PowerXL™

DA1 Variable frequency drive DA1-...20..., DA1-...55... and DA1-...O

Powering Business Worldwide

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Original Operating Instructions
The German-language edition of this document is the original operating manual.

Translation of the original operating manual.
All editions of this document other than those in German language are translations of the original operating manual.

1. 2022 edition, publication date 05/22
2. 2024 edition, publication date 05/24
3. 2024 edition, publication date 12/24
4. 2025 edition, publication date 08/25

See revision protocol in the „About this manual“ chapter

Danger!
Dangerous electrical voltage!

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally retriggered.
- Verify isolation from the supply.
- Ground and short-circuit.
- Cover or enclose neighbouring units that are live.
- Follow the engineering instructions (IL) of 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) must be connected to the protective earth (PE) or to the potential equalizing. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do 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 connection so that a cable or wire breakage on the signal side does not result in undefined states in the automation device.
- Ensure a reliable electrical isolation of the low voltage for the 24 V supply. Only use power supply units complying with IEC 60364-4-41 or HD 384.4.41 S2 (VDE 0100 part 410).
- Deviations of the mains voltage from the nominal value must not exceed the tolerance limits given in the technical data, 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 switching off devices must not cause restart.
- Built-in devices for enclosures or cabinets must only be run and operated in an installed state, desk-top devices or portable devices only when the housing is closed.
- 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 switching off devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, 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.).
- During operation, and depending on their degree of protection, variable frequency drives may have live, uninsulated, moving, and/or rotating parts, as well as hot surfaces.
- The impermissible removal of the required cover, improper installation or incorrect operation of the motor or variable frequency drive can cause the failure of the device and serious injury and/or material damage.
- Comply with all applicable national accident prevention regulations (e.g. BGV A3) when working with energized variable frequency drives.
- The electrical installation must be carried out in accordance with the relevant regulations (e.g. with regard to cable cross sections, fuses, PE).
- All transport, installation, commissioning and maintenance work must only be carried out by trained personnel (observe IEC 60364, HD 384 or DIN VDE 0100 and national accident prevention regulations).
- If applicable, systems in which variable frequency drives are installed must be equipped with additional monitoring and protective devices in accordance with the applicable safety regulations, e.g., the German Equipment and Product Safety Act, accident prevention regulations, etc. Making changes to the variable frequency drives by using the operating software is allowed.
- Keep all covers and doors closed during operation.
- When designing the machine, the user must incorporate mechanisms and measures that limit the consequences of a drive controller malfunction or failure (an increase in motor speed or the motor?9s sudden stop) so as to prevent hazards to people and property, e.g.:
  - Additional stand-alone devices for monitoring parameters that are relevant to safety (speed, travel, end positions, etc.)
  - Electrical and non-electrical safety devices (interlocks or mechanical locks) for mechanisms that protect the entire system
  - Due to the possibility of there being capacitors that are still holding a charge, do not touch live device parts or terminals immediately after disconnecting the variable frequency drives from the supply voltage. Heed the corresponding labels on the variable frequency drives

Content

0 About this manual

This manual contains specific information designed to enable you to select and commission a DA1 variable frequency drive. It covers all DA1 frame sizes.

Any differences between and special characteristics of the various models will be noted. Accessories that can be used to modify the DA1 variable frequency drive according to your specific needs will be listed where applicable.

0.1 Target audience

This manual is intended for engineers and electricians. Electrical engineering and practical knowledge and skills will be required in order to be able to commission these 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.

CAUTION

Installation requires a qualified electrician

0.2 Change protocol

The following significant amendments have been introduced since previous issues:

Publication date	Page	Keyword	new	modified	deleted
08/25	117	„Positions of the selector switch“		✓	
12/24	163	„Parameter group 1 (“Basic”)“		✓	
	215	„Frame sizes FS2, FS3 and FS4 in IP66“		✓	
05/24	61	„Synchronous, reluctance, and PM motors“		✓	
	135	„Parameter“	✓		
	63	„TÜV certification“		✓	
	-	Specification of the safety relay			✓
	71	„“Safe stop” function“		✓	
	198	„General rated data“		✓	
05/22		First edition	–	–	–

0.3 Writing conventions

Symbols with the following meaning are used in this manual:

▶ Indicates instructions to be followed.

0.3.1 Safety warning concerning property damage

WARNING

Indicates a potentially hazardous situation that may result in property damage.

0.3.2 Safety warning concerning personal injury hazards

CAUTION

Warns of hazardous situations that may cause slight injury.

WARNING

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

DANGER

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

0.3.3 Hints

Indicates useful tips.

In order to make it easier to understand some of the figures included in this manual, the variable frequency drive housing, as well as other safety-related parts, have been omitted. 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 online at:

Eaton.com/powerxl

as well as

Eaton.com/documentation

In the Search field, enter the document name (for example "MN040063" for this manual).

0.5 Abbreviations

The following abbreviations are used in this manual.

DS	Default setting
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 (drive 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 following rated operating voltages stated in the following tables are based on the standard values for star networks with a grounded central 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.
For example: 240 V → 230 V, 480 V → 460 V, 600 V → 575 V.

The broad tolerance range of the DA1 variable frequency drive allows for a permitted voltage drop of 10 % (i.e. U_{LN} - 10 %) and in the 400 V category the North American mains voltage of 480 V + 10 % (60 Hz).

The permissible power supplies for the DA1 series are listed in the technical data section in the appendix.

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

0.7 Units 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	Anglo American value	SI value	Conversion value
Length	inch	1 in (")	25.4 mm	0.0394
Output	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_F)	-17.222°C (T_C)	$T_F = T_C \times 9/5 + 32$
Speed	revolutions per minute	1 rpm	1 min^{-1}	1
Weight	pound	1 lb	0.4536 kg	2.205
Flow rate	cubic feed per minute	1 cfm	1.698 m^3/min	0.5889

1 DA1 device series

1.1 Introduction

Due to their comprehensive functionality and high reliability, PowerXL™ DA1 variable frequency drives are ideal for sophisticated applications involving synchronous or asynchronous three phase motors.

In fact, DA1 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 DA1 variable frequency drives feature an internal brake chopper.

In addition, devices belonging to the 230 V (DA1-32…) and 400 V (DA1-34…) 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.

DA1 devices are characterized by compact and rugged construction, are available in six frame sizes (FS2, …, FS7), and are designed for an assigned motor output of:

- 0.75 kW (with 230 V) to 37 kW (with 400 V) and 45 kW (with 500 V) with an IP20 degree of protection and a 7-segment digital display assembly
- 0.75 kW (with 230 V) to 22 kW (with 400 V) and 30 kW (with 500 V) with an IP66 degree of protection and an graphic display – also available in a version with a mains switch and controls for local control
- 5.5 kW (for 230 V) to 110 kW (with 500 V) and 160 kW (with 400 V) with an OLED display in IP55 degree of protection with internal DC link choke.

1.2 System overview

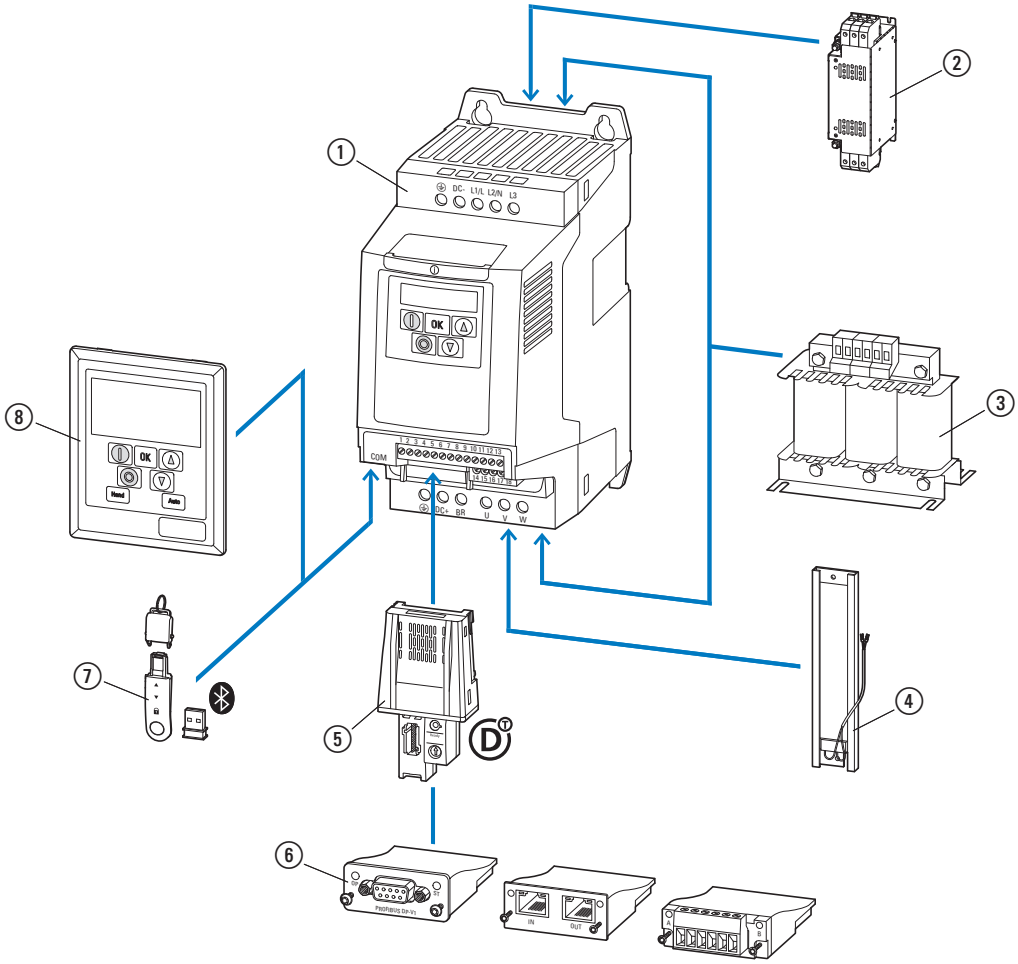


Figure 1: System overview (example: frame size FS2, degree of protection IP20)

① DA1-… variable frequency drives
② EMV filter DX-EMC…
③ Mains choke DX-LN…, Motor choke DX-LM3-…
Sine filter DX-SIN3-…, all-pole sine filter DX-SIN3-…-A
④ DX-BR… braking resistor
⑤ SWD interface DX-NET-SWD1
⑥ DX-NET… fieldbus connection and DXA-EXT… expansion group
⑦ DX-COM-STICK3 communication module and accessories (e.g. DX-CBL-… connection cable)
⑧ DX-KEY-… keypad (external)

1.3 Checking the delivery

→ Before opening the package, please check the rating plate on it to make sure that you have received the variable frequency drive type you ordered.

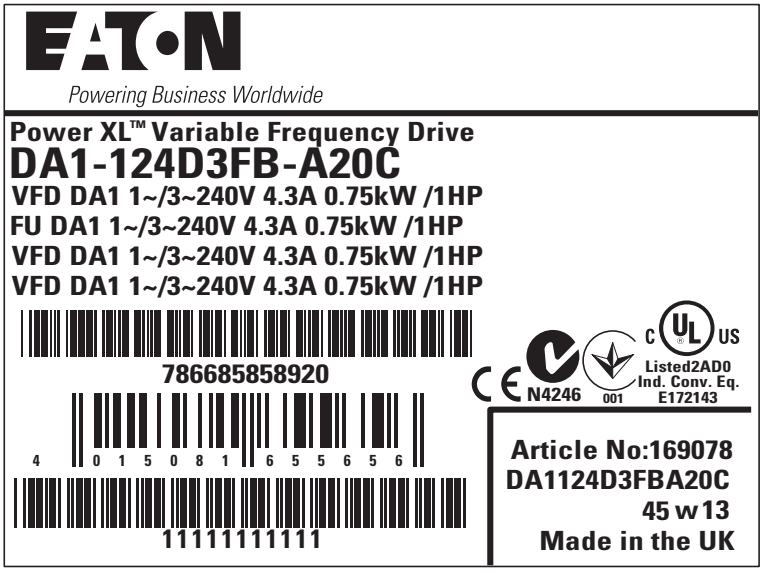


Figure 2: Label (example) on packaging

The sample label shown in figure 2 indicates that the package contains a DA1 variable frequency drive with the following characteristics:

- Single-phase mains connection: 230 V (200 - 240 V ±10 %)
- Rated current: 4.3 A
- Assigned motor rating: 0.75 kW/1 HP (at 230 V)

The DA1 series variable frequency drives are carefully packaged and prepared for delivery. The devices should be shipped only in their original packaging and using a suitable means of transportation.
Please take note of the labels and instructions on the packaging, as well as the manual for the unpacked device.

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

The packaging must contain the following parts:

- a DA1 device series variable frequency drive,
- an instruction leaflet
  - IL04020010Z for devices with IP20 degree of protection with frame size FS2, FS3
  - IL040049ZU for devices with IP20 degree of protection with frame size FS4, FS5
  - IL04020011Z for devices with IP55 degree of protection with frame size FS4, FS5, FS6, FS7
  - IL040061ZU for devices with IP66 degree of protection outdoor with frame size FS2, FS3, FS4

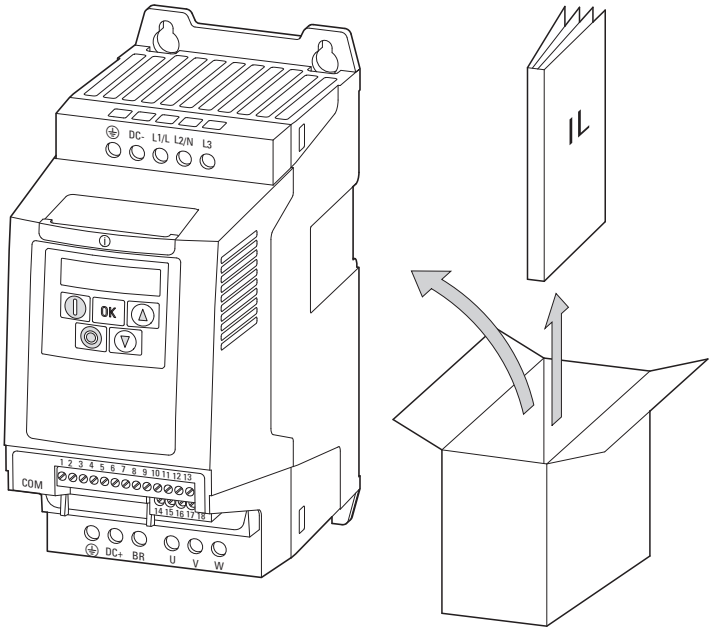


Figure 3: Equipment supplied (example: size FS2, degree of protection IP20)

1.4 Rated data

1.4.1 Rating data on the nameplate

The device-specific rated data of a DA1 variable frequency drive are listed on the device's rating plate.

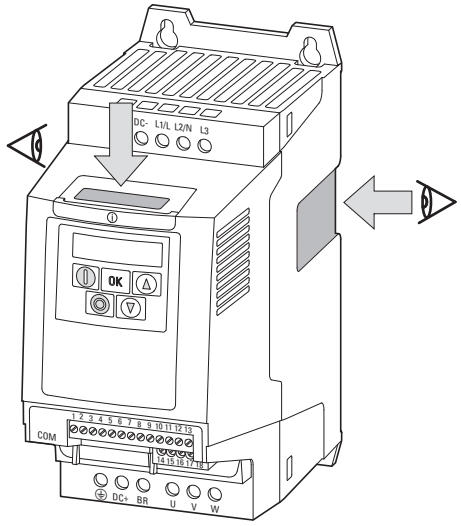


Figure 4: Nameplate on the device (example: frame size FS2, IP20 degree of protection)

The nameplate (②) attached to the top is a simplified version for clear identification of the device if the nameplate (①) is covered due to lateral attachment.

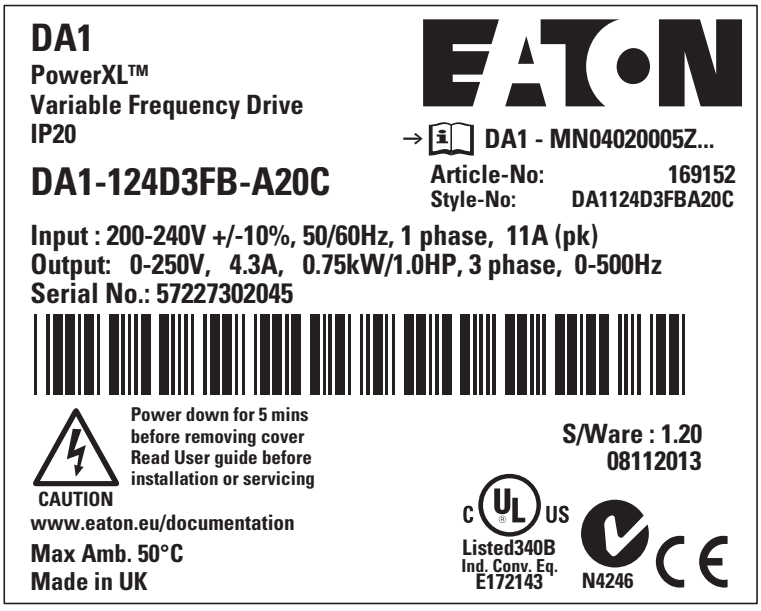


Figure 5: Nameplate ① (on the side)

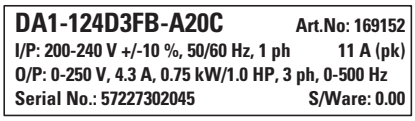


Figure 6: Nameplate ② (on the front)

The description on the nameplate (from → figure 5) has the following meaning (example):

Inscription	Meaning
DA1-124D3FB-A20C	Type designation: DA1 = DA1 device series variable frequency drive 1 = Single-phase mains connection / three-phase motor connection 2 = Mains voltage category 230 V 4D3 = 4.3 A Rated current (4-decimal-1, output current) F = Integrated radio interference suppression filter B = Integrated brake chopper A = LED display (7-segment text display) 20 = IP20 degree of protection C = PCB protection (coated board)
Input	Rated data of mains connection: Single-phase AC voltage (U_e 1~ AC) Voltage 200 - 240 V, frequency 50/60 Hz, input phase current (11 A)
Output	Load side (motor) rated data: Three-phase AC voltage (0 - U_e), output phase current (4.3 A), Output frequency (0 - 500 Hz) Assigned motor output: 0.75 kW at 230 V/1 HP with 230 V for a four-pole, internally cooled or surface-cooled three-phase motor (1500 rpm at 50 Hz/1800 rpm at 60 Hz)
Serial No.:	Serial number
IP20	Housing degree of protection: IP20, UL (cUL) Open type
Software	Software version (1.20)
08112013	Manufacturing date: 08.11.2013
Max. Amb. 50°C	Maximum permissible ambient air temperature (50°C)
→ 	Variable frequency drives are electrical equipment. Read the manual (in this case MN040063EN) before making any electrical connections and commissioning.

1.4.2 Type code

The catalog number selection/part no. for DA1 variable frequency drives is subdivided into three groups

Series – Power section – Model

The following figure shows it in greater detail:

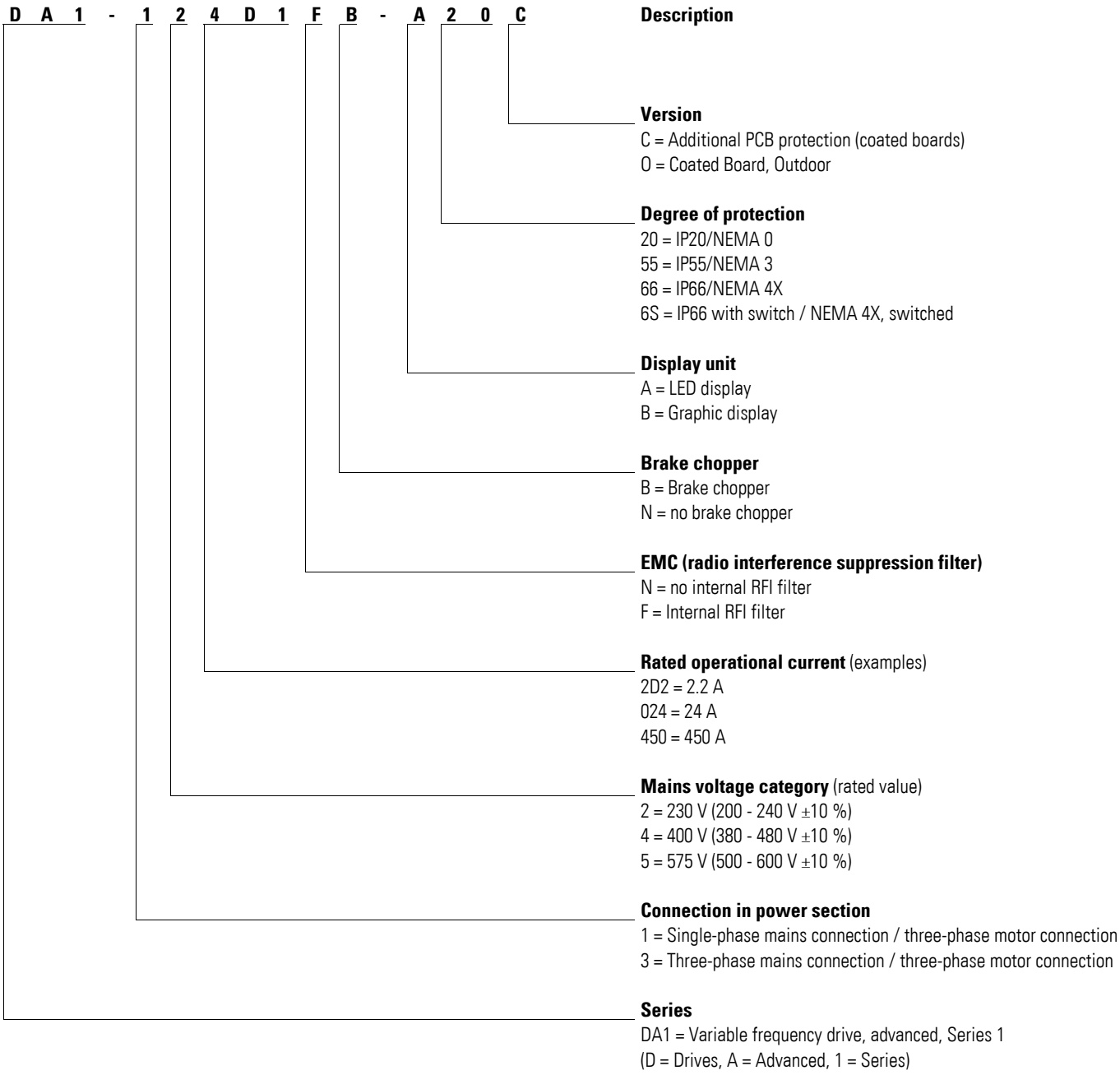


Figure 7: Type code

Type code examples

Inscription	Meaning
DA1-124D3FB-A20C	DA1 = DA1 device series variable frequency drive 1 = Single-phase mains connection 2 = Mains voltage category: 230 V (200 V - 240 V ±10 %) 4D3 = Rated current: 4.3 A F = Internal radio interference suppression filter B = Internal brake chopper A = LED display 20 = IP20 degree of protection C = PCB protection (coated board)
DA1-327D0FB-A20C	DA1 = DA1 device series variable frequency drive 3 = three-phase mains connection 2 = Mains voltage category: 230 V (200 V - 240 V ±10 %) 7D0 = Rated current: 7.0 A F = Internal radio interference suppression filter B = Internal brake chopper A = LED display 20 = IP20 degree of protection C = PCB protection (coated board)
DA1-34014FB-B66O	DA1 = DA1 device series variable frequency drive 3 = three-phase mains connection 4 = Mains voltage category: 400 V (380 V - 480 V ±10 %) 014 = Rated current: 14 A F = Internal radio interference suppression filter B = Internal brake chopper B = Graphic display 66 = IP66 degree of protection O = PCB protection (Coated Board), Outdoor
DA1-35043NB-B55C	DA1 = DA1 device series variable frequency drive 3 = three-phase mains connection 5 = Mains voltage category: 575 V (500 V - 600 V ±10 %) 043 = Rated current: 43 A N = No internal radio interference suppression filter[1)] B = Internal brake chopper B = Graphic display 55 = IP55 degree of protection C = PCB protection (coated board)

1) See following note

→ For DA1-35…**N**B-… 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 current	Motor output (Induction motor)		Display (keypad)	Local control	Radio interference suppression filter	(DC link choke)	Degree of protection	Frame size	Brake chopper
	I_e	P 1) (230 V, 50 Hz)	P 2) (220 - 240 V, 60 Hz)							
	A	kW	HP		✓/–	✓/–	✓/–	IP	FS	✓/–
DA1-124D3FB-A20C	4.3	0.75	1	LED	–	✓	–	IP20	FS2	✓
DA1-124D3FB-B66O	4.3	0.75	1	LCD	–	✓	–	IP66	FS2	✓
DA1-124D3FB-B6SO	4.3	0.75	1	LCD	✓	✓	–	IP66	FS2	✓
DA1-127D0FB-A20C	7	1.5	2	LED	–	✓	–	IP20	FS2	✓
DA1-127D0FB-B66O	7	1.5	2	LCD	–	✓	–	IP66	FS2	✓
DA1-127D0FB-B6SO	7	1.5	2	LCD	✓	✓	–	IP66	FS2	✓
DA1-12011FB-A20C	10.5	2.2	3	LED	–	✓	–	IP20	FS2	✓
DA1-12011FB-B66O	10.5	2.2	3	LCD	–	✓	–	IP66	FS2	✓
DA1-12011FB-B6SO	10.5	2.2	3	LCD	✓	✓	–	IP66	FS2	✓

1) As per IEC standards
2) Quote from "Power Conversion Equipment - UL 508C, May 3, 2002".

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

Type	Rated current	Motor output (Induction motor)		Display (keypad)	Local control	Radio interference suppression filter	(DC link choke)	Degree of protection	Frame size	Brake chopper
	I_e	P 1) (230 V, 50 Hz)	P 2) (220 - 240 V, 60 Hz)							
	A	kW	HP		✓/–	✓/–	✓/–	IP	FS	✓/–
DA1-324D3FB-A20C	4.3	0.75	1	LED	–	✓	–	IP20	FS2	✓
DA1-324D3FB-B66O	4.3	0.75	1	LCD	–	✓	–	IP66	FS2	✓
DA1-324D3FB-B6SO	4.3	0.75	1	LCD	✓	✓	–	IP66	FS2	✓
DA1-327D0FB-A20C	7	1.5	2	LED	–	✓	–	IP20	FS2	✓
DA1-327D0FB-B66O	7	1.5	2	LCD	–	✓	–	IP66	FS2	✓
DA1-327D0FB-B6SO	7	1.5	2	LCD	✓	✓	–	IP66	FS2	✓
DA1-32011FB-A20C	10.5	2.2	3	LED	–	✓	–	IP20	FS2	✓
DA1-32011FB-B66O	10.5	2.2	3	LCD	–	✓	–	IP66	FS2	✓
DA1-32011FB-B6SO	10.5	2.2	3	LCD	✓	✓	–	IP66	FS2	✓

Type	Rated current	Motor output (Induction motor)		Display (keypad)	Local control	Radio interference suppression filter	(DC link choke)	Degree of protection	Frame size	Brake chopper
	I_e	P 1) (230 V, 50 Hz)	P 2) (220 - 240 V, 60 Hz)							
	A	kW	HP		✓/–	✓/–	✓/–	IP	FS	✓/–
DA1-32018FB-A20C	18	4	5	LED	–	✓	–	IP20	FS3	✓
DA1-32018FB-B66O	18	4	5	LCD	–	✓	–	IP66	FS3	✓
DA1-32018FB-B6SO	18	4	5	LCD	✓	✓	–	IP66	FS3	✓
DA1-32024FB-A20C	24	5.5	7.5	LED	–	✓	–	IP20	FS3	✓
DA1-32024FB-B55C	24	5.5	7.5	OLED	–	✓	–	IP55	FS4	✓
DA1-32024FB-B66O	24	5.5	7.5	LCD	–	✓	–	IP66	FS3	✓
DA1-32024FB-B6SO	24	5.5	7.5	LCD	✓	✓	–	IP66	FS3	✓
DA1-32030FB-B20C	30	7.5	10	OLED	–	✓	–	IP20	FS4	✓
DA1-32030FB-B55C	30	7.5	10	OLED	–	✓	–	IP55	FS4	✓
DA1-32030FB-B66O	30	7.5	10	LCD	–	✓	–	IP66	FS4	✓
DA1-32030FB-B6SO	30	7.5	10	LCD	✓	✓	–	IP66	FS4	✓
DA1-32046FB-B20C	46	11	15	OLED	–	✓	–	IP20	FS4	✓
DA1-32046FB-B55C	46	11	15	OLED	–	✓	–	IP55	FS4	✓
DA1-32046FB-B66O	46	11	15	LCD	–	✓	–	IP66	FS4	✓
DA1-32046FB-B6SO	46	11	15	LCD	✓	✓	–	IP66	FS4	✓
DA1-32060FB-B20C	61	15	20	OLED	–	✓	✓	IP20	FS5	✓
DA1-32061FB-B55C	61	15	20	OLED	–	✓	✓	IP55	FS5	✓
DA1-32072FB-B20C	72	18.5	25	OLED	–	✓	✓	IP20	FS5	✓
DA1-32072FB-B55C	72	18.5	25	OLED	–	✓	✓	IP55	FS5	✓
DA1-32090FB-B55C	90	22	30	OLED	–	✓	✓	IP55	FS6	✓
DA1-32110FB-B55C	110	30	40	OLED	–	✓	✓	IP55	FS6	✓
DA1-32150FB-B55C	150	37	50	OLED	–	✓	✓	IP55	FS6	✓
DA1-32180FB-B55C	180	45	60	OLED	–	✓	✓	IP55	FS6	✓
DA1-32202FB-B55C	202	55	75	OLED	–	✓	✓	IP55	FS7	✓
DA1-32248FB-B55C	248	75	100	OLED	–	✓	✓	IP55	FS7	✓

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
Motor connection voltage: 3 AC 400 V, 50 Hz/440 - 480 V, 60 Hz

Type	Rated current	Motor output (Induction motor)[1]		Display (keypad)	Local control	Radio interference suppression filter	(DC link choke)	Degree of protection	Frame size	Brake chopper
	I_e	P[1)] (400 V, 50 Hz)	P[2)] (440 - 480 V, 60 Hz)							
	A	kW	HP		✓/–	✓/–	✓/–	IP	FS	✓/–
DA1-342D2FB-A20C	2.2	0.75	1	LED	–	✓	–	IP20	FS2	✓
DA1-342D2FB-B66O	2.2	0.75	1	LCD	–	✓	–	IP66	FS2	✓
DA1-342D2FB-B6SO	2.2	0.75	1	LCD	✓	✓	–	IP66	FS2	✓
DA1-344D1FB-A20C	4.1	1.5	2	LED	–	✓	–	IP20	FS2	✓
DA1-344D1FB-B66O	4.1	1.5	2	LCD	–	✓	–	IP66	FS2	✓
DA1-344D1FB-B6SO	4.1	1.5	2	LCD	✓	✓	–	IP66	FS2	✓
DA1-345D8FB-A20C	5.8	2.2	3	LED	–	✓	–	IP20	FS2	✓
DA1-345D8FB-B66O	5.8	2.2	3	LCD	–	✓	–	IP66	FS2	✓
DA1-345D8FB-B6SO	5.8	2.2	3	LCD	✓	✓	–	IP66	FS2	✓
DA1-349D5FB-A20C	9.5	4	5	LED	–	✓	–	IP20	FS2	✓
DA1-349D5FB-B66O	9.5	4	5	LCD	–	✓	–	IP66	FS2	✓
DA1-349D5FB-B6SO	9.5	4	5	LCD	✓	✓	–	IP66	FS2	✓
DA1-34014FB-A20C	14	5.5	7.5	LED	–	✓	–	IP20	FS3	✓
DA1-34014FB-B66O	14	5.5	7.5	LCD	–	✓	–	IP66	FS3	✓
DA1-34014FB-B6SO	14	5.5	7.5	LCD	✓	✓	–	IP66	FS3	✓
DA1-34018FB-A20C	18	7.5	10	LED	–	✓	–	IP20	FS3	✓
DA1-34018FB-B66O	18	7.5	10	LCD	–	✓	–	IP66	FS3	✓
DA1-34018FB-B6SO	18	7.5	10	LCD	✓	✓	–	IP66	FS3	✓
DA1-34024FB-A20C	24	11	15	LED	–	✓	–	IP20	FS3	✓
DA1-34024FB-B55C	24	11	15	OLED	–	✓	–	IP55	FS4	✓
DA1-34024FB-B66O	24	11	15	LCD	–	✓	–	IP66	FS3	✓
DA1-34024FB-B6SO	24	11	15	LCD	✓	✓	–	IP66	FS3	✓
DA1-34030FB-B20C	30	15	20	OLED	–	✓	–	IP20	FS4	✓
DA1-34030FB-B55C	30	15	20	OLED	–	✓	–	IP55	FS4	✓
DA1-34030FB-B66O	30	15	20	LCD	–	✓	–	IP66	FS4	✓
DA1-34030FB-B6SO	30	15	20	LCD	✓	✓	–	IP66	FS4	✓
DA1-34039FB-B20C	39	18.5	25	OLED	–	✓	–	IP20	FS4	✓
DA1-34039FB-B55C	39	18.5	25	OLED	–	✓	–	IP55	FS4	✓
DA1-34039FB-B66O	39	18.5	25	LCD	–	✓	–	IP66	FS4	✓
DA1-34039FB-B6SO	39	18.5	25	LCD	✓	✓	–	IP66	FS4	✓
DA1-34046FB-B20C	46	22	30	OLED	–	✓	–	IP20	FS4	✓

Type	Rated current	Motor output (Induction motor)[1]		Display (keypad)	Local control	Radio interference suppression filter	(DC link choke)	Degree of protection	Frame size	Brake chopper
	I_e	P[1)] (400 V, 50 Hz)	P[2)] (440 - 480 V, 60 Hz)							
	A	kW	HP		✓/–	✓/–	✓/–	IP	FS	✓/–
DA1-34046FB-B55C	46	22	30	OLED	–	✓	–	IP55	FS4	✓
DA1-34046FB-B66O	46	22	30	LCD	–	✓	–	IP66	FS4	✓
DA1-34046FB-B6SO	46	22	30	LCD	✓	✓	–	IP66	FS4	✓
DA1-34061FB-B20C	61	30	40	OLED	–	✓	✓	IP20	FS5	✓
DA1-34061FB-B55C	61	30	40	OLED	–	✓	✓	IP55	FS5	✓
DA1-34072FB-B20C	72	37	50	OLED	–	✓	✓	IP20	FS5	✓
DA1-34072FB-B55C	72	37	50	OLED	–	✓	✓	IP55	FS5	✓
DA1-34090FB-B55C	90	45	60	OLED	–	✓	✓	IP55	FS6	✓
DA1-34110FB-B55C	110	55	75	OLED	–	✓	✓	IP55	FS6	✓
DA1-34150FB-B55C	150	75	100	OLED	–	✓	✓	IP55	FS6	✓
DA1-34180FB-B55C	180	90	125	OLED	–	✓	✓	IP55	FS6	✓
DA1-34202FB-B55C	202	110	150	OLED	–	✓	✓	IP55	FS7	✓
DA1-34240FB-B55C	240	132	200	OLED	–	✓	✓	IP55	FS7	✓
DA1-34302FB-B55C	302	160	250	OLED	–	✓	✓	IP55	FS7	✓

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 %.

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

Type	Rated current	Assigned motor output (Induction motor)		Display (keypad)	Local control	Radio interference suppression filter	(DC link choke)	Degree of protection	Frame size	Brake chopper
	I_e	P (500 V, 50 Hz)	P[1] (550 - 600 V, 60 Hz)					IP	FS	
	A	kW	HP		✓/–	✓/–	✓/–			
DA1-352D1NB-A20C	2.1	0.75	1	LED	–	–	–	IP20	FS2	✓
DA1-352D1NB-B66O	2.1	0.75	1	LCD	–	–	–	IP66	FS2	✓
DA1-352D1NB-B6SO	2.1	0.75	1	LCD	✓	–	–	IP66	FS2	✓
DA1-353D1NB-A20C	3.1	1.5	2	LED	–	–	–	IP20	FS2	✓
DA1-353D1NB-B66O	3.1	1.5	2	LCD	–	–	–	IP66	FS2	✓
DA1-353D1NB-B6SO	3.1	1.5	2	LCD	✓	–	–	IP66	FS2	✓
DA1-354D1NB-A20C	4.1	2.2	3	LED	–	–	–	IP20	FS2	✓
DA1-354D1NB-B66O	4.1	2.2	3	LCD	–	–	–	IP66	FS2	✓
DA1-354D1NB-B6SO	4.1	2.2	3	LCD	✓	–	–	IP66	FS2	✓
DA1-356D5NB-A20C	6.5	4	5	LED	–	–	–	IP20	FS2	✓
DA1-356D5NB-B66O	6.5	4	5	LCD	–	–	–	IP66	FS2	✓
DA1-356D5NB-B6SO	6.5	4	5	LCD	✓	–	–	IP66	FS2	✓
DA1-359D0NB-A20C	9	5.5	7.5	LED	–	–	–	IP20	FS2	✓
DA1-359D0NB-B66O	9	5.5	7.5	LCD	–	–	–	IP66	FS2	✓
DA1-359D0NB-B6SO	9	5.5	7.5	LCD	✓	–	–	IP66	FS2	✓
DA1-35012NB-A20C	12	7.5	10	LED	–	–	–	IP20	FS3	✓
DA1-35012NB-B66O	12	7.5	10	LCD	–	–	–	IP66	FS3	✓
DA1-35012NB-B6SO	12	7.5	10	LCD	✓	–	–	IP66	FS3	✓
DA1-35017NB-A20C	17	11	15	LED	–	–	–	IP20	FS3	✓
DA1-35017NB-B66O	17	11	15	LCD	–	–	–	IP66	FS3	✓
DA1-35017NB-B6SO	17	11	15	LCD	✓	–	–	IP66	FS3	✓
DA1-35022NB-A20C	22	15	20	LED	–	–	–	IP20	FS3	✓
DA1-35022NB-B55C	22	15	20	OLED	–	–	–	IP55	FS4	✓
DA1-35022NB-B66O	22	15	20	LCD	–	–	–	IP66	FS3	✓
DA1-35022NB-B6SO	22	15	20	LCD	✓	–	–	IP66	FS3	✓
DA1-35028NB-B20C	28	18.5	25	OLED	–	–	–	IP20	FS4	✓
DA1-35028NB-B55C	28	18.5	25	OLED	–	–	–	IP55	FS4	✓
DA1-35028NB-B66O	28	18.5	25	LCD	–	–	–	IP66	FS4	✓
DA1-35028NB-B6SO	28	18.5	25	LCD	✓	–	–	IP66	FS4	✓
DA1-35034NB-B20C	34	22	30	OLED	–	–	–	IP20	FS4	✓
DA1-35034NB-B55C	34	22	30	OLED	–	–	–	IP55	FS4	✓
DA1-35034NB-B66O	34	22	30	LCD	–	–	–	IP66	FS4	✓

Type	Rated current	Assigned motor output (Induction motor)		Display (keypad)	Local control	Radio interference suppression filter	(DC link choke)	Degree of protection	Frame size	Brake chopper
	I_e	P (500 V, 50 Hz)	P[1] (550 - 600 V, 60 Hz)					IP	FS	
	A	kW	HP		✓/–	✓/–	✓/–			
DA1-35034NB-B6SO	34	22	30	LCD	✓	–	–	IP66	FS4	✓
DA1-35043NB-B20C	43	30	40	OLED	–	–	✓	IP20	FS5	✓
DA1-35043NB-B55C	43	30	40	OLED	–	–	✓	IP55	FS5	✓
DA1-35043NB-B66O	43	30	40	LCD	–	–	–	IP66	FS4	✓
DA1-35043NB-B6SO	43	30	40	LCD	✓	–	–	IP66	FS4	✓
DA1-35054NB-B20C	54	37	50	OLED	–	–	✓	IP20	FS5	✓
DA1-35054NB-B55C	54	37	50	OLED	–	–	✓	IP55	FS5	✓
DA1-35065NB-B20C	65	45	60	OLED	–	–	✓	IP20	FS5	✓
DA1-35065NB-B55C	65	45	60	OLED	–	–	✓	IP55	FS5	✓
DA1-35078NB-B55C	78	55	75	OLED	–	–	✓	IP55	FS6	✓
DA1-35105NB-B55C	105	75	100	OLED	–	–	✓	IP55	FS7	✓
DA1-35130NB-B55C	130	90	125	OLED	–	–	✓	IP55	FS6	✓
DA1-35150NB-B55C	150	110	150	OLED	–	–	✓	IP55	FS7	✓

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

1.5 Description

1.5.1 Degree of protection IP20 (FS2, FS3, FS4, FS5)

The following drawing serves as an example showing the designation used for the elements in DA1 variable frequency drives with a frame size of FS2 and IP20 protection.

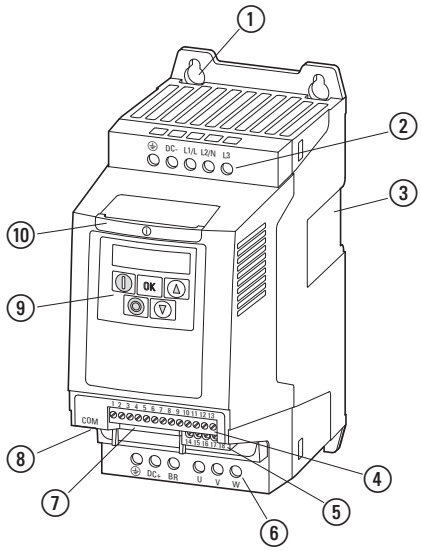


Figure 8: DA1 designations (here: FS2, IP20)

① Mounting holes (screw mounting)
② Mains connection
③ Notch for mounting on mounting rail
④ Control terminals (plug-in)
⑤ Relay terminals (plug-in)
⑥ Motor connection
⑦ Slot for fieldbus connection or expansion module
⑧ Communication interface (RJ45)
⑨ Keypad with 5 control buttons and LED display
⑩ Info card

1.5.2 Degree of protection IP55 (FS4, FS5, FS6, FS7)

The following drawing serves as an example showing the designation used for the elements in DA1 variable frequency drives with a frame size of FS4 and IP55 protection.

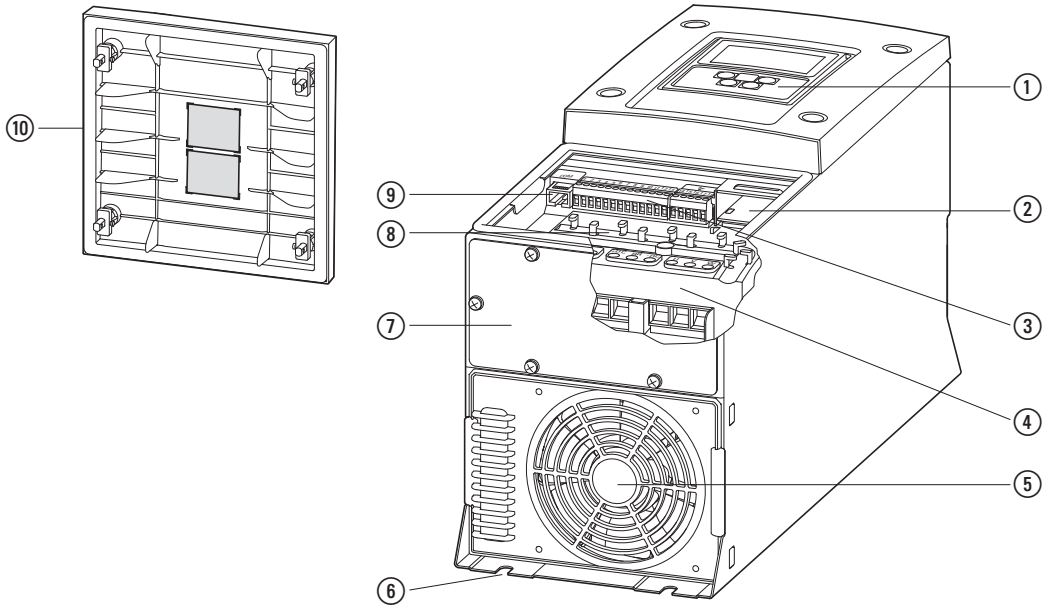


Figure 9: DA1 designations (here: FS4, IP55)

① Keypad 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 Devices fans
⑥ Fixing holes
⑦ Cover plate for mounting the cable glands with protection class IP55 (without cover plate: degree of protection IP40)
⑧ Retainer for the control section connection cables
⑨ Communication interface (RJ45)
⑩ Housing cover (connection terminals)

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

Gland plate

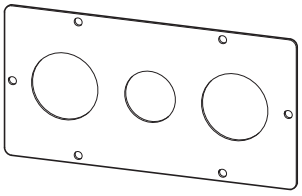


Figure 10: Gland plate with holes for cable glands (FS4, FS5)

→ DA1 in frame sizes FS4 and FS5 have an additional gland plate with holes ⑦ for the cable glands.

1.5.3 Degree of protection IP66 (FS2, FS3, FS4)

The following drawing serves as an example showing the designation used for the elements in DA1 variable frequency drives with a frame size of FS2 and IP66 protection.

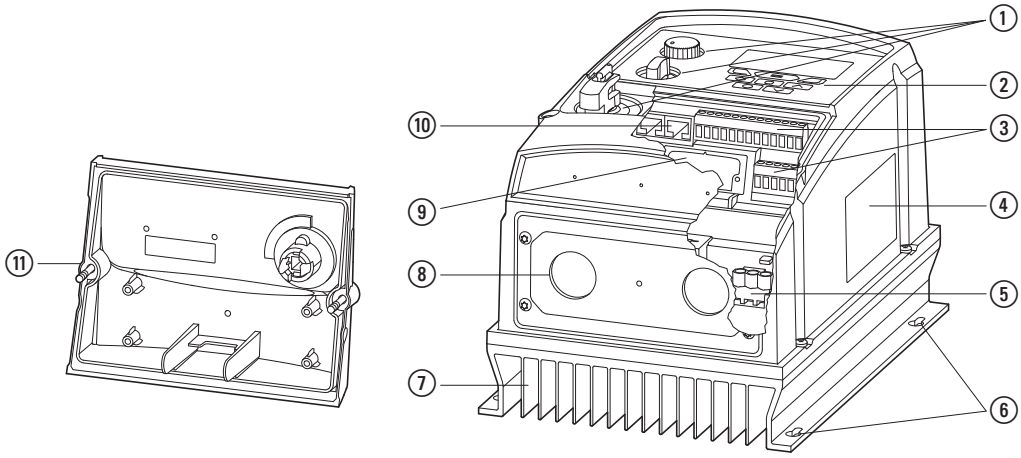


Figure 11: DA1 designations (here: FS2, IP66)

① Local controls on DA1-…-B6S0
② Keypad with 5 control buttons and graphic display
③ Control and relay terminals (plug-in)
④ Rating plate
⑤ Connection terminals in power section
⑥ Fixing holes
⑦ Heat sink
⑧ Cable bushing for EMC cable gland
⑨ Slot for fieldbus connection or expansion module
⑩ Communication interface (2 x RJ45)
⑪ Housing cover

→ In the low housing cover ⑪ there is a QR code for more information.

1.6 Voltage classes

DA1 variable frequency drives are divided into three voltage categories:

- 200 V: 200 – 240 V ±10 % → DA1-**12**…, DA1-**32**…
- 400 V: 380 – 480 V ±10 % → DA1-**34**…
- 575 V: 500 – 600 V ±10 % → DA1-**35**…

1.6.1 DA1-12…

- DA1-**12**…
  - Single-phase mains connection, rated operating voltage 230 V
  - U_{LN} = 1~, 200 - 240 V ±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)

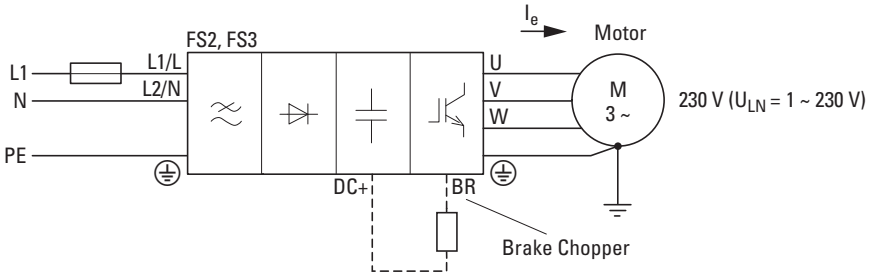


Figure 12: DA1-12…FB-…

1.6.2 DA1-32…

- DA1-**32**…
  - Three-phase mains connection, rated operating voltage 230 V
  - U_{LN} = 3~, 200 - 240 V ±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)

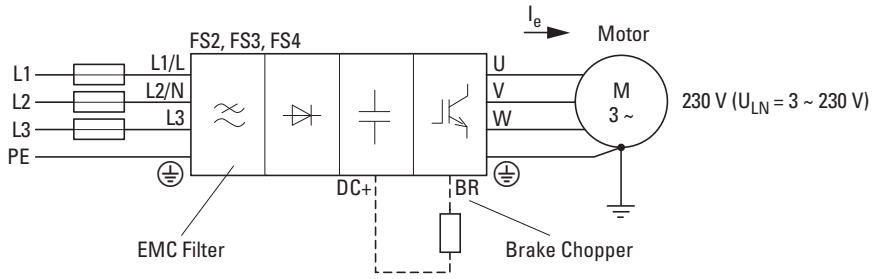


Figure 13: DA1-32…FB-…

- DA1-**32**…
  - Three-phase mains connection, rated operating voltage 230 V
  - U_{LN} = 3~, 200 - 240 V ±10 %, 50/60 Hz
  - I_e = 61 - 248 A
  - Motor: 15 - 75 kW (230 V, 50 Hz), 20 - 100 HP (230 V, 60 Hz)

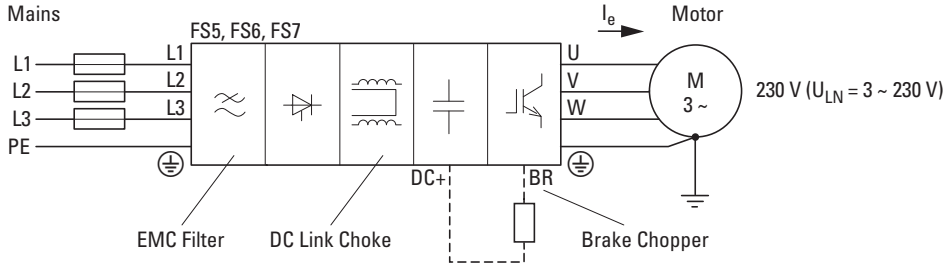


Figure 14: DA1-32…FB-B55C with DC link choke

1.6.3 DA1-34…

- DA1-**34**…
  - Three-phase mains connection, rated operating voltage 400/480 V
  - U_{LN} = 3~, 380 - 480 V ±10 %, 50/60 Hz
  - I_e = 2.2 - 46 A
  - Motor: 0.75 - 22 kW (400 V, 50 Hz), 1 - 30 HP (460 V, 60 Hz)

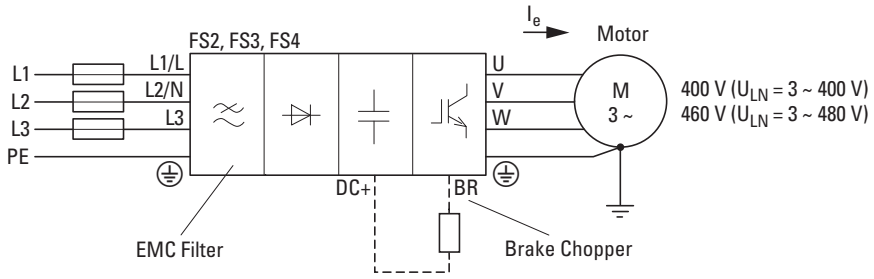


Figure 15: DA1-34…FB-…

- DA1-**34**…
  - Three-phase mains connection, rated operating voltage 400/480 V
  - U_{LN} = 3~, 380 - 480 V ±10 %, 50/60 Hz
  - I_e = 61 - 302 A
  - Motor: 30 - 160 kW (230 V, 50 Hz), 40 - 250 HP (460 V, 60 Hz)

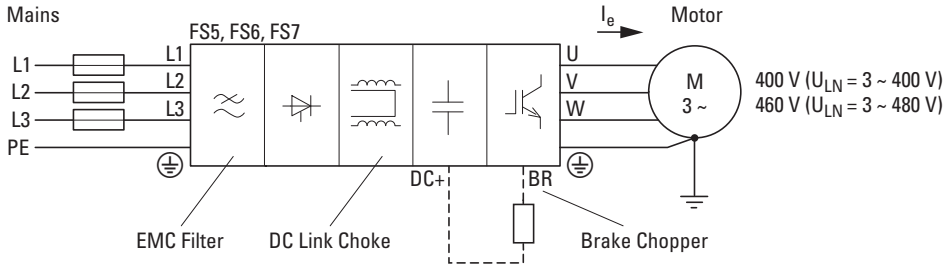


Figure 16: DA1-34…FB-… with DC link choke

- DA1-**34**…
  - Three-phase mains connection, rated operating voltage 400/480 V
  - U_{LN} = 3~, 380 - 480 V ±10 %, 50/60 Hz
  - I_e = 370 - 450 A
  - Motor: 200 - 250 kW (400 V, 50 Hz), 300 - 350 HP (460 V, 60 Hz)

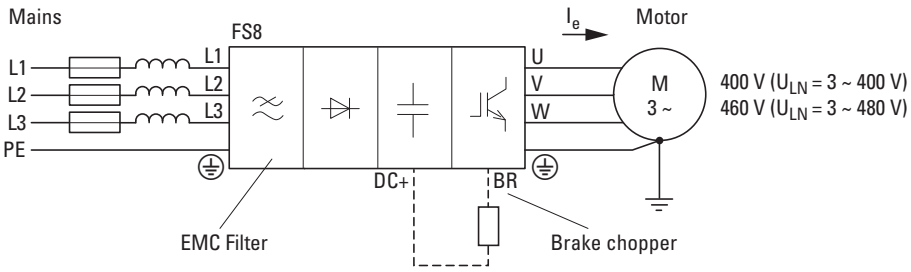


Figure 17: DA1-34…FB-B20C (external mains choke required)

1.6.4 DA1-35…

- DA1-**35**…
  - Three-phase mains connection, rated operating voltage 500/575 V
  - U_{LN} = 3~, 500 - 600 V ±10 %, 50/60 Hz
  - I_e = 2.1 - 34 A
  - Motor: 0.75 - 22 kW (500 V, 50 Hz), 1.5 - 30 HP (575 V, 60 Hz)

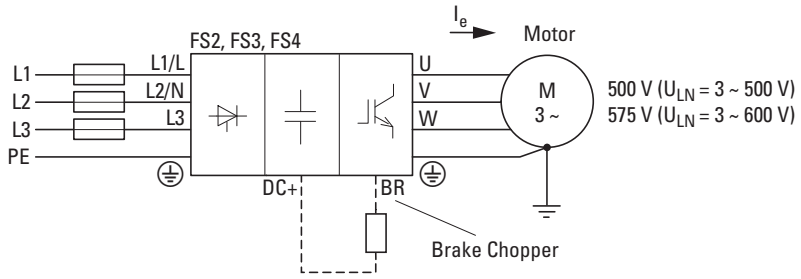


Figure 18: DA1-35…NB-… (without radio interference suppression filter)

- DA1-**35**…
  - Three-phase mains connection, rated operating voltage 500/575 V
  - U_{LN} = 3~, 500 - 600 V ±10 %, 50/60 Hz
  - I_e = 43 - 150 A
  - Motor: 30 - 110 kW (500 V, 50 Hz), 40 - 150 HP (575 V, 60 Hz)

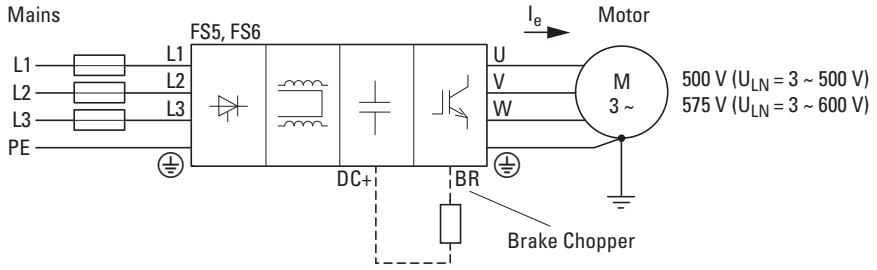


Figure 19: DA1-34…NB-B55C with DC link choke (without radio interference suppression filter)

1.7 Selection criteria

Select the variable frequency drive according to the supply voltage U_{LN} of the supply mains and the rated current of the assigned motor. The circuit type (Δ/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.

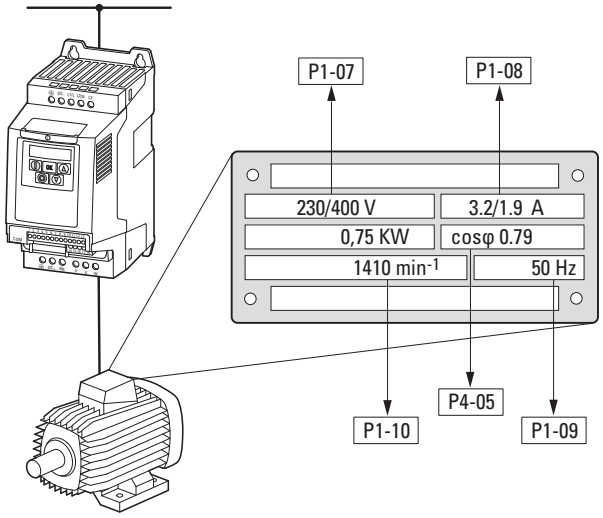


Figure 20: Selection criteria – Rating plate data

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

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

Example based on figure 20

- Mains voltage: 3~ 400 V, 50 Hz
- Star-connected circuit (400 V)
- Rated Current: 1.9 A (400 V)
- Control cabinet assembly → IP20 degree of protection
- Max. ambient temperature 50 °C without derating, IP20

→ variable frequency drive to be selected: DA1-342D2FB-B20C

- DA1-**34**…: three-phase mains connection, rated voltage: 400 V
- DA1-…**2D2**…: 2.2 A – The variable frequency drive's rated current (output current) guarantees that the motor will be supplied with the required rated current (1.9 A).

When connecting multiple motors in parallel to the output of a frequency inverter, the motor currents are added geometrically and 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 Performance reduction (derating)

A derating of the variable frequency drive DA1 or a limitation of the maximum continuous output current (I_2) is generally necessary if during operation the

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

The following tables list the factors that are applied when selecting a DA1 variable frequency drive when operating outside of these conditions:

Derating for ambient temperature

Housing variant in degree of protection	Maximum ambient temperature without derating	Reduction by	Maximum permissible ambient air temperature
IP20	50 °C	None	50 °C
IP40[1)]	40 °C	None	40 °C
IP55	40 °C	1.5 % per K	50 °C
IP66	40 °C	2.5 % per K	50 °C

Derating for the set-up altitude

Housing variant in degree of protection	Maximum height without derating	Reduction by	Maximum permissible altitude as per IEC (UL)
IP20, IP40[1)], IP55, IP66	1000 m	1 % per 100 m	4000 m (2000 m)

Derating for switching frequency

Housing variant in degree of protection	Switching Frequency (P2-24), setting value (audible)[2)]					
	4 kHz	8 kHz	12 kHz	16 kHz	24 kHz	32 kHz
IP20	None	None	20 %	30 %	40 %	50 %
IP40[1)]	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) DA1 variable frequency drive with IP55 enclosure and connection area open from below (without gland plate).
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, AP040039EN.
https://es-assets.eaton.com/DRIVES/POWERXL/01_APPLICATION_NOTE/English/DA1/AP040039EN_DA1_Derating.pdf

Examples for the application of 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: DA1-349D5FB-A20C:
Rated current 9.5 A, switching frequency 8 kHz (factory setting).

Required derating factors:

- for the switching frequency 12 kHz: **20 %**
- for the installation altitude of 2000 m: **10 %** (1 % per 100 m above 1000 m, 2000 m - 1000 m = 1000 m, 1000 m/100 m = 10)
- For the 42 °C ambient temperature: **none**
  (omit for DA1-349D5FB-A20C, degree of protection IP20).

9.5 A - 20 % - 10 % = (9.5 x 0.8 x 0.9) A = **6.84 A**

The DA1'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 frequency inverter of a higher power class and repeat the calculation to ensure that sufficient output current is permanently available.

b)
Selected variable frequency drive: DA1-34014FB-B55C:
Rated current 14 A.

Required derating factors:

- for the switching frequency 12 kHz: **10 %**
- for the installation altitude of 2.000 m: **10 %** (1 % per 100 m above 1000 m, 2000 m - 1000 m = 1000 m, 1000 m/100 m = 10)
- For the 42 °C ambient temperature: **3 %**
  (1.5 % per Kelvin, 42 °C - 40 °C = 2K, degree of protection IP55).

14 A - 10 % - 10 % - 3 % = (14 x 0.9 x 0.9 x 0.97) A = ca. **11 A**

The DA1-34014FB-B55C variable frequency drive meets the necessary operating conditions.

1.9 Proper use

The DA1 series of 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 DA1 variable frequency drives are not domestic appliances. They are designed only for industrial use as system components.

If the variable frequency drive 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 is responsible for ensuring the machine's usage is in compliance with EC Directives.

The CE labels applied to the DA1 series of variable frequency drives confirm that the devices comply with the Low Voltage Directive (2006/95/EU), the Electromagnetic Compatibility (EMC) Directive (2004/108/EU), and the RoHS Directive (2011/65/EU) when the typical drive configuration is applied.

In the described system configurations, the DA1 series of variable frequency drives are suitable for use in public and non-public systems.

A DA1 variable frequency drive can only be connected to IT networks (networks without a ground potential link) under certain conditions, because filter capacitors within the device connect the network to the ground potential (housing). With non-grounded networks, this can lead to hazardous situations or damage to the device (insulation monitoring is required).

At the output (terminals U, V, W) of the DA1 variable frequency drive you must not:

- connect a voltage or capacitive loads (e.g. phase compensation capacitors),
- nor 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 variable frequency drive and the documentation. Any other usage constitutes improper use.

1.10 Maintenance and inspection

DA1 variable frequency drives 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 DA1 variable frequency drive.

Because of this, we recommend inspecting the devices on a regular basis and carrying out the following maintenance activities at the specified intervals.

Table 2: Recommended maintenance

Maintenance measures	Maintenance interval
Clean cooling vents	If required
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 ground 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 (→ section 1.12, "Charging the internal DC link capacitors", page 40)

There are no plans for replacing or repairing individual components of DA1 variable frequency drives.

If an FS2 or FS3 (IP20, IP66) DA1 variable frequency drive is damaged or ruined by external factors, it will not be possible to repair it.

For frame sizes FS4 to FS7, conditional repairs can be carried out by qualified and certified specialist workshops (→ section 1.13, "Service and warranty", page 40).

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

1.10.1 Replacement of the device fan for sizes FS4 and FS5 (IP20)

The built-in device fan on DA1 variable frequency drives with frame sizes FS4 and FS5 can be replaced.
The fan is plugged in and can be removed from the bottom of the device.

In frame size FS4

▶ Remove the fan cover (①, ②).

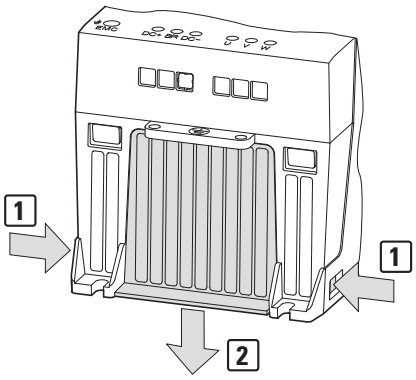


Figure 21: Remove fan cover

▶ Release the plug connection (③, ④) and slide out the fan (⑤, ⑥).

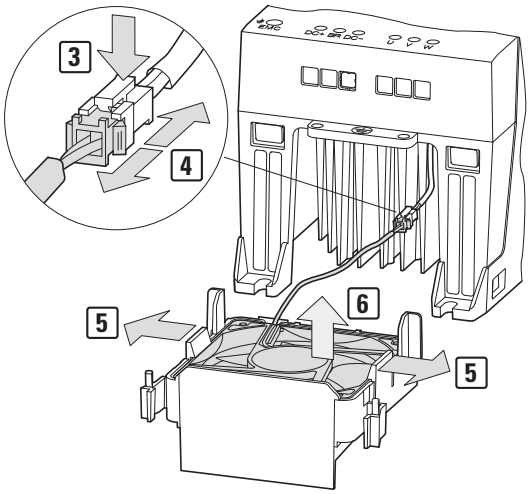


Figure 22: Release the plug connection

▶ Replace the fan and insert the new one (⑦).
Restore the plug connection (⑧).

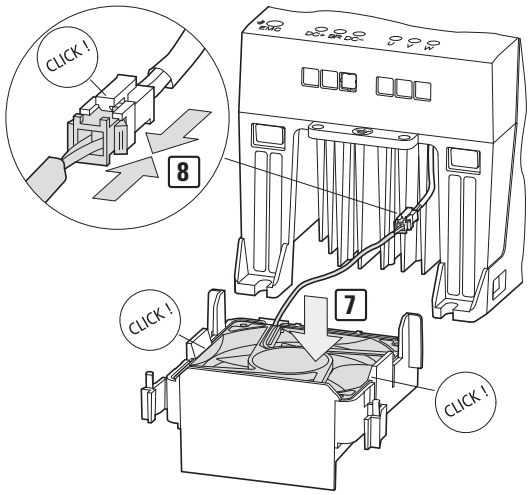


Figure 23: Reinsertion of the fan

▶ Reinsert the fan cover.

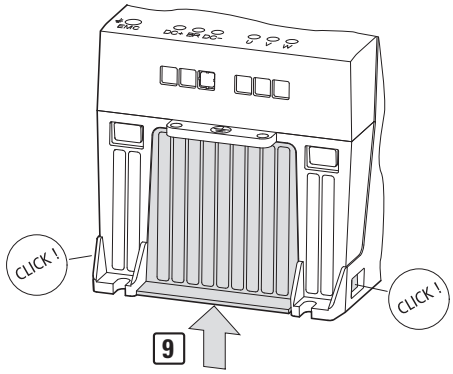


Figure 24: Reinsert the fan cover

In frame size FS5

▶ Remove the fan cover using a flat screwdriver.

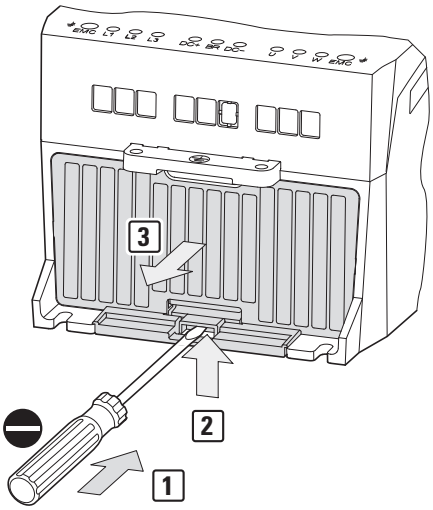


Figure 25: Remove fan cover

Slide the fan towards you (④) and release the plug connection (⑤, ⑥).

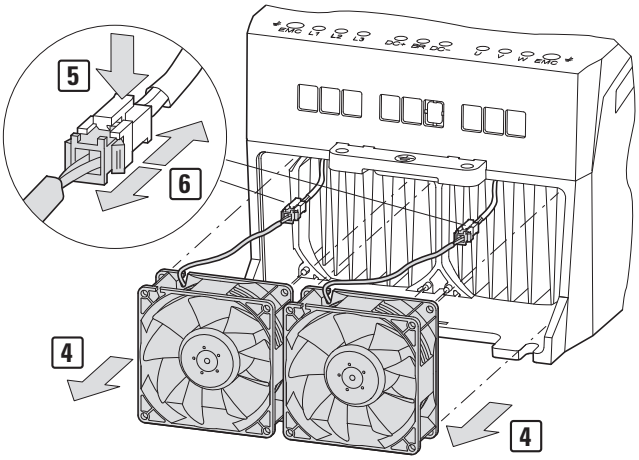


Figure 26: Remove fan

- Replace the fan and insert the new one as shown.
- Make the plug connection
- Insert the the fan
- Reinsert the fan cover

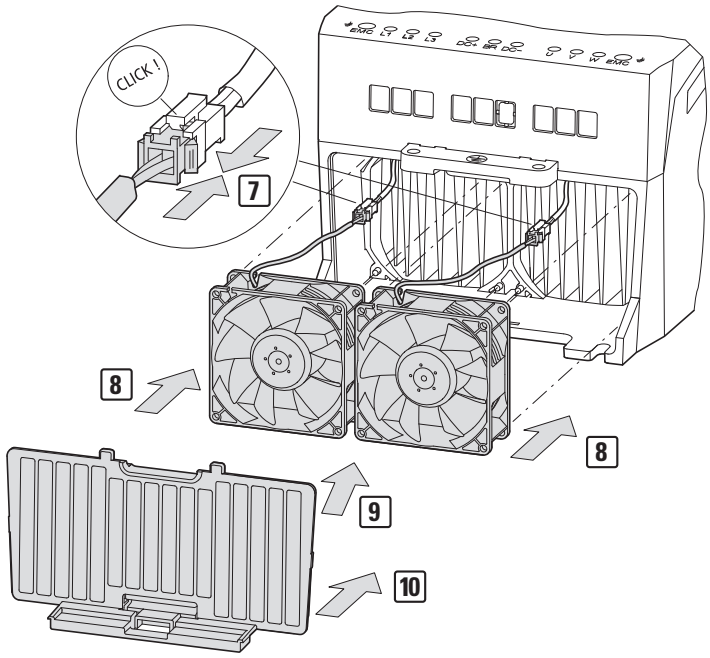


Figure 27: Reinsert the fan

1.11 Storage

If the DA1 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 humidity: < 95 %, non-condensing (EN 50178)
- To prevent damage to the variable frequency drive's internal DC link capacitors, it is not recommended that the variable frequency drive is stored for more than 12 months (→ section 1.12, "Charging the internal DC link capacitors", page 40).

1.12 Charging the internal DC link capacitors

After long storage times or long down times (> 12 months) without a power supply, the capacitors in the intermediate circuit must be recharged to prevent damage. To do this, the DA1 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} ~ 1.41 x U_e) and applied for one hour at least (regeneration time).

- DA1-12…, DA1-32…: about 324 V DC at U_e = 230 V AC
- DA1-34…: about 560 V DC at U_e = 400 V AC
- DA1-35…: 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 DA1 variable frequency drive, please contact your local sales office.

When you call, have the following data ready:

- the detailed type description of the variable frequency drive (see rating plate),
- 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.

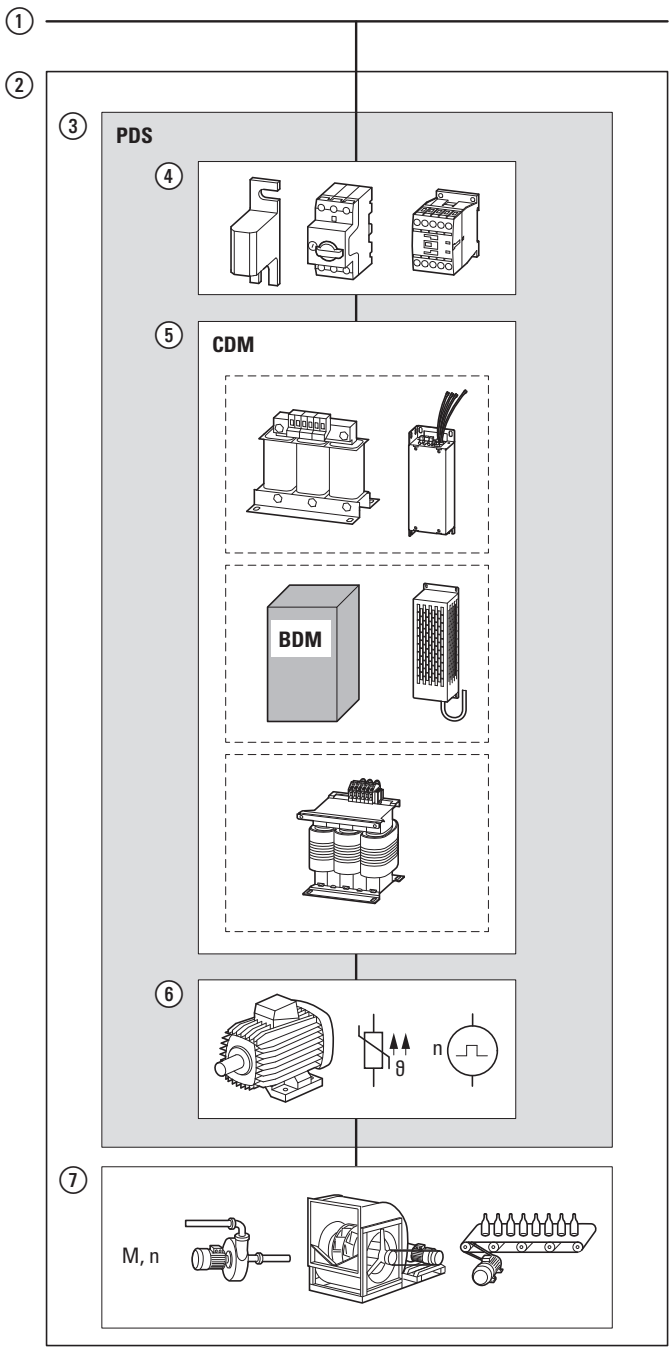
Information concerning the warranty can be found in the Eaton Industries GmbH Terms and Conditions.

2 Engineering

2.1 Introduction

This chapter describes in part the most important features in the power circuit of a drive system (PDS = power drive system) which you should take into account in your project planning.
It contains instructions that must be followed when determining which device to use with which assigned motor output, as well as when selecting protection devices and switchgear, selecting cables, cable entries, and operating the DA1 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 that will not be covered by the warranty.

Example of a drive system



① Electrical power network
(mains connection, network configuration, mains voltage, frequency, voltage balance, THD, compensation devices)
② Overall system – consisting of motor and load systems
③ PDS = Power drive system
④ Safety and switching
(disconnecting devices, fuses, cable cross-sections, residual current circuit breakers, mains contactors)
⑤ CDM = Complete drive module:
Variable frequency drive with auxiliary equipment (mains choke and motor choke, radio interference suppression filter, brake resistor, sine filter)
BDM = Basic Drive Module:
DA1 variable frequency drives
⑥ Motor and sensor (temperature, speed)
⑦ Load system:
Driven system equipment (process, speed, torque)

Figure 28: 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

The DA1 series of variable frequency drives can be connected to and run on all star point-grounded AC supply systems (TN-S, TN-C, TT- please refer to IEC 60364) without any limitations.

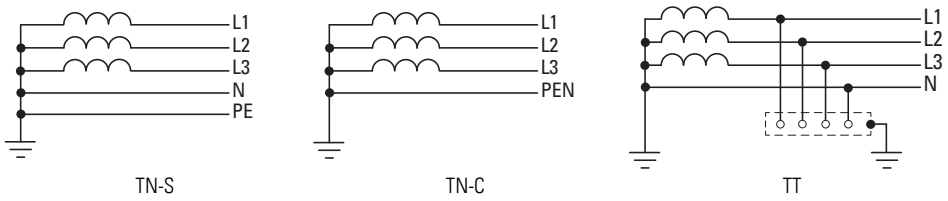


Figure 29: AC supply systems with earthed center point

→ 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).

The connection to IT networks (ungrounded, isolated) or to an asymmetrically grounded network is permitted only in sizes FS2 to FS5 in IP20 protection with an unscrewed VAR and EMC screw.

WARNING

With an unscrewed VAR screw, the variable frequency drive is no longer protected from transistor overvoltage.

→ Operation on non-earthed networks (IT) requires the use of suitable insulation monitoring relays (e.g. pulse-coded measurement procedure).

→ In networks with an earthed phase conductor, the maximum phase-earth voltage must not exceed 300 V AC.

Measures for electromagnetic compatibility are generally mandatory in a power drive system, to meet the legal standards for the EMC and Low Voltage Directives.
Good grounding measures are a prerequisite for the effective use of further measures such as shielding or filters.
Without respective grounding measures, further steps are superfluous.

DA1-35… (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 voltage value:
  ±10 % or less
- Deviation in the voltage balance:
  ±3 % or less
- Deviation from the rated frequency value:
  ±4 % or less

The wide tolerance range of the DA1 variable frequency drive takes into account as the rated value both the European (EU: U_{LN} = 230 V/400 V, 50 Hz) and the American (USA: U_{LN} = 240 V/480 V, 60 Hz) standard voltages:

- 230 V, 50 Hz (EU) and 240 V, 60 Hz (USA) at DA1-12…, DA1-32…
  200 V -10 % - 240 V +10 % (180 V -0 % - 264 V +0 %)
- 400 V, 50 Hz (EU) and 480 V, 60 Hz (USA) at DA1-34…
  380 V -10 % - 480 V +10 % (342 V -0 % - 528 V +0 %)
- 500 V, 50 Hz (EU) and 575 V, 60 Hz (USA) at DA1-35…
  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 mains 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 (DA1-3…), consider only AC supply systems that handle permitted asymmetric divergences in the mains voltage ≦ +3 %.
If this condition is not fulfilled, or symmetry at the connection location is not known, the use of an assigned mains 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 50).

FS5, FS6, and FS7 DA1 variable frequency drives feature chokes in their DC link. Using mains chokes in order to reduce current harmonics is not necessary in this case.

2.2.5 Reactive power compensation devices

Compensation on the mains side is not required for the variable frequency drive of the DA1 series. From the AC power supply network, they only take on very little reactive power of the fundamental harmonics (cos φ ~ 0.98).

In the AC supply systems with non-choked reactive current compensation devices, current oscillations, harmonics, parallel resonances and undefined conditions can occur.
In the project planning for the connection of variable frequency drives to AC supply systems with undefined circumstances, consider using mains chokes.

2.3 Safety and switching

2.3.1 Disconnecting device

Install a manual disconnecting device between the mains connection and the DA1 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 disconnector (EN 60947-3)
- A disconnector with an auxiliary contact that in all cases will disconnect the load circuit before the disconnector'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 DA1 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 DA1 variable frequency drive's input current I_{LN}.

For the recommended fuse sizing and assignment, see
→ section 7.1, "Fuses", page 219.

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.

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

For leakage currents above 3.5 mA, reinforced earthing (PE) must be connected in accordance with the requirements of the EN 61800-5-1 standard. The cable cross-section must be at least 10 mm^2 or consist of two separately connected underground cables.

You can find the leakage currents of the individual power sizes in → section 6.2, "Specific rated data", page 203.

The EMC requirements for the motor cables can be found in → section 3.5, "Correct EMC installation", page 84.

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 a US installation, only UL approved fuses, fuse bases and cables (AWG) must be used.
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).

The cable cross-sections assigned to the DA1 variable frequency drives can be found in the chapter on technical data in → section 6.4, "Cable cross-sections", page 216.

2.3.4 Residual current device (RCD)

When using variable frequency drive DA1-3… that work with a three-phase power supply (L1, L2, L3), ensure that only type B sensitive residual current devices are used.

When using variable frequency drive that work with a single-phase power supply (L, N) DA1-12… type B and type F residual current devices may be used.

> *WARNING*
>
> Residual current devices (RCD) may only be installed between the supply system (AC mains supply) and the DA1 variable frequency drive – on the other hand, they must never be installed in 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 switching frequency (switching frequency of the inverter),
- the implementation of the filter measures,
- grounding measures at the site of the motor.

Other protective measures against direct and indirect contact can be used for DA1 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 DA1 variable frequency drive for utilization category AC-1 (IEC 60947) and the ambient air temperature at the location of use.

→ The mains contactors listed on → section 7.2, "Mains contactors", page 223 take into account the input current I_{LN} of the variable frequency drive without an external mains choke. These are selected based on thermal current $I_{th} = I_e$ (AC-1) at the indicated ambient temperature.

> *WARNING*
>
> Inching operation is not permissible via the mains contactor. (Pause time ≧ 30 s between switching off and on).

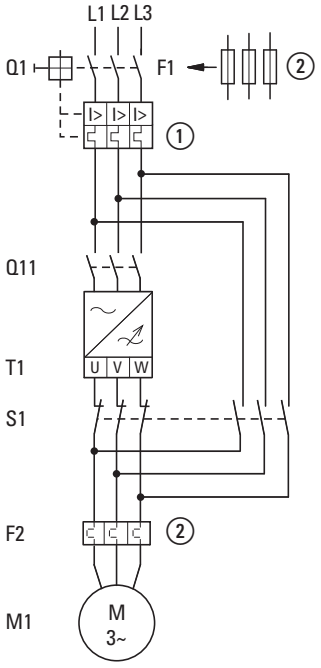
→ For UL-compliant installation and during operation, the mains side switching devices must allow for a 1.25 times higher input current.

2.3.6 Using a bypass connection

WARNING

Never connect the DA1 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 bypass is required, mechanically linked switches or contactors, or electrically interlocked contactors, should be used to ensure that the motor terminals are not connected to both the mains supply and the variable frequency drive´s output terminals at the same time.



① Q1 thermal overload and short-circuit protection
② F1 fuse and F2 overload relay (alternative to ①)
Q1 Mains contactor
T1 DA1 variable frequency drive
S1 Locked changeover between variable frequency drive and bypass
F2 Motor protection (overload relay, alternative to ①)
M1 Three-phase motor

Figure 30: Bypass motor control (example)

2.4 Mains chokes

Mains chokes reduce the current harmonic content (THD) as well as the mains perturbations and improve the power factor. The apparent current on the mains side is then reduced by around 30 %.

Towards the variable frequency drive, the mains 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 DA1 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 mains 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 mains choke is not necessary.
Mains chokes are designed based on the mains-side input current (I_{LN}) of the variable frequency drive.

FS5, FS6, and FS7 DA1 variable frequency drives feature mains chokes in their DC link. Using chokes in order to reduce current harmonics is not necessary in this case.

When the variable frequency drive is operating at its rated current limit, the mains choke at a $u_K$value of about 4 % causes the maximum possible output voltage of the variable frequency drive (U_2) to be reduced to about 96 % of the mains voltage (U_{LN}).

The main chokes assigned to the DA1 variable frequency drives can be found in the "Accessories" chapter.
→ section 7.3, "Mains chokes", page 227).

For more information and technical data on DX-LN… mains chokes, please refer to instruction leaflet IL00906003Z.

2.5 Radio interference suppression filter

DA1-12…FB-…, DA1-32…FB-… and DA1-34…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 maximum motor cable lengths are:

Table 3: Motor cable lengths

Number of phase inputs	Rated supply voltage	Frame size	Degree of protection	Maximum motor cable length		
				C1	C2	C3
1	230 V	FS2	IP20, IP66	1 m	5 m	25 m
		FS3	IP66	–	5 m	25 m
		FS4	IP66	–	–	25 m
3	230 V	FS2, FS3	IP20, IP66	1 m	5 m	25 m
		FS4, FS5	IP20, IP66	1 m	5 m	25 m
		FS4, FS5	IP55	–	–	25 m
3	400 V	FS2, FS3	IP20, IP66	1 m	5 m	25 m
		FS4, FS5	IP20, IP66	1 m	5 m	25 m
		FS4, FS5	IP55	–	–	25 m

Longer motor cable lengths are made possible by additional external radio interference suppression filters (DX-EMC…), → section 7.4, "Radio interference suppression filter", page 231.

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

DA1-35…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 DA1 variable frequency drive's frame size).

→ The radio interference suppression filters assigned to the DA1 variable frequency drives can be found in the "Accessories" chapter.
→ section 7.4, "Radio interference suppression filter", page 231.

2.6 Brake resistors

In certain operating conditions, 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. The DC link voltage U_{DC} is increased as a result. If the voltage value is too high, the DA1 variable frequency drive will disable its inverter, The motor then coasts down uncontrolled (coasting, freewheeling).
If there is a brake chopper and a connected brake resistor R_B, the braking energy fed back into the variable speed drive can be dissipated in order to limit the DC link voltage.
DA1-…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. The braking chopper function must be activated in 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.

Series	Mains connection	Voltage class	Brake chopper on	Brake chopper off
DA1-12…	1-phase	230 V	390 V	378 V
DA1-32…	3-phase	230 V	390 V	378 V
DA1-34…	3-phase	400 V	780 V	756 V
DA1-35…	3-phase	575 V	975 V	945 V

For example, in the case of DA1-34… variable frequency drives, the braking chopper will be switched on at a DC link voltage of approximately 780 V DC and then back off at 756 V DC. During this stage, the braking transistor and the brake resistor will be active continuously. To protect against thermal overload, under parameter P6-19, the resistance value R_B and under parameter P6-20 rated output P_{DB} of the braking resistance can be set.

It is often difficult to specify a suitable brake resistor for specific applications. Not all the application conditions required for a suitable design are always clear at the start of project planning.

In practice, brake resistors are therefore mostly classified in a simplified manner for two load groups:

- **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.

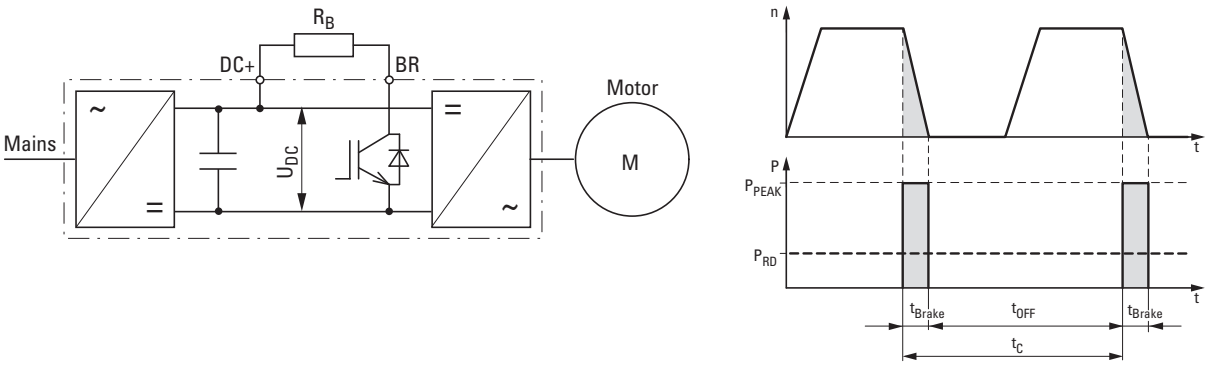


Figure 31: Braking cycle, fast motor stop with external brake resistor

Selection of brake resistors

The brake resistors are selected according to the continuous power loss P_{DB} and the 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. In the simplified procedure, as a guideline value for dimensioning for the impulse peak output P_{Peak}, the braking output P_{max} of the variable frequency drive or the rated motor output can be used, as the mechanical braking output is reduced by the efficiency level of the motor and the inverter.

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

The required rated output and continuous rating of the braking resistance P_{DB} is calculated from the braking energy W_{kin} and the cycle time$_C$:

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

If the kinetic energy is not known, the percentage ratio of braking time $t_{braking}$ and cycle time t_C is required:

$$DF_{[\%]} = \frac{t_{Brake}}{t_C} \times 100\ \%$$

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

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

The continuous rating P_{DB} of the braking resistance is therefore always the factor of the duty cycle DF [%] less than the maximum impulse output P_{Peak}.

The resistance value R_B must be at least as much as the minimum permitted resistance value R_{min} of the brake transistor.

→ Use braking resistors with the recommended resistance values R_{Brec}, which are assigned to the respective power ratings of the DA1 variable frequency drive.

→ The braking resistors assigned to the DA1 variable frequency drives can be found in the "Accessories" chapter
→ section 7.5, "Brake resistors", page 237.

2.7 Motor chokes

It is recommended to use a motor choke if using long cable lengths and 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 the variable frequency drive.

For DA1 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:

- Current smoothing and du/dt value (kV/µs) 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.

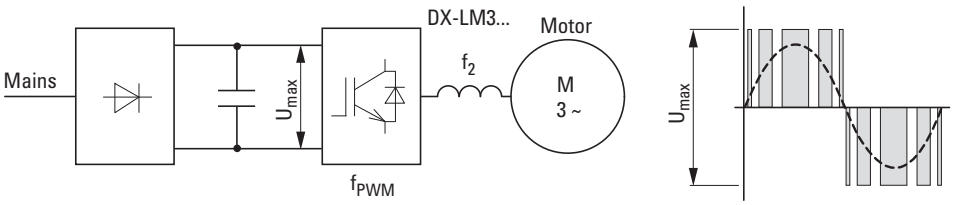


Figure 32: Rated operational data DX-LM3…:
U_{max} = 750 V, f_2 = 0 - 400 Hz, f_{PWM} = 8 - 24 kHz (Set value P2-24 at DA1)

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.

→ The motor reactors assigned to the DA1 variable frequency drives can be found in the "Accessories" chapter.
→ section 7.6, "Motor chokes", page 242.

→ For more information and technical data on DX-LM3… motor chokes, please refer to instruction leaflet IL00906003Z.

2.8 Sine filter

The DX-SIN3… sine filter removes high-frequency components from the variable frequency drive's output voltage (U_2). This reduces the conducted and radiated emission. The sine filter's output voltage has a sine wave shape with a small superimposed ripple voltage.
The sinusoidal voltage's total harmonic distortion will typically be 5 to 10 %. This reduces noise and losses in the motor.

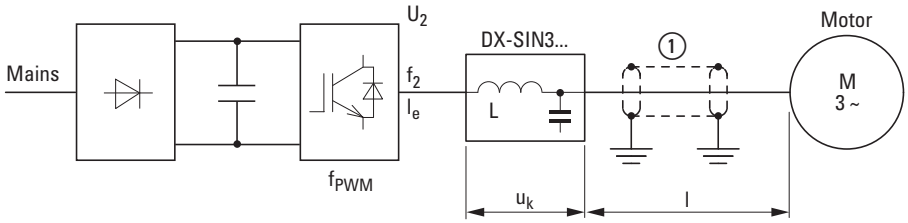


Figure 33: Maximum permissible motor cable lengths
① **Screened motor cable:** $U_2 \leqq 230$ V → l ≦ 200 m; $U_2 \leqq 500$ V → l ≦ 150 m
Unscreened motor cable: $U_2 \leqq 230$ V → l ≦ 300 m; $U_2 \leqq 500$ V → l ≦ 200 m

→ The DX-SIN3… sine wave filters are not permitted to be operated with a lower frequency than the switching frequency stated on the sine wave filter.
For this, the P6-02 parameter ("auto-temperature-management") needs to be set to the double value of the switching frequency set on the sine wave filter.

Permissible switching frequencies (P2-24) for DA1 with DX-SIN3…:
1 ≙ 8 kHz; 2 ≙12 kHz

For the DA1 variable frequency drive, the set value with the double-modulation procedure is the double value of the effective value in the sine filter
(1 ≙ 8 kHz → 4 kHz; 2 ≙ 12 kHz → 6 kHz).

→ The sine filters assigned to the DA1 variable frequency drives can be found in the "Accessories" chapter.
→ section 7.7, "Sine filter", page 244.

2.9 Three-phase motor

2.9.1 Motor selection

→ Check whether your selected DA1 variable frequency drive and the associated three-phase AC motor are compatible with each other with regard to voltage (mains and motor voltage) and rated current.

Please note the following general recommendations for the 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 DA1 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 where possible (With synchronous speeds of: 1500 min^{-1} at 50 Hz or 1800 min^{-1} 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).

  Set Frequency control (V/Hz) mode if the motor output is significantly lower (P4-01 = 2).

2.9.2 Circuit types with three-phase motors

Based on the mains voltage (U_{LN} = output voltage U_2) and the rated data on the motor's nameplate (rating plate), the stator winding of a three-phase motor can be configured as a star or delta circuit.

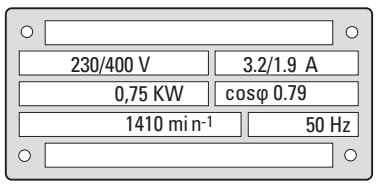


Figure 34: Example of a contactor rating plate of a motor

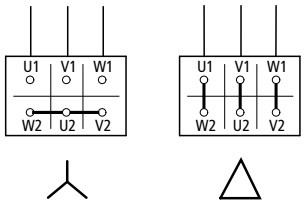


Figure 35: Circuit types:
Star-connected circuit (left), Delta circuit (right)

Examples based on figure 34 and figure 35

Motor with star connection:
Mains voltage: 3 ~ 400 V; Output voltage: 3 ~ 400 V

→ DA1-342D2…

Motor with delta circuit:
Mains voltage: 1 ~ 230 V; Output voltage: 3 ~ 230 V

→ DA1-124D3…

Motor connection

DA1 variable frequency drives	as per IEC	as per UL
U	U1 (-U2)	T1 (-T4)
V	V1 (-V2)	T2 (-T5)
W	W1 (-W2)	T3 (-T6)

2.9.3 Parallel connection of motors

When in V/Hz control mode (default setting, P4-01 = 2), DA1 variable frequency drives can be used to run multiple motors simultaneously.

→ If several motors are connected in parallel, the sum of the motor currents must be less than the rated current of the DA1 variable frequency drive.

Connecting motors in parallel will reduce the load resistance at the variable frequency drive's output. This will cause the total stator inductance to decrease and the cables' stray capacitance to increase. Current distortion therefore increases as compared to single motor load.

To reduce the current distortion, a motor choke or a sine filter should be used in the output of the variable frequency drive (→ figure 36).

→ 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 DA1 variable frequency drive's output as well.

WARNING

For the parallel operation of several motors on one DA1 variable frequency drive, the contactors of the individual motors must be designed according to utilization category AC-3.
The motor contactors are selected according to the rated current of the motor to be switched.

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.

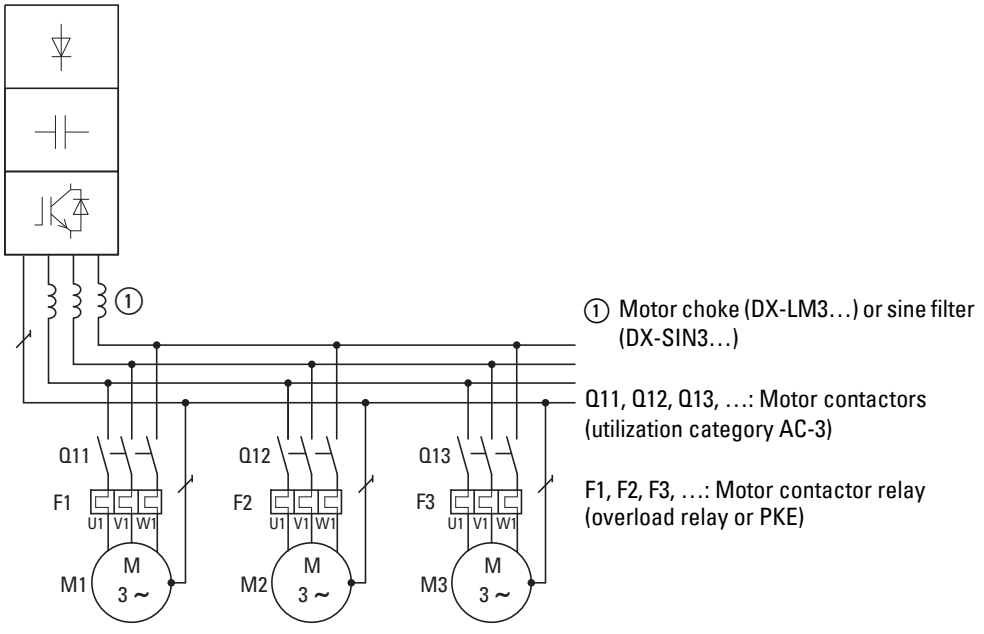


Figure 36: Example: Parallel connection of several motors to one variable frequency drive

2.9.4 Single-phase AC motors

It is not permitted to run DA1 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 DA1 variable frequency drive can be installed in an Ex housing within an Ex area or in a control panel outside of the Ex area.
- 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 sensors 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 Ex area (e.g. EMT6).

2.9.6 Synchronous, reluctance, and PM motors

The DA1 variable frequency drives enable the operation of three-phase motors with maximum energy efficiency, such as:

- Efficiency rating IE3 and IE4
  According to IEC/EN 60034-30, EU no. 4/2014,
- Permanent magnet motors (DA1 variable frequency drives require at least a BackEMF of 1 V per Hz when operating PM motors)
- 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.

The data on the rating plates also differs significantly from the usual data, e.g. 315 V, R_{20*} = 2,1 Ω, L* = 20 mH and U_{Pol} = 195 V/1000 min^{-1}

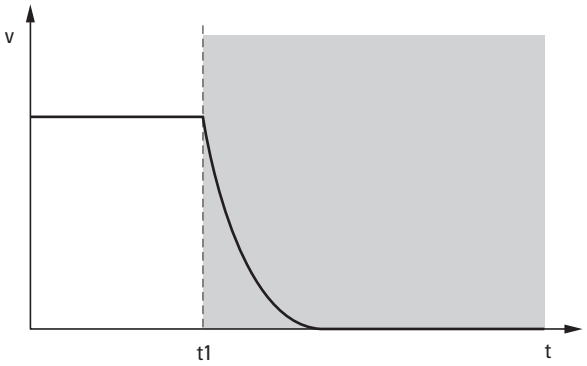
For information on and examples for permanent magnet and brushless DC motors, please refer to application note AP040051EN.

2.10 STO function

2.10.1 Overview

The STO function (STO = Safe Torque Off) is included in the standard range of functions of the DA1 variable frequency drive. 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 zero speed 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 uncontrolled run-down (coasting to a stop) has no safety implications.



v = Motor speed

t1 = STO shutdown Start of coasting

Gray = Coasting time for motorwithout safety implications

Figure 37: : 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).

Application examples can be found in the Eaton safety manual PU05907001Z.

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 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

The variable frequency drives of the device series DA1 in degree of protection IP20 and IP55 which have applied a TÜV logo on the nameplate, include an STO function in accordance with the standards listed here:

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

The variable frequency drives of the device series DA1 in degree of protection IP66, which have applied a TÜV logo on the nameplate, include an STO function in accordance with the standards listed here:

Standard	Classification
EN 61800-5-2:2007	Type 2: "Safely switched-off moment"
EN ISO 13849-1:2006	PL e
EN 61508 (Part 1 to 7)	SIL 3
EN60204-1	Stop category 0: "Uncontrolled stopping by means of immediately cutting the power supply to the machine drive elements"
EN 62061	SIL 3

→ To comply with the classification for DA1 variable frequency drives with IP66 degree of protection, the entire safety circuit must be tested at least once every 3 months.

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

2.10.3 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 must 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.
The safe operating state of the "STO input signal" (control signal terminals 12/13) must be guaranteed.

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.

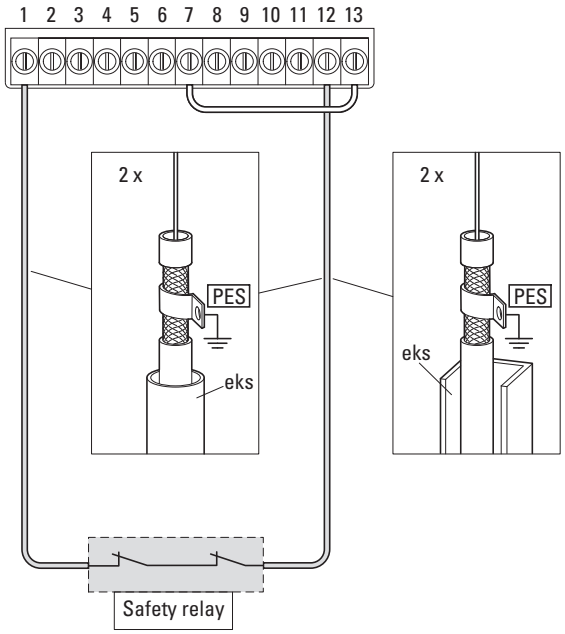
In order to prevent damage to the variable frequency drive, the devices should remain in their original packaging until right before they are installed.
They must be stored in a dry and clean area with a temperature range of -40 °C to 60 °C.

The conductor cross-section used for the STO installation must be between 0.05 and 2.5 mm^2 (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 EMC-compliant installation (→ section 3.5, "Correct EMC installation", page 84), the following information must be observed for "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 (ESC = ground and short-circuit-safe installation).
- The 24 V DC power supply for the STO inputs can be supplied from the DA1 variable frequency drive's internal 24 V DC voltage or from an external 24 V DC power supply. Accordingly, the DA1 variable frequency drive should be wired as described below:

2.10.3.1 STO installation with DA1 internal supply voltage (24 V DC)



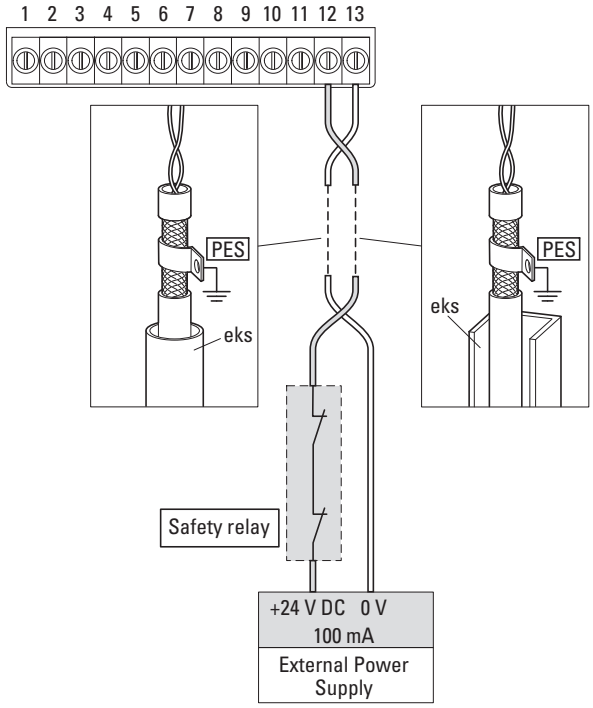
Control signal terminals

1:	24 V DC, output, max. 100 mA
7 or 9:	0 V
12:	STO+:, logical high signal, Input = 18 - 30 V DC from the safety controller
13:	STO-, 0 V connection to internal control voltage (terminal 7 or 9)

Figure 38: STO installation with internal control voltage

The two connecting cables from control signal terminal 1 (+24 V) to the safety relay's contact and from there back to control signal terminal 12 (STO+) must be wired individually and installed separately (ESC, 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).

2.10.3.2 STO installation with external supply voltage (24 V DC)



Control signal terminals

12: STO+:, logical high signal, Input = 18 - 30 V DC from the safety controller

13: STO-, 0 V connection to internal control voltage (terminal 7 or 9)

Figure 39: : STO installation with external control voltage

The two connecting cables from the external power supply and the safety relay to the Terminals 12 (STO+) and 13 (STO-) must be twisted cables. This twisted pair must be routed inside a closed cable duct or conduit (ESC) 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

2.10.4 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.
- 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 $5Eo-F$ is signaled (fault indicator, digital output) is less than 20 ms.

2.10.5 STO function parameters

In the DA1 variable frequency drives, the STO function is always activated and enabled, regardless of the operating mode or any parameter changes made by the user

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

If the STO inputs are de-energized:

- $InH\ ibE$ is displayed in the associated control unit (Inhibit - lock, locked state).
  Exception: If the DA1 variable frequency drive detects an error, the corresponding error code is displayed (not: $InH\ ibE$).
- 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 4: STO-relevant parameters

PNU	Modbus ID	Access right		Name	Value	Description	Default
		RUN/ STOP	ro/rw				
P2-15	237	RUN	rw	RO1 function	0 - 13	Selection of the function of the output relay RO1 Possible values: • **0**: RUN, Enable (FWD/REV) • **1**: READY, variable frequency drive ready for operation • **2**: Speed = speed reference value • **3**: Speed > 0 • **4**: Speed ≧ Limit: ON: ≧ P2-16; OFF: < P2-17 • **5**: Motor current ≧ Limiting value: ON: ≧ P2-16; OFF: < P2-17 • **6**: Speed ≧ Limit: ON: ≧ P2-16; OFF: < P2-17 • **7**: Analog input AI2 ≧ Limit: ON: > P2-16; OFF: < P2-17 • **8**: reserved • **9**: reserved • **9**: reserved • **10**: reserved • **11**: reserved • **12**: Drive tripped • **13**: STO-Status (STO = Safe Torque OFF)	1
P2-18	240	RUN	rw	RO2 function	0 - 13	Selection of the function of the output relay RO2 Possible values: • **0**: RUN, Enable (FWD/REV) • **1**: READY, variable frequency drive ready for operation • **2**: Speed = speed reference value • **3**: Speed > 0 • **4**: Speed ≧ Limit: ON: ≧ P2-19; OFF: < P2-20 • **5**: Motor current ≧ Limiting value: ON: ≧ P2-19; OFF: < P2-20 • **6**: Speed ≧ Limit: ON: ≧ P2-19; OFF: < P2-20 • **7**: Analog input AI2 ≧ Limit: ON: > P2-19; OFF: < P2-20 • **8**: Control signal for the external brake of a hoist drive (enables the "hoisting gear" mode). ON: Output frequency ≧ P2-07 when START command (FWD/REV) is present. OFF: output frequency ≦ P2-08 with no START (FWD/REV) command active. • **9**: reserved • **10**: reserved • **11**: reserved • **12**: Drive tripped • **13**: STO-Status (STO = Safe Torque OFF)	0

PNU	Modbus ID	Access right		Name	Value	Description	Default
		RUN/ STOP	ro/rw				
P2-36	258	RUN	rw	Start Mode	Edge-r Auto-0 … Auto-5	Defines the behavior of the drive relating to the enable sensor input and also configures the automatic restart function. Possible values: • **0**: Edge-r: After switching on the supply voltage or after a RESET, the drive does not start if the enable signal is still present. To start a rising edge is necessary. • **1**: Auto-0: After switching on the supply voltage or after a RESET, the drive starts automatically if the enable signal is still present. • **2**, …,**6**: Auto-1, …, Auto-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 start attempts is counted. If the drive does not start automatically even with the last attempt, it switches off with an error message. and will require the user to manually reset the fault. **Attention:** An automatic start is only possible if the control commands come via the terminals (P1-12 = 0, P1-12 = 11 if after a loss of communication the switchover to terminal operation was made automatically.) **Observe the following warning!**	Auto-0

DANGER

For the automatic start mode (Auto-0 to Auto-5), personnel protection and the implications for the drive system must be specifically noted.

2.10.6 Error messages

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

Table 5: Error messages

Display[1]	Fault code[2] Modbus RTU [hex]	Designation	Possible causes and remedies
PS-trP	05	Power section fault	• Fault message from the power section's output. • Check the connection to the motor (short-circuit, earth fault). • Disconnect the cable from terminals U, V, W. If the fault message cannot be reset, please contact your closest Eaton office.
Sto-F	29	Internal STO circuit fault	Please contact your closest Eaton 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

2.10.7 STO function checklist

The STO function of a drive must always be checked before initial commissioning, after maintenance, and at regular maintenance intervals. This check should include the following tests:

No.	Activity	Note
1	The STO inputs (control signal terminals 12, 13) are de-energized. With motor standstill and a stop command on the DA1 variable frequency drives, InH ibit is displayed (locked state).	
2	The STO inputs (control terminals 12, 13) are voltage-free and the DA1 variable frequency drive receives a start command (depending on the selected mode in P1-13, DI Config Select). InH ibit (locked state) is displayed. The motor does not start.	
3	The STO inputs (control signal terminals 12, 13) are supplied with 24 V DC and the DA1 variable frequency drive receives a start command (depending on the selected mode in P1-13, DI Config Select). The motor starts normally and is controlled by the DA1 variable frequency drive.	
4	The motor is controlled by the DA1 variable frequency drive and an STO input (control terminal 12 or 13) is switched off. InH ibit is displayed and the motor coasts to a stop.	

2.10.8 Regular maintenance

The STO function should always be included in a scheduled maintenance process (at least once a 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 condensation.
- The enclosure fan and air filter must provide the required airflow.
- Check all electrical connections:
  The screw terminals must be properly tightened and the power cables must not show any signs of heat damage.

2.10.9 "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 either an unexpected restart or an automatic restart (depending on the parameterization). Accordingly, it must not be used to perform maintenance or cleaning work on the machine.

The STO function eliminates the need for electromechanical contactors with self-checking auxiliary contacts to implement the safety functions.

DANGER

In certain applications, additional measuring and monitoring equipment may be needed in order to meet the requirements of the system's safety function.
The STO function does not provide motor braking and the braking function of the DA1 variable frequency drive alone cannot be claimed as a fail-safe method.
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 that is integrated into the DA1 variable frequency drive fulfills the definition of "safe stop" according to IEC61800-5-2 and corresponds to a non-controlled hold in accordance with category 0 (emergency-stop) of the IEC60204-1 norm. This means that the motor runs down (coasts), if 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 safety standards:

IP20/IP55	**SIL** (Safety Integrity Level)	**PFH_d** (Probability of dangerous Failures per Hour)	**SFF (%)** (Safe Failure Fraction)	**Lifetime assumed**
EN 61800-5-2	2	1.23E-09 1/h (0.12% of SIL 2)	50	20 Yrs
	PL (Performance Level)	**CCF (%)** (Common Cause Failure)		
EN ISO 13849-1	PL d	1		
	SIL			
EN 62061	SIL 2			

IP66	**SIL** (Safety Integrity Level)	**PFH_d** (Probability of dangerous Failures per Hour)	**SFF (%)** (Safe Failure Fraction)	**Lifetime assumed**
EN 61800-5-2	3	1.5E-10 1/h (1.5% of SIL 3 E-7 1/h)	90	20 Yrs
	PL (Performance Level)	**CCF (%)** (Common Cause Failure)		
EN ISO 13849-1	PL e	5		
	SIL			
EN 62061	SIL 3			

The values provided here can only be ensured if the DA1 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 DA1 variable frequency drive must always be free of frost and moisture.

3 Installation

3.1 Introduction

This chapter provides a description of the installation and the electrical connections for the variable frequency drive DA1 series.

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

Perform all installation work using only the specified proper tools and without excessive force.

For information on how to install DA1 variable frequency drives with the various enclosure versions, please refer to the following instruction leaflets:

- IL04020010Z (IP20 in FS2, FS3)
- IP040049ZU (IP20 in FS4, FS5)
- IL04020011Z (IP55 in FS4, …, FS7)
- IL040061ZU (IP66 in FS2, FS3, FS4)

3.2 Mounting position

DA1 variable frequency drives are available with three enclosure versions:

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

The IP55 and IP66 enclosure versions provide protection against moisture and dust. This enables use under difficult conditions indoors and, for devices with IP66 protection, also outdoors.

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

- Explosion-proof areas
- Environments with harmful substances:
  - Oils and acids
  - Gases and fumes
  - Dust
  - Radiation interference
- 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 required to guarantee machine and personnel protection.

3.3 Assembly

The installation guidance provided here takes into account building the devices into suitable housing with degrees of protection IP20 and IP55 in accordance with standard EN 60529 or other essential provisions that apply regionally.

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

→ Install the DA1 variable frequency drive only on a non-flammable mounting base (e.g., on a metal plate).

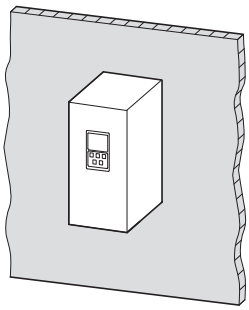


Figure 40: Surface mounting on metal plate

DA1 variable frequency drives with IP66 degree of protection must be installed as required by the local conditions for this degree of protection.

3.3.1 Installation position

DA1 series variable frequency drives are designed to be mounted vertically. The maximum permissible inclination is 30°.

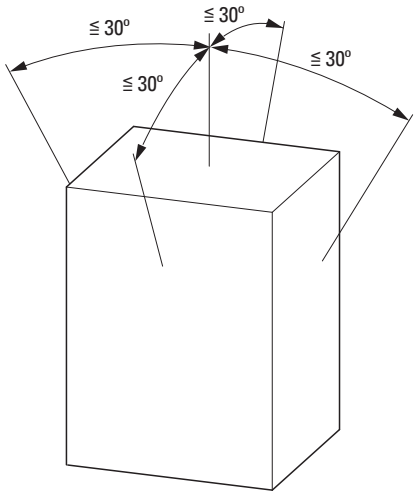


Figure 41: Installation position

3.3.2 Cooling measures

In order to ensure adequate air circulation, depending on the size (power rating), there must be sufficient thermal clearances on the variable frequency drive.

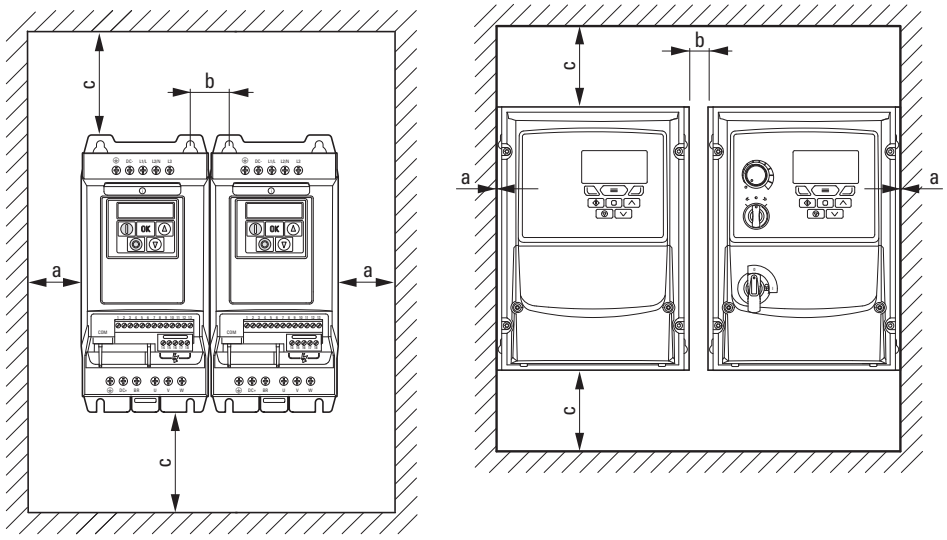


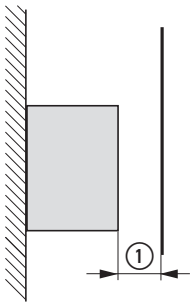
Figure 42: Clearances for air cooling (left: IP20; right: IP66)

Table 6: Minimum clearances and required cooling airflow

Frame size (Degree of protection)	a		b		c		required Cooling airflow	
	mm	in	mm	in	mm	in	m³/h	cfm
FS2 (IP20)	50	1.97	31	1.22	75	2.95	70	41
FS2 (IP66)	0	0	12	0.47	200	7.87	0	0
FS3 (IP20)	50	1.97	31	1.22	100	3.94	190	112
FS3 (IP66)	0	0	13	0.51	200	7.87	0	0
FS4 (IP20)	25	0.98	70	2.76	200	7.87	105	62
FS4 (IP55)	10	0.39	71	2.8	200	7.87	425	250
FS4 (IP66)	0	0	42.5	1.67	200	7.87	0	0
FS5 (IP20)	25	0.98	70	2.76	200	7.87	177	104
FS5 (IP55)	10	0.39	70	2.76	200	7.87	425	250
FS6 (IP55)	10	0.39	140	5.52	200	7.87	650	383
FS7 (IP55)	10	0.39	140	5.52	200	7.87	650	383

The values given in Table 6 are recommended values up to an ambient temperature of +50 °C with protection class IP20 or +40 °C with IP55 and IP66, 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 ①
FS2, …, FS7	≧ 15 mm (≧ 0.59 inch)

Figure 43: Minimum required clearance ① in front of the variable frequency drive when installed in an enclosure (control panel)

→ Please ensure that the installation makes it possible to properly open and close the control signal terminal enclosure.

In the case of variable frequency drives mounted vertically one above the other with an internal fan, an air baffle must be fitted between the devices. Otherwise there is a risk that the upper device will be thermally overloaded due to the guided air flow (device fan).

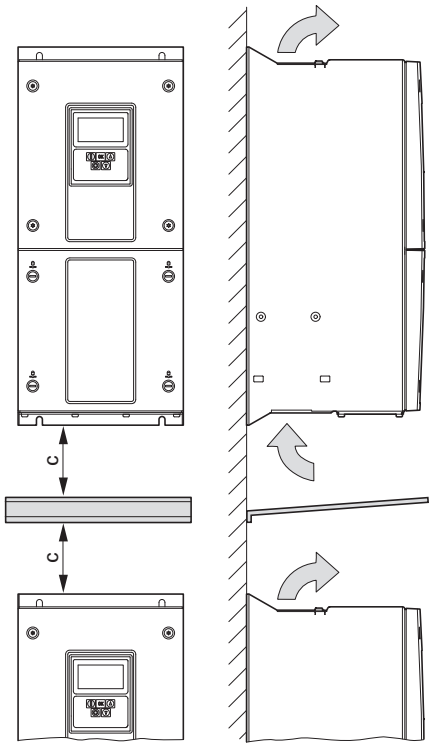


Figure 44: Deflector due to increased circulation caused by device fan

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 rated accessories in the power path (mains choke, motor choke, sine filter) will vary significantly depending on the load, the output frequency, and the carrier frequency being used.

→ The power losses of the variable frequency drives at the rated current are listed in → section 6.2, “Specific rated data”, page 203

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:

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

3.3.3 Mounting

The DA1 variable frequency drives of all sizes can be fastened to a mounting plate with screws.

Moreover, frame sizes FS2 and FS3 with an IP20 degree of protection can be mounted on a mounting rail as well.

→ Install the DA1 variable frequency drive only on a nonflammable mounting base (e.g., on a metal plate).

→ Information on the dimensions and weights of the DA1 variable frequency drive is available in → section 6.3, "Dimensions and frame sizes", page 213.

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.

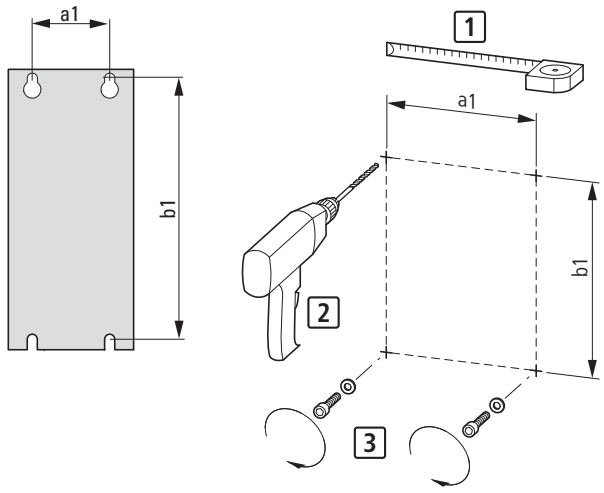


Figure 45: Mounting dimensions

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

Table 7: Installation dimensions, screws, tightening torques

Frame size	Degree of protection		a1		b1		Screw		Tightening torque	
FS	IP	NEMA	mm	in	mm	in	Number	Size	Nm	lb-in
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	8.85
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	8.85
FS4	IP20	NEMA 0	125	4.92	400	15.75	4	M8	2	18
FS4	IP55	NEMA 12	110	4,33	428	16.85	4	M8	4	35.4
FS4	IP66	NEMA 4X	227	8.94	300	11.82	4	M4	1	8.85
FS5	IP20	NEMA 0	175	6.89	460	18.11	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

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, DA1 variable frequency drives with 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.

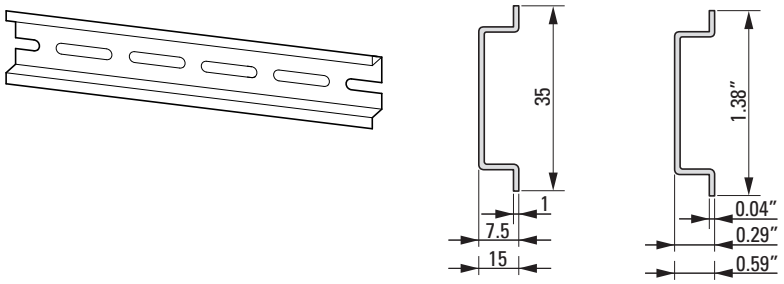


Figure 46: Mounting rail conforming with IEC/EN 60715

▶ 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].

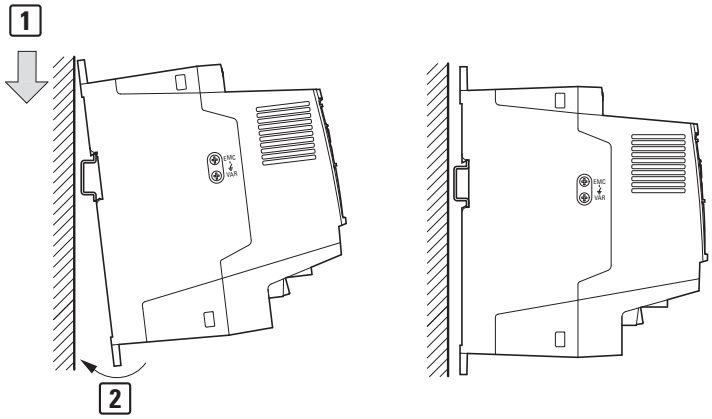


Figure 47: Fixing on the mounting rail

Dismantling from mounting rails

▶ To disassemble, press down [2] the spring-loaded latch [1]. There is a marked recess on the lower edge of the device for this purpose.
A screwdriver with a flat blade (e.g., blade width 5 mm) is recommended for unlocking.

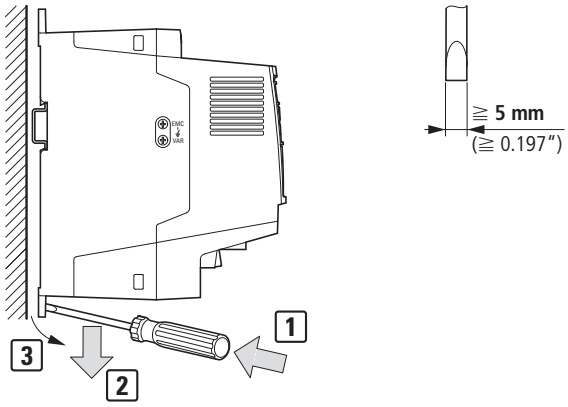


Figure 48: Dismantling from mounting rails

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

3.3.4 Control panel installation

If you install the DA1 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 against a back wall. Moreover, the top of the cabinet should be fastened to the wall [1] and the two front bottom corners should be fastened to the floor [2].

If the cabinet is set up in a freestanding configuration, all four corners must be fastened to the floor.

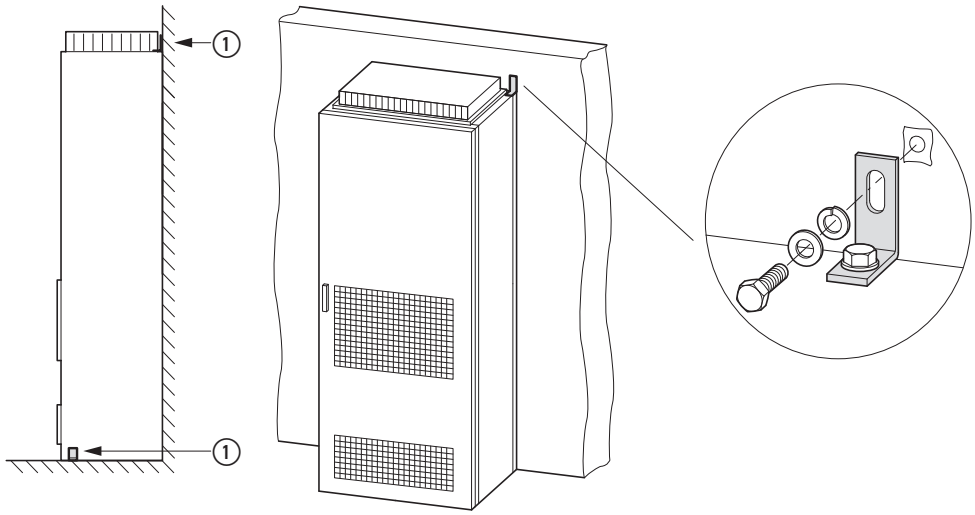


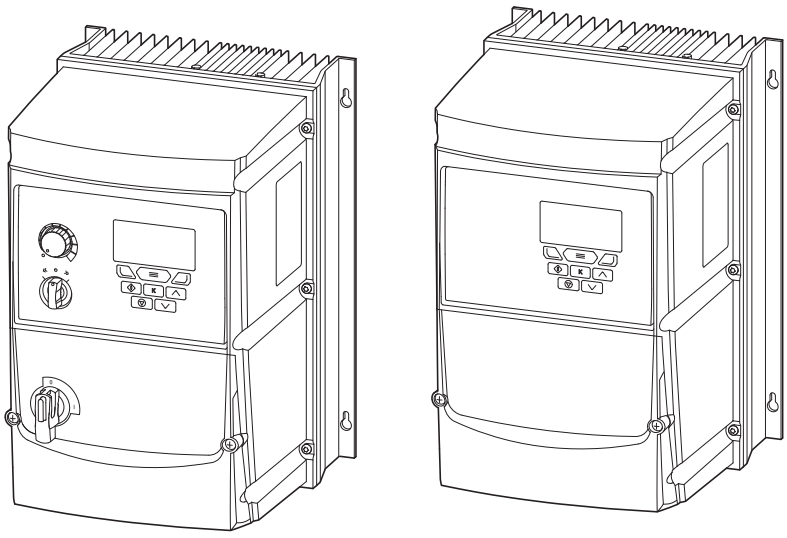
Figure 49: Stable control panel setup

Heavy accessories such as motor chokes or sine filters should always be mounted on the base plate of the control cabinet.

3.4 IP66 degree of protection/NEMA4X

The DA1 variable frequency drives are available in two variants with degree of protection IP66:

- DA1-…-A**66O**: Controlled via control signal terminals
- DA1-…-A**6SO**: Control via switching elements and/or control terminals arranged on the front



DA1-…-A66O DA1-…-A6SO

Figure 50: IP66 variants

It is mounted vertically with four screws on a wall made of non-flammable material and strong enough to support the weight of the variable frequency drive.

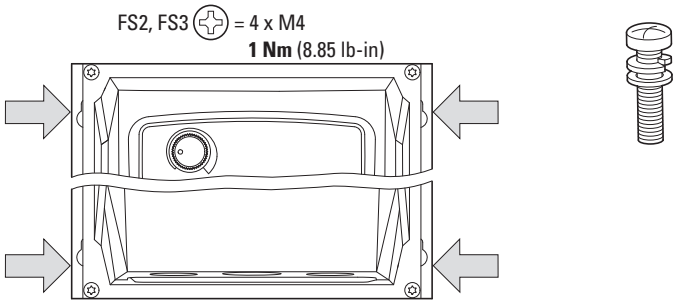


Figure 51: Holes for mounting screws

DA1-…-A6SO's main disconnect switch can be locked in the OFF position with a standard padlock.

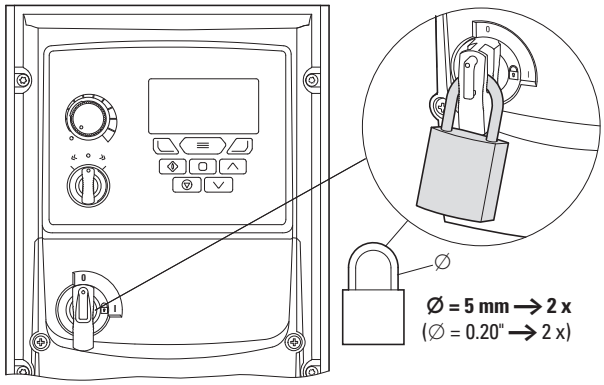


Figure 52: DA1-…-A6SO with padlock

▶ Press the center of the switch to open the slot for the padlock.

3.5 Correct 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. They must also take measures to minimize or remove emitted interference in the environment concerned. They must also utilize means to increase the interference immunity (immission) of the devices or systems.

In a drive system (PDS) with variable frequency drives, you should consider electromagnetic compatibility (EMC) during project planning, since changes or improvements to the installation site, which are required during the installation or mounting, normally imply additional and higher costs.

The technology and system of a variable frequency drive causes high frequency leakage currents during operation. Because of this, all grounding elements must be low-impedance elements connected across a large surface area.

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

- the cable cross-section of the protective conductor must be ≧ 10 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 the earth potential,
- shielded 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 measures 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).

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. shielded motor cables) and clean cables (e.g. mains supply cables, control and signal cables) should be installed at a distance of at least 100 mm from one another in order to avoid electromagnetic interference. You should also use separate cable entries if there is a major difference in voltage.
If control cables and power cables need to cross, they should always do so at a right angle (90°).

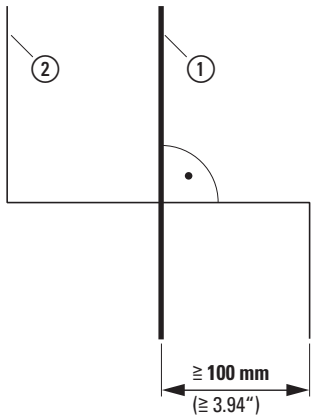


Figure 53: Cable routing

Never lay control or signal cables ② in the same duct as power cables ①.
Analog signal cables (measured values, set points, and correction values) must be routed inside shielded conduits.

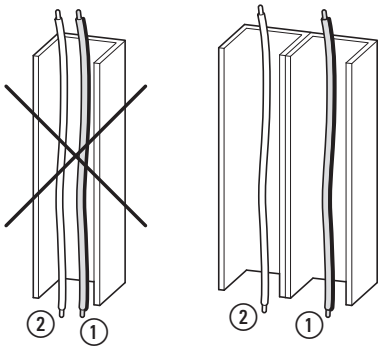


Figure 54: Separate routing
① Cable routing: Mains voltage, motor connection
② Control and signal lines, fieldbus connections

3.5.2 Grounding

The protective ground (PE) in the control panel should be connected from the mains supply to a central grounding point (mounting plate, system ground). 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 ground directly at the location of installation (system grounding). This protective ground 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 ground loop impedance must comply with all locally applicable industrial safety regulations. In order to meet UL standards, UL-listed ring cable lugs must be used for all ground wiring connections.

Avoid ground loops when installing multiple variable frequency drives in a single 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 ground

This refers to the legally required protective ground for a variable frequency drive. A grounding terminal on the variable frequency drive, or the system ground, must be connected to a neighboring steel element in the building (beam, ceiling joist), a ground electrode in the ground, or a mains ground bus. The ground 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 grounding

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

With a variable frequency drive, a fault current to ground can occur due to the system. DA1 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 (DA1-3…), this fault current must be monitored by a type B residual current device (RCD).

3.5.3 Internal filters (EMC and VAR screws)

3.5.3.1 EMC screw

The DA1 variable frequency drives in sizes FS2 and FS3 have two screws on the left-hand side in protection rating IP20, which are marked with EMC and VAR; in sizes FS4 and FS5, these screws are on the front; in protection class IP66, the EMC screw is present in the housing.

→ The EMC screws are found only in devices with an internal RFI filter.

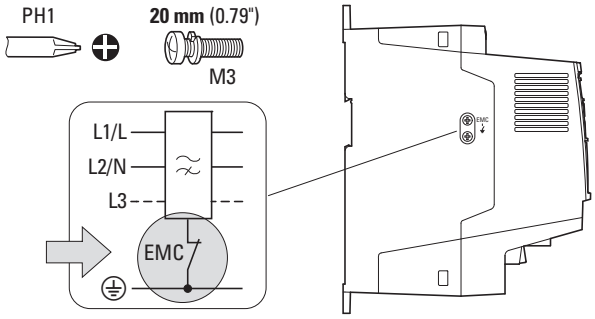


Figure 55: EMC screw

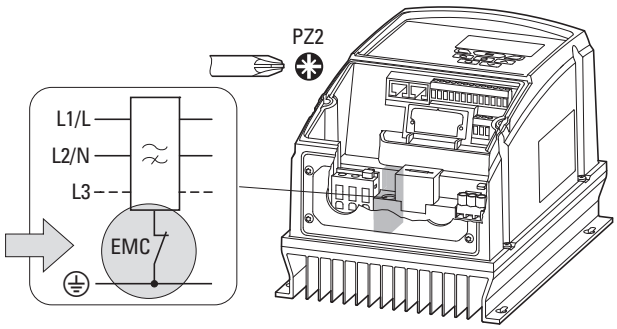


Figure 56: EMC screw (at IP66)

WARNING

The screw marked EMC must not be actuated as long as the variable frequency drive is connected to the electrical network.

→ The EMC screw galvanically connects the EMC filter's mains-side capacitors to the ground connection. The EMC screw must be screwed in all the way to the stop (default 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 ground 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 ground 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.

When connecting to isolated mains power sources (IT networks), the EMC and VAR screws must be unscrewed. The ground fault monitors required for IT networks must be suitable for operation with power electronic devices (IEC 61557-8).

3.5.3.2 VAR screws

DA1 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. The transient voltage peaks are typically caused by lightning strikes or by switching operations of other high power equipment 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.

→ The VAR screw is found only in DA1 variable frequency drives with IP20 in sizes FS2 and FS3 on the left hand side.

WARNING

The screw labeled VAR (→ figure 55, page 87) must not be manipulated as long as the variable frequency drive is connected to the mains.

3.5.4 Shielding

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 measured values) must be screened and laid separately from each other.

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

Use only screens with tin or nickel-plated copper braiding. Steel mesh screens are not suitable.

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

3.5.5 EMC-Cable holders

The DX-EMC-MNT-... cable brackets enable the cable routing and cable catch in the connection area of the DA1 variable frequency drive in sizes FS2 and FS3 of protection type IP20. The cable brackets are mounted on the mains connection side (DX-EMC-MNT-…N) and the motor side (DX-EMC-MNT-…M) of the variable frequency drive over the mounting holes and connected to the ground connection ⏚ of the variable frequency drive.

The integrated hole pattern of the cable holders (M4 screw thread) enables the cables to be connected to be fixed and strain-relieved using the associated cable clamps and, in the case of shielded cables, a 360-degree EMC connection (PES).

The cable brackets are made of galvanized sheet steel.

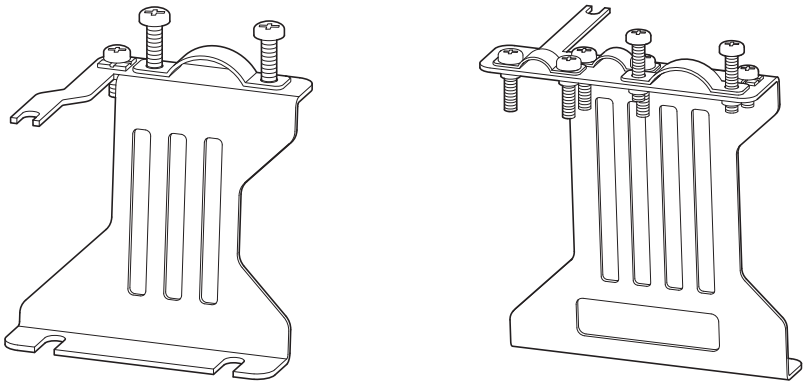


Figure 57: Cable brackets DX-EMC-MNT-…N (left),
Mains and Motor DX-EMC-MNT-…M (right)

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

→ DX-EMC-MNT-… EMC cable brackets are sold as individual units. They are assigned to the sizes (FS2 and FS3) of the DA1 variable frequency drive.
The gland plates and their fixing screws are included in the equipment supplied with the cable brackets.

Cable bracket	Frame size DA1	Gland plates Quantity / Designation
DX-EMC-MNT-2N	FS2	1/supply terminal
DX-EMC-MNT-2M	FS2	3/Control cables, motor connection, external brake resistor
DX-EMC-MNT-3N	FS3	1/supply terminal
DX-EMC-MNT-3M	FS3	3/Control cables, motor connection, external brake resistor

3.5.6 General installation diagram

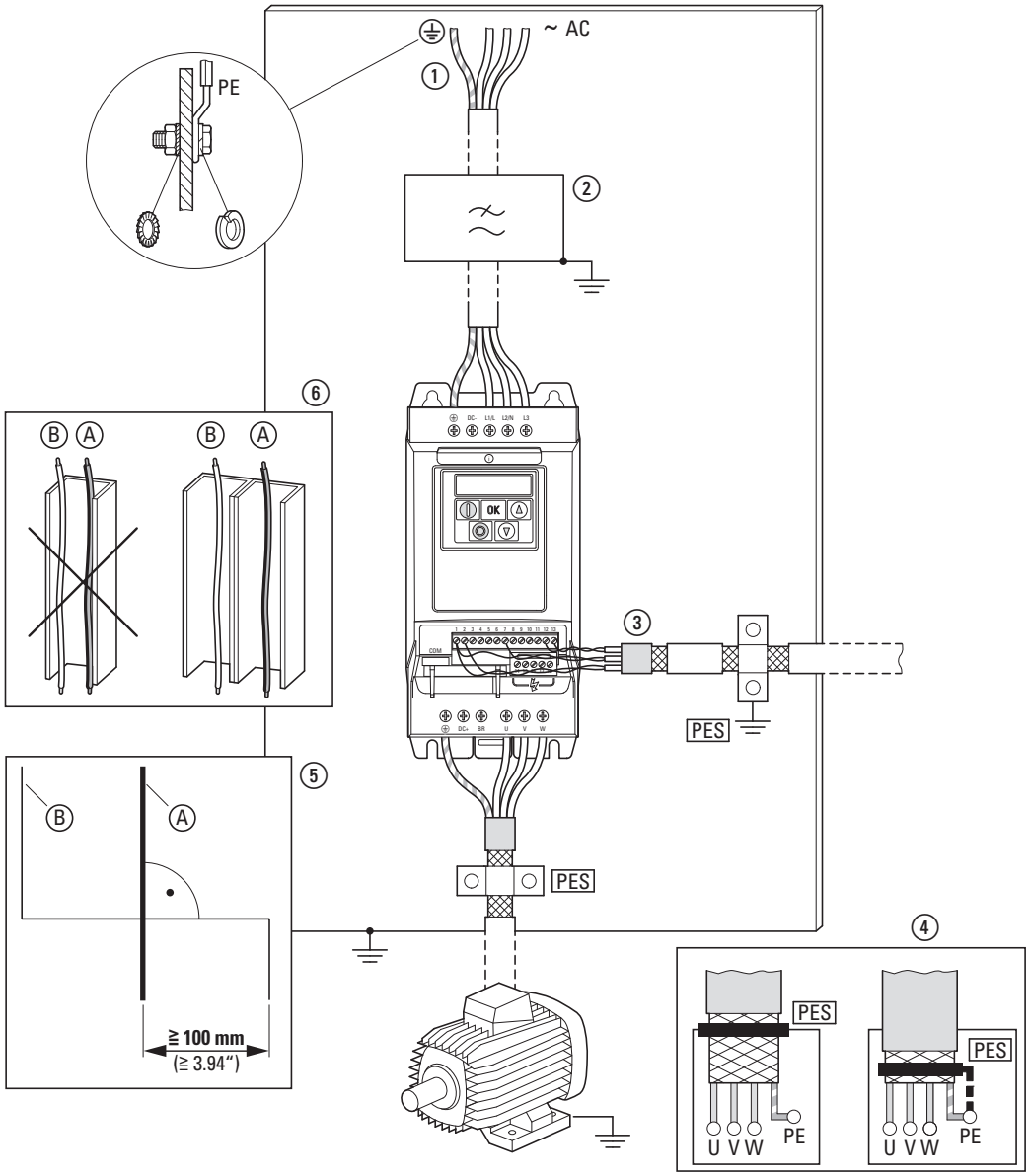


Figure 58: Correct EMC installation

① Mains connection: Supply voltage, central grounding 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 of the digital and analogue control lines, STO function and communication via RS45 plug connection

④ Motor connection: EMC-compliant connection (PES) between the shielded motor cable and the motor's terminal box, using metal screw fitting or with a cable clip in the terminal box.

⑤ Cable routing: Power cables (A) and control cables (B) routed separately and at a distance 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 the same cable duct. If they need to be routed in parallel, they should be in separate metal cable ducts (in order to meet EMC requirements).

3.6 Electrical installation

CAUTION

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

DANGER

Risk of injury due to electric shock!
Carry out wiring work only if the unit is de-energized.

WARNING

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

WARNING

On DA1 variable frequency drives, ground leakage currents can be greater than 3.5 mA (AC).
According to product standard IEC/EN 61800-5-1, an additional equipment grounding conductor must be connected, or the cross-section of the equipment grounding conductor must be at least 10 mm^2.

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!

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

3.6.1 Connection to the power section

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 is not important for frame sizes FS2 to FS7.
- 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 external brake resistor
- DC+ (or +) or DC- (or -), PE for connecting all-pole sine filters or DC link connection.

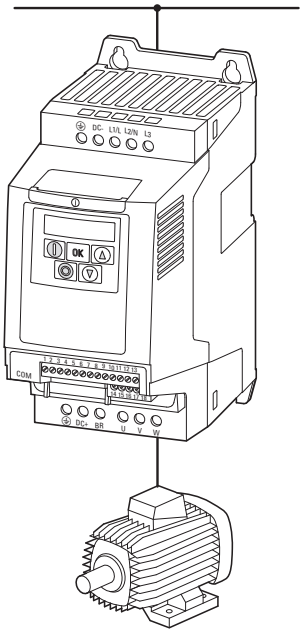


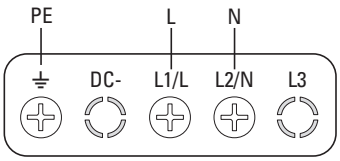
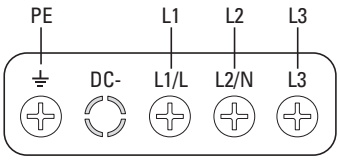
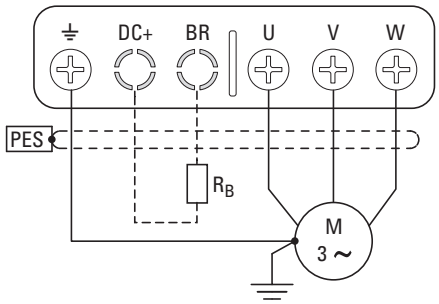
Figure 59: Connection in power section (schematic)

The number and arrangement of the connection terminals depend on the size and the design of the DA1 variable frequency drive.

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

3.6.1.1 Connection terminals for frame sizes FS2 and FS3 in IP20

Table 8: Connection terminals (FS2, FS3)

Connection terminals	Description
	Connection with single-phase supply voltage (230 V): • DA1-12… (200 - 240 V)
	Connection with three-phase supply voltage: • DA1-32… (200 - 240 V) • DA1-34… (380 - 400 V) • DA1-35… (500 - 600 V)
	Motor connection for three-phase motors: (motor voltage = supply voltage) • DA1-12… • DA1-32… • DA1-34… • DA1-35… optional: internal or external brake resistor (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 housings with an IP55 degree of protection (frame sizes FS4 to FS7), the connection area will be located behind the lower enclosure cover.

Frame sizes FS4 and FS5

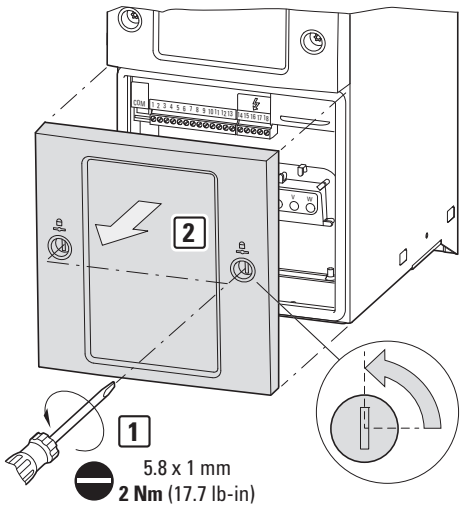


Figure 60: Removing the cover

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].

Frame sizes FS6 and FS7

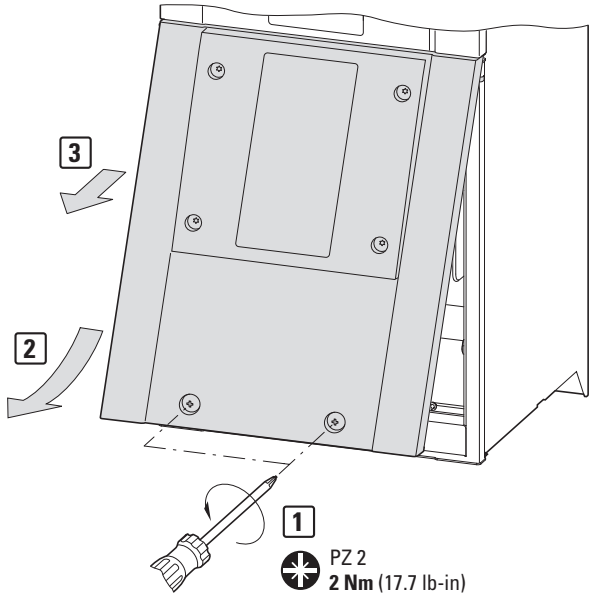


Figure 61: Removing the cover

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

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

Connect the cable at the bottom. To do this on these frame sizes (FS4 to FS7), the gland plate at the bottom (above the device fan) needs to be removed.

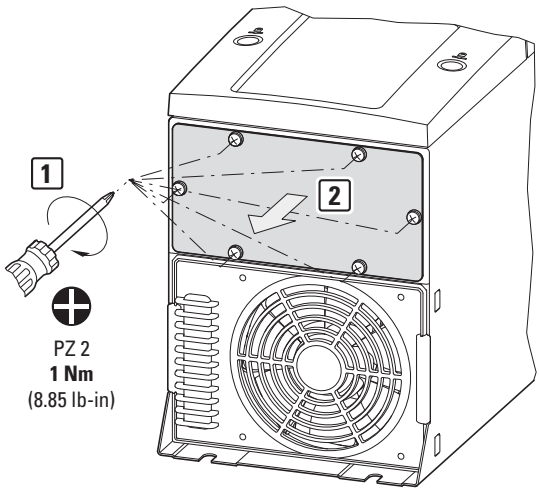


Figure 62: Remove the gland plate

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

Table 9: Connection terminals (FS4, FS5)

Description		
Connection with three-phase supply voltage: • DA1-32… (200 - 240 V) • DA1-34… (380 - 480 V) • DA1-35… (500 - 600 V)	Optional: internal or external brake resistor (R_B)	Connection for three-phase motors (motor voltage = supply voltage)

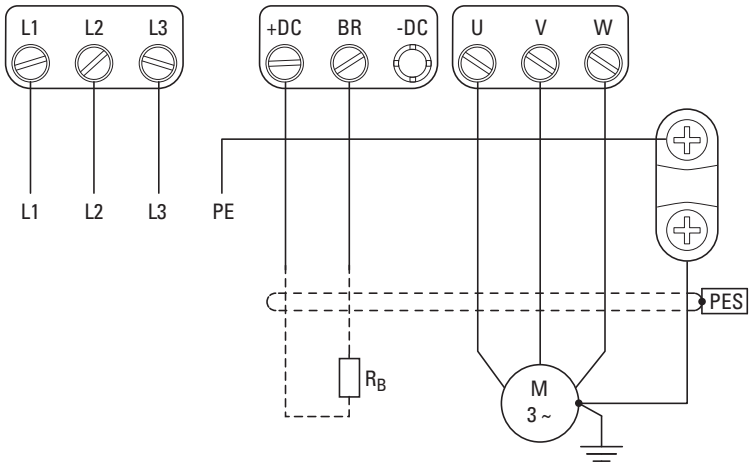


Figure 63: Connection terminals for sizes FS4 and FS5

PE earthing connection with ring terminals on the right side.

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

Table 10: Connection terminals (FS6, FS7)

Description		
Connection with three-phase supply voltage: • DA1-32… (200 - 240 V) • DA1-34… (380 - 480 V) • DA1-35… (500 - 600 V)	optional: external braking resistance (R_B)	Connection for three-phase motors (motor voltage = supply voltage)

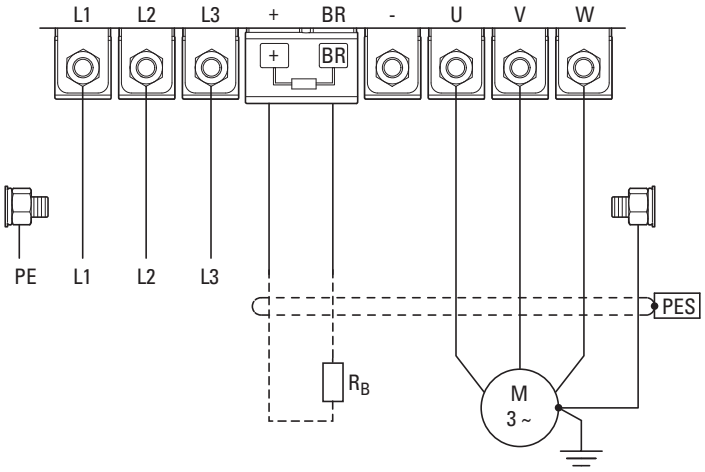


Figure 64: Connection terminals for sizes FS6 and FS7

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 gland plate and the front enclosure cover must not be installed.
Without the cover, the DA1 variable frequency drive will have an IP40 degree of protection.

3.6.1.3 Connection terminals for frame sizes FS2, FS3 and FS4 in IP66

On FS2, FS3 and FS4 frame sizes with an IP66 degree of protection, the connection area is located behind the lower enclosure cover.

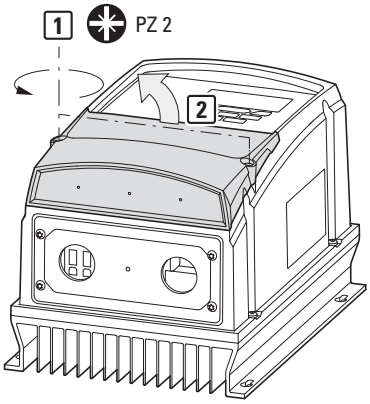
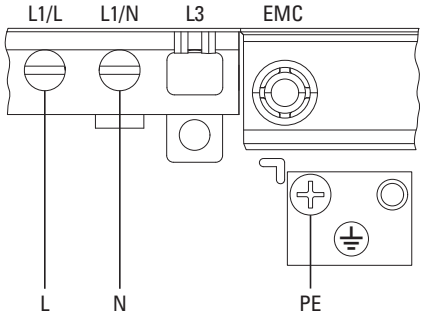
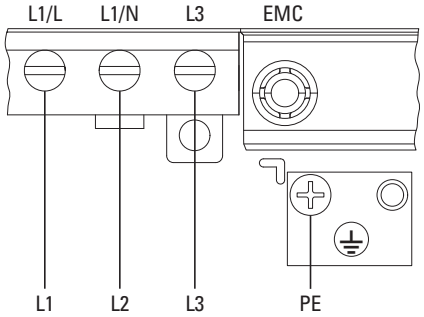
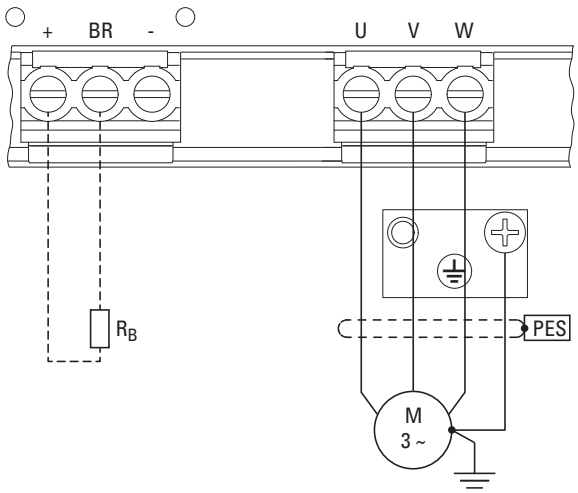


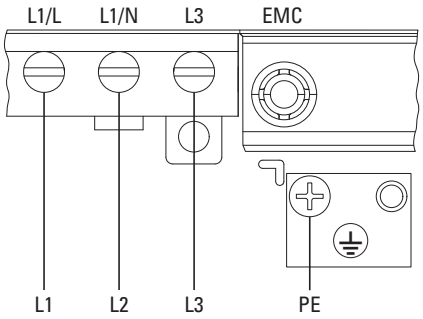
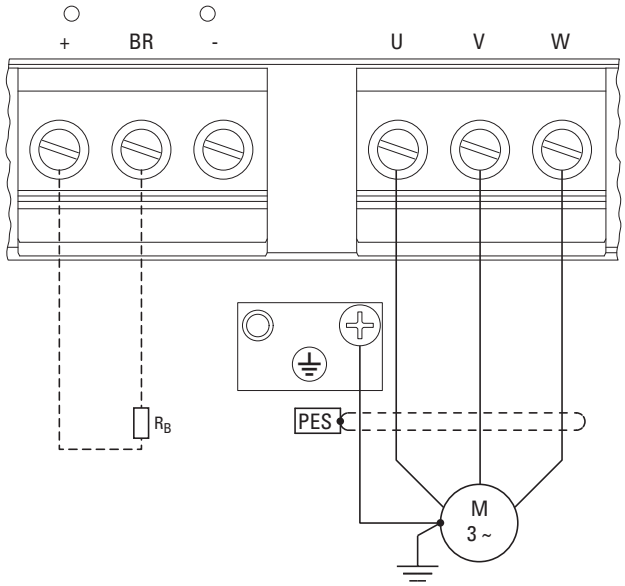
Figure 65: Remove housing cover (IP66) (Pcture doesn't describe remove action)

To open this cover, the two screws must be unscrewed [1].

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

Table 11: Connection terminals (FS2, FS3, FS4)

Frame size	Connection terminals	Description
FS2, FS3		Connection with single-phase supply voltage: • DA1-12… (200 - 240 V)
		Connection with three-phase supply voltage: • DA1-32… (200 - 240 V) • DA1-34… (380 - 480 V) • DA1-35… (500 - 600 V)
		Motor connection for three-phase motors: (motor voltage = supply voltage) **Note:** **+**, **BR**: Connection for external brake resistors (**BR** = Brake Chopper Output). The plastic cover of the terminals may be removed if necessary. The terminal **+** has the same function as the **DC+** terminal on devices with IP20 protection class.

Frame size	Connection terminals	Description
FS4		Connection with three-phase supply voltage: • DA1-32… (200 - 240 V) • DA1-34… (380 - 480 V) • DA1-35… (500 - 600 V)
		Motor connection for three-phase motors: (motor voltage = supply voltage) **Note:** **+**, **BR**: Connection for external brake resistors (**BR** = Brake Chopper Output). The plastic cover of the terminals may be removed if necessary. The terminal **+** has the same function as the **DC+** terminal on devices with IP20 protection class.

→ Terminal + has the same function as terminal DC+.

3.6.1.4 Stripping lengths and tightening torque

IP20/IP55

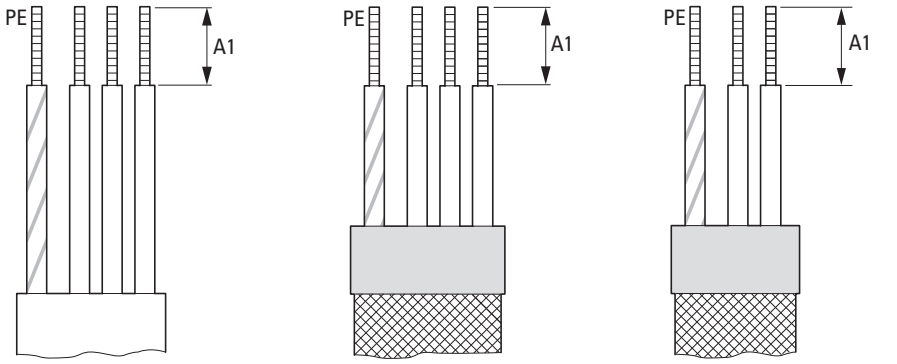


Figure 66: Connection cables

Mains = Electrical power network (mains voltage)
Motor = Motor connection
DC-Link = DC link coupling
Brake Resistor (connection to brake chopper)

Table 12: Stripping lengths in the power section

Frame size (Degree of protection)	A1 mm (in)	Tightening torque Nm (lb-in)
FS2 (IP20)	8 (0.3)	1 (8.85)
FS3 (IP20)	8 (0.3)	1 (8.85)
FS4 (IP20)	15, PE = ring cable lug, ∅ M6	2 (18)
FS4 (IP55)	15, PE = ring cable lug, ∅ M6	2 (18)
FS5 (IP20)	15, PE = ring cable lug, ∅ M8	4 (35.4)
FS5 (IP55)	15, PE = ring cable lug, ∅ M8	4 (35.4)
FS6	Ring cable lug, ∅ M10	15 (98.2)
FS7	Ring cable lug, ∅ M10	15 (98.2)

IP66

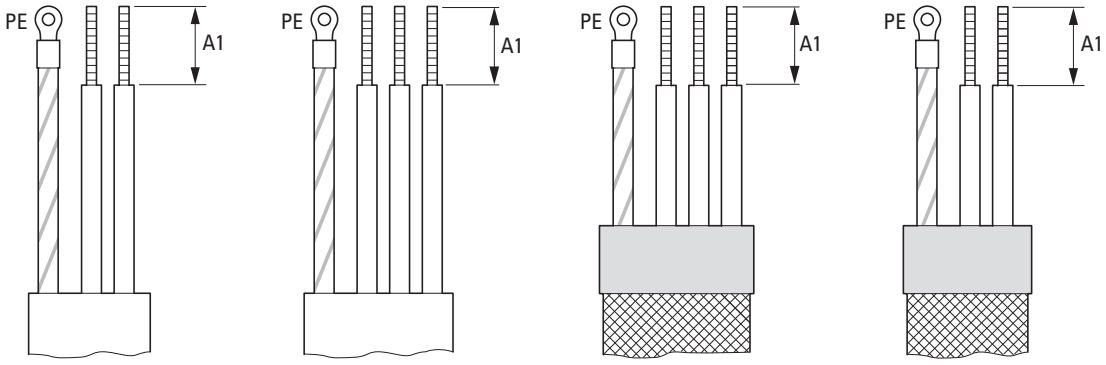


Figure 67: Connection cables

Mains = Electrical power network (mains voltage)
Motor = Motor connection
DC-Link = intermediate DC circuit (intermediate circuit coupling)
Brake Resistor (connection to brake chopper)

Table 13: Terminal capacities and tightening torques

Frame size	Screw	A1	Tightening torque		
			DA1-…-B66O	DA1-…-B6SO	
				Mains	Motor
	Type	mm (in)	Nm (lb-in)	Nm (lb-in)	Nm (lb-in)
FS1	M4	10 (0.39)	1 (8.85)	0.8 (7.08)	1 (8.85)
FS2	M4	10 (0.39)	1 (8.85)	0.8 (7.08)	1 (8.85)
FS3	M5	10 (0.39)	1 (8.85)	0.8 (7.08)	1 (8.85)
FS4	M6	10 (0.39)	2.2 (19.47)	2 (17.70)	2.2 (19.47)

3.6.1.5 Connecting the motor cable

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

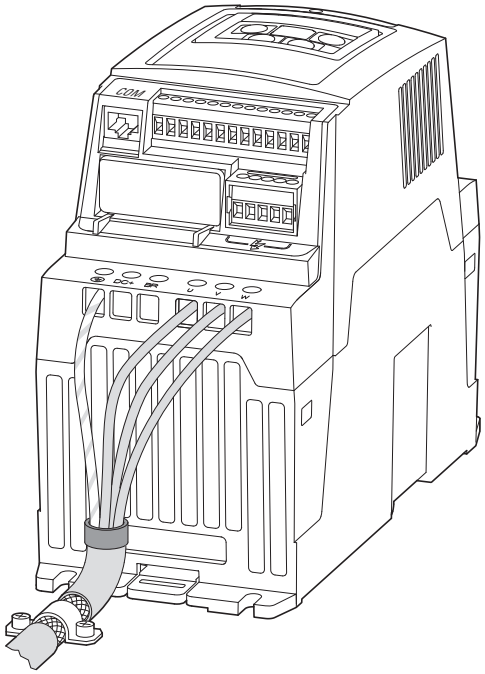


Figure 68: Connection on motor side

- Connect the screening, on both sides and across a large area (360° overlap), to the protective earth (PE) ⏚.
  The power screening's protective ground (PES) connection should be in the immediate vicinity of the variable frequency drive and directly on the motor terminal box.
- Prevent the screen ground shielding from becoming unbraided, i.e. by pushing the separated plastic covering over the end of the shielding or using a rubber grommet on the end of the shielding.
  Connect the shielding braid at the (PES) end across a large area.
  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 shielding connection should be as short as possible (recommended value for the twisted cable screen: b ≧ 1/5 a).

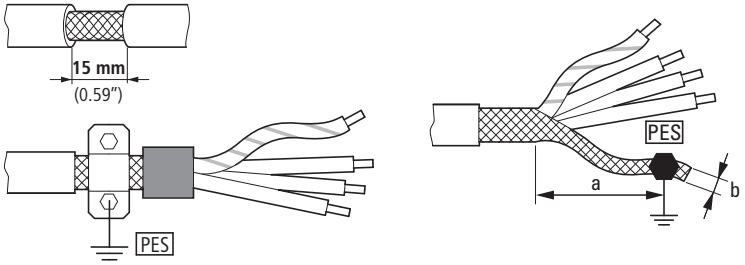


Figure 69: Screened connection cable in motor circuit

Screened, four-wire cable is recommended for the motor cables.
The green-yellow line of this cable connects the protective conductor connections of the motor and variable frequency drive, thereby minimizing the load on the braided shield due to high compensating currents.

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

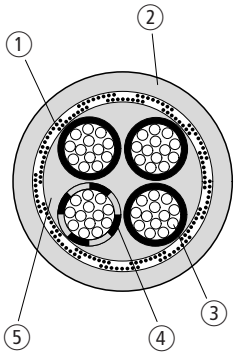


Figure 70: Four-core, shielded motor supply cable

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

If there are additional sub-assemblies 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 sub-assemblies and connected to the mounting plate (PES) with a large area connection. Free, i.e. unscreened connection cables should not be any longer than about 300 mm.

3.6.1.6 Cable glands

IP55

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 DA1 variable frequency drives with an IP55 degree of protection in order to establish an optimal connection.

In devices with an IP55 degree of protection (frame sizes FS4 to FS7), the blanking plates (→ figure 71) 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.

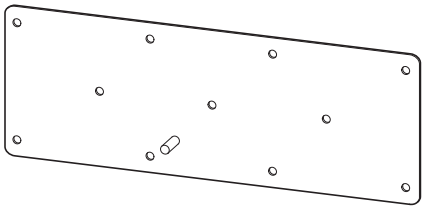


Figure 71: Blanking plate (FS6, FS7) with locating points and earthing stud

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.

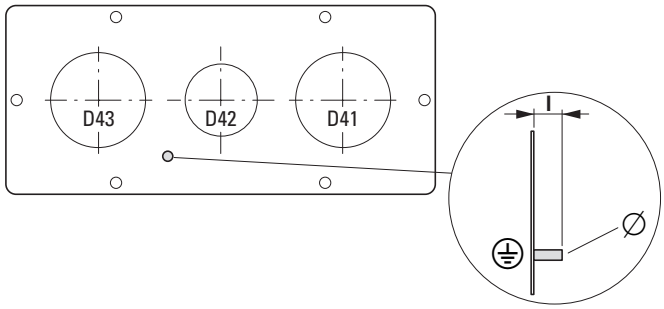


Figure 72: Blanking plate with openings and earthing stud (FS4, FS5)

Table 14: Openings (FS4, FS5)

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

IP66

A total of six cable glands can be installed with protection class IP66.
In the lower part there are two open cut-outs for cable glands to connect the connections in the power section. Guide holes are provided for an external brake resistor. In the housing cover located above, there are three additional guide holes for the feed-through of control and bus lines.

Make sure that no chips get into the device when drilling.

Holes

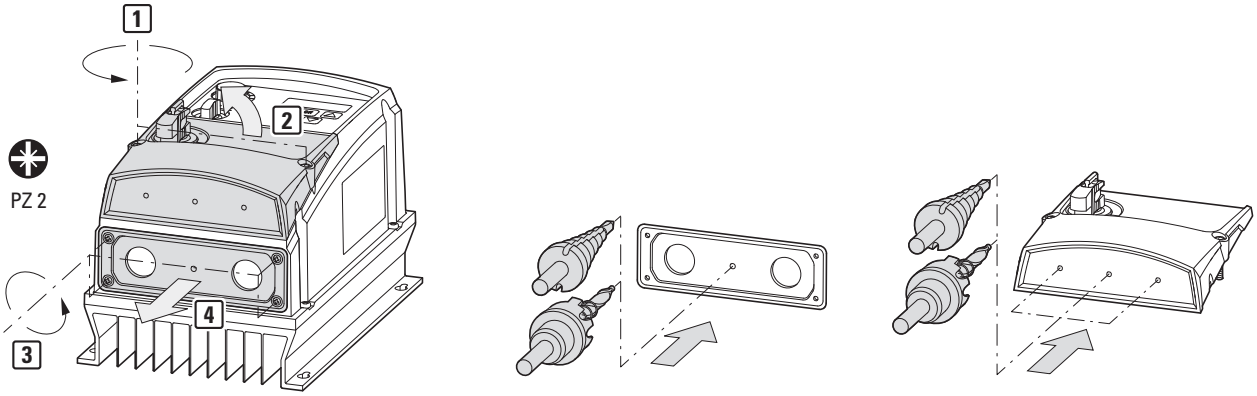


Figure 73: Holes

In order to be able to drill further passages, please loosen the two screws [1] and remove the housing cover [2].

To drill holes in the metal connection plate, loosen the four screws [3] and remove the connection plate [4]. You can now drill more holes without chips getting inside the device.

Installing the cable glands

A plastic cable gland can be inserted into the left, factory-opened cut-out to insert the mains connection cable. For EMC reasons, a metallic EMC cable gland should be used in the right-hand bushing in order to connect and ground the shield of the motor cable over a large area (→ figure 75).

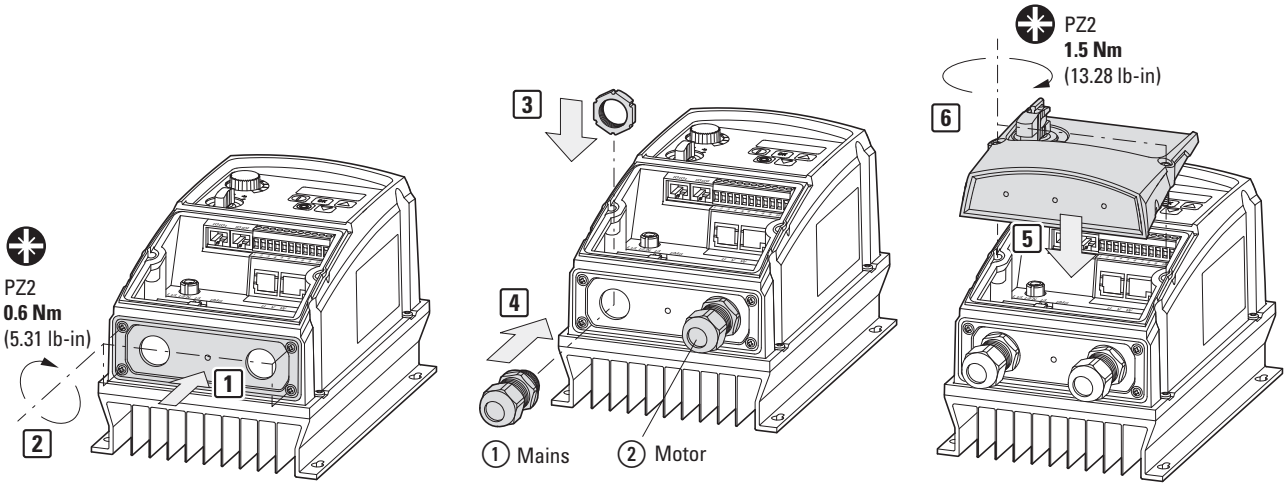


Figure 74: Install the cable glands.

- ▶ Put the gland plate on [1] and retighten the four screws in the connection plate [2].
- ▶ Now assemble the cable glands and tighten them [3], [4].
- ▶ Finally, put the housing cover on [5] and tighten the fastening screws [6].

→ Make sure that the cable gland has at least IP66 protection class.

Table 15: Cable glands that can be used (→ figure 74)

Area	Frame size	Hole size	PG-Gland nut	Metric gland
Control section Control	FS1, FS2, FS3, FS4	–	2 x PG 13.5 1 x PG 16	2 X M20 1 X M25
Power section	FS1	2 x 22 mm	2 x PG 13.5	2 X M25
Mains ①	FS2	2 x 27.2 mm	2 x PG 21	2 X M32
Motor ②	FS3	2 x 27.2 mm	2 x PG 21	2 X M32
	FS4	2 x 37 mm	2 x PG 29	2 X M40

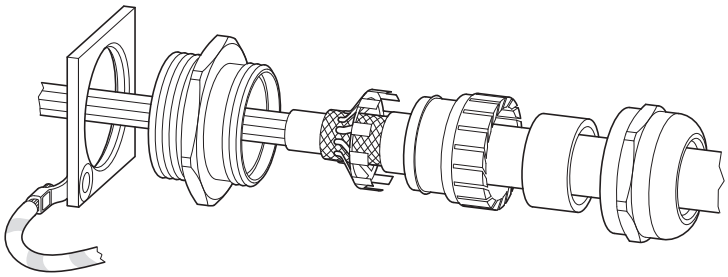


Figure 75: Example: Structure of the EMC screw connection

3.6.2 Connection to control section

The connection to the control unit is made via pluggable 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), 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.

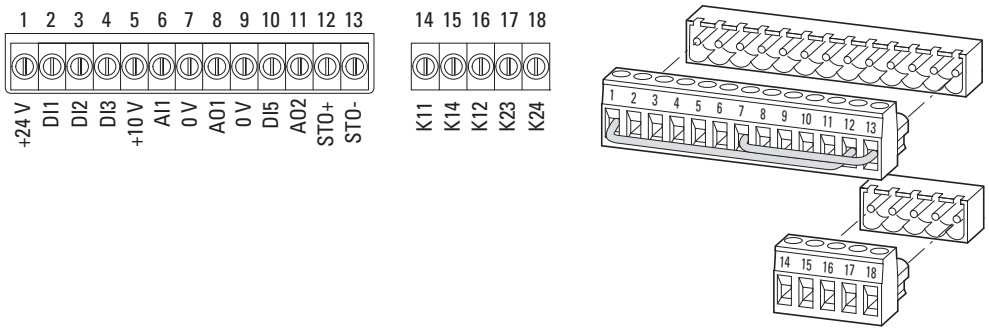


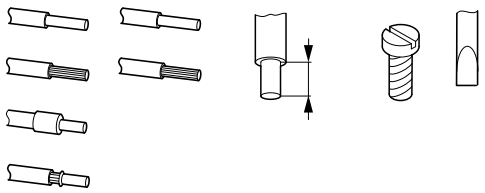
Figure 76: Plug-in control signal terminal designations

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 Connector cross sections

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	mm²	AWG	mm	in	Nm	mm
FS2, …, FS7	0.05 - 2.5	30 - 12	8	0.31	0.5	0.6 x 3.5

3.6.2.2 Connection data and functions

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

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

Terminal		Signal	Description	Default setting (P1-12 = 0, P1-13 = 11)
1	+24 V	Control voltage for DI1 - DI5, output (+24 V)	maximum load 100 mA, Reference potential 0 V	(= Input for external control voltage, +24 V DC, reference potential at terminal 7 or terminal 9)
2	DI1	Digital Input 1	8 - +30 V (High, R_i > 6 kΩ)	FWD (clockwise rotating field enable)
3	DI2	Digital input 2	8 - +30 V (High, R_i > 6 kΩ)	REV (anticlockwise rotating field enable)
4	DI3	Digital Input 3	8 - +30 V (High, R_i > 6 kΩ)	Select AI1 REF/f-Fix (Switch-over of the setpoint source from Analog input 1 to fixed frequency)
5	+10 V	Reference voltage, Output (+10 V)	maximum load 10 mA Reference potential 0 V	–
6	AI1 DI4	Analog Input 1 Digital Input 4	• analog: 0 - +10 V (R_i > 72 kΩ) 0/4 - 20 mA (R_B = 500 Ω) switchable using parameter P2-30 • digital: 8 - 30 V (High)	Select f-Fix Bit0 (Selection of the frequency setpoint values of Bit0: f-Fix1 = 5 Hz (P2-01))
7	0 V	Reference potential	0 V = connection terminal 9	–
8	AO1 DO1	Analog output 1 Digital output 1	• analog: 0 - +10 V maximum 20 mA switchable using parameter P2-11 • digital: 0 - +24 V	Output frequency f-Out (P2-11 = 8, ADO1 function & mode)
9	0 V	Reference potential	0 V = connection terminal 7	–
10	DI5 AI2	Digital Input 5 Analog Input 2	• digital: 8 - 30 V (High) • analog: 0 - +10 V (R_i > 72 kΩ) 0/4 - 20 mA (R_B = 500 Ω) switchable using parameter P2-33	Select f-Fix Bit0
11	AO2 DO2	Analog output 2 Digital output 2	• analog: 0 - +10 V maximum 20 mA switchable using parameter P2-13 • digital: 0 - +24 V	Output current A-Out (P2-13 = 9, ADO2 function & mode)
12	STO+	Safe Torque Off +	Enable = +24 V	→ section 2.10, "STO function", page 62
13	STO-	Safe Torque Off -	Enable = 0 V	
14	K11	Relay 1, changeover contact	Maximum switching load: 250 V AC/6 A or 30 V DC/5 A	(common connection for N/C and N/O)
15	K14	Relay 1, N/O (changeover contact)	Maximum switching load: 250 V AC/6 A or 30 V DC/5 A	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, NO	Maximum switching load: 250 V AC/6 A or 30 V DC/5 A	Closed = RUN operating signal
18	K24	Relay 2, NO		

3.6.2.3 STO terminals

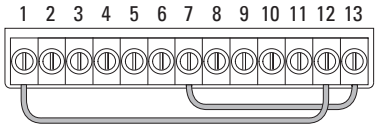


Figure 77: STO control signal terminals (direct enable)

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 V DC) is not connected to control signal terminals 12 and 13, the control section and the inverter will remain disabled.
Inh ibt (Inhibit = Disable) 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).

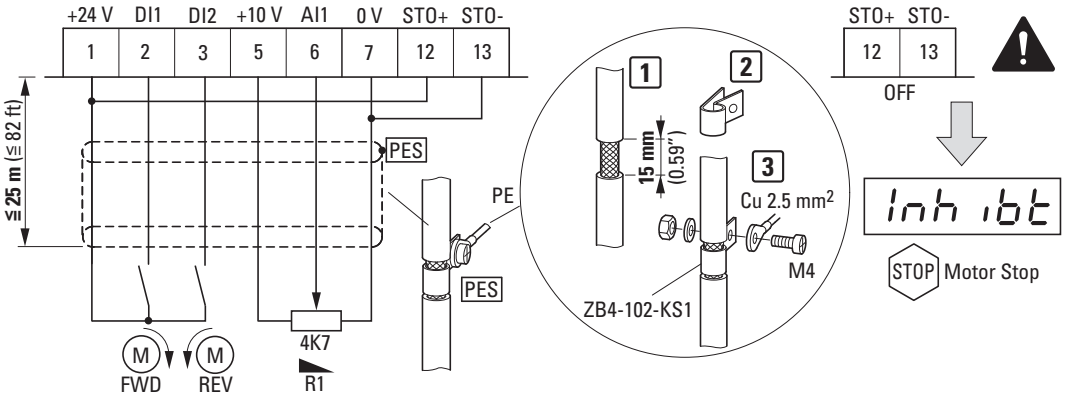


Figure 78: Simple connection example

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

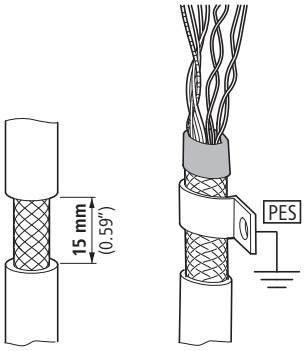


Figure 79: Preventing the screening from becoming unbraided

Alternatively, in addition to the broad area gland plate, you can twist the screen braid at the end and connect to the protective earth 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 screen braid must not make any connection with the protective ground here because this would cause problems with an interference loop.

3.6.2.5 Digital input signals

As digital inputs (DI1 to DI5), the control terminals 2, 3, 4, 6 and 10 are identical in their function and mode of operation.

It is controlled with +24 V (positive logic):

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

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

By default, the control terminals for the digital input signals are assigned as follows:

- Control signal terminal 2 as digital input 1 (DI1) = FWD (Clockwise rotating field enable),
- Control signal terminal 3 as digital input 2 (DI2) = REV (Anticlockwise rotating field enable),
- 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 parameter.

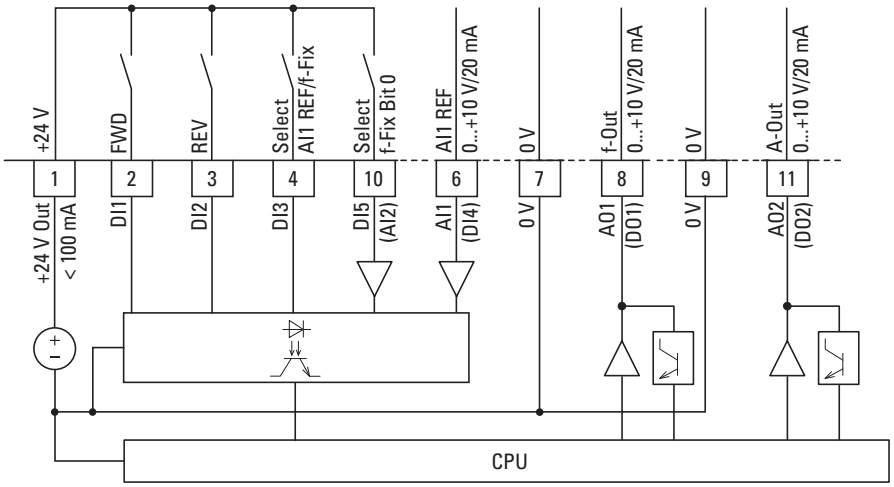


Figure 80: Control signal terminals (digital / analog)

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 80):

- 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 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 the control terminals 8 and 11 (→ figure 80) 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

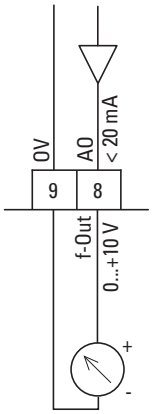


Figure 81: Analog output (AO) (connection example)

→ Control 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.

3.6.2.8 Digital Output (Transistor)

Control signal terminals 8 and 11 (→ figure 80) 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.

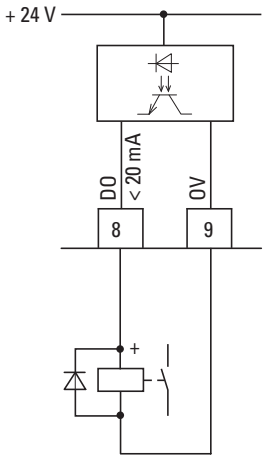


Figure 82: Connection example (coupling relay with free-wheel diode: ETS4-VS3; Part number 083094)

→ 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

DA1 variable frequency drives feature two relays with dry contacts.

Relay K1:
Control signal terminals 14 (change-over), 15 (closer) and 16 (opener)
Default setting: 1= Standby/error (Error)

Relay K2:
Control signal terminals 17 and 18 (normally open contact)
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, maximum 6 A
- 30 V DC, maximum 5 A

We recommend connecting any connected loads as follows:

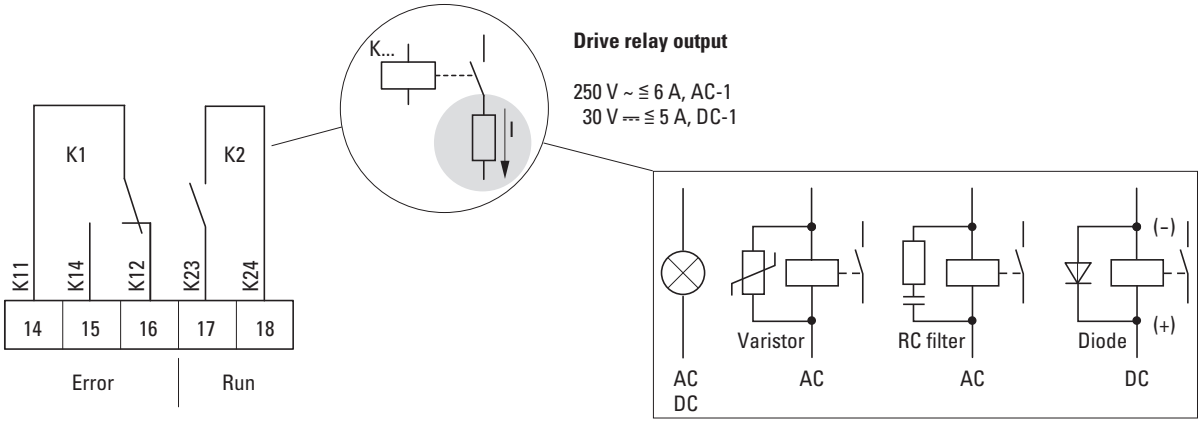


Figure 83: Connection examples with suppressor circuit

3.6.2.10 External control voltage

An external power supply unit can be used to supply the DA1 variable frequency drive's control section with 24 V DC.

DA1	External control voltage
Terminal 1	+24 V
Terminal 7, 9	0 V

The external control voltage (+24 V) must be able to handle a load of at least 100 mA.
The residual ripple of this external control voltage must be less than ±5 % $\Delta U_a/U_a$.

When supplied via an external power pack, the control panel, the control terminals and the RJ45 interface are active.

You can

- Change parameters (but not save them)
- Read measured values and error registers
- Parameters can be addressed and read out via the RJ45 interface, the drivesConnect parameterization software, fieldbuses and SmartWire-DT.
- Control level functions without the power section being powered.
- A fieldbus communication is maintained, even if there is no power supply.

3.6.2.11 RJ45 interface

The RJ45 interface on the front (IP20) or the two RJ45 interfaces under the cover of the connection terminals (IP66) enable a direct connection to communication modules and fieldbus connections.

The internal RS485 switch-on transfer Modbus RTU and CANopen and can also communicate via OP-Bus with other PowerXL components.

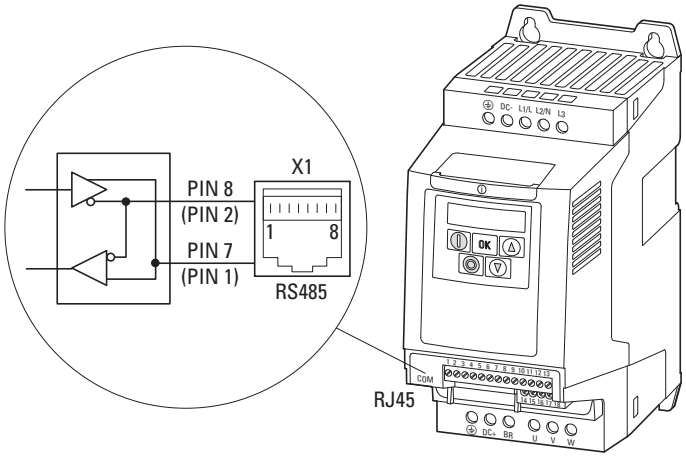


Figure 84: RJ45 interface (example: location at FS2 frame size)

IP66

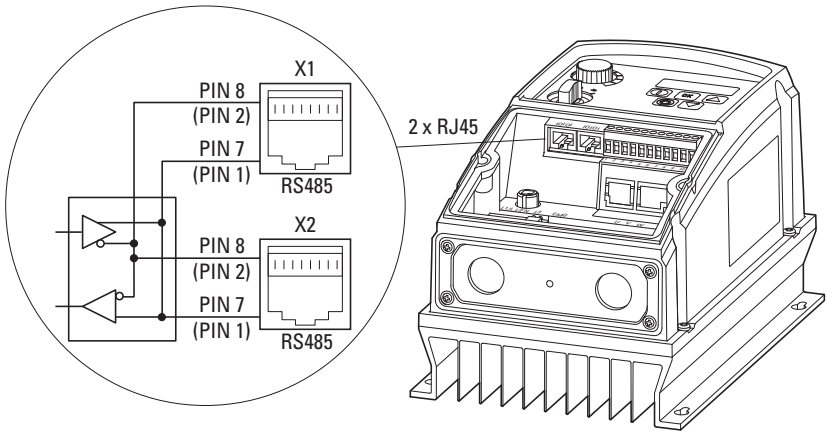


Figure 85: RJ45 interfaces (IP66)

→ DA1 variable frequency drives have no internal bus termination resistor. – Use EASY-NT-R as needed.

3.6.2.12 Using the REV–0–FWD selector switch

By adjusting the parameter settings, the variable frequency drive can be configured for different applications (including running forward or reverse). Typical applications are the manual/OFF/auto ("local/remote") applications for the heating, ventilation, air conditioning and pump industries.

The integrated selector switch works in parallel with control terminal 2 and terminal 3 as digital input 1 and digital input 2.
By default, the selector switch is enabled.

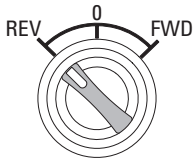
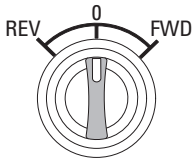
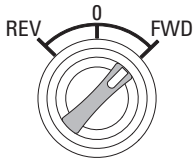
Disabling the built-in selector switch

The selector switch can be disabled as follows:

▶1. Make sure the drive is stopped.
(The display shows "Stop".)
▶2. Activate expanded parameter access in parameter P1- 14 (i.e. P1-14 = 201).
▶3. Scroll down to parameter P0-XX and make sure drive is in stop condition (not running, not tripped).
▶4. Press and hold the "STOP" button for at least one second: The IP66 Switch Setup appears.
▶5. Use the UP or DOWN button to select the appropriate option:
- 0: The selector switch is enabled. In FWD position DI1 is activated, in REV position both DI1 and DI2 are activated.
- 1: The selector switch is disabled.
- 2: The selector switch is enabled. In FWD position DI1 is activated, in REV position DI2 is activated.

▶6. To end the process, press the "STOP" button again.

Table 18: Positions of the selector switch

	switch position left		switch position middle		switch position right	
						
Option	**DI1**	**DI2**	**DI1**	**DI2**	**DI1**	**DI2**
0	1	1	0	0	1	0
1	0	0	0	0	0	0
2	0	1	0	0	1	0

3.7 Block diagrams

The following block diagrams show all the connection terminals on a DA1 variable frequency drive and their functions under 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 DA1-…-A20C

Type	Mains		Motor	
	Voltage U_{LN}	Frequency f_{LN}	Voltage U_2	Frequency f_2
DA1-12-…-A20C	1~ 200 V (-10 %) - 240 V (+10 %)	50/60 Hz	3 ~ 230 V	0 - 500 Hz
DA1-32-…-A20C	3~ 200 V (-10 %) - 240 V (+10 %)	50/60 Hz	3 ~ 230 V	0 - 500 Hz
DA1-34-…-A20C	3~ 380 V (-10 %) - 480 V (+10 %)	50/60 Hz	3~ 400 V/460 V	0 - 500 Hz
DA1-35-…-A20C	3~ 500 V (-10 %) - 600 V (+10 %)	50/60 Hz	3~ 500 V/575 V	0 - 500 Hz

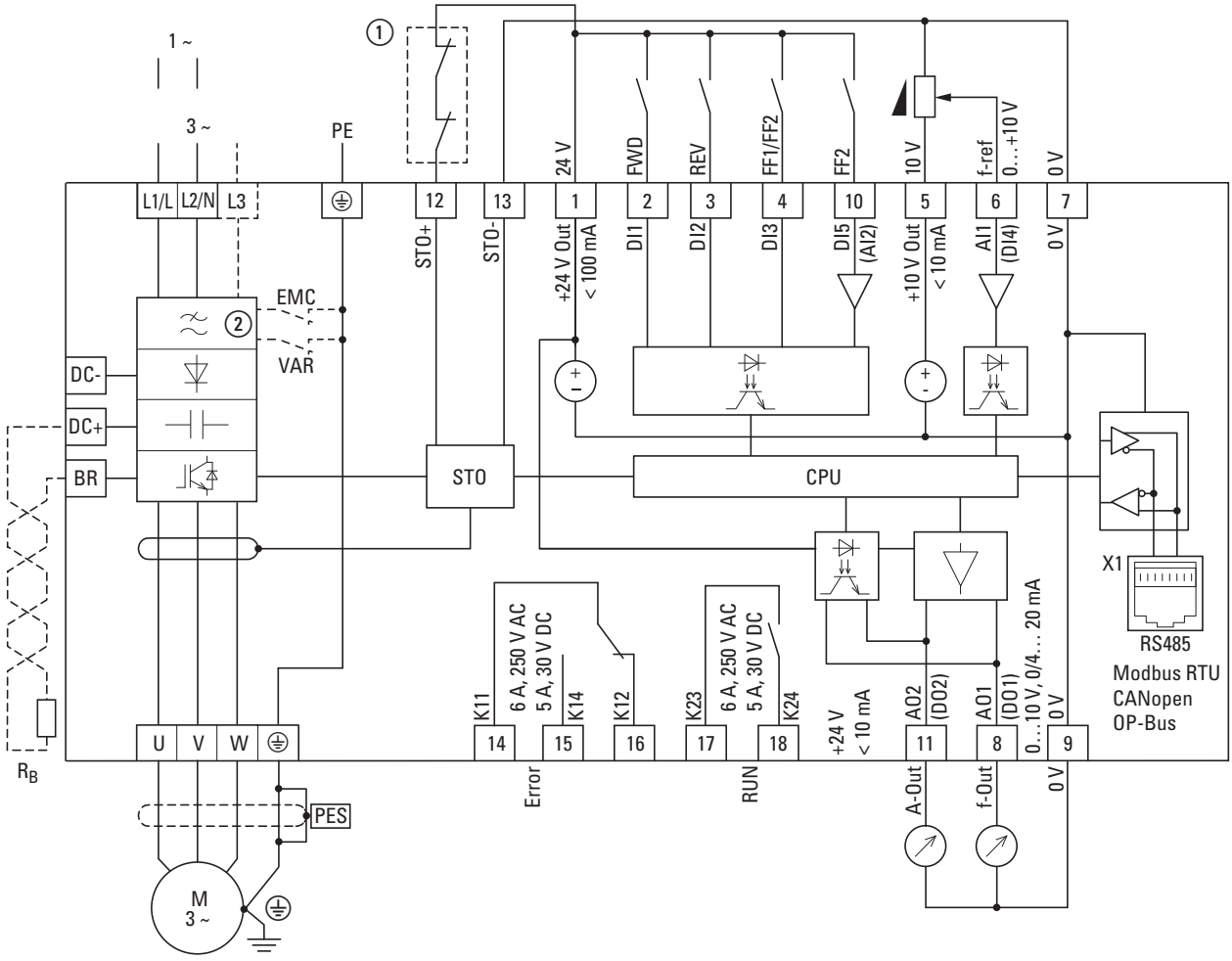


Figure 86: Block diagram DA1-…-A20C in frame sizes FS2 and FS3

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

② The RFI filter is not contained in the DA1-35-…-B6XC device.

→ The STO connection must be made by the user.

→ The VAR screw cannot be disabled with devices in sizes FS4 and FS5.

3.7.2 DA1-…-B55C

Type	Mains		Motor	
	Voltage U_{LN}	Frequency f_{LN}	Voltage U_2	Frequency f_2
DA1-32-…-B55C	3~ 200 V (-10 %) - 240 V (+10 %)	50/60 Hz	3 ~ 230 V	0 - 500 Hz
DA1-34-…-B55C	3~ 380 V (-10 %) - 480 V (+10 %)	50/60 Hz	3~ 400 V/460 V	0 - 500 Hz
DA1-35-…-B55C	3~ 500 V (-10 %) - 600 V (+10 %)	50/60 Hz	3~ 500 V/575 V	0 - 500 Hz

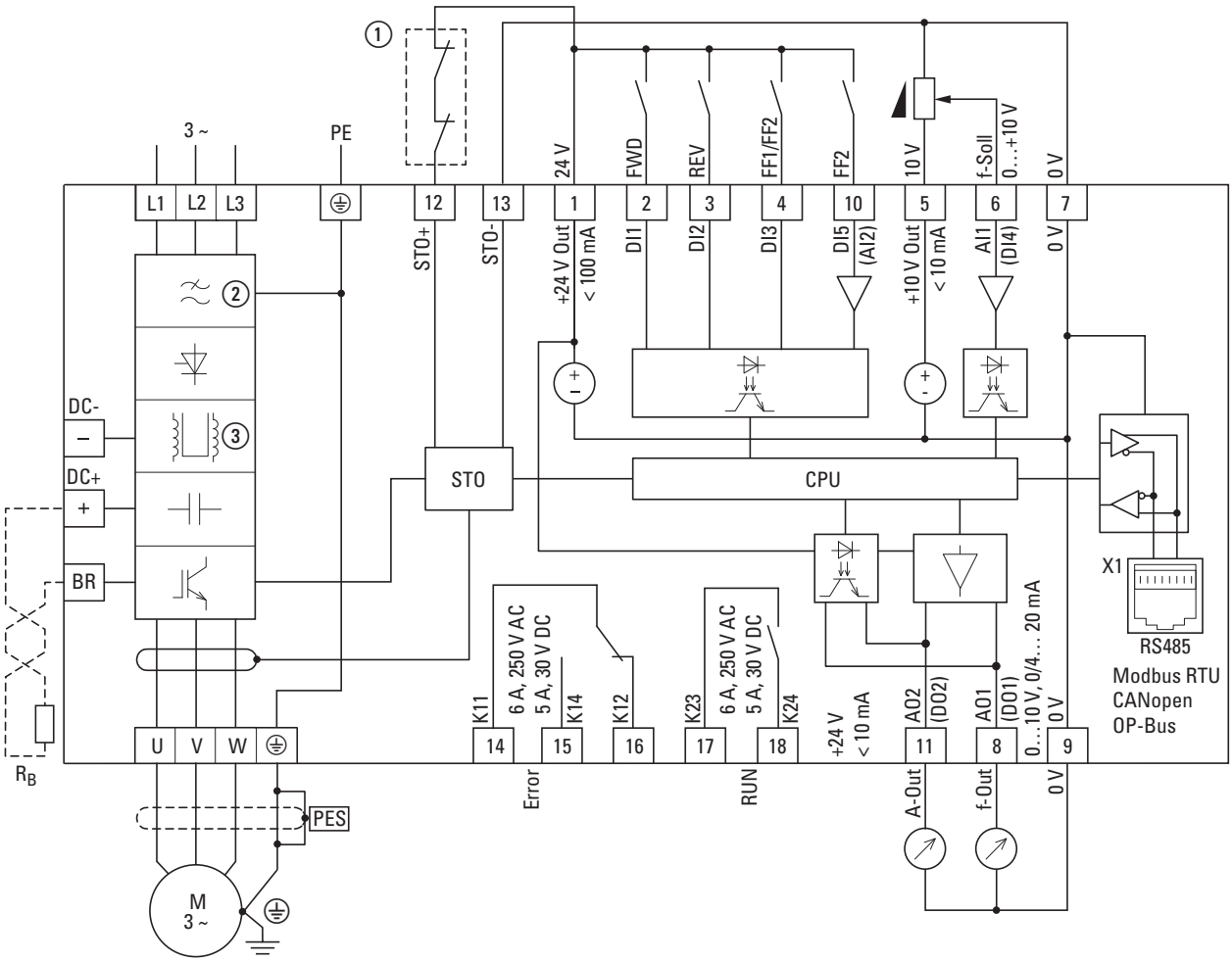


Figure 87: DA1-…-B55C block diagram

① Direct enable of the STO function or relay: Safe Torque Off (STO), SIL 2 (EN 61800-5-2)

② The RFI filter is not contained in the DA1-35-…-B6XC device.

③ A DC link choke is contained in sizes FS5, FS6, FS7.

→ The STO connection must be made by the user.

→ The VAR screw cannot be disabled with devices in sizes FS4, FS5, FS6 and FS7.

3.7.3 DA1-…-B6SO

Type	Mains		Motor	
	Voltage U_{LN}	Frequency f_{LN}	Voltage U_2	Frequency f_2
DA1-12-…-B6SO	1~ 200 V (-10 %) - 240 V (+10 %)	50/60 Hz	3 ~ 230 V	0 - 500 Hz
DA1-32-…-B6SO	3~ 200 V (-10 %) - 240 V (+10 %)	50/60 Hz	3 ~ 230 V	0 - 500 Hz
DA1-34-…-B6SO	3~ 380 V (-10 %) - 480 V (+10 %)	50/60 Hz	3~ 400 V/460 V	0 - 500 Hz
DA1-35-…-B6SO	3~ 500 V (-10 %) - 600 V (+10 %)	50/60 Hz	3~ 500 V/575 V	0 - 500 Hz

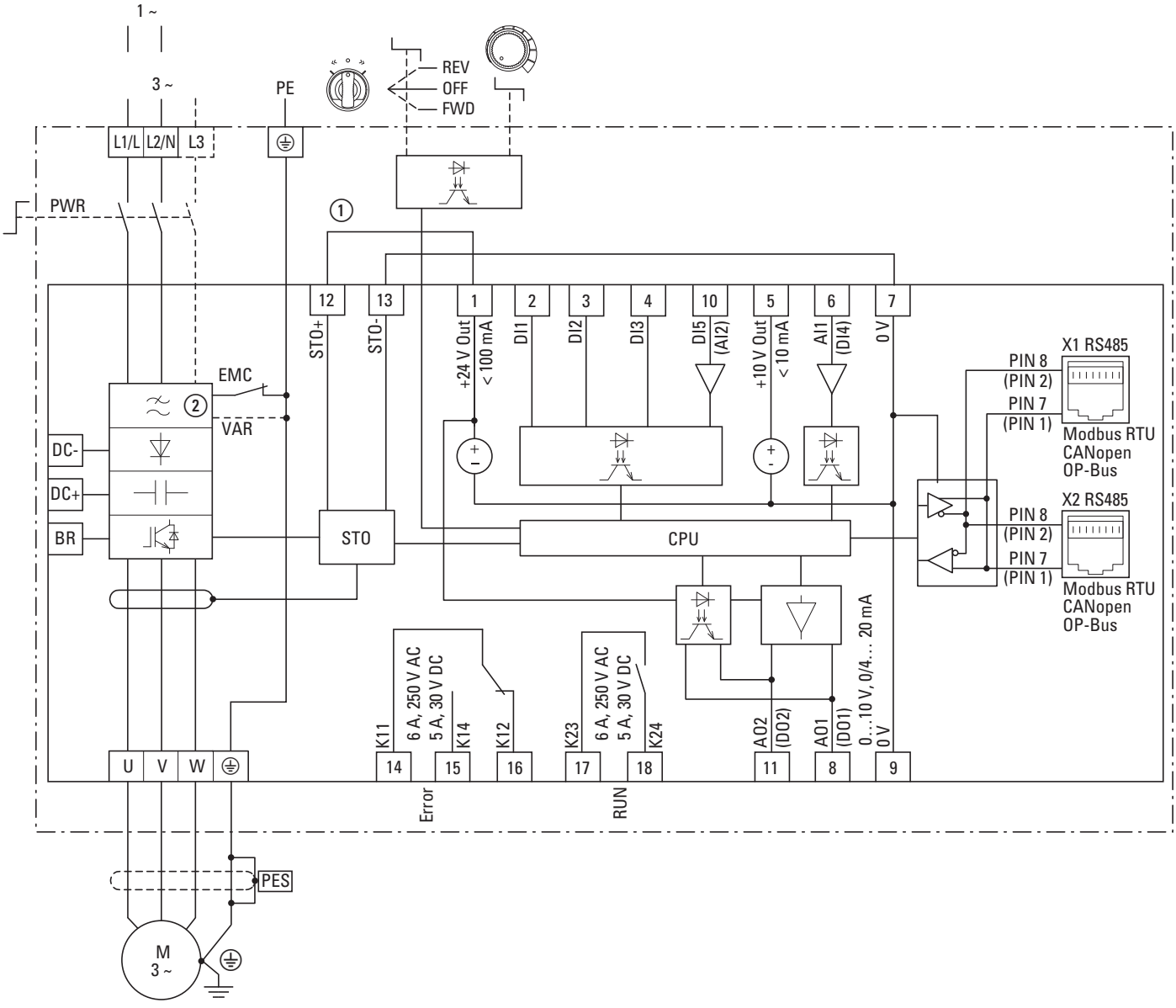


Figure 88: Block diagram DA1-…-B6SC

① Direct enable of the STO function or relay: Safe Torque Off (STO), SIL 2 (EN 61800-5-2) as seen in → figure 87, page 120.
② The RFI filter is not contained in the DA1-35-…-B6XC device.

→ The STO connection must be made by the user.

3.7.4 DA1-…-B66O

Type	Mains		Motor	
	Voltage U_{LN}	Frequency f_{LN}	Voltage U_2	Frequency f_2
DA1-12-…-B66O	1~ 200 V (-10 %) - 240 V (+10 %)	50/60 Hz	3 ~ 230 V	0 - 500 Hz
DA1-32-…-B66O	3~ 200 V (-10 %) - 240 V (+10 %)	50/60 Hz	3 ~ 230 V	0 - 500 Hz
DA1-34-…-B66O	3~ 380 V (-10 %) - 480 V (+10 %)	50/60 Hz	3~ 400 V/460 V	0 - 500 Hz
DA1-35-…-B66O	3~ 500 V (-10 %) - 600 V (+10 %)	50/60 Hz	3~ 500 V/575 V	0 - 500 Hz

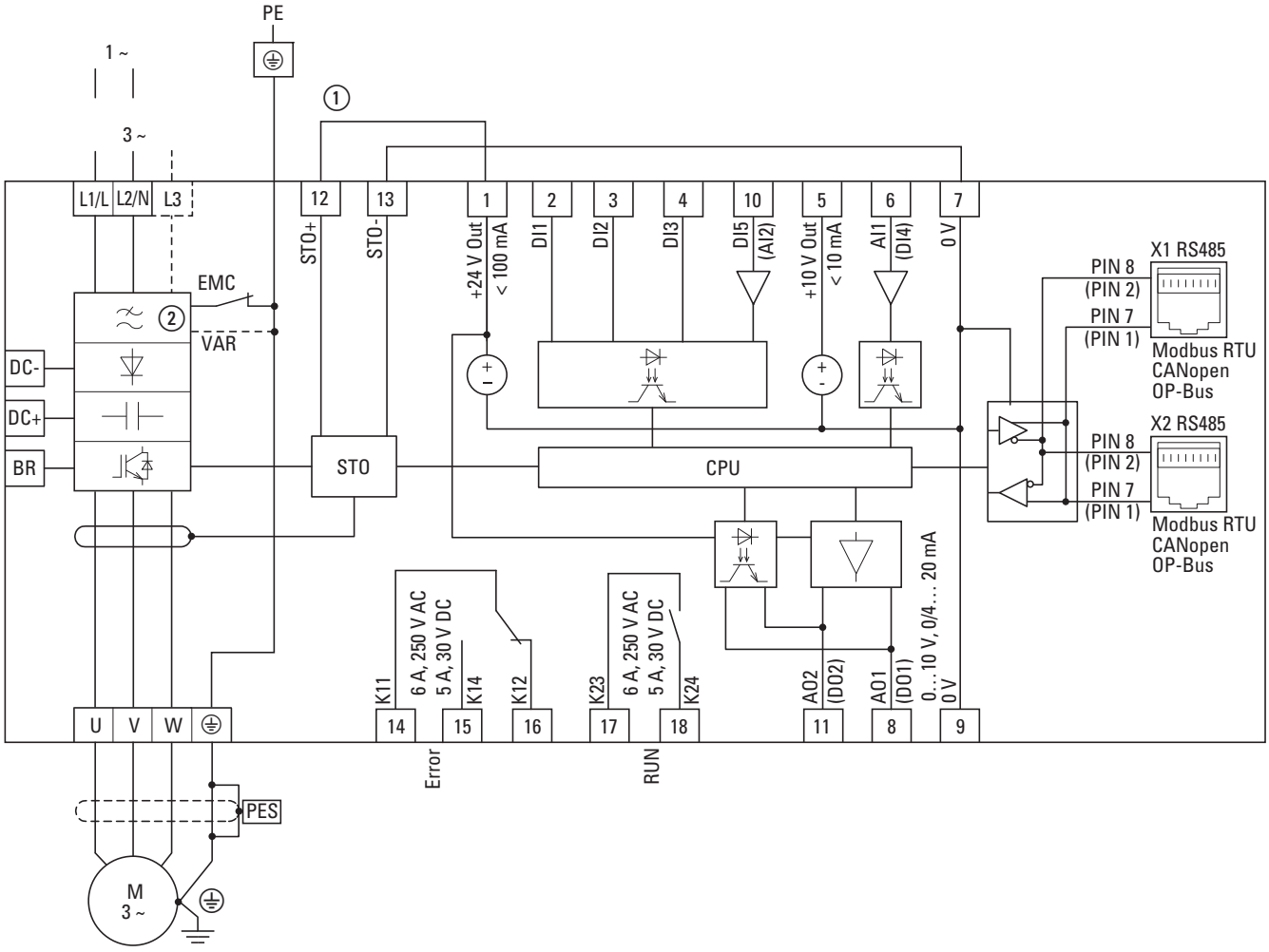


Figure 89: DA1-…-B66C block diagram

① Direct enable of the STO function or relay: Safe Torque Off (STO), SIL 2 (EN 61800-5-2) as seen in → figure 87, page 120.

② The RFI filter is not contained in the DA1-35-…-B6XC device.

→ The STO connection must be made by the user.

3.8 Insulation testing

The variable frequency drive of the DA1 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 disconnecting 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 each phase conductor and the protective conductor.

The insulation resistance must be greater than 1 MΩ.

Testing the mains cable insulation

- Disconnect the power cable from the mains supply network and from the connection terminals L1/L, L2/N and L3 of the variable frequency drive.
  Measure the mains cable's insulation resistance between the individual phase conductors and between each phase conductor and the protective conductor.

The insulation resistance must be greater than 1 MΩ.

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 MΩ.

→ Take the instructions from the motor manufacturer into account when testing the insulation resistance.

3.9 Protection against electric shock

Ensuring protection against electric shock when using DA1 variable frequency drives, as per IEC/EN 61800-5-1

Manufacturer's declaration for the initial validation under 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 as per IEC/HD 60364-4-41 (DIN VDE 0100-410 (VDE 0100-410)) for the circuit on the output side of the aforementioned equipment is ensured based on the following requirements:

- The installation instructions in this documentation have been followed.
- 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 above 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 applying 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 ground, the aforementioned equipment reduces the output voltage within the times as per Table 41.1 or otherwise within 5 seconds – whichever applies – in accordance with IEC/HD 60364-41 (DIN VDE 0100-410; VDE 0100-410):2007-06).

4 Operation

4.1 Commissioning checklist

Before starting to operate the variable frequency drive, use the checklist below to make sure that all the following requirements are met:

No.	Activity	Comment
1	The assembly and wiring have been carried out in accordance with the corresponding assembly instructions (→ IL04020010Z, IL040049ZU, IL04020011Z, IL040061ZU).	
2	Any wiring residue, pieces of cable and all tools used have been removed from the vicinity of the variable frequency drive.	
3	All connection terminals in the power section and in the control section are tightened with the specified torque.	
4	The lines connected to the output terminals of the variable frequency drive (U, V, W, DC+, BR) are **not** short-circuited and **not** connected to ground (PE).	
5	The variable frequency drive has been grounded 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, taking into account the degree of protection and were designed to meet the requirements.	
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 1.7, "Selection criteria", page 32 connection type (star, delta) of the motor checked).	
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 set point value = zero).	
11	The parameters that were preset at the factory have been checked with the list of parameters.	
12	The direction of action of a coupled machine will allow the motor to start.	
13	All EMERGENCY STOP and protective functions (→ section 2.10, "STO function", page 62) are in the proper state.	

4.2 Operational warnings

Please observe the following notes.

DANGER

Commissioning must only be completed by qualified technicians.

DANGER

Dangerous electrical 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: the 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 (14, 18) even if the variable frequency drive is not connected to the mains voltage (e.g. when installing 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 may start automatically (when the mains voltage is switched back on) if the automatic restart function has been enabled (→ parameters P2-36).

WARNING

Any contactors and switching devices on the line side are not to be opened during motor operation.
Inching operation using the mains contactor 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.

WARNING

Make sure that no danger will be caused by 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. Otherwise the motors could be damaged.

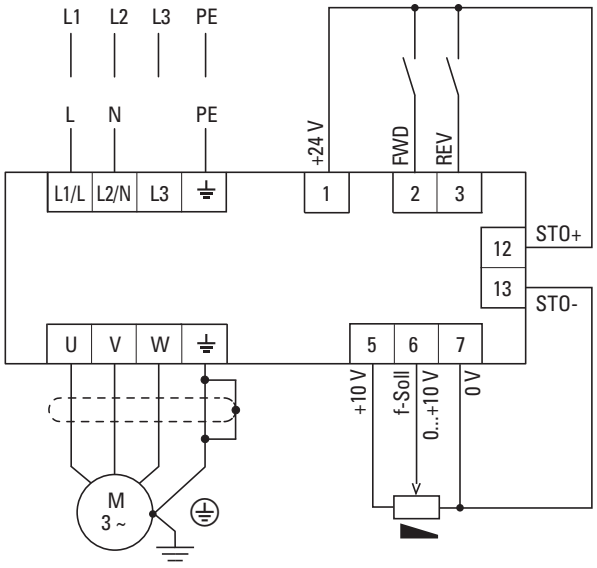
4.3 Commissioning with control signal terminals (default settings)

The controls on DA1 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 DA1 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.

Connecting example for three-phase motor

Connecting example for three-phase motor	Terminal	Designation	
	L1/L	Single-phase supply terminal (DA1-12…)	three-phase supply terminal (DA1-3…)
	L2/N		
	L3	–	
	⏚	Ground connection	
	1	Control voltage +24 V (output, maximum 100 mA)	
	2	FWD, Start enable clockwise rotating field	
	3	REV, Start enable left rotating field	
	U	Connection for three-phase AC motor (three-phase motor)	
	V		
	W		
	⏚		
	5	Set point value 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 -	

▶ Connect the Inverter according to the above connection example for easy commissioning with the specified factory setting (see above connection example).

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

Make sure that the enable contacts (FWD/REV) are open and the STO is properly connected before applying 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 enable (FWD/REV) for the first time.

When the specified supply voltage is applied to the mains connection terminals (L1/L, L2/N, L3), the control voltage is generated via the switched-mode power supply (SMPS) in the intermediate circuit and the 7-segment LED display is illuminated (STOP).

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

The start enable 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 output frequency will then be changed after a delay according to the specified acceleration and deceleration times. In the default settings, these times are set to 5 seconds each, from frame size FS4 onwards to 10 seconds each.

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

Figure 90 shows an example of the course when the enable signal (FWD/REV) is switched on and the maximum setpoint voltage (+10 V) is present. The speed of the motor follows the output frequency, depending on the load torque and moment of inertia (slip), from 0 to n_{max}.

If the enable signal (FWD, REV) is switched off during operation, the inverter will be disabled immediately (STOP) and the output frequency will be set to 0. The motor stops uncontrolled (see ① in Figure 90).
The acceleration time is set in parameter P1-03.

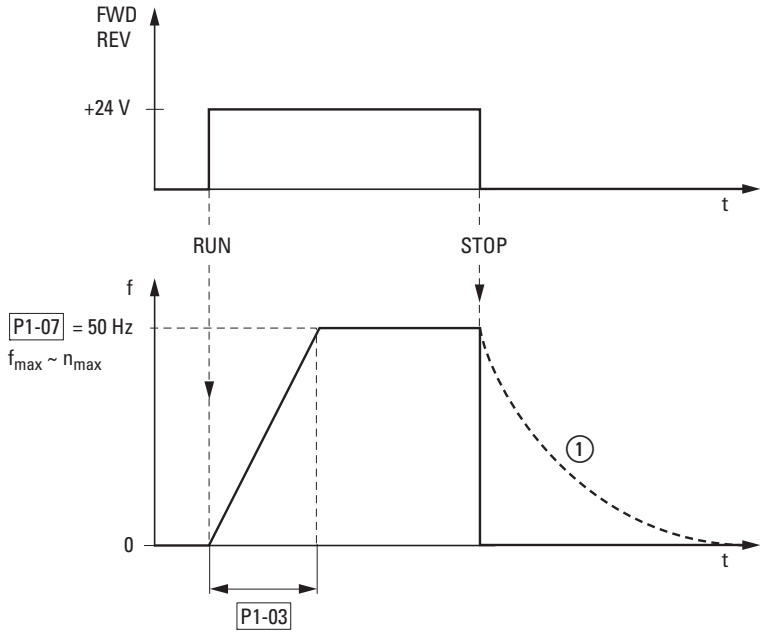


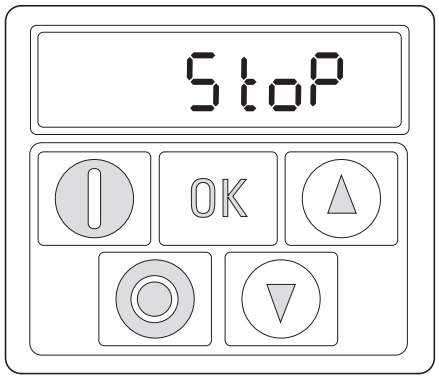
Figure 90: Start-stop command at maximum set point voltage

4.4 Handling of the control unit

The keypad can be used to configure the DA1 variable frequency drive's parameters and monitor its operation.

4.4.1 Keypad elements

The following figure shows the elements of the integrated keypad for the DA1 variable frequency drive.



Display (7-digital LEDs)

Buttons

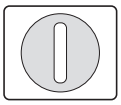
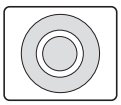
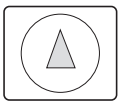
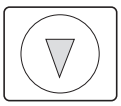
Figure 91: Operating unit view (example DA1-…-A20C)

The integrated operating unit on DA1-…-A20C devices and the (optional) external DX-KEY-LED keypad feature a six-digit 7-segment LED display.
Meanwhile, DA1-…-B20C, DA1-…-B55C devices and the (optional) external DX-KEY-OLED keypad feature a multi-language cleartext display (OLED = organic light-emitting diode display). The function of the control buttons is identical.
With the external DX-KEY-OLED operating unit, two additional keys (**Hand**, **Auto**) are available. These keys have no function in the basic version and can only be freely configured in the PLC Editor.

The language selection can be enabled on the OLED displays using the key combination **START** + ▲.
Display: **Select Language**.
Change the display language using the ▲ and ▼ arrow keys.
The selected language setting can then be saved by pressing the **OK** button.

The **START**, **STOP**, **UP** and **DOWN** buttons must be activated in parameter P1-12 (local process data source).

Table 19: Keypad elements – keys

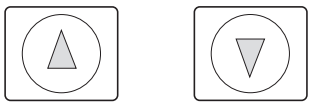
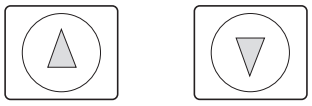
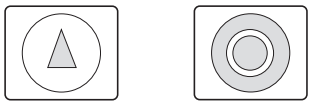
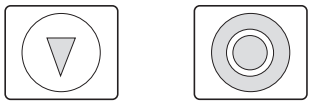
Button	Command	Explanation
	**OK**	• Navigating in parameter mode • Opens and closes the parameter interface (Press and hold the button for more than two seconds) • Saves parameter changes • Changing the display A, rpm, … (real-time information)
	**START**	• Starts the variable frequency drive[1)] • Change of direction of rotation[2)] while the motor is running
	**STOP**	• Stops the variable frequency drive[1)] • Reset – Reset after an error message
	**UP**	• Increases the speed[1)] • Increment numeric value or parameter number
	**DOWN**	• Decreases the speed[1)] • Decrement numeric value or parameter number

Note:

1) P1-12 = 1 (one direction of rotation) or P1-12 = 2 (two directions of rotation); Reversal of direction of rotation when the START button is pressed again
2) P1-12 = 2 only

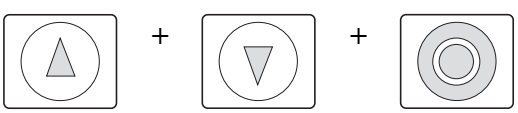
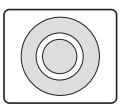
4.4.2 Setting parameters

Table 20: Modify parameters

Commands	Description
	Press the **OK** button and hold it down for two seconds in order to access the parameter interface. → The display shows the parameter that was used last.
	Select the parameters using the ▲ and ▼ buttons.
	Press the **OK** button. The value of the selected parameter can be changed.
	Change the parameters using the ▲ and ▼ buttons.
	Press the **OK** button to confirm the parameter value change. As soon as the parameter is displayed, the value will have been saved. Press the **OK** button and hold it down for two seconds in order to exit the parameter interface (display: StoP).
	**Switching between two parameter groups** 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 vice versa. **Note:** To access the extended parameter groups, you will need to enter the password in parameter P1-14 (default setting: Level 2 = 101, Level 3 = 201). Press the ▲ and **STOP** buttons to jump to the first parameter in the next parameter group.
	Press the ▼ and **STOP** buttons to jump to the first parameter in the previous parameter group.

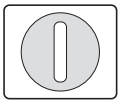
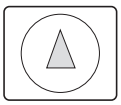
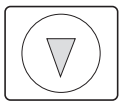
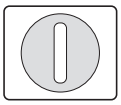
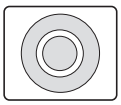
4.4.3 Resetting parameters (RESET)

Table 21: Resetting parameters (RESET)

Commands	Description
Reset to default settings	
	Press the ▲ and ▼ and STOP buttons together or simultaneously and hold them down for two seconds. **→ All parameters will be reset to their default settings.** The display will show P-dEF.
Reset after a fault	
	Press the **STOP** button to reset a fault message. The display will show StoP.

4.4.4 Control via keypad

Table 22: Control via keypad

Button	Attribute ID	Explanation
	**OK**	P1-12 = 1 or = 2 • P1-12 = 1: one operating direction (FWD) • P1-12 = 2: two operating directions (FWD/REV)
	**START**	Starts the variable frequency drive
 		▲ Increase speed ▼ Decrease speed
	**START**	Changes the operating direction if the motor is running **Note:** P1-12 = 2 only
	**OK**	Changes the value being displayed: A, rpm, etc.
	**STOP**	Stops the variable frequency drive

Note:
In this mode, a high-level signal must be applied at terminal 2 (DI1) as an enable signal for the DA1 variable frequency drive.

5 Parameter

5.1 Parameter Groups

The DA1 variable frequency drive's functions are configured with the use of parameters. These parameters are subdivided into ten groups (P0-…, …, P9-…):

Table 23: Parameter Groups

Parameter group	Theme
P0	Monitor
P1	Basic
P2	Functions
P3	PID
P4	Mode
P5	Bus
P6	Extended
P7	Motor
P8	Ramps
P9	Control assembly

→ The following page (“Menu Strcture“) features a diagram showing how to switch between parameter groups.

Default settings

By default, only parameter group 1 (“Basic”) will be accessible.

Extended parameter set

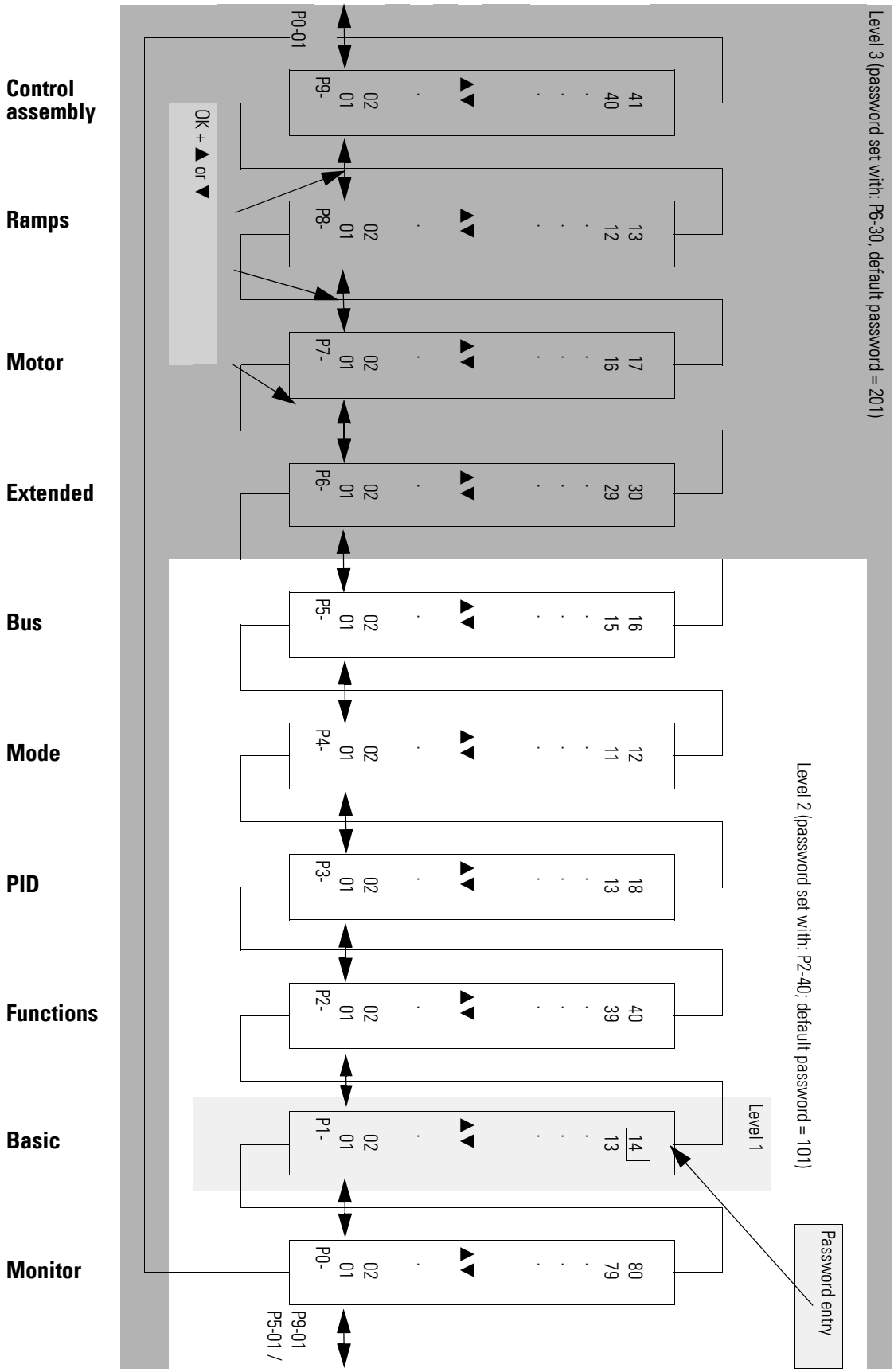
Level 2 (menu P0 to menu P5) and level 3 (menu P0 to menu P9) can be accessed by using parameter P-14 to enter the correct password.

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


Control assembly
Ramps
Motor
Extended
Bus
Mode
PID
Functions
Basic
Monitor
Level 3 (password set with: P6-30, default password = 201)
Level 2 (password set with: P2-40; default password = 101)
Level 1
Password entry
OK + ▲ or ▼
P0-01
P9-01
P5-01 /

5.2 Control signal terminals

5.2.1 Correspondence between inputs/outputs and terminals

Input/Output	Clips
Entries	
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
Outputs	
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 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:

Table 24: Abbreviations and acronyms for control signal terminal configurations

Abbreviation	Significance
AI1 REF	Analog input AI1 (terminal 6) Used as a speed setpoint input. • P2-30: configuration (voltage input/current input …) • P2-31: scaling • P2-32: offset
AI2 REF	Analog input AI2 (terminal 10) Used as a speed setpoint input. • P2-33: configuration (voltage input/current input …) • P2-34: scaling • P2-35: offset
AI2 Torque REF	Analog input AI2 (terminal 10) Used as a torque setpoint input. • P2-33: configuration (voltage input/current input …) • P2-34: scaling • P2-35: offset
DIR	Used to select an operating direction Used together with the START command. • Low = clockwise rotating field (FWD) • High = anticlockwise rotating field (REV) **Note:** If there is a wire breakage and the REV operating direction is selected, this will cause the drive to reverse! Alternative: Use configuration with FWD/REV.
DOWN	Used to reduce the speed if a digital setpoint value is selected (P1-12 = 1 or = 2). Used together with the UP command.
ENA	Variable frequency drive enable signal (ENA = Enable) A start signal (START, FWD, REV) is additionally required for starting. If ENA is removed, the drive will coast.
EXTFLT	Ext Fault/Warning Can be used to integrate an external signal into the variable frequency drive's fault messages. 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 *E-Er ,P* as a fault message.
FWD	Starts the drive with a clockwise rotating field (FWD = Forward) 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. 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) The operating direction will be reversed as per the configured ramps. • High = invert • Low = Do not reverse
Pulse FWD (NO) Pulse REV (NO) Pulse STOP (NC)	Pulse control 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 (counterclockwise rotating field) signal. The FWD and REV signals do not need to be continuously applied during operation. In order to be able to use this function, P9-05 must be set to 1.

Abbreviation	Significance
REV	Starts the drive with a counterclockwise rotating field (REV = Reverse) 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. In applications with two operating directions, the clockwise rotating field is selected with FWD. 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).
Select Quick-Dec	Quick Stop 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.
Select AI1 REF/AI2 REF	Used to select between the analog setpoint values on AI1 (terminal 6) and AI2 (terminal 10) • AI1 = Low • AI2 = High
Select AI1 REF/f-Fix	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. • Low = analog setpoint value • High = fixed frequency
Select AI1 REF/f-Fix1	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. • Low = analog setpoint value • High = Preset Speed 1
Select BUS REF/AI2 REF	Used to select between setpoint values • Low = Setpoint from bus or from a master drive (if P1-12 = 5) • High = AI2
Select BUS REF/f-Fix	Used to select between setpoint values • Low = Setpoint from bus or from a master drive (if P1-12 = 5) • High = fixed frequency. The fixed frequency itself is selected with the Select f-Fix Bit0, Select f-Fix Bit1, Select f-Fix Bit2 commands.
Select BUS REF/f-Fix1	Used to select between setpoint values • Low = Setpoint from bus or from a master drive (if P1-12 = 5) • High = f-Fix1 (set with P2-01)
Select DIG REF/AI2 REF	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) • Low = digital setpoint value • High = AI2
Select DIG REF/f-Fix	Used to select between the digital speed reference value (set with the keypad or with the UP and DOWN commands) and a fixed frequency The fixed frequency itself is selected with the Select f-Fix Bit0, Select f-Fix Bit1, Select f-Fix Bit2 commands. • Low = analog setpoint value • High = fixed frequency
Select DIG REF/f-Fix1	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 • Low = digital setpoint value • High = Preset Speed 1

<table>
<tr><th>Abbreviation</th><th>Significance</th></tr>
<tr><td>Select f-Fix Bit0
Select f-Fix Bit1
Select f-Fix Bit2</td><td>Used to select a fixed frequency with digital commands
Fixed frequencies f-Fix1, …, f-Fix8 are defined with parameters P2-01, …, P2-08.
<table>
<tr><th>Fixed frequency</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr>
<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>
</table>
0 = Low; 1 = High</td></tr>
<tr><td>Select PID REF/AI2 REF</td><td>Used to select between setpoint values
• Low = Setpoint from the PID controller’s output
• High = AI2</td></tr>
<tr><td>Select PID REF/f-Fix</td><td>Used to select between setpoint values
• Low = Setpoint from the PID controller’s output
• High = Fixed frequency
The fixed frequency itself is selected with the
Select f-Fix Bit0, Select f-Fix Bit1, Select f-Fix Bit2 commands.</td></tr>
<tr><td>Select PID REF/f-Fix1</td><td>Used to select between setpoint values
• Low = Setpoint from the PID controller's output
• High = f-Fix1 (set with P2-01)</td></tr>
<tr><td>Select Quick-dec</td><td>Used to activate a quick stop with the ramp set with P2-25
In order to activate the quick stop, there must be a high signal at both terminals</td></tr>
<tr><td>Select t-dec/t-dec2</td><td>Used to select between deceleration ramp 1 t-dec set with P1-04 and deceleration ramp 2 t-dec2 (P8-11)
• Low = Deceleration ramp 1
• High = Deceleration ramp 2</td></tr>
<tr><td>START</td><td>Used to start/stop the drive
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.
In applications with two operating directions, the directions are selected using the DIR and INV commands.</td></tr>
<tr><td>UP</td><td>Used to increase the speed if a digital setpoint is selected (P1-12 = 1 or 2)
Used together with the DOWN command.</td></tr>
</table>

5.2.2 Configuration of the control signal terminals

5.2.2.1 P1-12 = 0: Terminal-based operation (= default setting)

Table 25: P1-12 = 0: Terminal-based operation (= default setting)

P1-13	DI1 (terminal 2)	DI2 (terminal 3)	DI3 (terminal 4)	DI4/AI1 (terminal 6)	DI5/AI2 (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 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)

5.2.2.2 P1-12 = 1: Digital setpoint value, 1 operating direction

Table 26: P1-12 = 1: Digital setpoint value, 1 operating direction

P1-13	DI1 (terminal 2)	DI2 (terminal 3)	DI3 (terminal 4)	DI4/AI1 (terminal 6)	DI5/AI2 (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.

5.2.2.3 P1-12 = 2: Digital setpoint value, 2 operating directions

Table 27: P1-12 = 2: digital setpoint value, 2 operating directions

P1-13	DI1 (terminal 2)	DI2 (terminal 3)	DI3 (terminal 4)	DI4/AI1 (terminal 6)	DI5/AI2 (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.

5.2.2.4 P1-12 = 3: PID controller

Table 28: P1-12 = 3: PID controller

P1-13	DI1 (terminal 2)	DI2 (terminal 3)	DI3 (terminal 4)	DI4/AI1 (terminal 6)	DI5/AI2 (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				

5.2.2.5 P1-12 = 4: Control via field bus

Table 29: P1-12 = 4: Control via field bus

P1-13	DI1 (terminal 2)	DI2 (terminal 3)	DI3 (terminal 4)	DI4/AI1 (terminal 6)	DI5/AI2 (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 set exclusively through the bus. Simultaneously applying a signal at DI1 and DI2 will result in a quick stop.

5.2.2.6 P1-12 = 5: Slave mode

Table 30: P1-12 = 5: Slave mode

P1-13	DI1 (terminal 2)	DI2 (terminal 3)	DI3 (terminal 4)	DI4/AI1 (terminal 6)	DI5/AI2 (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!

5.2.2.7 P1-12 = 6: Control via CANopen

Table 31: P1-12 = 6: Control via CANopen

P1-13	DI1 (terminal 2)	DI2 (terminal 3)	DI3 (terminal 4)	DI4/AI1 (terminal 6)	DI5/AI2 (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.

5.2.2.8 P1-12 = 9: SWD control + setpoint value

Table 32: P1-12 = 9: SWD control + setpoint value

P1-13	DI1 (terminal 2)	DI2 (terminal 3)	DI3 (terminal 4)	DI4/AI1 (terminal 6)	DI5/AI2 (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				

5.2.2.9 P1-12 = 10: SWD control

Table 33: P1-12 = 10: SWD control

P1-13	DI1 (terminal 2)	DI2 (terminal 3)	DI3 (terminal 4)	DI4/AI1 (terminal 6)	DI5/AI2 (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				

5.2.2.10 P1-12 = 11: SWD setpoint value

Table 34: P1-12 = 11: SWD setpoint value

P1-13	DI1 (terminal 2)	DI2 (terminal 3)	DI3 (terminal 4)	DI4/AI1 (terminal 6)	DI5/AI2 (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				

5.2.2.11 P1-12 = 13: SmartWire-DT control + setpoint, start via bus and terminal

Table 35: P1-12 = 13: SmartWire-DT control + setpoint, start via bus and terminal

P1-13	DI1 (terminal 2)	DI2 (terminal 3)	DI3 (terminal 4)	DI4/AI1 (terminal 6)	DI5/AI2 (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).

5.3 Messages

5.3.1 List of messages

The following messages can occur:

Table 36: List of messages

Message	No.	Possible causes and fixes
StOP	–	Ready to start. There is no drive enable signal present. There are no fault messages present.
Inh ibt	–	STO inputs (terminals 12 and/or 13) de-energized • Safety relay switched off • Voltage source overloaded Consequence: The drive is disabled.
no-FLt	00	Shown for P0-13 if there are no messages in the error register.
OI -b	01	Excessively high braking current • Check the brake resistor and its wiring for short-circuits and ground faults. • Make sure that the braking resistance value is not lower than the minimum permissible braking resistance.
OL -br	02	Thermal overload on brake resistor The drive has been switched off in order to prevent the brake resistor from being thermally destroyed. • Make the P1-04 and P2-25 ramp times longer in order to have less frequent braking. • Reduce the load's inertia, if possible.
O-I	03	Overcurrent at variable frequency drive output Occurs right after switching on the unit: • Check the cable connection between the variable frequency drive and the motor • Check the motor for shorted turns and ground faults Occurs when starting the motor: • Check whether the motor can rotate freely and make sure that it is not being blocked mechanically. • Motor with mechanical brake: Check whether the brake is being applied. • Check the connection configuration (star/delta). • Check to make sure that the motor data was entered correctly in P1-07, P1-08, and P1-09. • In vector control mode (P4-01 = 0 or 1): Check to make sure that the cos φ (P4-05) value was entered correctly and that a motor identification run was performed correctly. • Increase the acceleration ramp time (t-acc, P1-03) if necessary. • In speed control mode (P4-01 = 2): Reduce the voltage boost with P1-11. Occurs during operation at a constant speed: • Check whether the motor is overloaded. Occurs during acceleration/deceleration: • 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.
I.t-trP	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. • Check to make sure that the motor data was entered correctly in P1-07, P1-08, and P1-09. • In vector control mode (P4-01 = 0 or 1): Check to make sure that the cos φ (P4-05) value was entered correctly and that a motor identification run was performed correctly. • Check the motor's connection configuration (e.g., start/delta) • If the decimal points on the display flash during operation, this means that the unit is being run in its overload range (> P1-08). In this case, use P1-03 to make the acceleration ramp longer or reduce the load. • Make sure that the motor is not being mechanically blocked and that there are no additional loads on the motor.
PS-trP	05	Overcurrent (Hardware) • Check the wiring to the motor and the motor itself for short-circuits and ground faults. • 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.

Message	No.	Possible causes and fixes
O.Uolt	06	Overvoltage in DC link 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). • Check to make sure that the supply voltage falls within the range for which the variable frequency drive is sized. • If the fault occurs during deceleration or stopping: Make the deceleration ramp (P1-04/P2-25) longer or use the brake resistor. • In vector control mode (P4-01 = 0 or = 1): Reduce the speed controller's gain (P4-03). • If using the PID controller: Reduce P3-11 (PID1 fault ramp) to ensure that the ramps are active.
U.Uolt	07	Undervoltage in DC link. **Note:** 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. If the message appears during operation: • Check whether the power supply voltage is too low. • 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.
O-t	08	Overtemperature at heat sink. The drive is too hot. 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). • 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). • Check to make sure that the device fan is running. • Make sure that cooling air can circulate freely (clearances to neighboring devices above and below the variable frequency drive). • 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. • Reduce the carrier frequency with P2-24. • Reduce the load if possible.
U-t	09	Under-temperature 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-dEF	10	The parameters' default settings have been loaded. • Press the STOP button: You will be able to reconfigure the drive after doing so.
E-tr iP	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. • If a thermistor is connected to terminal 10, check whether the motor is too hot.
SC-Obs	12	Communication error with an external operating unit or with a PC. • Check connections.
FLt-dc	13	Excessively high DC link voltage ripple The DC link voltage ripple can be viewed using P0-16. P0-37 contains a fault register with the last values before the unit was switched off (scan time: 20 ms). • Check to make sure that all the mains supply phases are present and that their voltage balance falls within the permissible tolerance range (3 %). • Reduce the load if possible. • If the fault persists, please contact your nearest Eaton sales branch.
P-LOSS	14	Incoming power phase failure (only for devices with a three-phase power supply)
h O-I	15	Overcurrent at output • See fault No. 03.
th-FLt	16	Malfunctioning heat sink thermistor. • Please contact your nearest Eaton sales branch.

Message	No.	Possible causes and fixes
dAtA-F	17	Error in internal memory. The parameters have not been saved and the default settings have been loaded. • Change the parameter values (again) and save them once more. • If the message appears again, please contact your nearest Eaton sales branch.
4-20 F	18	The analog input's input current does not fall within the specified range. • Check the setting in P2-30 for AI1 (terminal 6) and P2-33 for AI2 (terminal 10). • In the case of 4-20 mA: Check the setpoint connection for wire breakage.
dAtA-E	19	Error in internal memory. The parameters have not been saved and the default settings have been loaded. • Change the parameter values (again) and save them once more. • If the message appears again, please contact your nearest Eaton sales branch.
U-dEF	20	The customer's settings for the parameters have been imported. • Press the STOP button.
F-PtC	21	Motor PTC thermistor overtemperature
FAn-F	22	The device's internal fan is experiencing a fault In the case of frame size FS8: Wrong device fan operating direction Check the supply voltage phase sequence (L1–L2–L3).
O-hEAt	23	The measured ambient temperature exceeds the specified value. • Check the device's internal fan. • 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. • Reduce the carrier frequency with P2-24. • If possible: Reduce the load.
O-tor9	24	Maximum permissible torque exceeded. • If possible: Reduce the load or increase acceleration time t-acc.
U-tor9	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.
OUt-F	26	Device output fault • Please contact your nearest Eaton sales branch.
Sto-F	29	Internal STO circuit fault • Please contact your nearest Eaton sales branch.
Enc-01	30	No communication between the encoder module and the variable frequency drive. • Check to make sure that the module is correctly plugged in and secured.
Enc-02 SP-Err	31	The calculated motor speed is different from the measured motor speed. • Check the encoder connection, including the corresponding shielding. • Increase the value of P6-07 if necessary.
Enc-03	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. • Check the speed entered in P1-10.
Enc-04	33	Channel A fault: Usually a bad connection. • Check wiring.
Enc-05	34	Channel B fault Usually a bad connection. • Check wiring.
Enc-06	35	Error on channels A and B Usually a bad connection. • Check wiring.
AtF-01	40	Motor identification failed: The measured stator resistance varies between the phases. • Make sure that the motor is connected properly and working correctly. • Check the motor windings to make sure they have the same resistance values.

Message	No.	Possible causes and fixes
AtF-02	41	Motor identification failed: The measured stator resistance is too large. • Make sure that the motor is connected properly and working correctly. • 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.
AtF-03	42	Motor identification failed: The measured motor inductance is too low. • Make sure that the motor is connected properly and working correctly.
AtF-04	43	Motor identification failed: The measured motor inductance is too high. • Make sure that the motor is connected properly and working correctly. • 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.
AtF-05	44	Motor identification failed: The measured motor parameters do not match. • Make sure that the motor is connected properly and working correctly. • 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.
AtF-09	48	Malfunctioning encoder 1
OUt-Ph	49	A phase in the motor cable is not connected or has a discontinuity.
Sc-F01	50	No valid Modbus frame was received within the time specified in P5-06. • Check to make sure that the network master is working correctly. • Check connecting cables. • Increase the value of P5-06 to an acceptable value. or the communication between drive and fieldbus module is broken. • Check the correct mounting of the module
Sc-F02	51	No valid CANopen frame was received within the time specified in P5-06. • Check to make sure that the network master is working correctly. • Check connecting cables. • Increase the value of P5-06 to an acceptable value.
Sc-F03	52	Communication between the field bus module and the connected field bus or PLC has dropped out. • Check to make sure that the network master is working correctly. • Check connecting cables.
Sc-F04	53	Communication between the device and the plugged-in I/O expansion has dropped out. • Check to make sure that the module is installed properly.
Sc-F05	54	BacNet Com-Loss
OF-01	60	No internal connection to an optional card
OF-02	61	Optional module in undefined operating state
PLC-01	70	Non-supported function block from function block editor
PLC-02	71	Program from function block editor is too big
PLC-03	72	Division by zero
PLC-04	73	Lower limit is higher than upper limit
PLC-05	74	Overflow table Function block editor
FAuLtY	–	No communication between DSP and MCU
Sc-FLt	–	Serial communication problem
Ph-Lb	–	Input Phase Imbalance

5.3.2 Messages after a data transfer with a DX-COM-STICK

Table 37: Possible messages after a data transfer

View	Description
PASS-r	Parameter transfer to DX-COM-STICK interface card was successful
OS-Loc	DX-COM-STICK is interlocked. In order to transfer data, check the switch position on the side.
FAIL-r	Error while attempting to read the parameters from the variable frequency drive.
PASS-t	Parameter transfer to variable frequency drive successful.
FAIL-P	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.
FAIl-t	Error when attempting to copy parameter set to variable frequency drive
no-dAt	No data found in DX-COM-STICK.
dr-Loc	Parameter set in variable frequency drive locked. Unlock variable frequency drive first.
dr-rUn	The variable frequency drive has an enable signal and cannot take new parameters. Stop the variable frequency drive.
tYPE-E	The parameter set stored in the DX-COM-STICK does not match the variable frequency drive. Only transfers from the variable frequency drive to the DX-COM-STICK are possible.
tYPE-F	The DX-COM-STICK is not compatible with the variable frequency drive.

5.3.3 Operating keypad messages

View graphical display	View 7-segment display	Description
INHIBIT	Inhibit	Drive Inhibited. The STO connections are not made or disabled.
STOP	STOP	Drive Stopped / Disabled
Output Frequency 01 23.7Hz	H 10.0	Drive is enabled / running, display shows the ouput frequency (Hz). press the Navigate key to select alternative displays.
Motor Current 01 15.3A	A 0.1	Press the Navigate key for < 1 second. The display will show the motor current (Amps).
Motor Power 01 6.9kW	P 0.00	Press the Navigate key for < 1 second. The display will show the motor power (kW).
Motor Speed 01 718rpm	300	If P1-10 > 0, pressing the Navigatre key for < 1 second will display the motor speed (RPM).

5.3.4 Additional display messages

View graphical display	View 7-segment display	Description
Auto-tuning	AutO-t	Auto-tuning in progress. See parameter P4-02 information.
Ext 24V	EtL 24	The drive control board is powered only from an external 24 Volt source, with no mains power applied.
OL 23.7Hz	n/a	Indicates an Overload condition. Output current exceeds the motor rated current entered in Parameter P1-08.
SF↓ 23.7Hz	n/a	Switching frequency is reduced, due to high heatsink temperature.
ML 23.7Hz	n/a	The incoming mains power supply has been disconnected or is missing.
23.7Hz	n/a	The user programmable maintenance reminder time has elapsed.

5.4 Parameters

The following tables use a number of acronyms. These acronyms are defined below:

Abbreviation	Significance
RUN	The parameter can be accessed during operation ("Run" signal)
DS	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.

5.4.1 "Monitor" parameter group 0

Table 38: "Monitor" parameter group 0

Parameter	Designation	Description
P0-01	Analog Input1	Analog Input 1 Level of the signal applied to analog input 1 (terminal 6) after scaling and offsets have been applied. Display 1000 ≙ 100 %.
P0-02	Analog Input2	Analog input 2 Level of the signal applied to analog input 2 (terminal 10) after scaling and offsets have been applied. Display 1000 ≙ 100 %
P0-03	DI1 Status	Status of the Digital Inputs Status of the digital inputs, including the ones on option boards, starting on the left hand side with digital input 1, …, 8. Display: • 0 = Low • 1 = High
P0-04	f-PreRamp	Speed reference in front of the ramp
P0-05	Torque Reference	Torque Reference Display: 1000 ≙ 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 Display 4096 ≙ 100 %
P0-09	PID1 Feedback 1	Feedback value PID Controller 1 Display 4096 ≙ 100 %
P0-10	PID1 Output	PI(D) controller 1 Output Display 4096 ≙ 100 %
P0-11	Motor Voltage	Instantaneous output voltage
P0-12	Motor Torque	Motor Torque Display 1000 ≙ 100 %
P0-13	Fault Log	Display of the 4 latest faults

Para-meter	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 Display 600 ≙ 600 V
P0-21	Heatsink Temperature	Instantaneous Heatsink Temperature Display 40 ≙ 40 °C
P0-22	TimeToNextService	Time remaining to next service 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 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) 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) 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) Displays the energy consumption in kWh. When the value reaches 1000, it is reset back to 0 and the number of MWh in P0-27 is increased by 1. This parameter contains 2 values. The first value visible can be reset by the user with P6-23 = 1. 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 Shows the power consumed in MWh. This parameter contains two values: The first value shown when the parameter is accessed is the value that the user can reset with P6-23 = 1. 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 • Level 1: Application version + Check sum • Level 2: System version + Check sum

Parameter	Designation	Description
P0-29	"Device Information"	Shows specific device information. The first piece of information can be accessed by pressing the **OK** button. To view other information, press the ▲ and ▼ 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. 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 occured or power down in hours, minutes and seconds. 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 Displayed in hours, minutes and seconds. 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. 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) Displayed in hours. 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 Displays the most recent 8 samples of the DC bus voltage prior to a drive trip condition occurring. The sample interval is 256 ms.
P0-37	DC-Link V-Ripple0 Log	DC link voltage ripple history Shows the last eight DC link voltage ripple values before the device was switched off due to a fault. Scan time: 20 ms
P0-38	Heatsink0 Log	Heatsink temperature log Displays the most recent 8 samples of the heat sink temperature prior to a drive trip condition occurring. The sample interval is 30 s.
P0-39	AmbientTemp0 Log	Internal Ambient Temperature Log Displays the most recent 8 samples of the internal ambient temperature prior to a drive trip condition occurring. The sample interval is 30 s.
P0-40	MotorCurrent0 Log	Motor current log Displays the most recent 8 samples of the Motor current prior to a drive trip condition occurring. The sample interval is 256 ms.

Para-meter	Designation	Description
P0-41	FaultCounter Overcurrent	Counts, how often “Overcurrent” occured
P0-42	Fault-Counter DC-Overvoltage	Counts, how often “DC-Overvoltage” occured
P0-43	Fault-Counter DC-Undervoltage	Counts, how often “DC-Undervoltage” occured
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 Process Input Data (PDI, received from the fieldbus). There are 4 entries for this parameter (PDI1 … PDI4). 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	Ouput Data1 Value	Output Data 1, value Process Output Data (PDO, received from the fieldbus). There are 4 entries for this parameter (PDO1 … PDO4). 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 ofset and reference (value for diagnosis in case of problems)
P0-54	–	Phase V, current ofset 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 2nd line: Duty Cycle
P0-57	Stator voltage	U_d and U_q of the stator voltage. 1st value = U_d ("d" at the beginning of the line) 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 (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 Calculated. Displayed in Hz or rpm
P0-61	Relay hysteresis	Switching hysteresis of the Output Relays RO1 and RO2 in Hz resp. rpm. Display value = P6-04 x P1-01 **Remark:** Only in cases where P2-11 and/or P2-13 are set to 2 or 3.

Parameter	Designation	Description
P0-62	DroopFeedback	Difference in speed of two motors to achieve an equal load sharing. Displayed in Hz or rpm. → P6-09
P0-63	f-PostRamp	Speed reference after the ramp
P0-64	Actual Switching Frequency	Actual switching frequency. The value may be less than the one set with P2-24. → 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. 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. 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. **Remark:** 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. 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 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 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 Displays the value selected with P6-28.

5.4.2 Parameter group 1 ("Basic")

Table 39: Parameter group 1 ("Basic")

Parameter	RUN	Designation	Value	Description	DS
P1-01	✓	f-max	500 Hz max.	Maximum output frequency This can be set to any value between "f-min" and 5x the "motor nom frequency". • "Motor Nom Speed" (P1-10) = 0, the maximum speed limit will be displayed in Hz. • "Motor Nom Speed" (P1-10) > 0, the maximum speed limit will be displayed in rpm.	50.0 Hz
P1-02	✓	f-min		Minimum output frequency This can be set to any value between 0 and "f-max" (P1-01) • "Motor Nom Speed" (P1-10) = 0, the minimum speed limit will be displayed in Hz. • "Motor Nom Speed" (P1-10) > 0, the minimum speed limit will be displayed in rpm.	0.0 Hz
P1-03	✓	t-acc	0.0 - 600 s (FS2, FS3) 0.0 - 6000 s (FS4, FS5, FS6, FS7)	Sets the acceleration ramp time in seconds. The time interval set in "t-acc" represents the time taken to accelerate from zero to "Motor Nom Frequency" (P1-09).	5.0 s (FS2, FS3) 10.0 s (FS4, FS5, FS6, FS7)
P1-04	✓	t-dec	0.0 - 600 s (FS2, FS3) 0.0 - 6000 s (FS4, FS5, FS6, FS7)	Sets the deceleration ramp time in seconds. The time interval set in "t-dec" represents the time taken to decelerate from "Motor Nom Frequency" (P1-09) to zero.	5.0 s (FS2, FS3) 10.0 s (FS4, FS5, FS6, FS7)
P1-05	✓	Stop Mode	0, …, 4	Determines the action taken by the drive in the event of the drive enable signal being removed. This parameter is also used to disable (P1-05 = 0 or 1) or enable (P1-05 = 2 or 3) a brake chopper. Possible values: • **0**: 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. • **1**: 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. • **2**: 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. • **3**: 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. • **4**: 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.	1

Parameter	RUN	Designation	Value	Description	DS
P1-06	✓	EnergyOptimizer	0, 1	EnergyOptimizer 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. Available settings: • **0**: OFF • **1**: ON **Remark:** This mode of operation is less suitable for dynamic applications where the load conditions can suddenly increase significantly.	0
P1-07	–	Motor Nom Voltage		Defines the Motor rated voltage. 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).	U_e
P1-08	–	Motor Nom Current		Motor rated current. 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. Display: *I.t-trP*	I_e
P1-09	–	Motor Nom Frequency		The rated frequency of the motor. 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"	50 Hz
P1-10	✓	Motor Nom Speed		Motor rated speed • P1-10 = 0: the speed of the motor will be displayed in Hz. • P1-10 > 0: the speed related parameters (f-max, f-min etc.) will be displayed in rpm. 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. 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. **Remark:** 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.	0 rpm
P1-11	–	V-Boost		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. **Remark:** This parameter will only be enabled when using speed control (expanded V/Hz, P4-01 = 2).	2.5 % of P1-07

Parameter	RUN	Designation	Value	Description	DS
P1-12	–	Local ProcessData Source	0, …, 6, 9, 10, 11, 13 7, 8: reserved	Local Configuration of Command and Reference Sources Possible values: • **0**: Terminal Control. The drive responds directly to signals applied to the control terminals. • **1**: 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) • **2**: 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. • **3**: PID controller. The output frequency will be controlled by the internal PID controller • **4**: Fieldbus Control. Control via Modbus RTU if no fieldbus option is present, otherwise control from the fieldbus option module • **5**: Slave Mode. The Variable Frequency Drive acts as a slave to a connected drive operating in Master Mode. • **6**: CANopen Control. Control via the CANopen bus connected to the RJ45 serial interface connector. • **7**: Reserved • **8**: Reserved • **9**: SmartWire Device Control and speed ref. • **10**: SmartWire Device Control and terminal speed ref. • **11**: Terminal Control and SmartWire Device speed ref. • **12**: not permissible • **13**: SmartWire Device Control and speed ref. Digital input sets enable.	0

Parameter	RUN	Designation	Value	Description	DS
P1-13	–	DI Config Select	0, 1, …, 21	Configuration of digital inputs with a fix set of combinations The setting of P1-13 determines the input configuration depending on P1-12. Configuration in terminal mode (P01-12 = 0): • **0**: User defined • **1**: [START] [DIR] [Select 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 REF / f-Fix1] [AI1 REF] [AI2 Torque REF] • **4**: [START] [DIR] [Select REF / f-Fix1] [AI1 REF] [Select t-dec1 / t-Quick-Dec] • **5**: [START] [DIR] [Select REF / AI2] [AI1 REF] [AI2 REF] • **6**: [START] [DIR] [Select 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-dec1 / t-Quick-Dec] • **9**: [START] [DIR] [Select f-Fix Bit0] [Select f-Fix Bit1] [Select REF / f-Fix] • **10**: [START] [DIR] [UP] [DOWN] [Select REF / f-Fix1] • **11**: [FWD] [REV] [Select 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 REF / f-Fix1] [AI1 REF] [AI2 Torque REF] • **14**: [FWD] [REV] [Select REF / f-Fix1] [AI1 REF] [Select t-dec1 / t-Quick-Dec] • **15**: [FWD] [REV] [Select REF / AI2] [AI1 REF] [AI2 REF] • **16**: [FWD] [REV] [Select 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-dec1 / t-Quick-Dec] • **19**: [FWD] [REV] [Select f-Fix Bit0] [Select f-Fix Bit1] [Select 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 REF / f-Fix1] Select REF = reference defined by P9-10, ..., P9-17 and selected by P9-18 ... P9-20. Default: analog reference at AI1	11
P1-14		Password		Entry of the password to get access to the extended parameter set. The value to be put in is determined by the level to be accessed. • Level 2 (Access to parameter groups 0 to 5): P1-14 = P2-40 (Default: 101) • Level 3 (Access to parameter groups 0 to 9): P1-14 = P6-30 (Default: 201)	Level 2: 101 Level 3: 201

5.4.3 Parameter group 2 ("Functions")

Table 40: Parameter group 2 ("Functions")

Parameter	RUN	Designation	Value	Description	DS
P2-01	✓	f-Fix1	–	Preset Fixed Frequency 1 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 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 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 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 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 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 Value can be adjusted between f-min and f-max. Selection via a digital control signal. 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. 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 Value can be adjusted between f-min and f-max. Selection via a digital control signal. 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. If P1-10 > 0 the value is entered and displayed in rpm. 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 Defines the frequency range around f-Skip1 in which the drive doesn't work in steady-state to avoid mechanical resonances in the application. • Lower limit: = P2-09 - P2-10/2 • Upper limit = P2-09 + P2-10/2 The definition applies for both senses of rotation.	0.0 Hz

Parameter	RUN	Designation	Value	Description	DS
P2-11	✓	ADO1 Function & Mode	0, 1, …, 11	Selection of kind (analog or digital) and function of ADO1 / AO1 Possible values: P2-11 = 0, ..., 7: digital output • **0**: RUN, enable (FWD/REV) • **1**: READY, DA1 ready for operation • **2**: Speed: speed reference value • **3**: Speed > Speed Zero • **4**: Speed; ON: ≧ P2-16 / OFF: < P2-17 • **5**: Motor current; ON: ≧ P2-16 / OFF: < P2-17 • **6**: Motor torque; ON: ≧ P2-16 / OFF: < P2-17 • **7**: Analog input AI2; ON: ≧ P2-16 / OFF: < P2-17 P2-11 = 8, ...,11: Analog output • **8**: Output frequency (0 - 100 % f-max (P1-01)) • **9**: Motor current (0 - 200 % Motor rated current (P1-08)) • **10**: Motor torque (0 - 200 % Motor rated torque) • **11**: Motor power (0 - 200 % Motor rated power)	8
P2-12	✓	AO1 SignalFormat	0, 1, …, 5	Selection of the signal format at Analog Output 1 (AO1) Possible values: • **0**: 0 - 10 V • **1**: 10 - 0 V • **2**: 0 - 20 mA • **3**: 20 - mA • **4**: 4 - 20 mA • **5**: 20 - 4 mA	0
P2-13	✓	ADO2 Function & Mode	0, 1, …, 11	Selection of kind (analog or digital) and function of ADO2 / AO2 Possible values: P2-13 = 0, …, 7: digital output • **0**: RUN, enable (FWD/REV) • **1**: READY, DA1 ready for operation • **2**: Speed: speed reference value • **3**: Speed > Speed Zero • **4**: Speed; ON: ≧ P2-19 / OFF: < P2-20 • **5**: Motor current; ON: ≧ P2-19 / OFF: < P2-20 • **6**: Motor torque; ON: ≧ P2-19 / OFF: < P2-20 • **7**: Analog input AI2; ON: > P2-19 / OFF: < P2-20 P2-13 = 8, …,11: Analog output • **8**: Output frequency (0 - 100 % f-max (P1-01)) • **9**: Motor current (0 - 200 % Motor rated current (P1-08)) • **10**: Motor torque (0 - 200 % Motor rated torque) • **11**: Motor power (0 - 200 % Motor rated power)	9
P2-14	✓	AO2 SignalFormat	0, 1, …, 5	Selection of the signal format at Analog Output 2 (AO2) Possible values: • **0**: 0 - 10 V • **1**: 10 - 0 V • **2**: 0 - 20 mA • **3**: 20 - 0 mA • **4**: 4 - 20 mA • **5**: 20 - 4 mA	0

Parameter	RUN	Designation	Value	Description	DS
P2-15	✓	RO1 Function	0, 1, …, 7, 10, 11, 13	Selection of the function of output relay RO1 Possible values: • 0: RUN, enable (FWD/REV) • 1: READY, DA1 ready for operation • 2: Speed = speed reference value • 3: Speed > Speed Zero • 4: Speed; ON: ≧ P2-16 / OFF: < P2-17 • 5: Motor current; ON: ≧ P2-16 / OFF: < P2-17 • 6: Motor torque; ON: ≧ P2-16 / OFF: < P2-17 • 7: Analog input AI2; ON: > P2-16 / OFF: < P2-17 • 8: Reserved • 9: Reserved • 9: Reserved • 10: Maintenance due. The Service Interval Time (P6-24) has elapsed. • 11: 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. • 12: Drive tripped • 13: STO (Safe Torque OFF) Status	1
P2-16	✓	RO1 upper Limit		Switching ON threshold of relay RO1 → P2-11and P2-15	100.0 %
P2-17	✓	RO1 lower Limit		Switching OFF threshold of relay RO1 → P2-11 and P2-16	0.0 %
P2-18	✓	RO2 Function	0, 1, …, 7, 10, 11, 13	Selection of the function of output relay RO2 Possible values: • 0: RUN, enable (FWD/REV) • 1: READY, DA1 ready for operation • 2: Speed = speed reference value • 3: Speed > Speed Zero • 4: Speed; ON: ≧ P2-19 / OFF: < P2-20 • 5: Motor current; ON: ≧ P2-19 / OFF: < P2-20 • 6: Motor torque; ON: ≧ P2-19 / OFF: < P2-20 • 7: Analog input AI2; ON: ≧ P2-19 / OFF: < P2-20 • 8: Hoist brake control. (Enables the operating mode for hoists). ON: output frequency ≧ P2-07 with START (FWD/REV) command present. OFF: output frequency ≦ P2-08 with no START (FWD/REV) command active. • 9: Reserved • 10: Maintenance due. The Service Interval Time (P6-24) has elapsed. • 11: 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. • 12: Drive tripped • 13: STO (Safe Torque OFF) Status	0
P2-19	✓	RO2 upper Limit		Switching ON threshold of relay RO2 → P2-13 and P2-18	100.0 %
P2-20	✓	RO2 lower Limit		Switching OFF threshold of relay RO2 → P2-13 and P2-18	0.0 %

Parameter	RUN	Designation	Value	Description	DS
P2-21	✓	Display Scale		Scale factor display Determines the factor for scaling the display. • When set to 0.000 the scaling is disabled. • The variable selected in P2-22 is scaled by the factor set in P2-21	0.000
P2-22	✓	Display Source	0, 1, 2, 3	Display Source Selects the variable to be displayed and scaled by P2-21 Possible values: • **0**: Motor Speed • **1**: Motor current • **2**: Analog input 2 (AI2) • **3**: P0-80 with one fixed decimal place (signed)	0
P2-23	✓	t-n=0 Wait		ZeroSpeedHoldTime 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. 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. Possible values: • **0**: 4 kHz • **1**: 8 kHz • **2**: 12 kHz • **3**: 16 kHz • **4**: 24 kHz • **5**: 32 kHz **Attention:** 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. **Example:** Sine wave filter for 4 kHz → Setting of P2-24: 8 kHz!	3
P2-25	✓	t-QuickDec		Quick Stop Ramp The ramp is activated: • If DI1 and DI2 (terminals 2 and 3) are activated simultaneously and P1-13 = 11, …, 20 • If the mains voltage drops out and P2-38 = 2. If P2-25 = 0.0, the drive will coast without a ramp.	0.00 s
P2-26	✓	Spin Start Enable	0, 1, 2	Spin Start Enable 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) Possible values: • **0**: Spin start OFF • **1**: Spin Start ON • **2**: 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.	0

Parameter	RUN	Designation	Value	Description	DS
P2-27	✓	Standby Mode		Standby Mode Possible values: • **0**: Standby Mode disabled • **> 0**: The drive will enter Standby Mode (Output disabled), if the minumum frequency (P1-02) is maintained for the time specified in this parameter. Operation automatically resumes as soon as the reference increases above P1-02.	0.0 s
P2-28	–	Slave SpeedScalingControl	0, 1, …, 3	SlaveSpeedScalingControl 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. Possible values: • **0**: No scaling or offset is applied • **1**: Speed = Digital reference x P2-29 • **2**: Speed = (Digital reference x P2-29) + Reference at Analog Input 1 (AI1, Terminal 6) • **3**: Speed = (Digital reference x P2-29) x Reference at Analog Input 1 (AI1, Terminal 6)	0
P2-29	✓	Slave SpeedScalingFactor	-500.0 - +500 %	SlaveSpeedScalingFactor Setting of the Scaling Factor (see P2-28)	100.0 %
P2-30	–	AI1 Signal Range	0, 1, …, 7	Configures the Analog input 1 for the selected signal source type. Possible values: • **0**: 0 - 10 V • **1**: 10 - 0 V • **2**: bipolar 0 - 10 V • **3**: 0 - 20 mA • **4**: t 4 - 20 mA (Trips in case of wire break) • **5**: r 4 - 20 mA (Ramps to f-fix8 (P2-08) in case of wire break) • **6**: t 20 - 4 mA (Trips in case of wire break) • **7**: r 20 - 4 mA (Ramps to f-fix8 (P2-08) in case of wire break) • **8**: integrated Potentiometer (IP66 devices) (to deactivate the potentiometer set P2-30 to any other value from 0 to 7)	0
P2-31	✓	AI1 Gain	0.0 - 2000.0 %	Scaling of the Analog Input 1 Output value = Input value x Scaling. The scaling is also applied to an Offset, set with P2-32 **Example:** 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)	100.0 %
P2-32	✓	AI1 Offset	-500.0 - +500 %	Offset Analog Input 1 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. 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. Possible values: • **0**: 0 - 10 V • **1**: 10 - 0 V • **2**: Ptc-th (Thermistor connecvtion) • **3**: 0 - 20 mA • **4**: t 4 - 20 mA (Trips in case of wire break) • **5**: r 4 - 20 mA (Ramps to f-fix8 (P2-08) in case of wire break) • **6**: t 20 - 4 mA (Trips in case of wire break) • **7**: r 20 - 4 mA (Ramps to f-fix8 (P2-08) in case of wire break)	0

Parameter	RUN	Designation	Value	Description	DS
P2-34	✓	AI2 Gain	0.0 - 2000.0 %	Scaling of the Analog Input 2 Output value = Input value x Scaling. The scaling is also applied to an Offset, set with P2-35 **Example:** P2-33 = 0 - 10 V, P-2-34 = 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 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. 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. Possible values: • **0**: 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. • **1**: Auto-0 : Following a power on or reset, the drive will automatically start if digital input 1 is closed. • **2** ... **6**: 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. **Attention:** An automatic restart is only possible when the control commands are given via terminals (P1-12 = 0, P1-12 = 11when, after a communication loss, the control is toggled to the terminals).	0
P2-37	✓	Digital Reference Reset Mode	0, 1, …, 7	Defines the behavior of the drive on START when used in Keypad control or when controlled with UP/DOWN commands via terminals. This parameter is only active when P1-12: 1 or 2 (digital reference) Possible values: P2-37 = 0, …, 3 → Control via keypad • **0**: Start at min speed • **1**: Start with latest speed set with keypad • **2**: Start with latest speed before switching off (typically used when multiple sources for the reference are available e.g. Manual / Automatic or Local / Remote ...) • **3**: Start with f-fix 8 (P2-08) P2-37 = 4, …, 7 → Control via terminals (P1-13: 10 or 20) The START and STOP buttons on the keypad will be disabled. • **4**: Start at min speed • **5**: Start with latest speed set via terminals • **6**: Start with latest speed before switching off (typically used when multiple sources for the reference are available e.g. Manual / Automatic or Local / Remote ...) • **7**: Start with f-fix 8 (P2-08)	1

Parameter	RUN	Designation	Value	Description	DS
P2-38	✓	Action@MainsLoss	0, 1, 2, 3	MainsLossStopControl Determines the behavior of an enabled drive at mains loss. Possible values: • **0**: Mains loss ride through. 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. The Enable signal must be present for thge whole period of mains loss, otherwise the drive stops with the ramp set in P2-25) • **1**: Coast to stop 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 • **2**: Quick Stop (P2-25) The drive stops with the ramp set in P2-25. • **3**: Mains loss disabled This setting has to be used when the drive is powered through DC bus link directly. No supply through the input terminals.	0
P2-39	✓	Parameter Lock	0, 1	Determines whether to lock the parameters Possible values: • **0**: OFF. All parameters can be accessed and changed • **1**: 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.	0
P2-40	✓	Password Level2		Defines the password which is used to get access to extended parameter set (Level 2). Access via P1-14.	101

5.4.4 Parameter group 3 ("PID")

Table 41: Parameter group 3 ("PID")

Parameter	RUN	Designation	Value	Description	DS
P3-01	✓	PID1		PI(D) controller proportional gain 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 Higher values will result in a more damped response. 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 Possible values: • **0**: direct mode. This setting is used when an increase of the feedback signal should lead to a decrease of the motor speed. • **1**: inverse mode. If an increasing feedback signal should increase the speed of the motor, use inverse mode.	0
P3-05	✓	PID1 Set Point 1 Source	0, 1, 2	Defines the set point source 1 of controller 1 Possible values: • **0**: digital set point signal, set with P3-06 • **1**: analog input 1 • **2**: analog input 2	0
P3-06	✓	PID1 Set Point Digital		Digital set point controller 1 Digital set point of the PID controller in case P3-05 = 0	0.0 %
P3-07	✓	PID1 Out upper limit		PID1-OutLimHigh max. output value of the PI(D) controller	100.0 %
P3-08	✓	PID1 Out lower limit		PID1-OutLimLow 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 Possible values: • **0**: The output range of the PID controller is limited by P3-07 and P3-08 • **1**: Upper limit = value at analog input 1; lower limit = P3-08 • **2**: Upper limit = P3-07; lower limit = value at analog input 1 • **3**: The output value from the PID controller is added to the speed reference applied to analog input 1	0
P3-10	✓	PID1 Feedback 1 Source	0, 1	Defines the feedback source 1 of controller 1 Possible values: • **0**: analog input 2 (AI2) • **1**: analog input 1 (AI1)	0

Parameter	RUN	Designation	Value	Description	DS
P3-11	✓	PID1 Error Ramp		PI(D)1 Error Ramp 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. 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. Setting to 0.0 means that the drives ramps are always enabled.	0.0 %
P3-12	✓	PID1 feedback 1 DispScale		PID1 FeedBack Display scaling factor 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.	0.000
P3-13	✓	PID1 WakeUpLevel		Wake-up level controller 1 Sets an error level (difference between the PID reference and feedback values) above which the PID controller will wake from Standby mode.	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	This parameter is used to control the reset behavior of the PID loop. Possible values: • **0**: PID loop will run continuously as long as P gain (P3-01) ist not zero • **1**: 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)	0

5.4.5 Parameter group 4 ("Mode")

Table 42: Parameter group 4 ("Mode")

Parameter	RUN	Designation	Value	Description	DS
P4-01	–	Motor Control Mode	0, 1, …, 6	Motor Control Mode An autotune must be performed if setting 0 / 1 / 3 / 4 is used Possible values: • **0**: Speed Control with Torque Limit (vector) • **1**: Torque Control with Speed Limit (vector) • **2**: Speed Control (enhanced V/f) • **3**: PM Motor Speed Control • **4**: PM Motor Torque Control • **5**: Brushless DC Motor Speed Control • **6**: SyncRel Motor Speed Control	2
P4-02	–	Motor Identification	0, 1	Motor Identification 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. Possible values: • **0**: OFF • **1**: ON **Remark:** This function cannot be activated by using the DrivesConnect software 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.	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 When operating with Vector Control (P4-01 = 0 or 1) this parameter must be set to the motor nameplate power factor.	f (I_e)
P4-06	✓	M-Ref Source	0, 1, …, 5	Source for the torque reference P4-01 = 0: This parameter defines the source for the max. torque limit. P4-01 = 1: This parameter defines the source for the torque reference Possible values: • **0**: Fixed value. The torque reference / limit is set in P4-07 • **1**: Analog Input 1 (Terminal 6) controls the torque from 0 to P4-07 • **2**: Analog Input 2 (Terminal 10) controls the torque from 0 to P4-07 • **3**: Fieldbus. The torque reference is set via fieldbus, limited by P4-07. • **4**: Master / Slave. The torque reference from the master is used as torque limit for the Slave • **5**: PID Controller. The PID controller is used to control the torque from 0 to P4-07	0
P4-07	✓	M-Max Motoring		M-Max Motoring 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.	150 %

Parameter	RUN	Designation	Value	Description	DS
P4-08	✓	M-Min Motoring		M-Min Motoring 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. **Caution:** this can lead to situations where the setpoint frequency is exceeded!	0 %
P4-09	✓	M-Max Generative		M-Max Generative When working in Vector mode (P4-01 = 0 or 1) this parameter defines the max. torque limit during regeneration.	100 %
P4-10	–	f-MidV/f		Frequency to shape V/f curve 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. **Attention:** Care must be taken to avoid overheating and damaging the motor when using this function!	0.0 %
P4-11	✓	V-MidV/f		Voltage to shape V/f curve Used in conjunction with P4-10.	0.0 %
P4-12	✓	T-Memory Enable	0, 1	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. Possible values: • **0**: Thermal memory OFF • **1**: Thermal memory ON	0
P4-13		Change Phasesequence Motor	0, 1	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. • 0 = U, V, W (cw) • 1 = U, W, V (ccw) **Remark:** This parameter has to be set to "0" when using encoder feedback.	0

5.4.6 Parameter group 5 ("Bus")

Table 43: 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 Possible values: • **0**: 125 kBit/s • **1**: 250 kBit/s • **2**: 500 kBit/s • **3**: 1000 kBit/s	2
P5-03	✓	RS485-0 Baudrate	0, 1, …, 4	RS485 Baudrate Possible values: • **0**: 9.6 kBit/s • **1**: 19.2 kBit/s • **2**: 38.4 kBit/s • **3**: 57.6 kBit/s • **4**: 115.2 kBit/s	4
P5-04	✓	RS485-0 ParityType	0, 1, 2, 3	RS485 0 Parity Type Possible values: • **0**: No parity, 1 stop bit (N-1) • **1**: No parity, 2 stop bits (N-2) • **2**: Odd parity, 1 stop bit (0-1) • **3**: Even parity, 1 stop bit (E-1)	0
P5-05	✓	Modbus RTU0 COM Timeout		Timeout 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 Possible values: • **0**: Switch off • **1**: Ramps down to a full stop and is switched off. • **2**: Ramps down to a full stop; no fault message. • **3**: Ramps to fixed frequency 8 (P2-08).	0
P5-07	✓	FieldbusRampControl	0, 1	Fieldbus Ramp Control Possible values: • **0**: OFF. Ramps are controlled from internal drives parameters • **1**: ON. Ramps are controlled by the fieldbus.	0
P5-08	✓	NETSendPZD4	0, 1, …, 7	Configuration of the 4th process data word PDO-4 from the drive to the network master during cyclic communication. Possible values: • **0**: Torque as percentage value with one decimal place, e.g. 123 = 12.3 % • **1**: Output power in kW with 2 decimal places, e.g. 400 = 4.00 kW • **2**: Status of the digital inputs (DI). Bit 0 = Status DI1, Bit 1 = Status DI2 …) • **3**: Signal level at Analog Input 2 (AI2). 0 - 1000 = 0 - 100.0 % • **4**: Heatsink temperature. 0 - 100 = 0 - 100 °C • **5**: User register 1. Configuration with Function Block Editor • **6**: User register 2. Configuration with Function Block Editor • **7**: P0-80 value (Selection via P6-28)	0

Parameter	RUN	Designation	Value	Description	DS
P5-09	–	Reserved Parameter		Reserved Parameter	–
P5-10	–	Reserved Parameter		Reserved Parameter	–
P5-11	–	Reserved Parameter		Reserved Parameter	–
P5-12	✓	NETSendPZD3	0, 1, …, 7	Configuration of the 3rd process data word PDO-3 from the drive to the network master during cyclic communication. Possible values: • **0**: Motor current in A with one decimal place, e.g. 100 = 10.0 A • **1**: Output power in kW with 2 decimal places, e.g. 400 = 4.00 kW • **2**: Status of the digital inputs (DI). Bit 0 = Status DI1, Bit 1 = Status DI2 … • **3**: Signal level at Analog Input 2 (AI2). 0 - 1000 = 0 - 100.0 % • **4**: Heatsink temperature. 0 - 100 = 0 - 100 °C • **5**: User register 1. Configuration with Function Block Editor • **6**: User register 2. Configuration with Function Block Editor • **7**: P0-80 value (Selection via P6-28)	0
P5-13	✓	NETReceivePZD4	0, 1	Configuration of the 4th process data word PDI-4 from the network master to the drive during cyclic communication. Possible values: • **0**: User defined ramp times with 2 decimal places • **1**: User register 4. Configuration with Function Block Editor or via Parameters in group 9.	0
P5-14	✓	NETReceivePZD3	0, 1, 2	Configuration of the 3rd process data word PDI-3 from the network master to the drive during cyclic communication. Possible values: • **0**: Torque Reference/Limit. -5000 - + 5000 = -500.0 % - + 500.0 % • **1**: User defined PID reference. 0 - 1000 = 0 % - 100.0 % • **2**: User register 3. Configuration with Function Block Editor or via Parameters in group 9.	0
P5-15	✓	ParameterAccess	0, 1	Parameter access Possible values: • **0**: All parameters can be changed from any source. • **1**: All parameters are locked and can only be changed via SmartWire-DT.	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 Possible values: • **0**: No response • **1**: Output warning; drive continues to run • **2**: Stop if ramp active • **3**: Run-down • **4**: Switch off	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 The setting corresponds to the time, which is necessary to transmit 0 - 16 Bytes. The exact delay time depends on the baudrate.	0

5.4.7 Parameter group 6 ("Extended")

Table 44: Parameter group 6 ("extended")

Parameter	RUN	Designation	Value	Description	DS
P6-01	–	FirmwareUpgrade Enable	0, 1, 2, 3	Firmware Upgrade Enable Possible values: • **0**: no upgrade possible • **1**: upgrade control part and power part • **2**: upgrade control part only • **3**: upgrade power part only **Remark:** This function cannot be activated by using the DrivesConnect software	0
P6-02	✓	Auto Thermal Management	0, 1, …, 5	AutoThermalManagement 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. Possible values: • **0**: 4 kHz • **1**: 8 kHz • **2**: 12 kHz • **3**: 16 kHz • **4**: 24 kHz • **5**: 32 kHz **Attention:** 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.	0
P6-03	✓	Auto Reset Delay		AutoResetDelay Determines the time which will elapse between consecutive drive reset attempts when Auto Reset is enabled in P2-36.	20 s
P6-04	✓	RO1 n-Hysteresis		Speed dependant hysteresis for Relay Outputs 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 > 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 > Speed Zero". The tolerance band is given in % of P1-09. **Example:** P2-13 = 3, P1-09 = 50 Hz, P6-04 = 5 % → the relay contact closes above 2.5 Hz.	0.3 %

Parameter	RUN	Designation	Value	Description	DS
P6-05	–	Encoder Feedback Enable	0, 1	EncoderFeedbackEnable 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. **Attention:** 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)). Possible values: • **0**: Encoder feedback disabled • **1**: Encoder feedback enabled	0
P6-06	–	Encoder PPR		EncoderPPR 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.	0
P6-07	✓	Speed Error Limit		SpeedErrorTripLevel 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.	5.0 %
P6-08	✓	Freq RefMax		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). 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.	0 kHz
P6-09	✓	DroopMax		max. Speed Droop Value This parameter is used to share the load between motors equally. The speed reference is changed depending on the load. • P6-09 = 0: Function disabled • P6-09 > 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. Droop speed at rated load = P6-09 x P1-09 Amount of the speed reduction = (P6-09 x P1-09) x actual torque / rated torque Speed = speed reference - speed droop	0.0 %
P6-10	✓	PLC Operation Enable	0, 1	Enables the use of function blocks, which are created with the function block editor. Possible values: • **0**: Function blocks disabled • **1**: Function blocks enabled	0
P6-11	✓	t-f-Fix before Start		Defines a time after Enable for which the drive is operated with a fixed frequency. 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. • **Enable** - ramp to fFix7 - time set with P6-11 elapses - ramp to the set speed • **0**: Function disabled	0 s

Parameter	RUN	Designation	Value	Description	DS
P6-12	✓	t-f-Fix after Stop		Defines a time after removing the Enable signal for which the drive is operated with a fixed frequency 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. • **Remove Enable** - ramp to fFix8 - time set with P6-12 elapses - ramp to stop. • **0**: Function disabled	0 s
P6-13	✓	Brake Release Delay		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)).	0.2 s
P6-14	✓	Brake Apply Delay		Determines the time between the signal to close the brake and disabling of the drive. 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.	0.3 s
P6-15	✓	Brake M-Level Release		Required motor torque level at which the mechanical brake may be released. 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. This function is not active in V/f mode (P4-01 = 2)	8.0 %
P6-16	✓	Brake M-Level Timeout		Time, in which the motor torque, necessary for a release of a mechanical brake, has to be built up. Is this torque, set with P6-15, not built up within this time, the drive trips.	5.0 s
P6-17	✓	Max Torque Timeout		Max. time, for which the motor is allowed to operate with max. torque, before the drive trips. 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).	5.0 s
P6-18	–	DCBrakeCurrent	Auto 0 - 30 %	Amount of DC current as a percentage of the "Motor Nom Current" that is injected into the motor during DC braking. 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). 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.	0 %
P6-19	✓	Brake Resistor		Resistance of the brake resistor in Ohms This value, together with P6-20, is used for the thermal protection of the brake resistor.	Depends on the model

Parameter	RUN	Designation	Value	Description	DS
P6-20	✓	P-Brake Resistor		Power of the brake resistor in kW Resolution: 0.1 kW. 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 At very low temperatures (< -10 °C) the drive doesn't work and indicates "Under temperature" (Fault code 09 "H - t). 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. **Attention:** 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. Possible values: • **0**: no Reset • **1**: Reset: Reset of P6-22 to 0 is done automatically.	0
P6-23	✓	Reset kWh Meter	0, 1	Resets the energy counter Resets the internal energy counter, indicated by P0-26 (kWh) and P0-27 (MWh), back to 0. Possible values: • **0**: no Reset • **1**: Reset: Reset of P6-23 to 0 is done automatically.	0
P6-24	✓	Service Interval Time		Service Interval Time 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 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	✓	AO1 Scale		Scaling of the Analog Output 1 Defines a scaling factor in % for the signal at Analog Output 1.	100.0 %
P6-27	✓	AO1 Offset		Offset Analog Output 1 Defines an offset in % of 10 V for the signal at Analog Output 1. • **Positive** value of P6-27: Voltage at Analog Output 1 is reduced • **Negative** value of P6-27: Voltage at Analog Output 1 is increased	0.0 %

Parameter	RUN	Designation	Value	Description	DS
P6-28	✓	PointerToParameter		Pointer to an internal variable 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 vir Process Data Word 3 (PZD3, to be set with P5-12) or 4 (PZD4, to be set with P5-08). P6-28 is monstly used in conjunction with the Function Block Editor.	0
P6-29	–	Save Parameters	0, 1, 2	Save parameters as default 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. Possible values: • **0**: deactivated • **1**: 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. • **2**: The custom parameter set stored with P6-29 will be reset back to factory settings. P6-29 will be reset to 0 automatically. • **3**: Reset to factory default • **4**: Reset to user default Please note that if there is no user default settings saved and option 4 is selected, then drive will do factory default instead. New option 3 and 4 won't work via parameter list download (e.g. Comstick transfer etc). Value will be ignored and reset to 0.	0
P6-30	✓	Password Level3		Defines the password which is used to get access to extended parameter set (Level 3). Access via P-14	201

5.4.8 Parameter group 7 ("Motor")

Table 45: Parameter group 7 ("Motor")

Parameter	RUN	Designation	Value	Description	DS
P7-01	✓	Motor Stator Resistance R1		Stator resistance of the motor For induction and PM motors: phase to phase resistance value [R_s] in Ohms	f (I_e)
P7-02	✓	Motor Rotor Resistance R2		Rotor resistance of the motor For induction motors: phase to phase resistance value [R_r] in Ohms	f (I_e)
P7-03	✓	Motor Stator Inductance d-Axis		Stator inductance of the motor, torque producing • For induction motors: Phase to phase inductance value in Henry [H] • For PM-Motors: phase d-axis inductance value [L_{sd}] in Henry [H]	f (I_e)
P7-04	✓	Magnetizing Current @M=0		Magnetizing current For induction motors: Magnetizing current / no load current [I_d rms] 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_e)
P7-05	✓	Leak Inductance Rel		Relative Leakage Inductance of the motor Specified as a percentage [Sigma] of the stator inductance.	0.100
P7-06	✓	Motor Stator Inductance q-Axis		Stator inductance of the motor, magnetizing For PM-Motors: phase q-axis inductance value [L_{sd}] in Henry [H]	f (I_e)
P7-07	✓	EnhancedGeneratorControl	0, 1	EnhancedGeneratorControl Adaptation of the motor model in vector mode and with PM motors to achieve a better performance of the drive when regenerating. Possible values: • **0**: disable • **1**: enable	0
P7-08	✓	ParameterAdaptation	0, 1	ParameterAdaptation Possible values: • **0**: The motor parameters are identified once during auto tune and remain unchanged afterwards. • **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. **Background:** 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 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. A small value of P7-09 limits the torque of the motor, when the DC link voltage exceeds the threshoild. A high value can lead to current distortions and to a rough behavior of the motor.	5.0 %

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}) 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 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 • **Induction motors** (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. • **PM-motors** (P4-01 = 3 / 4): This value is used to align the rotor flux on enable.	f (I_e)
P7-13	✓	MSC Kd		Differential gain for the speed controller Used in Vector mode. Specified in %.	0.0 %
P7-14	✓	Torque Boost		Torque Boost at low speeds 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. Setting of P7-14: • Run the motor at the lowest speed, which is required by the application • Increase value of P7-14, until the reuired torque is present as well as a smooth opreation of the motor. **Note:** This function is not active with Speed Control (V/f, P4-01 = 2).	0.0 %
P7-15	✓	f-Torque Boost Limit		Torque Boost Range 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 Possible values: • **0**: disabled (= factory settings) • **1**: Identification during magnetizing period • **2**: Identification during low speed operation • **3**: Identification during magnetizing period and low speed operation	0
P7-17	✓	PM-MotorSignalInLevel		Selection of voltage and duration of the signal to identify the rotor position at PM motors 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

5.4.9 Parameter group 8 ("Ramp")

Table 46: Parameter group 8 ("Ramp")

Parameter	RUN	Designation	Value	Description	DS
P8-01	✓	t-acc2		Sets the acceleration ramp time 2 in seconds. The time interval set in "t-acc2" represents the time taken to accelerate from zero to "Motor Nom Frequency" (P1-09).	FS2, FS3: 5.0 s FS4, …: 10.0 s
P8-02	✓	n-accMulti1		Frequency / speed, at which the acceleration ramp changes from t-acc1 to t-acc2. This can be set to any value between 0 and "f-max" (P1-01) • "Motor Nom Speed" (P1-10) = 0, displayed in Hz. • "Motor Nom Speed" (P1-10) > 0, displayed in rpm. • Frequency / Speed > P8-06 = t-acc4 • Frequency / Speed > P8-04 AND < P8-06 = t-acc3 • Frequency / Speed > P8-02 AND < P8-04 AND < P8-06 = t-acc2 • Frequency / Speed < P8-02 AND < P8-04 AND < P8-06 = t-acc1" **Remark:** The AND condition must be interpreted as a "logical AND operator," i.e., all conditions linked with AND must be met simultaneously.	0.0 Hz
P8-03	✓	t-acc3		Sets the acceleration ramp time 3 in seconds. The time interval set in "t-acc3" represents the time taken to accelerate from zero to "Motor Nom Frequency" (P1-09).	FS2, FS3: 5.0 s FS4, …: 10.0 s
P8-04	✓	n-accMulti2		Frequency / speed, at which the acceleration ramp changes from t-acc2 to t-acc3. This can be set to any value between 0 and "f-max" (P1-01) • "Motor Nom Speed" (P1-10) = 0, displayed in Hz. • "Motor Nom Speed" (P1-10) > 0, displayed in rpm. Description of the functionality see → P8-02	0.0 Hz
P8-05	✓	t-acc4		Sets the acceleration ramp time 4 in seconds. The time interval set in "t-acc4" represents the time taken to accelerate from zero to "Motor Nom Frequency" (P1-09).	FS2, FS3: 5.0 s FS4, …: 10.0 s
P8-06	✓	n-accMulti3		Frequency / speed, at which the acceleration ramp changes from t-acc3 to t-acc4. This can be set to any value between 0 and "f-max" (P1-01) • "Motor Nom Speed" (P1-10) = 0, displayed in Hz. • "Motor Nom Speed" (P1-10) > 0, displayed in rpm. Description of the functionality see → P8-02	0.0 Hz
P8-07	✓	t-dec4		Sets the deceleration ramp time 4 in seconds. The time interval set in "t-dec4" represents the time taken to decelerate from "Motor Nom Frequency" (P1-09) to zero.	FS2, FS3: 5.0 s FS4, …: 10.0 s

Parameter	RUN	Designation	Value	Description	DS
P8-08	✓	n-decMulti3		Frequency / speed, at which the deceleration ramp changes from t-dec4 to t-dec3. This can be set to any value between 0 and "f-max" (P1-01) • "Motor Nom Speed" (P1-10) = 0, displayed in Hz. • "Motor Nom Speed" (P1-10) > 0, displayed in rpm. • Frequency / Speed > P8-08 = t-dec4 • Frequency / Speed > P8-10 AND < P8-08 = t-dec3 • Frequency / Speed > P8-12 AND < P8-10 AND < P8-08 = t-dec2 • Frequency / Speed < P8-12 AND < P8-10 AND < P8-08 = t-dec1 **Remark:** The AND condition must be interpreted as a "logical AND operator," i.e., all conditions linked with AND must be met simultaneously.	0.0 Hz
P8-09	✓	t-dec3		Sets the deceleration ramp time 3 in seconds. The time interval set in "t-dec3" represents the time taken to decelerate from "Motor Nom Frequency" (P1-09) to zero.	FS2, FS3: 5.0 s FS4, …: 10.0 s
P8-10	✓	n-decMulti2		Frequency / speed, at which the deceleration ramp changes from t-dec3 to t-dec2. This can be set to any value between 0 and "f-max" (P1-01) • "Motor Nom Speed" (P1-10) = 0, displayed in Hz. • "Motor Nom Speed" (P1-10) > 0, displayed in rpm. Description of the functionality see → P8-02	0.0 Hz
P8-11	✓	t-dec2		Sets the deceleration ramp time 2 in seconds. The time interval set in "t-dec2" represents the time taken to decelerate from "Motor Nom Frequency" (P1-09) to zero.	FS2, FS3: 5.0 s FS4, …: 10.0 s
P8-12	✓	n-decMulti1		Frequency / speed, at which the deceleration ramp changes from t-dec2 to t-dec1. This can be set to any value between 0 and "f-max" (P1-01) • "Motor Nom Speed" (P1-10) = 0, displayed in Hz. • "Motor Nom Speed" (P1-10) > 0, displayed in rpm. Description of the functionality see → P8-08	0.0 Hz
P8-13	✓	Ramp Mode	0, 1	Source for ramp selection • **0**: 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. • **1**: Acceleration and deceleration are carried out with the ramps set in P8-01 ... P8-12.	0

5.4.10 Parameter group 9 ("Control")

Table 47: Parameter group 9 ("Control")

Parameter	RUN	Designation	Value	Description	DS
P9-01	–	Enable Operation Source	0, 1, …, 8	Source for Enable Signal 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. Possible sources: • **0**: STO (Terminals 12 / 13) • **1**: Digital Input 1 (DI1 = Terminal 2) • **2**: Digital Input 2 (DI2 = Terminal 3) • **3**: Digital Input 3 (DI3 = Terminal 4) • **4**: Digital Input 4 (DI4 = Terminal 6) • **5**: Digital Input 5 (DI5 = Terminal 10) • **6**: Digital Input 6 (DI6 = Terminal 1 on DXA-EXT-3DI1RO) • **7**: Digital Input 7 (DI7 = Terminal 2 on DXA-EXT-3DI1RO) • **8**: Digital Input 8 (DI8 = Terminal 3 on DXA-EXT-3DI1RO) **Remark:** To use the parameters in group 9 (P9-...), P1-13 has to be "0" (user defined)	0

Parameter	RUN	Designation	Value	Description	DS
P9-02	–	QuickStop Source	0, 1, …, 25	Source for Quick Stop This signal (logic = 1) is necessary to operate the drive. At removal (logic = 0) the drive stops with the ramp selected by P2-25). Possible sources: • **0**: OFF / Function not activated • **1**: Digital Input 1 (DI1 = Terminal 2) • **2**: Digital Input 2 (DI2 = Terminal 3) • **3**: Digital Input 3 (DI3 = Terminal 4) • **4**: Digital Input 4 (DI4 = Terminal 6) • **5**: Digital Input 5 (DI5 = Terminal 10) • **6**: Digital input 6 (DI6 = terminal 1 on DXA-EXT-3DI1RO) • **7**: Digital input 7 (DI7 = terminal 2 on DXA-EXT-3DI1RO) • **8**: Digital input 8 (DI8 = terminal 3 on DXA-EXT-3DI1RO) • **9**: Analog Output 1 (AO1 = Terminal 8) • **10**: Analog Output 2 (AO2 = Terminal 11) • **11**: Digital Output 1 (RO1 = Terminal 14 / 15 / 16) • **12**: Digital Output 2 (RO2 = Terminal 17 / 18) • **13**: Digital Output 3 (DO3 = Terminal 5 / 6 on DXA-EXT-3DI1RO resp. Terminal 1 / 2 on DXA-EXT-3RO) • **14**: Digital Output 4 (DO4 = Terminal 3 / 4 on DXA-EXT-3RO) • **15**: Digital Output 5 (DO5 = Terminal 5 / 6 on DXA-EXT-3RO) • **16**: ON / Function activated • **17**: User register 1 • **18**: User register 2 • **19**: User register 3 • **20**: User register 4 • **21**: User register 5 • **22**: User register 6 • **23**: User register 7 • **24**: User register 8 • **25**: User register 9 **Remark:** To use the parameters in group 9 (P9-...), P1-13 has to be "0" (user defined)	0
P9-03	–	FWD Source		Source for the FWD command 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. When FWD and REV command are applied simultaneously, the drive executes a Quick Stop. Possible sources: → P9-02 The source, selected here, can also be configured for a control with a latch signal. Description → P9-05	1

Parameter	RUN	Designation	Value	Description	DS
P9-04	–	REV Source		Source for the REV command 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. When FWD and REV command are applied simultaneously, the drive executes a Quick Stop. Possible sources: → P9-02 The source, selected here, can also be configured for a control with a latch signal. Description → P9-05	2
P9-05	–	Signal Format	0, 1	Enables Latch function for FWD / REV inputs • **0**: OFF. The commands for forward (FWD) and reverse (REV) have to be applied constantly. • **1**: Latch control ON. The drive can be started, stopped and reversed by means of pulses. Function: ◦ 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. ◦ 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. ◦ 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. ◦ When FWD and REV commands are present simultaneously the drive will stop.	0
P9-06	–	Force REV Source		Source for "Force reverse operation" 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. Without this signal (logic = 0) the sense of rotation is determined by FWD and REV commands. Possible sources: → P9-02	0
P9-07	–	FaultReset Source		Source for Fault RESET A rising edge of this signal (from logic = 0 to 1) resets existing fault messages. Possible sources: → P9-02	1
P9-08	–	External Fault1 Source		Source for the "External Fault" signal • Logic 0 = external fault • Logic 1 = no external fault Possible sources: → P9-02	0
P9-09	–	LocalRemote @Startup		Source for "Local / Remote" selection This parameter is only effective with P1-12 > 0. It enables the changeover between the command channel defined by P1-12 and the sources selected with P9-01, …, P9-07. • Logic 0 = Command channel according P1-12 • Logic 1 = The drive is controlled by the sources defined with P9-01, …, P9-07. Possible sources: → P9-02	16

Parameter	RUN	Designation	Value	Description	DS
P9-10	–	SpeedSource1	0, 1, …, 16	Source for "Speed Reference 1" 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. Possible sources: • **0**: Analog input 1 as speed reference • **1**: Analog input 2 as speed reference • **2**: Preset fixed frequency (selected with P9-21, …, P9-23) • **3**: Digital reference (keypad) • **4**: PID controller output • **5**: Master speed • **6**: Speed reference via fieldbus • **7**: Reference from function block • **8**: Frequency reference (see P6-08) • **9**: Preset fixed frequency f-fix1 (P2-01) • **10**: Preset fixed frequency f-fix2 (P2-02) • **11**: Preset fixed frequency f-fix3 (P2-03) • **12**: Preset fixed frequency f-fix4 (P2-04) • **13**: Preset fixed frequency f-fix5 (P2-05) • **14**: Preset fixed frequency f-fix6 (P2-06) • **15**: Preset fixed frequency f-fix7 (P2-07) • **16**: Preset fixed frequency f-fix8 (P2-08) **Remark:** To use the parameters in group 9 (P9-...), P1-13 has to be 0 (user defined)	0
P9-11	–	SpeedSource2	0, 1, …, 16	Source for "Speed Reference 2" 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. Possible sources: → P9-10	2
P9-12	–	SpeedSource3	0, 1, …, 16	Source for "Speed Reference 3" 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. Possible sources: → P9-10	0
P9-13	–	SpeedSource4	0, 1, …, 16	Source for "Speed Reference 4" 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. Possible sources: → P9-10	0
P9-14	–	SpeedSource5	0, 1, …, 16	Source for "Speed Reference 5" 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. Possible sources: → P9-10	0

<table>
<tr><th>Parameter</th><th>RUN</th><th>Designation</th><th>Value</th><th>Description</th><th>DS</th></tr>
<tr><td>P9-15</td><td>–</td><td>SpeedSource6</td><td>0, 1, …, 16</td><td>Source for “Speed Reference 6”
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.

Possible sources: → P9-10</td><td>0</td></tr>
<tr><td>P9-16</td><td>–</td><td>SpeedSource7</td><td>0, 1, …, 16</td><td>Source for “Speed Reference 7”
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.

Possible sources: → P9-10</td><td>0</td></tr>
<tr><td>P9-17</td><td>–</td><td>SpeedSource8</td><td>0, 1, …, 16</td><td>Source for “Speed Reference 8”
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.

Possible sources: → P9-10</td><td>0</td></tr>
<tr><td>P9-18</td><td>–</td><td>Speed Select B0</td><td>0, 1, …, 25</td><td>Speed Reference Select Bit 0
Parameters P9-18 … P9-20 determine the selection of the actual speed reference value, defined by P9-10, …, P9-17.

Selection:
<table><tr><th>Speed Reference</th><th>P9-18</th><th>P9-19</th><th>P9-20</th></tr><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></table>Possible sources: → P9-02</td><td>3</td></tr>
<tr><td>P9-19</td><td>–</td><td>Speed Select B1</td><td>0, 1, …, 25</td><td>Speed Reference Select Bit 1
Parameters P9-18, …, P9-20 determine the selection of the actual speed reference value, defined by P9-10, …, P9-17.

Selection → P9-18

Possible sources: → P9-02</td><td>0</td></tr>
</table>

<table>
<tr><th>Parameter</th><th>RUN</th><th>Designation</th><th>Value</th><th>Description</th><th>DS</th></tr>
<tr><td>P9-20</td><td>–</td><td>Speed Select B2</td><td>0, 1, …, 25</td><td>Speed Reference Select Bit 2
Parameters P9-18, …, P9-20 determine the selection of the actual speed reference value, defined by P9-10, …, P9-17.

Selection → P9-18

Possible sources: → P9-02</td><td>0</td></tr>
<tr><td>P9-21</td><td>–</td><td>f-Fix Select B0</td><td>0, 1, …, 25</td><td>Preset Fixed Frequency Select Bit 0

Parameters P9-21, …, P9-23 determine the selection of the preset fixed frequencies defined by P2-01, …, P2-08.

Selection:
<table><tr><th>Preset Speed</th><th>P9-21</th><th>P9-22</th><th>P9-23</th></tr><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></table>Possible sources: → P9-02</td><td>5</td></tr>
<tr><td>P9-22</td><td>–</td><td>f-Fix Select B1</td><td>0, 1, …, 25</td><td>Preset Fixed Frequency Select Bit 1
Parameters P9-21, …, P9-23 determine the selection of the preset fixed frequencies defined by P2-01, …, P2-08.

Selection → P9-21

Possible sources: → P9-02</td><td>0</td></tr>
<tr><td>P9-23</td><td>–</td><td>f-Fix Select B2</td><td>0, 1, …, 25</td><td>Preset Fixed Frequency Select Bit 2
Parameters P9-21, …, P9-23 determine the selection of the preset fixed frequencies defined by P2-01, …, P2-08.

Selection → P9-21

Possible sources: → P9-02</td><td>0</td></tr>
</table>

<table>
<tr><th>Parameter</th><th>RUN</th><th>Designation</th><th>Value</th><th>Description</th><th>DS</th></tr>
<tr><td>P9-24</td><td>–</td><td>t-acc Select B0</td><td>0, 1, …, 25</td><td>Acceleration Ramp Select Bit 0
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.

Selection:
<table><tr><th>Acceleration time</th><th>P9-24</th><th>P9-25</th></tr><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></table>
Possible sources: → P9-02</td><td>0</td></tr>
<tr><td>P9-25</td><td>–</td><td>t-acc Select B1</td><td>0, 1, …, 25</td><td>Acceleration Ramp Select Bit 1
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.

Selection → P9-24

Possible sources: → P9-02</td><td>0</td></tr>
<tr><td>P9-26</td><td>–</td><td>t-dec Select B0</td><td>0, 1, …, 25</td><td>Deceleration Ramp Select Bit 0
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.

Selection:
<table><tr><th>Deceleration time</th><th>P9-26</th><th>P9-27</th></tr><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></table>
Possible sources: → P9-02</td><td>0</td></tr>
<tr><td>P9-27</td><td>–</td><td>t-dec Select B1</td><td>0, 1, …, 25</td><td>Deceleration Ramp Select Bit 1
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.

Selection → P9-26

Possible sources: → P9-02</td><td>0</td></tr>
</table>

Parameter	RUN	Designation	Value	Description	DS
P9-28	–	digRef UP Source	0, 1, …, 25	Source for "Increase Digital Reference" Defines the souce of a signal for the increasement of the digital reference (Motorpot) • Logic 0 = no increasement of the digital reference • Logic 1 = The digital reference will be increased. Acceleration according t-acc (P1-03) Possible sources: → P9-02	0
P9-29	–	digRef DOWN Source	0, 1, …, 25	Source for "Decrease Digital Reference" Defines the souce of a signal for an decreasement of the digital reference (Motorpot) • Logic 0 = no decreasement of the digital reference • Logic 1 = The digital reference will be decreased. Deceleration according t-dec (P1-04) Possible sources: → P9-02	0
P9-30	–	EnableDirFWD Source		Enable Direction FWD Defines a source for a signal to enable the "forward" (FWD) sense of rotation. • Logic 0 = An operation in forward direction is not possible. 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) • Logic 1 = An operation in forward direction is possible. Possible sources: → P9-02	0
P9-31	–	EnableDirREV Source		Enable Direction REV Defines a source for a signal to enable the "reverse" (REV) sense of rotation. • Logic 0 = An operation in reverse direction is not possible. 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). • Logic 1 = An operation in reverse direction is possible. 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 • **0**: Function of the Analog Output 1 is determined by P2-11 • **1**: User defined digital output (0 V / 24 V) from function block • **2**: User defined analog output from function block	0
P9-34	–	ADO2 Function & Mode Extension	0, 1, 2	Selection of additional functions for ADO2 • **0**: Function of the Analog Output 2 is determined by P2-13 • **1**: User defined digital output (0 V / 24 V) from function block • **2**: User defined analog output from function block	0
P9-35	–	RO1 Function Extension	0, 1	Selection of additional functions for RO1 • **0**: Function of Relay Output 1 is determined by P2-15 • **1**: User defined output from function block	0
P9-36	–	RO2 Function Extension	0, 1	Selection of additional functions for RO2 • **0**: Function of Relay Output 2 is determined by P2-18 • **1**: User defined output from function block	0
P9-37	–	Display Scale Source	0, 1	Source to Scale factor display • **0**: The source of the scaling factor is determined by P2-21. • **1**: User defined source from function block	0

Parameter	RUN	Designation	Value	Description	DS
P9-38	–	PID1 Set Point1 Source Ext	0, 1	Selection of additional sources for PID1 reference • **0**: The source of the reference is determined by P3-05. • **1**: User defined source from function block	0
P9-39	–	PID1 Feedback1 Source Ext	0, 1	Selection of additional sources for PID1 feedback • **0**: The source of the feedback is determined by P3-10. • **1**: User defined source from function block	0
P9-40	–	M-Ref Source Extension	0, 1	Extended Selection values for Source of torque reference • **0**: The source of the reference is determined by P4-06. • **1**: User defined source from function block	0
P9-41	–	RO5 Function Extension	0, 1	Selection of additional functions for RO5 The relays are located on option boards. • **0**: Factory settings active (Relay 3: Drive healthy (DXA-EXT-3RO + DXA-EXT-3DI1RO) Relay 4: Drive tripped (DXA-EXT-3RO) Relay 5: Drive running (DXA-EXT-3RO)) • **1**: User defined output from function block	0

6 Technical data

6.1 General rated data

Technical data	Symbol	Unit	Value
General			
Standards			EMC: EN 61800-3:2004+A1-2012 Safety: EN 61800-5: 2007
Certifications and manufacturer's declarations on conformity			CE, UL, cUL, c-Tick, UkrSEPRO, Gost-R
EcoDesign 29/125/EG			→ Eaton.com/EcoDesign-VFD
Production quality			RoHS, ISO 9001
Climate resistance	ρ_w	%	< 95%, mean relative humidity (RH), non-condensing (EN 50178)
Ambient temperature range			
Operation			
IP20 (NEMA 0)	ϑ	°C	-10 - +50 (frost-free and condensation-free)
IP55 (NEMA 3)	ϑ	°C	-10 - +40, with a derating of 1.5 % per °C above 40 °C on rated operational current I_e up to 50 °C **Note:** Operation within a temperature range of 40 to 50 °C does not conform to UL Certification.
IP66 (NEMA 4X)	ϑ	°C	-10 - +40, with a derating of 2.5 % per °C above 40 °C on rated operational current I_e up to 50 °C **Note:** Operation within a temperature range of 40 to 50 °C does not conform to UL Certification.
Storage	ϑ	°C	-40 - +60
Vibration level			
Bump test (IEC 60068-2-29)			
Pulse shape			Half sine
Peak acceleration			18 g
Duration			6 ms
Number of shocks			600 (100 per axis)
Random vibration frequency (IEC 60068-2-64)	f	Hz	5 - 200
Severity			5 - 20: 1.0 m/s^2 (0.01 g^2/Hz) ASD 20 - 200: -3dB/octave
Duration			30 minutes in each of 3 mutually perpendicular axes
Sinusoidal vibration test (IEC 60068-2-6)	f	Hz	2 - 500
Severity			2 - 9: 3.5 mm peak-peak shift 9 - 200: 10 m/s^2 Peak acceleration 200 - 500: 15 m/s^2 Peak acceleration
Duration			15 minutes in each of 3 mutually perpendicular axes
Sweep rate			1 octave/minute
$MTTF_d$		Years	4525
MTBF (mean operating time between two failures)		Years	50

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 ±2, phase/neutral conductor to ground
380 - 480 V, 500 - 600 V	U	kV	±2, phase to phase ±4, phase to ground
Voltage stability (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)			
Installation position			vertical
Altitude	h	m	0 - 1,000 above sea level, > 1000 with 1 % load current reduction every 100 m, maximum 2000 with UL approval, maximum 4000 without UL approval
Degree of protection			IP20 (NEMA 0) IP55 (NEMA 3) IP66 (NEMA 4X)
Fan (built-in)			yes
touch guard			BGV A3 (VBG4, finger and back-of-hand proof)
Main circuit / power section			
Feed			
Rated operational voltage			
DA1-12…	U_e	V	1~ 230 (200 V -10 % - 240 V +10 %)
DA1-32…	U_e	V	3~ 230 (200 V -10 % - 240 V +10 %)
DA1-34…	U_e	V	3~ 400 (380 V -10 % - 480 V +10 %)
DA1-35…	U_e	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 network with directly grounded star point. IT networks only with PCM insulation monitoring relays. Operation on phase-earthed networks is only permissible up to a maximum phase-earth voltage of 300 V AC.

Technical data	Symbol	Unit	Value
Motor feeder			
Output voltage			
DA1-12…, DA1-32…, DA1-34…, DA1-35…	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	Δf	Hz	0.1
Rated operational current	I_e	A	IP20: 4,3 - 72/370 - 450 IP55: 24 -302 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
Switching frequency (pulse frequency)	f_{PWM}	kHz	4 - 32 (double modulation) / 2 - 16 (effective) Maximum value depends on power size
Operational mode			V/Hz control, boost and slip compensation, vector control
SLV, max. Speed error	Δn	%	±0.5
DC braking			
Time before start	t	s	0 - 25, in the event of a stop
Motor pick-up control function			yes
Brake chopper			yes
Braking current during continuous operation	I_{BR}	%	100 (I_e)
Maximum braking current	I_{BRmax}	%	150 for 60 s

Technical data	Symbol	Unit	Value
Control section			
Terminal capacity (clampable)	A	mm^2	0.05 - 2.5 (30 - 12 AWG)
Control voltage			
Output voltage (control signal terminal 1)	U_c	V DC	24
Input voltage (control signal terminal 1)	U_c	V DC	18 - 30
Load rating (control signal terminal 1), maximum	I	mA	100
Reference voltage (control signal terminal 5)	U_S	V DC	10
Load rating (control signal terminal 5), maximum	I	mA	10
Digital input (DI)			
Number (configurable)			3 - 5
Logic (level)			positive
Response time	t	ms	< 4
Input voltage range High (1)	U_c	V DC	8 - 30
Input voltage range Low (0)	U_c	V DC	0 - 4
Analogue input (AI)			
Number (configurable)			0 - 2
Resolution			12 bit
Accuracy		%	< 1 to the final value
Response time	t	ms	< 4
Input voltage range	U_{Ref}	V	0/-10 - +10, DC (R_i ~ 72 kΩ)
Input current range	I	mA	0/4 - 20 (R_B ~ 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)			
Number			2 (digital/analog)
Output voltage			
DO	U_{out}	V DC	+24
AO	U_{out}	V DC	0/-10 - +10
Current carrying capacity DO	I_{out}	mA	< 20
AO resolution			12 bit
Interface (RJ45)			OP bus, Modbus RTU, CANopen, (RS485)
STO (Safe Torque Off)			
Voltage	U	V DC	+24 (18 - 30)
Current	I	mA	100

Technical data			Symbol	Unit	Value
	SIL category				
		IP/20/IP55			2
		IP66			3
	PL				
		IP/20/IP55			d
		IP66			e

6.2 Specific rated data

6.2.1 DA1-12… series

Size		Symbol	Unit	4D3	7D0	011
Rated 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[1)]	230 V	S	kVA	1.71	2.79	4.18
	240 V	S	kVA	1.79	2.91	4.36
Assigned motor output	230 V	P	kW	0.75	1.5	2.2
	230 V	P	HP	1	2	3
Mains side (primary side):						
Number of phases				single-phase or two-phase		
Rated voltage		U_{LN}	V	200 - 10 % - 240 + 10 %, 50/60 Hz (180 - 264 V ±0 %, 48 - 62 Hz ±0 %)		
Input current (phase current)		I_{LN}	A	8.5	15.2	19.5
Minimum brake resistor		R_B	Ω	100	50	35
Switching frequency (pulse frequency)						
Default setting		f_{PWM}	kHz	16	16	16
Adjustable range		f_{PWM}	kHz	4 - 32	4 - 32	4 - 32
Maximum leakage current to earth (PE), without motor		I_{PE}	mA	2.49	2.49	2.49
Efficiency		η		0.94	0.96	0.95
Heat dissipation at I_e		P_V	W	45.75	63	103.4
Frame size				FS2	FS2	FS2

6.2.2 DA1-32… series

Size		Symbol	Unit	4D3	7D0	011	018	024	024
Rated 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 motor output	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
Mains side (primary side):									
Number of phases				three-phase					
Rated voltage		U_{LN}	V	200 V - 10 % - 240 V +10 %, 50/60 Hz (180 - 264 V ±0 %, 48 - 62 Hz ±0 %)					
Input current (phase current)		I_{LN}	A	5.1	8.3	12.6	21.6	29.1	29.1
Minimum brake resistor		R_B	Ω	100	50	35	20	20	20
Switching frequency (pulse frequency)									
Default setting		f_{PWM}	kHz	16	16	16	16	16	16
Adjustable 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		η		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

DA1-32… series									
Size		**Symbol**	**Unit**	**030**	**046**	**061**	**072**	**090**	**110**
Rated 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 motor output	230 V	P	kW	7.5	11	15	18.5	22	30
	230 V	P	HP	10	15	20	25	30	40
Mains side (primary side):									
Number of phases				three-phase					
Rated voltage		U_{LN}	V	200 V - 10 % - 240 V +10 %, 50/60 Hz (180 - 264 V ±0 %, 48 - 62 Hz ±0 %)					
Input current (phase current)		I_{LN}	A	36.4	55.8	70.2	82.9	103.6	126.7
Minimum brake resistor		R_B	Ω	22	22	12	12	6	6
Switching frequency									
Default setting		f_{PWM}	kHz	8	8	8	8	8	4
Adjustable 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		η		0.97 (IP55) 0.96 (IP20)	0.97	0.97	0.97	0.97	0.97
Heat dissipation at I_e		P_V	W	187.5 (IP55) 410 (IP20)	264	345	518	550	720
Frame size				FS4	FS4	FS5	FS5	FS6	FS6

DA1-32… series Size		Symbol	Unit	150	180	202	248
Rated 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 motor output	230 V	P	kW	37	45	55	75
	230 V	P	HP	50	60	75	100
Mains side (primary side):							
Number of phases				three-phase			
Rated voltage		U_{LN}	V	200 V - 10 % - 240 V +10 %, 50/60 Hz (180 - 264 V ±0 %, 48 - 62 Hz ±0 %)			
Input current (phase current)		I_{LN}	A	172.7	183.3	205.7	255.5
Minimum brake resistor		R_B	Ω	6	6	6	6
Switching frequency (pulse frequency)							
Default setting		f_{PWM}	kHz	4	4	4	4
Adjustable 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		η		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 DA1-34… series

Size		Symbol	Unit	2D2	4D1	5D8	9D5	014	018	024
Rated 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 motor output	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
Mains side (primary side):										
Number of phases				three-phase						
Rated voltage		U_{LN}	V	380 V - 10 % - 480 V +10 %, 50/60 Hz (342 - 528 V ±0 %, 48 - 62 Hz ±0 %)						
Input current (phase current)		I_{LN}	A	2.4	5.1	7.5	11.2	19	22	28.9
Minimum brake resistor		R_B	Ω	400	200	150	100	75	50	40
Switching frequency (pulse frequency)										
Default setting		f_{PWM}	kHz	8	8	8	8	8	8	8
Adjustable 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		η		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

DA1-34… series Size		Symbol	Unit	024	030	039	046	061	072	090
Rated 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	kVA	16.6	20.8	27	31.9	42.3	49.9	62.4
	480 V	S	kVA	20	24.9	32.4	38.2	50.7	59.9	74.8
Assigned motor output	400 V	P	kW	11	15	18.5	22	30	37	45
	460 V	P	HP	15	20	25	30	40	50	60
Mains side (primary side):										
Number of phases					three-phase					
Rated voltage		U_{LN}	V		380 V - 10 % - 480 V +10 %, 50/60 Hz (342 - 528 V ±0 %, 48 - 62 Hz ±0 %)					
Input current (phase current)		I_{LN}	A	28.9	37.2	47	52.4	66.1	77.3	92.2
Minimum brake resistor		R_B	Ω	40	22	22	22	12	12	6
Switching frequency (pulse frequency)										
Default setting		f_{PWM}	kHz	8	8	8	8	8	8	4
Adjustable 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		η		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

DA1-34… series Size		Symbol	Unit	110	150	180	202	240	302
Rated current		I_e	A	110	150	180	202	240	302
Overload current for 60 s every 600 s		I_L	A	165	225	270	303	360	453
Apparent power at rated operation	400 V	S	kVA	76.2	104	125	140	166	209
	480 V	S	kVA	91.5	125	150	168	200	251
Assigned motor output	400 V	P	kW	55	75	90	110	132	160
	460 V	P	HP	75	120	150	175	200	250
Mains side (primary side):									
Number of phases				three-phase					
Rated voltage		U_{LN}	V	380 V - 10 % - 480 V +10 %, 50/60 Hz (342 - 528 V ±0 = %, 48 - 62 Hz ±0 %)					
Input current (phase current)		I_{LN}	A	112.5	153.2	183.7	217	256	302
Minimum brake resistor		R_B	Ω	6	6	6	6	6	6
Switching frequency (pulse frequency)									
Default setting		f_{PWM}	kHz	4	4	4	4	4	4
Adjustable range		f_{PWM}	kHz	4 - 16	4 - 12	4 - 8	4 - 16	4 - 12	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
Efficiency		η		0.98	0.98	0.98	0.98	0.98	0.98
Heat dissipation at I_e		P_V	W	1210	1575	1800	2090	2375	3040
Frame size				FS6	FS6	FS6	FS7	FS7	FS7

6.2.4 DA1-35… series

Size		Symbol	Unit	2D1	3D1	4D1	6D5	9D0	012
Rated 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	kVA	1.6	2.1	2.4	4.3	6	7.5
	600 V	S	kVA	2	2.5	2.9	5.1	7.3	9
Assigned motor output	500 V	P	kW	0.75	1.5	2.2	4	5.5	7.5
	575 V	P	HP	1	2	3	5	7.5	10
Mains side (primary side):									
Number of phases				three-phase					
Rated voltage		U_{LN}	V	500 V -10 % - 600 V +10 %, 50/60 Hz					
Input current (phase current)		I_{LN}	A	2.5	3.7	4.9	7.8	10.8	14.4
Minimum brake resistor		R_B	Ω	50	50	50	50	50	40
Switching frequency (pulse frequency)									
Default setting		f_{PWM}	kHz	8	8	8	8	8	8
Adjustable 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		η		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

DA1-35… series									
Size		**Symbol**	**Unit**	**017**	**022**	**022**	**028**	**034**	**043**
Rated 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 motor output	500 V	P	kW	11	15	15	18.5	22	30
	575 V	P	HP	15	20	20	25	30	40
Mains side (primary side):									
Number of phases				three-phase					
Rated voltage		U_{LN}	V	500 V -10 % - 600 V +10 %, 50/60 Hz					
Input current (phase current)		I_{LN}	A	20.6	26.7	26.7	34	41.2	53
Minimum brake resistor		R_B	Ω	40	40	22	22	22	22
Switching frequency (pulse frequency)									
Default setting		f_{PWM}	kHz	8	8	8	8	8	8
Adjustable range		f_{PWM}	kHz	24	24	24	24	24	24
Maximum leakage current to earth (PE), without motor		I_{PE}	mA	–	–	–	–	–	–
Efficiency		η		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

DA1-35… series Size		Symbol	Unit	054	065	078	105	130	150
Rated 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 motor output	500 V	P	kW	37	45	55	75	90	110
	575 V	P	HP	50	60	75	100	125	150
Mains side (primary side):									
Number of phases				three-phase					
Rated voltage		U_{LN}	V	500 V -10 % - 600 V +10 %, 50/60 Hz					
Input current (phase current)		I_{LN}	A	62.2	75.8	90.9	108.2	162	187
Minimum brake resistor		R_B	Ω	12	12	6	6	6	6
Switching frequency (pulse frequency)									
Default setting		f_{PWM}	kHz	8	8	4	4	4	4
Adjustable 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		η		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 and frame sizes

6.3.1 Frame sizes FS2, FS3, FS4 and FS5 for IP20

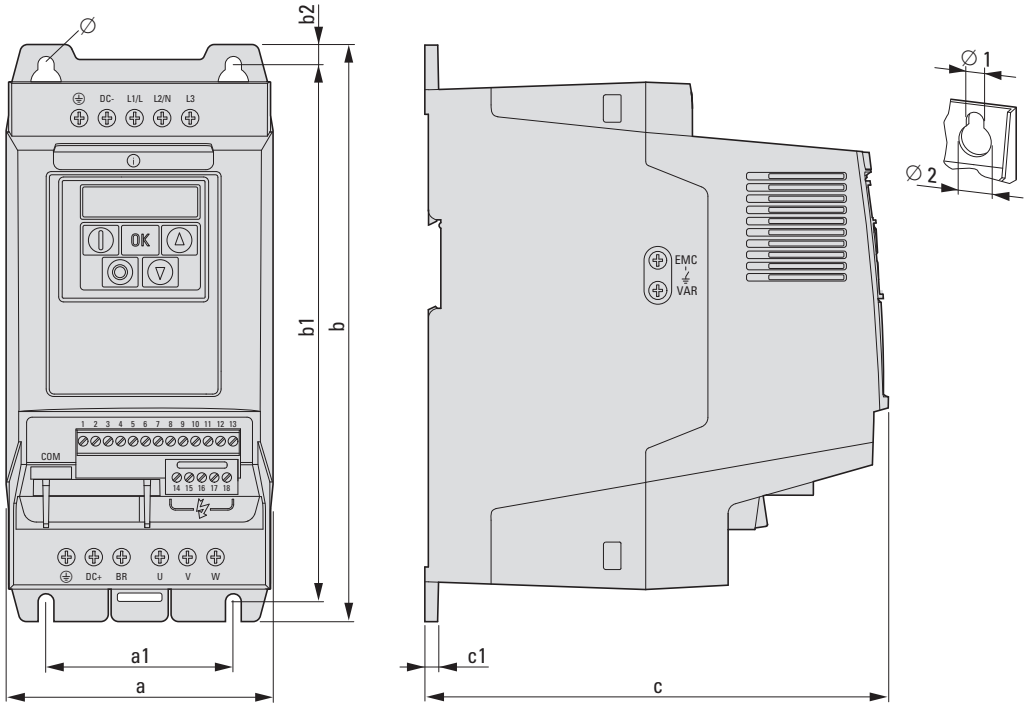


Figure 92: Frame sizes FS2, FS3, FS4 and FS5 in IP20 (NEMA 0)

Table 48: Dimensions and weights for frame sizes FS2, FS3, FS4 and FS5 in IP20 (NEMA 0)

Frame size	a [mm] (in)	a1 [mm] (in)	b [mm] (in)	b1 [mm] (in)	b2 [mm] (in)	c [mm] (in)	c1 [mm] (in)	Ø1 [mm] (in)	Ø2 [mm] (in)	m [kg] (lbs)
FS2	107 (4.2)	75 (3)	231 (9.1)	215 (8.5)	8 0.31	186 (7.3)	5 (0.2)	6.5 (0.26)	12.2 (0.48)	1.8 (3.97)
FS3	131 (5.2)	100 (3.9)	273 (10.8)	255 (10)	8.5 0.33	204 (8)	5 (0.2)	6.5 (0.26)	12.2 (0.48)	3.5 (7.72)
FS4	173 (6.81)	125 (4.92)	419 (16.5)	400 (15.75)	10 (0.39)	241 (9.49)	5 (0.2)	8 (0.31)	15 (0.59)	9.2 (20.3)
FS5	234 (9.21)	175 (6.89)	485 (19.09)	460 (18.11)	13 (0.51)	261 (10.28)	5 (0.2)	8 (0.31)	18 (0.71)	18.2 (40.1)

1 in = 1'' = 25,4 mm, 1 mm = 0.0394 in

6.3.2 Sizes FS4 to FS7 in IP55

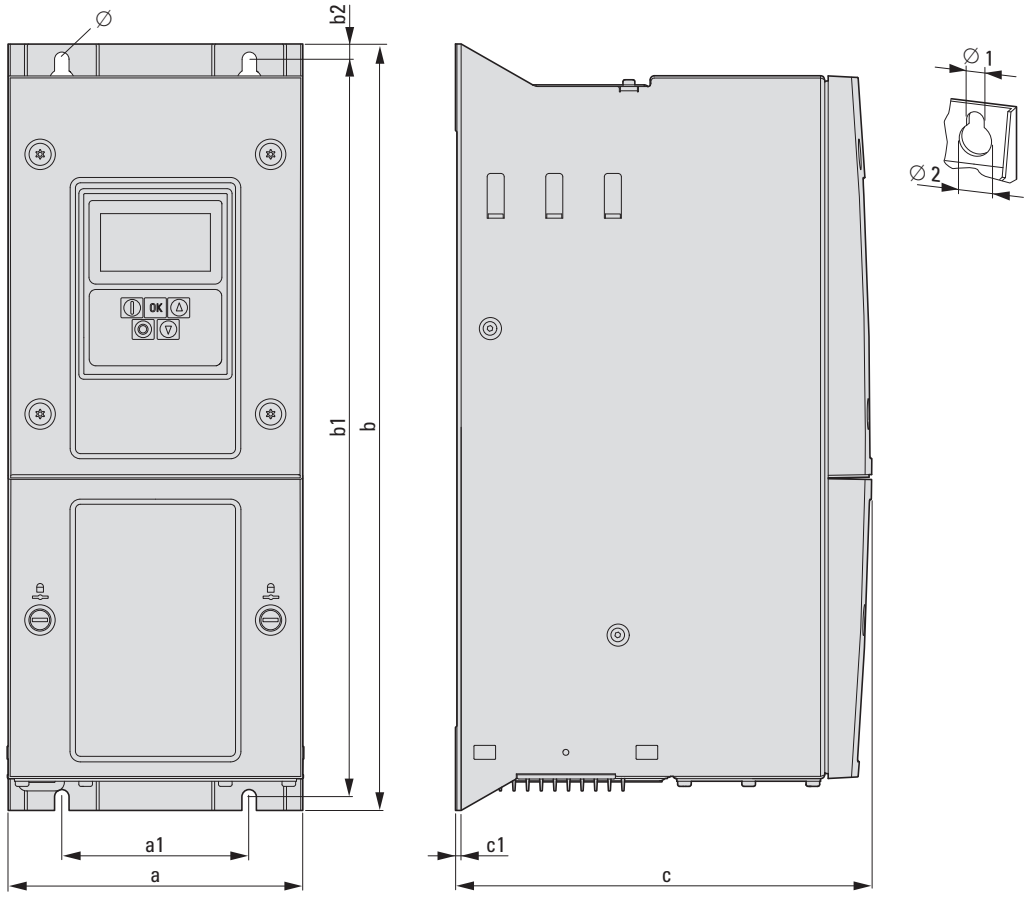


Figure 93: Frame sizes FS4 to FS7 in IP55 (NEMA 12)

Table 49: Dimensions and weights for sizes FS4 to FS7 in IP55 (NEMA 12)

Frame size	a [mm] (in)	a1 [mm] (in)	b [mm] (in)	b1 [mm] (in)	b2 [mm] (in)	c [mm] (in)	c1 [mm] (in)	Ø1 [mm] (in)	Ø2 [mm] (in)	m [kg] (lbs)
FS4	171 (6.7)	110 (175)	450 (17.7)	433 (17.1)	9 (0.35)	240 (9.7)	2 (0.79)	8 (0.32)	15 (0.59)	11.5 (25.35)
FS5	235 (9.3)	175 (6.9)	540 (21.3)	520 (20.5)	12 (0.47)	270 (10)	2 (0.79)	8 (0.32)	15 (0.59)	22.5 (49.60)
FS6	330 (13)	200 (7.9)	865 (34.1)	840 (33.1)	15 (0.59)	313.5 (12.4)	2 (0.79)	11 (0.43)	22 (0.87)	50 (110.23)
FS7	330 (14.2)	200 (7.9)	1280 (50.4)	1255 (49.5)	15 (0.59)	341 (13.4)	2 (0.79)	11 (0.43)	22 (0.87)	80 (176.37)

1 in = 1'' = 25,4 mm, 1 mm = 0.0394 in

6.3.3 Frame sizes FS2, FS3 and FS4 in IP66

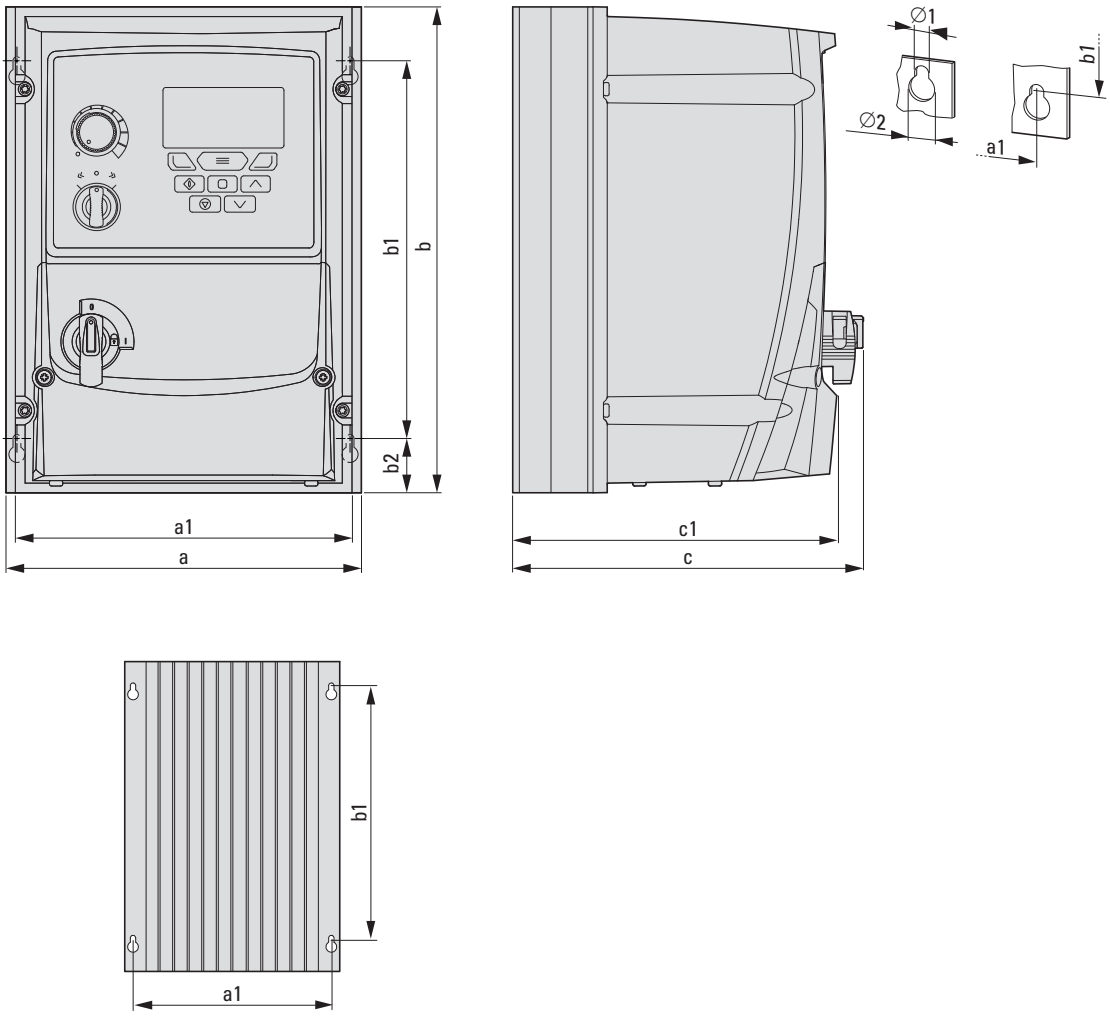


Figure 94: Frame sizes FS2, FS3 and FS4 in IP66 (NEMA 4X)

Table 50: Dimensions and weights for frame sizes FS2, FS3 and FS4 in IP66 (NEMA 4X)

Frame size	a [mm] (in)	a1 [mm] (in)	b [mm] (in)	b1 [mm] (in)	b2 [mm] (in)	c [mm] (in)	c1 [mm] (in)	Ø1 [mm] (in)	Ø2 [mm] (in)	m [kg] (lbs)
FS2	188 (7.4)	176 (6.93)	257 (10.13)	200 (7.88)	27 (1.06)	182 (7.17)	172 (6.78)	4.2 (0.17)	8.5 (0.33)	3.5 (7.72)
FS3	211 (8.31)	197 (7.76)	310 (12.21)	252 (9.93)	31 (1.22)	235 (9.26)	225 (8.87)	4.2 (0.17)	8.5 (0.33)	6.6 (14.55)
FS4	240 (9.45)	227 (8.94)	360 (14.18)	300 (11.82)	30 (1.18)	271 (10.68)	260 (10.24)	4.2 (0.17)	8.5 (0.33)	9.5 (20.95)

1 in = 1'' = 25,4 mm, 1 mm = 0.0394 in, 1 kg = 2.2046 lbs

6.4 Cable cross-sections

Table 51: Cable cross-sections – voltage class 230 V

Device type	Frame size	Input current	Maximum terminalcross-section		Output current
		A	mm²	AWG	A
Voltage class: 230 V Mains voltage (50/60 Hz) U_{LN} 200 (-10 %) - 240 (+10 %) V U_e 230 V AC, 1-phase / U_2 230 V AC, 3-phase					
DA1-124D3…	FS2	8.5	8	8	4.3
DA1-127D0…	FS2	15.2	8	8	7
DA1-12011…	FS2	19.5	8	8	10.5
Voltage class: 230 V Mains voltage (50/60 Hz) U_{LN} 200 (-10 %) - 240 (+10 %) V U_e 230 V AC, 3-phase / U_2 230 V AC, 3-phase					
DA1-324D3…	FS2	5.1	8	8	4.3
DA1-327D0…	FS2	8.3	8	8	7
DA1-32011…	FS2	12.6	8	8	10.5
DA1-32018…	FS3	21.6	8	8	18
DA1-32024FB-A20C	FS3	29.1	8	8	24
DA1-32024FB-B55C	FS4	29.1	16	5	25
DA1-32024FB-B6SO	FS3	29.1	8	8	24
DA1-32024FB-B66O	FS3	29.1	8	8	24
DA1-32030FB-B20C	FS4	36.4	16	5	30
DA1-32030FB-B55C	FS4	36.4	16	5	30
DA1-32030FB-B6SO	FS4	36.4	16	5	30
DA1-32030FB-B66O	FS4	36.4	16	5	30
DA1-32046FB-B20C	FS4	55.8	16	5	46
DA1-32046FB-B55C	FS4	55.8	16	5	46
DA1-32046FB-B6SO	FS4	55.8	16	5	46
DA1-32046FB-B66O	FS4	55.8	16	5	46
DA1-32060FB-B20C	FS5	63.9	35	2	61
DA1-32061FB-B55C	FS5	70.2	35	2	61
DA1-32072FB-B20C	FS5	74	35	2	72
DA1-32072FB-B55C	FS5	82.9	35	2	72
DA1-32090FB-B55C	FS6	103.6	150	300MCM	90
DA1-32110FB-B55C	FS6	126.7	150	300MCM	110
DA1-32150FB-B55C	FS6	172.7	150	300MCM	150
DA1-32180FB-B55C	FS6	183.3	150	300MCM	180
DA1-32202FB-B55C	FS7	205.7	150	300MCM	202
DA1-32248FB-B55C	FS7	255.5	150	300MCM	248

Table 52: Cable cross-sections – voltage class 400 V

Device type	Frame size	Input current	Maximum terminal cross-section		Output current
		A	mm²	AWG	A
Voltage class: 400 V Mains voltage (50/60 Hz) U_{LN} 380 (-10 %) - 480 (+10 %) V U_e 400 V AC, 3-phase / U_2 400 V AC, 3-phase					
DA1-342D2…	FS2	2.4	8	8	2.2
DA1-344D1…	FS2	5.1	8	8	4.1
DA1-345D8…	FS2	7.5	8	8	5.8
DA1-349D5…	FS2	11.2	8	8	9.5
DA1-34014…	FS3	19	8	8	14
DA1-34018…	FS3	21	8	8	18
DA1-34024FB-A20C	FS3	28.9	8	8	24
DA1-34024FB-B55C	FS4	28.9	16	5	24
DA1-34024FB-B6SO	FS3	28.9	8	8	24
DA1-34024FB-B66O	FS3	28.9	8	8	24
DA1-34030FB-B20C	FS4	37.2	16	5	30
DA1-34030FB-B55C	FS4	37.2	16	5	30
DA1-34030FB-B6SO	FS4	37.2	16	5	30
DA1-34030FB-B66O	FS4	37.2	16	5	30
DA1-34039FB-B20C	FS4	47	16	5	39
DA1-34039FB-B55C	FS4	47	16	5	39
DA1-34039FB-B6SO	FS4	47	16	5	39
DA1-34039FB-B66O	FS4	47	16	5	39
DA1-34046FB-B20C	FS4	52.4	16	5	46
DA1-34046FB-B55C	FS4	52.4	16	5	46
DA1-34046FB-B6SO	FS4	52.4	16	5	46
DA1-34046FB-B66O	FS4	52.4	16	5	46
DA1-34061FB-B20C	FS5	66.1	35	2	61
DA1-34061FB-B55C	FS5	63.8	35	2	61
DA1-34072FB-B20C	FS5	77.3	35	2	72
DA1-34072FB-B55C	FS5	76.4	35	2	72
DA1-34090FB-B55C	FS6	92.2	150	300MCM	90
DA1-34110FB-B55C	FS6	112.5	150	300MCM	110
DA1-34150FB-B55C	FS6	153.2	150	300MCM	150
DA1-34180FB-B55C	FS6	183.7	150	300MCM	180
DA1-34202FB-B55C	FS7	217	150	300MCM	202
DA1-34240FB-B55C	FS7	256	150	300MCM	240
DA1-34302FB-B55C	FS7	302	150	300MCM	302

Table 53: Cable cross-sections – voltage class 575 V

Device type	Frame size	Input current	Maximum terminal cross-section		Output current
		A	mm²	AWG	A
Voltage class: 575 V Mains voltage (50/60 Hz) U_{LN} 500 (-10 %) - 600 (+10 %) V U_e 575 V AC, 3-phase / U_2 575 V AC, 3-phase					
DA1-352D1NB-…	FS2	2.5	8	8	2.1
DA1-353D1NB-…	FS2	3.7	8	8	3.1
DA1-354D1NB-…	FS2	4.9	8	8	4.1
DA1-356D5NB-…	FS2	7.8	8	8	6.5
DA1-359D0NB-…	FS2	10.8	8	8	9
DA1-35012NB-…	FS3	14.4	8	8	12
DA1-35017NB-…	FS3	20.6	8	8	17
DA1-35022NB-A20C	FS3	26.7	8	8	22
DA1-35022NB-B55C	FS4	26.7	16	5	22
DA1-35022NB-B6SO	FS3	26.7	8	8	22
DA1-35022NB-B66O	FS3	26.7	8	8	22
DA1-35028NB-B20C	FS4	34	16	5	28
DA1-35028NB-B55C	FS4	34	16	5	28
DA1-35028NB-B6SO	FS4	34	16	5	28
DA1-35028NB-B66O	FS4	34	16	5	28
DA1-35034NB-B20C	FS4	41.2	16	5	34
DA1-35034NB-B55C	FS4	41.2	16	5	34
DA1-35034NB-B6SO	FS4	41.2	16	5	34
DA1-35034NB-B66O	FS4	41.2	16	5	34
DA1-35041NB-B20C	FS5	53	35	2	43
DA1-35043NB-B55C	FS4	53	16	5	43
DA1-35043NB-B6SO	FS5	53	16	5	43
DA1-35043NB-B66O	FS4	53	16	5	43
DA1-35054NB-B20C	FS5	59.5	35	2	54
DA1-35054NB-B55C	FS5	62.2	35	2	54
DA1-35065NB-B20C	FS5	70.4	35	2	65
DA1-35065NB-B55C	FS5	75.8	35	2	65
DA1-35078NB-B55N	FS6	90.9	150	300MCM	78
DA1-35105NB-B55N	FS6	108.2	150	300MCM	105
DA1-35130NB-B55N	FS6	162	150	300MCM	130
DA1-35150NB-B55N	FS6	187	150	300MCM	150

7 Accessories

7.1 Fuses

The Eaton circuit-breakers and fuses listed below are examples and can be used without additional measures. If you use other miniature circuit breakers and fuses, make sure to take their protective characteristics 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 mains' characteristic, and these must also be taken into account when selecting circuit-breakers and/or fuses.

Table 54: Safety features

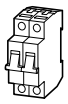
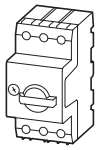
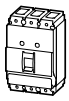
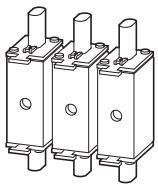
Symbol	Description
① 	**Miniature circuit breakers** FAZ-B…/1N: 1 pole + N FAZ-B…/2: 2 pole FAZ-B…/3: 3 pole Rated operating voltage: 230/400 V AC Switching capacity: 15 kA
② 	**Motor-Protective Circuit-Breakers** PKM0…, PKZM4…: 3 pole Rated operating voltage: 690 V AC Switching capacity: • PKM0: 150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

Table 55: Assigned fuses – voltage class 230 V

Device type	Input current	Fuse or miniature circuit-breaker					
	I_{LN}	IEC (Type B or gG)				UL (Class CC or J)	
	A	A	Eaton type			A	Eaton type
Voltage class: 230 V Mains voltage (50/60 Hz) U_{LN} 200 (-10 %) - 240 (+10 %) V U_e 230 V AC, 1-phase /U_2 230 V AC, 3-phase							
			①	②, 2-phase	④		⑤
DA1-124D3…	8.5	10	FAZ-B10/1N	FAZ-B10/2	Z-DII/SE-10A/GG	15	LPJ-15SP
DA1-127D0…	15.2	25	FAZ-B25/1N	FAZ-B25/2	Z-DII/SE-25A/GG	20	LPJ-20SP
DA1-12011…	19.5	25	FAZ-B25/1N	FAZ-B25/2	Z-DII/SE-25A/GG	25	LPJ-25SP
Voltage class: 230 V Mains voltage (50/60 Hz) U_{LN} 200 (-10 %) - 240 (+10 %) V U_e 230 V AC, 3-phase / U_2 230 V AC, 3-phase							
			①	②, ③	④, ⑥		⑤
DA1-324D3…	5.1	10	FAZ-B10/3	PKM0-10	Z-DII/SE-10A/GG	10	LPJ-10SP
DA1-327D0…	8.3	10	FAZ-B10/3	PKM0-10	Z-DII/SE-10A/GG	15	LPJ-15SP
DA1-32011…	12.6	16	FAZ-B16/3	PKM0-16	Z-DII/SE-16A/GG	17.5	LPJ-17,5SP
DA1-32018…	21.6	25	FAZ-B25/3	PKM0-25	Z-DII/SE-25A/GG	30	LPJ-30SP
DA1-32024…	29.1	40	FAZ-B40/3	PKZM4-40	Z-DII/SE-40A/GG	40	LPJ-40SP
DA1-32030…	36.4	50	FAZ-B50/3	PKZM4-50	Z-DII/SE-50A/GG	50	LPJ-50SP
DA1-32046…	55.8	63	FAZ-B63/3	NZMC1-S80	Z-DII/SE-63A/GG	70	LPJ-70SP
DA1-32060FB-B20C	63.9	80	–	NZMC1-S80	80NHG000B-400	70	LPJ-70SP
DA1-32061FB-B55C	70.2	80	–	NZMC1-S80	80NHG000B-400	90	LPJ-90SP
DA1-32072FB-B20C	74	80	–	NZMC1-S80	80NHG000B-400	90	LPJ-90SP
DA1-32072FB-B55C	82.9	100	–	NZMC1-S100	100HG000B-400	110	LPJ-110SP
DA1-32090FB-B55C	103.6	125	–	NZMC2-S125	125NHG00B-400	150	LPJ-150SP
DA1-32110FB-B55C	126.7	160	–	NZMC2-S160	160NHG00B-400	175	LPJ-175SP
DA1-32150FB-B55C	172.7	200	–	NZMC2-S200	250NHG1B-400	225	LPJ-225SP
DA1-32180FB-B55C	183.3	250	–	NZMC3-S250	250NHG1B-400	250	LPJ-250SP
DA1-32202FB-B55C	205.7	250	–	NZMC3-S250	250NHG1B-400	300	LPJ-300SP
DA1-32248FB-B55C	255.5	315	–	NZMC3-S400	315NHG2B-400	350	LPJ-350SP

Note: The numbers ①, ②, ③, ④, ⑤, ⑥ refer to the graphics in Table 54.

Table 56: Assigned fuses – voltage class 400 V

Device type	Input current	Fuse or miniature circuit-breaker					
	I_{LN}	IEC (Type B or gG)				UL (Class CC or J)	
	A	A	Eaton type			A	Eaton type
Voltage class: 400 V **Mains voltage (50/60 Hz) U_{LN} 380 (-10 %) - 480 (+10 %) V** **U_e 400 V AC, 3-phase / U_2 400 V AC, 3-phase**							
			①, max. 400 V	②, ③	④, ⑥		⑤
DA1-342D2…	2.4	10	FAZ-B10/3	PKM0-10	Z-DII/SE-10A/GG	6	LPJ-6SP
DA1-344D1…	5.1	10	FAZ-B10/3	PKM0-10	Z-DII/SE-10A/GG	10	LPJ-10SP
DA1-345D8…	7.5	10	FAZ-B10/3	PKM0-10	Z-DII/SE-10A/GG	10	LPJ-10SP
DA1-349D5…	11.2	16	FAZ-B16/3	PKM0-16	Z-DII/SE-16A/GG	15	LPJ-15SP
DA1-34014…	19	25	FAZ-B25/3	PKM0-25	Z-DII/SE-25A/GG	25	LPJ-25SP
DA1-34018…	21	25	FAZ-B25/3	PKM0-25	Z-DII/SE-25A/GG	30	LPJ-30SP
DA1-34024…	28.9	40	FAZ-B40/3	PKZM4-40	Z-DII/SE-40A/GG	40	LPJ-40SP
DA1-34030…	37.2	50	FAZ-B50/3	PKZM4-50	Z-DII/SE-50A/GG	50	LPJ-50SP
DA1-34039…	47	63	FAZ-B63/3	PKZM4-58	Z-DII/SE-63A/GG	60	LPJ-60SP
DA1-34046…	52.4	63	FAZ-B63/3	PKZM4-58	Z-DII/SE-63A/GG	70	LPJ-70SP
DA1-34061FB-B20C	66.1	80	–	NZMC1-S80	80NHG000B-400	80	LPJ-80SP
DA1-34061FB-B55C	63.8	80	–	NZMC1-S80	80NHG000B-400	80	LPJ-80SP
DA1-34072FB-B20C	77.3	100	–	NZMC1-S100	80NHG000B-400	100	LPJ-100SP
DA1-34072FB-B55C	76.4	100	–	NZMC1-S100	80NHG000B-400	100	LPJ-100SP
DA1-34090FB-B55C	92.2	125	–	NZMC2-S125	100HG000B-400	125	LPJ-125SP
DA1-34110FB-B55C	112.5	125	–	NZMC2-S125	125NHG00B-400	150	LPJ-150SP
DA1-34150FB-B55C	153.2	200	–	NZMC2-S200	160NHG00B-400	200	LPJ-200SP
DA1-34180FB-B55C	183.7	250	–	NZMC3-S250	250NHG1B-400	250	LPJ-250SP
DA1-34202FB-B55C	217	250	–	NZMC3-S250	250NHG1B-400	300	LPJ-300SP
DA1-34240FB-B55C	256	315	–	NZMC3-S320	315NHG2B-400	350	LPJ-350SP
DA1-34302FB-B55C	302	400	–	NZMC3-S400	315NHG2B-400	400	LPJ-400SP

Note: The numbers ①, ②, ③, ④, ⑤, ⑥ refer to the graphics in Table 54.

Table 57: Assigned fuses – voltage class 575 V

Device type	Input current	Fuse or miniature circuit-breaker					
	I_{LN}	IEC (Type B or gG)				UL (Class CC or J)	
	A	A	Eaton type			A	Eaton type
Voltage class: 575 V **Mains voltage (50/60 Hz) U_{LN} 500 (-10 %) - 600 (+10 %) V** **U_e 575 V AC, 3-phase / U_2 575 V AC, 3-phase**							
			②, ③	⑥, max. 500 V	⑥		⑤
DA1-352D1NB-…	2.5	10	PKM0-10	10NHG000B	10NHG000B-690	6	LPJ-6SP
DA1-353D1NB-…	3.7	10	PKM0-10	10NHG000B	10NHG000B-690	6	LPJ-6SP
DA1-354D1NB-…	4.9	10	PKM0-10	10NHG000B	10NHG000B-690	10	LPJ-10SP
DA1-356D5NB-…	7.8	10	PKM0-10	10NHG000B	10NHG000B-690	10	LPJ-10SP
DA1-359D0NB-…	10.8	16	PKM0-16	16NHG000B	16NHG000B-690	15	LPJ-15SP
DA1-35012NB-…	14.4	16	PKM0-16	16NHG000B	16NHG000B-690	20	LPJ-20SP
DA1-35017NB-…	20.6	25	PKM0-25	25NHG000B	25NHG000B-690	30	LPJ-30SP
DA1-35022…	26.7	32	PKM0-32	32NHG000B	32NHG000B-690	35	LPJ-35SP
DA1-35028…	34	40	PKZM4-40	40NHG000B	40NHG000B-690	45	LPJ-45SP
DA1-35034…	41.2	50	PKZM4-50	50NHG000B	50NHG000B-690	60	LPJ-60SP
DA1-35041NB-B20C	53	63	PKZM4-58	63NHG000B	63NHG000B-690	70	LPJ-70SP
DA1-35043…	53	63	PKZM4-58	63NHG000B	63NHG000B-690	70	LPJ-70SP
DA1-35054NB-B20C	59.5	80	NZMC1-S80	80NHG000B	80NHG000B-690	80	LPJ-80SP
DA1-35054NB-B55C	62.2	80	NZMC1-S80	80NHG000B	80NHG000B-690	80	LPJ-80SP
DA1-35065NB-B20C	70.4	100	NZMC1-S100	100NHG000B	100NHG000B-690	100	LPJ-100SP
DA1-35065NB-B55C	75.8	100	NZMC1-S100	100NHG000B	100NHG000B-690	100	LPJ-100SP
DA1-35078NB-B55N	90.9	125	NZMC2-S125	125NHG000B	125NHG000B-690	125	LPJ-125SP
DA1-35105NB-B55N	108.2	125	NZMC2-S125	125NHG000B	125NHG000B-690	150	LPJ-150SP
DA1-35130NB-B55N	162	160	NZMC2-S160	160NHG000B	160NHG000B-690	175	LPJ-175SP
DA1-35150NB-B55N	187	200	NZMC2-S200	200NHG1B	200NHG1B-690	200	LPJ-200SP

Note: The numbers ①, ②, ③, ④, ⑤, ⑥ refer to the graphics in Table 54.

7.2 Mains contactors

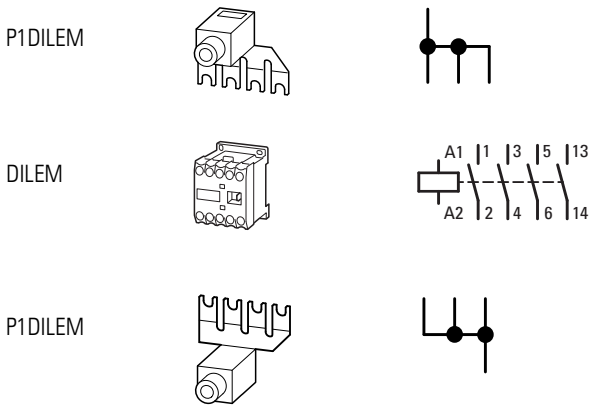


Figure 95: Mains contactor at single-phase connection (DA1-12…)

Table 58: Mains contactor – DA1 voltage class 230 V (1-phase)

Device type	Frame size	Input current	Output current	Mains contactors (thermal AC1 current)			
		A	A	Type max 50 °C and IEC	A	Type max. 40 °C and UL	A
Voltage class: 230 V Mains voltage (50/60 Hz) U_{LN} 200 (-10 %) - 240 (+10 %) V U_e 230 V AC, single-phase / U_2 230 V AC, 3-phase							
DA1-124D3…	FS2	8.5	4.3	DILEM-…+P1DILEM	50	DILEM-…+P1DILEM	50
DA1-127D0…	FS2	15.2	7	DILEM-…+P1DILEM	50	DILEM-…+P1DILEM	50
DA1-12011…	FS2	19.5	10.5	DILEM-…+P1DILEM	50	DILEM-…+P1DILEM	50

Table 59: Mains contactor – DA1 voltage class 230 V (3-phase)

Device type	Frame size	Input current	Output current	Mains contactors (thermal AC1 current)			
		A	A	Type max 50 °C and IEC	A	Type max. 40°C and UL	A
Voltage class: 230 V Mains voltage (50/60 Hz) U_{LN} 200 (-10 %) - 240 (+10 %) V U_e 230 V AC, 3-phase / U_2 230 V AC, 3-phase							
DA1-324D3…	FS2	5.1	4.3	DILEM-…	20	DILEM-…	20
DA1-327D0…	FS2	8.3	7	DILEM-…	20	DILEM-…	20
DA1-32011…	FS2	12.6	10.5	DILEM-…	20	DILEM-…	20
DA1-32018…	FS3	21.6	18	DILM17	38	DILM17	40
DA1-32024…	FS3, FS4	29.1	24	DILM17	38	DILM17	40
DA1-32030…	FS4	36.4	30	DILM17	38	DILM17	40
DA1-32046…	FS4	55.8	46	DILM40	57	DILM40	60
DA1-32060FB-B20C	FS5	63.9	61	DILM50	71	DILM50	80
DA1-32061FB-B55C	FS5	70.2	61	DILM50	71	DILM50	80
DA1-32072FB-B20C	FS5	74	72	DILM65	88	DILM50	80
DA1-32072FB-B55C	FS5	82.9	72	DILM65	88	DILM65	98
DA1-32090FB-B55C	FS6	103.6	90	DILM95	125	DILM80	110
DA1-32110FB-B55C	FS6	126.7	110	DILM115	142	DILM95	130
DA1-32150FB-B55C	FS6	172.7	150	DILM150	180	DILM150	190
DA1-32180FB-B55C	FS6	183.3	180	DILM170	200	DILM150	190
DA1-32202FB-B55C	FS7	205.7	202	DILM185A	301	DILM170	225
DA1-32248FB-B55C	FS7	255.5	248	DILM185A	301	DILM185A	337

Table 60: Mains contactor – DA1 voltage class 400 V

Device type	Frame size	Input current	Output current	Mains contactors (thermal AC1 current)			
		A	A	Type max 50 °C and IEC	A	Type max. 40°C and UL	A
Voltage class: 400 V Mains voltage (50/60 Hz) U_{LN} 380 (-10 %) - 480 (+10 %) V U_e 400 V AC, 3-phase / U_2 400 V AC, 3-phase							
DA1-342D2…	FS2	2.4	2.2	DILEM-…	20	DILEM-…	20
DA1-344D1…	FS2	5.1	4.1	DILEM-…	20	DILEM-…	20
DA1-345D8…	FS2	7.5	5.8	DILEM-…	20	DILEM-…	20
DA1-349D5…	FS2	11.2	9.5	DILEM-…	20	DILEM-…	20
DA1-34014…	FS3	19	14	DILEM-…	20	DILEM-…	20
DA1-34018…	FS3	21	18	DILM7	21	DILM7	22
DA1-34024…	FS3, FS4	28.9	24	DILM17	38	DILM17	40
DA1-34030…	FS4	37.2	30	DILM17	38	DILM17	40
DA1-34039…	FS4	47	39	DILM40	57	DILM40	60
DA1-34046…	FS4	52.4	46	DILM40	57	DILM40	60
DA1-34061FB-B20C	FS5	66.1	61	DILM50	71	DILM50	80
DA1-34061FB-B55C	FS5	63.8	61	DILM50	71	DILM50	80
DA1-34072FB-B20C	FS5	77.3	72	DILM65	88	DILM50	80
DA1-34072FB-B55C	FS5	76.4	72	DILM65	88	DILM50	80
DA1-34090FB-B55C	FS6	92.2	90	DILM80	98	DILM65	98
DA1-34110FB-B55C	FS6	112.5	110	DILM95	125	DILM95	130
DA1-34150FB-B55C	FS6	153.2	150	DILM150	180	DILM115	160
DA1-34180FB-B55C	FS6	183.7	180	DILM170	200	DILM150	190
DA1-34202FB-B55C	FS7	217	202	DILM185A	301	DILM170	225
DA1-34240FB-B55C	FS7	256	240	DILM185A	301	DILM185A	337
DA1-34302FB-B55C	FS7	302	302	DILM225A	310	DILM185A	337

Table 61: Mains contactor – DA1 voltage class 575 V

Device type	Frame size	Input current	Output current	Mains contactors (thermal AC1 current)			
		A	A	Type max 50 °C and IEC	A	Type max. 40 °C and UL	A
Voltage class: 575 V Mains voltage (50/60 Hz) U_{LN} 500 (-10 %) - 600 (+10 %) V U_e 575 V AC, 3-phase / U_2 575 V AC, 3-phase							
DA1-352D1NB-…	FS2	2.5	2.1	DILEM-…	20	DILEM-…	20
DA1-353D1NB-…	FS2	3.7	3.1	DILEM-…	20	DILEM-…	20
DA1-354D1NB-…	FS2	4.9	4.1	DILEM-…	20	DILEM-…	20
DA1-356D5NB-…	FS2	7.8	6.5	DILEM-…	20	DILEM-…	20
DA1-359D0NB-…	FS2	10.8	9	DILEM-…	20	DILEM-…	20
DA1-35012NB-…	FS3	14.4	12	DILEM-…	20	DILEM-…	20
DA1-35017NB-…	FS3	20.6	17	DILM7	21	DILM7	22
DA1-35022…	FS3, FS4	26.7	22	DILM17	38	DILM17	40
DA1-35028…	FS4	34	28	DILM17	38	DILM17	40
DA1-35034…	FS4	41.2	34	DILM25	43	DILM25	45
DA1-35041NB-B20C	FS5	53	43	DILM40	57	DILM40	60
DA1-35043NB…	FS4	53	43	DILM40	57	DILM40	60
DA1-35054NB-B20C	FS5	59.5	54	DILM50	71	DILM40	60
DA1-35054NB-B55C	FS5	62.2	54	DILM50	71	DILM50	80
DA1-35065NB-B20C	FS5	70.4	65	DILM50	71	DILM50	80
DA1-35065NB-B55C	FS5	75.8	65	DILM65	88	DILM50	80
DA1-35078NB-B55N	FS6	90.9	78	DILM80	98	DILM65	98
DA1-35105NB-B55N	FS6	108.2	105	DILM95	125	DILM80	110
DA1-35130NB-B55N	FS6	162	130	DILM150	162	DILM150	190
DA1-35150NB-B55N	FS6	187	150	DILM170	200	DILM150	190

For technical data on the line contactors, please refer to the product data sheets.

7.3 Mains chokes

DX-LN1…

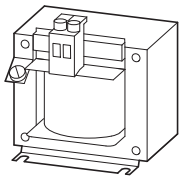


Figure 96: DX-LN1… mains chokes (single-phase)

Table 62: Assigned mains chokes – DA1 voltage class 230 V (1-phase)

Device type	Frame size	Input current	Mains choke U_{LN} max. 240 V +10 % 50/60 Hz ±10 %	
		I_{LN}	max. 50 °C	
		A	Type	A
Voltage class: 230 V **Mains voltage (50/60 Hz) U_{LN} 200 (-10 %) - 240 (+10 %) V** **U_e 230 V AC, 1-phase / U_2 230 V AC, 3-phase**				
DA1-124D3FB-…	FS2	8.5	DX-LN1-013	13
DA1-127D0FB-…	FS2	15.2	DX-LN1-018	18
DA1-12011FB-…	FS2	19.5	DX-LN1-024	24

DX-LN3…

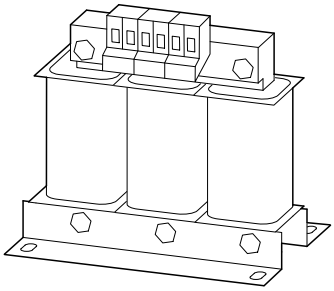


Figure 97: DX-LN3… mains chokes (three-phase)

Table 63: Assigned mains chokes – DA1 voltage class 230 V (3-phase)

Device type	Frame size	Input current	Mains choke U_{LN} max. 240 V +10 % 50/60 Hz ±10 % max. 50 °C	
		A	Type	A
Voltage class: 230 V Mains voltage (50/60 Hz) U_{LN} 200 (-10 %) - 240 (+10 %) V U_e 230 V AC, 3-phase / U_2 230 V AC, 3-phase				
DA1-324D3…	FS2	5.1	DX-LN3-006	6
DA1-327D0…	FS2	8.3	DX-LN3-010	10
DA1-32011…	FS2	12.6	DX-LN3-016	16
DA1-32018…	FS3	21.6	DX-LN3-025	25
DA1-32024…	FS3, FS4	29.1	DX-LN3-040	40
DA1-32030…	FS4	36.4	DX-LN3-040	40
DA1-32046…	FS4	55.8	DX-LN3-060	60
DA1-32060FB-B20C	FS5	63.9	DX-LN3-080	80
DA1-32061FB-B55C	FS5	70.2	DX-LN3-080	80
DA1-32072FB-B20C	FS5	74	DX-LN3-080	80
DA1-32072FB-B55C	FS5	82.9	DX-LN3-100	100
DA1-32090FB-B55C	FS6	103.6	DX-LN3-120	120
DA1-32110FB-B55C	FS6	126.7	DX-LN3-160	160
DA1-32150FB-B55C	FS6	172.7	DX-LN3-200	200
DA1-32180FB-B55C	FS6	183.3	DX-LN3-200	200
DA1-32202FB-B55C	FS7	205.7	DX-LN3-250	250
DA1-32248FB-B55C	FS7	255.5	DX-LN3-300	300

Table 64: Assigned mains chokes – DA1 voltage class 400 V (3-phase)

Device type	Frame size	Input current	Mains choke U_{LN} max. 240 V +10 % 50/60 Hz ±10 % max. 50 °C	
		A	Type	A
Voltage class: 400 V Mains voltage (50/60 Hz) U_{LN} 380 (-10 %) - 480 (+10 %) V U_e 400 V AC, 3-phase / U_2 400 V AC, 3-phase				
DA1-342D2…	FS2	2.4	DX-LN3-004	3.9
DA1-344D1…	FS2	5.1	DX-LN3-006	6
DA1-345D8…	FS2	7.5	DX-LN3-010	10
DA1-349D5…	FS2	11.2	DX-LN3-016	16
DA1-34014…	FS3	19	DX-LN3-025	25
DA1-34018…	FS3	21	DX-LN3-025	25
DA1-34024…	FS3, FS4	28.9	DX-LN3-040	40
DA1-34030…	FS4	37.2	DX-LN3-040	40
DA1-34039…	FS4	47	DX-LN3-050	50
DA1-34046…	FS4	52.4	DX-LN3-060	60
DA1-34061FB-B20C	FS5	66.1	DX-LN3-080	80
DA1-34061FB-B55C	FS5	63.8	DX-LN3-080	80
DA1-34072FB-B20C	FS5	77.3	DX-LN3-080	80
DA1-34072FB-B55C	FS5	76.4	DX-LN3-080	80
DA1-34090FB-B55C	FS6	92.2	DX-LN3-100	100
DA1-34110FB-B55C	FS6	112.5	DX-LN3-120	120
DA1-34150FB-B55C	FS6	153.2	DX-LN3-160	160
DA1-34180FB-B55C	FS6	183.7	DX-LN3-200	200
DA1-34202FB-B55C	FS7	217	DX-LN3-250	250
DA1-34240FB-B55C	FS7	256	DX-LN3-300	300
DA1-34302FB-B55C	FS7	302	DX-LN3-303	303

Table 65: Assigned mains chokes – DA1 voltage class 500 V (three-phase)

Device type	Frame size	Input current	Mains choke U_{LN} max. 240 V +10 % 50/60 Hz ±10 % max. 50 °C	
		A	Type	A
Voltage class: 500 V Mains voltage (50/60 Hz) U_{LN} 500 (-10 %) - 600 (+10 %) V U_e 500 V AC, 3-phase / U_2 500 V AC, 3-phase				
DA1-352D1NB-…	FS2	2.5	DX-LN3-004	3.9
DA1-353D1NB-…	FS2	3.7	DX-LN3-004	3.9
DA1-354D1NB-…	FS2	4.9	DX-LN3-006	6
DA1-356D5NB-…	FS2	7.8	DX-LN3-010	10
DA1-359D0NB-…	FS2	10.8	DX-LN3-016	16
DA1-35012NB-…	FS3	14.4	DX-LN3-016	16
DA1-35017NB-…	FS3	20.6	DX-LN3-025	25
DA1-35022NB…	FS3, FS4	26.7	DX-LN3-040	40
DA1-35028NB…	FS4	34	DX-LN3-040	40
DA1-35034NB…	FS4	41.2	DX-LN3-050	50
DA1-35041NB-B20C	FS5	53	DX-LN3-060	60
DA1-35043NB…	FS4	53	DX-LN3-060	60
DA1-35054NB-B20C	FS5	59.5	DX-LN3-060	60
DA1-35054NB-B55C	FS5	62.2	DX-LN3-080	80
DA1-35065NB-B20C	FS5	70.4	DX-LN3-080	80
DA1-35065NB-B55C	FS5	75.8	DX-LN3-080	80
DA1-35078NB-B55N	FS6	90.9	DX-LN3-100	100
DA1-35105NB-B55N	FS6	108.2	DX-LN3-120	120
DA1-35130NB-B55N	FS6	162	DX-LN3-200	200
DA1-35150NB-B55N	FS6	187	DX-LN3-200	200

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

→ For more information and technical data on DX-LN… mains chokes, please refer to instruction leaflet IL00906003Z.

7.4 Radio interference suppression filter

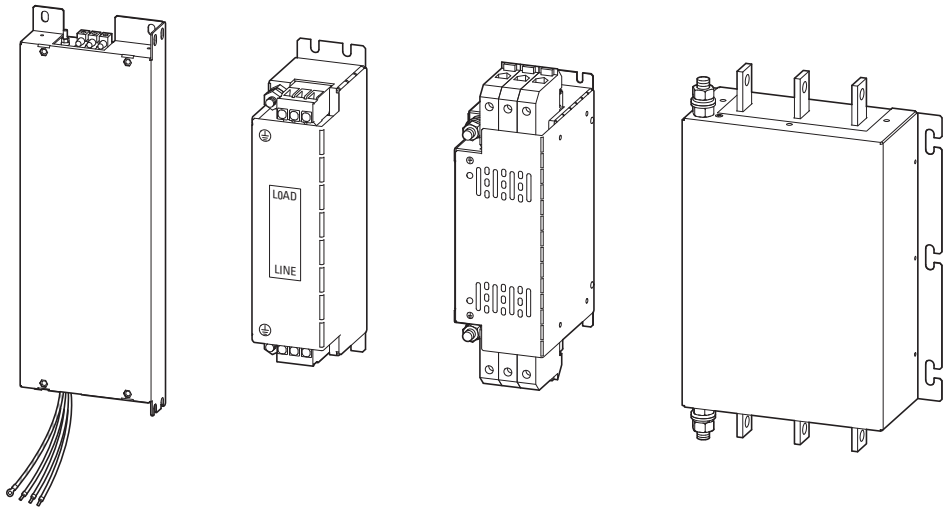


Figure 98: External radio interference suppression filters DX-EMC...-FS... (substructure filter with ready-made connecting cables) and DX-EMC... (add-on filter)

The external radio interference suppression filters DX-EMC… should always be installed in the immediate vicinity of the associated variable frequency drive. The connecting 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 shielding.

→ The DX-EMC… radio interference suppression filters listed below are designed with degree of protection IP20 for installation in a control cabinet.

→ Frame sizes DX-EMC34-400… and DX-EMC34-750… have a degree of protection of IP00.

→ Please enquire for higher degrees of protection.

→ Further information and technical data on the radio interference suppression filters DX-EMC... can be found in the instruction leaflets IL04012017Z and IL04012018Z.

→ The maximum motor cable lengths listed below in radio interference classes C1, C2 and C3 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) U_{LN} 200 (-10 %) - 240 (+10 %) V

U_e 230 V AC, 1-phase / U_2 230 V AC, 3-phase

Table 66: Assigned radio interference suppression filter (1-phase)

Device type	Frame size	Input current	Radio interference suppression filter	Rated current	Leakage current (IEC38 +10 %)	C1	C2	C3
		A	Type	A	A	m	m	m
DA1-124D3…	FS2	8.5	DX-EMC12-014-FS2	14	8	25	50	75
DA1-127D0…	FS2	15.2	DX-EMC12-014-FS2	14	8	25	50	75
DA1-12011…	FS2	19.5	DX-EMC12-025-FS2	25	8	25	75	100

→ DX-EMC…-**FS2**: Base-mounted filter for frame size FS2

Voltage class: 230 V

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

U_e 230 V AC, 3-phase / U_2 230 V AC, 3-phase

Table 67: Assigned radio interference suppression filter (3-phase)

Device type	Frame size	Input current	Radio interference suppression filter	Rated current	Leakage current (IEC38 +10 %)	C1	C2	C3
		A	Type	A	A	m	m	m
DA1-324D3…	FS2	5.1	DX-EMC34-016	16	21	25	50	75
			DX-EMC34-016-L	16	6	5	25	50
			DX-EMC34-016-SL	16	6	5	25	50
DA1-327D0…	FS2	8.3	DX-EMC34-016	16	21	25	50	75
			DX-EMC34-016-L	16	6	5	25	50
			DX-EMC34-016-SL	16	6	5	25	50
DA1-32011…	FS2	12.6	DX-EMC34-016	16	21	25	50	75
			DX-EMC34-016-L	16	6	5	25	50
			DX-EMC34-016-SL	16	6	5	25	50
DA1-32018…	FS3	21.6	DX-EMC34-030	30	29	25	50	75
			DX-EMC34-030-L	30	6.5	5	25	50
			DX-EMC34-030-SL	30	6.5	5	25	50
DA1-32024…	FS3	29.1	DX-EMC34-030	30	29	25	50	75
			DX-EMC34-030-L	30	6.5	5	25	50
			DX-EMC34-030-SL	30	6.5	5	25	50
DA1-32024FB-B55C	FS4	29.1	DX-EMC34-030	30	29	25	50	75
			DX-EMC34-030-L	30	6.5	5	25	50
			DX-EMC34-030-SL	30	6.5	5	25	50
DA1-32030…	FS4	36.4	DX-EMC34-042	42	30	25	50	75
			DX-EMC34-042-L	42	6.5	5	25	50
			DX-EMC34-042-SL	42	6.5	5	25	50
DA1-32046…	FS4	55.8	DX-EMC34-075	75	22	25	50	75
			DX-EMC34-075-L	75	6.5	5	25	50
			DX-EMC34-075-SL	75	6.5	5	25	50
DA1-32060FB-B20C	FS5	63.9	DX-EMC34-075	75	22	25	50	75
			DX-EMC34-075-L	75	6.5	5	25	50
			DX-EMC34-075-SL	75	6.5	5	25	50
DA1-32061FB-B55C	FS5	70.2	DX-EMC34-075	75	22	25	50	75
			DX-EMC34-075-L	75	6.5	5	25	50
			DX-EMC34-075-SL	75	6.5	5	25	50
DA1-32072FB-B20C	FS5	74	DX-EMC34-075	75	22	25	50	75
			DX-EMC34-075-L	75	6.5	5	25	50
			DX-EMC34-075-SL	75	6.5	5	25	50

Device type	Frame size	Input current	Radio interference suppression filter	Rated current	Leakage current (IEC38 +10 %)	C1	C2	C3
		A	Type	A	A	m	m	m
DA1-32072FB-B55C	FS5	82.9	DX-EMC34-100	100	30	25	50	75
			DX-EMC34-100-L	100	6.5	5	25	50
			DX-EMC34-100-SL	100	6.5	5	25	50
DA1-32090FB-B55C	FS6	103.6	DX-EMC34-130	130	22	25	50	75
			DX-EMC34-130-L	130	6.5	5	25	50
			DX-EMC34-130-SL	130	6.5	5	25	50
DA1-32110FB-B55C	FS6	126.7	DX-EMC34-130	130	22	25	50	75
			DX-EMC34-130-L	130	6.5	5	25	50
			DX-EMC34-130-SL	130	6.5	5	25	50
DA1-32150FB-B55C	FS6	172.7	DX-EMC34-180	180	31	25	50	75
			DX-EMC34-180-L	180	7	5	25	50
			DX-EMC34-180-SL	180	7	5	25	50
DA1-32180FB-B55C	FS6	183.3	DX-EMC34-250	250	37	25	50	75
			DX-EMC34-250-L	250	7	5	25	50
			DX-EMC34-250-SL	250	7	5	25	50
DA1-32202FB-B55C	FS7	205.7	DX-EMC34-250	250	37	25	50	75
			DX-EMC34-250-L	250	7	5	25	50
			DX-EMC34-250-SL	250	7	5	25	50
DA1-32248FB-B55C	FS7	255.5	DX-EMC34-400	400	60	5	25	50
			DX-EMC34-400-L	400	8	5	25	50

DX-EMC…-**FS**: Substructure filter for the specified frame size
DX-EMC…-**L**: Low leakage current (reduced leakage current)
DX-EMC…-**SL**: Super Low leakage current (high reduced leakage current)

Voltage class: 400 V

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

U_e 400 V AC, 3-phase / U_2 400 V AC, 3-phase

Table 68: Assigned radio interference suppression filter (3-phase)

Device type	Frame size	Input current	Radio interference suppression filter	Rated current	Leakage current (IEC38 +10 %)	C1	C2	C3
		A	Type	A	A	m	m	m
DA1-344D1…	FS2	5.1	DX-EMC34-016	16	21	25	50	75
			DX-EMC34-016-L	16	6	5	25	50
			DX-EMC34-016-SL	16	6	5	25	50
DA1-345D8…	FS2	7.5	DX-EMC34-016	16	21	25	50	75
			DX-EMC34-016-L	16	6	5	25	50
			DX-EMC34-016-SL	16	6	5	25	50
DA1-349D5…	FS2	11.2	DX-EMC34-016	16	21	25	50	75
			DX-EMC34-016-L	16	6	5	25	50
			DX-EMC34-016-SL	16	6	5	25	50
DA1-34014…	FS3	19	DX-EMC34-030	30	29	25	50	75
			DX-EMC34-030-L	30	6.5	5	25	50
			DX-EMC34-030-SL	30	6.5	5	25	50
DA1-34018…	FS3	21	DX-EMC34-030	30	29	25	50	75
			DX-EMC34-030-L	30	6.5	5	25	50
			DX-EMC34-030-SL	30	6.5	5	25	50
DA1-34024…	FS3	28.9	DX-EMC34-030	30	29	25	50	75
			DX-EMC34-030-L	30	6.5	5	25	50
			DX-EMC34-030-SL	30	6.5	5	25	50
DA1-34024FB-B55C	FS4	28.9	DX-EMC34-030	30	29	25	50	75
			DX-EMC34-030-L	30	6.5	5	25	50
			DX-EMC34-030-SL	30	6.5	5	25	50
DA1-34030…	FS4	37.2	DX-EMC34-042	42	30	25	50	75
			DX-EMC34-042-L	42	6.5	5	25	50
			DX-EMC34-042-SL	42	6.5	5	25	50
DA1-34039…	FS4	47	DX-EMC34-055	55	30	25	50	75
			DX-EMC34-055-L	55	6.5	5	25	50
			DX-EMC34-055-SL	55	6.5	5	25	50
DA1-34046…	FS4	52.4	DX-EMC34-055	55	30	25	50	75
			DX-EMC34-055-L	55	6.5	5	25	50
			DX-EMC34-055-SL	55	6.5	5	25	50
DA1-34061FB-B20C	FS5	66.1	DX-EMC34-075	75	22	25	50	75
			DX-EMC34-075-L	75	6.5	5	25	50

Device type	Frame size	Input current	Radio interference suppression filter	Rated current	Leakage current (IEC38 +10 %)	C1	C2	C3
		A	Type	A	A	m	m	m
			DX-EMC34-075-SL	75	6.5	5	25	50
DA1-34061FB-B55C	FS5	63.8	DX-EMC34-075	75	22	25	50	75
			DX-EMC34-075-L	75	6.5	5	25	50
			DX-EMC34-075-SL	75	6.5	5	25	50
DA1-34072FB-B20C	FS5	77.3	DX-EMC34-100	100	30	25	50	75
			DX-EMC34-100-L	100	6.5	5	25	50
			DX-EMC34-100-SL	100	6.5	5	25	50
DA1-34072FB-B55C	FS5	76.4	DX-EMC34-100	100	30	25	50	75
			DX-EMC34-100-L	100	6.5	5	25	50
			DX-EMC34-100-SL	100	6.5	5	25	50
DA1-34090FB-B55C	FS6	92.2	DX-EMC34-100	100	30	25	50	75
			DX-EMC34-100-L	100	6.5	5	25	50
			DX-EMC34-100-SL	100	6.5	5	25	50
DA1-34110FB-B55C	FS6	112.5	DX-EMC34-130	130	22	25	50	75
			DX-EMC34-130-L	130	6.5	5	25	50
			DX-EMC34-130-SL	130	6.5	5	25	50
DA1-34150FB-B55C	FS6	153.2	DX-EMC34-180	180	31	25	50	75
			DX-EMC34-180-L	180	7	5	25	50
			DX-EMC34-180-SL	180	7	5	25	50
DA1-34180FB-B55C	FS6	183.7	DX-EMC34-250	250	37	25	50	75
			DX-EMC34-250-L	250	7	5	25	50
			DX-EMC34-250-SL	250	7	5	25	50
DA1-34202FB-B55C	FS7	217	DX-EMC34-250	250	37	25	50	75
			DX-EMC34-250-L	250	7	5	25	50
			DX-EMC34-250-SL	250	7	5	25	50
DA1-34240FB-B55C	FS7	256	DX-EMC34-400	400	60	5	25	50
			DX-EMC34-400-L	400	8	5	25	50
DA1-34302FB-B55C	FS7	302	DX-EMC34-400	400	60	5	25	50
			DX-EMC34-400-L	400	8	5	25	50

→ DX-EMC…-**FS**: Substructure filter for the specified frame size
DX-EMC…-**L**: Low leakage current (reduced leakage current)
DX-EMC…-**SL**: Super Low leakage current (high reduced leakage current)

7.5 Brake resistors

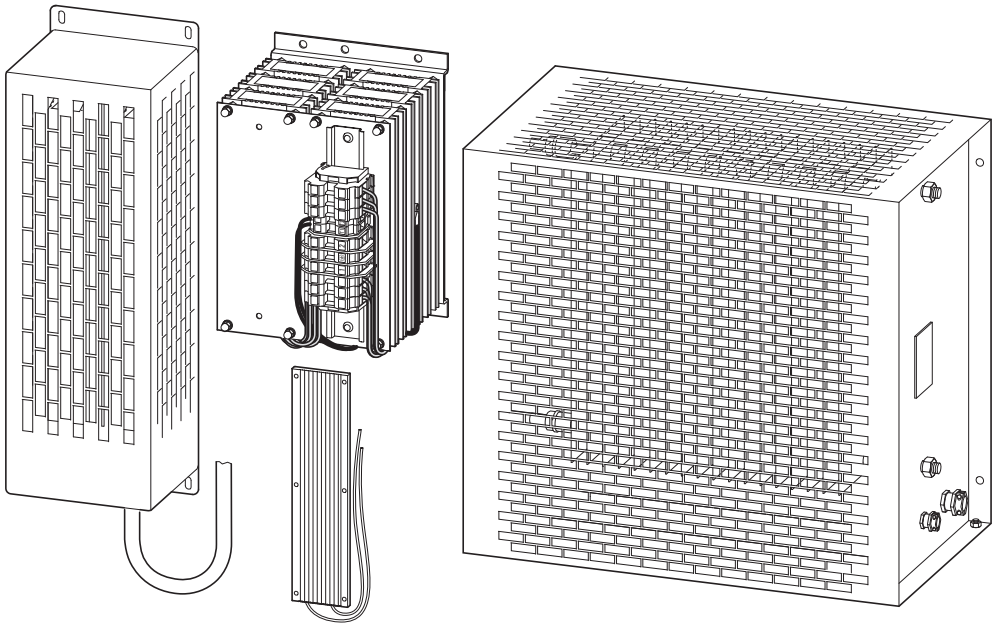


Figure 99: Examples of DX-BR… brake resistor designs

WARNING

You must never go below the specified minimum resistance R_{Bmin}.

CAUTION

Brake resistors get extremely hot during operation!

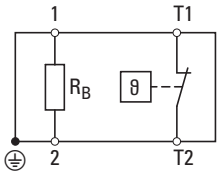
The following tables show examples of the assignment of brake resistors from the DX-BR... series to the individual DA1 variable frequency drives. They are specified according to the "High duty" and "Low duty" classification, for intermittent braking, with a cycle time t_C of 120 seconds, corresponding to a pulse power P_{Peak}, which corresponds to the maximum braking output 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 potential-free contact (NC contact) can be integrated directly into the control of the DA1 variable frequency drive and act as an external error message (control signal 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 in the heat sink of the DA1 variable frequency drive (for sizes FS2 and FS3 in IP20 and for FS4 and FS5 in IP55) and are thus automatically protected against thermal overload (overtemperature heat sink, display: $\square$- $\mathcal{E}$).

For more information and technical data on the DX-BR… series brake resistors listed here, please refer to the corresponding instruction leaflet for the individual models: IL04012024Z, IL04011ZU, IL04014ZU, IL04015ZU and IL04021ZU.

Table 69: Brake resistor – DA1 voltage class 230 V

Device type	Frame size	Resistance value			Braking resistor (Low duty)					Braking resistor (High duty)				
					Type					Type				
		R_{Bmin}	R_{Brec}	P_{max}		R_B	P_{DB}	ED	t_{Bresis}		R_B	P_{DB}	ED	t_{Brake}
		Ω	Ω	kW		Ω	kW	%	s		Ω	kW	%	s
Voltage class: 230 V | Mains voltage (50/60 Hz) U_{LN} 200 (-10%) - 240 (+10%) V | U_e 230 V AC, 1-phase / U_2 230 V AC, 3-phase														
DA1-124D3FB-A20C	FS2	25	100	0.75	DX-BR3-100	100	0.2	27	32	DX-BR100-240	100	0.24	32	38
DA1-127D0FB-A20C	FS2	25	50	1.5	DX-BR3-100	100	0.2	13	16	DX-BR050-600	50	0.6	40	48
DA1-12011FB-A20C	FS2	25	35	2.2	DX-BR3-100	100	0.2	9	11	DX-BR042-720	42	0.72	33	39
Voltage class: 230 V | Mains voltage (50/60 Hz) U_{LN} 200 (-10%) - 240 (+10%) V | U_e 230 V AC, 3-phase / U_2 230 V AC, 3-phase														
DA1-324D3FB-A20C	FS2	25	100	0.75	DX-BR3-100	100	0.2	27	32	DX-BR100-240	100	0.24	32	38
DA1-327D0FB-A20C	FS2	25	50	1.5	DX-BR3-100	100	0.2	13	16	DX-BR050-600	50	0.6	40	48
DA1-32011FB-A20C	FS2	25	35	2.2	DX-BR3-100	100	0.2	9	11	DX-BR042-720	42	0.72	33	39
DA1-32018FB-A20C	FS3	20	20	4	DX-BR5-33	33	0.5	13	15	DX-BR025-1440	25	1.44	36	43
DA1-32024FB-A20C	FS3	20	20	5.5	DX-BR5-33	33	0.5	9	11	DX-BR025-1920	25	1.92	35	42
DA1-32024FB-B55C	FS4	12	20	5.5	DX-BR5-33	33	0.5	9	11	DX-BR025-1920	25	1.92	35	42
DA1-32030FB-B55C	FS4	12	22	7.5	DX-025-1440	25	1.44	19	23	DX-027-2880	27	2.88	38	46
DA1-32046FB-B55C	FS4	12	22	11	DX-025-1440	25	1.44	13	16	DX-BR022-5K1	22	5.1	46	56
DA1-32061FB-B55C	FS5	6	12	15	2 // DX-025-1440	12.5	2.88	19	23	DX-BR012-5K1	12	5.1	34	41
DA1-32072FB-B55C	FS5	6	12	18.5	2 // DX-025-1440	12.5	2.88	16	19	DX-BR012-9K2	12	9.2	50	60
DA1-32090FB-B55C	FS6	6	6	22	2 // DX-BR050-1440	12.5	2.88	13	16	DX-BR012-9K2	12	9.2	42	50
DA1-32110FB-B55C	FS6	3	6	30	2 // DX-BR050-1440	12.5	2.88	10	12	DX-BR012-9K2	12	9.2	31	37
DA1-32150FB-B55C	FS6	3	6	37	DX-BR006-5K1	6	5.1	14	17	DX-BR006-18K1	6	18.1	49	59
DA1-32180FB-B55C	FS6	3	6	45	DX-BR006-5K1	6	5.1	11	14	DX-BR006-18K1	6	18.1	40	48
DA1-32202FB-B55C	FS7	3	6	55	DX-BR006-5K1	6	5.1	9	11	DX-BR006-18K1	6	18.1	33	39
DA1-32248FB-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
Resistance values: R_{Bmin} = minimum permitted resistance value; R_{Brec} = recommended resistance value
P_{max} = Rated power for the Low duty and High duty classifications

Table 70: Brake resistor – DA1 voltage class 400 V

Device type	Frame size	Resistance value			Braking resistor (Low duty)					Braking resistor (High duty)				
					Type					Type				
		R_{Bmin}	R_{Brec}	P_{max}		R_B	P_{DB}	ED	t_{Brake}		R_B	P_{DB}	ED	t_{Brake}
		Ω	Ω	kW		Ω	kW	%	s		Ω	kW	%	s
Voltage class: 400 V | Mains voltage (50/60 Hz) U_{LN} 380 (-10%) - 480 (+10%) V | U_e 400 V AC, 3-phase / U_2 400 V AC, 3-phase														
DA1-342D2FB-A20C	FS2	50	400	0.75	DX-BR3-100	100	0.2	27	32	DX-BR400-400	400	0.4	53	64
DA1-344D1FB-A20C	FS2	50	200	1.5	DX-BR3-100	100	0.2	13	16	DX-BR216-600	216	0.6	40	48
DA1-345D8FB-A20C	FS2	50	150	2.2	DX-BR3-100	100	0.2	9	11	DX-BR150-0K8	150	0.8	36	44
DA1-349D5FB-A20C	FS2	50	100	4	DX-BR100-600	100	0.6	15	18	DX-BR100-1K6	100	1.6	40	48
DA1-34014FB-A20C	FS3	40	75	5.5	DX-BR100-600	100	0.6	11	13	DX-BR050-1920	50	1.92	35	42
DA1-34018FB-A20C	FS3	40	50	7.5	DX-BR050-720	50	0.72	10	12	DX-BR050-2880	50	2.88	38	46
DA1-34024FB-A20C	FS3	40	40	11	DX-BR050-960	50	0.96	9	10	DX-BR047-5K1	47	5.1	46	56
DA1-34024FB-B55C	FS4	22	40	11	DX-BR050-960	50	0.96	9	10	DX-BR047-5K1	47	5.1	46	56
DA1-34030FB-B55C	FS4	22	22	15	DX-BR025-1440	25	1.44	10	12	DX-BR022-5K1	22	5.1	34	41
DA1-34039FB-B55C	FS4	22	22	18.5	DX-BR025-1920	25	1.92	10	12	DX-BR022-9K2	22	9.2	50	60
DA1-34046FB-B55C	FS4	22	22	22	DX-BR025-1920	25	1.92	9	10	DX-BR022-9K2	22	9.2	42	50
DA1-34061FB-B55C	FS5	12	12	30	2 // DX-BR050-1440	12.5	2.88	10	12	DX-BR012-9K2	12	9.2	31	37
DA1-34072FB-B55C	FS5	12	12	37	2 // DX-BR027-1920	12.5	3.84	10	12	DX-BR012-18K1	12	18.1	49	59
DA1-34090FB-B55C	FS6	6	6	45	DX-BR006-5K1	6	5.1	11	14	DX-BR006-18K1	6	18.1	40	48
DA1-34110FB-B55C	FS6	6	6	55	DX-BR006-9K2	6	9.2	17	20	DX-BR006-18K1	6	18.1	33	39
DA1-34150FB-B55C	FS6	6	6	75	DX-BR006-9K2	6	9.2	12	15	DX-BR006-33K3	6	33.3	44	53
DA1-34180FB-B55C	FS6	6	6	90	DX-BR006-9K2	6	9.2	10	12	DX-BR006-33K3	6	33.3	37	44
DA1-34202FB-B55C	FS7	6	6	110	DX-BR006-18K1	6	18.1	16	20	DX-BR012-18K1	6	36.2	33	39
DA1-34240FB-B55C	FS7	6	6	132	DX-BR006-18K1	6	18.1	14	16	4 // DX-BR006-18K1	6	72.4	55	66
DA1-34302FB-B55C	FS7	6	6	160	DX-BR006-18K1	6	18.1	11	14	4 // DX-BR006-18K1	6	72.4	45	54

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
Resistance values: R_{Bmin} = minimum permitted resistance value; R_{Brec} = recommended resistance value
P_{max} = Rated power for the Low duty and High duty classifications

Table 71: Brake resistor – DA1 voltage class 575 V

Device type	Frame size	Resistance value			Braking resistor (Low duty)					Braking resistor (High duty)				
					Type					Type				
		R_{Bmin}	R_{Brec}	P_{max}		R_B	P_{DB}	ED	t_{Bresis}		R_B	P_{RD}	ED	t_{Brake}
		Ω	Ω	kW		Ω	kW	%	s		Ω	kW	%	s
Voltage class: 575 V | Mains voltage (50/60 Hz) U_{LN} 500 (-10%) - 600 (+10%) V | U_e 575 V AC, 3-phase / U_2 575 V AC, 3-phase														
DA1-352D1NB-A20C	FS2	600	600	0.75	2 & DX-BR430-100	860	0.2	27	32	3 & DX-BR210-200	630	0.6	80	96
DA1-353D1NB-A20C	FS2	300	300	1.5	DX-BR400-0K4	400	0.4	27	32	2 & DX-BR150-0K5	300	1	67	80
DA1-354D1NB-A20C	FS2	200	200	2.2	DX-BR200-0K4	200	0.4	18	22	2 & DX-BR100-600	200	1.2	55	65
DA1-356D5NB-A20C	FS2	150	150	4	DX-BR150-0K5	150	0.5	13	15	2 & DX-BR075-1K1	150	2.2	55	66
DA1-359D0NB-A20C	FS2	100	100	5.5	DX-BR100-0K8	100	0.8	15	17	2 & DX-BR050-1440	100	2.88	52	63
DA1-35012NB-A20C	FS3	80	80	7.5	DX-BR100-920	100	0.96	13	15	2 & DX-BR050-1440	100	2.88	38	46
DA1-35017NB-A20C	FS3	50	50	11	DX-BR050-1440	50	1.44	13	16	2 & DX-BR025-1920	50	3.84	35	42
DA1-35022NB-A20C	FS3	33	33	15	DX-BR050-1440	50	1.44	10	12	DX-BR040-5K1	40	5.1	34	41
DA1-35022NB-B55C	FS4	33	33	15	DX-BR050-1440	50	1.44	10	12	DX-BR040-5K1	40	5.1	34	41
DA1-35028NB-B55C	FS4	33	33	18.5	DX-BR040-3K1	40	3.1	17	20	DX-BR047-9K2	47	9.2	50	60
DA1-35034NB-B55C	FS4	22	22	22	DX-BR022-3K1	22	3.1	14	17	DX-BR022-9K2	22	9.2	42	50
DA1-35043NB-B55C	FS5	16	16	30	DX-BR022-5K1	22	5.1	17	20	DX-BR022-9K2	22	9.2	31	37
DA1-35054NB-B55C	FS5	16	16	37	DX-BR022-5K1	22	5.1	14	17	2 & DX-BR012-9K2	24	18.4	50	60
DA1-35065NB-B55C	FS5	12	12	45	DX-BR012-5K1	12	5.1	11	14	DX-BR012-18K1	12	18.1	40	48
DA1-35078NB-B55C	FS6	12	12	55	DX-BR012-5K1	12	5.1	9	11	DX-BR012-18K1	12	18.1	33	39
DA1-35105NB-B55C	FS6	8	8	75	DX-BR012-9K2	12	9.2	12	15	2 & DX-BR006-18K1	12	36.2	48	…58
DA1-35130NB-B55C	FS6	8	8	90	DX-BR012-9K2	12	9.2	10	12	2 & DX-BR006-18K1	12	36.2	40	48
DA1-35150NB-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
Resistance values: R_{Bmin} = minimum permitted resistance value; R_{Brec} = recommended resistance value
P_{max} = Rated power for the Low duty and High duty classifications

7.6 Motor chokes

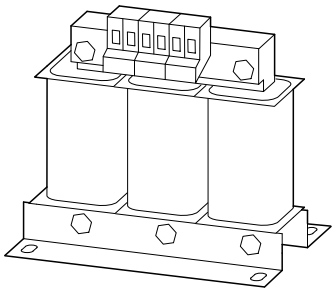


Figure 100:Motor choke DX-LM3…

Table 72: Assigned motor chokes

Device type			**Assigned motor chokes**[1]	
DA1-12… DA1-32…	**DA1-34…**	**DA1-35…**[2]	**Type**	**Rated current** **A**
DA1-124D3…	DA1-342D2…	DA1-352D1…	DX-LM3-008	8
DA1-324D3…	DA1-344D1…	DA1-353D1…	DX-LM3-008	8
		DA1-354D1…	DX-LM3-008	8
DA1-127D0…	DA1-345D8…	DA1-356D5…	DX-LM3-008	8
DA1-327D0…			DX-LM3-008	8
DA1-12011…[3]	DA1-349D5…	DA1-359D0…	DX-LM3-011	11
DA1-32011…[3]			DX-LM3-011	11
	DA1-34014…	DA1-35012…	DX-LM3-016	16
DA1-32018…	DA1-34018…	DA1-35017…	DX-LM3-035	35
DA1-32024…	DA1-34024…	DA1-35022…	DX-LM3-035	35
DA1-32030…	DA1-34030…	DA1-35028…	DX-LM3-035	35
		DA1-35034…	DX-LM3-035	35
DA1-32046…	DA1-34039…	DA1-35043…	DX-LM3-050	50
	DA1-34046…		DX-LM3-050	50
DA1-32061…	DA1-34061…	DA1-35054…	DX-LM3-063	63
DA1-32072…	DA1-34072…	DA1-35065…	DX-LM3-080	80
		DA1-35078…	DX-LM3-080	80
DA1-32090…	DA1-34090…		DX-LM3-100	100
DA1-32110…	DA1-34110…	DA1-35105…	DX-LM3-150	150
DA1-32150…	DA1-34150…	DA1-35130…	DX-LM3-150	150
		DA1-35150…	DX-LM3-150	150
DA1-32180…	DA1-34180…		DX-LM3-180	180
DA1-32202…	DA1-34202…		DX-LM3-220	220
DA1-32248…	DA1-34240…		DX-LM3-260	260

Device type			Assigned motor chokes[1]	
DA1-12… DA1-32…	**DA1-34…**	**DA1-35…**[2]	**Type**	**Rated current A**
	DA1-34302…		DX-LM3-303	303

1) Maximum ambient temperature of 50 °C for the corresponding DA1 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 DA1 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

For more information and technical data on DX-LM3… motor chokes, please refer to instruction leaflet IL00906003Z.

7.7 Sine filter

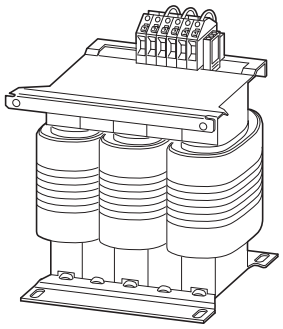


Figure 101:Sine filter DX-SIN3…

Sine filter DX-SIN3… should be operated only 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 DA1 with DX-SIN3…:
1 ≙ 8 kHz; 2 ≙12 kHz

For the DA1 variable frequency drive, the set value with the double-modulation procedure is the double value of the effective value in the sine filter (1 ≙ 8 kHz → 4 kHz; 2 ≙ 12 kHz → 6 kHz).

Table 73: Assigned sine filter

Device type			Assigned sine filter[1] Rated frequency f_2 = 0 - 150 Hz		
DA1-12… DA1-32…	**DA1-34…**	**DA1-35…[2]**	**Type**	**Rated current A**	**Voltage drop u_K at 400 V %**
–	DA1-342D2…	DA1-352D1…	DX-SIN3-004	4	–
–	–	DA1-353D1…	DX-SIN3-004	4	–
DA1-124D3…	DA1-344D1…	DA1-354D1…	DX-SIN3-010	10	7
DA1-127D0…	DA1-345D8…	DA1-356D5…	DX-SIN3-010	10	7
DA1-324D3…	DA1-349D5…	DA1-359D0…	DX-SIN3-010	10	7
DA1-327D0…	–	–	DX-SIN3-010	10	7
DA1-12011…[3]	DA1-34014…	DA1-35012…	DX-SIN3-016	16.5	7.5
DA1-32011…[3]	–	–	DX-SIN3-016	16.5	7.5
DA1-32018…	DA1-34018…	DA1-35017…	DX-SIN3-023	23.5	8
–	DA1-34024…	DA1-35022…	DX-SIN3-023	23.5	8
DA1-32024…	DA1-34030...	DA1-35028…	DX-SIN3-032	32	8.7
DA1-32030…	–	–	DX-SIN3-032	32	8.7
DA1-32046…	DA1-34039…	DA1-35034…	DX-SIN3-048	48	7.8
–	DA1-34046…	DA1-35041…	DX-SIN3-048	48	7.8
–	–	DA1-35043…	DX-SIN3-048	48	7.8
DA1-32060…	DA1-34061…	DA1-35054…	DX-SIN3-061	61	8.3
DA1-32061...	–	–	DX-SIN3-061	61	8.3
DA1-32072…	–	DA1-35065…	DX-SIN3-072	72	7.5
DA1-32090…	DA1-32072…	DA1-35078…	DX-SIN3-090	90	10
–	DA1-34090…	–	DX-SIN3-090	90	10
DA1-32110…	DA1-34110…	DA1-35105…	DX-SIN3-115	115	11
DA1-32150…	DA1-34150…	DA1-35130…	DX-SIN3-150	150	10.2
DA1-32180…	DA1-34180…	DA1-35150…	DX-SIN3-180	180	7.5
DA1-32202…	DA1-34202…	–	DX-SIN3-250	250	7.5
DA1-32248…	DA1-34240…	–	DX-SIN3-250	250	7.5
–	DA1-34302…	–	DX-SIN3-480	480	9.1

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) DA1-12011… and DA1-32011… 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.

7.8 All-pole sine filter

Please inquire for DX-SIN3-…-A all-pole sine filters for motor currents of up to 180A.

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. The bearing currents between the star point of the motor windings and the ground potential caused by the common-mode voltage can be eliminated in this way. This extends the engine'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 DA1 variable frequency drives.

They can be used

- with fixed switching frequencies ≧ 8 kHz (P2-24, double modulation),
- Output voltage U_{2max} to 500 V,
- Rotating field frequencies (f_2) of 0 to 150 Hz.

They allow to dispense with shielded motor cables.

DX-SIN3-…-A all-pole sine filters may be operated only 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 DA1 with DX-SIN3…:
1 ≙ 8 kHz; 2 ≙12 kHz

For the DA1 variable frequency drive, the set value with the double-modulation procedure is the double value of the effective value in the sine filter (1 ≙ 8 kHz → 4 kHz; 2 ≙ 12 kHz → 6 kHz).

Table 74: Assigned all-pole sine filter

Device type	**Assigned sine filter**[1]**, rated frequency f_2 = 0 - 150 Hz**		
DA1-34…	**Type**	**Rated current**	**Voltage drop u_K at 400 V**
		A	**%**
DA1-342D2…	DX-SIN3-006-A	6.5	6.5
DA1-344D1…	DX-SIN3-006-A	6.5	6.5
DA1-345D8…	DX-SIN3-013-A	13	6.5
DA1-349D5…	DX-SIN3-013-A	13	6.5
DA1-34014…	DX-SIN3-024-A	24	6.5
DA1-34018…	DX-SIN3-024-A	24	6.5
DA1-34024…	DX-SIN3-024-A	24	6.5
DA1-34030…	DX-SIN3-046-A	46	6.5
DA1-34039…	DX-SIN3-046-A	46	6.5
DA1-34046…	DX-SIN3-046-A	46	6.5
DA1-34061…	DX-SIN3-065-A	65	6.5
DA1-34072…	DX-SIN3-110-A	110	6.5
DA1-34090…	DX-SIN3-110-A	110	6.5
DA1-34110…	DX-SIN3-110-A	110	6.5

7.9 List of accessories

Type	Description	Document
DX-KEY-....	External operating panel	AP040022
DXA-EXT-3 RO	Extension by three relay outputs	IL040006ZU
DXA-EXT-3DI1RO	Extension by three digital inputs and one relay output	IL040007ZU
DXA-EXT-ENCOD	Dual-channel encoder module for using closed-loop vector control	AP040028
DX-NET-SWD1	Interface module for connection to a SmartWire-DT network	MN04012009Z
DX-NET-PROFIBUS	PROFIBUS DP communication module for DA1 variable frequency drives	MN04012004Z IL040003ZU
DX-NET-PROFINET-2	Fieldbus connection PROFINET for Variable Frequency Drives DA1	MN04012007Z IL040004ZU
DX-NET-MODBUSTCP-2	Fieldbus connection for Variable Frequency Drives DA1	MN04012008Z IL040004ZU
DX-NET-ETHERNET-2	Fieldbus connection EtherNet/IP for Variable Frequency Drives DA1	MN04012006Z IL040004ZU
DX-NET-ETHERCAT-2	Fieldbus connection EtherCAT for Variable Frequency Drives DA1	MN040009 IL040004ZU
DX-COM-STICK3-KIT	Parameter copying stick for establishing a Bluetooth connection to PC software, smartphone app	MN040003 IL040051ZU
DX-CBL-PC-3M0	Wired communication between DA1 and PC	MN040003 IL040025ZU
DX-SPL-RJ45-2SL1PL	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-EMC-MNT...	EMC cable bracket. Can be used to route and secure cables in the connection area	IL040010ZU
drivesConnect	PC parameterization software for variable frequency drives, with integrated oscilloscope function, drive control function and function block creation for DA1	MN040003

Eaton is an intelligent power management company dedicated to protecting the environment and improving the quality of life for people everywhere. We make products for the data center, utility, industrial, commercial, machine building, residential, aerospace and mobility markets. We are guided by our commitment to do business right, to operate sustainably and to help our customers manage power – today and well into the future.
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