        | 2                           | 77                             | 35                               | 3                           | 72                           | 25  | 3                           |
| VSA 34090FB-B55C   | FS6        | 150                       | 300                         | 103                            | 50                               | 1                           | 90                           | 35  | 2                           |
| VSA 34110FB-B55C   | FS6        | 150                       | 300                         | 126                            | 70                               | 1/0                         | 110                          | 50  | 1/0                         |
| VSA 34150FB-B55C   | FS6        | 150                       | 300                         | 165                            | 95                               | 3/0                         | 150                          | 70  | 3/0                         |
| VSA 34180FB-B55C   | FS6        | 150                       | 300                         | 192                            | 120                              | 4/0                         | 180                          | 95  | 4/0                         |
| VSA 34202FB-B55C   | FS7        | 150                       | 300                         | 211                            | 185                              | 300                         | 202                          | 120   | 250                         |
| VSA 34240FB-B55C   | FS7        | 150                       | 300                         | 241                            | 185                              | 350                         | 240                          | 150   | 350                         |
| VSA 34302FB-B55C   | FS7        | 150                       | 300                         | 299                            | 2 x 95                           | 600                         | 302                          | 2 x 70  | 500                         |
| VSA 34370FB-B20C   | FS8        | 240                       | 450                         | 377                            | 2 x 150                          | 750                         | 370                          | 2 x 95  | 750                         |
| VSA 34450FB-B20C   | FS8        | 240                       | 450                         | 459                            | 2 x 150                          | 1250                        | 450                          | 2 x 120   | 1250                        |

- 1) AWG = American wire gauge  
kcmil = Thousands of circular mils (1 kcmil = 0.5067 mm<sup>2</sup>)  
2) Maximum motor cable length = 100 m (330 ft)

**Table 29: Cable cross-sections – voltage class 575 V**

| Device Type  | Frame size | Maximum terminal capacity |                             | Input current<br>$I_{LN}$<br>A | Feeder unit cross-sectional area<br>L1/L, L2/N, L3, PE |                             | Output current<br>$I_e$<br>A | Motor connection cross-sectional area <sup>2)</sup><br>U, V, W, PE |                             |
|--|------------|---------------------------|-----------------------------|--------------------------------|--|-----------------------------|------------------------------|--|-----------------------------|
|  |            | mm <sup>2</sup>           | AWG/<br>kcmil <sup>1)</sup> |                                | mm <sup>2</sup>  | AWG/<br>kcmil <sup>1)</sup> |                              | mm <sup>2</sup>  | AWG/<br>kcmil <sup>1)</sup> |
| <b>Mains voltage: 575 V</b>  |            |                           |                             |                                |  |                             |                              |  |                             |
| <b>Supply voltage (50/60 Hz) <math>U_{LN}</math> 500 (-10%) - 600 (+10 %) V</b>        |            |                           |                             |                                |  |                             |                              |  |                             |
| <b><math>U_e</math> 575 V AC, three-phase / <math>U_2</math> 575 V AC, three-phase</b> |            |                           |                             |                                |  |                             |                              |  |                             |
| VSA 352D1NB-...  | FS2        | 8                         | 8                           | 3.5                            | 1.5  | 14                          | 2.1                          | 1.5  | 14                          |
| VSA 353D1NB-...  | FS2        | 8                         | 8                           | 4.5                            | 1.5  | 14                          | 3.1                          | 1.5  | 14                          |
| VSA 354D1NB-...  | FS2        | 8                         | 8                           | 5                              | 1.5  | 14                          | 4.1                          | 1.5  | 14                          |
| VSA 356D5NB-...  | FS2        | 8                         | 8                           | 9                              | 1.5  | 14                          | 6.5                          | 1.5  | 14                          |
| VSA 359D0NB-...  | FS2        | 8                         | 8                           | 12                             | 2.5  | 14                          | 9                            | 1.5  | 14                          |
| VSA 35012NB-...  | FS3        | 8                         | 8                           | 15                             | 4  | 12                          | 12                           | 1.5  | 14                          |
| VSA 35017NB-...  | FS3        | 8                         | 8                           | 21                             | 6  | 10                          | 17                           | 2.5  | 10                          |
| VSA 35022NB-A20C   | FS3        | 8                         | 8                           | 26                             | 10   | 8                           | 22                           | 4  | 10                          |
| VSA 35022NB-B55C   | FS4        | 16                        | 5                           | 26                             | 10   | 8                           | 22                           | 4  | 10                          |
| VSA 35028NB-B55C   | FS4        | 16                        | 5                           | 33                             | 16   | 8                           | 28                           | 6  | 8                           |
| VSA 35034NB-B55C   | FS4        | 16                        | 5                           | 40                             | 16   | 6                           | 34                           | 6  | 8                           |
| VSA 35043NB-B55C   | FS4        | 16                        | 5                           | 49                             | 16   | 6                           | 43                           | 10   | 6                           |
| VSA 35054NB-B55C   | FS5        | 35                        | 2                           | 60                             | 25   | 4                           | 54                           | 16   | 4                           |
| VSA 35065NB-B55C   | FS5        | 35                        | 2                           | 71                             | 35   | 3                           | 65                           | 25   | 4                           |
| VSA 35078NB-B55C   | FS6        | 150                       | 300                         | 91                             | 50   | 2                           | 78                           | 25   | 3                           |
| VSA 35105NB-B55C   | FS6        | 150                       | 300                         | 121                            | 70   | 1/0                         | 105                          | 50   | 1/0                         |
| VSA 35130NB-B55C   | FS6        | 150                       | 300                         | 143                            | 70   | 2/0                         | 130                          | 70   | 2/0                         |
| VSA 35150NB-B55C   | FS6        | 150                       | 300                         | 158                            | 95   | 2/0                         | 150                          | 70   | 3/0                         |

- 1) AWG = American wire gauge  
kcmil = Thousands of circular mils (1 kcmil = 0.5067 mm<sup>2</sup>)  
2) Maximum motor cable length = 100 m (330 ft)

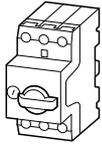
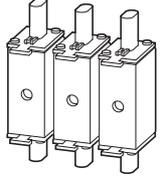
## 6 Technical Data

### 6.5 Fuses

#### 6.5 Fuses

The circuit-breakers and fuses listed below are examples and can be used without additional measures. If you use other circuit-breakers and/or fuses, make sure to take their protection characteristic and operational voltage into account. When using other circuit-breakers, it may be necessary to also use fuses depending on the circuit-breaker's model, design, and settings. There may also be limitations concerning the short-circuit capacity and the supply network's characteristic, and these must also be taken into account when selecting circuit-breakers and/or fuses.

**Table 30: Protective devices**

| Symbol  | Description   |
|---|---|
| ①    | <p><b>Miniature circuit breakers</b><br/>           FAZ-B.../1N: 1 pole + N<br/>           FAZ-B.../2: 2 pole<br/>           FAZ-B.../3: 3 pole<br/>           Rated operating voltage: 230/400 V AC<br/>           Switching capacity: 15 kA</p>   |
| ②   | <p><b>Motor-Protective Circuit-Breakers</b><br/>           PKM0..., PKZM4...: 3 pole<br/>           Rated operating voltage: 690V AC<br/>           Switching capacity:<br/>           • PKM0: 150 kA to 12 A and 50 kA to 32 A<br/>           • PKZM4: 50 kA</p>   |
| ③  | <p><b>Circuit-breaker</b><br/>           NZMC...: 3 pole<br/>           Rated operating voltage: 690V AC<br/>           Switching capacity: 36 kA</p>   |
| ④  | <p><b>Fuse</b><br/>           Rated operating voltage: 500V AC<br/>           Switching capacity: 50 kA<br/>           Size: DII, E27 / DIII, E33<br/>           Fuse base: S27... / S33...</p>   |
| ⑤  | <p><b>Fuse Class J</b><br/>           Rated operating voltage: 600V AC<br/>           Switching capacity: 300 kA<br/>           Fuse bases:<br/>           • up to 30 A: J60030...<br/>           • 35 - 60 A: J60060...<br/>           • 70 - 100 A: JM60100...<br/>           • 110 - 200 A: JM60200...<br/>           • 225 - 400 A: JM60400...<br/>           • 450 - 600 A: JM60600...</p> |
| ⑥  | <p><b>Fuse gG</b><br/>           Rated operating voltage:<br/>           • 400 V AC (NHG...B-400)<br/>           • 500 V AC (NHG...B)<br/>           • 660 V AC (NHG...B-660)<br/>           • 690 V AC (NHG...B-690)<br/>           Switching capacity: 120 kA<br/>           Size NHG...: 000 to 3<br/>           Fuse base: NH fuse bases<br/>           (SD = 1 pole, TD = 3 pole)</p>      |

**Table 31: Specified fuses – voltage class 230 V**

| Device Type | Input current<br>$I_{LN}$<br>A | Fuse or miniature circuit-breaker |                       |  |                    |   |                       |
|-------------|--------------------------------|-----------------------------------|-----------------------|--|--------------------|---|-----------------------|
|             |                                | IEC (Type B or gG)                |                       |  | UL (Class CC or J) |   |                       |
|             |                                | A                                 | Johnson Controls type |  |                    | A | Johnson Controls type |

**Mains voltage: 230 V**

**Supply voltage (50/60 Hz)  $U_{LN}$  200 (-10%) - 240 (+10 %) V**

**$U_e$  230 V AC, single-phase /  $U_2$  230 V AC, three-phase**

|                 |    | ①  | ②, 2 phase | ④         | ⑤               |    |          |
|-----------------|----|----|------------|-----------|-----------------|----|----------|
| VSA 124D3FB-... | 9  | 16 | FAZ-B16/1N | FAZ-B16/2 | Z-DII/SE-16A/GG | 15 | LPJ-15SP |
| VSA 127D0FB-... | 13 | 20 | FAZ-B20/1N | FAZ-B20/2 | Z-DII/SE-20A/GG | 20 | LPJ-20SP |
| VSA 12011FB-... | 19 | 25 | FAZ-B25/1N | FAZ-B25/2 | Z-DII/SE-25A/GG | 25 | LPJ-25SP |

**Mains voltage: 230 V**

**Supply voltage (50/60 Hz)  $U_{LN}$  200 (-10%) - 240 (+10 %) V**

**$U_e$  230 V AC, three-phase /  $U_2$  230 V AC, three-phase**

|                  |     | ①   | ②, ③      | ④, ⑥       | ⑤                |      |           |
|------------------|-----|-----|-----------|------------|------------------|------|-----------|
| VSA 324D3FB-...  | 6   | 10  | FAZ-B10/3 | PKM0-10    | Z-DII/SE-10A/GG  | 10   | LPJ-10SP  |
| VSA 327D0FB-...  | 11  | 16  | FAZ-B16/3 | PKM0-16    | Z-DII/SE-16A/GG  | 15   | LPJ-15SP  |
| VSA 32011FB-...  | 13  | 16  | FAZ-B16/3 | PKM0-16    | Z-DII/SE-16A/GG  | 17.5 | LPJ-17½SP |
| VSA 32018FB-...  | 21  | 32  | FAZ-B32/3 | PKM0-32    | Z-DII/SE-35A/GG  | 30   | LPJ-30SP  |
| VSA 32024FB-A20C | 26  | 40  | FAZ-B40/3 | PKZM4-40   | Z-DIII/SE-50A/GG | 40   | LPJ-40SP  |
| VSA 32024FB-B55C | 27  | 40  | FAZ-B40/3 | PKZM4-40   | Z-DIII/SE-50A/GG | 40   | LPJ-40SP  |
| VSA 32030FB-B55C | 33  | 50  | FAZ-B50/3 | PKZM4-50   | Z-DIII/SE-50A/GG | 50   | LPJ-50SP  |
| VSA 32046FB-B55C | 50  | 80  | –         | NZMC1-S80  | 80NHG000B-400    | 70   | LPJ-70SP  |
| VSA 32061FB-B55C | 64  | 100 | –         | NZMC1-S100 | 100NHG000B-400   | 90   | LPJ-90SP  |
| VSA 32072FB-B55C | 74  | 125 | –         | NZMC2-S125 | 125NHG000B-400   | 110  | LPJ-110SP |
| VSA 32090FB-B55C | 99  | 160 | –         | NZMC2-S160 | 160NHG000B-400   | 150  | LPJ-150SP |
| VSA 32110FB-B55C | 121 | 160 | –         | NZMC2-S160 | 160NHG000B-400   | 175  | LPJ-175SP |
| VSA 32150FB-B55C | 160 | 250 | –         | NZMC3-S250 | 250NHG1B-400     | 225  | LPJ-225SP |
| VSA 32180FB-B55C | 188 | 250 | –         | NZMC3-S250 | 250NHG1B-400     | 250  | LPJ-250SP |
| VSA 32202FB-B55C | 207 | 300 | –         | NZMC3-S320 | 315NHG2B-400     | 300  | LPJ-300SP |
| VSA 32248FB-B55C | 246 | 400 | –         | NZMC3-S400 | 400NHG2B-400     | 350  | LPJ-350SP |

**Note:** Numbers ①, ②, ③, ④, ⑤, ⑥ refer to the drawings in Table 30.

## 6 Technical Data

### 6.5 Fuses

**Table 32: Specified fuses – voltage class 400 V**

| Device Type | Input current<br><br>$I_{LN}$<br><br>A | Fuse or miniature circuit-breaker |                       |   |                       |                    |                       |
|-------------|--|-----------------------------------|-----------------------|---|-----------------------|--------------------|-----------------------|
|             |  | IEC (Type B or gG)                |                       |   |                       | UL (Class CC or J) |                       |
|             |  | A                                 | Johnson Controls type | A | Johnson Controls type | A                  | Johnson Controls type |

**Mains voltage: 400 V**

**Supply voltage (50/60 Hz)  $U_{LN}$  380 (-10%) - 480 (+10 %) V**

**$U_e$  400 V AC, three-phase /  $U_2$  400 V AC, three-phase**

|                  |     | ①, max. 400 V | ②, ③      | ④, ⑥        | ⑤                |     |           |
|------------------|-----|---------------|-----------|-------------|------------------|-----|-----------|
| VSA 342D2FB-...  | 3.5 | 6             | FAZ-B6/3  | PKM0-6.3    | Z-DII/SE-6A/GG   | 6   | LPJ-6SP   |
| VSA 344D1FB-...  | 6   | 10            | FAZ-B10/3 | PKM0-10     | Z-DII/SE-10A/GG  | 10  | LPJ-10SP  |
| VSA 345D8FB-...  | 7.5 | 10            | FAZ-B10/3 | PKM0-10     | Z-DII/SE-10A/GG  | 10  | LPJ-10SP  |
| VSA 349D5FB-...  | 12  | 16            | FAZ-B16/3 | PKM0-16     | Z-DII/SE-16A/GG  | 15  | LPJ-15SP  |
| VSA 34014FB-...  | 17  | 25            | FAZ-B25/3 | PKM0-25     | Z-DII/SE-25A/GG  | 25  | LPJ-25SP  |
| VSA 34018FB-...  | 22  | 32            | FAZ-B32/3 | PKM0-32     | Z-DIII/SE-35A/GG | 30  | LPJ-30SP  |
| VSA 34024FB-...  | 28  | 40            | FAZ-B40/3 | PKZM4-40    | Z-DIII/SE-50A/GG | 40  | LPJ-40SP  |
| VSA 34030FB-B55C | 34  | 50            | FAZ-B50/3 | PKZM4-50    | Z-DIII/SE-50A/GG | 50  | LPJ-50SP  |
| VSA 34039FB-B55C | 44  | 63            | FAZ-B63/3 | PKZM4-58    | Z-DIII/SE-63A/GG | 60  | LPJ-60SP  |
| VSA 34046FB-B55C | 52  | 80            | –         | NZMC1-S80   | 80NHG000B-400    | 70  | LPJ-70SP  |
| VSA 34061FB-B55C | 66  | 80            | –         | NZMC1-S80   | 80NHG000B-400    | 80  | LPJ-80SP  |
| VSA 34072FB-B55C | 77  | 100           | –         | NZMC1-S100  | 100NHG000B-400   | 100 | LPJ-100SP |
| VSA 34090FB-B55C | 103 | 125           | –         | NZMC2-S125  | 125NHG000B-400   | 125 | LPJ-125SP |
| VSA 34110FB-B55C | 126 | 160           | –         | NZMC2-S160  | 160NHG000B-400   | 150 | LPJ-150SP |
| VSA 34150FB-B55C | 165 | 200           | –         | NZMC2-S200  | 200NHG1B-400     | 200 | LPJ-200SP |
| VSA 34180FB-B55C | 192 | 250           | –         | NZMC3-S250  | 250NHG1B-400     | 250 | LPJ-250SP |
| VSA 34202FB-B55C | 211 | 300           | –         | NZMC3-S320  | 315NHG2B-400     | 300 | LPJ-300SP |
| VSA 34240FB-B55C | 241 | 400           | –         | NZMC3-S400  | 400NHG2B-400     | 350 | LPJ-350SP |
| VSA 34302FB-B55C | 299 | 400           | –         | NZMC3-S400  | 400NHG2B-400     | 400 | LPJ-400SP |
| VSA 34370FB-B20C | 377 | 500           | –         | NZMC3-S500  | 500NHG3B-400     | 500 | LPJ-500SP |
| VSA 34450FB-B20C | 459 | 600           | –         | NZMN3-AE630 | 630NHG3B-400     | 600 | LPJ-600SP |

**Note:** Numbers ①, ②, ③, ④, ⑤, ⑥ refer to the drawings in Table 30.

**Table 33: Specified fuses – voltage class 575 V**

| Device Type  | Input current<br>$I_{LN}$<br>A | Fuse or miniature circuit-breaker |                       |               |                       |                    |                       |
|--|--------------------------------|-----------------------------------|-----------------------|---------------|-----------------------|--------------------|-----------------------|
|  |                                | IEC (Type B or gG)                |                       |               |                       | UL (Class CC or J) |                       |
|  |                                | A                                 | Johnson Controls type | A             | Johnson Controls type | A                  | Johnson Controls type |
| <b>Mains voltage: 575 V</b>  |                                |                                   |                       |               |                       |                    |                       |
| <b>Supply voltage (50/60 Hz) <math>U_{LN}</math> 500 (-10%) - 600 (+10 %) V</b>        |                                |                                   |                       |               |                       |                    |                       |
| <b><math>U_e</math> 575 V AC, three-phase / <math>U_2</math> 575 V AC, three-phase</b> |                                |                                   |                       |               |                       |                    |                       |
|  |                                | ②, ③                              |                       | ⑥, max. 500 V | ⑥                     |                    | ⑤                     |
| VSA 352D1NB-...  | 3.5                            | 6                                 | PKM0-6.3              | 6NHG000B      | 6NHG000B-690          | 6                  | LPJ-6SP               |
| VSA 353D1NB-...  | 4.5                            | 10                                | PKM0-10               | 10NHG000B     | 10NHG000B-690         | 6                  | LPJ-6SP               |
| VSA 354D1NB-...  | 5                              | 10                                | PKM0-10               | 10NHG000B     | 10NHG000B-690         | 10                 | LPJ-10SP              |
| VSA 356D5NB-...  | 9                              | 16                                | PKM0-16               | 16NHG000B     | 16NHG000B-690         | 15                 | LPJ-15SP              |
| VSA 359D0NB-...  | 12                             | 16                                | PKM0-16               | 16NHG000B     | 16NHG000B-690         | 15                 | LPJ-15SP              |
| VSA 35012NB-...  | 15                             | 20                                | PKM0-20               | 20NHG000B     | 20NHG000B-690         | 20                 | LPJ-20SP              |
| VSA 35017NB-...  | 21                             | 32                                | PKM0-32               | 32NHG000B     | 32NHG000B-690         | 30                 | LPJ-30SP              |
| VSA 35022NB-...  | 26                             | 40                                | PKZM4-40              | 40NHG000B     | 40NHG000B-690         | 35                 | LPJ-35SP              |
| VSA 35028NB-B55C   | 33                             | 50                                | PKZM4-50              | 50NHG000B     | 50NHG000B-690         | 45                 | LPJ-45SP              |
| VSA 35034NB-B55C   | 40                             | 63                                | NZMC1-S63             | 63NHG000B     | 63NHG000B-690         | 60                 | LPJ-60SP              |
| VSA 35043NB-B55C   | 49                             | 63                                | NZMC1-S80             | 63NHG000B     | 63NHG000B-690         | 70                 | LPJ-70SP              |
| VSA 35054NB-B55C   | 60                             | 80                                | NZMC1-S80             | 80NHG000B     | 80NHG000B-690         | 80                 | LPJ-80SP              |
| VSA 35065NB-B55C   | 71                             | 100                               | NZMC1-S100            | 100NHG000B    | 100NHG000B-690        | 100                | LPJ-100SP             |
| VSA 35078NB-B55C   | 91                             | 125                               | NZMC2-S125            | 125NHG000B    | 125NHG000B-690        | 125                | LPJ-125SP             |
| VSA 35105NB-B55C   | 121                            | 160                               | NZMC2-S160            | 160NHG000B    | 160NHG000B-660        | 150                | LPJ-150SP             |
| VSA 35130NB-B55C   | 143                            | 160                               | NZMC2-S160            | 160NHG000B    | 160NHG000B-660        | 175                | LPJ-175SP             |
| VSA 35150NB-B55C   | 158                            | 200                               | NZMC2-S200            | 200NHG1B      | 200NHG1B-690          | 175                | LPJ-175SP             |

**Note:** Numbers ①, ②, ③, ④, ⑤, ⑥ refer to the drawings in Table 30.

### 6.6 Mains contactors

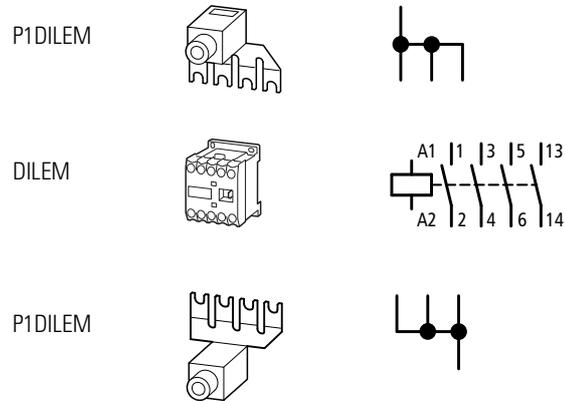


Figure 98: Mains contactor at single-phase connection (VSA 12...)

**Table 34: Mains contactors – VSA voltage class 230 V (single-phase)**

| Device Type   | Input current<br>$I_{LN}$<br>A | Mains contactor (thermal current AC-1) |    |                           |    |
|---|--------------------------------|--|----|---------------------------|----|
|   |                                | Type<br>max. 50 °C and IEC             | A  | Type<br>max. 40 °C and UL | A  |
| <b>Mains voltage: 230 V</b>   |                                |  |    |                           |    |
| <b>Supply voltage (50/60 Hz) <math>U_{LN}</math> 200 (-10%) - 240 (+10 %) V</b>         |                                |  |    |                           |    |
| <b><math>U_e</math> 230 V AC, single-phase / <math>U_2</math> 230 V AC, three-phase</b> |                                |  |    |                           |    |
| VSA 124D3FB-...   | 9                              | DILEM-...+P1DILEM                      | 50 | DILEM-...+P1DILEM         | 50 |
| VSA 127D0FB-...   | 13                             | DILEM-...+P1DILEM                      | 50 | DILEM-...+P1DILEM         | 50 |
| VSA 12011FB-...   | 19                             | DILEM-...+P1DILEM                      | 50 | DILEM-...+P1DILEM         | 50 |

**Table 35: Mains contactors – VSA voltage class 230 V (three-phase)**

| Device Type  | Input current<br>$I_{LN}$<br>A | Mains contactor (thermal current AC-1) |     |                           |     |
|--|--------------------------------|--|-----|---------------------------|-----|
|  |                                | Type<br>max. 50 °C and IEC             | A   | Type<br>max. 40 °C and UL | A   |
|  |                                |  |     |                           |     |
| <b>Mains voltage: 230 V</b>  |                                |  |     |                           |     |
| <b>Supply voltage (50/60 Hz) <math>U_{LN}</math> 200 (-10%) - 240 (+10 %) V</b>        |                                |  |     |                           |     |
| <b><math>U_e</math> 230 V AC, three-phase / <math>U_2</math> 230 V AC, three-phase</b> |                                |  |     |                           |     |
| VSA 324D3FB-...  | 6                              | DILEM-...                              | 20  | DILEM-...                 | 20  |
| VSA 327D0FB-...  | 11                             | DILEM-...                              | 20  | DILEM-...                 | 20  |
| VSA 32011FB-...  | 13                             | DILEM-...                              | 20  | DILEM-...                 | 20  |
| VSA 32018FB-...  | 21                             | DILM17-...                             | 38  | DILM17-...                | 40  |
| VSA 32024FB-A20C   | 26                             | DILM17-...                             | 38  | DILM17-...                | 40  |
| VSA 32024FB-B55C   | 27                             | DILM17-...                             | 38  | DILM17-...                | 40  |
| VSA 32030FB-B55C   | 33                             | DILM17-...                             | 38  | DILM25-...                | 45  |
| VSA 32046FB-B55C   | 50                             | DILM40-...                             | 57  | DILM50-...                | 80  |
| VSA 32061FB-B55C   | 64                             | DILM50-...                             | 71  | DILM50-...                | 80  |
| VSA 32072FB-B55C   | 74                             | DILM65-...                             | 88  | DILM80-...                | 110 |
| VSA 32090FB-B55C   | 99                             | DILM95-...                             | 125 | DILM95-...                | 130 |
| VSA 32110FB-B55C   | 121                            | DILM95-...                             | 125 | DILM115-...               | 160 |
| VSA 32150FB-B55C   | 160                            | DILM150-...                            | 180 | DILM170-...               | 225 |
| VSA 32180FB-B55C   | 188                            | DILM170-...                            | 200 | DILM185A-...              | 337 |
| VSA 32202FB-B55C   | 207                            | DILM185A-...                           | 301 | DILM185A-...              | 337 |
| VSA 32248FB-B55C   | 246                            | DILM185A-...                           | 301 | DILM185A-...              | 337 |

6 Technical Data  
6.6 Mains contactors

**Table 36: Mains contactor – VSA voltage class 400 V**

| Device Type  | Input current<br>$I_{LN}$<br>A | Mains contactor (thermal current AC-1) |     |                           |     |
|--|--------------------------------|--|-----|---------------------------|-----|
|  |                                | Type<br>max. 50 °C and IEC             | A   | Type<br>max. 40 °C and UL | A   |
| <b>Mains voltage: 400 V</b>  |                                |  |     |                           |     |
| <b>Supply voltage (50/60 Hz) <math>U_{LN}</math> 380 (-10%) - 480 (+10 %) V</b>        |                                |  |     |                           |     |
| <b><math>U_e</math> 400 V AC, three-phase / <math>U_2</math> 400 V AC, three-phase</b> |                                |  |     |                           |     |
| VSA 342D2FB-...  | 3.5                            | DILEM-...                              | 20  | DILEM-...                 | 20  |
| VSA 344D1FB-...  | 6                              | DILEM-...                              | 20  | DILEM-...                 | 20  |
| VSA 345D8FB-...  | 7.5                            | DILEM-...                              | 20  | DILEM-...                 | 20  |
| VSA 349D5FB-...  | 12                             | DILEM-...                              | 20  | DILEM-...                 | 20  |
| VSA 34014FB-...  | 17                             | DILEM-...                              | 20  | DILM7-...                 | 22  |
| VSA 34018FB-...  | 22                             | DILM17-...                             | 38  | DILM17-...                | 40  |
| VSA 34024FB-...  | 28                             | DILM17-...                             | 38  | DILM17-...                | 40  |
| VSA 34030FB-B55C   | 34                             | DILM17-...                             | 38  | DILM25-...                | 45  |
| VSA 34039FB-B55C   | 44                             | DILM40-...                             | 57  | DILM40-...                | 60  |
| VSA 34046FB-B55C   | 52                             | DILM40-...                             | 57  | DILM50-...                | 80  |
| VSA 34061FB-B55C   | 66                             | DILM50-...                             | 71  | DILM65-...                | 98  |
| VSA 34072FB-B55C   | 77                             | DILM65-...                             | 88  | DILM65-...                | 98  |
| VSA 34090FB-B55C   | 103                            | DILM95-...                             | 125 | DILM95-...                | 130 |
| VSA 34110FB-B55C   | 126                            | DILM115-...                            | 142 | DILM150-...               | 180 |
| VSA 34150FB-B55C   | 165                            | DILM150-...                            | 180 | DILM170-...               | 225 |
| VSA 34180FB-B55C   | 192                            | DILM185A-...                           | 301 | DILM185A-...              | 337 |
| VSA 34202FB-B55C   | 211                            | DILM185A-...                           | 301 | DILM185A-...              | 337 |
| VSA 34240FB-B55C   | 241                            | DILM185A-...                           | 301 | DILM185A-...              | 337 |
| VSA 34302FB-B55C   | 299                            | DILM185A-...                           | 301 | DILM250-...               | 400 |
| VSA 34370FB-B20C <sup>1)</sup>   | 377                            | DILM300A-...                           | 385 | DILM400-...               | 612 |
| VSA 34450FB-B20C <sup>2)</sup>   | 459                            | DILM400-...                            | 548 | DILM400-...               | 612 |

If it is not guaranteed that the system percentage impedance is greater than or equal to 1%, a mains choke must be connected.

Your  $u_k$  value should fall between 1 and 4%.

Examples:

- 1) VSA 34370FB-320C with mains choke DX-LN3-370
- 2) VSA 34450FB-320C with mains choke DX-LN3-450

**Table 37: Mains contactor – VSA voltage class 575 V**

| Device Type  | Input current | Mains contactor (thermal current AC-1) |     |                           |     |
|--|---------------|--|-----|---------------------------|-----|
|  | $I_{LN}$      | Type<br>max. 50 °C and IEC             |     | Type<br>max. 40 °C and UL |     |
|  | A             |  | A   |                           | A   |
| <b>Mains voltage: 575 V</b>  |               |  |     |                           |     |
| <b>Supply voltage (50/60 Hz) <math>U_{LN}</math> 500 (-10%) - 600 (+10 %) V</b>        |               |  |     |                           |     |
| <b><math>U_e</math> 575 V AC, three-phase / <math>U_2</math> 575 V AC, three-phase</b> |               |  |     |                           |     |
| VSA 352D1NB-...  | 3.5           | DILEM-...                              | 20  | DILEM-...                 | 20  |
| VSA 353D1NB-...  | 4.5           | DILEM-...                              | 20  | DILEM-...                 | 20  |
| VSA 354D1NB-...  | 5             | DILEM-...                              | 20  | DILEM-...                 | 20  |
| VSA 356D5NB-...  | 9             | DILEM-...                              | 20  | DILEM-...                 | 20  |
| VSA 359D0NB-...  | 12            | DILEM-...                              | 20  | DILEM-...                 | 20  |
| VSA 35012NB-...  | 15            | DILEM-...                              | 20  | DILEM-...                 | 20  |
| VSA 35017NB-...  | 21            | DILM7-...                              | 21  | DILM17-...                | 40  |
| VSA 35022NB-...  | 26            | DILM17-...                             | 38  | DILM17-...                | 40  |
| VSA 35028NB-B55C   | 33            | DILM17-...                             | 38  | DILM25-...                | 45  |
| VSA 35034NB-B55C   | 40            | DILM25-...                             | 43  | DILM40-...                | 60  |
| VSA 35043NB-B55C   | 49            | DILM40-...                             | 57  | DILM50-...                | 80  |
| VSA 35054NB-B55C   | 60            | DILM50-...                             | 71  | DILM50-...                | 80  |
| VSA 35065NB-B55C   | 71            | DILM50-...                             | 71  | DILM65-...                | 98  |
| VSA 35078NB-B55C   | 91            | DILM80-...                             | 98  | DILM95-...                | 130 |
| VSA 35105NB-B55C   | 121           | DILM95-...                             | 125 | DILM115-...               | 160 |
| VSA 35130NB-B55C   | 143           | DILM150-...                            | 180 | DILM150-...               | 190 |
| VSA 35150NB-B55C   | 158           | DILM150-...                            | 180 | DILM170-...               | 225 |

## 6.7 Mains chokes

### DX-LN1...

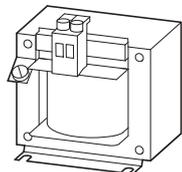


Figure 99:DEX-LN1... mains chokes (single-phase)

**Table 38: Assigned mains chokes – VSA voltage class 230 V (single-phase)**

| Device Type   | Input current<br>$I_{LN}$<br>A | Mains choke<br>$U_{LN}$ max. 240 V +10%<br>50/60 Hz $\pm 10$ %<br>max. 50 °C<br>Type | A  |
|---|--------------------------------|--|----|
| <b>Mains voltage: 230 V</b>   |                                |  |    |
| <b>Supply voltage (50/60 Hz) <math>U_{LN}</math> 200 (-10%) - 240 (+10 %) V</b>         |                                |  |    |
| <b><math>U_e</math> 230 V AC, single-phase / <math>U_2</math> 230 V AC, three-phase</b> |                                |  |    |
| VSA 124D3FB-...   | 9                              | DX-LN1-013   | 13 |
| VSA 127D0FB-...   | 13                             | DX-LN1-018   | 18 |
| VSA 12011FB-...   | 19                             | DX-LN1-024   | 24 |

**DX-LN3...**

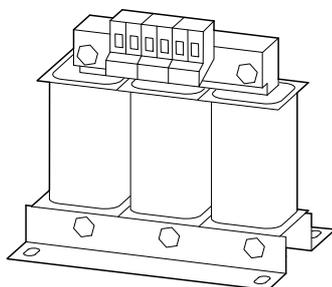


Figure 100: Mains chokes DEX-LN3... (three-phase)

**Table 39: Assigned mains chokes – VSA voltage class 230 V (three-phase)**

| Device Type  | Input current<br>$I_{LN}$<br>A | Mains choke<br>$U_{LN}$ max. 500 V +10%, 50/60 Hz $\pm 10$ %<br>max. 40 °C |     |            |     |
|--|--------------------------------|--|-----|------------|-----|
|  |                                | max. 40 °C   |     | max. 50 °C |     |
|  |                                | Type   | A   | Type       | A   |
| <b>Mains voltage: 230 V</b>  |                                |  |     |            |     |
| <b>Supply voltage (50/60 Hz) <math>U_{LN}</math> 200 (-10%) - 240 (+10 %) V</b>        |                                |  |     |            |     |
| <b><math>U_e</math> 230 V AC, three-phase / <math>U_2</math> 230 V AC, three-phase</b> |                                |  |     |            |     |
| VSA 324D3FB-...  | 6                              | DX-LN3-006   | 6   | DX-LN3-006 | 6   |
| VSA 327D0FB-...  | 11                             | DX-LN3-010   | 10  | DX-LN3-010 | 10  |
| VSA 32011FB-...  | 13                             | DX-LN3-016   | 16  | DX-LN3-016 | 16  |
| VSA 32018FB-...  | 21                             | DX-LN3-025   | 25  | DX-LN3-025 | 25  |
| VSA 32024FB-A20C   | 26                             | DX-LN3-025   | 25  | DX-LN3-040 | 40  |
| VSA 32024FB-B55C   | 27                             | DX-LN3-040   | 40  | DX-LN3-040 | 40  |
| VSA 32030FB-B55C   | 33                             | DX-LN3-040   | 40  | DX-LN3-040 | 40  |
| VSA 32046FB-B55C   | 50                             | DX-LN3-050   | 50  | DX-LN3-080 | 80  |
| VSA 32061FB-B55C <sup>1)</sup>   | 64                             | DX-LN3-080   | 80  | DX-LN3-080 | 80  |
| VSA 32072FB-B55C <sup>1)</sup>   | 74                             | DX-LN3-080   | 80  | DX-LN3-080 | 80  |
| VSA 32090FB-B55C <sup>1)</sup>   | 99                             | DX-LN3-100   | 100 | DX-LN3-120 | 120 |
| VSA 32110FB-B55C <sup>1)</sup>   | 121                            | DX-LN3-120   | 120 | DX-LN3-160 | 160 |
| VSA 32150FB-B55C <sup>1)</sup>   | 160                            | DX-LN3-160   | 160 | DX-LN3-200 | 200 |
| VSA 32180FB-B55C <sup>1)</sup>   | 188                            | DX-LN3-200   | 200 | DX-LN3-200 | 200 |
| VSA 32202FB-B55C <sup>1)</sup>   | 207                            | DX-LN3-250   | 250 | DX-LN3-250 | 250 |
| VSA 32248FB-B55C <sup>1)</sup>   | 246                            | DX-LN3-250   | 250 | DX-LN3-300 | 300 |

1) VSA variable frequency drive with DC link choke

6 Technical Data  
6.7 Mains chokes

**Table 40: Assigned mains chokes – VSA voltage class 400 V (three-phase)**

| Device Type  | Input current<br>$I_{LN}$<br>A | Mains choke<br>$U_{LN}$ max. 500 V +10%, 50/60 Hz $\pm$ 10 %<br>max. 40 °C |     |                |     |
|--|--------------------------------|--|-----|----------------|-----|
|  |                                | max. 40 °C   |     | max. 50 °C     |     |
|  |                                | Type   | A   | Type           | A   |
| <b>Mains voltage: 400 V</b>  |                                |  |     |                |     |
| <b>Supply voltage (50/60 Hz) <math>U_{LN}</math> 380 (-10%) - 480 (+10 %) V</b>        |                                |  |     |                |     |
| <b><math>U_e</math> 400 V AC, three-phase / <math>U_2</math> 400 V AC, three-phase</b> |                                |  |     |                |     |
| VSA 342D2FB-...  | 3.5                            | DX-LN3-006   | 6   | DX-LN3-006     | 6   |
| VSA 344D1FB-...  | 6                              | DX-LN3-006   | 6   | DX-LN3-006     | 6   |
| VSA 345D8FB-...  | 7.5                            | DX-LN3-010   | 10  | DX-LN3-010     | 10  |
| VSA 349D5FB-...  | 12                             | DX-LN3-016   | 16  | DX-LN3-016     | 16  |
| VSA 34014FB-...  | 17                             | DX-LN3-025   | 25  | DX-LN3-025     | 25  |
| VSA 34018FB-...  | 22                             | DX-LN3-025   | 25  | DX-LN3-025     | 25  |
| VSA 34024FB-...  | 28                             | DX-LN3-040   | 40  | DX-LN3-040     | 40  |
| VSA 34030FB-B55C   | 34                             | DX-LN3-040   | 40  | DX-LN3-040     | 40  |
| VSA 34039FB-B55C   | 44                             | DX-LN3-050   | 50  | DX-LN3-050     | 50  |
| VSA 34046FB-B55C   | 52                             | DX-LN3-050   | 50  | DX-LN3-080     | 80  |
| VSA 34061FB-B55C <sup>1)</sup>   | 66                             | DX-LN3-060   | 60  | DX-LN3-080     | 80  |
| VSA 34072FB-B55C <sup>1)</sup>   | 77                             | DX-LN3-080   | 80  | DX-LN3-080     | 80  |
| VSA 34090FB-B55C <sup>1)</sup>   | 103                            | DX-LN3-100   | 100 | DX-LN3-120     | 120 |
| VSA 34110FB-B55C <sup>1)</sup>   | 126                            | DX-LN3-120   | 120 | DX-LN3-160     | 160 |
| VSA 34150FB-B55C <sup>1)</sup>   | 165                            | DX-LN3-160   | 160 | DX-LN3-200     | 200 |
| VSA 34180FB-B55C <sup>1)</sup>   | 192                            | DX-LN3-200   | 200 | DX-LN3-200     | 200 |
| VSA 34202FB-B55C <sup>1)</sup>   | 211                            | DX-LN3-250   | 250 | DX-LN3-250     | 250 |
| VSA 34240FB-B55C <sup>1)</sup>   | 241                            | DX-LN3-250   | 250 | DX-LN3-300     | 300 |
| VSA 34302FB-B55C <sup>1)</sup>   | 299                            | DX-LN3-300   | 300 | DX-LN3-370     | 370 |
| VSA 34370FB-B20C <sup>2)</sup>   | 377                            | DX-LN3-370   | 370 | DX-LN3-450     | 450 |
| VSA 34450FB-B20C <sup>2)</sup>   | 459                            | DX-LN3-450   | 450 | Please enquire | N/A |

1) VSA variable frequency drive with DC link choke

2) If it is not guaranteed that the system percentage impedance is greater than or equal to 1%, a mains choke must be connected. Your  $u_k$  value should fall between 1 and 4%.

**Table 41: Assigned mains chokes – VSA voltage class 500 V (three-phase)**

| Device Type  | Input current<br>$I_{LN}$<br>A | Mains choke<br>$U_{LN}$ max. 500 V +10%, 50/60 Hz $\pm$ 10 % |     |            |     |
|--|--------------------------------|--|-----|------------|-----|
|  |                                | max. 40 °C   |     | max. 50 °C |     |
|  |                                | Type   | A   | Type       | A   |
| <b>Mains voltage: 500 V</b>  |                                |  |     |            |     |
| <b>Supply voltage (50/60 Hz) <math>U_{LN}</math> 500 (-10%) - 600 (+10 %) V</b>        |                                |  |     |            |     |
| <b><math>U_e</math> 500 V AC, three-phase / <math>U_2</math> 500 V AC, three-phase</b> |                                |  |     |            |     |
| VSA 352D1NB-...  | 3.5                            | DX-LN3-006   | 6   | DX-LN3-006 | 6   |
| VSA 353D1NB-...  | 4.5                            | DX-LN3-006   | 6   | DX-LN3-006 | 6   |
| VSA 354D1NB-...  | 5                              | DX-LN3-006   | 6   | DX-LN3-006 | 6   |
| VSA 356D5NB-...  | 9                              | DX-LN3-010   | 10  | DX-LN3-010 | 10  |
| VSA 359D0NB-...  | 12                             | DX-LN3-016   | 16  | DX-LN3-016 | 16  |
| VSA 35012NB-...  | 15                             | DX-LN3-016   | 16  | DX-LN3-016 | 16  |
| VSA 35017NB-...  | 21                             | DX-LN3-025   | 25  | DX-LN3-025 | 25  |
| VSA 35022NB-...  | 26                             | DX-LN3-025   | 25  | DX-LN3-040 | 40  |
| VSA 35028NB-B55C   | 33                             | DX-LN3-040   | 40  | DX-LN3-040 | 40  |
| VSA 35034NB-B55C   | 40                             | DX-LN3-040   | 40  | DX-LN3-050 | 50  |
| VSA 35043NB-B55C <sup>1)</sup>   | 49                             | DX-LN3-050   | 50  | DX-LN3-050 | 50  |
| VSA 35054NB-B55C <sup>1)</sup>   | 60                             | DX-LN3-060   | 60  | DX-LN3-080 | 80  |
| VSA 35065NB-B55C <sup>1)</sup>   | 71                             | DX-LN3-080   | 80  | DX-LN3-080 | 80  |
| VSA 35078NB-B55C <sup>1)</sup>   | 91                             | DX-LN3-100   | 100 | DX-LN3-100 | 100 |
| VSA 35105NB-B55C <sup>1)</sup>   | 121                            | DX-LN3-120   | 120 | DX-LN3-160 | 160 |
| VSA 35130NB-B55C <sup>1)</sup>   | 143                            | DX-LN3-160   | 160 | DX-LN3-160 | 160 |
| VSA 35150NB-B55C <sup>1)</sup>   | 158                            | DX-LN3-160   | 160 | DX-LN3-200 | 200 |

1) VSA variable frequency drive with DC link choke



Please enquire for mains chokes for mains voltages > 500 V.

## 6 Technical Data

### 6.8 Radio interference suppression filter

#### 6.8 Radio interference suppression filter

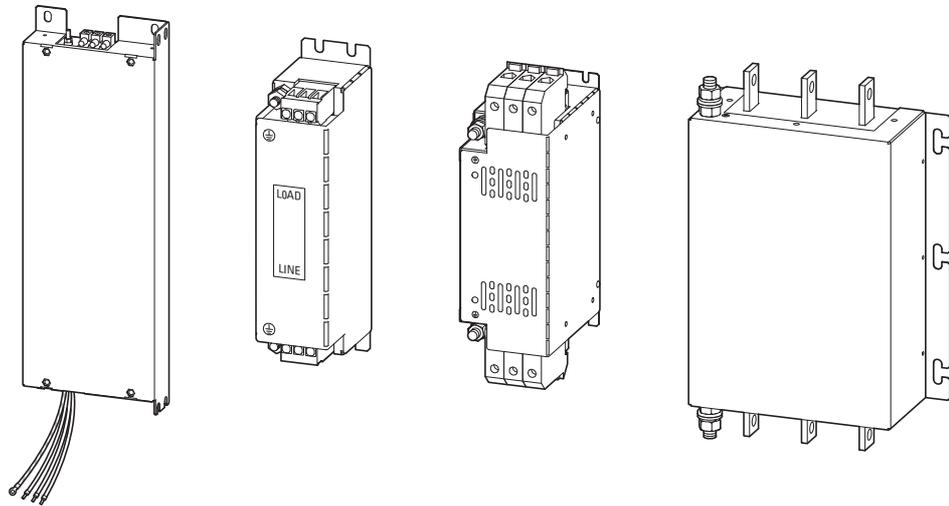


Figure 101:DX-EMC...-FS... (base-mounted filters with prefabricated connection cables) and DX-EMC... (side-mounting filters) external radio interference suppression filters

DX-EMC... external radio interference suppression filters should always be installed in the immediate proximity of the corresponding variable frequency drive. The connection cables between the radio interference suppression filter and the variable frequency drive should not be longer than 300 to 500 mm if they are installed without screening.



The DX-EMC... radio interference suppression filters with an IP20 degree of protection listed below are intended for installation in a control panel.



Sizes DX-EMC34-400... and DX-EMC34-750... have a degree of protection of IP00.



Please enquire for higher degrees of protection.



For more information and technical data on DX-EMC... radio interference suppression filters, please refer to instructional leaflets IL04012017Z and IL04012018Z.



The maximum motor cable lengths for the C1, C2, and C3 interference categories listed below are standardized recommended values. They apply to the adjustable switching frequencies ( $f_{PWM}$ ) of 4 to 16 kHz (parameter P2-24) in the corresponding ratings.

**Voltage class: 230 V**

**Mains voltage (50/60 Hz) ULN 200 (-10%) - 240 (+10 %) V**

**U<sub>e</sub> 230 V AC, single-phase / U<sub>2</sub> 230 V AC, three-phase**

**Table 42: Assigned radio interference suppression filter (single-phase)**

| Device Type      | Frame size | Input current<br><br>I <sub>LN</sub><br>A | Radio interference suppression filter U <sub>LN</sub> : max. 250 V +0 %, 50/60 Hz ±10 %, maximum ambient air temperature: 50 °C |  |   |                         |              |              |
|------------------|------------|---|---|--|---|-------------------------|--------------|--------------|
|                  |            |   | Type  | Ampere rating<br><br>I <sub>e</sub><br>A | Leakage current (IEC38 +10 %)<br><br>I <sub>PE</sub><br>A | max. motor cable length |              |              |
|                  |            |   |   |  |   | C1<br>l<br>m            | C2<br>l<br>m | C3<br>l<br>m |
| VSA 124D3FB-A20C | FS2        | 9   | DX-EMC12-014-FS2  | 14                                       | 8   | 25                      | 50           | 75           |
| VSA 127D0FB-A20C | FS2        | 13  | DX-EMC12-014-FS2  | 14                                       | 8   | 25                      | 50           | 75           |
| VSA 12011FB-A20C | FS2        | 19  | DX-EMC12-025-FS2  | 25                                       | 8   | 25                      | 75           | 100          |



**DX-EMC...-FS2:** base-mounted filter for frame size FS2

## 6 Technical Data

### 6.8 Radio interference suppression filter

**Voltage class: 230 V**

**Mains voltage (50/60 Hz)  $U_{LN}$  200 (-10%) - 240 (+10 %) V**

**$U_e$  230 V AC, three-phase /  $U_2$  230 V AC, three-phase**

**Table 43: Assigned radio interference suppression filter (three-phase)**

| Device Type      | Frame size | Input current<br><br>$I_{LN}$<br>A | Radio interference suppression filter $U_{LN}$ : max. 520 V +0 %, 50/60 Hz $\pm 10$ %, maximum ambient air temperature: 50 °C |                                 |  |                         |              |              |
|------------------|------------|------------------------------------|---|---------------------------------|--|-------------------------|--------------|--------------|
|                  |            |                                    | Type  | Ampere rating<br><br>$I_e$<br>A | Leakage current (IEC38 +10 %)<br><br>$I_{PE}$<br>A | max. motor cable length |              |              |
|                  |            |                                    |   |                                 |  | C1<br>l<br>m            | C2<br>l<br>m | C3<br>l<br>m |
| VSA 324D3FB-A20C | FS2        | 6                                  | DX-EMC34-008  | 8                               | 21   | 25                      | 50           | 75           |
|                  |            |                                    | DX-EMC34-008-L  | 8                               | 6  | 5                       | 25           | 50           |
|                  |            |                                    | DX-EMC34-011-FS2  | 16                              | 21   | 25                      | 50           | 75           |
|                  |            |                                    | DX-EMC34-011-FS2-L  | 16                              | 6  | 5                       | 25           | 50           |
| VSA 327D0FB-A20C | FS2        | 11                                 | DX-EMC34-016  | 16                              | 21   | 25                      | 50           | 75           |
|                  |            |                                    | DX-EMC34-016-L  | 16                              | 6  | 5                       | 25           | 50           |
|                  |            |                                    | DX-EMC34-011-FS2  | 11                              | 21   | 25                      | 50           | 75           |
|                  |            |                                    | DX-EMC34-011-FS2-L  | 11                              | 6  | 5                       | 25           | 50           |
| VSA 32011FB-A20C | FS2        | 13                                 | DX-EMC34-016  | 16                              | 21   | 25                      | 75           | 100          |
|                  |            |                                    | DX-EMC34-016-L  | 16                              | 6  | 15                      | 25           | 30           |
|                  |            |                                    | DX-EMC34-025-FS3 <sup>2)</sup>  | 25                              | 21   | 25                      | 50           | 75           |
|                  |            |                                    | DX-EMC34-025-FS3-L <sup>2)</sup>  | 25                              | 6  | 5                       | 25           | 50           |
| VSA 32018FB-A20C | FS3        | 21                                 | DX-EMC34-030  | 30                              | 29   | 25                      | 50           | 75           |
|                  |            |                                    | DX-EMC34-030-L  | 30                              | 6.5  | 25                      | 25           | 50           |
|                  |            |                                    | DX-EMC34-025-FS3  | 25                              | 21   | 25                      | 50           | 75           |
|                  |            |                                    | DX-EMC34-025-FS3-L  | 25                              | 6  | 25                      | 25           | 50           |
| VSA 32024FB-A20C | FS3        | 26                                 | DX-EMC34-030  | 30                              | 29   | 25                      | 100          | 125          |
|                  |            |                                    | DX-EMC34-030-L  | 30                              | 6.5  | 25                      | 35           | 50           |
|                  |            |                                    | DX-EMC34-031-FS4 <sup>2)</sup>  | 31                              | 21   | 25                      | 50           | 75           |
|                  |            |                                    | DX-EMC34-031-FS4-L <sup>2)</sup>  | 31                              | 6  | 25                      | 25           | 50           |
| VSA 32024FB-B55C | FS4        | 27                                 | DX-EMC34-030  | 30                              | 29   | 25                      | 50           | 75           |
|                  |            |                                    | DX-EMC34-030-L  | 30                              | 6.5  | 25                      | 50           | 75           |
|                  |            |                                    | DX-EMC34-031-FS4  | 31                              | 20   | 25                      | 50           | 75           |
|                  |            |                                    | DX-EMC34-031-FS4-L  | 31                              | 6  | 25                      | 50           | 75           |
| VSA 32046FB-B55C | FS4        | 50                                 | DX-EMC34-055  | 55                              | 30   | 25                      | 100          | 125          |
|                  |            |                                    | DX-EMC34-055-L  | 55                              | 6.5  | 25                      | 35           | 50           |
|                  |            |                                    | DX-EMC34-075-FS5 <sup>2)</sup>  | 75                              | 20   | 25                      | 50           | 75           |
|                  |            |                                    | DX-EMC34-075-FS5-L <sup>2)</sup>  | 75                              | 6  | 25                      | 25           | 50           |

6 Technical Data  
6.8 Radio interference suppression filter

| Device Type                    | Frame size | Input current<br><br>$I_{LN}$<br>A | Radio interference suppression filter $U_{LN}$ : max. 520 V +0 %, 50/60 Hz ±10 %, maximum ambient air temperature: 50 °C |                                 |  |                         |              |              |
|--------------------------------|------------|------------------------------------|--|---------------------------------|--|-------------------------|--------------|--------------|
|                                |            |                                    | Type   | Ampere rating<br><br>$I_e$<br>A | Leakage current (IEC38 +10 %)<br><br>$I_{PE}$<br>A | max. motor cable length |              |              |
|                                |            |                                    |  |                                 |  | C1<br>l<br>m            | C2<br>l<br>m | C3<br>l<br>m |
| VSA 32061FB-B55C <sup>1)</sup> | FS5        | 64                                 | DX-EMC34-075   | 75                              | 22   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-075-L   | 75                              | 6.5  | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-075-FS5   | 75                              | 22   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-075-FS5-L   | 75                              | 6.5  | 25                      | 50           | 75           |
| VSA 32072FB-B55C <sup>1)</sup> | FS5        | 74                                 | DX-EMC34-075   | 75                              | 22   | 50                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-075-L   | 75                              | 6.5  | 20                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-075-FS5   | 75                              | 22   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-075-FS5-L   | 75                              | 6.5  | 5                       | 25           | 50           |
| VSA 32110FB-B55C <sup>1)</sup> | FS6        | 121                                | DX-EMC34-130   | 130                             | 22   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-130-L   | 130                             | 6.5  | 5                       | 25           | 50           |
| VSA 32150FB-B55C <sup>1)</sup> | FS6        | 160                                | DX-EMC34-180   | 180                             | 31   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-180-L   | 180                             | 6.5  | 5                       | 25           | 50           |
| VSA 32180FB-B55C <sup>1)</sup> | FS6        | 188                                | DX-EMC34-180   | 180                             | 31   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-180-L   | 180                             | 7  | 5                       | 25           | 50           |
| VSA 32202FB-B55C <sup>1)</sup> | FS7        | 207                                | DX-EMC34-250   | 250                             | 37   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-250-L   | 250                             | 7  | 5                       | 25           | 50           |
| VSA 32248FB-B55C <sup>1)</sup> | FS7        | 246                                | DX-EMC34-250   | 250                             | 37   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-250-L   | 250                             | 7  | 5                       | 25           | 50           |

1) VSA variable frequency drive with DC link choke

2) Side-mounting configuration only



DX-EMC...-**FS**: Base-mounted filter for the specified frame size  
DX-EMC...-**L**: Low leakage current

## 6 Technical Data

### 6.8 Radio interference suppression filter

**Voltage class: 400 V**

**Mains voltage (50/60 Hz)  $U_{LN}$  380 (-10%) - 480 (+10 %) V**

**$U_e$  400 V AC, three-phase /  $U_2$  400 V AC, three-phase**

**Table 44: Assigned radio interference suppression filter (three-phase)**

| Device Type      | Frame size | Input current<br><br>$I_{LN}$<br>A | Radio interference suppression filter $U_{LN}$ : max. 520 V +0%, 50/60 Hz $\pm 10$ %, maximum ambient air temperature: 50 °C |                                 |  |                         |              |              |  |
|------------------|------------|------------------------------------|--|---------------------------------|--|-------------------------|--------------|--------------|--|
|                  |            |                                    |  | Ampere rating<br><br>$I_e$<br>A | Leakage current (IEC38 +10 %)<br><br>$I_{PE}$<br>A | max. motor cable length |              |              |  |
|                  |            |                                    |  |                                 |  | C1<br>l<br>m            | C2<br>l<br>m | C3<br>l<br>m |  |
| VSA 342D2FB-A20C | FS2        | 3.5                                | DX-EMC34-008   | 8                               | 21   | 25                      | 50           | 75           |  |
|                  |            |                                    | DX-EMC34-008-L   | 8                               | 6  | 5                       | 25           | 50           |  |
|                  |            |                                    | DX-EMC34-011-FS2   | 11                              | 21   | 25                      | 50           | 75           |  |
|                  |            |                                    | DX-EMC34-011-FS2-L   | 11                              | 6  | 5                       | 25           | 50           |  |
| VSA 344D1FB-A20C | FS2        | 6                                  | DX-EMC34-008   | 8                               | 21   | 25                      | 50           | 75           |  |
|                  |            |                                    | DX-EMC34-008-L   | 8                               | 6  | 5                       | 25           | 50           |  |
|                  |            |                                    | DX-EMC34-011-FS2   | 16                              | 21   | 25                      | 50           | 75           |  |
|                  |            |                                    | DX-EMC34-011-FS2-L   | 16                              | 6  | 5                       | 25           | 50           |  |
| VSA 349D5FB-A20C | FS2        | 12                                 | DX-EMC34-008   | 8                               | 21   | 25                      | 50           | 75           |  |
|                  |            |                                    | DX-EMC34-008-L   | 8                               | 6  | 5                       | 25           | 50           |  |
|                  |            |                                    | DX-EMC34-011-FS2   | 16                              | 21   | 25                      | 50           | 75           |  |
|                  |            |                                    | DX-EMC34-011-FS2-L   | 16                              | 6  | 25                      | 25           | 50           |  |
| VSA 34018FB-A20C | FS3        | 22                                 | DX-EMC34-030   | 30                              | 29   | 25                      | 50           | 75           |  |
|                  |            |                                    | DX-EMC34-030-L   | 30                              | 6.5  | 25                      | 25           | 50           |  |
|                  |            |                                    | DX-EMC34-025-FS3   | 25                              | 21   | 25                      | 50           | 75           |  |
|                  |            |                                    | DX-EMC34-025-FS3-L   | 25                              | 6  | 25                      | 25           | 50           |  |
| VSA 34024FB-A20C | FS3        | 28                                 | DX-EMC34-030   | 30                              | 29   | 25                      | 50           | 75           |  |
|                  |            |                                    | DX-EMC34-030-L   | 30                              | 6.5  | 25                      | 25           | 50           |  |
|                  |            |                                    | DX-EMC34-031-FS4 <sup>2)</sup>   | 31                              | 20   | 25                      | 50           | 75           |  |
|                  |            |                                    | DX-EMC34-031-FS4-L <sup>2)</sup>   | 31                              | 6  | 25                      | 25           | 50           |  |
| VSA 34024FB-B55C | FS4        | 28                                 | DX-EMC34-030   | 30                              | 29   | 25                      | 50           | 75           |  |
|                  |            |                                    | DX-EMC34-030-L   | 30                              | 6.5  | 25                      | 25           | 50           |  |
|                  |            |                                    | DX-EMC34-031-FS4   | 31                              | 20   | 25                      | 50           | 75           |  |
|                  |            |                                    | DX-EMC34-031-FS4-L   | 31                              | 6  | 25                      | 25           | 50           |  |
| VSA 34030FB-B55C | FS4        | 34                                 | DX-EMC34-042   | 42                              | 29   | 25                      | 50           | 75           |  |
|                  |            |                                    | DX-EMC34-042-L   | 42                              | 6.5  | 25                      | 50           | 75           |  |
|                  |            |                                    | DX-EMC34-048-FS4   | 48                              | 20   | 25                      | 50           | 75           |  |
|                  |            |                                    | DX-EMC34-048-FS4-L   | 48                              | 6  | 25                      | 50           | 75           |  |

## 6 Technical Data

### 6.8 Radio interference suppression filter

| Device Type                    | Frame size | Input current<br><br>$I_{LN}$<br>A | Radio interference suppression filter $U_{LN}$ : max. 520 V +0%, 50/60 Hz $\pm 10$ %, maximum ambient air temperature: 50 °C |                                 |  |                         |              |              |
|--------------------------------|------------|------------------------------------|--|---------------------------------|--|-------------------------|--------------|--------------|
|                                |            |                                    |  | Ampere rating<br><br>$I_e$<br>A | Leakage current (IEC38 +10 %)<br><br>$I_{PE}$<br>A | max. motor cable length |              |              |
|                                |            |                                    |  |                                 |  | C1<br>l<br>m            | C2<br>l<br>m | C3<br>l<br>m |
| VSA 34039FB-B55C               | FS4        | 44                                 | DX-EMC34-055   | 55                              | 30   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-055-L   | 55                              | 6.5  | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-048-FS4   | 48                              | 20   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-048-FS4-L   | 48                              | 6  | 25                      | 50           | 75           |
| VSA 34046FB-B55C               | FS4        | 52                                 | DX-EMC34-055   | 55                              | 30   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-055-L   | 55                              | 6.5  | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-075-FS5 <sup>2)</sup>   | 75                              | 20   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-075-FS5-L <sup>2)</sup>   | 75                              | 6  | 25                      | 50           | 75           |
| VSA 34072FB-B55C <sup>1)</sup> | FS5        | 77                                 | DX-EMC34-100   | 100                             | 30   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-100-L   | 100                             | 6.5  | 25                      | 50           | 75           |
| VSA 34090FB-B55C <sup>1)</sup> | FS6        | 103                                | DX-EMC34-130   | 130                             | 22   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-130-L   | 130                             | 6.5  | 25                      | 50           | 75           |
| VSA 34110FB-B55C <sup>1)</sup> | FS6        | 126                                | DX-EMC34-130   | 130                             | 22   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-130-L   | 130                             | 6.5  | 25                      | 50           | 75           |
| VSA 34150FB-B55C <sup>1)</sup> | FS6        | 165                                | DX-EMC34-180   | 180                             | 31   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-180-L   | 180                             | 6.5  | 25                      | 50           | 75           |
| VSA 34180FB-B55C <sup>1)</sup> | FS6        | 192                                | DX-EMC34-250   | 250                             | 37   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-250-L   | 250                             | 7  | 25                      | 50           | 75           |
| VSA 34202FB-B55C <sup>1)</sup> | FS7        | 211                                | DX-EMC34-250   | 250                             | 37   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-250-L   | 250                             | 7  | 25                      | 50           | 75           |
| VSA 34240FB-B55C <sup>1)</sup> | FS7        | 241                                | DX-EMC34-250   | 250                             | 37   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-250-L   | 250                             | 7  | 25                      | 50           | 75           |
| VSA 34302FB-B55C <sup>1)</sup> | FS7        | 299                                | DX-EMC34-400   | 400                             | 60   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-400-L   | 400                             | 8  | 25                      | 50           | 75           |
| VSA 34370FB-B20C <sup>2)</sup> | FS8        | 377                                | DX-EMC34-400   | 400                             | 60   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-400-L   | 400                             | 8  | 5                       | 25           | 50           |
| VSA 34450FB-B20C <sup>2)</sup> | FS8        | 459                                | DX-EMC34-750   | 750                             | 60   | 25                      | 50           | 75           |
|                                |            |                                    | DX-EMC34-750-L   | 750                             | 8  | 5                       | 25           | 50           |

1) VSA variable frequency drive with DC link choke

2) Side-mounting configuration only

3) If it is not guaranteed that the system percentage impedance is greater than or equal to 1%, a mains choke must be connected. Your  $u_k$  value should fall between 1 and 4 %.



DX-EMC...-**FS**: Base-mounted filter for the specified frame size  
DX-EMC...-**L**: Low leakage current

## 6.9 Braking resistances

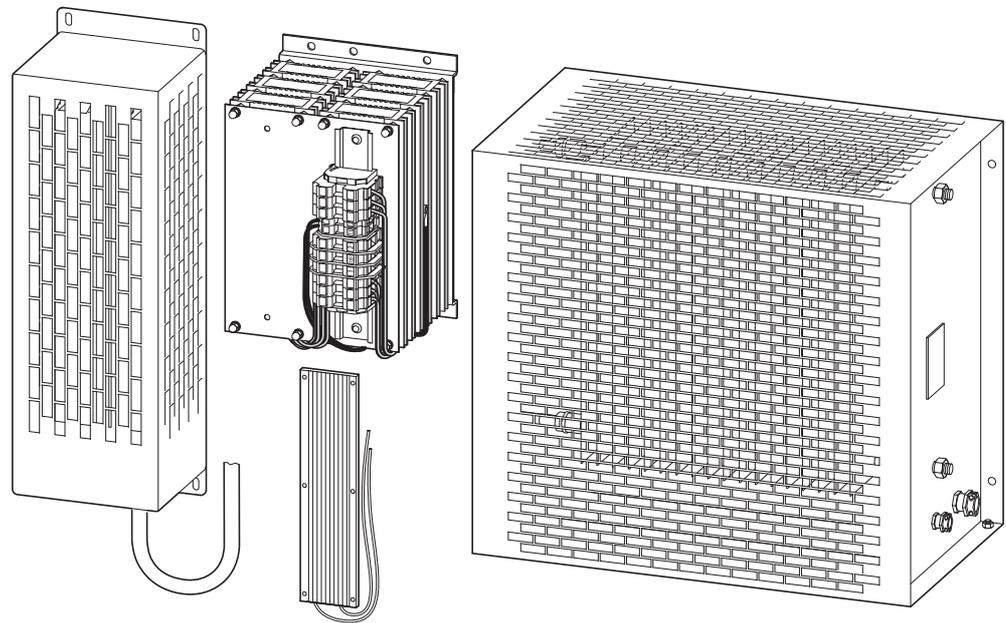


Figure 102: Examples of DX-BR... brake resistor designs

### NOTICE

The specified minimum resistance  $R_{Bmin}$  must not be fallen below.



### CAUTION

Brake resistors get extremely hot during operation!

The following tables provide examples of DX-BR... brake resistors rated for individual VSA variable frequency drives. They are specified based on the "high duty" and "low duty" classification for intermittent braking with a cycle time  $t_C$  of 120 seconds and a pulse power  $P_{Peak}$  equal to maximum braking power  $P_{max}$  of the variable frequency drive with the rated motor output.

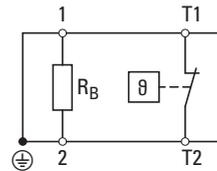
Load groups (simplified classification)

- **Low duty:** Low load with short braking duration and low duty factor (up to about 25 %), e.g., for horizontal conveyors and handling equipment for bulk cargo and general cargo, end carriages, sliding doors, and turbomachinery (centrifugal pumps, fans).
- **High duty:** High load with long braking duration and high duty factor (at least 30 %), e.g., for elevators, downhill conveyors, winders, centrifuges, flywheel motors, and large fans.



All brake resistors feature a temperature switch for protection against thermal overload.

This dry contact (N/C) can be directly integrated into the VSA variable frequency drive's control section and work as an external fault message (control terminal 10, DI5, parameter P9-08 = 5).



**Exception:**

Resistors DX-BR3-100 and DX-BR5-33 do not feature a circuit-breaker. They are inserted into the corresponding recesses on the VSA variable frequency drive's heat sinks (frame sizes FS2 to FS5) and are automatically protected against thermal overloads as a result (heat sink overtemperature, display:  $\square$ -  $t$ ).

6 Technical Data  
6.9 Braking resistances

**Table 45: Braking resistance – VSA voltage class 230 V**

| Device Type  | Resistance value |                        |                        |                 | Braking resistance (Low duty) |                   |                |         | Braking resistance (High duty) |               |                   |                |         |                  |
|--|------------------|------------------------|------------------------|-----------------|-------------------------------|-------------------|----------------|---------|--------------------------------|---------------|-------------------|----------------|---------|------------------|
|  | Frame size       | $R_{Bmin}$<br>$\Omega$ | $R_{Brec}$<br>$\Omega$ | $P_{max}$<br>kW | Type                          | $R_B$<br>$\Omega$ | $P_{DB}$<br>kW | DF<br>% | $t_{Brems}$<br>s               | Type          | $R_B$<br>$\Omega$ | $P_{DB}$<br>kW | DF<br>% | $t_{Brems}$<br>s |
| <b>Mains voltage: 230 V   supply voltage (50/60 Hz) <math>U_{LN}</math> 200 (-10%) - 240 (+10%) V   <math>U_e</math> 230 V AC, single-phase / <math>U_2</math> 230 V AC, three-phase</b> |                  |                        |                        |                 |                               |                   |                |         |                                |               |                   |                |         |                  |
| VSA 124D3FB-A20C   | FS2              | 25                     | 100                    | 0.75            | DX-BR3-100                    | 100               | 0.2            | 27      | 32                             | DX-BR100-240  | 100               | 0.24           | 32      | 38               |
| VSA 127D0FB-A20C   | FS2              | 25                     | 50                     | 1.5             | DX-BR3-100                    | 100               | 0.2            | 13      | 16                             | DX-BR050-600  | 50                | 0.6            | 40      | 48               |
| VSA 12011FB-A20C   | FS2              | 25                     | 35                     | 2.2             | DX-BR3-100                    | 100               | 0.2            | 9       | 11                             | DX-BR042-720  | 42                | 0.72           | 33      | 39               |
| <b>Mains voltage: 230 V   supply voltage (50/60 Hz) <math>U_{LN}</math> 200 (-10%) - 240 (+10%) V   <math>U_e</math> 230 V AC, three-phase / <math>U_2</math> 230 V AC, three-phase</b>  |                  |                        |                        |                 |                               |                   |                |         |                                |               |                   |                |         |                  |
| VSA 324D3FB-A20C   | FS2              | 25                     | 100                    | 0.75            | DX-BR3-100                    | 100               | 0.2            | 27      | 32                             | DX-BR100-240  | 100               | 0.24           | 32      | 38               |
| VSA 327D0FB-A20C   | FS2              | 25                     | 50                     | 1.5             | DX-BR3-100                    | 100               | 0.2            | 13      | 16                             | DX-BR050-600  | 50                | 0.6            | 40      | 48               |
| VSA 32011FB-A20C   | FS2              | 25                     | 35                     | 2.2             | DX-BR3-100                    | 100               | 0.2            | 9       | 11                             | DX-BR042-720  | 42                | 0.72           | 33      | 39               |
| VSA 32018FB-A20C   | FS3              | 20                     | 20                     | 4               | DX-BR5-33                     | 33                | 0.5            | 13      | 15                             | DX-BR025-1440 | 25                | 1.44           | 36      | 43               |
| VSA 32024FB-A20C   | FS3              | 20                     | 20                     | 5.5             | DX-BR5-33                     | 33                | 0.5            | 9       | 11                             | DX-BR025-1920 | 25                | 1.92           | 35      | 42               |
| VSA 32024FB-B55C   | FS4              | 12                     | 20                     | 5.5             | DX-BR5-33                     | 33                | 0.5            | 9       | 11                             | DX-BR025-1920 | 25                | 1.92           | 35      | 42               |
| VSA 32030FB-B55C   | FS4              | 12                     | 22                     | 7.5             | DX-025-1440                   | 25                | 1.44           | 19      | 23                             | DX-027-2880   | 27                | 2.88           | 38      | 46               |
| VSA 32046FB-B55C   | FS4              | 12                     | 22                     | 11              | DX-025-1440                   | 25                | 1.44           | 13      | 16                             | DX-BR022-5K1  | 22                | 5.1            | 46      | 56               |
| VSA 32061FB-B55C   | FS5              | 6                      | 12                     | 15              | 2 // DX-025-1440              | 12.5              | 2.88           | 19      | 23                             | DX-BR012-5K1  | 12                | 5.1            | 34      | 41               |
| VSA 32072FB-B55C   | FS5              | 6                      | 12                     | 18.5            | 2 // DX-025-1440              | 12.5              | 2.88           | 16      | 19                             | DX-BR012-9K2  | 12                | 9.2            | 50      | 60               |
| VSA 32090FB-B55C   | FS6              | 6                      | 6                      | 22              | 2 // DX-BR025-1440            | 12.5              | 2.88           | 13      | 16                             | DX-BR012-9K2  | 12                | 9.2            | 42      | 50               |
| VSA 32110FB-B55C   | FS6              | 3                      | 6                      | 30              | 2 // DX-BR025-1440            | 12.5              | 2.88           | 10      | 12                             | DX-BR012-9K2  | 12                | 9.2            | 31      | 37               |
| VSA 32150FB-B55C   | FS6              | 3                      | 6                      | 37              | DX-BR006-5K1                  | 6                 | 5.1            | 14      | 17                             | DX-BR006-18K1 | 6                 | 18.1           | 49      | 59               |
| VSA 32180FB-B55C   | FS6              | 3                      | 6                      | 45              | DX-BR006-5K1                  | 6                 | 5.1            | 11      | 14                             | DX-BR006-18K1 | 6                 | 18.1           | 40      | 48               |
| VSA 32202FB-B55C   | FS7              | 3                      | 6                      | 55              | DX-BR006-5K1                  | 6                 | 5.1            | 9       | 11                             | DX-BR006-18K1 | 6                 | 18.1           | 33      | 39               |
| VSA 32248FB-B55C   | FS7              | 3                      | 6                      | 75              | DX-BR006-9K2                  | 6                 | 9.2            | 12      | 15                             | DX-BR006-33K  | 6                 | 33             | 44      | 53               |

2 // DX-BR... = Two units of this model connected in parallel | 2 & DX-BR... = Two units of this model connected in series  
 2 // 2 & DX-BR... = Four units of this model, two and two connected in parallel, and the resulting two parallel links connected in series with each other  
 Resistances:  $R_{Bmin}$  = Minimum permissible resistance;  $R_{Brec}$  = Recommended resistance  
 $P_{max}$  = Rated power for the low duty and high duty classification

**Table 46: Braking resistance – VSA voltage class 400 V**

| Device Type  | Resistance value |                        |                        |                        | Braking resistance (Low duty) |                     |                       |         | Braking resistance (High duty) |                    |                     |                       |         |                         |
|--|------------------|------------------------|------------------------|------------------------|-------------------------------|---------------------|-----------------------|---------|--------------------------------|--------------------|---------------------|-----------------------|---------|-------------------------|
|  | Frame size       | R <sub>Bmin</sub><br>Ω | R <sub>Brec</sub><br>Ω | P <sub>max</sub><br>kW | Type                          | R <sub>B</sub><br>Ω | P <sub>DB</sub><br>kW | DF<br>% | t <sub>Brems</sub><br>s        | Type               | R <sub>B</sub><br>Ω | P <sub>DB</sub><br>kW | DF<br>% | t <sub>Brems</sub><br>s |
| <b>Mains voltage: 400 V   supply voltage (50/60 Hz) U<sub>LN</sub> 380 (-10 %) - 480 (+10 %) V   U<sub>e</sub> 400 V AC, three-phase / U<sub>2</sub> 400 V AC, three-phase</b> |                  |                        |                        |                        |                               |                     |                       |         |                                |                    |                     |                       |         |                         |
| VSA 342D2FB-A20C   | FS2              | 50                     | 400                    | 0.75                   | DX-BR3-100                    | 100                 | 0.2                   | 27      | 32                             | DX-BR400-400       | 400                 | 0.4                   | 53      | 64                      |
| VSA 344D1FB-A20C   | FS2              | 50                     | 200                    | 1.5                    | DX-BR3-100                    | 100                 | 0.2                   | 13      | 16                             | DX-BR216-600       | 216                 | 0.6                   | 40      | 48                      |
| VSA 345D8FB-A20C   | FS2              | 50                     | 150                    | 2.2                    | DX-BR3-100                    | 100                 | 0.2                   | 9       | 11                             | DX-BR150-0K8       | 150                 | 0.8                   | 36      | 44                      |
| VSA 349D5FB-A20C   | FS2              | 50                     | 100                    | 4                      | DX-BR100-600                  | 100                 | 0.6                   | 15      | 18                             | 2 & DX-BR050-920   | 100                 | 1.92                  | 48      | 58                      |
| VSA 34014FB-A20C   | FS3              | 40                     | 75                     | 5.5                    | DX-BR100-600                  | 100                 | 0.6                   | 11      | 13                             | 2 & DX-BR050-920   | 100                 | 1.92                  | 35      | 42                      |
| VSA 34018FB-A20C   | FS3              | 40                     | 50                     | 7.5                    | DX-BR050-720                  | 50                  | 0.72                  | 10      | 12                             | DX-BR050-2880      | 50                  | 2.88                  | 38      | 46                      |
| VSA 34024FB-B55C   | FS4              | 22                     | 40                     | 11                     | DX-BR050-920                  | 50                  | 0.92                  | 9       | 10                             | DX-BR047-5K1       | 47                  | 5.1                   | 46      | 56                      |
| VSA 34024FB-B55C   | FS4              | 22                     | 40                     | 11                     | DX-BR050-920                  | 50                  | 0.96                  | 9       | 10                             | DX-BR047-5K1       | 47                  | 5.1                   | 46      | 56                      |
| VSA 34030FB-B55C   | FS4              | 22                     | 22                     | 15                     | DX-BR025-1440                 | 25                  | 1.44                  | 10      | 12                             | DX-BR022-5K1       | 22                  | 5.1                   | 34      | 41                      |
| VSA 34039FB-B55C   | FS4              | 22                     | 22                     | 18.5                   | DX-BR025-1920                 | 25                  | 1.92                  | 10      | 12                             | DX-BR022-9K2       | 22                  | 9.2                   | 50      | 60                      |
| VSA 34046FB-B55C   | FS4              | 22                     | 22                     | 22                     | DX-BR025-1920                 | 25                  | 1.92                  | 9       | 10                             | DX-BR022-9K2       | 22                  | 9.2                   | 42      | 50                      |
| VSA 34061FB-B55C   | FS5              | 12                     | 12                     | 30                     | 2 // DX-BR025-1440            | 12.5                | 2.88                  | 10      | 12                             | DX-BR012-9K2       | 12                  | 9.2                   | 31      | 37                      |
| VSA 34072FB-B55C   | FS5              | 12                     | 12                     | 37                     | 2 // DX-BR027-1920            | 12.5                | 3.84                  | 10      | 12                             | DX-BR012-18K1      | 12                  | 18.1                  | 49      | 59                      |
| VSA 34090FB-B55C   | FS6              | 6                      | 6                      | 45                     | DX-BR006-5K1                  | 6                   | 5.1                   | 11      | 14                             | DX-BR006-18K1      | 6                   | 18.1                  | 40      | 48                      |
| VSA 34110FB-B55C   | FS6              | 6                      | 6                      | 55                     | DX-BR006-9K2                  | 6                   | 9.2                   | 17      | 20                             | DX-BR006-18K1      | 6                   | 18.1                  | 33      | 39                      |
| VSA 34150FB-B55C   | FS6              | 6                      | 6                      | 75                     | DX-BR006-9K2                  | 6                   | 9.2                   | 12      | 15                             | DX-BR006-33K3      | 6                   | 33.3                  | 44      | 53                      |
| VSA 34180FB-B55C   | FS6              | 6                      | 6                      | 90                     | DX-BR006-9K2                  | 6                   | 9.2                   | 10      | 12                             | DX-BR006-33K3      | 6                   | 33.3                  | 37      | 44                      |
| VSA 34202FB-B55C   | FS7              | 6                      | 6                      | 110                    | DX-BR006-18K1                 | 6                   | 18.1                  | 16      | 20                             | DX-BR012-18K1      | 6                   | 36.2                  | 33      | 39                      |
| VSA 34240FB-B55C   | FS7              | 6                      | 6                      | 132                    | DX-BR006-18K1                 | 6                   | 18.1                  | 14      | 16                             | 4 // DX-BR006-18K1 | 6                   | 72.4                  | 55      | 66                      |
| VSA 34302FB-B55C   | FS7              | 6                      | 6                      | 160                    | DX-BR006-18K1                 | 6                   | 18.1                  | 11      | 14                             | 4 // DX-BR006-18K1 | 6                   | 72.4                  | 45      | 54                      |

## 6 Technical Data

### 6.9 Braking resistances

| Device Type      | Resistance value |                        |                        | Braking resistance (Low duty) |               |                   |                |         | Braking resistance (High duty) |                |                   |                |         |                  |
|------------------|------------------|------------------------|------------------------|-------------------------------|---------------|-------------------|----------------|---------|--------------------------------|----------------|-------------------|----------------|---------|------------------|
|                  | Frame size       | $R_{Bmin}$<br>$\Omega$ | $R_{Brec}$<br>$\Omega$ | $P_{max}$<br>kW               | Type          | $R_B$<br>$\Omega$ | $P_{DB}$<br>kW | DF<br>% | $t_{Brems}$<br>s               | Type           | $R_B$<br>$\Omega$ | $P_{DB}$<br>kW | DF<br>% | $t_{Brems}$<br>s |
| VSA 34370FB-B20C | FS8              | 2                      | 2                      | 200                           | DX-BR006-33K3 | 6                 | 33.3           | 17      | 20                             | DX-BR002-102K4 | 2                 | 102.4          | 51      | 61               |
| VSA 34450FB-B20C | FS8              | 2                      | 2                      | 250                           | DX-BR006-33K3 | 6                 | 33.3           | 13      | 16                             | DX-BR002-102K4 | 2                 | 102.4          | 41      | 49               |

2 // DX-BR... = Two units of this model connected in parallel | 2 & DX-BR... = Two units of this model connected in series  
 2 // 2 & DX-BR... = Four units of this model, two and two connected in parallel, and the resulting two parallel links connected in series with each other  
 Resistances:  $R_{Bmin}$  = Minimum permissible resistance;  $R_{Brec}$  = Recommended resistance  
 $P_{max}$  = Rated power for the low duty and high duty classification

**Table 47: Braking resistance – VSA voltage class 575 V**

| Device Type  | Resistance value |                        |                        |                        | Braking resistance (Low duty) |                     |                       |         | Braking resistance (High duty) |                   |                     |                       |         |                         |
|--|------------------|------------------------|------------------------|------------------------|-------------------------------|---------------------|-----------------------|---------|--------------------------------|-------------------|---------------------|-----------------------|---------|-------------------------|
|  | Frame size       | R <sub>Bmin</sub><br>Ω | R <sub>Brec</sub><br>Ω | P <sub>max</sub><br>kW | Type                          | R <sub>B</sub><br>Ω | P <sub>DB</sub><br>kW | DF<br>% | t <sub>Brems</sub><br>s        | Type              | R <sub>B</sub><br>Ω | P <sub>RD</sub><br>kW | DF<br>% | t <sub>Brems</sub><br>s |
| <b>Mains voltage: 575 V   supply voltage (50/60 Hz) U<sub>LN</sub> 500 (-10 %) - 600 (+10 %) V   U<sub>e</sub> 575 V AC, three-phase / U<sub>2</sub> 575 V AC, three-phase</b> |                  |                        |                        |                        |                               |                     |                       |         |                                |                   |                     |                       |         |                         |
| VSA 352D1NB-A20C   | FS2              | 600                    | 600                    | 0.75                   | 2 & DX-BR430-100              | 860                 | 0.2                   | 27      | 32                             | 3 & DX-BR210-200  | 630                 | 0.6                   | 80      | 96                      |
| VSA 353D1NB-A20C   | FS2              | 300                    | 300                    | 1.5                    | DX-BR400-0K4                  | 400                 | 0.4                   | 27      | 32                             | 2 & DX-BR150-0K5  | 300                 | 1                     | 67      | 80                      |
| VSA 354D1NB-A20C   | FS2              | 200                    | 200                    | 2.2                    | DX-BR200-0K4                  | 200                 | 0.4                   | 18      | 22                             | 2 & DX-BR100-600  | 200                 | 1.2                   | 55      | 65                      |
| VSA 356D5NB-A20C   | FS2              | 150                    | 150                    | 4                      | DX-BR150-0K5                  | 150                 | 0.5                   | 13      | 15                             | 2 & DX-BR075-1K1  | 150                 | 2.2                   | 55      | 66                      |
| VSA 359D0NB-A20C   | FS2              | 100                    | 100                    | 5.5                    | DX-BR100-0K8                  | 100                 | 0.8                   | 15      | 17                             | 2 & DX-BR050-1440 | 100                 | 2.88                  | 52      | 63                      |
| VSA 35012NB-A20C   | FS3              | 80                     | 80                     | 7.5                    | DX-BR100-920                  | 100                 | 0.96                  | 13      | 15                             | 2 & DX-BR050-1440 | 100                 | 2.88                  | 38      | 46                      |
| VSA 35017NB-A20C   | FS3              | 50                     | 50                     | 11                     | DX-BR050-1440                 | 50                  | 1.44                  | 13      | 16                             | 2 & DX-BR025-1920 | 50                  | 3.84                  | 35      | 42                      |
| VSA 35022NB-A20C   | FS3              | 33                     | 33                     | 15                     | DX-BR050-1440                 | 50                  | 1.44                  | 10      | 12                             | DX-BR040-5K1      | 40                  | 5.1                   | 34      | 41                      |
| VSA 35022NB-B55C   | FS4              | 33                     | 33                     | 15                     | DX-BR050-1440                 | 50                  | 1.44                  | 10      | 12                             | DX-BR040-5K1      | 40                  | 5.1                   | 34      | 41                      |
| VSA 35028NB-B55C   | FS4              | 33                     | 33                     | 18.5                   | DX-BR040-3K1                  | 40                  | 3.1                   | 17      | 20                             | DX-BR047-9K2      | 47                  | 9.2                   | 50      | 60                      |
| VSA 35034NB-B55C   | FS4              | 22                     | 22                     | 22                     | DX-BR022-3K1                  | 22                  | 3.1                   | 14      | 17                             | DX-BR022-9K2      | 22                  | 9.2                   | 42      | 50                      |
| VSA 35043NB-B55C   | FS5              | 16                     | 16                     | 30                     | DX-BR022-5K1                  | 22                  | 5.1                   | 17      | 20                             | DX-BR022-9K2      | 22                  | 9.2                   | 31      | 37                      |
| VSA 35054NB-B55C   | FS5              | 16                     | 16                     | 37                     | DX-BR022-5K1                  | 22                  | 5.1                   | 14      | 17                             | 2 & DX-BR012-9K2  | 24                  | 18.4                  | 50      | 60                      |
| VSA 35065NB-B55C   | FS5              | 12                     | 12                     | 45                     | DX-BR012-5K1                  | 12                  | 5.1                   | 11      | 14                             | DX-BR012-18K1     | 12                  | 18.1                  | 40      | 48                      |
| VSA 35078NB-B55C   | FS6              | 12                     | 12                     | 55                     | DX-BR012-5K1                  | 12                  | 5.1                   | 9       | 11                             | DX-BR012-18K1     | 12                  | 18.1                  | 33      | 39                      |
| VSA 35105NB-B55C   | FS6              | 8                      | 8                      | 75                     | DX-BR012-9K2                  | 12                  | 9.2                   | 12      | 15                             | 2 & DX-BR006-18K1 | 12                  | 36.2                  | 48      | 58                      |
| VSA 35130NB-B55C   | FS6              | 8                      | 8                      | 90                     | DX-BR012-9K2                  | 12                  | 9.2                   | 10      | 12                             | 2 & DX-BR006-18K1 | 12                  | 36.2                  | 40      | 48                      |
| VSA 35150NB-B55C   | FS6              | 8                      | 8                      | 110                    | DX-BR012-9K2                  | 12                  | 9.2                   | 8       | 10                             | 2 & DX-BR006-18K1 | 12                  | 36.2                  | 33      | 39                      |

2 & DX-BR... Two units of this model connected in series  
Resistances: R<sub>Bmin</sub> = Minimum permissible resistance; R<sub>Brec</sub> = Recommended resistance  
P<sub>max</sub> = Rated power for the low duty and high duty classification

## 6.10 Motor chokes

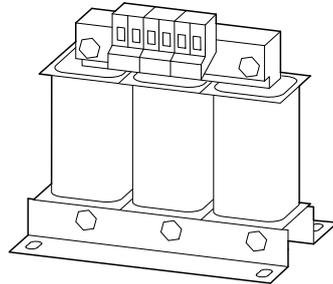


Figure 103: Motor choke DX-LM3...

**Table 48: Motor chokes that should be used**

| Device Type                |              |                         | Assigned motor choke <sup>1)</sup> |                    |
|----------------------------|--------------|-------------------------|------------------------------------|--------------------|
| VSA 12...<br>VSA 32...     | VSA 34...    | VSA 35... <sup>2)</sup> | Type                               | Ampere rating<br>A |
| VSA 124D3...               | VSA 342D2... | VSA 352D1...            | DX-LM3-005                         | 5                  |
| VSA 324D3...               | VSA 344D1... | VSA 353D1...            | DX-LM3-005                         | 5                  |
|                            |              | VSA 354D1...            | DX-LM3-005                         | 5                  |
| VSA 127D0...               | VSA 345D8... | VSA 356D5...            | DX-LM3-008                         | 8                  |
| VSA 327D0...               |              |                         | DX-LM3-008                         | 8                  |
| VSA 12011... <sup>3)</sup> | VSA 349D5... | VSA 359D0...            | DX-LM3-011                         | 11                 |
| VSA 32011... <sup>3)</sup> |              |                         | DX-LM3-011                         | 11                 |
|                            | VSA 34014... | VSA 35012...            | DX-LM3-016                         | 16                 |
| VSA 32018..                | VSA 34018... | VSA 35017...            | DX-LM3-035                         | 35                 |
| VSA 32024...               | VSA 34024... | VSA 35022...            | DX-LM3-035                         | 35                 |
| VSA 32030...               | VSA 34030... | VSA 35028...            | DX-LM3-035                         | 35                 |
|                            |              | VSA 35034...            | DX-LM3-035                         | 35                 |
| VSA 32046...               | VSA 34039... | VSA 35043...            | DX-LM3-050                         | 50                 |
|                            | VSA 34046... |                         | DX-LM3-050                         | 50                 |
| VSA 32061...               | VSA 34061... | VSA 35054...            | DX-LM3-063                         | 63                 |
| VSA 32072...               | VSA 34072... | VSA 35065....           | DX-LM3-080                         | 80                 |
|                            |              | VSA 35078...            | DX-LM3-080                         | 80                 |
| VSA 32090...               | VSA 34090... |                         | DX-LM3-100                         | 100                |
| VSA 32110...               | VSA 34110... | VSA 35105...            | DX-LM3-150                         | 150                |
| VSA 32150...               | VSA 34150... | VSA 35130...            | DX-LM3-150                         | 150                |
|                            |              | VSA 35150...            | DX-LM3-150                         | 150                |
| VSA 32180...               | VSA 34180... |                         | DX-LM3-180                         | 180                |
| VSA 32202...               | VSA 34202... |                         | DX-LM3-220                         | 220                |
| VSA 32248...               | VSA 34240... |                         | DX-LM3-260                         | 260                |

| Device Type            |                            |                         | Assigned motor choke <sup>1)</sup> |                    |
|------------------------|----------------------------|-------------------------|------------------------------------|--------------------|
|                        |                            |                         | Type                               | Ampere rating<br>A |
| VSA 12...<br>VSA 32... | VSA 34...                  | VSA 35... <sup>2)</sup> |                                    |                    |
|                        | VSA 34302...               |                         | DX-LM3-303                         | 303                |
|                        | VSA 34370... <sup>4)</sup> |                         | DX-LM3-370                         | 370                |
|                        | VSA 34450... <sup>4)</sup> |                         | DX-LM3-450                         | 450                |

- 1) Maximum ambient temperature of 50 °C for the corresponding VSA variable frequency drive with an IP20 degree of protection. For devices with an IP55 degree of protection: with a derating of 1.5 % per °C above 40 °C on rated operational current  $I_e$  of VSA and DX-LM3...
- 2) DX-LM3... motor choke only for motor voltages (= mains voltages  $U_{LN}$ ) of up to 500 V AC
- 3) Above 40 °C, use DX-LM3-016 motor choke
- 4) Above 40 °C, with a derating of 1.5 % on rated operational current  $I_e$  of VSA and DX-LM3...



For more information and technical data on DX-LM3... motor chokes, please refer to instruction leaflet IL00906003Z.

## 6 Technical Data

### 6.11 Sine filter

#### 6.11 Sine filter

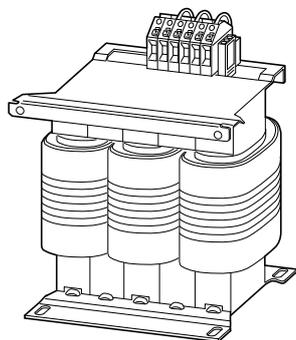


Figure 104:Sine filter DX-SIN3...



Sine filter DX-SIN3... should only be operated with fixed switching frequencies.

Accordingly, the switching frequency (P2-24) must be set to the value set in parameter P6-02 (auto temperature management) (P2-24 = P6-02).

Permissible switching frequencies for VSA with DX-SIN3...:

1  $\triangleq$  8 kHz; 2  $\triangleq$  12 kHz

As a result of double modulation, the value set on the VSA variable frequency drive will be twice the effective value on the sine filter (1  $\triangleq$  8 kHz  $\rightarrow$  4 kHz; 2  $\triangleq$  12 kHz  $\rightarrow$  6 kHz).

**Table 49: Assigned sine filters (degree of protection IP00)**

| Device Type                |              |                         | Assigned sine filter <sup>1)</sup> , rated frequency $f_2 = 0 - 150$ Hz |                    |                                  |
|----------------------------|--------------|-------------------------|---|--------------------|----------------------------------|
| VSA 12...<br>VSA 32...     | VSA 34...    | VSA 35... <sup>2)</sup> | Type  | Ampere rating<br>A | Voltage drop $u_K$ at 400 V<br>% |
| VSA 124D3...               | VSA 342D2... | VSA 352D1...            | DX-SIN3-010   | 10                 | 7                                |
| VSA 127D0...               | VSA 344D1... | VSA 353D1...            | DX-SIN3-010   | 10                 | 7                                |
| VSA 12011... <sup>3)</sup> | VSA 345D8... | VSA 354D1...            | DX-SIN3-010   | 10                 | 7                                |
| VSA 324D3...               | VSA 349D5... | VSA 356D5...            | DX-SIN3-010   | 10                 | 7                                |
| VSA 327D0...               |              | VSA 359D0...            | DX-SIN3-010   | 10                 | 7                                |
| VSA 32011... <sup>3)</sup> |              |                         | DX-SIN3-010   | 10                 | 7                                |
|                            | VSA 34014... | VSA 35012...            | DX-SIN3-016   | 16.5               | 7.5                              |
| VSA 32018..                | VSA 34018... | VSA 35017...            | DX-SIN3-023   | 23.5               | 8                                |
|                            |              | VSA 35022...            | DX-SIN3-023   | 23.5               | 8                                |
| VSA 32024...               | VSA 34024... | VSA 35028...            | DX-SIN3-032   | 32                 | 8.7                              |
| VSA 32030...               | VSA 34030... | VSA 35028...            | DX-SIN3-032   | 32                 | 8.7                              |
|                            |              | VSA 35034...            | DX-SIN3-037   | 37                 | 8.6                              |
| VSA 32046...               | VSA 34039... | VSA 35043...            | DX-SIN3-048   | 48                 | 7.8                              |
|                            | VSA 34046... |                         | DX-SIN3-048   | 48                 | 7.8                              |
| VSA 32061...               | VSA 34061... | VSA 35054...            | DX-SIN3-061   | 61                 | 8.3                              |
| VSA 32072...               | VSA 34072... | VSA 35065...            | DX-SIN3-072   | 72                 | 7.5                              |
| VSA 32090...               | VSA 34090... | VSA 35078...            | DX-SIN3-090   | 90                 | 10                               |
| VSA 32110...               | VSA 34110... | VSA 35105...            | DX-SIN3-115   | 115                | 11                               |
| VSA 32150...               | VSA 34150... | VSA 35130...            | DX-SIN3-150   | 150                | 10.2                             |
|                            |              | VSA 35150...            | DX-SIN3-150   | 150                | 10.2                             |
| VSA 32180...               | VSA 34180... |                         | DX-SIN3-180   | 180                | 7.5                              |
| VSA 32202...               | VSA 34202... |                         | DX-SIN3-250   | 250                | 7.5                              |
| VSA 32248...               | VSA 34240... |                         | DX-SIN3-250   | 250                | 7.5                              |
|                            | VSA 34302... |                         | DX-SIN3-440   | 440                | 7.5                              |
|                            | VSA 34370... |                         | DX-SIN3-440   | 440                | 7.5                              |
|                            | VSA 34450... |                         | DX-SIN3-480   | 480                | 7                                |

1) Maximum permissible ambient air temperature: + 50 °C; maximum permissible motor voltage  $U_{2max}$ : 520 V

2) Sine filter DX-SIN3... only for (= supply voltage  $U_{LN}$ ) to 500 V AC

3) VSA 12011... and VSA 32011... for load currents (rated motor current) of up to 10 A



For more information and technical data on DX-SIN3... sine filters, please refer to instruction leaflet IL00906001Z.

## 6.12 All-pole sine filters



Please enquire for DX-SIN3-...-A all-pole sine filters for motor currents of up to 180 A.

All-pole sine filters make it possible to reduce differential-mode and common-mode interference at the variable frequency drive output when using extremely long motor cable lengths. This makes it possible to eliminate the bearing currents, caused by common-mode voltage, between the motor windings' neutral point and earth potential, extending the motor's lifespan.

DX-SIN3-...-A all-pole sine filters also require being connected to DC+ (or +) and DC- (or -) on the internal DC link in VSA variable frequency drives.

They can be used

- For fixed switching frequencies  $\geq 8$  kHz (P2-24, double modulation)
- Output voltage  $U_{2max}$  to 500 V,
- Rotating field frequencies ( $f_2$ ) of 0 to 60 Hz.

They make it possible to forego the use of screened motor cables.



DX-SIN3-...-A all-pole sine filters may only be operated with fixed switching frequencies. Accordingly, the switching frequency (P2-24) must be set to the value set in parameter P6-02 (auto temperature management) (P2-24 = P6-02).

Permissible switching frequencies for VSA with DX-SIN3...:  
1  $\geq 8$  kHz; 2  $\geq 12$  kHz

As a result of double modulation, the value set on the VSA variable frequency drive will be twice the effective value on the sine filter (1  $\geq 8$  kHz  $\rightarrow$  4 kHz; 2  $\geq 12$  kHz  $\rightarrow$  6 kHz).

**Table 50: Rated all-pole sine filters (IP20 degree of protection)**

| Device Type<br><br>VSA 34... | Assigned sine filter <sup>1)</sup> , rated frequency $f_2 = 0 - 150$ Hz |                           |   |
|------------------------------|---|---------------------------|---|
|                              | Type  | Ampere rating<br><b>A</b> | Voltage drop $u_K$ at 400 V<br><b>%</b> |
| VSA 342D2...                 | DX-SIN3-005-A   | 5                         | 5                                       |
| VSA 344D1...                 | DX-SIN3-005-A   | 5                         | 5                                       |
| VSA 345D8...                 | DX-SIN3-013-A   | 13                        | 5                                       |
| VSA 349D5...                 | DX-SIN3-013-A   | 13                        | 5                                       |
| VSA 34014...                 | DX-SIN3-024-A   | 24                        | 5                                       |
| VSA 34018...                 | DX-SIN3-024-A   | 24                        | 5                                       |
| VSA 34024...                 | DX-SIN3-024-A   | 24                        | 5                                       |
| VSA 34030...                 | DX-SIN3-046-A   | 46                        | 5                                       |
| VSA 34039...                 | DX-SIN3-046-A   | 46                        | 5                                       |
| VSA 34046...                 | DX-SIN3-046-A   | 46                        | 5                                       |
| VSA 34061...                 | DX-SIN3-062-A   | 62                        | 5                                       |
| VSA 34072...                 | DX-SIN3-075-A   | 75                        | 5                                       |
| VSA 34090...                 | DX-SIN3-150-A   | 150                       | 5                                       |
| VSA 34110...                 | DX-SIN3-150-A   | 150                       | 5                                       |
| VSA 34150...                 | DX-SIN3-150-A   | 150                       | 5                                       |

1) Maximum permissible ambient temperature: + 45 °C;  
Permissible motor voltage range: 380 - 480 V ±10%

## 6 Technical Data

### 6.12 All-pole sine filters

## 7 Accessories

### 7.1 List of accessories

| Type               | Description   | Document    |
|--------------------|---|-------------|
| DX-KEY-....        | External keypad   | AP040022    |
| DXA-EXT-3 RO       | Adds three relay outputs  | IL040006ZU  |
| DXA-EXT-3DI1RO     | Adds three digital inputs and one relay output  | IL040007ZU  |
| DXA-EXT-ENCOD      | Dual-channel encoder module for using closed-loop vector control  | AP040028DE  |
| DX-NET-SWD1        | Interface card for connecting to a SmartWire-DT network   | MN04012009Z |
| DX-COM-STICK       | Parameter copying stick for establishing a Bluetooth connection to PC software  | MN040003    |
| DX-COM-PCKIT       | Wired communication between VSA and PC  | MN040003    |
| DX-CBL-PC1M5       | Wired communication between VSA and PC  | MN040003    |
| DX-SPL-R145-2SL1PL | RJ45, 8-pin, splitter, 2 sockets, 1 plug on short connection cable  | IL04012023Z |
| DX-SPL-RJ45-3SL    | RJ45, 8-pin, splitter, 3 sockets  | IL04012023Z |
| DX-SPL-RJ45        | RJ45, 8-pin, splitter, 2 sockets, 1 plug  | IL 040026ZU |
| DX-SPL-RJ45-TERM   | RJ45, 8-pin, splitter, 1 socket, 1 plug, integrated bus termination resistor for CANopen and Modbus   | IL 040026ZU |
| DX-EMC-MNT...      | EMC cable bracket. Can be used to route and secure cables in the connection area  | IL040010ZU  |
| drivesConnect      | PC parameter configuration software for variable frequency drives, with integrated oscilloscope function, drive control function, and function block creation for VSA | MN040003    |

PowerXL™

VSA

Variable Frequency Drives

Parameter Manual





## **Danger!** **Dangerous electrical voltage!**

---

### **Before commencing the installation**

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit the device.
- Cover or enclose any adjacent live components.
- Follow the engineering instructions (AWA/IL) for the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE, PES) must be connected to the protective earth (PE) or the potential equalisation. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that an open circuit on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the extra-low voltage of the 24 V supply. Only use power supply units complying with IEC 60364-4-41 (VDE 0100 Part 410) or HD384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause a restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed and with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause injury or material damage, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).
- Depending on their degree of protection, frequency inverters may contain live bright metal parts, moving or rotating components or hot surfaces during and immediately after operation.
- Removal of the required covers, improper installation or incorrect operation of motor or frequency inverter may cause the failure of the device and may lead to serious injury or damage.
- The applicable national accident prevention and safety regulations apply to all work carried on live frequency inverters.
- The electrical installation must be carried out in accordance with the relevant regulations (e. g. with regard to cable cross sections, fuses, PE).
- Transport, installation, commissioning and maintenance work must be carried out only by qualified personnel (IEC 60364, HD 384 and national occupational safety regulations).
- Installations containing frequency inverters must be provided with additional monitoring and protective devices in accordance with the applicable safety regulations. Modifications to the frequency inverters using the operating software are permitted.
- All covers and doors must be kept closed during operation.
- To reduce the hazards for people or equipment, the user must include in the machine design measures that restrict the consequences of a malfunction or failure of the drive (increased motor speed or sudden standstill of motor). These measures include:
  - Other independent devices for monitoring safety-related variables (speed, travel, end positions etc.).
  - Electrical or non-electrical system-wide measures (electrical or mechanical interlocks).
  - Never touch live parts or cable connections of the frequency inverter after it has been disconnected from the power supply. Due to the charge in the capacitors, these parts may still be live after disconnection. Fit appropriate warning signs.

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## 0 About this manual

This manual provides special information that is intended to enable you to configure the parameters for a VSA variable frequency drive according to your needs.

The details apply to the indicated hardware and software versions.



For a general description (installation, technical data, etc.) of VSA variable frequency drives, please refer to manual MN04020005Z ("Installation Manual").

### 0.1 Target group

The content of MN04020006Z-EN manual is written for engineers and electricians. Electrical engineering and physics-related knowledge and skills will be required in order to be able to commission the corresponding devices.

We assume that you have a good knowledge of engineering fundamentals and that you are familiar with handling electrical systems and machines, as well as with reading technical drawings.

### 0.2 List of revisions

| Publication date | Page | Keyword  | New | Modification | Deleted |
|------------------|------|--|-----|--------------|---------|
| 11/16            |      | P1-12 = 12: SWD control + setpoint value, auto   |     |              | ✓       |
| 01/16            | –    | Initial issue  |     |              |         |
|                  |      | This manual (MN04020006Z – "Parameter Configuration Manual") was part of manual MN04020005Z up to version 10/2012. |     |              |         |

### 0.3 Writing conventions

Symbols with the following meaning are used in this manual:

- ▶ Indicates instructions to be followed.

#### 0.3.1 Hazard warnings of material damages

***NOTICE***

Warns about the possibility of material damage.

#### 0.3.2 Hazard warnings of personal injury



**CAUTION**

Warns of the possibility of hazardous situations that may possibly cause slight injury.



**WARNING**

Warns of the possibility of hazardous situations that could result in serious injury or even death.



**DANGER**

Warns of hazardous situations that result in serious injury or death.

#### 0.3.3 Tips



Indicates useful tips.



All the specifications in this manual refer to the hardware and software versions documented in it.

# 1 General

## 1.1 Parameter Groups

The VSA variable frequency drive's functions are configured with the use of parameters. These parameters are subdivided into ten groups (P0-..., ..., P9-...):

Table 1: Parameter Groups

| Parameter group | Theme            |
|-----------------|------------------|
| P0              | Monitor          |
| P1              | Basic            |
| P2              | Functions        |
| P3              | PID              |
| P4              | Modbus           |
| P5              | Bus              |
| P6              | Extended         |
| P7              | motor            |
| P8              | Ramps            |
| P9              | control assembly |



The following page ("Menu structure") features a diagram showing how to switch between parameter groups.

### Default settings

By default (= unit as supplied), only parameter group 1 ("Basic") will be accessible.

### Extended parameter set

Level 2 (menu P0 to menu P5) and level 3 (menu P0 to menu P9) can be accessed by using parameter P-14 to enter the correct password.

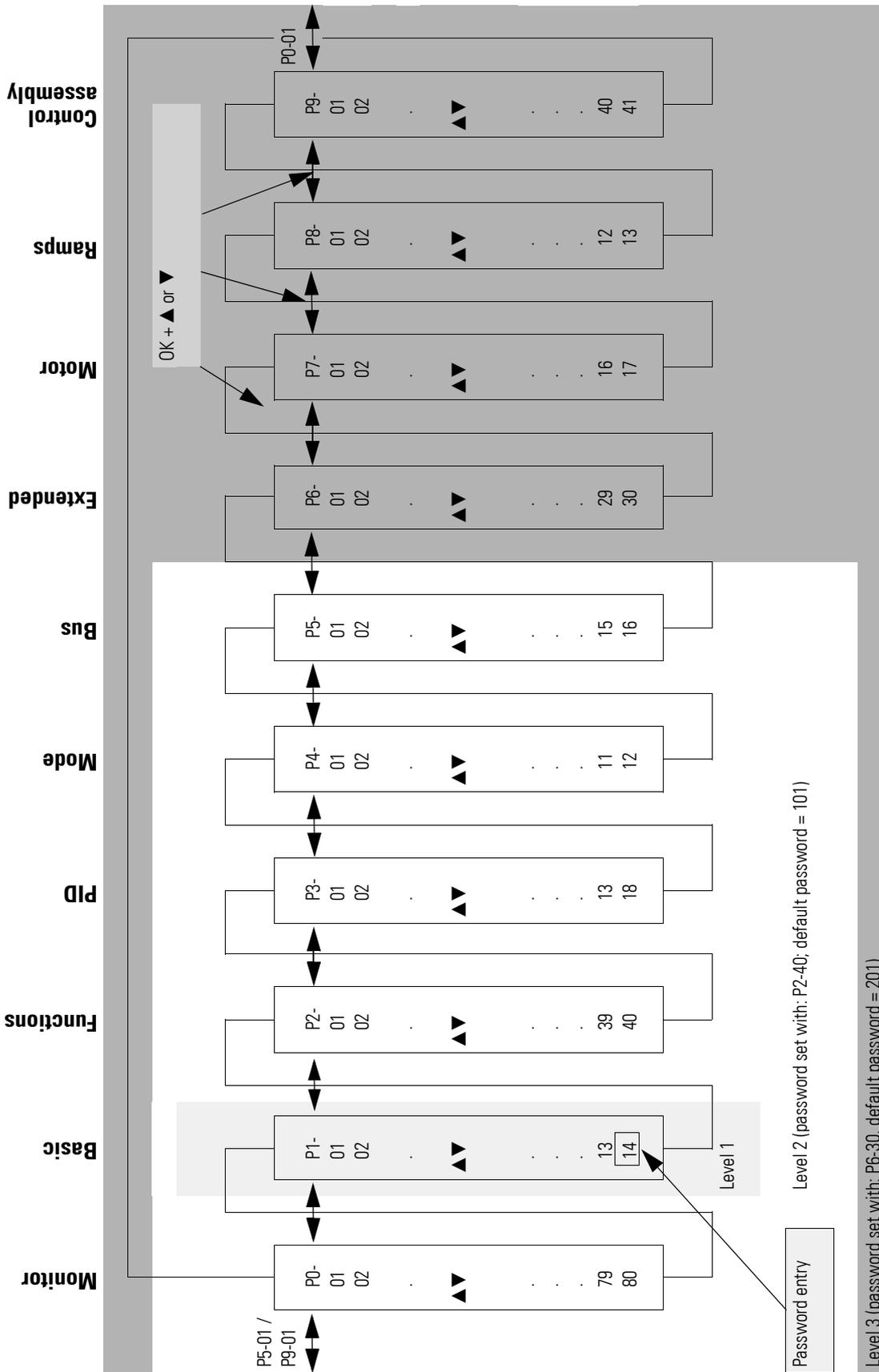
The default passwords are:

- Access to level 2: 101
- Access to level 3: 201

Users can change this password as required:

- Password for Level 2 with: P2-40
- Password for Level 3 with: P6-30

9 1.2 Menu structure



## 2 Operating unit

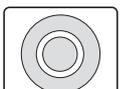
### 2.1 Control unit elements

The following figure shows the elements of the VSA variable frequency drive integrated operating unit.



Figure 1: Operating unit view

Table 2: Keypad elements – Buttons

| Button  | Attribute ID | Explanation   |
|---|--------------|---|
|  | <b>OK</b>    | <ul style="list-style-type: none"> <li>• Opens and closes the parameter interface</li> <li>• Saves parameter values</li> <li>• Changes the value being displayed: A, rpm, etc.</li> </ul> |
|  | <b>START</b> | <ul style="list-style-type: none"> <li>• Starts the variable frequency drive<sup>1)</sup></li> <li>• Changes the operating direction<sup>2)</sup> if the motor is running</li> </ul>      |
|  | <b>STOP</b>  | <ul style="list-style-type: none"> <li>• Stops the variable frequency drive<sup>1)</sup></li> <li>• Reset – Resetting after an error message</li> </ul>                                   |
|  | <b>UP</b>    | <ul style="list-style-type: none"> <li>• Increases the speed<sup>1)</sup></li> <li>• Increment numeric value or parameter number</li> </ul>   |
|  | <b>DOWN</b>  | <ul style="list-style-type: none"> <li>• Decreases the speed<sup>1)</sup></li> <li>• Decrement numeric value or parameter number</li> </ul>   |

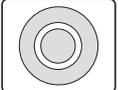
**Note:**

1) P1-12 = 1 only (one operating direction) or = 2 (two operating directions)

2) P1-12 = 2 only

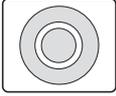
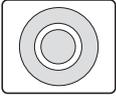
## 2.2 Setting parameters

Table 3: Navigating within the keypad

| Commands  | Description   |
|---|---|
|    | Press the <b>OK</b> button and hold it down for two seconds in order to access the parameter interface<br>→ The display will show the parameter that was last used.   |
|       | Use the <b>▲</b> and <b>▼</b> buttons to select a parameter   |
|    | Press the <b>OK</b> button.   |
|       | Use the <b>▲</b> and <b>▼</b> buttons to change the parameter's value   |
|    | Press the <b>OK</b> button to confirm the parameter value change.   |
|    | Press the <b>OK</b> button and hold it down for two seconds in order to exit the parameter interface  |
|   | <p><b>Switching between two parameter groups</b></p> <p>The parameters are in sequential order. In other words: Moving forward from the last parameter in a parameter group will take you to the first parameter in the next parameter group and the other way around.</p> <p>Press the <b>▲</b> and <b>STOP</b> buttons to jump to the first parameter in the next parameter group</p> |
|   | <p>Press the <b>▼</b> and <b>STOP</b> buttons to jump to the first parameter in the previous parameter group</p>  |

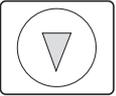
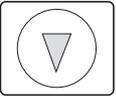
## 2.3 Resetting Parameters (RESET)

Table 4: Resetting parameters (RESET)

| Commands   | Description   |
|--|---|
| <b>Reset to default settings</b>   |   |
|    | Press the ▲ and ▼ and STOP buttons and hold them down for two seconds<br>→ All parameters will be restored to their default settings.<br>The keypad will display <i>P - dEF</i> . |
| <b>Resetting after a fault</b>   |   |
|   | Press the <b>STOP</b> button to reset the unit after a fault  |

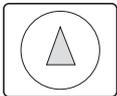
## 2.4 Extended parameter set

Table 5: Enabling and disabling access to the extended parameter set

| Commands  | Description   |
|---|---|
| <b>Enabling access to the extended parameter set</b>  |   |
|    | Press the <b>OK</b> button and hold it down for two seconds in order to access the parameter interface<br>→ The display will show the parameter that was last used. |
|   | Use the ▲ and ▼ buttons to select parameter P1-14.  |
|    | Press the <b>OK</b> button.   |
|   | Use the ▲ and ▼ buttons to enter the password set with P2-40 (level 2; default: 101) or P6-30 (level 3; default: 201)   |
|    | Press the <b>OK</b> button to confirm<br>→ The extended parameter set will now be available.  |

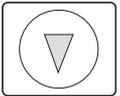
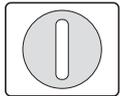
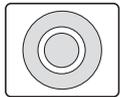
## 2 Operating unit

### 2.5 Control via keypad

| Commands  | Description   |
|---|---|
| <b>Disabling access to the extended parameter set</b>   |   |
|   | Use the ▲ and ▼ buttons to set a value for P1-14 that does not match the password (P2-40 or P6-30).   |
|    | Press the <b>OK</b> button to confirm<br>→ Only the "basic parameters," i.e., the parameters in the first parameter group (P1-01 to P1-14), will be accessible now. |

## 2.5 Control via keypad

Table 6: Control via keypad

| Button  | Attribute ID | Explanation  |
|---|--------------|--|
|   | <b>OK</b>    | P1-12 = 1 or = 2 <ul style="list-style-type: none"> <li>• P1-12 = 1: one operating direction (FWD)</li> <li>• P1-12 = 2: two operating directions (FWD/REV)</li> </ul> |
|    | <b>START</b> | Starts the variable frequency drive  |
|   |              | ▲ Increase speed<br>▼ Decrease speed   |
|    | <b>START</b> | Changes the operating direction if the motor is running<br><br><b>Note:</b><br>P1-12 = 2 only  |
|    | <b>OK</b>    | Changes the value being displayed: A, rpm, etc.  |
|    | <b>STOP</b>  | Stops the variable frequency drive   |

**Note:**

In this mode, a high-level signal must be applied at terminal 2 (D11) as an enable signal for the VSA variable frequency drive.

## 3 Control signal terminals

### 3.1 Correspondence between inputs/outputs and terminals

| Input/Output                      | Clips  |
|-----------------------------------|--|
| <b>Entries</b>                    |  |
| DI1                               | Terminal 2   |
| DI2                               | Terminal 3   |
| DI3                               | Terminal 4   |
| DI4/AI1                           | Terminal 6   |
| DI5/AI2                           | Terminal 10  |
| DigIN: 6                          | Terminal 1 on DXA-EXT-3DI1RO                                       |
| DigIN: 7                          | Terminal 2 on DXA-EXT-3DI1RO                                       |
| DigIN: 8                          | Terminal 3 on DXA-EXT-3DI1RO                                       |
| Safety Torque Off                 | Terminals 12 / 13  |
| <b>Outputs</b>                    |  |
| AO1/DO1                           | Terminal 8   |
| AO2/DO2                           | Terminal 11  |
| RO1 (relays, changeover contacts) | Terminals 14/15/16   |
| RO2 (relay, N/O)                  | Terminals 17/18  |
| RO3 (relay, N/O)                  | Terminals 5/6 on DXA-EXT-3DI1RO or<br>Terminals 1/2 on DXA-EXT-3RO |
| RO4 (relay, N/O)                  | Terminals 3/4 on DXA-EXT-3RO                                       |
| RO5 (relay, N/O)                  | Terminals 5/6 on DXA-EXT-3RO                                       |

Parameter P1-13 can be used to select the configuration for the control signal terminals. More specifically, you can select predefined terminal configurations by setting P1-13 to a value between 1 and 21. The setting (digital/analog) for terminals 6 and 10 will be configured automatically based on the value set for parameter P1-13. In addition to this, you have the option of configuring the terminals freely. To do this, set P1-13 to 0. You can then use menu 9 to configure the terminals according to your needs.

The following control signal terminal configuration tables use the abbreviations and acronyms listed below:

### 3 Control signal terminals

#### 3.1 Correspondence between inputs/outputs and terminals

Table 7: Abbreviations and acronyms for control signal terminal configurations

| Abbreviation  | Significance  |
|---|---|
| AI1 REF   | Analog input AI1 (terminal 6)<br>Used as a speed setpoint input. <ul style="list-style-type: none"> <li>• P2-30: configuration (voltage input/current input ...)</li> <li>• P2-31: scaling</li> <li>• P2-32: offset</li> </ul>  |
| AI2 REF   | Analog input AI2 (terminal 10)<br>Used as a speed setpoint input. <ul style="list-style-type: none"> <li>• P2-33: configuration (voltage input/current input ...)</li> <li>• P2-34: scaling</li> <li>• P2-35: offset</li> </ul>   |
| AI2 Torque REF                                      | Analog input AI2 (terminal 10)<br>Used as a torque setpoint input. <ul style="list-style-type: none"> <li>• P2-33: configuration (voltage input/current input ...)</li> <li>• P2-34: scaling</li> <li>• P2-35: offset</li> </ul>  |
| DIR   | Used to select an operating direction<br>Used together with the START command. <ul style="list-style-type: none"> <li>• Low = clockwise rotating field (FWD )</li> <li>• High = anticlockwise rotating field (REV)</li> </ul> <p><b>Note:</b><br/>If there is a wire breakage and the REV operating direction is selected, this will cause the drive to reverse!<br/>Alternative: Use configuration with FWD/REV.</p>   |
| DOWN  | Used to reduce the speed if a digital setpoint value is selected (P1-12 = 1 or = 2).<br>Used together with the UP command.  |
| ENA   | Variable frequency drive enable signal (ENA = Enable)<br>A start signal (START, FWD, REV) is additionally required for starting.<br>If ENA is removed, the drive will coast.  |
| EXTFLT  | Ext Fault/Warning<br>Can be used to integrate an external signal into the variable frequency drive's fault messages.<br>During operation, there must be a high-level signal at the terminal. If the unit detects a low-level signal instead, the drive will be switched off and display <i>E - E r , P</i> as a fault message.  |
| FWD   | Starts the drive with a clockwise rotating field (FWD = Forward)<br>If a high-level signal is applied at the corresponding terminal, the drive will accelerate with the selected ramp. Removing the signal will cause the drive to stop. In this case, the specific way in which it stops will depend on the value set for P1-05 (stop mode). Once the variable frequency drive stops, it will be locked.<br>In applications with two operating directions, the counterclockwise rotating field is linked to REV. FWD and REV are XOR'd. If both signals are applied simultaneously, the drive will ramp down to zero with the quick stop ramp (P2-25). |
| INV   | Change of rotation (INV = Inverse)<br>The operating direction will be reversed as per the configured ramps. <ul style="list-style-type: none"> <li>• High = invert</li> <li>• Low = Do not reverse</li> </ul>   |
| Pulse FWD (NO)<br>Pulse REV (NO)<br>Pulse STOP (NC) | Pulse control<br>Used to control the drive like a latching reversing contactor circuit. The Pulse STOP signal must always be present when operating the drive. If the signal is not present, it will not be possible to start the drive / the drive will ramp down to zero. To start, all that is required is a pulse via the FWD (clockwise rotating field) or REV (anticlockwise rotating field) signal.<br>The FWD and REV signals do not need to be continuously applied during operation.<br>In order to be able to use this function, P9-05 must be set to 1.   |

## 3 Control signal terminals

### 3.1 Correspondence between inputs/outputs and terminals

| Abbreviation           | Significance  |
|------------------------|---|
| REV                    | <p>Starts the drive with a counterclockwise rotating field (REV = Reverse)</p> <p>If a high-level signal is applied at the corresponding terminal, the drive will accelerate with the selected ramp. Removing the signal will cause the drive to stop. In this case, the specific way in which it stops will depend on the value set for P1-05 (stop mode). Once the variable frequency drive stops, it will be locked.</p> <p>In applications with two operating directions, the clockwise rotating field is selected with FWD. FWD and REV are XOR'd.</p> <p>If both signals are applied simultaneously, the drive will ramp down to zero with the quick stop ramp (P2-25).</p> |
| Select Quick-Dec       | <p>Quick Stop</p> <p>If both inputs have a high level at the same time, the drive will do a quick stop with the ramp configured with P2-25.</p>   |
| Select AI1 REF/AI2 REF | <p>Used to select between the analog setpoint values on AI1 (terminal 6) and AI2 (terminal 10)</p> <ul style="list-style-type: none"> <li>AI1 = Low</li> <li>AI2 = High</li> </ul>  |
| Select AI1 REF/f-Fix   | <p>Used to select between the analog speed reference value at analog input 1 (AI1 = terminal 6) and a fixed frequency. The fixed frequency itself can be selected with the Select f-Fix Bit0, Select f-Fix Bit1, Select f-Fix Bit2 commands.</p> <ul style="list-style-type: none"> <li>Low = analog setpoint value</li> <li>High = fixed frequency</li> </ul>  |
| Select AI1 REF/f-Fix1  | <p>Used to select between the analog speed reference value at analog input 1 (AI1 = terminal 6) and fixed frequency 1 (f-Fix1), which is set with P2-01.</p> <ul style="list-style-type: none"> <li>Low = analog setpoint value</li> <li>High = Preset Speed 1</li> </ul>   |
| Select BUS REF/AI2 REF | <p>Used to select between setpoint values</p> <ul style="list-style-type: none"> <li>Low = Setpoint from bus or from a master drive (if P1-12 = 5)</li> <li>High = AI2</li> </ul>   |
| Select BUS REF/f-Fix   | <p>Used to select between setpoint values</p> <ul style="list-style-type: none"> <li>Low = Setpoint from bus or from a master drive (if P1-12 = 5)</li> <li>High = fixed frequency.</li> </ul> <p>The fixed frequency itself is selected with the Select f-Fix Bit0, Select f-Fix Bit1, Select f-Fix Bit2 commands.</p>   |
| Select BUS REF/f-Fix1  | <p>Used to select between setpoint values</p> <ul style="list-style-type: none"> <li>Low = Setpoint from bus or from a master drive (if P1-12 = 5)</li> <li>High = f-Fix1 (set with P2-01)</li> </ul>   |
| Select DIG REF/AI2 REF | <p>Used to select between the digital speed reference value (set with the keypad or with the UP and DOWN commands) and analog setpoint value AI2 REF (terminal 10)</p> <ul style="list-style-type: none"> <li>Low = digital setpoint value</li> <li>High = AI2</li> </ul>   |
| Select DIG REF/f-Fix   | <p>Used to select between the digital speed reference value (set with the keypad or with the UP and DOWN commands) and a fixed frequency</p> <p>The fixed frequency itself is selected with the Select f-Fix Bit0, Select f-Fix Bit1, Select f-Fix Bit2 commands.</p> <ul style="list-style-type: none"> <li>Low = analog setpoint value</li> <li>High = fixed frequency</li> </ul>   |
| Select DIG REF/f-Fix1  | <p>Used to select between the digital speed reference value (set with the keypad or with the UP and DOWN commands) and fixed frequency 1 (f-Fix1) set with P2-01</p> <ul style="list-style-type: none"> <li>Low = digital setpoint value</li> <li>High = Preset Speed 1</li> </ul>  |

### 3 Control signal terminals

#### 3.1 Correspondence between inputs/outputs and terminals

| Abbreviation  | Significance  |                 |      |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |
|---|---|-----------------|------|------|------|----------------|---|---|---|----------------|---|---|---|----------------|---|---|---|----------------|---|---|---|----------------|---|---|---|----------------|---|---|---|----------------|---|---|---|----------------|---|---|---|
| Select f-Fix Bit0<br>Select f-Fix Bit1<br>Select f-Fix Bit2 | <p>Used to select a fixed frequency with digital commands<br/>Fixed frequencies f-Fix1, ..., f-Fix8 are defined with parameters P2-01, ..., P2-08.</p> <table border="1"> <thead> <tr> <th>Fixed frequency</th> <th>Bit2</th> <th>Bit1</th> <th>Bit0</th> </tr> </thead> <tbody> <tr> <td>f-Fix1 (P2-01)</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>f-Fix2 (P2-02)</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>f-Fix3 (P2-03)</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>f-Fix4 (P2-04)</td> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>f-Fix5 (P2-05)</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>f-Fix6 (P2-06)</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>f-Fix7 (P2-07)</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>f-Fix8 (P2-08)</td> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table> <p>0 = Low; 1 = High</p> | Fixed frequency | Bit2 | Bit1 | Bit0 | f-Fix1 (P2-01) | 0 | 0 | 0 | f-Fix2 (P2-02) | 0 | 0 | 1 | f-Fix3 (P2-03) | 0 | 1 | 0 | f-Fix4 (P2-04) | 0 | 1 | 1 | f-Fix5 (P2-05) | 1 | 0 | 0 | f-Fix6 (P2-06) | 1 | 0 | 1 | f-Fix7 (P2-07) | 1 | 1 | 0 | f-Fix8 (P2-08) | 1 | 1 | 1 |
| Fixed frequency   | Bit2  | Bit1            | Bit0 |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |
| f-Fix1 (P2-01)  | 0   | 0               | 0    |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |
| f-Fix2 (P2-02)  | 0   | 0               | 1    |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |
| f-Fix3 (P2-03)  | 0   | 1               | 0    |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |
| f-Fix4 (P2-04)  | 0   | 1               | 1    |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |
| f-Fix5 (P2-05)  | 1   | 0               | 0    |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |
| f-Fix6 (P2-06)  | 1   | 0               | 1    |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |
| f-Fix7 (P2-07)  | 1   | 1               | 0    |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |
| f-Fix8 (P2-08)  | 1   | 1               | 1    |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |
| Select PID REF/AI2 REF                                      | <p>Used to select between setpoint values</p> <ul style="list-style-type: none"> <li>Low = Setpoint from the PID controller's output</li> <li>High = AI2</li> </ul>   |                 |      |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |
| Select PID REF/f-Fix  | <p>Used to select between setpoint values</p> <ul style="list-style-type: none"> <li>Low = Setpoint from the PID controller's output</li> <li>High = Fixed frequency</li> </ul> <p>The fixed frequency itself is selected with the Select f-Fix Bit0, Select f-Fix Bit1, Select f-Fix Bit2 commands.</p>  |                 |      |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |
| Select PID REF/f-Fix1                                       | <p>Used to select between setpoint values</p> <ul style="list-style-type: none"> <li>Low = Setpoint from the PID controller's output</li> <li>High = f-Fix1 (set with P2-01)</li> </ul>   |                 |      |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |
| Select Quick-dec  | <p>Used to activate a quick stop with the ramp set with P2-25<br/>In order to activate the quick stop, there must be a high signal at both terminals</p>  |                 |      |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |
| Select t-dec/t-dec2   | <p>Used to select between deceleration ramp 1 t-dec set with P1-04 and deceleration ramp 2 t-dec2 (P8-11)</p> <ul style="list-style-type: none"> <li>Low = Deceleration ramp 1</li> <li>High = Deceleration ramp 2</li> </ul>   |                 |      |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |
| START   | <p>Used to start/stop the drive<br/>If a high-level signal is applied at the corresponding terminal, the drive will accelerate with the selected ramp. Removing the signal will cause the drive to stop. In this case, the specific way in which it stops will depend on the value set for P1-05 (stop mode). Once the variable frequency drive stops, it will be locked.<br/>In applications with two operating directions, the directions are selected using the DIR and INV commands.</p>  |                 |      |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |
| UP  | <p>Used to increase the speed if a digital setpoint is selected (P1-12 = 1 or 2)<br/>Used together with the DOWN command.</p>   |                 |      |      |      |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |

### 3.2 Configuration of the control signal terminals

#### 3.2.1 P1-12 = 0: Terminal-based operation (= default setting)

Table 8: P1-12 = 0: Terminal-based operation (= default setting)

| P1-13 | DI1<br>(terminal 2) | DI2<br>(terminal 3) | DI3<br>(terminal 4)    | DI4/AI1<br>(terminal 6) | DI5/AI2<br>(terminal 10) |
|-------|---------------------|---------------------|------------------------|-------------------------|--------------------------|
| 0     | user-definable      | user-definable      | user-definable         | user-definable          | user-definable           |
| 1     | START               | DIR                 | Select AI1 REF/f-Fix   | AI1 REF                 | Select f-Fix Bit0        |
| 2     | START               | DIR                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select f-Fix Bit2        |
| 3     | START               | DIR                 | Select AI1 REF/f-Fix1  | AI1 REF                 | AI2 Torque REF           |
| 4     | START               | DIR                 | Select AI1 REF/f-Fix1  | AI1 REF                 | Select t-dec/t-dec2      |
| 5     | START               | DIR                 | Select AI1 REF/AI2 REF | AI1 REF                 | AI2 REF                  |
| 6     | START               | DIR                 | Select AI1 REF/f-Fix1  | AI1 REF                 | EXTFLT                   |
| 7     | START               | DIR                 | Select f-Fix Bit0      | Select f-Fix Bit1       | EXTFLT                   |
| 8     | START               | DIR                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select t-dec/t-dec2      |
| 9     | START               | DIR                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select AI1 REF/f-Fix     |
| 10    | START               | DIR                 | UP                     | DOWN                    | Select DIG REF/f-Fix1    |
| 11    | FWD                 | REV                 | Select AI1 REF/f-Fix   | AI1 REF                 | Select f-Fix Bit0        |
| 12    | FWD                 | REV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select f-Fix Bit2        |
| 13    | FWD                 | REV                 | Select AI1 REF/f-Fix1  | AI1 REF                 | AI2 Torque REF           |
| 14    | FWD                 | REV                 | Select AI1 REF/f-Fix1  | AI1 REF                 | Select t-dec/t-dec2      |
| 15    | FWD                 | REV                 | Select AI1 REF/AI2 REF | AI1 REF                 | AI2 REF                  |
| 16    | FWD                 | REV                 | Select AI1 REF/f-Fix1  | AI1 REF                 | EXTFLT                   |
| 17    | FWD                 | REV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | EXTFLT                   |
| 18    | FWD                 | REV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select t-dec/t-dec2      |
| 19    | FWD                 | REV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select AI1 REF/f-Fix     |
| 20    | FWD                 | REV                 | UP                     | DOWN                    | Select REF/f-Fix1        |
| 21    | Pulse FWD (NO)      | Pulse STOP (NC)     | Pulse REV (NO)         | AI1 REF                 | Select AI1 REF/f-Fix1    |

The setpoint and the control commands are set/issued via terminals.

P1-12 = 11: default settings

- AI1 REF, 0 - 10 V analog setpoint at control signal terminal 6 (= 0 -  $f_{max}$ )
- f-Fix Bit0, fixed frequency 1 = 5 Hz (f-Fix1, P2-01) and fixed frequency 2 = 10 Hz (f-Fix2, P2-02)

### 3 Control signal terminals

#### 3.2 Configuration of the control signal terminals

#### 3.2.2 P1-12 = 1: Digital setpoint value, 1 operating direction

Table 9: P1-12 = 1: Digital setpoint value, 1 operating direction

| P1-13 | DI1<br>(terminal 2) | DI2<br>(terminal 3) | DI3<br>(terminal 4)    | DI4/AI1<br>(terminal 6) | DI5/AI2<br>(terminal 10) |
|-------|---------------------|---------------------|------------------------|-------------------------|--------------------------|
| 0     | user-definable      | user-definable      | user-definable         | user-definable          | user-definable           |
| 1     | START               | DIR                 | Select DIG REF/f-Fix   | No function             | Select f-Fix Bit0        |
| 2     | START               | DIR                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select f-Fix Bit2        |
| 3     | START               | DIR                 | Select DIG REF/f-Fix1  | No function             | No function              |
| 4     | START               | DIR                 | Select DIG REF/f-Fix1  | No function             | Select t-dec/t-dec2      |
| 5     | START               | DIR                 | Select DIG REF/AI2 REF | No function             | AI2 REF                  |
| 6     | START               | DIR                 | Select DIG REF/f-Fix1  | No function             | EXTFLT                   |
| 7     | START               | DIR                 | Select f-Fix Bit0      | Select f-Fix Bit1       | EXTFLT                   |
| 8     | START               | DIR                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select t-dec/t-dec2      |
| 9     | START               | DIR                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select DIG REF/f-Fix     |
| 10    | START               | DIR                 | UP                     | DOWN                    | Select DIG REF/f-Fix1    |
| 11    | Select Quick-dec    | Select Quick-dec    | Select DIG REF/f-Fix   | No function             | Select f-Fix Bit0        |
| 12    | Select Quick-dec    | Select Quick-dec    | Select f-Fix Bit0      | Select f-Fix Bit1       | Select f-Fix Bit2        |
| 13    | Select Quick-dec    | Select Quick-dec    | Select DIG REF/f-Fix1  | No function             | No function              |
| 14    | Select Quick-dec    | Select Quick-dec    | Select DIG REF/f-Fix1  | No function             | Select t-dec/t-dec2      |
| 15    | Select Quick-dec    | Select Quick-dec    | Select DIG REF/AI2 REF | No function             | AI2 REF                  |
| 16    | Select Quick-dec    | Select Quick-dec    | Select DIG REF/f-Fix1  | No function             | EXTFLT                   |
| 17    | Select Quick-dec    | Select Quick-dec    | Select f-Fix Bit0      | Select f-Fix Bit1       | EXTFLT                   |
| 18    | Select Quick-dec    | Select Quick-dec    | Select f-Fix Bit0      | Select f-Fix Bit1       | Select t-dec/t-dec2      |
| 19    | Select Quick-dec    | Select Quick-dec    | Select f-Fix Bit0      | Select f-Fix Bit1       | Select DIG REF/f-Fix     |
| 20    | Select Quick-dec    | Select Quick-dec    | UP                     | DOWN                    | Select DIG REF/f-Fix1    |
| 21    | Not permissible     |                     |                        |                         |                          |

The setpoint value is set using the keypad = digital setpoint value.

The arrow keys are used to adjust the setpoint value.

- If P1-13 = 1, ..., 10:  
DI2 can be used to select the operating direction.
- P1-13 = 10 or P1-13 = 20:  
DI3 and DI4 can also be used to adjust the setpoint. In this case, they will work simultaneously with the arrow keys on the keypad.

## 3.2.3 P1-12 = 2: Digital setpoint value, 2 operating directions

Table 10: P1-12 = 2: digital setpoint value, 2 operating directions

| P1-13 | DI1<br>(terminal 2) | DI2<br>(terminal 3) | DI3<br>(terminal 4)    | DI4/AI1<br>(terminal 6) | DI5/AI2<br>(terminal 10) |
|-------|---------------------|---------------------|------------------------|-------------------------|--------------------------|
| 0     | user-definable      | user-definable      | user-definable         | user-definable          | user-definable           |
| 1     | START               | INV                 | Select DIG REF/f-Fix   | No function             | Select f-Fix Bit0        |
| 2     | START               | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select f-Fix Bit2        |
| 3     | START               | INV                 | Select DIG REF/f-Fix1  | No function             | No function              |
| 4     | START               | INV                 | Select DIG REF/f-Fix1  | No function             | Select t-dec/t-dec2      |
| 5     | START               | INV                 | Select DIG REF/AI2 REF | No function             | AI2 REF                  |
| 6     | START               | INV                 | Select DIG REF/f-Fix1  | No function             | EXTFLT                   |
| 7     | START               | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | EXTFLT                   |
| 8     | START               | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select t-dec/t-dec2      |
| 9     | START               | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select DIG REF/f-Fix     |
| 10    | START               | INV                 | UP                     | DOWN                    | Select DIG REF/f-Fix1    |
| 11    | Select Quick-dec    | Select Quick-dec    | Select DIG REF/f-Fix   | No function             | Select f-Fix Bit0        |
| 12    | Select Quick-dec    | Select Quick-dec    | Select f-Fix Bit0      | Select f-Fix Bit1       | Select f-Fix Bit2        |
| 13    | Select Quick-dec    | Select Quick-dec    | Select DIG REF/f-Fix1  | No function             | No function              |
| 14    | Select Quick-dec    | Select Quick-dec    | Select DIG REF/f-Fix1  | No function             | Select t-dec/t-dec2      |
| 15    | Select Quick-dec    | Select Quick-dec    | Select DIG REF/AI2 REF | No function             | AI2 REF                  |
| 16    | Select Quick-dec    | Select Quick-dec    | Select DIG REF/f-Fix1  | No function             | EXTFLT                   |
| 17    | Select Quick-dec    | Select Quick-dec    | Select f-Fix Bit0      | Select f-Fix Bit1       | EXTFLT                   |
| 18    | Select Quick-dec    | Select Quick-dec    | Select f-Fix Bit0      | Select f-Fix Bit1       | Select t-dec/t-dec2      |
| 19    | Select Quick-dec    | Select Quick-dec    | Select f-Fix Bit0      | Select f-Fix Bit1       | Select DIG REF/f-Fix     |
| 20    | Select Quick-dec    | Select Quick-dec    | UP                     | DOWN                    | Select DIG REF/f-Fix1    |
| 21    | Not permissible     |                     |                        |                         |                          |

The setpoint value is set using the keypad = digital setpoint value; the arrow keys are used to adjust the setpoint value. If the motor is running, pressing the green button again will reverse the operating direction. The last operating direction will be stored when the unit is switched off.

- P1-13 = 1, ..., 10:  
If P1-13 = 1, ..., 10, a signal at DI2 will cause the operating direction set with the keypad to be reversed.
- P1-13 = 10 or P1-13 = 20:  
DI3 and DI4 can also be used to adjust the setpoint. In this case, they will work at the same time as the arrow keys on the keypad.

### 3 Control signal terminals

#### 3.2 Configuration of the control signal terminals

#### 3.2.4 P1-12 = 3: PID controller

Table 11: P1-12 = 3: PID controller

| P1-13 | DI1<br>(terminal 2) | DI2<br>(terminal 3) | DI3<br>(terminal 4)    | DI4/AI1<br>(terminal 6)      | DI5/AI2<br>(terminal 10) |
|-------|---------------------|---------------------|------------------------|------------------------------|--------------------------|
| 0     | user-definable      | user-definable      | user-definable         | user-definable               | user-definable           |
| 1     | Not permissible     |                     |                        |                              |                          |
| 2     | Not permissible     |                     |                        |                              |                          |
| 3     | START               | DIR                 | Select PID REF/f-Fix1  | Defined with P3-05/P3-10     | Defined with P3-05/P3-10 |
| 4     | Not permissible     |                     |                        |                              |                          |
| 5     | START               | DIR                 | Select PID REF/AI2 REF | PID actual value (P3-10 = 1) | AI2 REF                  |
| 6     | START               | DIR                 | Select PID REF/f-Fix1  | PID actual value (P3-10 = 1) | EXTFLT                   |
| 7     | Not permissible     |                     |                        |                              |                          |
| 8     | Not permissible     |                     |                        |                              |                          |
| 9     | Not permissible     |                     |                        |                              |                          |
| 10    | Not permissible     |                     |                        |                              |                          |
| 11    | Not permissible     |                     |                        |                              |                          |
| 12    | Not permissible     |                     |                        |                              |                          |
| 13    | FWD                 | REV                 | Select PID REF/f-Fix1  | Defined with P3-05/P3-10     | Defined with P3-05/P3-10 |
| 14    | Not permissible     |                     |                        |                              |                          |
| 15    | FWD                 | REV                 | Select PID REF/AI2 REF | PID actual value (P3-10 = 1) | AI2 REF                  |
| 16    | FWD                 | REV                 | Select PID REF/f-Fix1  | PID actual value (P3-10 = 1) | EXTFLT                   |
| 17    | Not permissible     |                     |                        |                              |                          |
| 18    | Not permissible     |                     |                        |                              |                          |
| 19    | Not permissible     |                     |                        |                              |                          |
| 20    | Not permissible     |                     |                        |                              |                          |
| 21    | Not permissible     |                     |                        |                              |                          |

## 3.2.5 P1-12 = 4: Control via field bus

Table 12: P1-12 = 4: Control via field bus

| P1-13 | DI1<br>(terminal 2) | DI2<br>(terminal 3) | DI3<br>(terminal 4)    | DI4/AI1<br>(terminal 6) | DI5/AI2<br>(terminal 10) |
|-------|---------------------|---------------------|------------------------|-------------------------|--------------------------|
| 0     | user-definable      | user-definable      | user-definable         | user-definable          | user-definable           |
| 1     | START               | INV                 | Select BUS REF/f-Fix   | No function             | Select f-Fix Bit0        |
| 2     | Not permissible     |                     |                        |                         |                          |
| 3     | Not permissible     |                     |                        |                         |                          |
| 4     | START               | INV                 | Select BUS REF/f-Fix1  | No function             | Select t-dec/t-dec2      |
| 5     | START               | INV                 | Select BUS REF/AI2 REF | No function             | AI2 REF                  |
| 6     | START               | INV                 | Select BUS REF/f-Fix1  | No function             | EXTFLT                   |
| 7     | Not permissible     |                     |                        |                         |                          |
| 8     | Not permissible     |                     |                        |                         |                          |
| 9     | START               | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select BUS REF/f-Fix     |
| 10    | START               | INV                 | No function            | No function             | Select BUS REF/f-Fix1    |
| 11    | Select Quick-dec    | Select Quick-dec    | Select BUS REF/f-Fix   | No function             | Select f-Fix Bit0        |
| 12    | Not permissible     |                     |                        |                         |                          |
| 13    | Not permissible     |                     |                        |                         |                          |
| 14    | Select Quick-dec    | Select Quick-dec    | Select BUS REF/f-Fix1  | No function             | Select t-dec/t-dec2      |
| 15    | Select Quick-dec    | Select Quick-dec    | Select BUS REF/AI2 REF | No function             | AI2 REF                  |
| 16    | Select Quick-dec    | Select Quick-dec    | Select BUS REF/f-Fix1  | No function             | EXTFLT                   |
| 17    | Not permissible     |                     |                        |                         |                          |
| 18    | Not permissible     |                     |                        |                         |                          |
| 19    | Select Quick-dec    | Select Quick-dec    | Select f-Fix Bit0      | Select f-Fix Bit1       | Select BUS REF/f-Fix     |
| 20    | Select Quick-dec    | Select Quick-dec    | No function            | No function             | Select BUS REF/f-Fix1    |
| 21    | Not permissible     |                     |                        |                         |                          |

- P1-13 = 1, ..., 10:  
An enable signal is required at DI1 in order to run the drive. The drive is started through the bus.
- P1-13 = 11, ..., 20:  
The enable signal for the drive is issued exclusively through the bus. Simultaneously applying a signal at DI1 and DI2 will result in a quick stop.

### 3 Control signal terminals

#### 3.2 Configuration of the control signal terminals

##### 3.2.6 P1-12 = 5: Slave mode

Table 13: P1-12 = 5: Slave mode

| P1-13 | DI1<br>(terminal 2) | DI2<br>(terminal 3) | DI3<br>(terminal 4)    | DI4/AI1<br>(terminal 6) | DI5/AI2<br>(terminal 10) |
|-------|---------------------|---------------------|------------------------|-------------------------|--------------------------|
| 0     | user-definable      | user-definable      | user-definable         | user-definable          | user-definable           |
| 1     | START               | INV                 | Select BUS REF/f-Fix   | No function             | Select f-Fix Bit0        |
| 2     | Not permissible     |                     |                        |                         |                          |
| 3     | Not permissible     |                     |                        |                         |                          |
| 4     | START               | INV                 | Select BUS REF/f-Fix1  | No function             | Select t-dec/t-dec2      |
| 5     | START               | INV                 | Select BUS REF/AI2 REF | No function             | AI2 REF                  |
| 6     | START               | INV                 | Select BUS REF/f-Fix1  | No function             | EXTFLT                   |
| 7     | Not permissible     |                     |                        |                         |                          |
| 8     | Not permissible     |                     |                        |                         |                          |
| 9     | START               | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select BUS REF/f-Fix     |
| 10    | START               | INV                 | No function            | No function             | Select BUS REF/f-Fix1    |
| 11    | Select Quick-dec    | Select Quick-dec    | Select BUS REF/f-Fix   | No function             | Select f-Fix Bit0        |
| 12    | Not permissible     |                     |                        |                         |                          |
| 13    | Not permissible     |                     |                        |                         |                          |
| 14    | Select Quick-dec    | Select Quick-dec    | Select BUS REF/f-Fix1  | No function             | Select t-dec/t-dec2      |
| 15    | Select Quick-dec    | Select Quick-dec    | Select BUS REF/AI2 REF | No function             | AI2 REF                  |
| 16    | Select Quick-dec    | Select Quick-dec    | Select BUS REF/f-Fix1  | No function             | EXTFLT                   |
| 17    | Not permissible     |                     |                        |                         |                          |
| 18    | Not permissible     |                     |                        |                         |                          |
| 19    | Select Quick-dec    | Select Quick-dec    | Select f-Fix Bit0      | Select f-Fix Bit1       | Select BUS REF/f-Fix     |
| 20    | Select Quick-dec    | Select Quick-dec    | No function            | No function             | Select BUS REF/f-Fix1    |
| 21    | Not permissible     |                     |                        |                         |                          |

In order to be able to run the slave, an enable signal for the master is always required as well – even if the setpoint does not come from the master!

### 3.2.7 P1-12 = 6: Control via CANopen

Table 14: P1-12 = 6: Control via CANopen

| P1-13 | DI1<br>(terminal 2) | DI2<br>(terminal 3) | DI3<br>(terminal 4)    | DI4/AI1<br>(terminal 6) | DI5/AI2<br>(terminal 10) |
|-------|---------------------|---------------------|------------------------|-------------------------|--------------------------|
| 0     | user-definable      | user-definable      | user-definable         | user-definable          | user-definable           |
| 1     | ENA                 | INV                 | Select BUS REF/f-Fix   | No function             | Select f-Fix Bit0        |
| 2     | ENA                 | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select f-Fix Bit2        |
| 3     | ENA                 | INV                 | Select BUS REF/f-Fix1  | No function             | AI2 Torque REF           |
| 4     | ENA                 | INV                 | Select BUS REF/f-Fix1  | No function             | Select t-dec/t-dec2      |
| 5     | ENA                 | INV                 | Select BUS REF/AI2 REF | No function             | AI2 REF                  |
| 6     | ENA                 | INV                 | Select BUS REF/f-Fix1  | No function             | EXTFLT                   |
| 7     | ENA                 | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | EXTFLT                   |
| 8     | ENA                 | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select t-dec/t-dec2      |
| 9     | ENA                 | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select BUS REF/f-Fix     |
| 10    | ENA                 | INV                 | No function            | No function             | Select BUS REF/f-Fix1    |
| 11    | Select Quick-dec    | Select Quick-dec    | Select BUS REF/f-Fix   | No function             | Select f-Fix Bit0        |
| 12    | Select Quick-dec    | Select Quick-dec    | Select f-Fix Bit0      | Select f-Fix Bit1       | Select f-Fix Bit2        |
| 13    | Select Quick-dec    | Select Quick-dec    | Select BUS REF/f-Fix1  | No function             | AI2 Torque REF           |
| 14    | Select Quick-dec    | Select Quick-dec    | Select BUS REF/f-Fix1  | No function             | Select t-dec/t-dec2      |
| 15    | Select Quick-dec    | Select Quick-dec    | Select BUS REF/AI2 REF | No function             | AI2 REF                  |
| 16    | Select Quick-dec    | Select Quick-dec    | Select BUS REF/f-Fix1  | No function             | EXTFLT                   |
| 17    | Select Quick-dec    | Select Quick-dec    | Select f-Fix Bit0      | Select f-Fix Bit1       | EXTFLT                   |
| 18    | Select Quick-dec    | Select Quick-dec    | Select f-Fix Bit0      | Select f-Fix Bit1       | Select t-dec/t-dec2      |
| 19    | Select Quick-dec    | Select Quick-dec    | Select f-Fix Bit0      | Select f-Fix Bit1       | Select BUS REF/f-Fix     |
| 20    | Select Quick-dec    | Select Quick-dec    | No function            | No function             | Select BUS REF/f-Fix1    |
| 21    | Not permissible     |                     |                        |                         |                          |

- P1-13 = 1, ..., 10:  
An enable signal is required at DI1 in order to run the drive. The drive is started through the bus.
- P1-13 = 11, ..., 20:  
The enable signal for the drive is issued exclusively through the bus. Simultaneously applying a signal at DI1 and DI2 will result in a quick stop.

### 3 Control signal terminals

#### 3.2 Configuration of the control signal terminals

#### 3.2.8 P1-12 = 9: SWD control + setpoint value

Table 15: P1-12 = 9: SWD control + setpoint value

| P1-13 | DI1<br>(terminal 2) | DI2<br>(terminal 3) | DI3<br>(terminal 4) | DI4/AI1<br>(terminal 6) | DI5/AI2<br>(terminal 10) |
|-------|---------------------|---------------------|---------------------|-------------------------|--------------------------|
| 0     | user-definable      | user-definable      | user-definable      | user-definable          | user-definable           |
| 1     | ENA                 | No function         | No function         | No function             | No function              |
| 2     | ENA                 | No function         | No function         | No function             | No function              |
| 3     | ENA                 | No function         | No function         | No function             | No function              |
| 4     | ENA                 | No function         | No function         | No function             | No function              |
| 5     | ENA                 | No function         | No function         | No function             | No function              |
| 6     | ENA                 | No function         | No function         | No function             | No function              |
| 7     | ENA                 | No function         | No function         | No function             | No function              |
| 8     | ENA                 | No function         | No function         | No function             | No function              |
| 9     | ENA                 | No function         | No function         | No function             | No function              |
| 10    | ENA                 | No function         | No function         | No function             | No function              |
| 11    | ENA                 | No function         | No function         | No function             | No function              |
| 12    | ENA                 | No function         | No function         | No function             | No function              |
| 13    | ENA                 | No function         | No function         | No function             | No function              |
| 14    | ENA                 | No function         | No function         | No function             | No function              |
| 15    | ENA                 | No function         | No function         | No function             | No function              |
| 16    | ENA                 | No function         | No function         | No function             | No function              |
| 17    | ENA                 | No function         | No function         | No function             | No function              |
| 18    | ENA                 | No function         | No function         | No function             | No function              |
| 19    | ENA                 | No function         | No function         | No function             | No function              |
| 20    | ENA                 | No function         | No function         | No function             | No function              |
| 21    | Not permissible     |                     |                     |                         |                          |

**3.2.9 P1-12 = 10: SWD control**

Table 16: P1-12 = 10: SWD control

| P1-13 | DI1<br>(terminal 2) | DI2<br>(terminal 3) | DI3<br>(terminal 4)    | DI4/AI1<br>(terminal 6) | DI5/AI2<br>(terminal 10) |
|-------|---------------------|---------------------|------------------------|-------------------------|--------------------------|
| 0     | user-definable      | user-definable      | user-definable         | user-definable          | user-definable           |
| 1     | ENA                 | INV                 | Select AI1 REF/f-Fix   | AI1 REF                 | Select f-Fix Bit0        |
| 2     | ENA                 | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select f-Fix Bit2        |
| 3     | ENA                 | INV                 | Select AI1 REF/f-Fix1  | AI1 REF                 | AI2 Torque REF           |
| 4     | ENA                 | INV                 | Select AI1 REF/f-Fix1  | AI1 REF                 | Select t-dec/t-dec2      |
| 5     | ENA                 | INV                 | Select AI1 REF/AI2 REF | AI1 REF                 | AI2 REF                  |
| 6     | ENA                 | INV                 | Select AI1 REF/f-Fix1  | AI1 REF                 | EXTFLT                   |
| 7     | ENA                 | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | EXTFLT                   |
| 8     | ENA                 | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select t-dec/t-dec2      |
| 9     | ENA                 | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select REF/f-Fix         |
| 10    | ENA                 | INV                 | UP                     | DOWN                    | Select DIG REF/f-Fix1    |
| 11    | ENA                 | INV                 | Select AI1 REF/f-Fix   | AI1 REF                 | Select f-Fix Bit0        |
| 12    | ENA                 | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select f-Fix Bit2        |
| 13    | ENA                 | INV                 | Select AI1 REF/f-Fix1  | AI1 REF                 | AI2 Torque REF           |
| 14    | ENA                 | INV                 | Select AI1 REF/f-Fix1  | AI1 REF                 | Select t-dec/t-dec2      |
| 15    | ENA                 | INV                 | Select AI1 REF/AI2     | AI1 REF                 | AI2 REF                  |
| 16    | ENA                 | INV                 | Select AI1 REF/f-Fix1  | AI1 REF                 | EXTFLT                   |
| 17    | ENA                 | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | EXTFLT                   |
| 18    | ENA                 | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select t-dec/t-dec2      |
| 19    | ENA                 | INV                 | Select f-Fix Bit0      | Select f-Fix Bit1       | Select REF/f-Fix         |
| 20    | ENA                 | INV                 | UP                     | DOWN                    | Select DIG REF/f-Fix1    |
| 21    | Not permissible     |                     |                        |                         |                          |

### 3 Control signal terminals

#### 3.2 Configuration of the control signal terminals

##### 3.2.10 P1-12 = 11: SWD setpoint value

Table 17: P1-12 = 11: SWD setpoint value

| P1-13 | DI1<br>(terminal 2) | DI2<br>(terminal 3) | DI3<br>(terminal 4) | DI4/AI1<br>(terminal 6) | DI5/AI2<br>(terminal 10) |
|-------|---------------------|---------------------|---------------------|-------------------------|--------------------------|
| 0     | user-definable      | user-definable      | user-definable      | user-definable          | user-definable           |
| 1     | ENA                 | No function         | No function         | No function             | No function              |
| 2     | ENA                 | No function         | No function         | No function             | No function              |
| 3     | ENA                 | No function         | No function         | No function             | No function              |
| 4     | ENA                 | No function         | No function         | No function             | No function              |
| 5     | ENA                 | No function         | No function         | No function             | No function              |
| 6     | ENA                 | No function         | No function         | No function             | No function              |
| 7     | ENA                 | No function         | No function         | No function             | No function              |
| 8     | ENA                 | No function         | No function         | No function             | No function              |
| 9     | ENA                 | No function         | No function         | No function             | No function              |
| 10    | ENA                 | No function         | No function         | No function             | No function              |
| 11    | ENA                 | No function         | No function         | No function             | No function              |
| 12    | ENA                 | No function         | No function         | No function             | No function              |
| 13    | ENA                 | No function         | No function         | No function             | No function              |
| 14    | ENA                 | No function         | No function         | No function             | No function              |
| 15    | ENA                 | No function         | No function         | No function             | No function              |
| 16    | ENA                 | No function         | No function         | No function             | No function              |
| 17    | ENA                 | No function         | No function         | No function             | No function              |
| 18    | ENA                 | No function         | No function         | No function             | No function              |
| 19    | ENA                 | No function         | No function         | No function             | No function              |
| 20    | ENA                 | No function         | No function         | No function             | No function              |
| 21    | Not permissible     |                     |                     |                         |                          |

### 3.2.11 P1-12 = 13: SmartWire-DT control + setpoint, start via bus and terminal

Table 18: P1-12 = 13: SmartWire-DT control + setpoint, start via bus and terminal

| P1-13 | DI1<br>(terminal 2) | DI2<br>(terminal 3) | DI3<br>(terminal 4) | DI4/AI1<br>(terminal 6) | DI5/AI2<br>(terminal 10) |
|-------|---------------------|---------------------|---------------------|-------------------------|--------------------------|
| 0     | user-definable      | user-definable      | user-definable      | user-definable          | user-definable           |
| 1     | ENA                 | START               | No function         | No function             | No function              |
| 2     | ENA                 | START               | No function         | No function             | No function              |
| 3     | ENA                 | START               | No function         | No function             | No function              |
| 4     | ENA                 | START               | No function         | No function             | No function              |
| 5     | ENA                 | START               | No function         | No function             | No function              |
| 6     | ENA                 | START               | No function         | No function             | No function              |
| 7     | ENA                 | START               | No function         | No function             | No function              |
| 8     | ENA                 | START               | No function         | No function             | No function              |
| 9     | ENA                 | START               | No function         | No function             | No function              |
| 10    | ENA                 | START               | No function         | No function             | No function              |
| 11    | ENA                 | START               | No function         | No function             | No function              |
| 12    | ENA                 | START               | No function         | No function             | No function              |
| 13    | ENA                 | START               | No function         | No function             | No function              |
| 14    | ENA                 | START               | No function         | No function             | No function              |
| 15    | ENA                 | START               | No function         | No function             | No function              |
| 16    | ENA                 | START               | No function         | No function             | No function              |
| 17    | ENA                 | START               | No function         | No function             | No function              |
| 18    | ENA                 | START               | No function         | No function             | No function              |
| 19    | ENA                 | START               | No function         | No function             | No function              |
| 20    | ENA                 | START               | No function         | No function             | No function              |
| 21    | Not permissible     |                     |                     |                         |                          |

An enable signal is required at DI1 in order to run the drive.  
The start signal is issued both through the bus and DI2 (AND'ed).

## 4 Messages

### 4.1 List of messages

## 4 Messages

### 4.1 List of messages

The following messages can occur:

Table 19: List of messages

| Message          | No. | Possible causes and fixes   |
|------------------|-----|---|
| <i>5 70P</i>     | –   | Ready to start. There is no drive enable signal present. There are no fault messages present.   |
| <i>no-FLt</i>    | 00  | Shown for P0-13 if there are no messages in the error register.   |
| <i>01 -b</i>     | 01  | Excessively high braking current <ul style="list-style-type: none"> <li>• Check the brake resistor and its wiring for short-circuits and ground faults.</li> <li>• Make sure that the braking resistance value is not lower than the minimum permissible braking resistance.</li> </ul>   |
| <i>0L -br</i>    | 02  | Thermal overload on brake resistor<br>The drive has been switched off in order to prevent the brake resistor from being thermally destroyed. <ul style="list-style-type: none"> <li>• Make the P1-04 and P2-25 ramp times longer in order to have less frequent braking.</li> <li>• Reduce the load's inertia, if possible.</li> </ul>  |
| <i>0 -I</i>      | 03  | Overcurrent at variable frequency drive output<br>Occurs right after switching on the unit: <ul style="list-style-type: none"> <li>• Check the cable connection between the variable frequency drive and the motor</li> <li>• Check the motor for shorted turns and ground faults</li> </ul> Occurs when starting the motor: <ul style="list-style-type: none"> <li>• Check whether the motor can rotate freely and make sure that it is not being blocked mechanically.</li> <li>• Motor with mechanical brake: Check whether the brake is being applied.</li> <li>• Check the connection configuration (star/delta).</li> <li>• Check to make sure that the motor data was entered correctly in P1-07, P1-08, and P1-09.</li> <li>• In vector control mode (P4-01 = 0 or 1): Check to make sure that the cos <math>\varphi</math> (P4-05) value was entered correctly and that a motor identification run was performed correctly.</li> <li>• Increase the acceleration ramp time (t-acc, P1-03) if necessary.</li> <li>• In speed control mode (P4-01 = 2): Reduce the voltage boost with P1-11.</li> </ul> Occurs during operation at a constant speed: <ul style="list-style-type: none"> <li>• Check whether the motor is overloaded.</li> </ul> Occurs during acceleration/deceleration: <ul style="list-style-type: none"> <li>• The ramp times are too short and require too much power. If P-03 / P-04 cannot be increased, a larger device may be required.</li> </ul> |
| <i>I.Lt -ErP</i> | 04  | Motor overload. The thermal protection mechanism has tripped as a result of the device being run above the rated motor current set with P1-08 longer than a specific time. <ul style="list-style-type: none"> <li>• Check to make sure that the motor data was entered correctly in P1-07, P1-08, and P1-09.</li> <li>• In vector control mode (P4-01 = 0 or 1): Check to make sure that the cos <math>\varphi</math> (P4-05) value was entered correctly and that a motor identification run was performed correctly.</li> <li>• Check the motor's connection configuration (e.g., start/delta)</li> <li>• If the decimal points on the display flash during operation, this means that the unit is being run in its overload range (&gt; P1-08). In this case, use P1-03 to make the acceleration ramp longer or reduce the load.</li> <li>• Make sure that the motor is not being mechanically blocked and that there are no additional loads on the motor.</li> </ul>   |

## 4 Messages

### 4.1 List of messages

| Message        | No. | Possible causes and fixes   |
|----------------|-----|---|
| <i>P5-ErrP</i> | 05  | <p>Overcurrent (Hardware)</p> <ul style="list-style-type: none"> <li>• Check the wiring to the motor and the motor itself for short-circuits and ground faults.</li> <li>• Disconnect the motor cable from the variable frequency drive and switch the variable frequency drive back on. If the fault message still appears, the device needs to be replaced. Before commissioning the new device, check the system for short-circuits or ground faults that could have caused the device to fail.</li> </ul>   |
| <i>UUoI t</i>  | 06  | <p>Overvoltage in DC link</p> <p>The DC link voltage value can be viewed using parameter P0-20. P0-36 contains a fault register with the last values before the unit was switched off (scan time: 256 ms).</p> <ul style="list-style-type: none"> <li>• Check to make sure that the supply voltage falls within the range for which the variable frequency drive is sized.</li> <li>• If the fault occurs during deceleration or stopping: Make the deceleration ramp (P1-04/P2-25) longer or use the brake resistor.</li> <li>• In vector control mode (P4-01 = 0 or = 1): Reduce the speed controller's gain (P4-03).</li> <li>• If using the PID controller: Reduce P3-11 (PID1 fault ramp) to ensure that the ramps are active.</li> </ul>  |
| <i>UUoI t</i>  | 07  | <p>Undervoltage in DC link.</p> <p><b>Note:</b><br/>Generally, this message will appear when the supply voltage is switched off on the device and the DC link voltage dies away. In this case, there is no fault.</p> <p>If the message appears during operation:</p> <ul style="list-style-type: none"> <li>• Check whether the power supply voltage is too low.</li> <li>• Check all components/devices in the variable frequency drive's feeder circuit (circuit-breaker, contactor, choke, etc.) to make sure they are connected properly and have an adequate contact resistance.</li> </ul>   |
| <i>O-t</i>     | 08  | <p>Overtemperature at heat sink. The drive is too hot.</p> <p>The heat sink temperature can be viewed by using P0-21. P0-38 contains a fault register with the last values before the unit was switched off (scan time: 30 s).</p> <ul style="list-style-type: none"> <li>• Check to make sure that the variable frequency drive is being operated within the ambient temperature range specified for it (IP20 devices: max. 50 °C; IP66 devices: max. 40 °C).</li> <li>• Check to make sure that the device fan is running.</li> <li>• Make sure that cooling air can circulate freely (clearances to neighboring devices above and below the variable frequency drive).</li> <li>• Improve the control cabinet's ventilation if necessary: The device's vents must not be obstructed, e.g., by dirt or as a result of devices being installed too close to each other.</li> <li>• Reduce the carrier frequency with P2-24.</li> <li>• Reduce the load if possible.</li> </ul> |
| <i>U-t</i>     | 09  | <p>Under-temperature</p> <p>The message will appear if the ambient temperature falls below -10 °C. In order to be able to start the drive, the temperature must be higher than this.</p>  |
| <i>P-def</i>   | 10  | <p>The parameters' default settings have been loaded.</p> <ul style="list-style-type: none"> <li>• Press the STOP button: You will be able to reconfigure the drive after doing so.</li> </ul>  |
| <i>E-ErrP</i>  | 11  | <p>External fault (at digital input 5, terminal 10, if P1-13 = 6/7/16/17). There must be a high-level signal at this input in order to be able to run the variable frequency drive.</p> <ul style="list-style-type: none"> <li>• If a thermistor is connected to terminal 10, check whether the motor is too hot.</li> </ul>  |

## 4 Messages

### 4.1 List of messages

| Message       | No. | Possible causes and fixes  |
|---------------|-----|--|
| <i>SC-0b5</i> | 12  | Communication error with an external operating unit or with a PC. <ul style="list-style-type: none"> <li>Check connections.</li> </ul>   |
| <i>FLt-dc</i> | 13  | Excessively high DC link voltage ripple<br>The DC link voltage ripple can be viewed using P0-16.<br>P0-37 contains a fault register with the last values before the unit was switched off (scan time: 20 ms). <ul style="list-style-type: none"> <li>Check to make sure that all the mains supply phases are present and that their voltage balance falls within the permissible tolerance range (3 %).</li> <li>Reduce the load if possible.</li> <li>If the fault persists, please contact your nearest JCI sales branch.</li> </ul> |
| <i>P-LOSS</i> | 14  | Incoming power phase failure (only for devices with a three-phase power supply)  |
| <i>h 0-1</i>  | 15  | Overcurrent at output <ul style="list-style-type: none"> <li>See fault No. 03.</li> </ul>  |
| <i>th-FLt</i> | 16  | Malfunctioning heat sink thermistor. <ul style="list-style-type: none"> <li>Please contact your nearest JCI sales branch.</li> </ul>   |
| <i>dRtR-F</i> | 17  | Error in internal memory. The parameters have not been saved and the default settings have been loaded. <ul style="list-style-type: none"> <li>Change the parameter values (again) and save them once more.</li> <li>If the message appears again, please contact your nearest JCI sales branch.</li> </ul>  |
| <i>4-20 F</i> | 18  | The analog input's input current does not fall within the specified range. <ul style="list-style-type: none"> <li>Check the setting in P2-30 for AI1 (terminal 6) and P2-33 for AI2 (terminal 10).</li> <li>In the case of 4-20 mA: Check the setpoint connection for wire breakage.</li> </ul>  |
| <i>dRtR-E</i> | 19  | Error in internal memory. The parameters have not been saved and the default settings have been loaded. <ul style="list-style-type: none"> <li>Change the parameter values (again) and save them once more.</li> <li>If the message appears again, please contact your nearest JCI sales branch.</li> </ul>  |
| <i>U-dEF</i>  | 20  | The customer's settings for the parameters have been imported. <ul style="list-style-type: none"> <li>Press the STOP button.</li> </ul>  |
| <i>F-PtC</i>  | 21  | Motor PTC thermistor overtemperature   |
| <i>FRn-F</i>  | 22  | The device's internal fan is experiencing a fault<br>In the case of frame size FS8: Wrong device fan operating direction<br>Check the supply voltage phase sequence (L1–L2–L3).  |
| <i>0-hERt</i> | 23  | The measured ambient temperature exceeds the specified value. <ul style="list-style-type: none"> <li>Check the device's internal fan.</li> <li>Make sure that the required clearance around the device is being maintained and that cooling air can flow through the vents on the device unimpeded.</li> <li>Reduce the carrier frequency with P2-24.</li> <li>If possible: Reduce the load.</li> </ul>  |
| <i>0-tor9</i> | 24  | Maximum permissible torque exceeded. <ul style="list-style-type: none"> <li>If possible: Reduce the load or increase acceleration time t-acc.</li> </ul>   |
| <i>U-tor9</i> | 25  | Only active if brake control is enabled in hoisting gear mode (P2-18 = 8).<br>The torque produced before the hoisting gear's mechanical brake is enabled falls below the set threshold.  |
| <i>0Ut-F</i>  | 26  | Device output fault <ul style="list-style-type: none"> <li>Please contact your nearest JCI sales branch.</li> </ul>  |
| <i>Sto-F</i>  | 29  | Internal STO circuit fault <ul style="list-style-type: none"> <li>Please contact your nearest JCI sales branch.</li> </ul>   |

## 4 Messages

### 4.1 List of messages

| Message                        | No. | Possible causes and fixes  |
|--------------------------------|-----|--|
| <i>Enc-01</i>                  | 30  | No communication between the encoder module and the variable frequency drive.<br><ul style="list-style-type: none"> <li>• Check to make sure that the module is correctly plugged in and secured.</li> </ul>   |
| <i>Enc-02</i><br><i>SP-Err</i> | 31  | The calculated motor speed is different from the measured motor speed.<br><ul style="list-style-type: none"> <li>• Check the encoder connection, including the corresponding shielding.</li> <li>• Increase the value of P6-07 if necessary.</li> </ul>  |
| <i>Enc-03</i>                  | 32  | The motor speed and the PPR value entered in P6-06 do not match. The PPR value in P6-06 must be at least 60.<br><ul style="list-style-type: none"> <li>• Check the speed entered in P1-10.</li> </ul>  |
| <i>Enc-04</i>                  | 33  | Channel A fault:<br>Usually a bad connection.<br><ul style="list-style-type: none"> <li>• Check wiring.</li> </ul>   |
| <i>Enc-05</i>                  | 34  | Channel B fault<br>Usually a bad connection.<br><ul style="list-style-type: none"> <li>• Check wiring.</li> </ul>  |
| <i>Enc-06</i>                  | 35  | Error on channels A and B<br>Usually a bad connection.<br><ul style="list-style-type: none"> <li>• Check wiring.</li> </ul>  |
| <i>Rel-01</i>                  | 40  | Motor identification failed:<br>The measured stator resistance varies between the phases.<br><ul style="list-style-type: none"> <li>• Make sure that the motor is connected properly and working correctly.</li> <li>• Check the motor windings to make sure they have the same resistance values.</li> </ul>  |
| <i>Rel-02</i>                  | 41  | Motor identification failed:<br>The measured stator resistance is too large.<br><ul style="list-style-type: none"> <li>• Make sure that the motor is connected properly and working correctly.</li> <li>• Check to make sure that the device's rated output matches the motor's rated output. The difference should not exceed one full output class.</li> </ul> |
| <i>Rel-03</i>                  | 42  | Motor identification failed:<br>The measured motor inductance is too low.<br><ul style="list-style-type: none"> <li>• Make sure that the motor is connected properly and working correctly.</li> </ul>   |
| <i>Rel-04</i>                  | 43  | Motor identification failed:<br>The measured motor inductance is too high.<br><ul style="list-style-type: none"> <li>• Make sure that the motor is connected properly and working correctly.</li> <li>• Check to make sure that the device's rated output matches the motor's rated output. The difference should not exceed one full output class.</li> </ul>   |
| <i>Rel-05</i>                  | 44  | Motor identification failed:<br>The measured motor parameters do not match.<br><ul style="list-style-type: none"> <li>• Make sure that the motor is connected properly and working correctly.</li> <li>• Check to make sure that the device's rated output matches the motor's rated output. The difference should not exceed one full output class.</li> </ul>  |
| <i>DUE-Ph</i>                  | 49  | A phase in the motor cable is not connected or has a discontinuity.  |
| <i>Sc-F01</i>                  | 50  | No valid Modbus frame was received within the time specified in P5-06.<br><ul style="list-style-type: none"> <li>• Check to make sure that the network master is working correctly.</li> <li>• Check connecting cables.</li> <li>• Increase the value of P5-06 to an acceptable value.</li> </ul>  |
| <i>Sc-F02</i>                  | 51  | No valid CANopen frame was received within the time specified in P5-06.<br><ul style="list-style-type: none"> <li>• Check to make sure that the network master is working correctly.</li> <li>• Check connecting cables.</li> <li>• Increase the value of P5-06 to an acceptable value.</li> </ul>   |
| <i>Sc-F03</i>                  | 52  | Communication between the device and the plugged-in optional field bus module has dropped out.<br><ul style="list-style-type: none"> <li>• Check to make sure that the module is installed properly.</li> </ul>  |

## 4 Messages

### 4.1 List of messages

| <b>Message</b> | <b>No.</b> | <b>Possible causes and fixes</b>   |
|----------------|------------|--|
| <i>Sc-F04</i>  | 53         | Communication between the device and the plugged-in I/O expansion has dropped out. <ul style="list-style-type: none"><li>• Check to make sure that the module is installed properly.</li></ul> |
| <i>DF-01</i>   | 60         | No internal connection to an optional card   |
| <i>DF-02</i>   | 61         | Optional module in undefined operating state   |
| <i>PLC-01</i>  | 70         | Non-supported function block from function block editor  |
| <i>PLC-02</i>  | 71         | Program from function block editor is too big  |
| <i>PLC-03</i>  | 72         | Division by zero   |
| <i>PLC-04</i>  | 73         | Lower limit is higher than upper limit   |
| <i>PLC-05</i>  | 74         | Overflow table Function block editor   |

## 4.2 Messages after a data transfer with a DX-COM-STICK

Table 20: Possible messages after a data transfer

| View          | Description  |
|---------------|--|
| <i>PRSS-r</i> | Parameter transfer to DX-COM-STICK interface card was successful   |
| <i>DS-Loc</i> | DX-COM-STICK is interlocked.<br>In order to transfer data, check the switch position on the side.  |
| <i>FRIL-r</i> | Error while attempting to read the parameters from the variable frequency drive.   |
| <i>PRSS-t</i> | Parameter transfer to variable frequency drive successful.   |
| <i>FRIL-P</i> | The parameter set stored in the DX-COM-STICK is for a different output variable (different motor current, motor output, etc.) than that of the connected variable frequency drive. |
| <i>FRIL-t</i> | Error when attempting to copy parameter set to variable frequency drive  |
| <i>no-dAt</i> | No data found in DX-COM-STICK.   |
| <i>dr-Loc</i> | Parameter set in variable frequency drive locked. Unlock variable frequency drive first.   |
| <i>dr-rUn</i> | The variable frequency drive has an enable signal and cannot take new parameters.<br>Stop the variable frequency drive.  |
| <i>tYPE-E</i> | The parameter set stored in the DX-COM-STICK does not match the variable frequency drive.<br>Only transfers from the variable frequency drive to the DX-COM-STICK are possible.    |
| <i>tYPE-F</i> | The DX-COM-STICK is not compatible with the variable frequency drive.  |

## 5 Parameter

### 5.1 "Monitor" parameter group 0

## 5 Parameter

The following tables use a number of acronyms. These acronyms are defined below:

| Abbreviation | Significance   |
|--------------|--|
| <b>RUN</b>   | The parameter can be accessed during operation ("Run" signal)                    |
| <b>DS</b>    | Default setting (the parameter's value when using the device's factory settings) |



None of the parameters in parameter group 0 can be modified by the user, i.e., they are read-only parameters.

### 5.1 "Monitor" parameter group 0

Table 21: "Monitor" parameter group 0

| Parameter | Designation        | Description  |
|-----------|--------------------|--|
| P0-01     | Analog Input1      | Analog Input 1<br>Level of the signal applied to analog input 1 (terminal 6) after scaling and offsets have been applied.<br>Display 1000 $\pm$ 100 %.   |
| P0-02     | Analog Input2      | Analog input 2<br>Level of the signal applied to analog input 2 (terminal 10) after scaling and offsets have been applied.<br>Display 1000 $\pm$ 100 %   |
| P0-03     | DI1 Status         | Status of the Digital Inputs<br>Status of the digital inputs, including the ones on option boards, starting on the left hand side with digital input 1, ..., 8.<br><br>Display:<br><ul style="list-style-type: none"> <li>• 0 = Low</li> <li>• 1 = High</li> </ul> |
| P0-04     | f-PreRamp          | Speed reference in front of the ramp   |
| P0-05     | Torque Reference   | Torque Reference<br>Display: 1000 $\pm$ 100%   |
| P0-06     | MotorPot Reference | Digital reference value, e.g. coming from the keypad   |
| P0-07     | f-Ref Interface0   | Speed reference received via fieldbus interface  |
| P0-08     | PID1 Set Point     | Reference PID Controller 1<br>Display 4096 $\pm$ 100 %   |
| P0-09     | PID1 Feedback 1    | Feedback value PID Controller 1<br>Display 4096 $\pm$ 100 %  |
| P0-10     | PID1 Output        | PI(D) controller 1 Output<br>Display 4096 $\pm$ 100 %  |
| P0-11     | Motor Voltage      | Instantaneous output voltage   |
| P0-12     | Motor Torque       | Motor Torque<br>Display 1000 $\pm$ 100 %   |
| P0-13     | Fault Log          | Display of the 4 latest faults   |

| Parameter | Designation                  | Description  |
|-----------|------------------------------|--|
| P0-14     | Magnetizing current $I_q$    | Calculated Magnetizing Current ( $I_q$ ), providing an autotune has successfully been completed.   |
| P0-15     | Torque current $I_d$         | Calculated Torque producing Current ( $I_d$ ), providing an autotune has successfully been completed.  |
| P0-16     | DC-Link Voltage Ripple       | DC-Link Voltage Ripple   |
| P0-17     | Motor Stator Resistance Meas | Measured Motor Stator Resistance ( $R_s$ ), providing an autotune has successfully been completed.   |
| P0-18     | Motor Stator Inductance Meas | Measured Motor Stator Inductance ( $L_s$ ), providing an autotune has successfully been completed.   |
| P0-19     | Motor Rotor Resistance Meas  | Measured Motor Rotor Resistance ( $R_r$ ), providing an autotune has successfully been completed.  |
| P0-20     | DC-Link Voltage              | Instantaneous DC Link Voltage<br>Display $600 \pm 600$ V   |
| P0-21     | Heatsink Temperature         | Instantaneous Heatsink Temperature<br>Display $40 \pm 40$ °C   |
| P0-22     | TimeToNextService            | Time remaining to next service<br>The service interval is set with P6-24.  |
| P0-23     | t-Run IGBT in OT             | Time elapsed, in which the drive has operated with a high heatsink temperature<br>Displays the time in hours and minutes above 85 °C. The value is used for various internal protective functions.   |
| P0-24     | t-Run PCB in OT              | Time elapsed, in which the drive has operated with a high temperature at the PCBs (ambient temperature)<br>Displays the time in hours and minutes above 80 °C. The value is used for various internal protective functions.  |
| P0-25     | Motor Speed                  | Motorspeed (calculated or measured)<br>In vector mode this parameter displays the calculated motor speed if no encoder is present. In case of an encoder feedback the measured speed is displayed.   |
| P0-26     | kWh Meter                    | Energy Consumption kWh Meter (resettable)<br>Displays the energy consumption in kWh.<br>When the value reaches 1000, it is reset back to 0 and the number of MWh in P0-27 is increased by 1.<br>This parameter contains 2 values.<br>The first value visible can be reset by the user with P6-23 = 1.<br>The second value cannot be reset and shows together with P0-27 the energy consumption since the day of manufacture. |
| P0-27     | MWh Meter                    | Energy Consumption MWh Meter<br>Shows the power consumed in MWh. This parameter contains two values:<br>The first value shown when the parameter is accessed is the value that the user can reset with P6-23 = 1.<br>The second value cannot be reset and, together with P0-26, shows the total energy consumption since the device's date of manufacture.   |
| P0-28     | Application Version          | Application Version <ul style="list-style-type: none"> <li>Level 1: Application version + Check sum</li> <li>Level 2: System version + Check sum</li> </ul>  |

## 5 Parameter

### 5.1 "Monitor" parameter group 0

| Parameter | Designation           | Description  |
|-----------|-----------------------|--|
| P0-29     | "Device Information"  | Shows specific device information.<br>The first piece of information can be accessed by pressing the <b>OK</b> button. To view other information, press the <b>▲</b> and <b>▼</b> arrow keys.  |
|           | FrameSize             | Frame Size   |
|           | NoOfInputPhases       | Number of input phases   |
|           | kW/HP                 | Motor Power  |
|           | Power@Ue              | Device Power at Device Voltage Rating  |
|           | Device Voltage        | Device Voltage Rating  |
|           | DeviceType            | Device Type  |
| P0-30     | Serial Number         | Serial Number of the device  |
| P0-31     | t-Run                 | Total operating time of the drive since the date of manufacture Displayed in hours, minutes and seconds.<br>Pressing the UP key on the drive keypad will change the display from "hours" to "minutes and seconds".   |
| P0-32     | t-Run since Restart   | Total operating time of the drive since the last trip occurred or power down in hours, minutes and seconds.<br>Pressing the UP key on the drive keypad will change the display from "hours" to "minutes and seconds".  |
| P0-33     | t-Run since Trip      | Total operating time of the drive since the last trip occurred<br>Displayed in hours, minutes and seconds.<br>Pressing the UP key on the drive keypad will change the display from "hours" to "minutes and seconds".   |
| P0-34     | t-HoursRun Enable     | The drive's operating time since the most recent enable signal, in hours, minutes, and seconds.<br>Pressing the UP key on the drive keypad will change the display from "hours" to "minutes and seconds".  |
| P0-35     | Fan Runtime           | Run time of the integrated fan (resettable by the user)<br>Displayed in hours.<br>Value 1 is the time since last reset with P6-22. Pressing the UP key on the keypad will change the display to "Fan runtime since the date of manufacture" ("F" is displayed at the beginning of the line). |
| P0-36     | DC-Link0 Log          | DC link voltage log<br>Displays the most recent 8 samples of the DC bus voltage prior to a drive trip condition occurring.<br>The sample interval is 256 ms.   |
| P0-37     | DC-Link V-Ripple0 Log | DC link voltage ripple history<br>Shows the last eight DC link voltage ripple values before the device was switched off due to a fault.<br>Scan time: 20 ms  |
| P0-38     | Heatsink0 Log         | Heatsink temperature log<br>Displays the most recent 8 samples of the heat sink temperature prior to a drive trip condition occurring.<br>The sample interval is 30 s.   |
| P0-39     | AmbientTemp0 Log      | Internal Ambient Temperature Log<br>Displays the most recent 8 samples of the internal ambient temperature prior to a drive trip condition occurring.<br>The sample interval is 30 s.  |
| P0-40     | MotorCurrent0 Log     | Motor current log<br>Displays the most recent 8 samples of the Motor current prior to a drive trip condition occurring.<br>The sample interval is 256 ms.  |

## 5 Parameter

### 5.1 "Monitor" parameter group 0

| Parameter | Designation                            | Description  |
|-----------|--|--|
| P0-41     | FaultCounter Overcurrent               | Counts, how often "Overcurrent" occurred   |
| P0-42     | Fault-Counter DC-Overvoltage           | Counts, how often "DC-Overvoltage" occurred  |
| P0-43     | Fault-Counter DC-Undervoltage          | Counts, how often "DC-Undervoltage" occurred   |
| P0-44     | FaultCounter Overtemperature Heatsink  | Number of times the device has been switched off due to heatsink overtemperature since the date of manufacture   |
| P0-45     | FaultCounter Overcurrent Brake Chopper | Number of times the device has been switched off due to the brake chopper since the date of manufacture  |
| P0-46     | FaultCounter Overtemperature Ambient   | Number of times the device has been switched off due to overtemperature (internal ambient temperature) since the date of manufacture   |
| P0-47     | FaultCounter Internal Fault (IO)       | Number of communication errors between the power section and control section detected by the I/O processor since the last time the unit was switched on  |
| P0-48     | FaultCounter Internal Fault (DSP)      | Number of communication errors between the power section and control section detected by the power section processor since the last time the unit was switched on  |
| P0-49     | FaultCounter Communication Loss        | Number of Modbus communication errors detected by the I/O processor since the last time the unit was switched on   |
| P0-50     | FaultCounter CANopen COM Loss          | Number of CANopen communication errors detected by the I/O processor since the last time the unit was switched on  |
| P0-51     | Input Data1 Value                      | Input Data 1, Value<br>Process Input Data (PDI, received from the fieldbus).<br>There are 4 entries for this parameter (PDI1 ... PDI4).<br>By default it shows the CANopen exchanged data. In case a fieldbus module is present inside the drive and P1-12 is set to 4, the fieldbus data are displayed.   |
| P0-52     | Output Data1 Value                     | Output Data 1, value<br>Process Output Data (PDO, received from the fieldbus).<br>There are 4 entries for this parameter (PDO1 ... PDO4).<br>By default it shows the CANopen exchanged data. In case a fieldbus module is present inside the drive and P1-12 is set to 4, the fieldbus data are displayed. |
| P0-53     | –                                      | Phase U, current offset and reference (value for diagnosis in case of problems)  |
| P0-54     | –                                      | Phase V, current offset and reference (value for diagnosis in case of problems)  |
| P0-55     | –                                      | Reserved Parameter   |
| P0-56     | Brake Chopper t-On                     | 1st line: max. On Time of the Brake Chopper<br>2nd line: Duty Cycle  |
| P0-57     | Stator voltage                         | $U_d$ and $U_q$ of the stator voltage.<br>1st value = $U_d$ ("d" at the beginning of the line)<br>Pressing the UP key on the drive keypad the display will change to $U_q$ ("q" at the beginning of the line).   |
| P0-58     | Encoder Speed                          | Encoder Feedback Speed<br>(If Encoder is present) Displayed in Hz or rpm   |
| P0-59     | f-RefOfFreq-Ref                        | Speed reference received by a frequency signal   |
| P0-60     | n-Slip                                 | Motor Slip Speed<br>Calculated. Displayed in Hz or rpm   |
| P0-61     | Relay hysteresis                       | Switching hysteresis of the Output Relays RO1 and RO2 in Hz resp. rpm.<br>Display value = P6-04 x P1-01<br><br><b>Remark:</b><br>Only in cases where P2-11 and/or P2-13 are set to 2 or 3.   |

## 5 Parameter

### 5.1 "Monitor" parameter group 0

| Parameter | Designation                  | Description   |
|-----------|------------------------------|---|
| P0-62     | DroopFeedback                | Difference in speed of two motors to achieve an equal load sharing. Displayed in Hz or rpm.<br>→ P6-09  |
| P0-63     | f-PostRamp                   | Speed reference after the ramp  |
| P0-64     | Actual Switching Frequency   | Actual switching frequency.<br>The value may be less than the one set with P2-24.<br>→ P6-02  |
| P0-65     | t-PowerOn                    | Total time for which the drive was powered up since the day of manufacture. Displayed in hours, minutes and seconds.<br>Pressing the UP key on the drive keypad will change the display from "hours" to "minutes and seconds" |
| P0-66     | UserProgramID                | ID of a program generated by the Function Block Editor.<br>This ID can be set by the user when developing the program.  |
| P0-67     | M-Ref Interface              | Torque reference received via fieldbus interface  |
| P0-68     | t-accNetwork                 | Ramp time received via fieldbus interface.<br><b>Remark:</b><br>This value is only active with P5-07 = 1  |
| P0-69     | FaultCounter Option COM Loss | Number of communication errors in an optional module since the last time the unit was switched on   |
| P0-70     | OptionID0                    | Identification Code of an option installed  |
| P0-71     | OptionSignature              | Fieldbus Module Identifier (Option)   |
| P0-72     | T-Controlboard               | Internal device ambient temperature   |
| P0-73     | 24h timer                    | Content of an internal 24 h timer in minutes.<br>The timer starts to count when power is applied to the drive, and allows simple time based functions to be programmed with the function block editor.                        |
| P0-74     | L1 Input Voltage             | Input voltage L1  |
| P0-75     | L2 Input Voltage             | Input voltage L2  |
| P0-76     | L3 Input Voltage             | Input voltage L3  |
| P0-77     | Encoder Puls counter         | Encoder Feedback Value<br>The two values (High Word and Low Word) contain the 32 Bit value of the Encoder Input   |
| P0-78     | –                            | Test Parameter  |
| P0-79     | Application Software Version | I/O Controller / Application SW Version<br>Pressing the UP key on the drive keypad will change the display to System Software   |
| P0-79     | System Software Version      | System Software Version   |
| P0-80     | Value@Pointer                | Pointer on an internal parameter<br>Displays the value selected with P6-28.   |

## 5.2 Parameter group 1 ("Basic")

Table 22: Parameter group 1 ("Basic")

| Parameter | RUN | Designation | Value       | Description  | DS      |
|-----------|-----|-------------|-------------|--|---------|
| P1-01     | ✓   | f-max       | 500 Hz max. | <p>Maximum output frequency<br/>This can be set to any value between "f-min" and 5x the "motor nom frequency".</p> <ul style="list-style-type: none"> <li>"Motor Nom Speed" (P1-10) = 0, the maximum speed limit will be displayed in Hz.</li> <li>"Motor Nom Speed" (P1-10) &gt; 0, the maximum speed limit will be displayed in rpm.</li> </ul>  | 50.0 Hz |
| P1-02     | ✓   | f-min       |             | <p>Minimum output frequency<br/>This can be set to any value between 0 and "f-max" (P1-01)</p> <ul style="list-style-type: none"> <li>"Motor Nom Speed" (P1-10) = 0, the minimum speed limit will be displayed in Hz.</li> <li>"Motor Nom Speed" (P1-10) &gt; 0, the minimum speed limit will be displayed in rpm.</li> </ul>  | 0.0 Hz  |
| P1-03     | ✓   | t-acc       | 0.0 - 600 s | <p>Sets the acceleration ramp time in seconds.<br/>The time interval set in "t-acc" represents the time taken to accelerate from zero to "Motor Nom Frequency" (P1-09).</p>  | 5.0 s   |
| P1-04     | ✓   | t-dec       | 0.0 - 600 s | <p>Sets the deceleration ramp time in seconds.<br/>The time interval set in "t-dec" represents the time taken to decelerate from "Motor Nom Frequency" (P1-09) to zero.</p>  | 5.0 s   |
| P1-05     | ✓   | Stop Mode   | 0, ..., 4   | <p>Determines the action taken by the drive in the event of the drive enable signal being removed.<br/>This parameter is also used to disable (P1-05 = 0 or 1) or enable (P1-05 = 2 or 3) a brake chopper.<br/>Possible values:</p> <ul style="list-style-type: none"> <li><b>0:</b> Ramp to stop. When the enable signal is removed, the drive will ramp to stop, with the rate controlled by "t-dec" (P1-04). A brake chopper (where fitted) is always disabled.</li> <li><b>1:</b> Coasting. When the enable signal is removed, the drive output is immediately disabled, and the motor will coast (freewheel) to stop. If the load can continue to rotate due to inertia and may possibly be re-enabled whilst the motor is still rotating, the Spin Start Function shall be enabled with P2-26. A brake chopper (where fitted) is always disabled, even during normal operation.</li> <li><b>2:</b> Ramping. When the enable signal is removed, the drive will ramp to stop, with the rate controlled by "t-dec" (P1-04). In this mode the brake chopper (where fitted) is always enabled.</li> <li><b>3:</b> Coasting. When the enable signal is removed, the drive output is immediately disabled, and the motor will coast (freewheel) to stop. If the load can continue to rotate due to inertia and may possibly be re-enabled whilst the motor is still rotating, the Spin Start Function shall be enabled with P2-26. In this mode the brake chopper (where fitted) is enabled during normal operation, but not after removing the enable signal.</li> <li><b>4:</b> AC flux braking. When stopping the drive, AC flux braking is used to reduce the stopping time. In this mode the brake chopper is disabled, even during normal operation.</li> </ul> | 1       |

## 5 Parameter

### 5.2 Parameter group 1 ("Basic")

| Parameter | RUN | Designation         | Value | Description   | DS             |
|-----------|-----|---------------------|-------|---|----------------|
| P1-06     | ✓   | EnergyOptimizer     | 0, 1  | <p>EnergyOptimizer</p> <p>When energy optimization is activated, the motor voltage is dynamically varied, dependent on load. This results in reduced voltage being applied to the motor on light load, significantly reduce energy consumption.</p> <p>Available settings:</p> <ul style="list-style-type: none"> <li>• <b>0</b>: OFF</li> <li>• <b>1</b>: ON</li> </ul> <p><b>Remark:</b><br/>This mode of operation is less suitable for dynamic applications where the load conditions can suddenly increase significantly.</p>  | 0              |
| P1-07     | –   | Motor Nom Voltage   |       | <p>Defines the Motor rated voltage.</p> <p>If P1-07 = 0 the DC bus voltage compensation is disabled (in V/f mode only) and the output voltage will be equal to the incoming supply voltage when operating at "Motor Nom Frequency" (P1-09).</p>   | $U_e$          |
| P1-08     | –   | Motor Nom Current   |       | <p>Motor rated current.</p> <p>By setting the "Motor Nom Current" in the drive, the motor overload protection is configured to match the motor rating. If the motor current exceeds the value set with P1-08, the flashing decimal points on the display will indicate that there is an overload. If this situation persists for a prolonged period of time, the device may switch off due to overloading.</p> <p>Display: <i>I.L - L.r.P</i></p>   | $I_e$          |
| P1-09     | –   | Motor Nom Frequency |       | <p>The rated frequency of the motor.</p> <p>This is the frequency at which "Motor Nom Voltage" is applied to the motor. Below this frequency, the applied motor voltage will be reduced. Above this frequency the voltage remains limited to "Motor Nom Voltage"</p>  | 50 Hz          |
| P1-10     | ✓   | Motor Nom Speed     |       | <p>Motor rated speed</p> <ul style="list-style-type: none"> <li>• P1-10 = 0: the speed of the motor will be displayed in Hz.</li> <li>• P1-10 &gt; 0: the speed related parameters (f-max, f-min etc.) will be displayed in rpm.</li> </ul> <p>The slip compensation is also activated, where the shaft speed of the motor is maintained under varying load conditions by compensating for the load-dependent slip of the motor.</p> <p>If "Motor Nom Speed" = motor synchronous speed (e.g. 3000rpm for a 2-pole 50Hz motor), the speed can be displayed in rpm without activating the slip compensation.</p> <p><b>Remark:</b><br/>When the drive is operated with the optional Encoder Feedback Interface, this parameter must be set to the correct nameplate rpm of the connected motor.</p> | 0 rpm          |
| P1-11     | –   | V-Boost             |       | <p>Voltage is used to increase the applied motor voltage at low output frequency, in order to improve low speed and starting torque. Excessive voltage boost levels may result in increased motor current and temperature, and forced ventilation may be required. An automatic setting (Auto) is also possible, whereby the drive will automatically adjust this parameter based on the motor parameters measured during an Autotune.</p> <p><b>Remark:</b><br/>This parameter will only be enabled when using speed control (expanded V/Hz, P4-01 = 2).</p>   | 2.5 % of P1-07 |

5 Parameter  
5.2 Parameter group 1 ("Basic")

| Parameter | RUN | Designation              | Value   | Description   | DS |
|-----------|-----|--------------------------|---|---|----|
| P1-12     | –   | Local ProcessData Source | 0, ..., 6,<br>9, 10, 11,<br>13<br><br>7, 8:<br>reserved | <p>Local Configuration of Command and Reference Sources</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> Terminal Control. The drive responds directly to signals applied to the control terminals.</li> <li>• <b>1:</b> Uni-directional digital reference. The drive can be controlled in the forward direction only using a digital reference (via internal or remote Keypad or terminals)</li> <li>• <b>2:</b> Bi-directional digital reference. The drive can be controlled in the forward and reverse directions using a digital reference (via internal or remote Keypad or terminals). Pressing the keypad START button toggles between forward and reverse.</li> <li>• <b>3:</b> PID controller. The output frequency will be controlled by the internal PID controller</li> <li>• <b>4:</b> Fieldbus Control. Control via Modbus RTU if no fieldbus option is present, otherwise control from the fieldbus option module</li> <li>• <b>5:</b> Slave Mode. The Variable Frequency Drive acts as a slave to a connected drive operating in Master Mode.</li> <li>• <b>6:</b> CANopen Control. Control via the CANopen bus connected to the RJ45 serial interface connector.</li> <li>• <b>7:</b> Reserved</li> <li>• <b>8:</b> Reserved</li> <li>• <b>9:</b> SmartWire Device Control and speed ref.</li> <li>• <b>10:</b> SmartWire Device Control and terminal speed ref.</li> <li>• <b>11:</b> Terminal Control and SmartWire Device speed ref.</li> <li>• <b>12:</b> not permissible</li> <li>• <b>13:</b> SmartWire Device Control and speed ref. Digital input sets enable.</li> </ul> | 0  |

## 5 Parameter

### 5.2 Parameter group 1 ("Basic")

| Parameter | RUN | Designation      | Value         | Description  | DS  |
|-----------|-----|------------------|---------------|--|---|
| P1-13     | –   | DI Config Select | 0, 1, ..., 21 | <p>Configuration of digital inputs with a fix set of combinations<br/>The setting of P1-13 determines the input configuration depending on P1-12.</p> <p>Configuration in terminal mode (P01-12 = 0):</p> <ul style="list-style-type: none"> <li>• <b>0:</b> User defined</li> <li>• <b>1:</b> [START] [DIR] [Select REF / f-Fix] [AI1 REF] [Select f-Fix Bit0]</li> <li>• <b>2:</b> [START] [DIR] [Select f-Fix Bit0] [Select f-Fix Bit1] [Select f-Fix Bit2]</li> <li>• <b>3:</b> [START] [DIR] [Select REF / f-Fix1] [AI1 REF] [AI2 Torque REF]</li> <li>• <b>4:</b> [START] [DIR] [Select REF / f-Fix1] [AI1 REF] [Select t-dec1 / t-Quick-Dec]</li> <li>• <b>5:</b> [START] [DIR] [Select REF / AI2] [AI1 REF] [AI2 REF]</li> <li>• <b>6:</b> [START] [DIR] [Select REF / f-Fix1] [AI1 REF] [EXTFLT]</li> <li>• <b>7:</b> [START] [DIR] [Select f-Fix Bit0] [Select f-Fix Bit1] [EXTFLT]</li> <li>• <b>8:</b> [START] [DIR] [Select f-Fix Bit0] [Select f-Fix Bit1] [Select t-dec1 / t-Quick-Dec]</li> <li>• <b>9:</b> [START] [DIR] [Select f-Fix Bit0] [Select f-Fix Bit1] [Select REF / f-Fix]</li> <li>• <b>10:</b> [START] [DIR] [UP] [DOWN] [Select REF / f-Fix1]</li> <li>• <b>11:</b> [FWD] [REV] [Select REF / f-Fix] [AI1 REF] [Select f-Fix Bit0]</li> <li>• <b>12:</b> [FWD] [REV] [Select f-Fix Bit0] [Select f-Fix Bit1] [Select f-Fix Bit2]</li> <li>• <b>13:</b> [FWD] [REV] [Select REF / f-Fix1] [AI1 REF] [AI2 Torque REF]</li> <li>• <b>14:</b> [FWD] [REV] [Select REF / f-Fix1] [AI1 REF] [Select t-dec1 / t-Quick-Dec]</li> <li>• <b>15:</b> [FWD] [REV] [Select REF / AI2] [AI1 REF] [AI2 REF]</li> <li>• <b>16:</b> [FWD] [REV] [Select REF / f-Fix1] [AI1 REF] [EXTFLT]</li> <li>• <b>17:</b> [FWD] [REV] [Select f-Fix Bit0] [Select f-Fix Bit1] [EXTFLT]</li> <li>• <b>18:</b> [FWD] [REV] [Select f-Fix Bit0] [Select f-Fix Bit1] [Select t-dec1 / t-Quick-Dec]</li> <li>• <b>19:</b> [FWD] [REV] [Select f-Fix Bit0] [Select f-Fix Bit1] [Select REF / f-Fix]</li> <li>• <b>20:</b> [FWD] [REV] [UP] [DOWN] [Select REF / f-Fix1]</li> <li>• <b>21:</b> [Pulse FWD (NO)] [Pulse STOP (NC)] [Pulse REV (NO)] [AI1 REF] [Select REF / f-Fix1]</li> </ul> <p>Select REF = reference defined by P9-10, ..., P9-17 and selected by P9-18 ... P9-20.<br/>Default: analog reference at AI1</p> | 11  |
| P1-14     |     | Password         |               | <p>Entry of the password to get access to the extended parameter set.<br/>The value to be put in is determined by the level to be accessed.</p> <ul style="list-style-type: none"> <li>• Level 2 (Access to parameter groups 0 to 5): P1-14 = P2-40 (Default: 101)</li> <li>• Level 3 (Access to parameter groups 0 to 9): P1-14 = P6-30 (Default: 201)</li> </ul>   | <p>Level 2:<br/>101</p> <p>Level 3:<br/>201</p> |

## 5.3 Parameter group 2 ("Functions")

Table 23: Parameter group 2 ("Functions")

| Parameter | RUN | Designation | Value | Description  | DS      |
|-----------|-----|-------------|-------|--|---------|
| P2-01     | ✓   | f-Fix1      | –     | Preset Fixed Frequency 1<br>Value can be adjusted between f-min and f-max. Selection via a digital control signal.   | 5.0 Hz  |
| P2-02     | ✓   | f-Fix2      | –     | Preset Fixed Frequency 2<br>Value can be adjusted between f-min and f-max. Selection via a digital control signal.   | 10.0 Hz |
| P2-03     | ✓   | f-Fix3      | –     | Preset Fixed Frequency 3<br>Value can be adjusted between f-min and f-max. Selection via a digital control signal.   | 25.0 Hz |
| P2-04     | ✓   | f-Fix4      | –     | Preset Fixed Frequency 4<br>Value can be adjusted between f-min and f-max. Selection via a digital control signal.   | 50.0 Hz |
| P2-05     | ✓   | f-Fix5      | –     | Preset Fixed Frequency 5<br>Value can be adjusted between f-min and f-max. Selection via a digital control signal.   | 0.0 Hz  |
| P2-06     | ✓   | f-Fix6      | –     | Preset Fixed Frequency 6<br>Value can be adjusted between f-min and f-max. Selection via a digital control signal.   | 0.0 Hz  |
| P2-07     | ✓   | f-Fix7      | –     | Preset Fixed Frequency 7<br>Value can be adjusted between f-min and f-max. Selection via a digital control signal.<br>When Hoist mode is active (P2-18 = 8), this parameter defines the frequency or speed which will be used to generate a holding torque prior to releasing the mechanical brake. If P1-10 > 0 the value is entered and displayed in rpm.<br>This parameter must be set > 0 when using hoist mode and the value should be high enough to ensure the connected motor can develop sufficient torque to hold the maximum load capacity. | 0.0 Hz  |
| P2-08     | ✓   | f-Fix8      | –     | Preset Fixed Frequency 8<br>Value can be adjusted between f-min and f-max. Selection via a digital control signal.<br>When hoist mode is active (P2-18 = 8) this parameter defines the frequency or speed at which the drive will signal the motor brake to close when stopping.<br>If P1-10 > 0 the value is entered and displayed in rpm.<br>This parameter must be set > 0 when using hoist mode and the value should be high enough to ensure the connected motor can develop sufficient torque to hold the maximum load capacity.                 | 0.0 Hz  |
| P2-09     | ✓   | f-Skip1     | –     | Centre point of the frequency band defined by f-Skip-Band1 in which the drive doesn't work in steady-state.  | 0.0 Hz  |
| P2-10     | ✓   | f-SkipBand1 | –     | Skip frequency band width<br>Defines the frequency range around f-Skip1 in which the drive doesn't work in steady-state to avoid mechanical resonances in the application.<br><ul style="list-style-type: none"> <li>• Lower limit: = P2-09 - P2-10/2</li> <li>• Upper limit = P2-09 + P2-10/2</li> </ul> The definition applies for both senses of rotation.  | 0.0 Hz  |

## 5 Parameter

### 5.3 Parameter group 2 ("Functions")

| Parameter | RUN | Designation          | Value         | Description  | DS |
|-----------|-----|----------------------|---------------|--|----|
| P2-11     | ✓   | AD01 Function & Mode | 0, 1, ..., 11 | <p>Selection of kind (analog or digital) and function of AD01 / AO1</p> <p>Possible values:</p> <p>P2-11 = 0, ..., 7: digital output</p> <ul style="list-style-type: none"> <li>• <b>0:</b> RUN, enable (FWD/REV)</li> <li>• <b>1:</b> READY, VSA ready for operation</li> <li>• <b>2:</b> Speed: speed reference value</li> <li>• <b>3:</b> Speed &gt; Speed Zero</li> <li>• <b>4:</b> Speed; ON: <math>\geq</math> P2-16 / OFF: &lt; P2-17</li> <li>• <b>5:</b> Motor current; ON: <math>\geq</math> P2-16 / OFF: &lt; P2-17</li> <li>• <b>6:</b> Motor torque; ON: <math>\geq</math> P2-16 / OFF: &lt; P2-17</li> <li>• <b>7:</b> Analog input AI2; ON: <math>\geq</math> P2-16 / OFF: &lt; P2-17</li> </ul> <p>P2-11 = 8, ..., 11: Analog output</p> <ul style="list-style-type: none"> <li>• <b>8:</b> Output frequency (0 - 100 % f-max (P1-01))</li> <li>• <b>9:</b> Motor current (0 - 200 % Motor rated current (P1-08))</li> <li>• <b>10:</b> Motor torque (0 - 200 % Motor rated torque)</li> <li>• <b>11:</b> Motor power (0 - 200 % Motor rated power)</li> </ul> | 8  |
| P2-12     | ✓   | AO1 SignalFormat     | 0, 1, ..., 5  | <p>Selection of the signal format at Analog Output 1 (AO1)</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> 0 - 10 V</li> <li>• <b>1:</b> 10 - 0 V</li> <li>• <b>2:</b> 0 - 20 mA</li> <li>• <b>3:</b> 20 - mA</li> <li>• <b>4:</b> 4 - 20 mA</li> <li>• <b>5:</b> 20 - 4 mA</li> </ul>  | 0  |
| P2-13     | ✓   | AD02 Function & Mode | 0, 1, ..., 11 | <p>Selection of kind (analog or digital) and function of AD02 / AO2</p> <p>Possible values:</p> <p>P2-13 = 0, ..., 7: digital output</p> <ul style="list-style-type: none"> <li>• <b>0:</b> RUN, enable (FWD/REV)</li> <li>• <b>1:</b> READY, VSA ready for operation</li> <li>• <b>2:</b> Speed: speed reference value</li> <li>• <b>3:</b> Speed &gt; Speed Zero</li> <li>• <b>4:</b> Speed; ON: <math>\geq</math> P2-19 / OFF: &lt; P2-20</li> <li>• <b>5:</b> Motor current; ON: <math>\geq</math> P2-19 / OFF: &lt; P2-20</li> <li>• <b>6:</b> Motor torque; ON: <math>\geq</math> P2-19 / OFF: &lt; P2-20</li> <li>• <b>7:</b> Analog input AI2; ON: &gt; P2-19 / OFF: &lt; P2-20</li> </ul> <p>P2-13 = 8, ..., 11: Analog output</p> <ul style="list-style-type: none"> <li>• <b>8:</b> Output frequency (0 - 100 % f-max (P1-01))</li> <li>• <b>9:</b> Motor current (0 - 200 % Motor rated current (P1-08))</li> <li>• <b>10:</b> Motor torque (0 - 200 % Motor rated torque)</li> <li>• <b>11:</b> Motor power (0 - 200 % Motor rated power)</li> </ul>              | 9  |
| P2-14     | ✓   | AO2 SignalFormat     | 0, 1, ..., 5  | <p>Selection of the signal format at Analog Output 2 (AO2)</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> 0 - 10 V</li> <li>• <b>1:</b> 10 - 0 V</li> <li>• <b>2:</b> 0 - 20 mA</li> <li>• <b>3:</b> 20 - 0 mA</li> <li>• <b>4:</b> 4 - 20 mA</li> <li>• <b>5:</b> 20 - 4 mA</li> </ul>  | 0  |

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### 5.3 Parameter group 2 ("Functions")

| Parameter | RUN | Designation     | Value                    | Description   | DS      |
|-----------|-----|-----------------|--------------------------|---|---------|
| P2-15     | ✓   | RO1 Function    | 0, 1, ..., 7, 10, 11, 13 | <p>Selection of the function of output relay RO1</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> RUN, enable (FWD/REV)</li> <li>• <b>1:</b> READY, VSA ready for operation</li> <li>• <b>2:</b> Speed = speed reference value</li> <li>• <b>3:</b> Speed &gt; Speed Zero</li> <li>• <b>4:</b> Speed; ON: <math>\geq</math> P2-16 / OFF: &lt; P2-17</li> <li>• <b>5:</b> Motor current; ON: <math>\geq</math> P2-16 / OFF: &lt; P2-17</li> <li>• <b>6:</b> Motor torque; ON: <math>\geq</math> P2-16 / OFF: &lt; P2-17</li> <li>• <b>7:</b> Analog input AI2; ON: &gt; P2-16 / OFF: &lt; P2-17</li> <li>• <b>8:</b> Reserved</li> <li>• <b>9:</b> Reserved</li> <li>• <b>9:</b> Reserved</li> <li>• <b>10:</b> Maintenance due. The Service Interval Time (P6-24) has elapsed.</li> <li>• <b>11:</b> Drive ready. The drive is: not in inhibit mode (STO), not in mains loss condition and not in trip condition. The mains AC power is present and the hardware enable is applied.</li> <li>• <b>12:</b> Reserved</li> <li>• <b>13:</b> STO (Safe Torque OFF) Status</li> </ul>  | 1       |
| P2-16     | ✓   | RO1 upper Limit |                          | <p>Switching ON threshold of relay RO1</p> <p>→ P2-11 and P2-15</p>   | 100.0 % |
| P2-17     | ✓   | RO1 lower Limit |                          | <p>Switching OFF threshold of relay RO1</p> <p>→ P2-11 and P2-16</p>  | 0.0 %   |
| P2-18     | ✓   | RO2 Function    | 0, 1, ..., 7, 10, 11, 13 | <p>Selection of the function of output relay RO2</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> RUN, enable (FWD/REV)</li> <li>• <b>1:</b> READY, VSA ready for operation</li> <li>• <b>2:</b> Speed = speed reference value</li> <li>• <b>3:</b> Speed &gt; Speed Zero</li> <li>• <b>4:</b> Speed; ON: <math>\geq</math> P2-19 / OFF: &lt; P2-20</li> <li>• <b>5:</b> Motor current; ON: <math>\geq</math> P2-19 / OFF: &lt; P2-20</li> <li>• <b>6:</b> Motor torque; ON: <math>\geq</math> P2-19 / OFF: &lt; P2-20</li> <li>• <b>7:</b> Analog input AI2; ON: <math>\geq</math> P2-19 / OFF: &lt; P2-20</li> <li>• <b>8:</b> Hoist brake control. (Enables the operating mode for hoists). ON: output frequency <math>\geq</math> P2-07 with START (FWD/REV) command present. OFF: output frequency <math>\leq</math> P2-08 with no START (FWD/REV) command active.</li> <li>• <b>9:</b> Reserved</li> <li>• <b>9:</b> Reserved</li> <li>• <b>10:</b> Maintenance due. The Service Interval Time (P6-24) has elapsed.</li> <li>• <b>11:</b> Drive ready. The drive is: not in inhibit mode (STO), not in mains loss condition and not in trip condition. The mains AC power is present and the hardware enable is applied.</li> <li>• <b>12:</b> Reserved</li> <li>• <b>13:</b> STO (Safe Torque OFF) Status</li> </ul> | 0       |
| P2-19     | ✓   | RO2 upper Limit |                          | <p>Switching ON threshold of relay RO2</p> <p>→ P2-13 and P2-18</p>   | 100.0 % |
| P2-20     | ✓   | RO2 lower Limit |                          | <p>Switching OFF threshold of relay RO2</p> <p>→ P2-13 and P2-18</p>  | 0.0 %   |

## 5 Parameter

### 5.3 Parameter group 2 ("Functions")

| Parameter | RUN | Designation         | Value        | Description   | DS     |
|-----------|-----|---------------------|--------------|---|--------|
| P2-21     | ✓   | Display Scale       |              | Scale factor display<br>Determines the factor for scaling the display.<br><ul style="list-style-type: none"> <li>When set to 0.000 the scaling is disabled.</li> <li>The variable selected in P2-22 is scaled by the factor set in P2-21</li> </ul>   | 0.000  |
| P2-22     | ✓   | Display Source      | 0, 1, 2, 3   | Display Source<br>Selects the variable to be displayed and scaled by P2-21<br><br>Possible values:<br><ul style="list-style-type: none"> <li><b>0</b>: Motor Speed</li> <li><b>1</b>: Motor current</li> <li><b>2</b>: Analog input 2 (AI2)</li> <li><b>3</b>: PO-80 with one fixed decimal place (signed)</li> </ul>   | 0      |
| P2-23     | ✓   | t-n=0 Wait          |              | ZeroSpeedHoldTime<br>Determines the time for which the drive output is held at zero speed when stopping, before the drive output is disabled.   | 0.2 s  |
| P2-24     | ✓   | Switching Frequency | 0, 1, ..., 5 | Power stage switching frequency.<br>Higher frequency reduces the audible ringing noise from the motor, and improves the output current waveform, at the expense of increased heat losses within the drive.<br><br>Possible values:<br><ul style="list-style-type: none"> <li><b>0</b>: 4 kHz</li> <li><b>1</b>: 8 kHz</li> <li><b>2</b>: 12 kHz</li> <li><b>3</b>: 16 kHz</li> <li><b>4</b>: 24 kHz</li> <li><b>5</b>: 32 kHz</li> </ul> <p><b>Attention:</b><br/>In case a sine wave filter is used, the switching frequency has to be in the range which is permissible for the filter. In this case P2-24 has to be set to twice the switching frequency mentioned on the filter.</p> <p><b>Example:</b><br/>Sine wave filter for 4 kHz → Setting of P2-24: 8 kHz!</p> | 3      |
| P2-25     | ✓   | t-QuickDec          |              | Quick Stop Ramp<br>The ramp is activated:<br><ul style="list-style-type: none"> <li>If DI1 and DI2 (terminals 2 and 3) are activated simultaneously and P1-13 = 11, ..., 20</li> <li>If the mains voltage drops out and P2-38 = 2.<br/>If P2-25 = 0.0, the drive will coast without a ramp.</li> </ul>  | 0.00 s |

## 5 Parameter

### 5.3 Parameter group 2 ("Functions")

| Parameter | RUN | Designation               | Value           | Description  | DS      |
|-----------|-----|---------------------------|-----------------|--|---------|
| P2-26     | ✓   | Spin Start Enable         | 0, 1, 2         | <p>Spin Start Enable<br/>Enables spin start, where the drive starts from the detected motor speed. A short start delay is possible if the rotor is stationary. Recommended for applications where the motor spins when applying the FWD/REV signal to the drive (high inertia loads, fans ...), especially with P1-05 = 1 or 3 (coast to stop)</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0</b>: Spin start OFF</li> <li>• <b>1</b>: Spin Start ON</li> <li>• <b>2</b>: Spin Start ON on coast (P1-05 = 1 or 3), mains loss or trip due to a fault, but not before start in general. This provides a faster starting in cases where it is known that the motor is at standstill prior to enable, but spin start will still activate if the previous motor stop condition was an uncontrolled stop.</li> </ul> | 0       |
| P2-27     | ✓   | Standby Mode              |                 | <p>Standby Mode</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0</b>: Standby Mode disabled</li> <li>• <b>&gt;0</b>: The drive will enter Standby Mode (Output disabled), if the minimum frequency (P1-02) is maintained for the time specified in this parameter. Operation automatically resumes as soon as the reference increases above P1-02.</li> </ul>   | 0.0 s   |
| P2-28     | –   | Slave SpeedScalingControl | 0, 1, ..., 3    | <p>SlaveSpeedScalingControl<br/>Enabled in slave mode only (P1-12 = 5). The digital setpoint value can be multiplied by a preset factor and/or adjusted with an analog value.</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0</b>: No scaling or offset is applied</li> <li>• <b>1</b>: Speed = Digital reference x P2-29</li> <li>• <b>2</b>: Speed = (Digital reference x P2-29) + Reference at Analog Input 1 (AI1, Terminal 6)</li> <li>• <b>3</b>: Speed = (Digital reference x P2-29) x Reference at Analog Input 1 (AI1, Terminal 6)</li> </ul>   | 0       |
| P2-29     | ✓   | Slave SpeedScalingFactor  | -500.0 - +500 % | <p>SlaveSpeedScalingFactor<br/>Setting of the Scaling Factor (see P2-28)</p>   | 100.0 % |
| P2-30     | –   | AI1 Signal Range          | 0, 1, ..., 7    | <p>Configures the Analog input 1 for the selected signal source type.</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0</b>: 0 - 10 V</li> <li>• <b>1</b>: 10 - 0 V</li> <li>• <b>2</b>: bipolar 0 - 10 V</li> <li>• <b>3</b>: 0 - 20 mA</li> <li>• <b>4</b>: t 4 - 20 mA (Trips in case of wire break)</li> <li>• <b>5</b>: r 4 - 20 mA (Ramps to f-fix8 (P2-08) in case of wire break)</li> <li>• <b>6</b>: t 20 - 4 mA (Trips in case of wire break)</li> <li>• <b>7</b>: r 20 - 4 mA (Ramps to f-fix8 (P2-08) in case of wire break)</li> </ul>  | 0       |
| P2-31     | ✓   | AI1 Gain                  | 0.0 - 2000.0 %  | <p>Scaling of the Analog Input 1<br/>Output value = Input value x Scaling.<br/>The scaling is also applied to an Offset, set with P2-32</p> <p><b>Example:</b><br/>P2-30 = 0...10 V, P2-31 = 200 %: at 5 V the motor turns with max speed (P1-01) (5 V x 200 % = 10 V)</p>   | 100.0 % |

## 5 Parameter

### 5.3 Parameter group 2 ("Functions")

| Parameter | RUN | Designation      | Value              | Description  | DS      |
|-----------|-----|------------------|--------------------|--|---------|
| P2-32     | ✓   | AI1 Offset       | -500.0 -<br>+500 % | Offset Analog Input 1<br>Sets an offset as a percentage of the full scale range of the Analog Input 1 (AI1), which is subtracted from the signal at AI1.<br>Positive values of P2-32 lead to a decrease, negative ones to an increase.   | 0.0 %   |
| P2-33     | ✓   | AI2 Signal Range | 0, 1, ..., 7       | Configures the Analog input 2 for the selected signal source type.<br><br>Possible values: <ul style="list-style-type: none"> <li>• <b>0</b>: 0 - 10 V</li> <li>• <b>1</b>: 10 - 0 V</li> <li>• <b>2</b>: Ptc-th (Thermistor connection)</li> <li>• <b>3</b>: 0 - 20 mA</li> <li>• <b>4</b>: t 4 - 20 mA (Trips in case of wire break)</li> <li>• <b>5</b>: r 4 - 20 mA (Ramps to f-fix8 (P2-08) in case of wire break)</li> <li>• <b>6</b>: t 20 - 4 mA (Trips in case of wire break)</li> <li>• <b>7</b>: r 20 - 4 mA (Ramps to f-fix8 (P2-08) in case of wire break)</li> </ul>   | 0       |
| P2-34     | ✓   | AI2 Gain         | 0.0 -<br>2000.0 %  | Scaling of the Analog Input 2<br>Output value = Input value x Scaling.<br>The scaling is also applied to an Offset, set with P2-35<br><br><b>Example:</b><br>P2-33 = 0 - 10 V, P2-34 = 200 %: at 5 V the motor turns with max speed (P1-01) (5 V x 200 % = 10 V)   | 100.0 % |
| P2-35     | ✓   | AI2 Offset       |                    | Offset Analog Input 2<br>Sets an offset as a percentage of the full scale range of the Analog Input 2 (AI2), which is subtracted from the signal at AI2.<br>Positive values of P2-35 lead to a decrease, negative ones to an increase.   | 100.0 % |
| P2-36     | ✓   | Start Mode       | 0, 1, ..., 6       | Defines the behavior of the drive relating to the enable digital input and also configures the automatic restart function.<br><br>Possible values: <ul style="list-style-type: none"> <li>• <b>0</b>: Edge-r : Following power on or reset, the drive will not start if a start signal (FWD/REV) is still present. To start DC1 a rising edge is necessary.</li> <li>• <b>1</b>: Auto-0 : Following a power on or reset, the drive will automatically start if digital input 1 is closed.</li> <li>• <b>2 ... 6</b>: Auto-1 to 5 : Following a trip, the drive will make up to 5 attempts to restart at intervals set in P6-03. The drive must be powered down to reset the counter. The number of restart attempts are counted, and if the drive fails to start on the final attempt, the drive will trip, and will require the user to manually reset the fault.</li> </ul> <b>Attention:</b><br>An automatic restart is only possible when the control commands are given via terminals (P1-12 = 0, P1-12 = 1) when, after a communication loss, the control is toggled to the terminals. | 0       |

## 5 Parameter

### 5.3 Parameter group 2 (“Functions”)

| Parameter | RUN | Designation                  | Value        | Description   | DS  |
|-----------|-----|------------------------------|--------------|---|-----|
| P2-37     | ✓   | Digital Reference Reset Mode | 0, 1, ..., 7 | <p>Defines the behavior of the drive on START when used in Keypad control or when controlled with UP/DOWN commands via terminals.<br/>This parameter is only active when P1-12: 1 or 2 (digital reference)</p> <p>Possible values:<br/>P2-37 = 0, ..., 3 → Control via keypad</p> <ul style="list-style-type: none"> <li>• <b>0:</b> Start at min speed</li> <li>• <b>1:</b> Start with latest speed set with keypad</li> <li>• <b>2:</b> Start with latest speed before switching off (typically used when multiple sources for the reference are available e.g. Manual / Automatic or Local / Remote ...)</li> <li>• <b>3:</b> Start with f-fix 8 (P2-08)</li> </ul> <p>P2-37 = 4, ..., 7 → Control via terminals (P1-13: 10 or 20)<br/>The START and STOP buttons on the keypad will be disabled.</p> <ul style="list-style-type: none"> <li>• <b>4:</b> Start at min speed</li> <li>• <b>5:</b> Start with latest speed set via terminals</li> <li>• <b>6:</b> Start with latest speed before switching off (typically used when multiple sources for the reference are available e.g. Manual / Automatic or Local / Remote ...)</li> <li>• <b>7:</b> Start with f-fix 8 (P2-08)</li> </ul> | 1   |
| P2-38     | ✓   | Action@MainsLoss             | 0, 1, 2, 3   | <p>MainsLossStopControl<br/>Determines the behavior of an enabled drive at mains loss.</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> Mains loss ride through.<br/>The drive will attempt to continue operating by recovering energy from the load, provided that the mains loss period is short enough and that enough energy can be recovered.<br/>The Enable signal must be present for the whole period of mains loss, otherwise the drive stops with the ramp set in P2-25)</li> <li>• <b>1:</b> Coast to stop<br/>The drive will immediately disable the output and the motor coasts to stop. When using this setting with high inertia loads, the Spin Start function (P2-26) may need to be enabled to have a quick restart</li> <li>• <b>2:</b> Quick Stop (P2-25)<br/>The drive stops with the ramp set in P2-25.</li> <li>• <b>3:</b> Mains loss disabled<br/>This setting has to be used when the drive is powered through DC bus link directly. No supply through the input terminals.</li> </ul>  | 0   |
| P2-39     | ✓   | Parameter Lock               | 0, 1         | <p>Determines whether to lock the parameters</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> OFF. All parameters can be accessed and changed</li> <li>• <b>1:</b> ON. Parameter values can be displayed, but cannot be changed. If a remote keypad is connected, parameters cannot be accessed by the remote keypad if they are locked.</li> </ul>   | 0   |
| P2-40     | ✓   | Password Level2              |              | <p>Defines the password which is used to get access to extended parameter set (Level 2).<br/>Access via P1-14.</p>  | 101 |

## 5 Parameter

### 5.4 Parameter group 3 ("PID")

#### 5.4 Parameter group 3 ("PID")

Table 24: Parameter group 3 ("PID")

| Parameter | RUN | Designation             | Value      | Description  | DS      |
|-----------|-----|-------------------------|------------|--|---------|
| P3-01     | ✓   | PID1                    |            | PI(D) controller proportional gain<br>Higher values will result in a larger change at the frequency inverter output frequency as a response to small changes in the feedback. Too high value can cause instability   | 1.0     |
| P3-02     | ✓   | PID1 Ti                 |            | PI(D) controller integral time constant<br>Higher values will result in a more damped response.<br>Used in systems in which the overall process responds slowly.   | 1.0 s   |
| P3-03     | ✓   | PID1 Kd                 |            | PID controller differential time constant  | 0.00 s  |
| P3-04     | ✓   | PID1 Mode               | 0, 1       | PI(D) controller 1 mode<br><br>Possible values:<br><ul style="list-style-type: none"> <li>• <b>0</b>: direct mode. This setting is used when an increase of the feedback signal should lead to a decrease of the motor speed.</li> <li>• <b>1</b>: inverse mode. If an increasing feedback signal should increase the speed of the motor, use inverse mode.</li> </ul>   | 0       |
| P3-05     | ✓   | PID1 Set Point 1 Source | 0, 1, 2    | Defines the set point source 1 of controller 1<br><br>Possible values:<br><ul style="list-style-type: none"> <li>• <b>0</b>: digital set point signal, set with P3-06</li> <li>• <b>1</b>: analog input 1</li> <li>• <b>2</b>: analog input 2</li> </ul>   | 0       |
| P3-06     | ✓   | PID1 Set Point Digital  |            | Digital set point controller 1<br>Digital set point of the PID controller in case P3-05 = 0  | 0.0 %   |
| P3-07     | ✓   | PID1 Out upper limit    |            | PID1-OutLimHigh<br>max. output value of the PI(D) controller   | 100.0 % |
| P3-08     | ✓   | PID1 Out lower limit    |            | PID1-OutLimLow<br>min. output value of the PI(D) controller  | 0.0 %   |
| P3-09     | ✓   | PID1 Output LimitSelect | 0, 1, 2, 3 | Source selection for the output limitation<br><br>Possible values:<br><ul style="list-style-type: none"> <li>• <b>0</b>: The output range of the PID controller is limited by P3-07 and P3-08</li> <li>• <b>1</b>: Upper limit = value at analog input 1; lower limit = P3-08</li> <li>• <b>2</b>: Upper limit = P3-07; lower limit = value at analog input 1</li> <li>• <b>3</b>: The output value from the PID controller is added to the speed reference applied to analog input 1</li> </ul> | 0       |
| P3-10     | ✓   | PID1 Feedback 1 Source  | 0, 1       | Defines the feedback source 1 of controller 1<br><br>Possible values:<br><ul style="list-style-type: none"> <li>• <b>0</b>: analog input 2 (AI2)</li> <li>• <b>1</b>: analog input 1 (AI1)</li> </ul>  | 0       |

## 5 Parameter

### 5.4 Parameter group 3 ("PID")

| Parameter | RUN | Designation               | Value | Description  | DS    |
|-----------|-----|---------------------------|-------|--|-------|
| P3-11     | ✓   | PID1 Error Ramp           |       | <p>PI(D)1 Error Ramp<br/>           Defines a threshold PID error level, whereby if the difference between the setpoint and the feedback values is less than the set threshold, the internal ramp times of the drive are disabled. Where a greater PID error exists, the ramp times are enabled to limit the rate of change of motor speed on large PID errors, and react quickly on small errors.</p> <p>This parameter is intended to allow the user to disable the drive internal ramps where a fast reaction of PID control is required, however by only disabling the ramps when a small PID error exists, the risk of possible over current or over voltage trips being generated are reduced.</p> <p>Setting to 0.0 means that the drives ramps are always enabled.</p> | 0.0 % |
| P3-12     | ✓   | PID1 feedback 1 DispScale |       | <p>PID1 FeedBack Display scaling factor<br/>           Applies a scaling factor to the displayed PID feedback, allowing the user to display the actual signal level from a transducer, e.g. 0...15 bar etc.</p>  | 0.000 |
| P3-13     | ✓   | PID1 WakeUpLevel          |       | <p>Wake-up level controller 1<br/>           Sets an error level (difference between the PID reference and feedback values) above which the PID controller will wake from Standby mode.</p>  | 5.0 % |
| P3-14     | –   | Reserved Parameter        |       | Reserved Parameter   | 0     |
| P3-15     | –   | Reserved Parameter        |       | Reserved Parameter   | 0     |
| P3-16     | –   | Reserved Parameter        |       | Reserved Parameter   | 0     |
| P3-17     | –   | Reserved Parameter        |       | Reserved Parameter   | 0     |
| P3-18     | ✓   | PID1 ResetControl         | 0, 1  | <p>This parameter is used to control the reset behavior of the PID loop.</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0</b>: PID loop will run continuously as long as P gain (P3-01) is not zero</li> <li>• <b>1</b>: PID loop will only run when the drive is enabled. If the drive is not running, the PID output will be reset to zero (including the integral result)</li> </ul>   | 0     |

## 5 Parameter

### 5.5 Parameter group 4 ("Mode")

#### 5.5 Parameter group 4 ("Mode")

Table 25: Parameter group 4 ("Mode")

| Parameter | RUN | Designation          | Value        | Description  | DS                  |
|-----------|-----|----------------------|--------------|--|---------------------|
| P4-01     | –   | Motor Control Mode   | 0, 1, ..., 6 | <p>Motor Control Mode</p> <p>An autotune must be performed if setting 0 / 1 / 3 / 4 is used</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0</b>: Speed Control with Torque Limit (vector)</li> <li>• <b>1</b>: Torque Control with Speed Limit (vector)</li> <li>• <b>2</b>: Speed Control (enhanced V/f)</li> <li>• <b>3</b>: PM Motor Speed Control</li> <li>• <b>4</b>: PM Motor Torque Control</li> <li>• <b>5</b>: Brushless DC Motor Speed Control</li> <li>• <b>6</b>: SyncRel Motor Speed Control</li> </ul>   | 2                   |
| P4-02     | –   | Motor Identification | 0, 1         | <p>Motor Identification</p> <p>When set to 1, the drive immediately carries out a non-rotating autotune to measure the motor parameters for optimum control and efficiency. Following completion of the autotune, the parameter automatically returns to 0.</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0</b>: OFF</li> <li>• <b>1</b>: ON</li> </ul> <p><b>Remark:</b></p> <p>This function cannot be activated by using the DrivesConnect software</p> <p>When operating with Vector Control (P4-01 = 0 or 1) this parameter must be set to the motor nameplate power factor before performing auto tune.</p>  | 0                   |
| P4-03     | ✓   | MSC Kp               |              | Proportional gain $K_p$ at Motor Speed Control (P4-01 = 0, 3, 5, 6)  | 50.0 %              |
| P4-04     | ✓   | MSC Ti               | 0 - 2000 s   | Integral time $T_i$ at Motor speed Control (P4-01 = 0, 3, 5, 6)  | 0.050 s             |
| P4-05     | ✓   | Motor PF             |              | Power factor $\cos \phi$ of the motor  | f (I <sub>e</sub> ) |
| P4-06     | ✓   | M-Ref Source         | 0, 1, ..., 5 | <p>Source for the torque reference</p> <p>P4-01 = 0: This parameter defines the source for the max. torque limit.</p> <p>P4-01 = 1: This parameter defines the source for the torque reference</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0</b>: Fixed value. The torque reference / limit is set in P4-07</li> <li>• <b>1</b>: Analog Input 1 (Terminal 6) controls the torque from 0 to P4-07</li> <li>• <b>2</b>: Analog Input 2 (Terminal 10) controls the torque from 0 to P4-07</li> <li>• <b>3</b>: Fieldbus. The torque reference is set via fieldbus, limited by P4-07.</li> <li>• <b>4</b>: Master / Slave. The torque reference from the master is used as torque limit for the Slave</li> <li>• <b>5</b>: PID Controller. The PID controller is used to control the torque from 0 to P4-07</li> </ul> | 0                   |
| P4-07     | ✓   | M-Max Motoring       |              | <p>M-Max Motoring</p> <p>When working in Vector mode (P4-01 = 0 or 1) this parameter defines the max. torque limit or reference used by the drive in conjunction with P4-06.</p>   | 150 %               |

## 5 Parameter 5.5 Parameter group 4 ("Mode")

| Parameter | RUN | Designation                | Value | Description   | DS    |
|-----------|-----|----------------------------|-------|---|-------|
| P4-08     | ✓   | M-Min Motoring             |       | <p>M-Min Motoring<br/>When working in Vector mode (P4-01 = 0 or 1) this parameter defines a min. torque limit. When the drive is enabled, it will always attempt to maintain this torque on the motor.</p> <p><b>Caution:</b><br/>this can lead to situations where the setpoint frequency is exceeded!</p>   | 0 %   |
| P4-09     | ✓   | M-Max Generative           |       | <p>M-Max Generative<br/>When working in Vector mode (P4-01 = 0 or 1) this parameter defines the max. torque limit during regeneration.</p>  | 100 % |
| P4-10     | –   | f-MidV/f                   |       | <p>Frequency to shape V/f curve<br/>When operating in V/f mode (P4-01 = 2) this parameter is used in conjunction with P4-11 and sets a frequency point at which the voltage set in P4-11 is applied to the motor.</p> <p><b>Attention:</b><br/>Care must be taken to avoid overheating and damaging the motor when using this function!</p>   | 0.0 % |
| P4-11     | ✓   | V-MidV/f                   |       | <p>Voltage to shape V/f curve<br/>Used in conjunction with P4-10.</p>   | 0.0 % |
| P4-12     | ✓   | T-Memory Enable            | 0, 1  | <p>When enabled, the motor thermal memory retention function will save the calculated motor thermal history on drive power down, using this saved value as the starting value on next power up. If this function is disabled, the motor thermal history is reset to zero on every power up.</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0</b>: Thermal memory OFF</li> <li>• <b>1</b>: Thermal memory ON</li> </ul> | 0     |
| P4-13     |     | Change Phasesequence Motor | 0, 1  | <p>Changes the sequence of the output phases. This prevents, that two phases of the motor cable have to be changed in case the motor runs in the wrong direction.</p> <ul style="list-style-type: none"> <li>• 0 = U, V, W (cw)</li> <li>• 1 = U, W, V (ccw)</li> </ul> <p><b>Remark:</b><br/>This parameter has to be set to "0" when using encoder feedback.</p>  | 0     |

## 5 Parameter

### 5.6 Parameter group 5 ("Bus")

#### 5.6 Parameter group 5 ("Bus")

Table 26: Parameter group 5 ("Bus")

| Parameter | RUN | Designation             | Value        | Description  | DS    |
|-----------|-----|-------------------------|--------------|--|-------|
| P5-01     | ✓   | PDP address             |              | The drive's unique address on a communication network  | 1     |
| P5-02     | ✓   | CAN0 Baudrate           | 0, 1, 2, 3   | CANopen Baudrate<br><br>Possible values:<br><ul style="list-style-type: none"> <li>• <b>0</b>: 125 kBit/s</li> <li>• <b>1</b>: 250 kBit/s</li> <li>• <b>2</b>: 500 kBit/s</li> <li>• <b>3</b>: 1000 kBit/s</li> </ul>  | 2     |
| P5-03     | ✓   | RS485-0 Baudrate        | 0, 1, ..., 4 | RS485 Baudrate<br><br>Possible values:<br><ul style="list-style-type: none"> <li>• <b>0</b>: 9.6 kBit/s</li> <li>• <b>1</b>: 19.2 kBit/s</li> <li>• <b>2</b>: 38.4 kBit/s</li> <li>• <b>3</b>: 57.6 kBit/s</li> <li>• <b>4</b>: 115.2 kBit/s</li> </ul>  | 4     |
| P5-04     | ✓   | RS485-0 ParityType      | 0, 1, 2, 3   | RS485 0 Parity Type<br><br>Possible values:<br><ul style="list-style-type: none"> <li>• <b>0</b>: No parity, 1 stop bit (N-1)</li> <li>• <b>1</b>: No parity, 2 stop bits (N-2)</li> <li>• <b>2</b>: Odd parity, 1 stop bit (O-1)</li> <li>• <b>3</b>: Even parity, 1 stop bit (E-1)</li> </ul>                                    | 0     |
| P5-05     | ✓   | Modbus RTU0 COM Timeout |              | Timeout<br>With an active communication link, if a valid telegram is not received by the drive within the period set with this parameter, the drive will react as set in P5-06.  | 1.0 s |
| P5-06     | ✓   | Action@Modbus RTU Fault | 0, 1, 2, 3   | Modbus communication loss error<br><br>Possible values:<br><ul style="list-style-type: none"> <li>• <b>0</b>: Switch off</li> <li>• <b>1</b>: Ramps down to a full stop and is switched off.</li> <li>• <b>2</b>: Ramps down to a full stop; no fault message.</li> <li>• <b>3</b>: Ramps to fixed frequency 8 (P2-08).</li> </ul> | 0     |
| P5-07     | ✓   | FieldbusRampControl     | 0, 1         | Fieldbus Ramp Control<br><br>Possible values:<br><ul style="list-style-type: none"> <li>• <b>0</b>: OFF. Ramps are controlled from internal drives parameters</li> <li>• <b>1</b>: ON. Ramps are controlled by the fieldbus.</li> </ul>  | 0     |

## 5 Parameter 5.6 Parameter group 5 ("Bus")

| Parameter | RUN | Designation        | Value        | Description   | DS |
|-----------|-----|--------------------|--------------|---|----|
| P5-08     | ✓   | NETSendPZD4        | 0, 1, ..., 7 | <p>Configuration of the 4th process data word PDO-4 from the drive to the network master during cyclic communication.</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> Torque as percentage value with one decimal place, e.g. 123 = 12.3 %</li> <li>• <b>1:</b> Output power in kW with 2 decimal places, e.g. 400 = 4.00 kW</li> <li>• <b>2:</b> Status of the digital inputs (DI). Bit 0 = Status DI1, Bit 1 = Status DI2 ...)</li> <li>• <b>3:</b> Signal level at Analog Input 2 (AI2). 0 - 1000 = 0 - 100.0 %</li> <li>• <b>4:</b> Heatsink temperature. 0 - 100 = 0 - 100 °C</li> <li>• <b>5:</b> User register 1. Configuration with Function Block Editor</li> <li>• <b>6:</b> User register 2. Configuration with Function Block Editor</li> <li>• <b>7:</b> P0-80 value (Selection via P6-28)</li> </ul> | 0  |
| P5-09     | –   | Reserved Parameter |              | Reserved Parameter  | –  |
| P5-10     | –   | Reserved Parameter |              | Reserved Parameter  | –  |
| P5-11     | –   | Reserved Parameter |              | Reserved Parameter  | –  |
| P5-12     | ✓   | NETSendPZD3        | 0, 1, ..., 7 | <p>Configuration of the 3rd process data word PDO-3 from the drive to the network master during cyclic communication.</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> Motor current in A with one decimal place, e.g. 100 = 10.0 A</li> <li>• <b>1:</b> Output power in kW with 2 decimal places, e.g. 400 = 4.00 kW</li> <li>• <b>2:</b> Status of the digital inputs (DI). Bit 0 = Status DI1, Bit 1 = Status DI2 ...</li> <li>• <b>3:</b> Signal level at Analog Input 2 (AI2). 0 - 1000 = 0 - 100.0 %</li> <li>• <b>4:</b> Heatsink temperature. 0 - 100 = 0 - 100 °C</li> <li>• <b>5:</b> User register 1. Configuration with Function Block Editor</li> <li>• <b>6:</b> User register 2. Configuration with Function Block Editor</li> <li>• <b>7:</b> P0-80 value (Selection via P6-28)</li> </ul>          | 0  |
| P5-13     | ✓   | NETReceivePZD4     | 0, 1         | <p>Configuration of the 4th process data word PDI-4 from the network master to the drive during cyclic communication.</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> User defined ramp times with 2 decimal places</li> <li>• <b>1:</b> User register 4. Configuration with Function Block Editor or via Parameters in group 9.</li> </ul>  | 0  |
| P5-14     | ✓   | NETReceivePZD3     | 0, 1, 2      | <p>Configuration of the 3rd process data word PDI-3 from the network master to the drive during cyclic communication.</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> Torque Reference/Limit. -5000 - + 5000 = -500.0 % - + 500.0 %</li> <li>• <b>1:</b> User defined PID reference. 0 - 1000 = 0 % - 100.0 %</li> <li>• <b>2:</b> User register 3. Configuration with Function Block Editor or via Parameters in group 9.</li> </ul>  | 0  |

## 5 Parameter

### 5.6 Parameter group 5 ("Bus")

| Parameter | RUN | Designation                | Value      | Description  | DS |
|-----------|-----|----------------------------|------------|--|----|
| P5-15     | ✓   | ParameterAccess            | 0, 1       | Parameter access<br><br>Possible values:<br><ul style="list-style-type: none"> <li>• <b>0</b>: All parameters can be changed from any source.</li> <li>• <b>1</b>: All parameters are locked and can only be changed via SmartWire-DT.</li> </ul>  | 0  |
| P5-16     | ✓   | Action@Communication Loss  |            | Number of Modbus communication errors detected by the I/O processor since the last time the unit was switched on<br><br>Possible values:<br><ul style="list-style-type: none"> <li>• <b>0</b>: No response</li> <li>• <b>1</b>: Output warning; drive continues to run</li> <li>• <b>2</b>: Stop if ramp active</li> <li>• <b>3</b>: Run-down</li> <li>• <b>4</b>: Switch off</li> </ul> | 0  |
| P5-17     |     | Modbus RTU0 Response Delay | 0, ..., 16 | Delays the response to Modbus devices, which are not fully compliant with the modbus specification and require a longer delay time between telegrams<br>The setting corresponds to the time, which is necessary to transmit 0 - 16 Bytes. The exact delay time depends on the baudrate.  | 0  |

## 5.7 Parameter group 6 ("extended")

Table 27: Parameter group 6 ("extended")

| Parameter | RUN | Designation             | Value        | Description   | DS    |
|-----------|-----|-------------------------|--------------|---|-------|
| P6-01     | –   | FirmwareUpgrade Enable  | 0, 1, 2, 3   | <p>Firmware Upgrade Enable</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0</b>: no upgrade possible</li> <li>• <b>1</b>: upgrade control part and power part</li> <li>• <b>2</b>: upgrade control part only</li> <li>• <b>3</b>: upgrade power part only</li> </ul> <p><b>Remark:</b><br/>This function cannot be activated by using the DrivesConnect software</p>   | 0     |
| P6-02     | ✓   | Auto Thermal Management | 0, 1, ..., 5 | <p>AutoThermalManagement</p> <p>In case of too high temperature at the heatsink, the drive reduces the switching frequency set with P2-24 to reduce the likelihood of an overtemperature trip. P6-02 determines the lower limit of the reduction.</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0</b>: 4 kHz</li> <li>• <b>1</b>: 8 kHz</li> <li>• <b>2</b>: 12 kHz</li> <li>• <b>3</b>: 16 kHz</li> <li>• <b>4</b>: 24 kHz</li> <li>• <b>5</b>: 32 kHz</li> </ul> <p><b>Attention:</b><br/>In cases where a sine wave filter is used in the drive's output circuit, the switching frequency has to be kept constant to avoid resonances. In this cases P2-24 and P6-02 have to be set to the same value.</p> | 0     |
| P6-03     | ✓   | Auto Reset Delay        |              | <p>AutoResetDelay</p> <p>Determines the time which will elapse between consecutive drive reset attempts when Auto Reset is enabled in P2-36.</p>  | 20 s  |
| P6-04     | ✓   | RO1 n-Hysteresis        |              | <p>Speed dependant hysteresis for Relay Outputs</p> <p>This parameter is used in conjunction with P2-11 (AO1 Function) and P2-13 (AO2 Function), when they are set to 2 (Speed = Speed Reference Value) or 3 (Speed &gt; Speed Zero). P6-04 defines a tolerance band to avoid "chatter" of the relay. If the speed is inside the defined band, the relay signals "Speed = Speed Reference Value" resp. "Speed &gt; Speed Zero". The tolerance band is given in % of P1-09.</p> <p><b>Example:</b><br/>P2-13 = 3, P1-09 = 50 Hz, P6-04 = 5 % → the relay contact closes above 2.5 Hz.</p>  | 0.3 % |

## 5 Parameter

### 5.7 Parameter group 6 ("extended")

| Parameter | RUN | Designation             | Value | Description   | DS    |
|-----------|-----|-------------------------|-------|---|-------|
| P6-05     | –   | Encoder Feedback Enable | 0, 1  | <p>EncoderFeedbackEnable<br/>Enables the operation with encoder feedback. For correct operation, ensure that the encoder is properly fitted to the motor and its wiring is connected to the encoder feedback module in accordance with the manual.</p> <p><b>Attention:</b><br/>Before enabling this parameter, ensure that the sense of rotation is correct by using parameter P0-58 while running in V/f mode (P4-01=2). The sign in P0-58 should match that of the speed reference. (+ = cw (FWD); - = ccw (REV)).</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0</b>: Encoder feedback disabled</li> <li>• <b>1</b>: Encoder feedback enabled</li> </ul> | 0     |
| P6-06     | –   | Encoder PPR             |       | <p>EncoderPPR<br/>Number of pulses per revolution of the encoder. This value has to be set correctly to guarantee a proper operation of the drive when the encoder feedback module is enabled (P6-05 = 1). Improper setting of this parameter could cause the loss of control of the drive and / or a trip. If set to zero, encoder feedback will be disabled.</p>  | 0     |
| P6-07     | ✓   | Speed Error Limit       |       | <p>SpeedErrorTripLevel<br/>This parameter specifies the max. permissible error between the encoder feedback and the speed, calculated by the internal motor control algorithms. If the speed error exceeds the limit the drive will trip. When set to zero, this protection is disabled.</p>  | 5.0 % |
| P6-08     | ✓   | Freq RefMax             |       | <p>Frequency at an input terminal of the drive which, in case the speed reference is given as a frequency signal, corresponds to the max. output frequency (f-max).<br/>The frequency input signal is connected to Terminal 4 (DI3) and must be in the range between 5 kHz and 20 kHz. When set to 0 this function is disabled.</p>   | 0 kHz |
| P6-09     | ✓   | DroopMax                |       | <p>max. Speed Droop Value<br/>This parameter is used to share the load between motors equally. The speed reference is changed depending on the load.</p> <ul style="list-style-type: none"> <li>• P6-09 = 0: Function disabled</li> <li>• P6-09 &gt; 0 defines a slip speed droop at rated torque as a percentage of "MotorNomFrequency" (P1-09). The reference for the motor speed will be reduced, depending on the load.<br/>Droop speed at rated load = P6-09 x P1-09<br/>Amount of the speed reduction = (P6-09 x P1-09) x actual torque / rated torque<br/>Speed = speed reference - speed droop</li> </ul>   | 0.0 % |
| P6-10     | ✓   | PLC Operation Enable    | 0, 1  | <p>Enables the use of function blocks, which are created with the function block editor.</p> <p>Possible values:</p> <ul style="list-style-type: none"> <li>• <b>0</b>: Function blocks disabled</li> <li>• <b>1</b>: Function blocks enabled</li> </ul>  | 0     |
| P6-11     | ✓   | t-f-Fix before Start    |       | <p>Defines a time after Enable for which the drive is operated with a fixed frequency.<br/>Fixed frequency specified with f-Fix7 (P2-07). This function can be used on pumps, to provide a reverse spin on start, to clear potential blockages.</p> <ul style="list-style-type: none"> <li>• <b>Enable</b> - ramp to fFix7 - time set with P6-11 elapses - ramp to the set speed</li> <li>• <b>0</b>: Function disabled</li> </ul>  | 0 s   |

## 5 Parameter 5.7 Parameter group 6 ("extended")

| Parameter | RUN | Designation           | Value            | Description   | DS                   |
|-----------|-----|-----------------------|------------------|---|----------------------|
| P6-12     | ✓   | t-f-Fix after Stop    |                  | <p>Defines a time after removing the Enable signal for which the drive is operated with a fixed frequency</p> <p>Fixed frequency specified with f-Fix8 (P2-08). This function can be used on underground pumps, to provide an unwind of the drives shaft on stopping.</p> <ul style="list-style-type: none"> <li>• <b>Remove Enable</b> - ramp to fFix8 - time set with P6-12 elapses - ramp to stop.</li> <li>• <b>0</b>: Function disabled</li> </ul>   | 0 s                  |
| P6-13     | ✓   | Brake Release Delay   |                  | <p>Determines the time before the mechanical brake is released. When hoist mode is active (P2-18 = 8) the control of the mechanical brake will be delayed by the time set here, to enable the motor to develop torque (adjustable with fFix7 (P2-07)).</p>  | 0.2 s                |
| P6-14     | ✓   | Brake Apply Delay     |                  | <p>Determines the time between the signal to close the brake and disabling of the drive.</p> <p>When hoist mode is active (P2-18 = 8) the drive will run with the speed set in fFix8 (P2-08) for the time set here before it is disabled. The time has to be chosen in a way that it is not below the brake response time (specified by the brake manufacturer). The min. time is 0.1 s.</p>  | 0.3 s                |
| P6-15     | ✓   | Brake M-Level Release |                  | <p>Required motor torque level at which the mechanical brake may be released.</p> <p>Determines the torque in % of the rated motor torque, which has to be present, before the mechanical brake may be released. It is used to ensure, that the motor is connected and produces sufficient torque to prevent the load dropping on release of the mechanical brake.</p> <p>This function is not active in V/f mode (P4-01 = 2)</p>   | 8.0 %                |
| P6-16     | ✓   | Brake M-Level Timeout |                  | <p>Time, in which the motor torque, necessary for a release of a mechanical brake, has to be built up.</p> <p>Is this torque, set with P6-15, not built up within this time, the drive trips.</p>   | 5.0 s                |
| P6-17     | ✓   | Max Torque Timeout    |                  | <p>Max. time, for which the motor is allowed to operate with max. torque, before the drive trips.</p> <p>The torque limitation is set with P4-07 (motor) resp. P4-09 (generator). This parameter is only active in Vector Mode (P4-01 = 0 or 1).</p>  | 5.0 s                |
| P6-18     | –   | DCBrakeCurrent        | Auto<br>0 - 30 % | <p>Amount of DC current as a percentage of the "Motor Nom Current" that is injected into the motor during DC braking.</p> <p>DC braking is only possible in V/f Control Mode (P4-01 = 2). The Stop Mode has to be set to "Ramp to stop" (P1-05 = 2). During DC brake the ramp, set with P2-25, is effective. The duration of a DC braking is determined by the ramp set with P2-25 and the "Zero Speed Hold Time" set with P2-23. A DC braking will always be performed when the Quick Stop Ramp is activated (see P2-25).</p> <p>With P6-18 = Auto the brake current is set automatically, based on stator resistance and magnetizing current. Stator resistance and magnetizing current are set to typical values by default, but can also be evaluated by performing an Auto Tune (P4-02), when necessary.</p> | 0 %                  |
| P6-19     | ✓   | Brake Resistor        |                  | <p>Resistance of the brake resistor in Ohms</p> <p>This value, together with P6-20, is used for the thermal protection of the brake resistor.</p>   | Depends on the model |

## 5 Parameter

### 5.7 Parameter group 6 ("extended")

| Parameter | RUN | Designation              | Value | Description  | DS                   |
|-----------|-----|--------------------------|-------|--|----------------------|
| P6-20     | ✓   | P-Brake Resistor         |       | Power of the brake resistor in kW<br>Resolution: 0.1 kW.<br>This value, together with P6-19, is used for the thermal protection of the brake resistor.   | Depends on the model |
| P6-21     | ✓   | Brake Chopper ED Heat-Up |       | Brake Chopper Duty Cycle<br>At very low temperatures (< -10 °C) the drive doesn't work and indicates "Under temperature" (Fault code 09 "H - L"). On devices of the frame sizes FS2, FS3 and FS4 (optional) brake resistors mounted to the heatsink can be used to warm up the device. Parameter P6-21 determines the duty cycle.<br><br><b>Attention:</b><br>It is important to provide thermal protection of the brake resistor to avoid overload. | 2.0 %                |
| P6-22     | ✓   | Reset Fan RunTime        | 0, 1  | Resets the internal fan run-time counter, indicated by P0-35, back to 0.<br><br>Possible values:<br><ul style="list-style-type: none"> <li>• <b>0</b>: no Reset</li> <li>• <b>1</b>: Reset: Reset of P6-22 to 0 is done automatically.</li> </ul>  | 0                    |
| P6-23     | ✓   | Reset kWh Meter          | 0, 1  | Resets the energy counter<br>Resets the internal energy counter, indicated by P0-26 (kWh) and P0-27 (MWh), back to 0.<br><br>Possible values:<br><ul style="list-style-type: none"> <li>• <b>0</b>: no Reset</li> <li>• <b>1</b>: Reset: Reset of P6-23 to 0 is done automatically.</li> </ul>   | 0                    |
| P6-24     | ✓   | Service Interval Time    |       | Service Interval Time<br>Defines the number of operating hours, after which the service indicator is shown on the display. With P6-25 = 1 the counter is set to the value defined here. The remaining time until the next service is indicated with P0-22.   | 0                    |
| P6-25     | ✓   | Reset ServiceIndicator   |       | Reset Service Indicator<br>With P6-25 = 1 the counter for the remaining hours until the next service is set to the value defined in P6-24. Reset of P6-25 to 0 is done automatically.  | 0                    |
| P6-26     | ✓   | A01 Scale                |       | Scaling of the Analog Output 1<br>Defines a scaling factor in % for the signal at Analog Output 1.   | 100.0 %              |
| P6-27     | ✓   | A01 Offset               |       | Offset Analog Output 1<br>Defines an offset in % of 10 V for the signal at Analog Output 1.<br><ul style="list-style-type: none"> <li>• <b>Positive</b> value of P6-27: Voltage at Analog Output 1 is reduced</li> <li>• <b>Negative</b> value of P6-27: Voltage at Analog Output 1 is increased</li> </ul>  | 0.0 %                |

5 Parameter  
5.7 Parameter group 6 ("extended")

| Parameter | RUN | Designation        | Value   | Description  | DS  |
|-----------|-----|--------------------|---------|--|-----|
| P6-28     | ✓   | PointerToParameter |         | Pointer to an internal variable<br>P6-28 defines the internal variable (or the parameter), whose value is displayed with P0-80. In addition the value can be transferred to a fieldbus master via Process Data Word 3 (PZD3, to be set with P5-12) or 4 (PZD4, to be set with P5-08). P6-28 is mostly used in conjunction with the Function Block Editor.  | 0   |
| P6-29     | –   | Save Parameters    | 0, 1, 2 | Save parameters as default<br>Pressing the UP, DOWN, and STOP buttons on the keypad at the same time will load a predefined parameter set onto the device. Normally, this parameter set will contain the device's factory settings. However, P6-29 can be used to change this parameter set.<br><br>Possible values: <ul style="list-style-type: none"> <li>• <b>0</b>: deactivated</li> <li>• <b>1</b>: The current parameter values will be stored as the default settings, and pressing the UP, DOWN, and STOP buttons on the keypad will load these values.</li> <li>• <b>2</b>: The custom parameter set stored with P6-29 will be reset back to factory settings. P6-29 will be reset to 0 automatically.</li> </ul> | 0   |
| P6-30     | ✓   | Password Level3    |         | Defines the password which is used to get access to extended parameter set (Level 3).<br>Access via P-14   | 201 |

## 5 Parameter

### 5.8 Parameter group 7 ("Motor")

#### 5.8 Parameter group 7 ("Motor")

Table 28: Parameter group 7 ("Motor")

| Parameter | RUN | Designation                    | Value | Description  | DS                  |
|-----------|-----|--------------------------------|-------|--|---------------------|
| P7-01     | ✓   | Motor Stator Resistance R1     |       | Stator resistance of the motor<br>For induction and PM motors: phase to phase resistance value [R <sub>s</sub> ] in Ohms   | f (I <sub>e</sub> ) |
| P7-02     | ✓   | Motor Rotor Resistance R2      |       | Rotor resistance of the motor<br>For induction motors: phase to phase resistance value [R <sub>r</sub> ] in Ohms   | f (I <sub>e</sub> ) |
| P7-03     | ✓   | Motor Stator Inductance d-Axis |       | Stator inductance of the motor, torque producing <ul style="list-style-type: none"> <li>For induction motors: Phase to phase inductance value in Henry [H]</li> <li>For PM-Motors: phase d-axis inductance value [L<sub>sd</sub>] in Henry [H]</li> </ul>  | f (I <sub>e</sub> ) |
| P7-04     | ✓   | Magnetizing Current @M=0       |       | Magnetizing current<br>For induction motors: Magnetizing current / no load current [I <sub>d rms</sub> ]<br>Before Auto-Tune this value is approximated to 30 - 40 % of the motor rated current (P1-08), assuming a motor power factor (cos phi) of 0.8. It is automatically calculated on the basis of P1-08 respectively as a result of an Auto-tune.  | f (I <sub>e</sub> ) |
| P7-05     | ✓   | Leak Inductance Rel            |       | Relative Leakage Inductance of the motor<br>Specified as a percentage [Sigma] of the stator inductance.  | 0.100               |
| P7-06     | ✓   | Motor Stator Inductance q-Axis |       | Stator inductance of the motor, magnetizing<br>For PM-Motors: phase q-axis inductance value [L <sub>sd</sub> ] in Henry [H]  | f (I <sub>e</sub> ) |
| P7-07     | ✓   | EnhancedGeneratorControl       | 0, 1  | EnhancedGeneratorControl<br>Adaptation of the motor model in vector mode and with PM motors to achieve a better performance of the drive when regenerating.<br><br>Possible values: <ul style="list-style-type: none"> <li>0: disable</li> <li>1: enable</li> </ul>  | 0                   |
| P7-08     | ✓   | ParameterAdaptation            | 0, 1  | ParameterAdaptation<br><br>Possible values: <ul style="list-style-type: none"> <li>0: The motor parameters are identified once during auto tune and remain unchanged afterwards.</li> <li>1: The motor parameters are identified during auto tune. These values are used at start. During operation the drive estimates the actual values automatically and uses them.</li> </ul> <b>Background:</b><br>Changes e.g. of the resistance because of temperature changes. This parameter is only used in Vector Mode (P4-01 = 0 / 1 / 3 / 4)  | 0                   |
| P7-09     | ✓   | Overvoltage Currentlimit       |       | Current limitation to prevent over voltage trips<br>This parameter is only active at Speed Control with Torque Limit (P4-01 = 0) and becomes effective in case the DC link voltage exceeds a threshold. This value, set internally, is just below the one for a trip because of over voltage. P7-08 limits the torque producing current at the output, to prevent energy feedback which may lead to an over voltage trip.<br>A small value of P7-09 limits the torque of the motor, when the DC link voltage exceeds the threshold. A high value can lead to current distortions and to a rough behavior of the motor. | 5.0 %               |

5 Parameter  
5.8 Parameter group 7 ("Motor")

| Parameter | RUN | Designation           | Value      | Description  | DS          |
|-----------|-----|-----------------------|------------|--|-------------|
| P7-10     | ✓   | LoadInertiaFactor     |            | Ratio of the inertia of a complete system to the one of a motor only ( $J_{tot} / J_{mot}$ )<br>The default value (10) can mostly be kept. It is used as feed forward, to provide the optimal torque during the acceleration phase. By using the exact value, a better reaction and dynamics of the complete system will be achieved. If the ratio of the inertias is not known, the factory setting should not be changed.  | 10          |
| P7-11     | ✓   | PWM lower Limit       |            | Minimum pulse width of the output voltage<br>This parameter is used in applications with long motor cables. Increasing the value reduces the risk of an over current trip but it also reduces the value of the max. possible output voltage at a given input voltage.  | 150         |
| P7-12     | ✓   | t-Excitation-V/f      |            | Magnetizing period in V/f and PM Mode <ul style="list-style-type: none"> <li>• <b>Induction motors</b> (P4-01 = 2): This parameter defines a delay time for the control of the magnetizing current after a Start signal for the drive in V/f mode. Too low values can cause an over current trip, if the acceleration ramp is very short.</li> <li>• <b>PM-motors</b> (P4-01 = 3 / 4): This value is used to align the rotor flux on enable.</li> </ul>  | f ( $I_e$ ) |
| P7-13     | ✓   | MSC Kd                |            | Differential gain for the speed controller<br>Used in Vector mode. Specified in %.   | 0.0 %       |
| P7-14     | ✓   | Torque Boost          |            | Torque Boost at low speeds<br>Set in % of the motor rated current (P1-08). At lower speeds a current is injected into the motor, to achieve an effective operation. Parameter P7-15 determines, up to which speed P7-14 is effective.<br><br>Setting of P7-14: <ul style="list-style-type: none"> <li>• Run the motor at the lowest speed, which is required by the application</li> <li>• Increase value of P7-14, until the required torque is present as well as a smooth operation of the motor.</li> </ul> <b>Note:</b><br>This function is not active with Speed Control (V/f, P4-01 = 2). | 0.0 %       |
| P7-15     | ✓   | f-Torque Boost Limit  |            | Torque Boost Range<br>Determines the frequency in % of P1-09, up to which the torque boost, set with P7-14, is active. Above this frequency the torque boost is not active.  | 0.0 %       |
| P7-16     | ✓   | PM-MotorSignalIn      | 0, 1, 2, 3 | Selection of the signal to identify the rotor position at PM motors<br><br>Possible values: <ul style="list-style-type: none"> <li>• <b>0</b>: disabled (= factory settings)</li> <li>• <b>1</b>: Identification during magnetizing period</li> <li>• <b>2</b>: Identification during low speed operation</li> <li>• <b>3</b>: Identification during magnetizing period and low speed operation</li> </ul>   | 0           |
| P7-17     | ✓   | PM-MotorSignalInLevel |            | Selection of voltage and duration of the signal to identify the rotor position at PM motors<br>If this value is set too low, the rotor's position may not be detected, in which case excessively high values may result in the device being switched off due to overcurrent.   | 10          |

## 5 Parameter

### 5.9 Parameter group 8 ("Ramp")

#### 5.9 Parameter group 8 ("Ramp")

Table 29: Parameter group 8 ("Ramp")

| Parameter | RUN | Designation | Value | Description  | DS  |
|-----------|-----|-------------|-------|--|---|
| P8-01     | ✓   | t-acc2      |       | Sets the acceleration ramp time 2 in seconds.<br>The time interval set in "t-acc2" represents the time taken to accelerate from zero to "Motor Nom Frequency" (P1-09).   | FS2, FS3:<br>5.0 s<br>FS4, ...:<br>10.0 s |
| P8-02     | ✓   | n-accMulti1 |       | Frequency / speed, at which the acceleration ramp changes from t-acc1 to t-acc2.<br>This can be set to any value between 0 and "f-max" (P1-01) <ul style="list-style-type: none"> <li>"Motor Nom Speed" (P1-10) = 0, displayed in Hz.</li> <li>"Motor Nom Speed" (P1-10) &gt; 0, displayed in rpm.</li> </ul> <ul style="list-style-type: none"> <li>Frequency / Speed &gt; P8-06 = t-acc4</li> <li>Frequency / Speed &gt; P8-04 AND &lt; P8-06 = t-acc3</li> <li>Frequency / Speed &gt; P8-02 AND &lt; P8-04 AND &lt; P8-06 = t-acc2</li> <li>Frequency / Speed &lt; P8-02 AND &lt; P8-04 AND &lt; P8-06 = t-acc1"</li> </ul> <p><b>Remark:</b><br/>The AND condition must be interpreted as a "logical AND operator," i.e., all conditions linked with AND must be met simultaneously.</p> | 0.0 Hz                                    |
| P8-03     | ✓   | t-acc3      |       | Sets the acceleration ramp time 3 in seconds.<br>The time interval set in "t-acc3" represents the time taken to accelerate from zero to "Motor Nom Frequency" (P1-09).   | FS2, FS3:<br>5.0 s<br>FS4, ...:<br>10.0 s |
| P8-04     | ✓   | n-accMulti2 |       | Frequency / speed, at which the acceleration ramp changes from t-acc2 to t-acc3.<br>This can be set to any value between 0 and "f-max" (P1-01) <ul style="list-style-type: none"> <li>"Motor Nom Speed" (P1-10) = 0, displayed in Hz.</li> <li>"Motor Nom Speed" (P1-10) &gt; 0, displayed in rpm.</li> </ul> <p>Description of the functionality see → P8-02</p>  | 0.0 Hz                                    |
| P8-05     | ✓   | t-acc4      |       | Sets the acceleration ramp time 4 in seconds.<br>The time interval set in "t-acc4" represents the time taken to accelerate from zero to "Motor Nom Frequency" (P1-09).   | FS2, FS3:<br>5.0 s<br>FS4, ...:<br>10.0 s |
| P8-06     | ✓   | n-accMulti3 |       | Frequency / speed, at which the acceleration ramp changes from t-acc3 to t-acc4.<br>This can be set to any value between 0 and "f-max" (P1-01) <ul style="list-style-type: none"> <li>"Motor Nom Speed" (P1-10) = 0, displayed in Hz.</li> <li>"Motor Nom Speed" (P1-10) &gt; 0, displayed in rpm.</li> </ul> <p>Description of the functionality see → P8-02</p>  | 0.0 Hz                                    |
| P8-07     | ✓   | t-dec4      |       | Sets the deceleration ramp time 4 in seconds.<br>The time interval set in "t-dec4" represents the time taken to decelerate from "Motor Nom Frequency" (P1-09) to zero.   | FS2, FS3:<br>5.0 s<br>FS4, ...:<br>10.0 s |

## 5 Parameter 5.9 Parameter group 8 ("Ramp")

| Parameter | RUN | Designation        | Value | Description  | DS  |
|-----------|-----|--------------------|-------|--|---|
| P8-08     | ✓   | n-decMulti3        |       | <p>Frequency / speed, at which the deceleration ramp changes from t-dec4 to t-dec3.</p> <p>This can be set to any value between 0 and "f-max" (P1-01)</p> <ul style="list-style-type: none"> <li>• "Motor Nom Speed" (P1-10) = 0, displayed in Hz.</li> <li>• "Motor Nom Speed" (P1-10) &gt; 0, displayed in rpm.</li> </ul> <ul style="list-style-type: none"> <li>• Frequency / Speed &gt; P8-08 = t-dec4</li> <li>• Frequency / Speed &gt; P8-10 AND &lt; P8-08 = t-dec3</li> <li>• Frequency / Speed &gt; P8-12 AND &lt; P8-10 AND &lt; P8-08 = t-dec2</li> <li>• Frequency / Speed &lt; P8-12 AND &lt; P8-10 AND &lt; P8-08 = t-dec1</li> </ul> <p><b>Remark:</b><br/>The AND condition must be interpreted as a "logical AND operator," i.e., all conditions linked with AND must be met simultaneously.</p> | 0.0 Hz                                    |
| P8-09     | ✓   | t-dec3             |       | <p>Sets the deceleration ramp time 3 in seconds.</p> <p>The time interval set in "t-dec3" represents the time taken to decelerate from "Motor Nom Frequency" (P1-09) to zero.</p>  | FS2, FS3:<br>5.0 s<br>FS4, ...:<br>10.0 s |
| P8-10     | ✓   | n-decMulti2        |       | <p>Frequency / speed, at which the deceleration ramp changes from t-dec3 to t-dec2.</p> <p>This can be set to any value between 0 and "f-max" (P1-01)</p> <ul style="list-style-type: none"> <li>• "Motor Nom Speed" (P1-10) = 0, displayed in Hz.</li> <li>• "Motor Nom Speed" (P1-10) &gt; 0, displayed in rpm.</li> </ul> <p>Description of the functionality see → P8-02</p>   | 0.0 Hz                                    |
| P8-11     | ✓   | t-dec2             |       | <p>Sets the deceleration ramp time 2 in seconds.</p> <p>The time interval set in "t-dec2" represents the time taken to decelerate from "Motor Nom Frequency" (P1-09) to zero.</p>  | FS2, FS3:<br>5.0 s<br>FS4, ...:<br>10.0 s |
| P8-12     | ✓   | n-decMulti1        |       | <p>Frequency / speed, at which the deceleration ramp changes from t-dec2 to t-dec1.</p> <p>This can be set to any value between 0 and "f-max" (P1-01)</p> <ul style="list-style-type: none"> <li>• "Motor Nom Speed" (P1-10) = 0, displayed in Hz.</li> <li>• "Motor Nom Speed" (P1-10) &gt; 0, displayed in rpm.</li> </ul> <p>Description of the functionality see → P8-08</p>   | 0.0 Hz                                    |
| P8-13     | ✓   | Ramp Mode          | 0, 1  | <p>Source for ramp selection</p> <ul style="list-style-type: none"> <li>• <b>0</b>: Acceleration and Deceleration ramps 1 (t-acc1 (P1-03) und t-dec1 (P1-04)) are used. With a corresponding configuration in parameter group 9 a selection of individual ramps with P9: 24, ..., 27 is possible.</li> <li>• <b>1</b>: Acceleration and deceleration are carried out with the ramps set in P8-01 ... P8-12.</li> </ul>   | 0   |
| P8-14     | –   | Reserved Parameter |       | Reserved Parameter   | –   |
| P8-15     | –   | Reserved Parameter |       | Reserved Parameter   | –   |

## 5 Parameter

### 5.10 Parameter group 9 ("Control")

#### 5.10 Parameter group 9 ("Control")

Table 30: Parameter group 9 ("Control")

| Parameter | RUN | Designation             | Value        | Description  | DS |
|-----------|-----|-------------------------|--------------|--|----|
| P9-01     | –   | Enable Operation Source | 0, 1, ..., 8 | <p>Source for Enable Signal</p> <p>This signal is usually assigned to Digital Input 1. It is e.g. used in applications, where the START signal comes via fieldbus or from a function block. This signal (logic = 1) is necessary to operate the drive. At removal (logic = 0) the drive stops with the ramp selected by P9-26 / P9-27.</p> <p>Possible sources:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> STO (Terminals 12 / 13)</li> <li>• <b>1:</b> Digital Input 1 (DI1 = Terminal 2)</li> <li>• <b>2:</b> Digital Input 2 (DI2 = Terminal 3)</li> <li>• <b>3:</b> Digital Input 3 (DI3 = Terminal 4)</li> <li>• <b>4:</b> Digital Input 4 (DI4 = Terminal 6)</li> <li>• <b>5:</b> Digital Input 5 (DI5 = Terminal 10)</li> <li>• <b>6:</b> Digital Input 6 (DI6 = Terminal 1 on DXA-EXT-3DI1RO)</li> <li>• <b>7:</b> Digital Input 7 (DI7 = Terminal 2 on DXA-EXT-3DI1RO)</li> <li>• <b>8:</b> Digital Input 8 (DI8 = Terminal 3 on DXA-EXT-3DI1RO)</li> </ul> <p><b>Remark:</b><br/>To use the parameters in group 9 (P9-...), P1-13 has to be "0" (user defined)</p> | 0  |

5 Parameter  
5.10 Parameter group 9 ("Control")

| Parameter | RUN | Designation      | Value         | Description  | DS |
|-----------|-----|------------------|---------------|--|----|
| P9-02     | –   | QuickStop Source | 0, 1, ..., 25 | <p>Source for Quick Stop<br/>This signal (logic = 1) is necessary to operate the drive. At removal (logic = 0) the drive stops with the ramp selected by P2-25).</p> <p>Possible sources:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> OFF / Function not activated</li> <li>• <b>1:</b> Digital Input 1 (DI1 = Terminal 2)</li> <li>• <b>2:</b> Digital Input 2 (DI2 = Terminal 3)</li> <li>• <b>3:</b> Digital Input 3 (DI3 = Terminal 4)</li> <li>• <b>4:</b> Digital Input 4 (DI4 = Terminal 6)</li> <li>• <b>5:</b> Digital Input 5 (DI5 = Terminal 10)</li> <li>• <b>6:</b> Digital input 6 (DI6 = terminal 1 on DXA-EXT-3DI1RO)</li> <li>• <b>7:</b> Digital input 7 (DI7 = terminal 2 on DXA-EXT-3DI1RO)</li> <li>• <b>8:</b> Digital input 8 (DI8 = terminal 3 on DXA-EXT-3DI1RO)</li> <li>• <b>9:</b> Analog Output 1 (AO1 = Terminal 8)</li> <li>• <b>10:</b> Analog Output 2 (AO2 = Terminal 11)</li> <li>• <b>11:</b> Digital Output 1 (RO1 = Terminal 14 / 15 / 16)</li> <li>• <b>12:</b> Digital Output 2 (RO2 = Terminal 17 / 18)</li> <li>• <b>13:</b> Digital Output 3 (DO3 = Terminal 5 / 6 on DXA-EXT-3DI1RO resp. Terminal 1 / 2 on DXA-EXT-3RO)</li> <li>• <b>14:</b> Digital Output 4 (DO4 = Terminal 3 / 4 on DXA-EXT-3RO)</li> <li>• <b>15:</b> Digital Output 5 (DO5 = Terminal 5 / 6 on DXA-EXT-3RO)</li> <li>• <b>16:</b> ON / Function activated</li> <li>• <b>17:</b> User register 1</li> <li>• <b>18:</b> User register 2</li> <li>• <b>19:</b> User register 3</li> <li>• <b>20:</b> User register 4</li> <li>• <b>21:</b> User register 5</li> <li>• <b>22:</b> User register 6</li> <li>• <b>23:</b> User register 7</li> <li>• <b>24:</b> User register 8</li> <li>• <b>25:</b> User register 9</li> </ul> <p><b>Remark:</b><br/>To use the parameters in group 9 (P9-...), P1-13 has to be "0" (user defined)</p> | 0  |
| P9-03     | –   | FWD Source       |               | <p>Source for the FWD command<br/>This signal (logic = 1) is necessary to operate the drive in the forward direction of rotation. At removal (logic = 0) the drive stops with the ramp selected by P9-26 / P9-27.<br/>When FWD and REV command are applied simultaneously, the drive executes a Quick Stop.</p> <p>Possible sources: → P9-02</p> <p>The source, selected here, can also be configured for a control with a latch signal.</p> <p>Description → P9-05</p>  | 1  |

## 5 Parameter

### 5.10 Parameter group 9 ("Control")

| Parameter | RUN | Designation            | Value | Description  | DS |
|-----------|-----|------------------------|-------|--|----|
| P9-04     | –   | REV Source             |       | <p>Source for the REV command<br/>This signal (logic = 1) is necessary to operate the drive in the reverse direction of rotation. At removal (logic = 0) the drive stops with the ramp selected by P9-26 / P9-27.<br/>When FWD and REV command are applied simultaneously, the drive executes a Quick Stop.</p> <p>Possible sources: → P9-02</p> <p>The source, selected here, can also be configured for a control with a latch signal.</p> <p>Description → P9-05</p>  | 2  |
| P9-05     | –   | Signal Format          | 0, 1  | <p>Enables Latch function for FWD / REV inputs</p> <ul style="list-style-type: none"> <li>• <b>0</b>: OFF. The commands for forward (FWD) and reverse (REV) have to be applied constantly.</li> <li>• <b>1</b>: Latch control ON. The drive can be started, stopped and reversed by means of pulses.</li> </ul> <p>Function:</p> <ul style="list-style-type: none"> <li>• P9-01 (Enable): This signal has to be applied constantly during run. Removing the signal for a short time leads to a stop of the drive. For a restart a signal at the source, defined with P9-03 or P9-04, is necessary.</li> <li>• P9-03 (FWD): Start of the drive (direction: forward) via a pulse at the source defined here. To stop the removing of the enable signal is necessary.</li> <li>• P9-04 (REV): Start of the drive (direction: reverse) via a pulse at the source defined here. To stop the removing of the enable signal is necessary.</li> <li>• When FWD and REV commands are present simultaneously the drive will stop.</li> </ul> | 0  |
| P9-06     | –   | Force REV Source       |       | <p>Source for "Force reverse operation"<br/>This signal (logic = 1) forces the drive to run in the reverse direction. It is irrelevant, if the FWD or the REV command is applied.<br/>Without this signal (logic = 0) the sense of rotation is determined by FWD and REV commands.</p> <p>Possible sources: → P9-02</p>  | 0  |
| P9-07     | –   | FaultReset Source      |       | <p>Source for Fault RESET<br/>A rising edge of this signal (from logic = 0 to 1) resets existing fault messages.</p> <p>Possible sources: → P9-02</p>  | 1  |
| P9-08     | –   | External Fault1 Source |       | <p>Source for the "External Fault" signal</p> <ul style="list-style-type: none"> <li>• Logic 0 = external fault</li> <li>• Logic 1 = no external fault</li> </ul> <p>Possible sources: → P9-02</p>   | 0  |
| P9-09     | –   | LocalRemote @Startup   |       | <p>Source for "Local / Remote" selection<br/>This parameter is only effective with P1-12 &gt; 0.<br/>It enables the changeover between the command channel defined by P1-12 and the sources selected with P9-01, ..., P9-07.</p> <ul style="list-style-type: none"> <li>• Logic 0 = Command channel according P1-12</li> <li>• Logic 1 = The drive is controlled by the sources defined with P9-01, ..., P9-07.</li> </ul> <p>Possible sources: → P9-02</p>  | 16 |

## 5 Parameter 5.10 Parameter group 9 ("Control")

| Parameter | RUN | Designation  | Value         | Description  | DS |
|-----------|-----|--------------|---------------|--|----|
| P9-10     | –   | SpeedSource1 | 0, 1, ..., 16 | <p>Source for "Speed Reference 1"<br/>It is possible to define up to 8 sources for the speed reference, and to select them during operation using P9-18, ..., P9-20. When changing the speed reference source, the operation is effective immediately. A stop and restart is not required.</p> <p>Possible sources:</p> <ul style="list-style-type: none"> <li>• <b>0:</b> Analog input 1 as speed reference</li> <li>• <b>1:</b> Analog input 2 as speed reference</li> <li>• <b>2:</b> Preset fixed frequency (selected with P9-21, ..., P9-23)</li> <li>• <b>3:</b> Digital reference (keypad)</li> <li>• <b>4:</b> PID controller output</li> <li>• <b>5:</b> Master speed</li> <li>• <b>6:</b> Speed reference via fieldbus</li> <li>• <b>7:</b> Reference from function block</li> <li>• <b>8:</b> Frequency reference (see P6-08)</li> <li>• <b>9:</b> Preset fixed frequency f-fix1 (P2-01)</li> <li>• <b>10:</b> Preset fixed frequency f-fix2 (P2-02)</li> <li>• <b>11:</b> Preset fixed frequency f-fix3 (P2-03)</li> <li>• <b>12:</b> Preset fixed frequency f-fix4 (P2-04)</li> <li>• <b>13:</b> Preset fixed frequency f-fix5 (P2-05)</li> <li>• <b>14:</b> Preset fixed frequency f-fix6 (P2-06)</li> <li>• <b>15:</b> Preset fixed frequency f-fix7 (P2-07)</li> <li>• <b>16:</b> Preset fixed frequency f-fix8 (P2-08)</li> </ul> <p><b>Remark:</b><br/>To use the parameters in group 9 (P9-...), P1-13 has to be 0 (user defined)</p> | 0  |
| P9-11     | –   | SpeedSource2 | 0, 1, ..., 16 | <p>Source for "Speed Reference 2"<br/>It is possible to define up to 8 sources for the speed reference, and to select them during operation using P9-18, ..., P9-20. When changing the speed reference source, the operation is effective immediately. A stop and restart is not required.</p> <p>Possible sources: → P9-10</p>  | 2  |
| P9-12     | –   | SpeedSource3 | 0, 1, ..., 16 | <p>Source for "Speed Reference 3"<br/>It is possible to define up to 8 sources for the speed reference, and to select them during operation using P9-18, ..., P9-20. When changing the speed reference source, the operation is effective immediately. A stop and restart is not required.</p> <p>Possible sources: → P9-10</p>  | 0  |
| P9-13     | –   | SpeedSource4 | 0, 1, ..., 16 | <p>Source for "Speed Reference 4"<br/>It is possible to define up to 8 sources for the speed reference, and to select them during operation using P9-18, ..., P9-20. When changing the speed reference source, the operation is effective immediately. A stop and restart is not required.</p> <p>Possible sources: → P9-10</p>  | 0  |
| P9-14     | –   | SpeedSource5 | 0, 1, ..., 16 | <p>Source for "Speed Reference 5"<br/>It is possible to define up to 8 sources for the speed reference, and to select them during operation using P9-18, ..., P9-20. When changing the speed reference source, the operation is effective immediately. A stop and restart is not required.</p> <p>Possible sources: → P9-10</p>  | 0  |

## 5 Parameter

### 5.10 Parameter group 9 ("Control")

| Parameter                       | RUN   | Designation     | Value         | Description  | DS              |       |       |       |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |   |
|---------------------------------|-------|-----------------|---------------|--|-----------------|-------|-------|-------|---------------------------------|---|---|---|---------------------------------|---|---|---|---------------------------------|---|---|---|---------------------------------|---|---|---|---------------------------------|---|---|---|---------------------------------|---|---|---|---------------------------------|---|---|---|---------------------------------|---|---|---|---|
| P9-15                           | –     | SpeedSource6    | 0, 1, ..., 16 | <p>Source for "Speed Reference 6"</p> <p>It is possible to define up to 8 sources for the speed reference, and to select them during operation using P9-18, ..., P9-20. When changing the speed reference source, the operation is effective immediately. A stop and restart is not required.</p> <p>Possible sources: → P9-10</p>   | 0               |       |       |       |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |   |
| P9-16                           | –     | SpeedSource7    | 0, 1, ..., 16 | <p>Source for "Speed Reference 7"</p> <p>It is possible to define up to 8 sources for the speed reference, and to select them during operation using P9-18, ..., P9-20. When changing the speed reference source, the operation is effective immediately. A stop and restart is not required.</p> <p>Possible sources: → P9-10</p>   | 0               |       |       |       |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |   |
| P9-17                           | –     | SpeedSource8    | 0, 1, ..., 16 | <p>Source for "Speed Reference 8"</p> <p>It is possible to define up to 8 sources for the speed reference, and to select them during operation using P9-18, ..., P9-20. When changing the speed reference source, the operation is effective immediately. A stop and restart is not required.</p> <p>Possible sources: → P9-10</p>   | 0               |       |       |       |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |   |
| P9-18                           | –     | Speed Select B0 | 0, 1, ..., 25 | <p>Speed Reference Select Bit 0</p> <p>Parameters P9-18 ... P9-20 determine the selection of the actual speed reference value, defined by P9-10, ..., P9-17.</p> <p>Selection:</p> <table border="1"> <thead> <tr> <th>Speed Reference</th> <th>P9-18</th> <th>P9-19</th> <th>P9-20</th> </tr> </thead> <tbody> <tr> <td>Speed reference value 1 (P9-10)</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>Speed reference value 2 (P9-11)</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>Speed reference value 3 (P9-12)</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>Speed reference value 4 (P9-13)</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>Speed reference value 5 (P9-14)</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>Speed reference value 6 (P9-15)</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>Speed reference value 7 (P9-16)</td> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>Speed reference value 8 (P9-17)</td> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table> <p>Possible sources: → P9-02</p> | Speed Reference | P9-18 | P9-19 | P9-20 | Speed reference value 1 (P9-10) | 0 | 0 | 0 | Speed reference value 2 (P9-11) | 1 | 0 | 0 | Speed reference value 3 (P9-12) | 0 | 1 | 0 | Speed reference value 4 (P9-13) | 1 | 1 | 0 | Speed reference value 5 (P9-14) | 0 | 0 | 1 | Speed reference value 6 (P9-15) | 1 | 0 | 1 | Speed reference value 7 (P9-16) | 0 | 1 | 1 | Speed reference value 8 (P9-17) | 1 | 1 | 1 | 3 |
| Speed Reference                 | P9-18 | P9-19           | P9-20         |  |                 |       |       |       |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |   |
| Speed reference value 1 (P9-10) | 0     | 0               | 0             |  |                 |       |       |       |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |   |
| Speed reference value 2 (P9-11) | 1     | 0               | 0             |  |                 |       |       |       |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |   |
| Speed reference value 3 (P9-12) | 0     | 1               | 0             |  |                 |       |       |       |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |   |
| Speed reference value 4 (P9-13) | 1     | 1               | 0             |  |                 |       |       |       |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |   |
| Speed reference value 5 (P9-14) | 0     | 0               | 1             |  |                 |       |       |       |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |   |
| Speed reference value 6 (P9-15) | 1     | 0               | 1             |  |                 |       |       |       |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |   |
| Speed reference value 7 (P9-16) | 0     | 1               | 1             |  |                 |       |       |       |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |   |
| Speed reference value 8 (P9-17) | 1     | 1               | 1             |  |                 |       |       |       |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |   |
| P9-19                           | –     | Speed Select B1 | 0, 1, ..., 25 | <p>Speed Reference Select Bit 1</p> <p>Parameters P9-18, ..., P9-20 determine the selection of the actual speed reference value, defined by P9-10, ..., P9-17.</p> <p>Selection → P9-18</p> <p>Possible sources: → P9-02</p>   | 0               |       |       |       |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |                                 |   |   |   |   |

5 Parameter  
5.10 Parameter group 9 ("Control")

| Parameter      | RUN   | Designation     | Value         | Description  | DS           |       |       |       |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |   |
|----------------|-------|-----------------|---------------|--|--------------|-------|-------|-------|----------------|---|---|---|----------------|---|---|---|----------------|---|---|---|----------------|---|---|---|----------------|---|---|---|----------------|---|---|---|----------------|---|---|---|----------------|---|---|---|---|
| P9-20          | –     | Speed Select B2 | 0, 1, ..., 25 | <p>Speed Reference Select Bit 2<br/>Parameters P9-18, ..., P9-20 determine the selection of the actual speed reference value, defined by P9-10, ..., P9-17.</p> <p>Selection → P9-18</p> <p>Possible sources: → P9-02</p>  | 0            |       |       |       |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |   |
| P9-21          | –     | f-Fix Select B0 | 0, 1, ..., 25 | <p>Preset Fixed Frequency Select Bit 0</p> <p>Parameters P9-21, ..., P9-23 determine the selection of the preset fixed frequencies defined by P2-01, ..., P2-08.</p> <p>Selection:</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Preset Speed</th> <th>P9-21</th> <th>P9-22</th> <th>P9-23</th> </tr> </thead> <tbody> <tr> <td>f-Fix1 (P2-01)</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>f-Fix2 (P2-02)</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>f-Fix3 (P2-03)</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>f-Fix4 (P2-04)</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>f-Fix5 (P2-05)</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>f-Fix6 (P2-06)</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>f-Fix7 (P2-07)</td> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>f-Fix8 (P2-08)</td> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table> <p>Possible sources: → P9-02</p> | Preset Speed | P9-21 | P9-22 | P9-23 | f-Fix1 (P2-01) | 0 | 0 | 0 | f-Fix2 (P2-02) | 1 | 0 | 0 | f-Fix3 (P2-03) | 0 | 1 | 0 | f-Fix4 (P2-04) | 1 | 1 | 0 | f-Fix5 (P2-05) | 0 | 0 | 1 | f-Fix6 (P2-06) | 1 | 0 | 1 | f-Fix7 (P2-07) | 0 | 1 | 1 | f-Fix8 (P2-08) | 1 | 1 | 1 | 5 |
| Preset Speed   | P9-21 | P9-22           | P9-23         |  |              |       |       |       |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |   |
| f-Fix1 (P2-01) | 0     | 0               | 0             |  |              |       |       |       |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |   |
| f-Fix2 (P2-02) | 1     | 0               | 0             |  |              |       |       |       |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |   |
| f-Fix3 (P2-03) | 0     | 1               | 0             |  |              |       |       |       |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |   |
| f-Fix4 (P2-04) | 1     | 1               | 0             |  |              |       |       |       |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |   |
| f-Fix5 (P2-05) | 0     | 0               | 1             |  |              |       |       |       |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |   |
| f-Fix6 (P2-06) | 1     | 0               | 1             |  |              |       |       |       |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |   |
| f-Fix7 (P2-07) | 0     | 1               | 1             |  |              |       |       |       |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |   |
| f-Fix8 (P2-08) | 1     | 1               | 1             |  |              |       |       |       |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |   |
| P9-22          | –     | f-Fix Select B1 | 0, 1, ..., 25 | <p>Preset Fixed Frequency Select Bit 1<br/>Parameters P9-21, ..., P9-23 determine the selection of the preset fixed frequencies defined by P2-01, ..., P2-08.</p> <p>Selection → P9-21</p> <p>Possible sources: → P9-02</p>  | 0            |       |       |       |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |   |
| P9-23          | –     | f-Fix Select B2 | 0, 1, ..., 25 | <p>Preset Fixed Frequency Select Bit 2<br/>Parameters P9-21, ..., P9-23 determine the selection of the preset fixed frequencies defined by P2-01, ..., P2-08.</p> <p>Selection → P9-21</p> <p>Possible sources: → P9-02</p>  | 0            |       |       |       |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |                |   |   |   |   |

## 5 Parameter

### 5.10 Parameter group 9 ("Control")

| Parameter         | RUN   | Designation     | Value         | Description   | DS                |       |       |               |   |   |                |   |   |                |   |   |                |   |   |   |
|-------------------|-------|-----------------|---------------|---|-------------------|-------|-------|---------------|---|---|----------------|---|---|----------------|---|---|----------------|---|---|---|
| P9-24             | –     | t-acc Select B0 | 0, 1, ..., 25 | <p>Acceleration Ramp Select Bit 0<br/>With parameters P9-24 and P9-25 alternative acceleration ramp times can be selected. Condition is, that P8-13 is set to 0, because otherwise the selection of the ramps is done automatically depending on the speed.</p> <p>Selection:</p> <table border="1"> <thead> <tr> <th>Acceleration time</th> <th>P9-24</th> <th>P9-25</th> </tr> </thead> <tbody> <tr> <td>t-acc (P1-03)</td> <td>0</td> <td>0</td> </tr> <tr> <td>t-acc2 (P8-01)</td> <td>1</td> <td>0</td> </tr> <tr> <td>t-acc3 (P8-02)</td> <td>0</td> <td>1</td> </tr> <tr> <td>t-acc4 (P8-03)</td> <td>1</td> <td>1</td> </tr> </tbody> </table> <p>Possible sources: → P9-02</p>     | Acceleration time | P9-24 | P9-25 | t-acc (P1-03) | 0 | 0 | t-acc2 (P8-01) | 1 | 0 | t-acc3 (P8-02) | 0 | 1 | t-acc4 (P8-03) | 1 | 1 | 0 |
| Acceleration time | P9-24 | P9-25           |               |   |                   |       |       |               |   |   |                |   |   |                |   |   |                |   |   |   |
| t-acc (P1-03)     | 0     | 0               |               |   |                   |       |       |               |   |   |                |   |   |                |   |   |                |   |   |   |
| t-acc2 (P8-01)    | 1     | 0               |               |   |                   |       |       |               |   |   |                |   |   |                |   |   |                |   |   |   |
| t-acc3 (P8-02)    | 0     | 1               |               |   |                   |       |       |               |   |   |                |   |   |                |   |   |                |   |   |   |
| t-acc4 (P8-03)    | 1     | 1               |               |   |                   |       |       |               |   |   |                |   |   |                |   |   |                |   |   |   |
| P9-25             | –     | t-acc Select B1 | 0, 1, ..., 25 | <p>Acceleration Ramp Select Bit 1<br/>With parameters P9-24 and P9-25 alternative acceleration ramp times can be selected. Condition is, that P8-13 is set to 0, because otherwise the selection of the ramps is done automatically depending on the speed.</p> <p>Selection → P9-24</p> <p>Possible sources: → P9-02</p>   | 0                 |       |       |               |   |   |                |   |   |                |   |   |                |   |   |   |
| P9-26             | –     | t-dec Select B0 | 0, 1, ..., 25 | <p>Deceleration Ramp Select Bit 0<br/>With parameters P9-26 and P9-27 alternative deceleration ramp times can be selected.<br/>Condition is, that P8-13 is set to 0, because otherwise the selection of the ramps is done automatically depending on the speed.</p> <p>Selection:</p> <table border="1"> <thead> <tr> <th>Deceleration time</th> <th>P9-26</th> <th>P9-27</th> </tr> </thead> <tbody> <tr> <td>t-dec (P1-04)</td> <td>0</td> <td>0</td> </tr> <tr> <td>t-dec2 (P8-11)</td> <td>1</td> <td>0</td> </tr> <tr> <td>t-dec3 (P8-09)</td> <td>0</td> <td>1</td> </tr> <tr> <td>t-dec4 (P8-07)</td> <td>1</td> <td>1</td> </tr> </tbody> </table> <p>Possible sources: → P9-02</p> | Deceleration time | P9-26 | P9-27 | t-dec (P1-04) | 0 | 0 | t-dec2 (P8-11) | 1 | 0 | t-dec3 (P8-09) | 0 | 1 | t-dec4 (P8-07) | 1 | 1 | 0 |
| Deceleration time | P9-26 | P9-27           |               |   |                   |       |       |               |   |   |                |   |   |                |   |   |                |   |   |   |
| t-dec (P1-04)     | 0     | 0               |               |   |                   |       |       |               |   |   |                |   |   |                |   |   |                |   |   |   |
| t-dec2 (P8-11)    | 1     | 0               |               |   |                   |       |       |               |   |   |                |   |   |                |   |   |                |   |   |   |
| t-dec3 (P8-09)    | 0     | 1               |               |   |                   |       |       |               |   |   |                |   |   |                |   |   |                |   |   |   |
| t-dec4 (P8-07)    | 1     | 1               |               |   |                   |       |       |               |   |   |                |   |   |                |   |   |                |   |   |   |
| P9-27             | –     | t-dec Select B1 | 0, 1, ..., 25 | <p>Deceleration Ramp Select Bit 1<br/>With parameters P9-26 and P9-27 alternative deceleration ramp times can be selected. Condition is, that P8-13 is set to 0, because otherwise the selection of the ramps is done automatically depending on the speed.</p> <p>Selection → P9-26</p> <p>Possible sources: → P9-02</p>   | 0                 |       |       |               |   |   |                |   |   |                |   |   |                |   |   |   |

## 5 Parameter 5.10 Parameter group 9 ("Control")

| Parameter | RUN | Designation                    | Value         | Description   | DS |
|-----------|-----|--------------------------------|---------------|---|----|
| P9-28     | –   | digRef UP Source               | 0, 1, ..., 25 | Source for "Increase Digital Reference"<br>Defines the source of a signal for the increase of the digital reference (Motorpot)<br><ul style="list-style-type: none"> <li>Logic 0 = no increase of the digital reference</li> <li>Logic 1 = The digital reference will be increased.<br/>Acceleration according t-acc (P1-03)</li> </ul> Possible sources: → P9-02   | 0  |
| P9-29     | –   | digRef DOWN Source             | 0, 1, ..., 25 | Source for "Decrease Digital Reference"<br>Defines the source of a signal for a decrease of the digital reference (Motorpot)<br><ul style="list-style-type: none"> <li>Logic 0 = no decrease of the digital reference</li> <li>Logic 1 = The digital reference will be decreased.<br/>Deceleration according t-dec (P1-04)</li> </ul> Possible sources: → P9-02   | 0  |
| P9-30     | –   | EnableDirFWD Source            |               | Enable Direction FWD<br>Defines a source for a signal to enable the "forward" (FWD) sense of rotation.<br><ul style="list-style-type: none"> <li>Logic 0 = An operation in forward direction is not possible.<br/>If the motor already turns in forward direction when the signal changes from logic 1 to 0, it ramps to stand still by using the quick stop ramp (P2-25)</li> <li>Logic 1 = An operation in forward direction is possible.</li> </ul> Possible sources: → P9-02  | 0  |
| P9-31     | –   | EnableDirREV Source            |               | Enable Direction REV<br>Defines a source for a signal to enable the "reverse" (REV) sense of rotation.<br><ul style="list-style-type: none"> <li>Logic 0 = An operation in reverse direction is not possible.<br/>If the motor already turns in reverse direction when the signal changes from logic 1 to 0, it ramps to stand still by using the quick stop ramp (P2-25).</li> <li>Logic 1 = An operation in reverse direction is possible.</li> </ul> Possible sources: → P9-02 | 0  |
| P9-32     | –   | Reserved Parameter             |               | Reserved Parameter  | 0  |
| P9-33     | –   | ADO1 Function & Mode Extension | 0, 1, 2       | Selection of additional functions for ADO1<br><ul style="list-style-type: none"> <li><b>0</b>: Function of the Analog Output 1 is determined by P2-11</li> <li><b>1</b>: User defined digital output (0 V / 24 V) from function block</li> <li><b>2</b>: User defined analog output from function block</li> </ul>  | 0  |
| P9-34     | –   | ADO2 Function & Mode Extension | 0, 1, 2       | Selection of additional functions for ADO2<br><ul style="list-style-type: none"> <li><b>0</b>: Function of the Analog Output 2 is determined by P2-13</li> <li><b>1</b>: User defined digital output (0 V / 24 V) from function block</li> <li><b>2</b>: User defined analog output from function block</li> </ul>  | 0  |
| P9-35     | –   | RO1 Function Extension         | 0, 1          | Selection of additional functions for RO1<br><ul style="list-style-type: none"> <li><b>0</b>: Function of Relay Output 1 is determined by P2-15</li> <li><b>1</b>: User defined output from function block</li> </ul>   | 0  |
| P9-36     | –   | RO2 Function Extension         | 0, 1          | Selection of additional functions for RO2<br><ul style="list-style-type: none"> <li><b>0</b>: Function of Relay Output 2 is determined by P2-18</li> <li><b>1</b>: User defined output from function block</li> </ul>   | 0  |
| P9-37     | –   | Display Scale Source           | 0, 1          | Source to Scale factor display<br><ul style="list-style-type: none"> <li><b>0</b>: The source of the scaling factor is determined by P2-21.</li> <li><b>1</b>: User defined source from function block</li> </ul>   | 0  |

## 5 Parameter

### 5.10 Parameter group 9 ("Control")

| Parameter | RUN | Designation                | Value | Description  | DS |
|-----------|-----|----------------------------|-------|--|----|
| P9-38     | –   | PID1 Set Point1 Source Ext | 0, 1  | Selection of additional sources for PID1 reference <ul style="list-style-type: none"> <li>• <b>0</b>: The source of the reference is determined by P3-05.</li> <li>• <b>1</b>: User defined source from function block</li> </ul>  | 0  |
| P9-39     | –   | PID1 Feedback1 Source Ext  | 0, 1  | Selection of additional sources for PID1 feedback <ul style="list-style-type: none"> <li>• <b>0</b>: The source of the feedback is determined by P3-10.</li> <li>• <b>1</b>: User defined source from function block</li> </ul>  | 0  |
| P9-40     | –   | M-Ref Source Extension     | 0, 1  | Extended Selection values for Source of torque reference <ul style="list-style-type: none"> <li>• <b>0</b>: The source of the reference is determined by P4-06.</li> <li>• <b>1</b>: User defined source from function block</li> </ul>  | 0  |
| P9-41     | –   | R05 Function Extension     | 0, 1  | Selection of additional functions for R05<br>The relays are located on option boards. <ul style="list-style-type: none"> <li>• <b>0</b>: Factory settings active<br/>(Relay 3: Drive healthy (DXA-EXT-3R0 + DXA-EXT-3DI1R0)<br/>Relay 4: Drive tripped (DXA-EXT-3R0)<br/>Relay 5: Drive running (DXA-EXT-3R0))</li> <li>• <b>1</b>: User defined output from function block</li> </ul> | 0  |

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