MAKING MODERN LIVING POSSIBLE

Quick Guide
VLT®HVAC Basic Drive FC 101

www.DanfossDrives.com

VLT®
THE REAL DRIVE

Contents

1 Introduction

1.1 Purpose of the Quick Guide

The quick guide provides information for safe installation and commissioning of the adjustable frequency drive.

The quick guide is intended for use by qualified personnel. Read and follow the quick guide to use the adjustable frequency drive safely and professionally, and pay particular attention to the safety instructions and general warnings. Keep this quick guide available with the adjustable frequency drive at all times.
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1.2 Additional Resources

- *VLT® HVAC Basic Drive FC 101 Programming Guide* provides information on how to program and includes complete parameter descriptions.
- VLT® HVAC Basic Drive FC 101 *Design Guide* provides all of the technical information about the adjustable frequency drive and customer design and applications. It also lists options and accessories.

The technical documentation is available in electronic form on the documentation CD that is shipped with the product, or in print at the local Danfoss sales office.

MCT 10 Set-up Software Support
Download the software from *http://www.danfoss.com/BusinessAreas/DrivesSolutions/Software+MCT10/MCT10+Downloads.htm*.

During the installation process of the software, enter access code 81463800 to activate FC 101 functionality. A license key is not required for using FC 101 functionality.

The latest software does not always contain the latest drive updates. Contact the local sales office for the latest drive updates (*.upd files), or download the drive updates from *www.danfoss.com/BusinessAreas/DrivesSolutions/fc101driveupdates*.

1.3 Document and Software Version

The Quick Guide is regularly reviewed and updated. All suggestions for improvement are welcome.

Edition	Remarks	Software version
MG18A6xx	Replaces MG18A5xx	2.70

1.4 Certificates and Approvals

Certification		IP20	IP54
EC Declaration of Conformity	CE	✓	✓
UL-listed	c UL us	✓	-
C-tick		✓	✓

Table 1.1 Certificates and Approvals

The adjustable frequency drive complies with UL508C thermal memory retention requirements. For more information, refer to the section *Motor Thermal Protection* in the product specific *design guide*.

1.5 Disposal

Equipment containing electrical components may not be disposed of together with domestic waste.
It must be separately collected with electrical and electronic waste according to local and currently valid legislation.

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2 Safety

2.1 Introduction

The following symbols are used in this document:

⚠WARNING

Indicates a potentially hazardous situation that could result in death or serious injury.

⚠CAUTION

Indicates a potentially hazardous situation that could result in minor or moderate injury. It can also be used to alert against unsafe practices.

NOTICE!

Indicates important information, including situations that can result in damage to equipment or property.

2.2 Qualified Personnel

Correct and reliable transport, storage, installation, operation, and maintenance are required for the trouble-free and safe operation of the adjustable frequency drive. Only qualified personnel are allowed to install or operate this equipment.

Qualified personnel are defined as trained staff, who are authorized to install, commission, and maintain equipment, systems, and circuits in accordance with pertinent laws and regulations. Additionally, the personnel must be familiar with the instructions and safety measures described in this manual.

2.3 Safety

⚠WARNING

HIGH VOLTAGE

Adjustable frequency drives contain high voltage when connected to AC line power input, DC power supply, or load sharing. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury.

- **Installation, start-up, and maintenance must be performed by qualified personnel only.**

⚠WARNING

UNINTENDED START

When the adjustable frequency drive is connected to AC line power, DC power supply, or load sharing, the motor may start at any time. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage. The motor can start by means of an external switch, a serial bus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 software, or after a cleared fault condition.
To prevent unintended motor start:

- **Disconnect the adjustable frequency drive from line power.**
- **Press [Off/Reset] on the LCP before programming parameters.**
- **Ensure that the adjustable frequency drive is fully wired and assembled when it is connected to AC line power, DC power supply, or load sharing.**

⚠WARNING

DISCHARGE TIME!

Adjustable frequency drives contain DC link capacitors that can remain charged even when the adjustable frequency drive is not powered. To avoid electrical hazards, disconnect AC line power, any permanent magnet type motors, and any remote DC link power supplies, including battery backups, UPS and DC link connections to other adjustable frequency drives. Wait for the capacitors to fully discharge before performing any service or repair work. The amount of waiting time is listed in *Table 2.1*. Failure to wait for the specified period of time after power has been removed to do service or repair could result in death or serious injury.

Voltage [V]	Power range [kW (HP)]	Minimum waiting time (minutes)
3x200	0.25–3.7 (0.33-5)	4
3x200	5.5–11 (7-15)	15
3x400	0.37–7.5 (0.5–10)	4
3x400	11–90 (15–125)	15
3x600	2.2–7.5 (3–10)	4
3x600	11–90 (15–125)	15

Table 2.1 Discharge Time

⚠WARNING

LEAKAGE CURRENT HAZARD

Leakage currents exceed 3.5 mA. Failure to ground the adjustable frequency drive properly can result in death or serious injury.

- **Ensure the correct grounding of the equipment by a certified electrical installer.**

⚠WARNING

EQUIPMENT HAZARD

Contact with rotating shafts and electrical equipment can result in death or serious injury.

- **Ensure that only trained and qualified personnel perform installation, start-up, and maintenance.**
- **Ensure that electrical work conforms to national and local electrical codes.**
- **Follow the procedures in this manual.**

⚠CAUTION

INTERNAL FAILURE HAZARD

An internal failure in the adjustable frequency drive can result in serious injury when the adjustable frequency drive is not properly closed.

- **Ensure that all safety covers are in place and securely fastened before applying power.**

2.4 Motor Thermal Protection

Set *1-90 Motor Thermal Protection* to *[4] ETR trip 1* to enable the motor thermal protection function.

3 Installation

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3.1 Mechanical Installation

3.1.1 Side-by-Side Installation

The adjustable frequency drive can be mounted side-by-side but requires the clearance above and below for cooling.

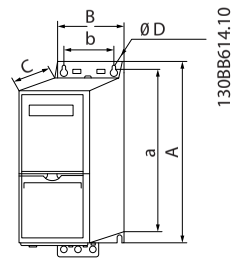
		Power [kW (HP)]			Clearance above/below [mm (in)]
Frame	IP class	3x200-240 V	3x380-480 V	3x525-600 V	
H1	IP20	0.25-1.5 (0.33-2)	0.37-1.5 (0.5-2)	–	100 (4)
H2	IP20	2.2 (3)	2.2-4 (3-5)	–	100 (4)
H3	IP20	3.7 (5)	5.5-7.5 (7.5-10)	–	100 (4)
H4	IP20	5.5-7.5 (7.5-10)	11-15 (15-20)	–	100 (4)
H5	IP20	11 (15)	18.5-22 (25-30)	–	100 (4)
H6	IP20	15-18.5 (20-25)	30-45 (40-60)	18.5-30 (25-40)	200 (7.9)
H7	IP20	22-30 (30-40)	55-75 (70-100)	37-55 (50-70)	200 (7.9)
H8	IP20	37-45 (50-60)	90 (125)	75-90 (100-125)	225 (8.9)
H9	IP20	–	–	2.2-7.5 (3-10)	100 (4)
H10	IP20	–	–	11-15 (15-20)	200 (7.9)
I2	IP54	–	0.75-4.0 (1-5)	–	100 (4)
I3	IP54	–	5.5-7.5 (7.5-10)	–	100 (4)
I4	IP54	–	11-18.5 (15-25)	–	100 (4)
I6	IP54	–	22-37 (30-50)	–	200 (7.9)
I7	IP54	–	45-55 (60-70)	–	200 (7.9)
I8	IP54	–	75-90 (100-125)	–	225 (8.9)

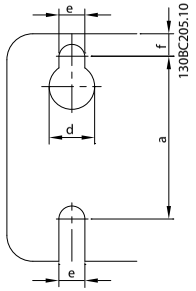
Table 3.1 Clearance Required for Cooling

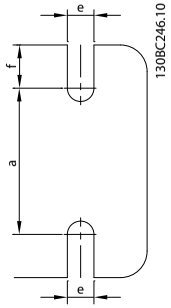
NOTICE!

With IP21/NEMA Type1 option kit mounted, a distance of 50 mm (2 in) between the units is required.

3.1.2 Adjustable Frequency Drive Dimensions





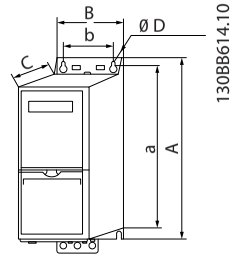


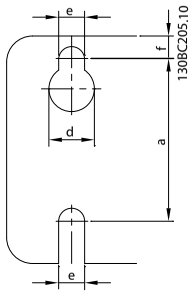
Enclosure		Power [kW (HP)]			Height [mm (in)]			Width [mm (in)]		Depth [mm (in)]	Mounting hole [mm (in)]			Max. Weight
Size	IP Class	3x200-240 V	3x380-480 V	3x525-600 V	A	A[1)]	a	B	b	C	d	e	f	kg (lb)
H1	IP20	0.25–1.5 (0.33–2)	0.37–1.5 (0.5–2)	–	195 (7.7)	273 (10.7)	183 (7.2)	75 (3.0)	56 (2.2)	168 (6.6)	9 (0.35)	4.5 (0.18)	5.3 (0.21)	2.1 (4.6)
H2	IP20	2.2 (3)	2.2–4.0 (3–5)	–	227 (8.9)	303 (11.9)	212 (8.3)	90 (3.5)	65 (2.6)	190 (7.5)	11 (0.43)	5.5 (0.22)	7.4 (0.29)	3.4 (7.5)
H3	IP20	3.7 (5)	5.5–7.5 (7.5-10)	–	255 (10.0)	329 (13.0)	240 (9.4)	100 (3.9)	74 (2.9)	206 (8.1)	11 (0.43)	5.5 (0.22)	8.1 (0.32)	4.5 (9.9)
H4	IP20	5.5–7.5 (7.5-10)	11–15 (15-20)	–	296 (11.7)	359 (14.1)	275 (10.8)	135 (5.3)	105 (4.1)	241 (9.5)	12.6 (0.50)	7 (0.28)	8.4 (0.33)	7.9 (17.4)
H5	IP20	11 (15)	18.5–22 (25-30)	–	334 (13.1)	402 (15.8)	314 (12.4)	150 (5.9)	120 (4.7)	255 (10)	12.6 (0.50)	7 (0.28)	8.5 (0.33)	9.5 (20.9)
H6	IP20	15–18.5 (20–25)	30–45 (40–60)	18.5–30 (25-40)	518 (20.4)	595 (23.4)/635 (25) (45 kW)	495 (19.5)	239 (9.4)	200 (7.9)	242 (9.5)	–	8.5 (0.33)	15 (0.6)	24.5 (54)
H7	IP20	22–30 (30–40)	55–75 (70–100)	37–55 (50–70)	550 (21.7)	630 (24.8)/690 (27.2) (75 kW)	521 (20.5)	313 (12.3)	270 (10.6)	335 (13.2)	–	8.5 (0.33)	17 (0.67)	36 (79)
H8	IP20	37–45 (50–60)	90 (125)	75–90 (100–125)	660 (26)	800 (31.5)	631 (24.8)	375 (14.8)	330 (13)	335 (13.2)	–	8.5 (0.33)	17 (0.67)	51 (112)
H9	IP20	–	–	2.2–7.5 (3–10)	269 (10.6)	374 (14.7)	257 (10.1)	130 (5.1)	110 (4.3)	205 (8)	11 (0.43)	5.5 (0.22)	9 (0.35)	6.6 (14.6)
H10	IP20	–	–	11–15 (15-20)	399 (15.7)	419 (16.5)	380 (15)	165 (6.5)	140 (5.5)	248 (9.8)	12 (0.47)	6.8 (0.27)	7.5 (0.30)	12 (26.5)

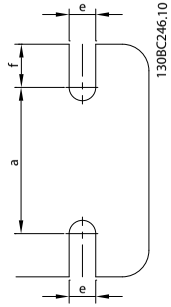
1) Including decoupling plate

The dimensions are only for the physical units. When installing in an application, it is necessary to allow space above and below the units for cooling. The amount of space for free air passage is listed in *Table 3.1*.

Table 3.3 Dimensions, Enclosure Size H1-H10







Enclosure		Power [kW (HP)]			Height [mm (in)]			Width [mm (in)]		Depth [mm (in)]	Mounting hole [mm (in)]			Max. Weight
Size	IP Class	3x200-240 V	3x380-480 V	3x525-600 V	A	A[1)]	a	B	b	C	d	e	f	kg (lb)
I2	IP54	–	0.75–4.0 (1–5)	–	332 (13.1)	–	318.5 (12.53)	115 (4.5)	74 (2.9)	225 (8.9)	11 (0.43)	5.5 (0.22)	9 (0.35)	5.3 (11.7)
I3	IP54	–	5.5–7.5 (7.5-10)	–	368 (14.5)	–	354 (13.9)	135 (5.3)	89 (3.5)	237 (9.3)	12 (0.47)	6.5 (0.26)	9.5 (0.37)	7.2 (15.9)
I4	IP54	–	11–18.5 (15–25)	–	476 (18.7)	–	460 (18.1)	180 (7)	133 (5.2)	290 (11.4)	12 (0.47)	6.5 (0.26)	9.5 (0.37)	13.8 (30.42)
I6	IP54	–	22-37 (30-50)	–	650 (25.6)	–	624 (24.6)	242 (9.5)	210 (8.3)	260 (10.2)	19 (0.75)	9 (0.35)	9 (0.35)	27 (59.5)
I7	IP54	–	45-55 (60-70)	–	680 (26.8)	–	648 (25.5)	308 (12.1)	272 (10.7)	310 (12.2)	19 (0.75)	9 (0.35)	9.8 (0.39)	45 (99.2)
I8	IP54	–	75-90 (100-125)	–	770 (30)	–	739 (29.1)	370 (14.6)	334 (13.2)	335 (13.2)	19 (0.75)	9 (0.35)	9.8 (0.39)	65 (143.3)

1) Including decoupling plate

The dimensions are only for the physical units. When installing in an application, it is necessary to allow space above and below the units for cooling. The amount of space for free air passage is listed in *Table 3.1*.

Table 3.4 Dimensions, Enclosure Size I2-I8

3.2 Electrical Installation

3.2.1 Electrical Installation in General

All cabling must comply with national and local regulations on cable cross-sections and ambient temperature. Copper conductors are required. 75 °C (167 °F) is recommended.

Power [kW (HP)]				Torque [Nm (in-lb]					
Frame	IP class	3x200-240 V	3x380-480 V	Line power	Motor	DC connection	Control terminals	Ground	Relay
H1	IP20	0.25–1.5 (0.33-2)	0.37–1.5 (0.5–2)	0.8 (7)	0.8 (7)	0.8 (7)	0.5 (4)	0.8 (7)	0.5 (4)
H2	IP20	2.2 (3)	2.2–4.0 (3–5)	0.8 (7)	0.8 (7)	0.8 (7)	0.5 (4)	0.8 (7)	0.5 (4)
H3	IP20	3.7 (5)	5.5–7.5 (7.5-10)	0.8 (7)	0.8 (7)	0.8 (7)	0.5 (4)	0.8 (7)	0.5 (4)
H4	IP20	5.5–7.5 (7.5-10)	11–15 (15-20)	1.2 (11)	1.2 (11)	1.2 (11)	0.5 (4)	0.8 (7)	0.5 (4)
H5	IP20	11 (15)	18.5–22 (25-30)	1.2 (11)	1.2 (11)	1.2 (11)	0.5 (4)	0.8 (7)	0.5 (4)
H6	IP20	15–18.5 (20–25)	30–45 (40–60)	4.5 (40)	4.5 (40)	–	0.5 (4)	3 (27)	0.5 (4)
H7	IP20	22–30 (30–40)	55 (70)	10 (89)	10 (89)	–	0.5 (4)	3 (27)	0.5 (4)
H7	IP20	–	75 (100)	14 (124)	14 (124)	–	0.5 (4)	3 (27)	0.5 (4)
H8	IP20	37–45 (50–60)	90 (125)	24 (212)[2)]	24 (212)[2)]	–	0.5 (4)	3 (27)	0.5 (4)

Table 3.5 Tightening Torques for Enclosure H1-H8, 3x200-240 V & 3x380-480 V

Power [kW (HP)]			Torque [Nm (in-lb]					
Frame	IP class	3x380-480 V	Line power	Motor	DC connection	Control terminals	Ground	Relay
I2	IP54	0.75–4.0 (1–5)	0.8 (7)	0.8 (7)	0.8 (7)	0.5 (4)	0.8 (7)	0.5 (4)
I3	IP54	5.5–7.5 (7.5-10)	0.8 (7)	0.8 (7)	0.8 (7)	0.5 (4)	0.8 (7)	0.5 (4)
I4	IP54	11–18.5 (15–25)	1.4 (12)	0.8 (7)	0.8 (7)	0.5 (4)	0.8 (7)	0.5 (4)
I6	IP54	22–37 (30–50)	4.5 (40)	4.5 (40)	–	0.5 (4)	3 (27)	0.6 (5)
I7	IP54	45–55 (60–70)	10 (89)	10 (89)	–	0.5 (4)	3 (27)	0.6 (5)
I8	IP54	75–90 (100–125)	14 (124)/24 (212)[1)]	14 (124)/24 (212)[1)]	–	0.5 (4)	3 (27)	0.6 (5)

Table 3.6 Tightening Torques for Enclosure I1–I8

Power [kW (HP)]			Torque [Nm (in-lb)]					
Frame	IP class	3x525-600 V	Line power	Motor	DC connection	Control terminals	Ground	Relay
H9	IP20	2.2–7.5 (3–10)	1.8 (16)	1.8 (16)	not recommended	0.5 (4)	3 (27)	0.6 (5)
H10	IP20	11–15 (15-20)	1.8 (16)	1.8 (16)	not recommended	0.5 (4)	3 (27)	0.6 (5)
H6	IP20	18.5–30 (25-40)	4.5 (40)	4.5 (40)	–	0.5 (4)	3 (27)	0.5 (4)
H7	IP20	37–55 (50–70)	10 (89)	10 (89)	–	0.5 (4)	3 (27)	0.5 (4)
H8	IP20	75–90 (100–125)	14 (124)/24 (212)[1)]	14 (124)/24 (212)[1)]	–	0.5 (4)	3 (27)	0.5 (4)

Table 3.7 Tightening Torques for Enclosure H6-H10, 3x525-600 V

1) Cable dimensions≤95 mm²

2) Cable dimensions >95 mm²

3

3.2.2 IT Line Power

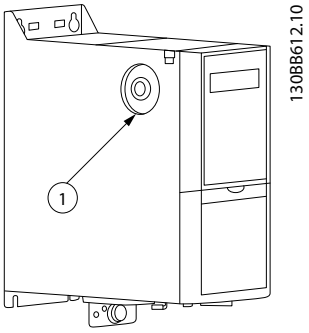
⚠CAUTION

IT Line Power

Installation on isolated line power source, that is, IT line power.

Ensure the supply voltage does not exceed 440 V (3x380-480 V units) when connected to line power.

On IP20, 200-240 V, 0.25-11 kW (0.33-15 HP) and 380-480 V, IP20, 0.37-22 kW (0.5-30 HP) units, open the RFI switch by removing the screw on the side of the adjustable frequency drive when at IT grid.

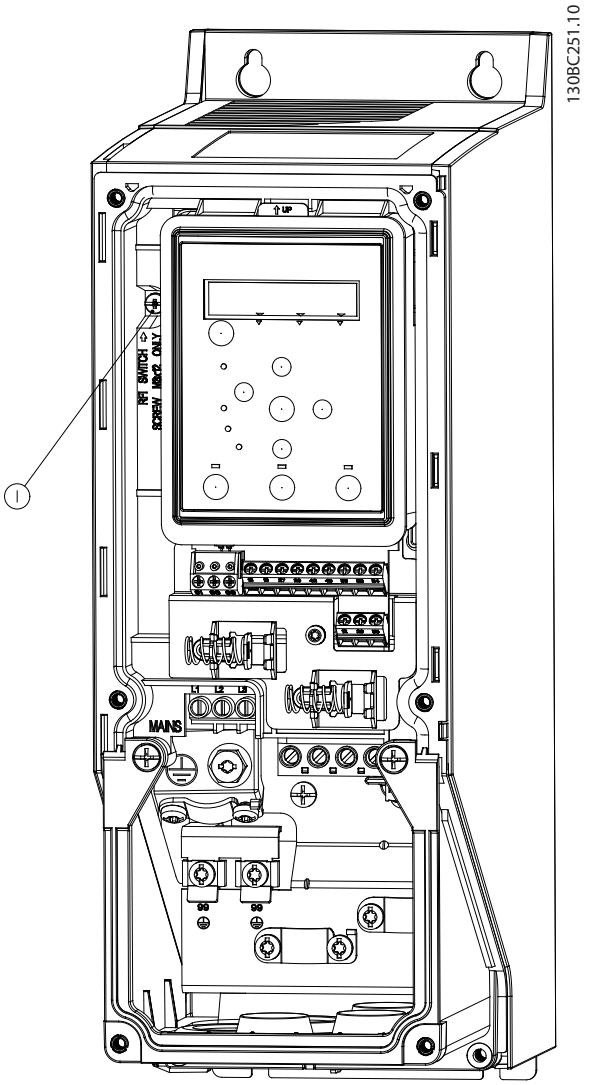


1	EMC screw

Figure 3.1 IP20, 200-240 V, 0.25-11 kW (0.33-15 HP), IP20, 0.37-22 kW (0.5-30 HP), 380-480 V

On 400 V, 30-90 kW (40-125 HP) and 600 V units, set *14-50 RFI Filter* to *[0] Off* when operating in IT line power.

For IP54, 400V, 0.75-18.5 kW (1-25 HP) units, the EMC screw is inside the adjustable frequency drive, as shown in *Figure 3.2*.



1	EMC screw

Figure 3.2 IP54, 400 V, 0.75-18.5 kW (1-25 HP)

NOTICE!

If reinserted, use only M3x12 screw.

3.2.3 Connecting to Line Power and Motor

The adjustable frequency drive is designed to operate all standard 3-phase asynchronous motors. For maximum cross-section on cables, see *chapter 6.4 General Technical Data*.

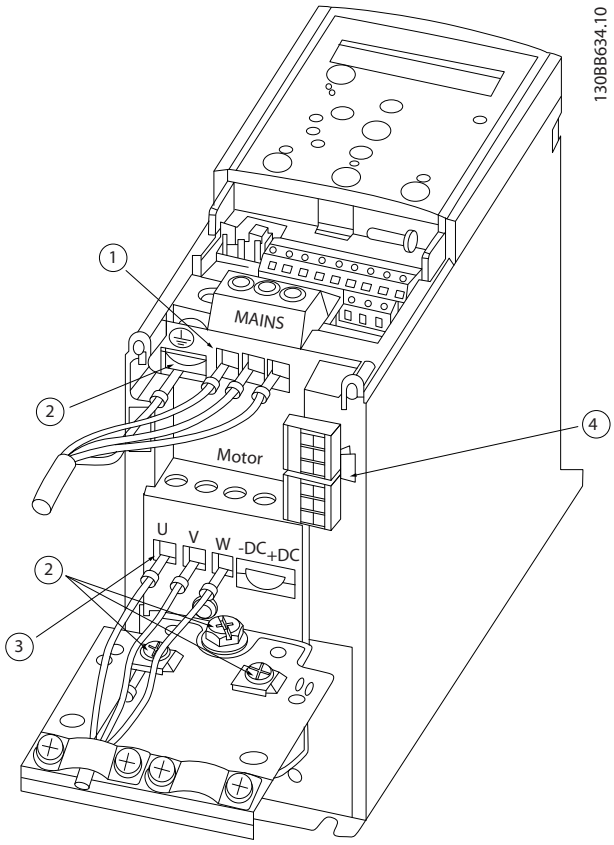
- Use a shielded/armored motor cable to comply with EMC emission specifications, and connect

this cable to both the decoupling plate and the motor.

- Keep the motor cable as short as possible to reduce the noise level and leakage currents.
- For further details on mounting the decoupling plate, see *FC 101 De-coupling Plate Mounting Instruction*.
- Also see *EMC-Compatible Installation* in the *FC 101 Design Guide*.

1. Mount the ground cables to the ground terminal.
2. Connect the motor to terminals U, V, and W, and tighten the screws according to the torques specified in *chapter 3.2.1 Electrical Installation in General*.
3. Connect the line power supply to terminals L1, L2, and L3, and tighten the screws according to the torques specified in *chapter 3.2.1 Electrical Installation in General*.

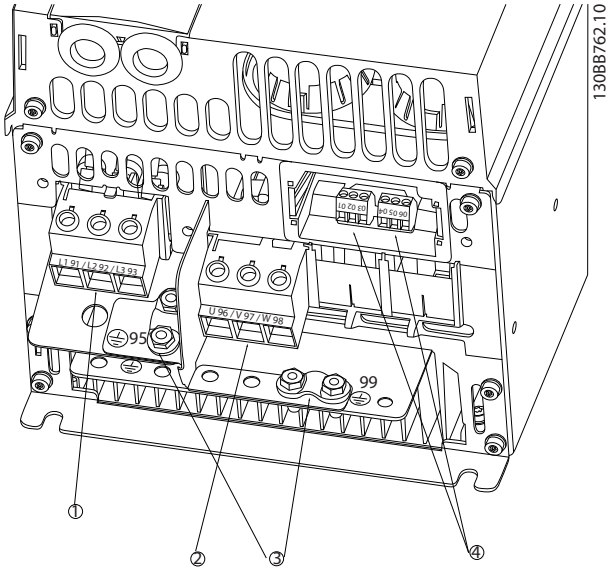
Relays and terminals on H1-H5 enclosures



1	Line power
2	Ground
3	Motor
4	Relays

Figure 3.3 H1–H5 Enclosures
IP20, 200-240 V, 0.25–11 kW (0.33–15 HP)
IP20, 380-480 V, 0.37–22 kW (0.5–30 HP)

Relays and terminals on H6 enclosure

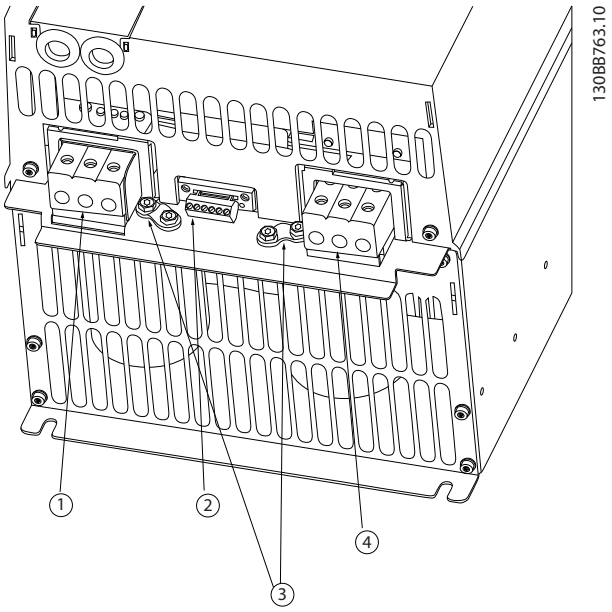


1	Line power
2	Motor
3	Ground
4	Relays

Figure 3.4 H6 Enclosure
IP20, 380-480 V, 30-45 kW (40-60 HP)
IP20, 200-240 V, 15-18.5 kW (20-25 HP)
IP20, 525-600 V, 22-30 kW (30-40 HP)

3

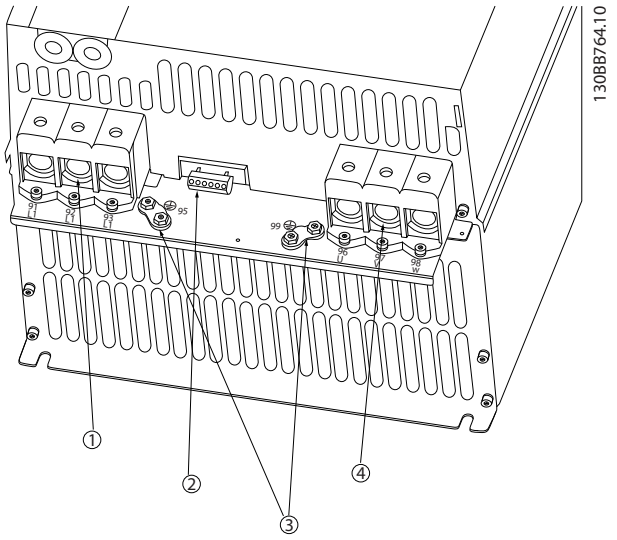
Relays and terminals on H7 enclosure



1	Line power
2	Relays
3	Ground
4	Motor

Figure 3.5 H7 Enclosure
IP20, 380-480 V, 55-75 kW (70-100 HP)
IP20, 200-240 V, 22-30 kW (30-40 HP)
IP20, 525-600 V, 45-55 kW (60-70 HP)

Relays and terminals on H8 enclosure



1	Line power
2	Relays
3	Ground
4	Motor

Figure 3.6 H8 Enclosure
IP20, 380-480 V, 90 kW (125 HP)
IP20, 200-240 V, 37-45 kW (50-60 HP)
IP20, 525-600 V, 75-90 kW (100-125 HP)

Connecting to line power and motor for H9 enclosure

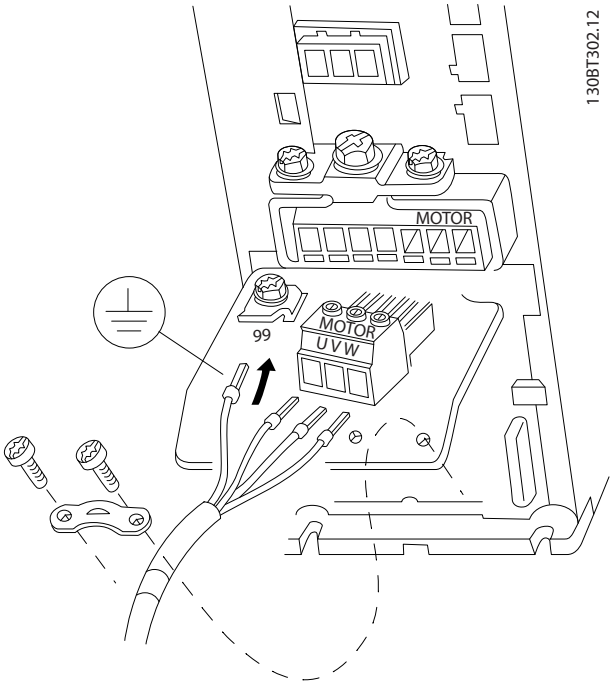


Figure 3.7 Connecting the Adjustable Frequency Drive to the Motor, H9 Enclosure
IP20, 600 V, 2.2-7.5 kW (3-10 HP)

Complete the following steps to connect the line cables for H9 enclosure. Use the tightening torques described in *chapter 3.2.1 Electrical Installation in General*.

1. Slide the mounting plate into place and tighten the two screws, as shown in *Figure 3.8*.

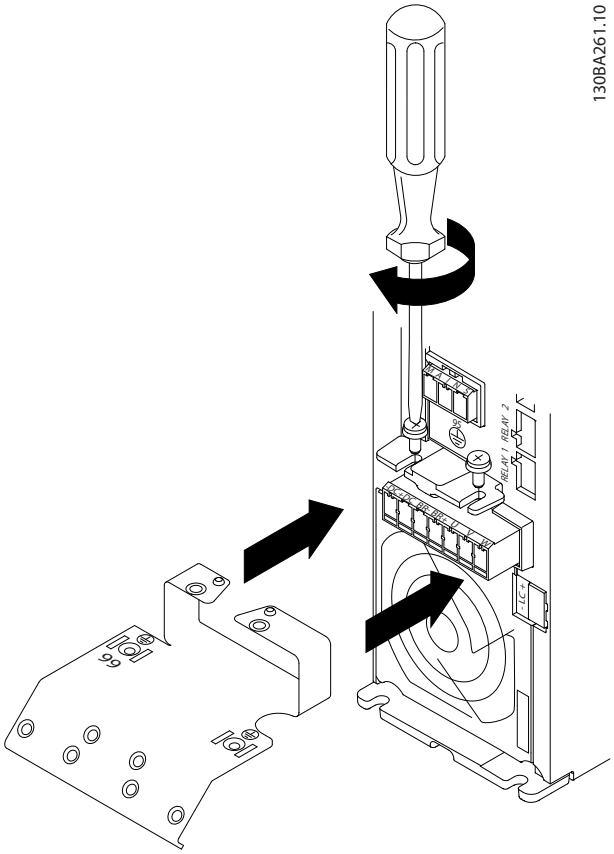


Figure 3.8 Mounting the Mounting Plate

2. Mount the ground cable, as shown in *Figure 3.9*.

3

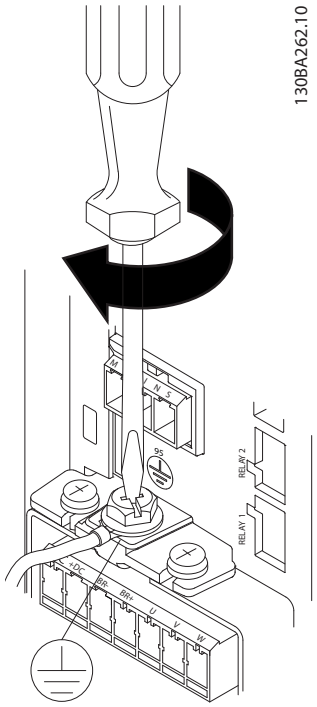


Figure 3.9 Mounting the Ground Cable

3. Insert the line cables to the line power plug and tighten the screws, as shown in *Figure 3.10*.

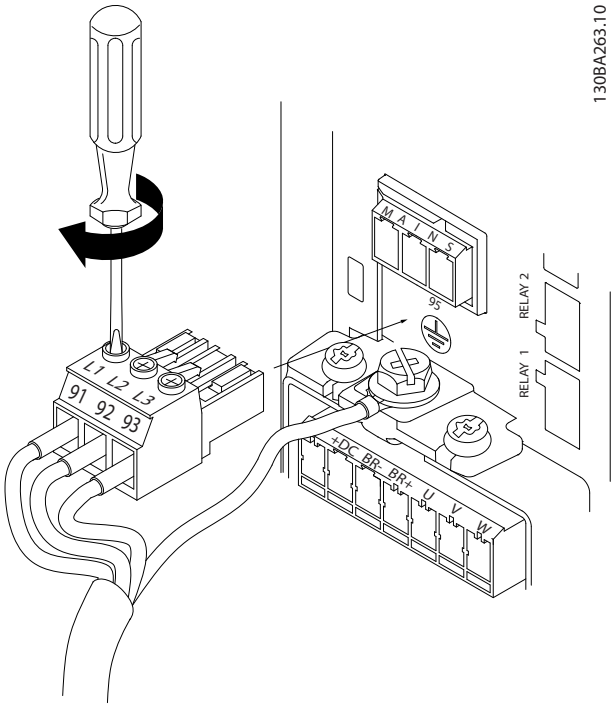


Figure 3.10 Mounting the Line Power Plug

4. Mount the support bracket across the line cables and tighten the screws, as shown in *Figure 3.11*.

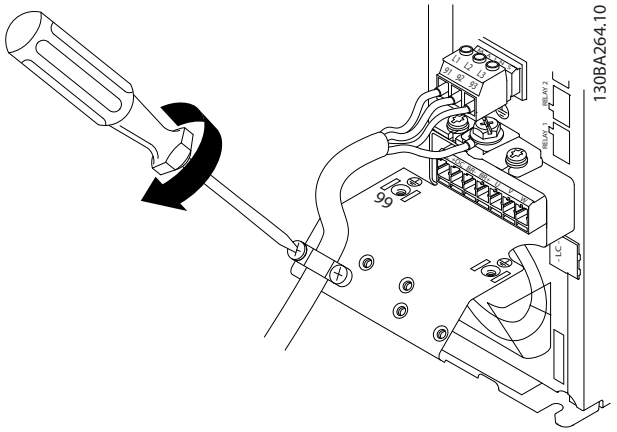


Figure 3.11 Mounting the Support Bracket

Relays and terminals on H10 enclosure

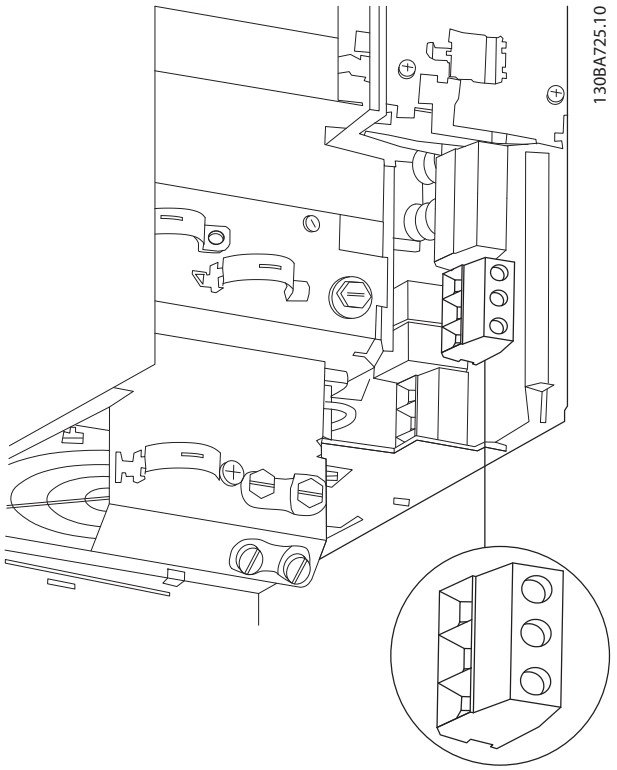
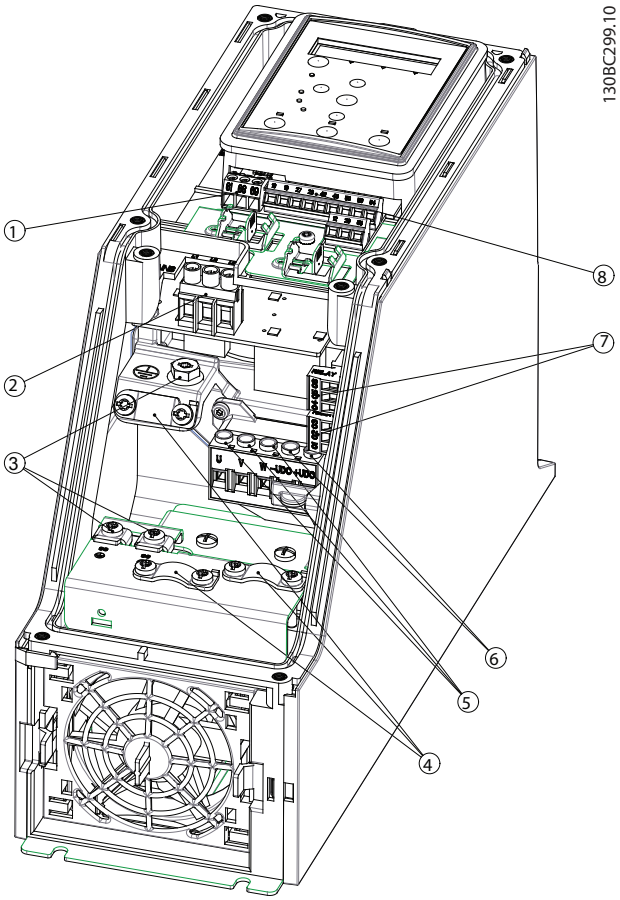


Figure 3.12 H10 Enclosure
IP20, 600 V, 11-15 kW (15-20 HP)

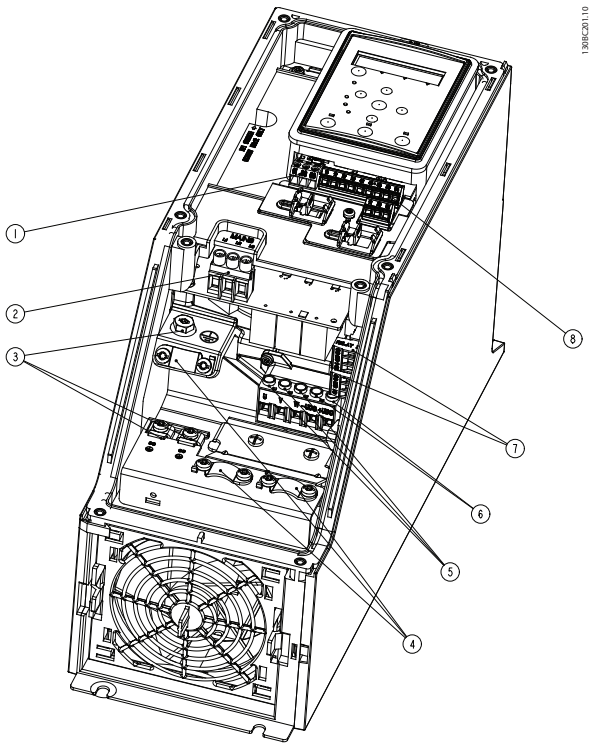
I2 enclosure



1	RS-485
2	Line power
3	Ground
4	Cable clamps
5	Motor
6	UDC
7	Relays
8	I/O

Figure 3.13 I2 Enclosure
IP54, 380-480 V, 0.75-4.0 kW (1-5 HP)

I3 enclosure

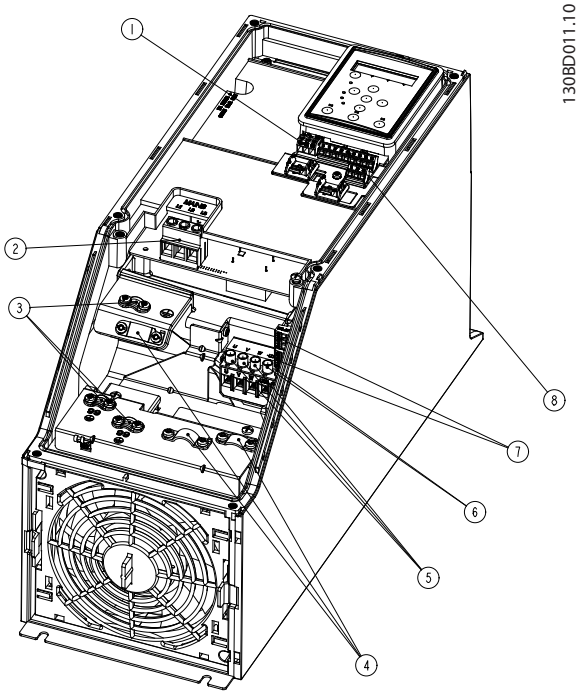


1	RS-485
2	Line power
3	Ground
4	Cable clamps
5	Motor
6	UDC
7	Relays
8	I/O

Figure 3.14 I3 Enclosure
IP54, 380-480 V, 5.5-7.5 kW (7.5-10 HP)

3

I4 enclosure



1	RS-485
2	Line power
3	Ground
4	Cable clamps
5	Motor
6	UDC
7	Relays
8	I/O

Figure 3.15 I4 Enclosure
IP54, 380-480 V, 0.75-4.0 kW (1-5 HP)

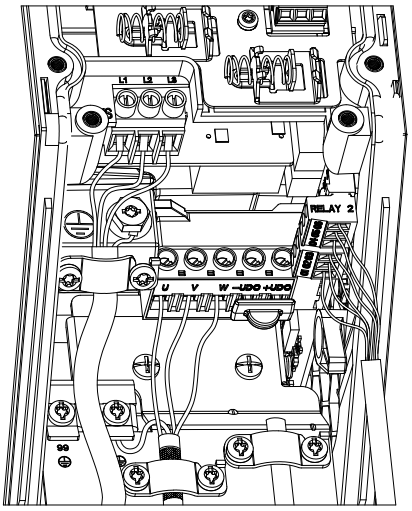


Figure 3.16 IP54 I2-I3-I4 Enclosure

I6 enclosure

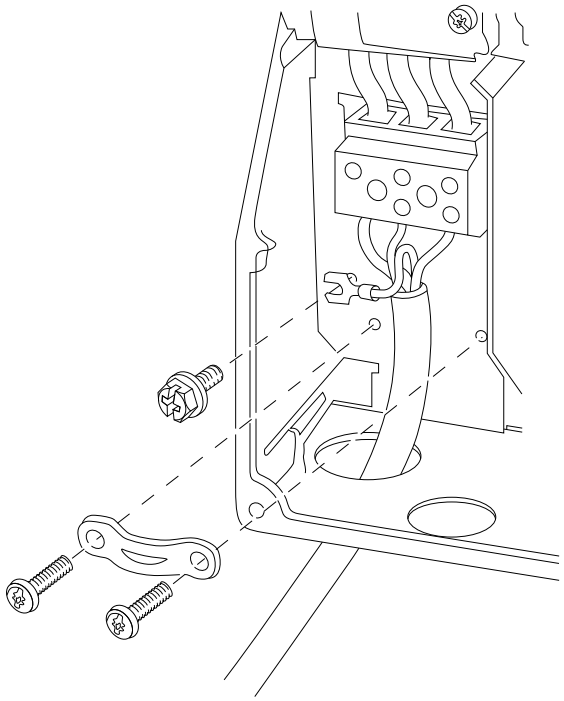


Figure 3.17 Connecting to Line Power for I6 Enclosure
IP54, 380-480 V, 22-37 kW (30-50 HP)

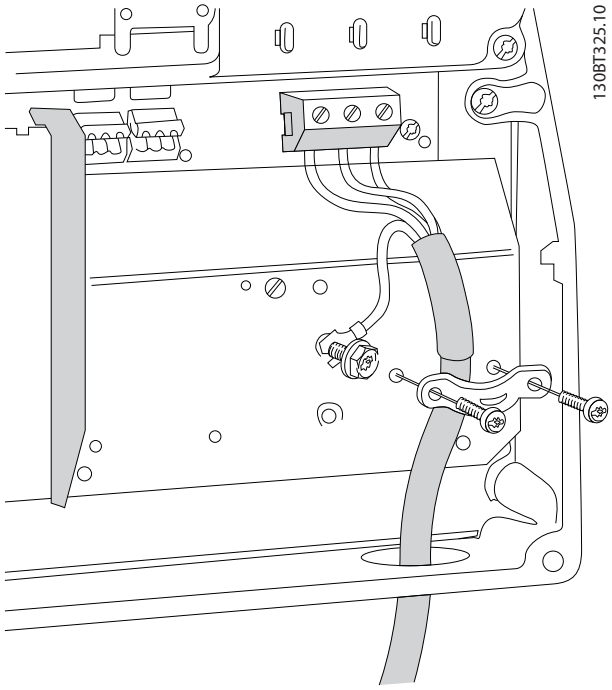


Figure 3.18 Connecting to Motor for I6 Enclosure
IP54, 380-480 V, 22-37 kW (30-50 HP)

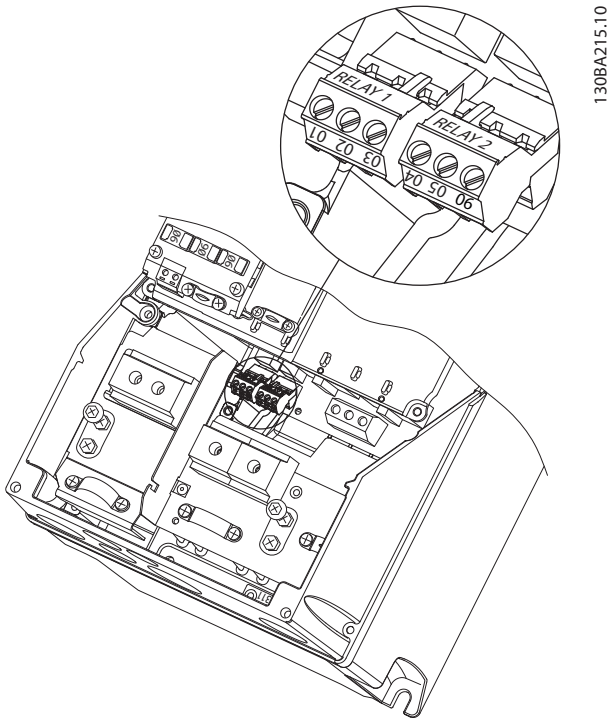


Figure 3.19 Relays on I6 Enclosure
IP54, 380-480 V, 22-37 kW (30-50 HP)

I7, I8 enclosures

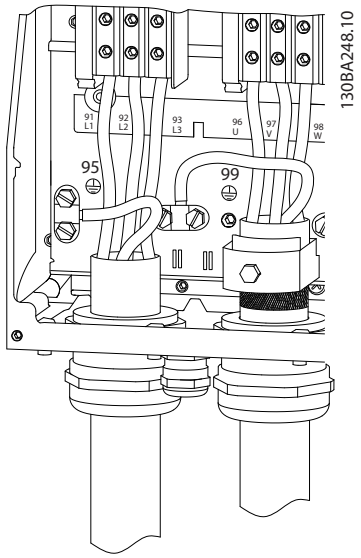


Figure 3.20 I7, I8 Enclosure
IP54, 380-480 V, 45-55 kW (60-70 HP)
IP54, 380-480 V, 75-90 kW (100-125 HP)

3

3.2.4 Fuses and Circuit Breakers

Branch circuit protection
To protect the installation against electrical and fire hazard, all branch circuits in an installation, switch gear, machines, etc., must be short-circuit and overcurrent protected according to national and local regulations.

Short circuit protection
Danfoss recommends using the fuses and circuit breakers listed in *Table 3.8* to protect service personnel or other equipment in case of an internal failure in the unit or short circuit on DC link. The adjustable frequency drive provides full short-circuit protection in case of a short-circuit on the motor.

Overcurrent protection
Provide overload protection to avoid overheating of the cables in the installation. Overcurrent protection must always be carried out according to local and national regulations. Circuit breakers and fuses must be designed for protection in a circuit capable of supplying a maximum of 100000 A_{rms} (symmetrical), 480 V maximum.

UL/Non-UL compliance
Use the circuit breakers or fuses listed in *Table 3.8* to ensure compliance with UL or IEC 61800-5-1.
Circuit breakers must be designed for protection in a circuit capable of supplying a maximum of 10000 Arms (symmetrical), 480 V maximum.

NOTICE!

In the event of malfunction, failure to follow the protection recommendation may result in damage to the adjustable frequency drive.

	Circuit breaker		Fuse				
	UL	Non-UL	UL				Non-UL
			Bussmann	Bussmann	Bussmann	Bussmann	Maximum fuse
Power [kW (HP)]			Type RK5	Type RK1	Type J	Type T	Type G
3x200–240 V IP20							
0.25 (0.33)			FRS-R-10	KTN-R10	JKS-10	JJN-10	10
0.37 (0.5)			FRS-R-10	KTN-R10	JKS-10	JJN-10	10
0.75 (1)			FRS-R-10	KTN-R10	JKS-10	JJN-10	10
1.5 (2)			FRS-R-10	KTN-R10	JKS-10	JJN-10	10
2.2 (3)			FRS-R-15	KTN-R15	JKS-15	JJN-15	16
3.7 (5)			FRS-R-25	KTN-R25	JKS-25	JJN-25	25
5.5 (7.5)			FRS-R-50	KTN-R50	JKS-50	JJN-50	50
7.5 (10)			FRS-R-50	KTN-R50	JKS-50	JJN-50	50
11 (15)			FRS-R-80	KTN-R80	JKS-80	JJN-80	65
15 (20)	Cutler-Hammer EGE3100FFG	Moeller NZMB1-A125	FRS-R-100	KTN-R100	JKS-100	JJN-100	125
18.5 (25)			FRS-R-100	KTN-R100	JKS-100	JJN-100	125
22 (30)	Cutler-Hammer JGE3150FFG	Moeller NZMB1-A160	FRS-R-150	KTN-R150	JKS-150	JJN-150	160
30 (40)			FRS-R-150	KTN-R150	JKS-150	JJN-150	160
37 (50)	Cutler-Hammer JGE3200FFG	Moeller NZMB1-A200	FRS-R-200	KTN-R200	JKS-200	JJN-200	200
45 (60)			FRS-R-200	KTN-R200	JKS-200	JJN-200	200
3x380–480 V IP20							
0.37 (0.5)			FRS-R-10	KTS-R10	JKS-10	JJS-10	10
0.75 (1)			FRS-R-10	KTS-R10	JKS-10	JJS-10	10
1.5 (2)			FRS-R-10	KTS-R10	JKS-10	JJS-10	10
2.2 (3)			FRS-R-15	KTS-R15	JKS-15	JJS-15	16
3 (4)			FRS-R-15	KTS-R15	JKS-15	JJS-15	16
4 (5)			FRS-R-15	KTS-R15	JKS-15	JJS-15	16
5.5 (7.5)			FRS-R-25	KTS-R25	JKS-25	JJS-25	25
7.5 (10)			FRS-R-25	KTS-R25	JKS-25	JJS-25	25
11 (15)			FRS-R-50	KTS-R50	JKS-50	JJS-50	50
15 (20)			FRS-R-50	KTS-R50	JKS-50	JJS-50	50
18.5 (25)			FRS-R-80	KTS-R80	JKS-80	JJS-80	65
22 (30)			FRS-R-80	KTS-R80	JKS-80	JJS-80	65
30 (40)	Cutler-Hammer EGE3125FFG	Moeller NZMB1-A125	FRS-R-125	KTS-R125	JKS-R125	JJS-R125	80
37 (50)			FRS-R-125	KTS-R125	JKS-R125	JJS-R125	100
45 (60)			FRS-R-125	KTS-R125	JKS-R125	JJS-R125	125
55 (70)	Cutler-Hammer JGE3200FFG	Moeller NZMB1-A200	FRS-R-200	KTS-R200	JKS-R200	JJS-R200	150
75 (100)			FRS-R-200	KTS-R200	JKS-R200	JJS-R200	200
90 (125)	Cutler-Hammer JGE3250FFG	Moeller NZMB2-A250	FRS-R-250	KTS-R250	JKS-R250	JJS-R250	250
3x525–600 V IP20							
2.2 (3)			FRS-R-20	KTS-R20	JKS-20	JJS-20	20
3 (4)			FRS-R-20	KTS-R20	JKS-20	JJS-20	20
3.7 (5)			FRS-R-20	KTS-R20	JKS-20	JJS-20	20
5.5 (7.5)			FRS-R-20	KTS-R20	JKS-20	JJS-20	20
7.5 (10)			FRS-R-20	KTS-R20	JKS-20	JJS-20	30
11 (15)			FRS-R-30	KTS-R30	JKS-30	JJS-30	35
15 (20)			FRS-R-30	KTS-R30	JKS-30	JJS-30	35

3

	Circuit breaker		Fuse				
	UL	Non-UL	UL				Non-UL
			Bussmann	Bussmann	Bussmann	Bussmann	Maximum fuse
Power [kW (HP)]			Type RK5	Type RK1	Type J	Type T	Type G
18.5 (25)	Cutler-Hammer EGE3080FFG	Cutler-Hammer EGE3080FFG	FRS-R-80	KTN-R80	JKS-80	JJS-80	80
22 (30)			FRS-R-80	KTN-R80	JKS-80	JJS-80	80
30 (40)			FRS-R-80	KTN-R80	JKS-80	JJS-80	80
37 (50)	Cutler-Hammer JGE3125FFG	Cutler-Hammer JGE3125FFG	FRS-R-125	KTN-R125	JKS-125	JJS-125	125
45 (60)			FRS-R-125	KTN-R125	JKS-125	JJS-125	125
55 (70)			FRS-R-125	KTN-R125	JKS-125	JJS-125	125
75 (100)	Cutler-Hammer JGE3200FAG	Cutler-Hammer JGE3200FAG	FRS-R-200	KTN-R200	JKS-200	JJS-200	200
90 (125)			FRS-R-200	KTN-R200	JKS-200	JJS-200	200
3x380–480 V IP54							
0.75 (1)		PKZM0-16	FRS-R-10	KTS-R-10	JKS-10	JJS-10	16
1.5 (2)		PKZM0-16	FRS-R-10	KTS-R-10	JKS-10	JJS-10	16
2.2 (3)		PKZM0-16	FRS-R-15	KTS-R-15	JKS-15	JJS-15	16
3 (4)		PKZM0-16	FRS-R-15	KTS-R-15	JKS-15	JJS-15	16
4 (5)		PKZM0-16	FRS-R-15	KTS-R-15	JKS-15	JJS-15	16
5.5 (7.5)		PKZM0-25	FRS-R-25	KTS-R-25	JKS-25	JJS-25	25
7.5 (10)		PKZM0-25	FRS-R-25	KTS-R-25	JKS-25	JJS-25	25
11 (15)		PKZM4-63	FRS-R-50	KTS-R-50	JKS-50	JJS-50	63
15 (20)		PKZM4-63	FRS-R-50	KTS-R-50	JKS-50	JJS-50	63
18.5 (25)		PKZM4-63	FRS-R-80	KTS-R-80	JKS-80	JJS-80	63
22 (30)	Moeller NZMB1-A125		FRS-R-80	KTS-R-80	JKS-80	JJS-80	125
30 (40)			FRS-R-125	KTS-R-125	JKS-125	JJS-125	125
37 (50)			FRS-R-125	KTS-R-125	JKS-125	JJS-125	125
45 (60)	Moeller NZMB2-A160		FRS-R-125	KTS-R-125	JKS-125	JJS-125	160
55 (70)			FRS-R-200	KTS-R-200	JKS-200	JJS-200	160
75 (100)	Moeller NZMB2-A250		FRS-R-200	KTS-R-200	JKS-200	JJS-200	200
90 (125)			FRS-R-250	KTS-R-250	JKS-200	JJS-200	200

Table 3.8 Circuit Breakers and Fuses

3.2.5 EMC-compatible Electrical Installation

General points to be observed to ensure EMC-compatible electrical installation.

- Use only shielded/armored motor cables and shielded/armored control cables.
- Ground the shield at both ends.
- Avoid installation with twisted shield ends (pigtails) because this reduces the shielding effect at high frequencies. Use the cable clamps provided.
- Ensure the same potential between drive and ground potential of PLC.
- Use starwashers and galvanically grounding plates.

3

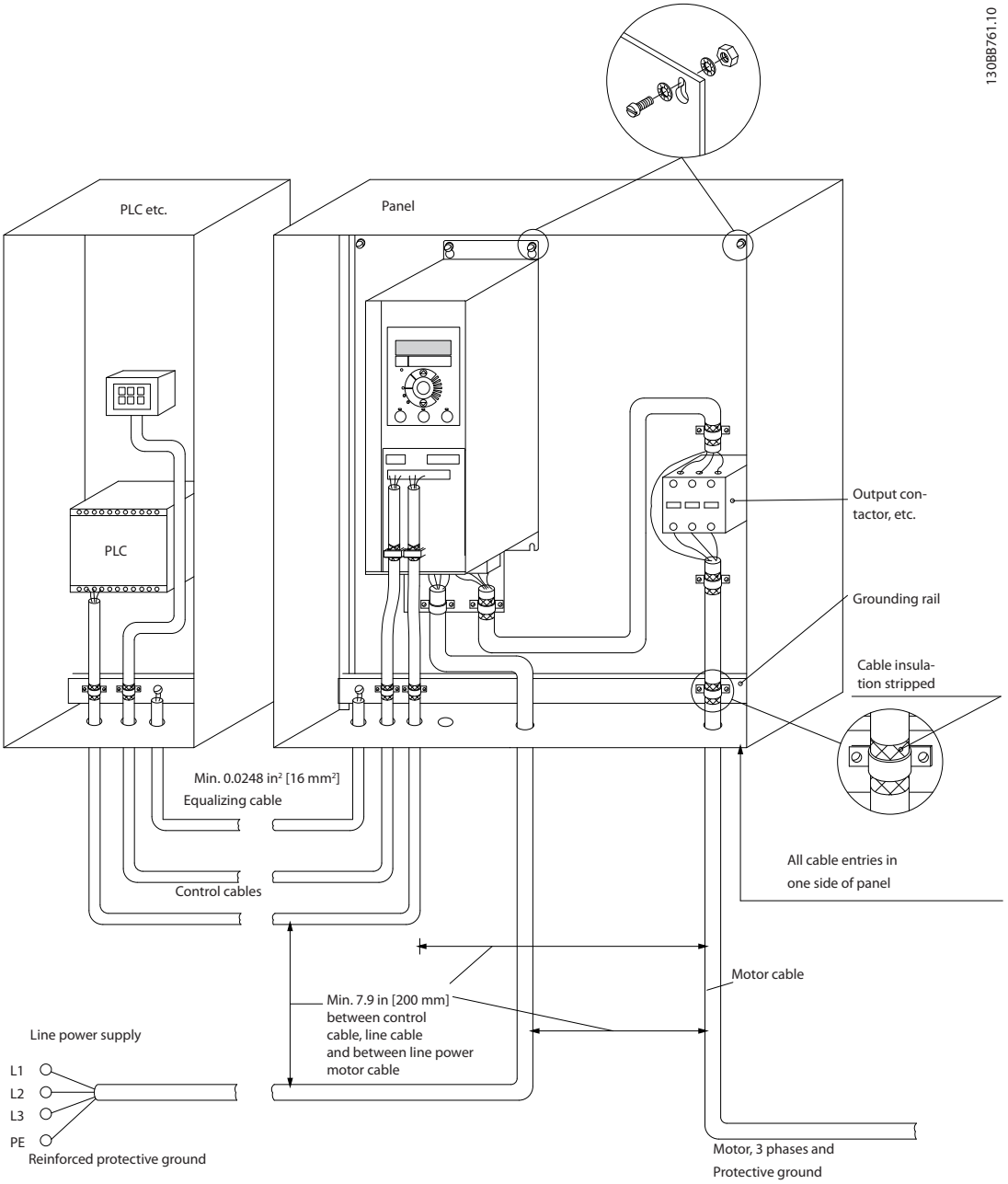


Figure 3.21 EMC-compatible Electrical Installation

For North America, use metal conduits instead of shielded cables.

3.2.6 Control Terminals

Remove the terminal cover to access the control terminals.

Use a flat-edged screwdriver to push down the lock lever of the terminal cover under the LCP, then remove the terminal cover, as shown in *Figure 3.22*.

For IP54 units, remove the front cover before removing the terminal cover.

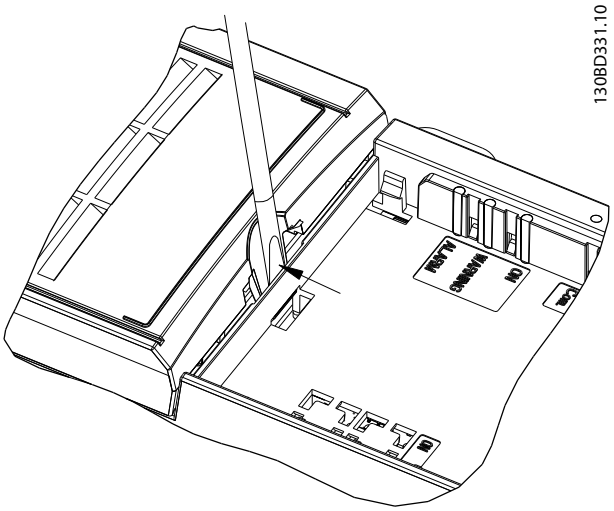


Figure 3.22 Removing the Terminal Cover

Control terminals

Figure 3.23 shows all the adjustable frequency drive control terminals. Applying Start (terminal 18), connection between terminal 12-27, and an analog reference (terminal 53 or 54 and 55) make the adjustable frequency drive run.

The digital input mode of terminal 18, 19, and 27 is set in *5-00 Digital Input Mode* (PNP is default value). Digital input 29 mode is set in *5-03 Digital Input 29 Mode* (PNP is default value).

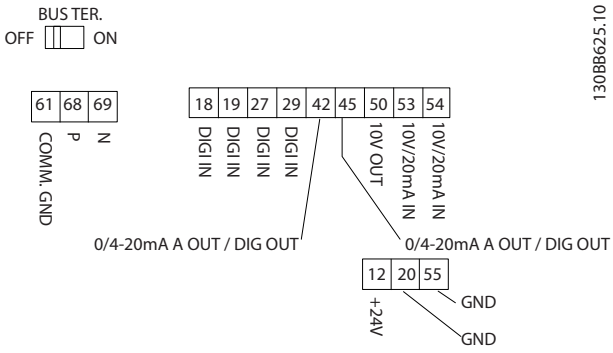


Figure 3.23 Control Terminals

3.2.7 Electrical Wiring

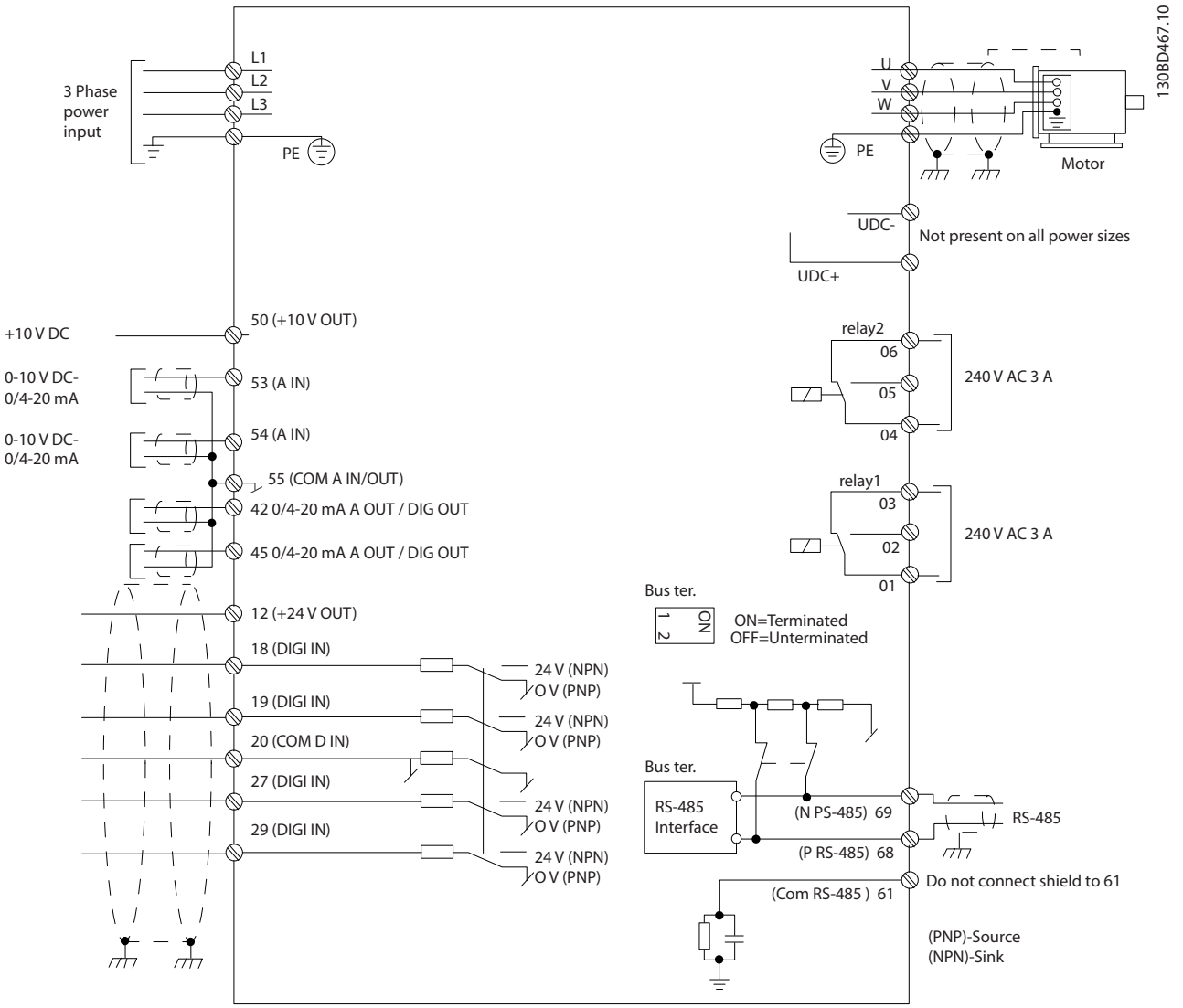


Figure 3.24 Basic Wiring Schematic Drawing

NOTICE!

There is no access to UDC- and UDC+ on the following units:
IP20, 380–480 V, 30–90 kW (40–125 HP)
IP20, 200–240 V, 15–45 kW (20–60 HP)
IP20, 525–600 V, 2.2–90 kW (3–125 HP)
IP54, 380–480 V, 22–90 kW (30–125 HP)

3.2.8 Acoustic Noise or Vibration

If the motor or the equipment driven by the motor - e.g., a fan - is making noise or vibrations at certain frequencies, configure the following parameters or parameter groups to reduce or eliminate the noise or vibrations:

- Parameter group *4-6* Speed Bypass*
- Set *14-03 Overmodulation* to *[0] Off*
- Switching pattern and switching frequency parameter group *14-0* Inverter Switching*
- *1-64 Resonance Dampening*

4 Programming

4.1 Local Control Panel (LCP)

4

NOTICE!

The adjustable frequency drive can also be programmed from a PC via the RS-485 COM port by installing the MCT 10 Set-up Software. Refer to *chapter 1.2.1 MCT 10 Set-up Software Support* for more details about the software.

The LCP is divided into four functional sections.

A. Display

B. Menu key

C. Navigation keys and LEDs

D. Operation keys and LEDs

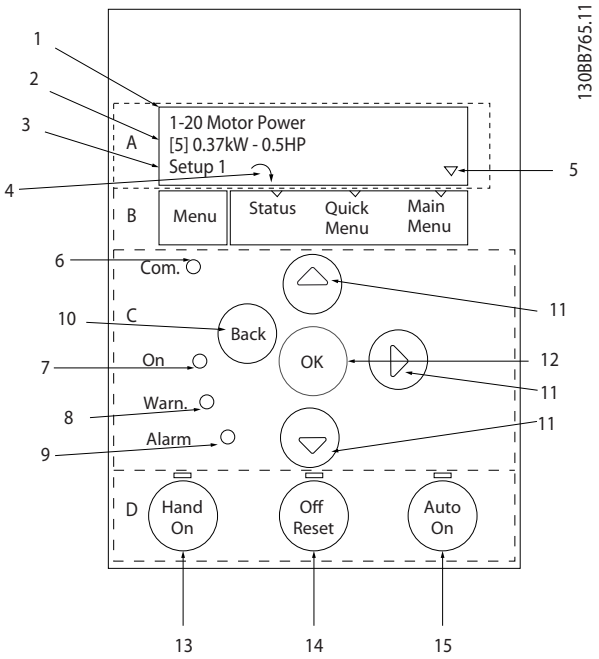


Figure 4.1 Local Control Panel (LCP)

A. Display
The LCD display is backlit with two alphanumeric lines. All data is displayed on the LCP.

Figure 4.1 describes the information that can be read from the display.

1	Parameter number and name.
2	Parameter value.
3	Set-up number shows the active set-up and the edit set-up. If the same set-up acts as both the active and edit set-up, only that set-up number is shown (factory setting). When active and edit set-up differ, both numbers are shown in the display (Set-up 12). The flashing number indicates the edit set-up.
4	Motor direction is shown to the bottom left of the display – indicated by a small arrow pointing either clockwise or counter-clockwise.
5	The triangle indicates if the LCP is in status quick menu or main menu.

Table 4.1 Legend to *Figure 4.1*

B. Menu key
Press [Menu] to select between status, quick menu or main menu.

C. Navigation keys and LEDs

6	Com LED: Flashes when bus communication is communicating.
7	Green LED/On: Control section is working correctly.
8	Yellow LED/Warn.: Indicates a warning.
9	Flashing Red LED/Alarm: Indicates an alarm.
10	[Back]: For moving to the previous step or layer in the navigation structure.
11	[▲] [▼] [►]: For navigating among parameter groups, parameters and within parameters. They can also be used for setting local reference.
12	[OK]: For selecting a parameter and for accepting changes to parameter settings.

Table 4.2 Legend to *Figure 4.1*

D. Operation keys and LEDs

13	[Hand On]: Starts the motor and enables control of the adjustable frequency drive via the LCP. ***NOTICE!*** ***[2] coast inverse* is the default option for *5-12 Terminal 27 Digital Input*. This means that [Hand On] does not start the motor if there is no 24 V supply to terminal 27. Connect terminal 12 to terminal 27.**
14	[Off/Reset]: Stops the motor (Off). If in alarm mode, the alarm is reset.
15	[Auto On]: The adjustable frequency drive is controlled either via control terminals or serial communication.

Table 4.3 Legend to *Figure 4.1*

4.2 Set-up Wizard

The built-in wizard menu guides the installer through the set-up of the adjustable frequency drive in a clear and structured manner for open-loop and closed-loop applications and quick motor settings.

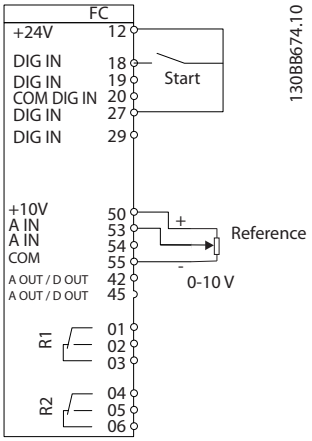


Figure 4.2 Adjustable Frequency Drive Wiring

The wizard will initially be shown after power-up until any parameter has been changed. The wizard can always be accessed again through the Quick Menu. Press [OK] to start the wizard. Press [Back] to return to the status screen.

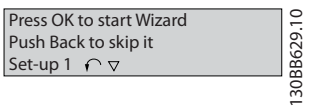


Figure 4.3 Start-up/Quit Wizard

4

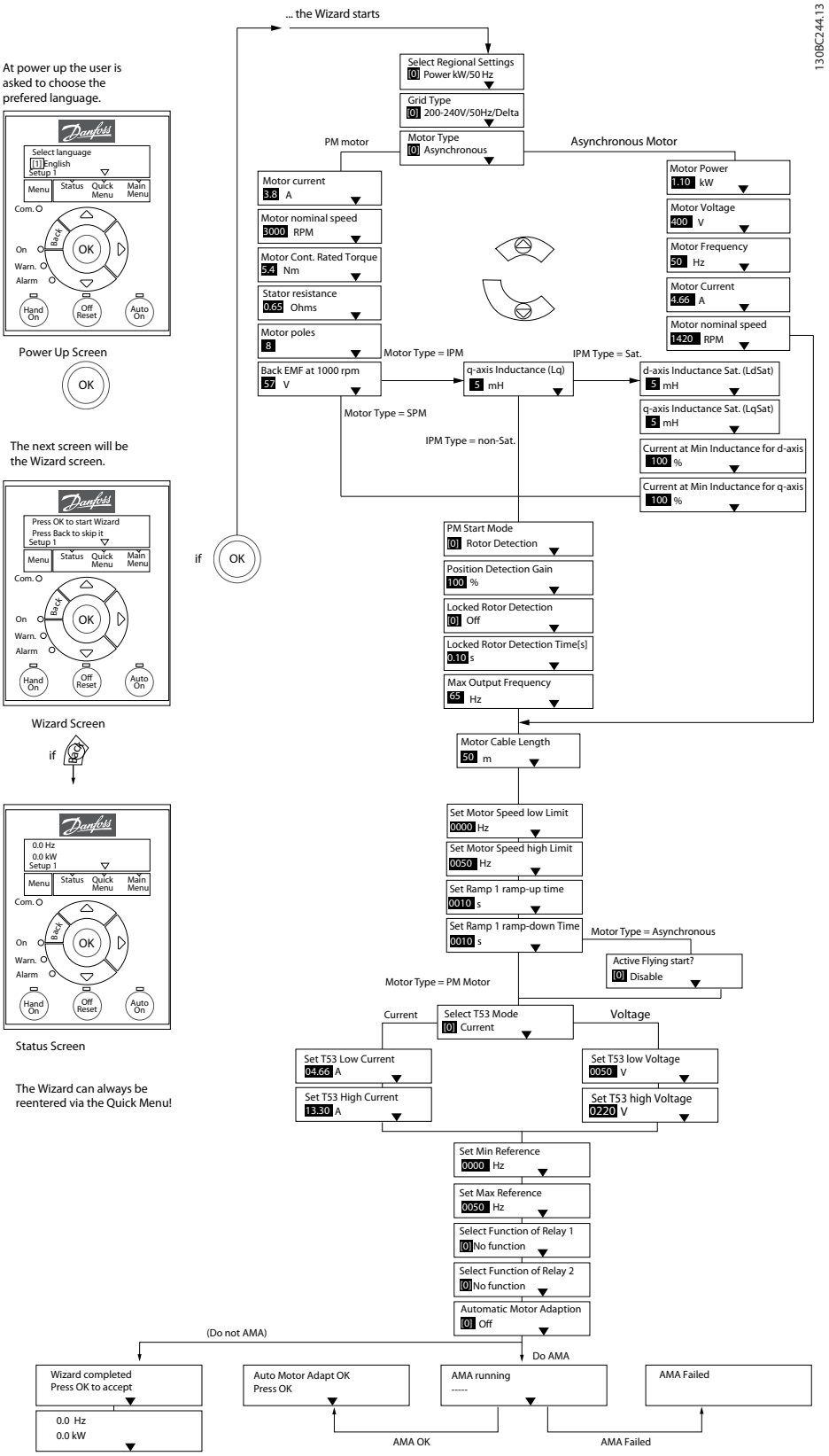


Figure 4.4 Set-up Wizard for Open-Loop Applications

1-46 Position Detection Gain and *1-70 PM Start Mode* are available in software version 2.80 and subsequent versions.

Set-up Wizard for Open-Loop Applications

Parameter	Option	Default	Usage
0-03 Regional Settings	[0] International [1] US	0	
0-06 GridType	[0] 200–240 V/50 Hz/IT grid [1] 200–240 V/50 Hz/ Delta [2] 200–240 V/50 Hz [10] 380–440 V/50 Hz/IT grid [11] 380–440 V/50 Hz/ Delta [12] 380–440 V/50 Hz [20] 440–480 V/50 Hz/IT grid [21] 440–480 V/50 Hz/ Delta [22] 440–480 V/50 Hz [30] 525–600 V/50 Hz/IT grid [31] 525–600 V/50 Hz/ Delta [32] 525–600 V/50 Hz [100] 200–240 V/60 Hz/IT grid [101] 200–240 V/60 Hz/ Delta [102] 200–240 V/60 Hz [110] 380–440 V/60 Hz/IT grid [111] 380–440 V/60 Hz/ Delta [112] 380–440 V/60 Hz [120] 440–480 V/60 Hz/IT grid [121] 440–480 V/60 Hz/ Delta [122] 440–480 V/60 Hz [130] 525–600 V/60 Hz/IT grid [131] 525–600 V/60 Hz/ Delta [132] 525–600 V/60 Hz	Size related	Select the operating mode for restart upon reconnection of the drive to AC line voltage after power-down.

4

Parameter	Option	Default	Usage
1-10 Motor Construction	*[0] Asynchron [1] PM, non-salient SPM [2] PM, salient IPM, non Sat. [3] PM, salient IPM, Sat.	[0] Asynchron	Setting the parameter value might change these parameters: *1-01 Motor Control Principle* *1-03 Torque Characteristics* *1-14 Damping Gain* *1-15 Low Speed Filter Time Const.* *1-16 High Speed Filter Time Const.* *1-17 Voltage filter time const.* *1-20 Motor Power [kW]* *1-22 Motor Voltage* *1-23 Motor Frequency* *1-24 Motor Current* *1-25 Motor Nominal Speed* *1-26 Motor Cont. Rated Torque* *1-30 Stator Resistance (Rs)* *1-33 Stator Leakage Reactance (X1)* *1-35 Main Reactance (Xh)* *1-37 d-axis Inductance (Ld)* *1-38 q-axis Inductance (Lq)* *1-39 Motor Poles* *1-40 Back EMF at 1000 RPM* *1-44 d-axis Inductance Sat. (LdSat)* *1-45 q-axis Inductance Sat. (LqSat)* *1-46 Position Detection Gain* *1-48 Current at Min Inductance for d-axis* *1-49 Current at Min Inductance for q-axis* *1-66 Min. Current at Low Speed* *1-70 PM Start Mode* *1-72 Start Function* *1-73 Flying Start* *4-14 Motor Speed High Limit [Hz]* *4-19 Max Output Frequency* *4-58 Missing Motor Phase Function* *14-65 Speed Derate Dead Time Compensation*
1-20 Motor Power	0.12–110 kW/0.16–150 HP	Size related	Enter the motor power from the nameplate data.
1-22 Motor Voltage	50.0–1000.0 V	Size related	Enter the motor voltage from the nameplate data.
1-23 Motor Frequency	20.0–400.0 Hz	Size related	Enter the motor frequency from the nameplate data.
1-24 Motor Current	0.01–10000.00 A	Size related	Enter the motor current from the nameplate data.
1-25 Motor Nominal Speed	50.0–9999.0 RPM	Size related	Enter the motor nominal speed from the nameplate data.

Parameter	Option	Default	Usage
1-26 Motor Cont. Rated Torque	0.1–1000.0 Nm	Size related	This parameter is available when 1-10 Motor Construction is set to options that enable permanent motor mode. ***NOTICE!*** **Changing this parameter will affect the settings of other parameters.**
1-29 Automatic Motor Adaption (AMA)	See *1-29 Automatic Motor Adaption (AMA)*	Off	Performing an AMA optimizes motor performance.
1-30 Stator Resistance (Rs)	0.000–99.990 Ohm	Size related	Set the stator resistance value.
1-37 d-axis Inductance (Ld)	0–1000 mH	Size related	Enter the value of the d-axis inductance. Obtain the value from the permanent magnet motor data sheet. The de-axis inductance cannot be found by performing an AMA.
1-38 q-axis Inductance (Lq)	0–1000 mH	Size related	Enter the value of the q-axis inductance.
1-39 Motor Poles	2–100	4	Enter the number of motor poles.
1-40 Back EMF at 1000 RPM	10–9000 V	Size related	Line-Line RMS back EMF voltage at 1000 RPM.
1-42 Motor Cable Length	0–100 m (0–330 ft)	50 m (164 ft)	Enter the motor cable length.
1-44 d-axis Inductance Sat. (LdSat)	0–1000 mH	Size related	This parameter corresponds to the inductance saturation of Ld. Ideally, this parameter has the same value as *1-37 d-axis Inductance (Ld)*. However, if the motor supplier provides an induction curve, the induction value @ 200% of isNom should be entered here.
1-45 q-axis Inductance Sat. (LqSat)	0–1000 mH	Size related	This parameter corresponds to the inductance saturation of Lq. Ideally, this parameter has the same value as *1-38 q-axis Inductance (Lq)*. However, if the motor supplier provides an induction curve, the induction value @ 200% of isNom should be entered here.
1-46 Position Detection Gain	20–200%	100%	Adjusts the height of the test pulse during position detection at Start.
1-48 Current at Min Inductance for d-axis	20–200%	100%	Enter the inductance saturation point.

4

Parameter	Option	Default	Usage
1-49 Current at Min Inductance for q-axis	20–200%	100%	This parameter specifies the saturation curve of the d- and q-inductance values. From 20% to 100% of this parameter, the inductances are linearly approximated due to parameters 1-37, 1-38, 1-44, and 1-45.
1-70 PM Start Mode	[0] Rotor Detection [1] Parking	[0] Rotor Detection	–
1-73 Flying Start	[0] Disabled [1] Enabled	0	Select *[1] Enable* to enable the drive to catch a motor spinning due to line drop-out. Select *[0] Disable* if this function is not required. When this parameter is set to *[1] Enable*, *1-71 Start Delay* and *1-72 Start Function* have no function. *1-73 Flying Start* is active in VVC+ mode only
3-02 Minimum Reference	-4999–4999	0	The minimum reference is the lowest value obtainable by summing all references.
3-03 Maximum Reference	-4999–4999	50	The maximum reference is the lowest obtainable by summing all references.
3-41 Ramp 1 Ramp Up Time	0.05–3600.0 s	Size related	Ramp-up time from 0 to rated *1-23 Motor Frequency* if Asynchron motor is selected; ramp up time from 0 to *1-25 Motor Nominal Speed* if PM motor is selected.
3-42 Ramp 1 Ramp Down Time	0.05–3600.0 s	Size related	Ramp-down time from rated *1-23 Motor Frequency* to 0 if Asynchron motor is selected; ramp down time from *1-25 Motor Nominal Speed* to 0 if PM motor is selected.
4-12 Motor Speed Low Limit [Hz]	0.0–400 Hz	0 Hz	Enter the minimum limit for low speed.
4-14 Motor Speed High Limit [Hz]	0.0–400 Hz	100 Hz	Enter the maximum limit for high speed.
4-19 Max Output Frequency	0–400	100 Hz	Enter the maximum output frequency value.
5-40 Function Relay [0] Function relay	See *5-40 Function Relay*	Alarm	Select the function to control output relay 1.
5-40 Function Relay [1] Function relay	See *5-40 Function Relay*	Drive running	Select the function to control output relay 2.
6-10 Terminal 53 Low Voltage	0–10 V	0.07 V	Enter the voltage that corresponds to the low reference value.
6-11 Terminal 53 High Voltage	0–10 V	10 V	Enter the voltage that corresponds to the high reference value.
6-12 Terminal 53 Low Current	0–20 mA	4 mA	Enter the current that corresponds to the low reference value.

Parameter	Option	Default	Usage
6-13 Terminal 53 High Current	0–20 mA	20 mA	Enter the current that corresponds to the high reference value.
6-19 Terminal 53 mode	[0] Current [1] Voltage	1	Select if terminal 53 is used for current or voltage input.
30-22 Locked Rotor Detection	[0] Off [1] On	[0] Off	–
30-23 Locked Rotor Detection Time [s]	0.05–1 s	0.10 s	–

Table 4.4 Set-up Wizard for Open-loop Applications

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Set-up Wizard for Closed-loop Applications

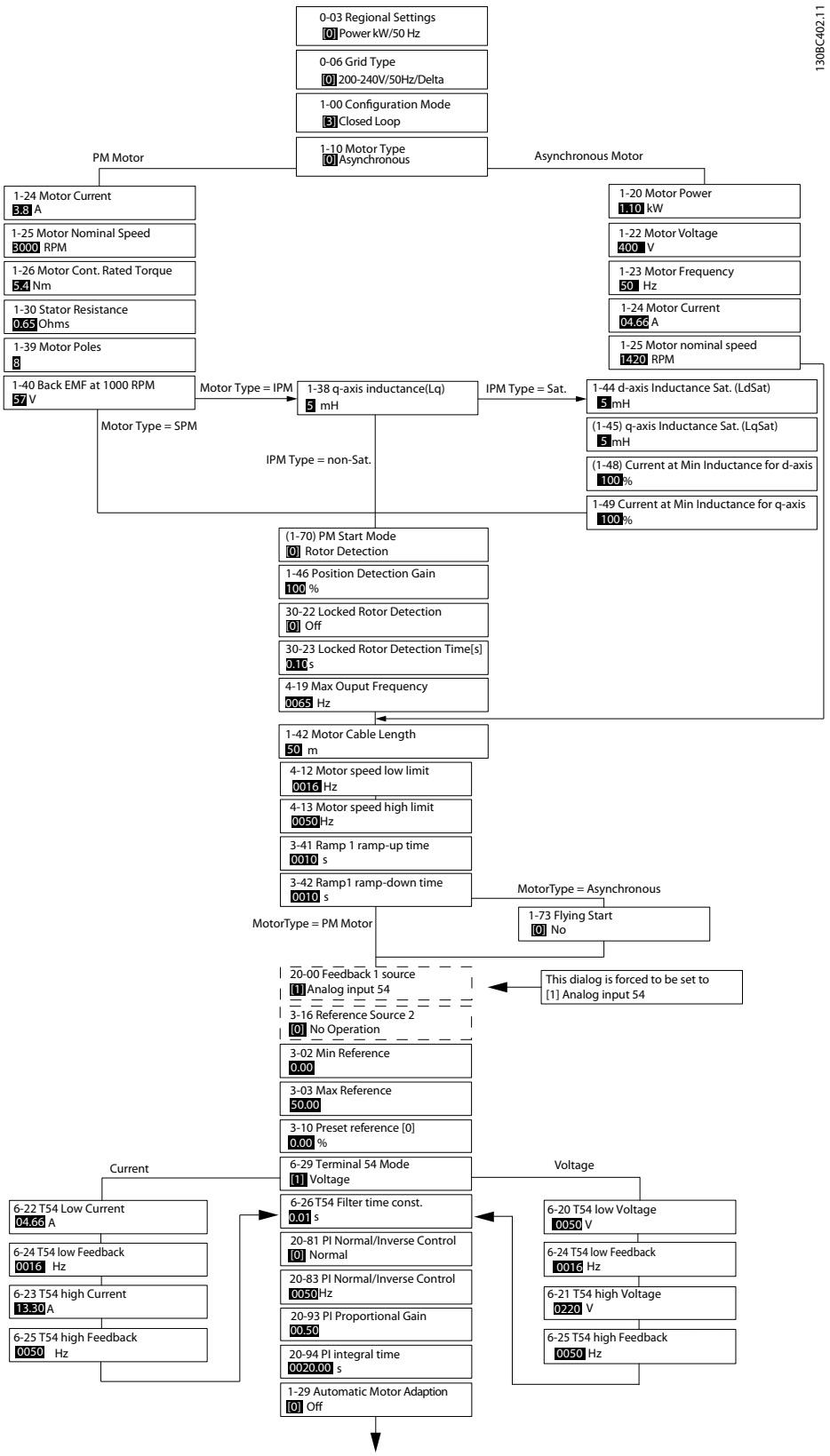

Figure 4.5 Set-up Wizard for Closed-loop Applications

1-46 Position Detection Gain and *1-70 PM Start Mode* are available in software version 2.80 and subsequent versions.

Parameter	Range	Default	Usage
0-03 Regional Settings	[0] International [1] US	0	–
0-06 GridType	[0] -[[132] see start-up wizard for open-loop application	Size selected	Select operating mode for restart upon reconnection of the adjustable frequency drive to AC line voltage after power-down.
1-00 Configuration Mode	[0] Open-loop [3] Closed-loop	0	–
1-10 Motor Construction	*[0] Asynchron [1] PM, non-salient SPM [2] PM, salient IPM, non Sat. [3] PM, salient IPM, Sat.	[0] Asynchron	Setting the parameter value might change these parameters: *1-01 Motor Control Principle* *1-03 Torque Characteristics* *1-14 Damping Gain* *1-15 Low Speed Filter Time Const.* *1-16 High Speed Filter Time Const.* *1-17 Voltage filter time const.* *1-20 Motor Power [kW]* *1-22 Motor Voltage* *1-23 Motor Frequency* *1-24 Motor Current* *1-25 Motor Nominal Speed* *1-26 Motor Cont. Rated Torque* *1-30 Stator Resistance (Rs)* *1-33 Stator Leakage Reactance (X1)* *1-35 Main Reactance (Xh)* *1-37 d-axis Inductance (Ld)* *1-38 q-axis Inductance (Lq)* *1-39 Motor Poles* *1-40 Back EMF at 1000 RPM* *1-44 d-axis Inductance Sat. (LdSat)* *1-45 q-axis Inductance Sat. (LqSat)* *1-46 Position Detection Gain* *1-48 Current at Min Inductance for d-axis* *1-49 Current at Min Inductance for q-axis* *1-66 Min. Current at Low Speed* *1-72 Start Function* *1-73 Flying Start* *4-14 Motor Speed High Limit [Hz]* *4-19 Max Output Frequency* *4-58 Missing Motor Phase Function* *14-65 Speed Derate Dead Time Compensation*
1-20 Motor Power	0.09–110 kW	Size related	Enter the motor power from the nameplate data.
1-22 Motor Voltage	50–1000 V	Size related	Enter the motor voltage from the nameplate data.
1-23 Motor Frequency	20–400 Hz	Size related	Enter the motor frequency from the nameplate data.
1-24 Motor Current	0–10000 A	Size related	Enter the motor current from the nameplate data.
1-25 Motor Nominal Speed	50–9999 RPM	Size related	Enter the motor nominal speed from the nameplate data.

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Parameter	Range	Default	Usage
1-26 Motor Cont. Rated Torque	0.1–1000.0 Nm	Size related	This parameter is available when*1-10 Motor Construction* is set to options that enable permanent motor mode. ***NOTICE!*** **Changing this parameter affects the settings of other parameters.**
1-29 Automatic Motor Adaption (AMA)		Off	Performing an AMA optimizes motor performance.
1-30 Stator Resistance (Rs)	0–99.990 Ohm	Size related	Set the stator resistance value.
1-37 d-axis Inductance (Ld)	0–1000 mH	Size related	Enter the value of the d-axis inductance. Obtain the value from the permanent magnet motor data sheet. The de-axis inductance cannot be found by performing an AMA.
1-38 q-axis Inductance (Lq)	0–1000 mH	Size related	Enter the value of the q-axis inductance.
1-39 Motor Poles	2–100	4	Enter the number of motor poles.
1-40 Back EMF at 1000 RPM	10–9000 V	Size related	Line-Line RMS back EMF voltage at 1000 RPM.
1-42 Motor Cable Length	0–100 m (0–330 ft)	50 m (164 ft)	Enter the motor cable length.
1-44 d-axis Inductance Sat. (LdSat)	0–1000 mH	Size related	This parameter corresponds to the inductance saturation of Ld. Ideally, this parameter has the same value as *1-37 d-axis Inductance (Ld)*. However, if motor supplier provides an induction curve, the induction value @ 200% of isNom should be entered here.
1-45 q-axis Inductance Sat. (LqSat)	0–1000 mH	Size related	This parameter corresponds to the inductance saturation of Lq. Ideally, this parameter has the same value as *1-38 q-axis Inductance (Lq)*. However, if motor supplier provides an induction curve, the induction value @ 200% of isNom should be entered here.
1-46 Position Detection Gain	20–200%	100%	Adjusts the height of the test pulse during position detection at start.
1-48 Current at Min Inductance for d-axis	20–200%	100%	Enter the inductance saturation point.
1-49 Current at Min Inductance for q-axis	20–200%	100%	This parameter specifies the saturation curve of the d- and q-inductance values. From 20% to 100% of this parameter, the inductances are linearly approximated due to parameters 1-37, 1-38, 1-44, and 1-45.
1-70 PM Start Mode	[0] Rotor Detection [1] Parking	[0] Rotor Detection	–
1-73 Flying Start	[0] Disabled [1] Enabled	0	Select *[1] Enable* to enable the adjustable frequency drive to catch a spinning motor, e.g, in fan applications. When PM is selected, Flying Start is enabled.
3-02 Minimum Reference	-4999–4999	0	The minimum reference is the lowest value obtainable by summing all references.
3-03 Maximum Reference	-4999–4999	50	The maximum reference is the highest value obtainable by summing all references.

Parameter	Range	Default	Usage
3-10 Preset Reference	-100–100%	0	Enter the set point.
3-41 Ramp 1 Ramp Up Time	0.05–3600.0 s	Size related	Ramp-up time from 0 to rated *1-23 Motor Frequency* if asynchron motor is selected; ramp up time from 0 to *1-25 Motor Nominal Speed* if PM motor is selected.
3-42 Ramp 1 Ramp Down Time	0.05–3600.0 s	Size related	Ramp-down time from rated *1-23 Motor Frequency* to 0 if asynchron motor is selected; ramp down time from *1-25 Motor Nominal Speed* to 0 if PM motor is selected.
4-12 Motor Speed Low Limit [Hz]	0–400 Hz	0.0 Hz	Enter the minimum limit for low speed.
4-14 Motor Speed High Limit [Hz]	0–400 Hz	100 Hz	Enter the minimum limit for high speed.
4-19 Max Output Frequency	0–400	100 Hz	Enter the maximum output frequency value.
6-29 Terminal 54 mode	[0] Current [1] Voltage	1	Select if terminal 54 is used for current or voltage input.
6-20 Terminal 54 Low Voltage	0–10 V	0.07 V	Enter the voltage that corresponds to the low reference value.
6-21 Terminal 54 High Voltage	0–10 V	10 V	Enter the voltage that corresponds to the low high reference value.
6-22 Terminal 54 Low Current	0–20 mA	4 mA	Enter the current that corresponds to the high reference value.
6-23 Terminal 54 High Current	0–20 mA	20 mA	Enter the current that corresponds to the high reference value.
6-24 Terminal 54 Low Ref./Feedb. Value	-4999–4999	0	Enter the feedback value that corresponds to the voltage or current set in *6-20 Terminal 54 Low Voltage*/*6-22 Terminal 54 Low Current*.
6-25 Terminal 54 High Ref./Feedb. Value	-4999–4999	50	Enter the feedback value that corresponds to the voltage or current set in *6-21 Terminal 54 High Voltage*/*6-23 Terminal 54 High Current*.
6-26 Terminal 54 Filter Time Constant	0–10 s	0.01	Enter the filter time constant.
20-81 PI Normal/ Inverse Control	[0] Normal [1] Inverse	0	Select *[0] Normal* to set the process control to increase the output speed when the process error is positive. Select *[1] Inverse* to reduce the output speed.
20-83 PI Start Speed [Hz]	0–200 Hz	0 Hz	Enter the motor speed to be attained as a start signal for commencement of PI control.
20-93 PI Proportional Gain	0–10	0.01	Enter the process controller proportional gain. Quick control is obtained at high amplification. However, if the amplification is too great, the process may become unstable.
20-94 PI Integral Time	0.1–999.0 s	999.0 s	Enter the process controller integral time. Obtain quick control through a short integral time, though if the integral time is too short, the process becomes unstable. An excessively long integral time disables the integral action.
30-22 Locked Rotor Detection	[0] Off [1] On	[0] Off	–
30-23 Locked Rotor Detection Time [s]	0.05–1 s	0.10 s	–

Table 4.5 Set-up Wizard for Closed-loop Applications

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Motor set-up

The Motor Set-up wizard guides through the needed motor parameters.

Parameter	Range	Default	Usage
0-03 Regional Settings	[0] International [1] US	0	–
0-06 GridType	[0] -[132] see start-up wizard for open-loop application	Size selected	Select the operating mode for restart upon reconnection of the drive to AC line voltage after power-down.
1-10 Motor Construction	*[0] Asynchron [1] PM, non-salient SPM [2] PM, salient IPM, non Sat. [3] PM, salient IPM, Sat.	[0] Asynchron	–
1-20 Motor Power	0.12–110 kW/0.16–150 HP	Size related	Enter the motor power from the nameplate data.
1-22 Motor Voltage	50–1000 V	Size related	Enter the motor voltage from the nameplate data.
1-23 Motor Frequency	20–400 Hz	Size related	Enter the motor frequency from the nameplate data.
1-24 Motor Current	0.01–10000.00 A	Size related	Enter the motor current from the nameplate data.
1-25 Motor Nominal Speed	50–9999 RPM	Size related	Enter the motor nominal speed from the nameplate data.
1-26 Motor Cont. Rated Torque	0.1–1000.0 Nm	Size related	This parameter is available when *1-10 Motor Construction* is set to options that enable permanent motor mode. ***NOTICE!*** **Changing this parameter affects the settings of other parameters.**
1-30 Stator Resistance (Rs)	0–99.990 Ohm	Size related	Set the stator resistance value.
1-37 d-axis Inductance (Ld)	0–1000 mH	Size related	Enter the value of the d-axis inductance. Obtain the value from the permanent magnet motor data sheet. The de-axis inductance cannot be found by performing an AMA.
1-38 q-axis Inductance (Lq)	0–1000 mH	Size related	Enter the value of the q-axis inductance.
1-39 Motor Poles	2–100	4	Enter the number of motor poles.
1-40 Back EMF at 1000 RPM	10–9000 V	Size related	Line-Line RMS back EMF voltage at 1000 RPM.
1-42 Motor Cable Length	0–100 m (0–330 ft)	50 m (164 ft)	Enter the motor cable length.
1-44 d-axis Inductance Sat. (LdSat)	0–1000 mH	Size related	This parameter corresponds to the inductance saturation of Ld. Ideally, this parameter has the same value as *1-37 d-axis Inductance (Ld)*. However, if the motor supplier provides an induction curve, the induction value @ 200% of isNom should be entered here.

Parameter	Range	Default	Usage
1-45 q-axis Inductance Sat. (LqSat)	0–1000 mH	Size related	This parameter corresponds to the inductance saturation of Lq. Ideally, this parameter has the same value as *1-38 q-axis Inductance (Lq)*. However, if the motor supplier provides an induction curve, the induction value @ 200% of isNom should be entered here.
1-46 Position Detection Gain	20–200%	100%	Adjusts the height of the test pulse during position detection at start.
1-48 Current at Min Inductance for d-axis	20–200%	100%	Enter the inductance saturation point.
1-49 Current at Min Inductance for q-axis	20–200%	100%	This parameter specifies the saturation curve of the d- and q-inductance values. From 20% to 100% of this parameter, the inductances are linearly approximated due to parameters 1-37, 1-38, 1-44, and 1-45.
1-70 PM Start Mode	[0] Rotor Detection [1] Parking	[0] Rotor Detection	–
1-73 Flying Start	[0] Disabled [1] Enabled	0	Select *[1] Enable* to enable the adjustable frequency drive to catch a spinning motor.
3-41 Ramp 1 Ramp Up Time	0.05–3600.0 s	Size related	Ramp-up time from 0 to rated *1-23 Motor Frequency*.
3-42 Ramp 1 Ramp Down Time	0.05–3600.0 s	Size related	Ramp-down time from rated *1-23 Motor Frequency* to 0.
4-12 Motor Speed Low Limit [Hz]	0–400 Hz	0.0 Hz	Enter the minimum limit for low speed.
4-14 Motor Speed High Limit [Hz]	0–400 Hz	100 Hz	Enter the maximum limit for high speed.
4-19 Max Output Frequency	0–400	100 Hz	Enter the maximum output frequency value.
30-22 Locked Rotor Detection	[0] Off [1] On	[0] Off	–
30-23 Locked Rotor Detection Time [s]	0.05–1 s	0.10 s	–

Table 4.6 Motor Set-up Wizard Settings

Changes Made

The *Changes Made* function lists all parameters changed from default settings.

- The list shows only parameters which have been changed in the current edit set-up.
- Parameters which have been reset to default values are not listed.
- The message *Empty* indicates that no parameters have been changed.

Changing parameter settings

1. Press the [Menu] key to enter the Quick Menu until indicator in display is placed above Quick Menu.
2. Press [▲] [▼] to select the wizard, closed-loop set-up, motor set-up or changes made, then press [OK].
3. Press [▲] [▼] to browse through the parameters in the Quick Menu.
4. Press [OK] to select a parameter.

5. Press [▲] [▼] to change the value of a parameter setting.
6. Press [OK] to accept the change.
7. Press either [Back] twice to enter *Status*, or press [Menu] once to enter the Main Menu.

The Main Menu accesses all parameters.

1. Press the [Menu] key until indicator in display is placed above Main Menu.
2. Press [▲] [▼] to browse through the parameter groups.
3. Press [OK] to select a parameter group.
4. Press [▲] [▼] to browse through the parameters in the specific group.
5. Press [OK] to select the parameter.
6. Press [▲] [▼] to set/change the parameter value.

4.3 Parameter List

- **0-** Operation/Display**
- **0-0* Basic Settings**
- 0-01 Language
- 0-03 Regional Settings
- 0-04 Operating State at Power-up
- 0-06 GridType
- 0-07 Auto DC Braking
- **0-1* Set-up Operations**
- 0-10 Active Set-up
- 0-11 Programming Set-up
- 0-12 Link Set-ups
- **0-3* LCP Custom Readout**
- 0-30 Custom Readout Unit
- 0-31 Custom Readout Min Value
- 0-32 Custom Readout Max Value
- 0-37 Display Text 1
- 0-38 Display Text 2
- 0-39 Display Text 3
- **0-4* LCP Keypad**
- 0-40 [Hand on] Key on LCP
- 0-42 [Auto on] Key on LCP
- 0-44 [Off/Reset] Key on LCP
- **0-5* Copy/Save**
- 0-50 LCP Copy
- 0-51 Set-up Copy
- **0-6* Password**
- 0-60 Main Menu Password
- **1-** Load and Motor**
- **1-0* General Settings**
- 1-00 Configuration Mode
- 1-01 Motor Control Principle
- 1-03 Torque Characteristics
- 1-06 Clockwise Direction
- **1-1* Motor Selection**
- 1-10 Motor Construction
- 1-14 Damping Gain
- 1-15 Low Speed Filter Time Const
- 1-16 High Speed Filter Time Const
- 1-17 Voltage filter time const
- **1-2* Motor Data**
- 1-20 Motor Power
- 1-22 Motor Voltage
- 1-23 Motor Frequency
- 1-24 Motor Current
- 1-25 Motor Nominal Speed
- 1-26 Motor Cont. Rated Torque
- 1-29 Automatic Motor Adaption (AMA)
- **1-3* Adv. Motor Data**
- 1-30 Stator Resistance (Rs)
- 1-33 Stator Leakage Reactance (X1)
- 1-35 Main Reactance (Xh)
- 1-37 d-axis Inductance (Ld)
- 1-39 Motor Poles
- **1-4* Adv. Motor Data II**
- 1-40 Back EMF at 1000 RPM
- 1-42 Motor Cable Length
- 1-43 Motor Cable Length Feet
- **1-5* Load Indep. Setting**
- 1-50 Motor Magnetization at Zero Speed
- 1-52 Min Speed Normal Magnetizing [Hz]
- 1-55 U/f Characteristic - U
- 1-56 U/f Characteristic - F
- **1-6* Load Depen. Setting**
- 1-60 Low Speed Load Compensation
- 1-61 High Speed Load Compensation
- 1-62 Slip Compensation
- 1-63 Slip Compensation Time Constant
- 1-64 Resonance Dampening
- 1-65 Resonance Dampening Time Constant
- 1-66 Min. Current at Low Speed
- **1-7* Start Adjustments**
- 1-71 Start Delay
- 1-72 Start Function
- 1-73 Flying Start
- **1-8* Stop Adjustments**
- 1-80 Function at Stop
- 1-82 Min Speed for Function at Stop [Hz]
- **1-9* Motor Temperature**
- 1-90 Motor Thermal Protection
- 1-93 Thermistor Source
- **2-** Brakes**
- **2-0* DC Brake**
- 2-00 DC Hold/Motor Preheat Current
- 2-01 DC Brake Current
- 2-02 DC Braking Time
- 2-04 DC Brake Cut-in Speed
- 2-06 Parking Current
- 2-07 Parking Time
- **2-1* Brake Energy Funct.**
- 2-10 Brake Function
- 2-16 AC Brake, Max current
- 2-17 Over-voltage Control
- **3-** Reference / Ramps**
- **3-0* Reference Limits**
- 3-02 Minimum Reference
- 3-03 Maximum Reference
- **3-1* References**
- 3-10 Preset Reference
- 3-11 Jog Speed [Hz]
- 3-14 Preset Relative Reference
- 3-15 Reference 1 Source
- 3-16 Reference 2 Source
- 3-17 Reference 3 Source
- **3-4* Ramp 1**
- 3-41 Ramp 1 Ramp-up Time
- 3-42 Ramp 1 Ramp-down Time
- **3-5* Ramp 2**
- 3-51 Ramp 2 Ramp-up Time
- 3-52 Ramp 2 Ramp-down Time
- **3-8* Other Ramps**
- 3-80 Jog Ramp Time
- 3-81 Quick Stop Ramp Time
- **4-** Limits / Warnings**
- **4-1* Motor Limits**
- 4-10 Motor Speed Direction
- 4-12 Motor Speed Low Limit [Hz]
- 4-14 Motor Speed High Limit [Hz]
- 4-18 Current Limit
- 4-19 Max Output Frequency
- **4-4* Adj. Warnings 2**
- 4-40 Warning Freq. Low
- 4-41 Warning Freq. High
- **4-5* Adj. Warnings**
- 4-50 Warning Current Low
- 4-51 Warning Current High
- 4-54 Warning Reference Low
- 4-55 Warning Reference High
- 4-56 Warning Feedback Low
- 4-57 Warning Feedback High
- 4-58 Missing Motor Phase Function
- **4-6* Speed Bypass**
- 4-61 Bypass Speed From [Hz]
- 4-63 Bypass Speed To [Hz]
- 4-64 Semi-Auto Bypass Set-up
- **5-** Digital In/Out**
- **5-0* Digital I/O mode**
- 5-00 Digital Input Mode
- 5-03 Digital Input 29 Mode
- **5-1* Digital Inputs**
- 5-10 Terminal 18 Digital Input
- 5-11 Terminal 19 Digital Input
- 5-12 Terminal 27 Digital Input
- 5-13 Terminal 29 Digital Input
- **5-3* Digital Outputs**
- 5-34 On Delay, Digital Output
- 5-35 Off Delay, Digital Output
- **5-4* Relays**
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5 Warnings and Alarms

Fault number	Alarm/ warning bit number	Fault text	Warning	Alarm	Trip locked	Cause of problem
2	16	Live zero error	X	X	–	Signal on terminal 53 or 54 is less than 50% of the value set in *6-10 Terminal 53 Low Voltage*, *6-12 Terminal 53 Low Current*, *6-20 Terminal 54 Low Voltage*, or *6-22 Terminal 54 Low Current*. See also parameter group *6-0* Analog I/O Mode*.
4	14	Mains ph. loss	X	X	X	Missing phase on the supply side or too high voltage imbalance. Check the supply voltage. See *14-12 Function at Mains Imbalance*.
7	11	DC overvolt	X	X	–	Intermediate circuit voltage exceeds the limit.
8	10	DC undervolt	X	X	–	Intermediate circuit voltage drops below *voltage warning low* limit.
9	9	Inverter overload	X	X	–	More than 100% load for a long time.
10	8	Motor ETR over	X	X	–	Motor is too hot due to more than 100% load for a long time. See *1-90 Motor Thermal Protection*.
11	7	Motor th over	X	X	–	The thermistor or the thermistor connection is disconnected. See *1-90 Motor Thermal Protection*.
13	5	Overcurrent	X	X	X	Inverter peak current limit is exceeded.
14	2	Ground Fault	–	X	X	Discharge from output phases to ground.
16	12	Short circuit	–	X	X	Short circuit in motor or on motor terminals.
17	4	Ctrl. word TO	X	X	–	No communication to the adjustable frequency drive. See parameter group *8-0* General Settings*.
24	50	Fan Fault	X	X	–	The heatsink cooling fan is not working (only on 400 V, 30–90 kW (40–125 HP) units).
30	19	U phase loss	–	X	X	Motor phase U is missing. Check the phase. See *4-58 Missing Motor Phase Function*.
31	20	V phase loss	–	X	X	Motor phase V is missing. Check the phase. See *4-58 Missing Motor Phase Function*.
32	21	W phase loss	–	X	X	Motor phase W is missing. Check the phase. See *4-58 Missing Motor Phase Function*.
38	17	Internal fault	–	X	X	Contact the local Danfoss supplier.
44	28	Ground Fault	–	X	X	Discharge from output phases to ground, using the value of *15-31 Alarm Log Value* if possible.
46	33	Control Voltage Fault	–	X	X	Control voltage is low. Contact the local Danfoss supplier.
47	23	24 V supply low	X	X	X	24 V DC supply may be overloaded.
50		AMA calibration failed	–	X	–	Contact the local Danfoss supplier.
51	15	AMA Unom,Inom	–	X	–	The setting of motor voltage, motor current, and motor power is wrong. Check the settings.
52	–	AMA low Inom	–	X	–	The motor current is too low. Check the settings.
53	–	AMA big motor	–	X	–	The motor is too big to perform AMA.
54	–	AMA small mot	–	X	–	The motor is too small to perform AMA.
55	–	AMA par. range	–	X	–	The parameter values found from the motor are outside the acceptable range.
56	–	AMA user interrupt	–	X	–	The AMA has been interrupted by the user.

Fault number	Alarm/ warning bit number	Fault text	Warning	Alarm	Trip locked	Cause of problem
57	–	AMA timeout	–	X	–	Try to start the AMA again a number of times, until the AMA is carried out. ***NOTICE!*** **Repeated runs may heat the motor to a level where the resistance Rs and Rr are increased. In most cases, however, this is not critical.**
58	–	AMA internal	X	X	–	Contact the local Danfoss supplier.
59	25	Current limit	X	–	–	The current is higher than the value in *4-18 Current Limit*.
60	44	External Interlock	–	X	–	External interlock has been activated. To resume normal operation, apply 24 V DC to the terminal programmed for external interlock and reset the adjustable frequency drive (via serial communication, digital I/O, or by pressing reset button on keypad).
66	26	Heatsink Temperature Low	X	–	–	This warning is based on the temperature sensor in the IGBT module (on 400 V, 30–90 kW (40–125 HP) and 600 V units).
69	1	Pwr. Card Temp	X	X	X	The temperature sensor on the power card exceeds the upper or lower limits.
70	36	Illegal FC configuration	–	X	X	The control card and power card are not matched.
79	–	Illegal power section configuration	X	X	–	Internal fault. Contact the local Danfoss supplier.
80	29	Drive initialized	–	X	–	All parameter settings are initialized to default settings.
87	47	Auto DC Braking	X		–	The drive is auto DC braking.
95	40	Broken Belt	X	X	–	Torque is below the torque level set for no load, indicating a broken belt. See parameter group *22-6* Broken Belt Detection*.
126	–	Motor Rotating	–	X	–	High back emf voltage. Stop the rotor of the PM motor.
200	–	Fire Mode	X	–	–	Fire mode has been activated.
202	–	Fire Mode Limits Exceeded	X	–	–	Fire mode has suppressed one or more warranty voiding alarms.
250	–	New spare part	–	X	X	The power or switch mode power supply has been exchanged (on 400 V, 30–90 kW (40–125 HP) and 600 V units). Contact the local Danfoss supplier.
251	–	New Typecode	–	X	X	The adjustable frequency drive has a new type code (on 400 V, 30–90 kW (40–125 HP) and 600 V units). Contact the local Danfoss supplier.

Table 5.1 Warnings and Alarms

6 Specifications

6.1 Line Power Supply

6.1.1 3x200–240 V AC

Adjustable frequency drive	PK25	PK37	PK75	P1K5	P2K2	P3K7	P5K5	P7K5	P11K	P15K	P18K	P22K	P30K	P37K	P45K
Typical shaft output [kW]	0.25	0.37	0.75	1.5	2.2	3.7	5.5	7.5	11.0	15.0	18.5	22.0	30.0	37.0	45.0
Typical shaft output [HP]	0.33	0.5	1.0	2.0	3.0	5.0	7.5	10.0	15.0	20.0	25.0	30.0	40.0	50.0	60.0
IP20 frame	H1	H1	H1	H1	H2	H3	H4	H4	H5	H6	H6	H7	H7	H8	H8
Maximum cable size in terminals (line power, motor) [mm² (AWG)]	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	16 (6)	16 (6)	16 (6)	35 (2)	35 (2)	50 (1)	50 (1)	95 (0)	120 (4/0)
Output current															
40 °C (104 °F) ambient temperature															
Continuous (3x200–240 V) [A]	1.5	2.2	4.2	6.8	9.6	15.2	22.0	28.0	42.0	59.4	74.8	88.0	115.0	143.0	170.0
Intermittent (3x200–240 V) [A]	1.7	2.4	4.6	7.5	10.6	16.7	24.2	30.8	46.2	65.3	82.3	96.8	126.5	157.3	187.0
Maximum input current															
Continuous (3x200–240 V) [A]	1.1	1.6	2.8	5.6	8.6/ 7.2	14.1/ 12.0	21.0/ 18.0	28.3/ 24.0	41.0/ 38.2	52.7	65.0	76.0	103.7	127.9	153.0
Intermittent (3x200–240 V) [A]	1.2	1.8	3.1	6.2	9.5/ 7.9	15.5/ 13.2	23.1/ 19.8	31.1/ 26.4	45.1/ 42.0	58.0	71.5	83.7	114.1	140.7	168.3
Maximum electrical fuses	See *chapter 3.2.4 Fuses and Circuit Breakers*														
Estimated power loss [W], Best case/typical1)	12/ 14	15/ 18	21/ 26	48/ 60	80/ 102	97/ 120	182/ 204	229/ 268	369/ 386	512	697	879	1149	1390	1500
Weight enclosure IP20 [kg (lb)]	2.0 (4.4)	2.0 (4.4)	2.0 (4.4)	2.1 (4.6)	3.4 (7.5)	4.5 (9.9)	7.9 (17.4)	7.9 (17.4)	9.5 (20.9)	24.5 (54)	24.5 (54)	36.0 (79.4)	36.0 (79.4)	51.0 (112.4)	51.0 (112.4)
Efficiency [%], best case/ typical[2)]	97.0/ 96.5	97.3/ 96.8	98.0/ 97.6	97.6/ 97.0	97.1/ 96.3	97.9/ 97.4	97.3/ 97.0	98.5/ 97.1	97.2/ 97.1	97.0	97.1	96.8	97.1	97.1	97.3
Output current															
50 °C (122 °F) ambient temperature															
Continuous (3x200–240 V) [A]	1.5	1.9	3.5	6.8	9.6	13.0	19.8	23.0	33.0	41.6	52.4	61.6	80.5	100.1	119
Intermittent (3x200–240 V) [A]	1.7	2.1	3.9	7.5	10.6	14.3	21.8	25.3	36.3	45.8	57.6	67.8	88.6	110.1	130.9

Table 6.1 3x200–240 V AC, 0.25–45 kW (0.33–60 HP)

1) Applies for dimensioning of adjustable frequency drive cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included. For power loss data according to EN 50598-2, refer to www.danfoss.com/vltenergyefficiency.

2) Efficiency measured at nominal current. For energy efficiency class, see chapter 6.4.13 Ambient Conditions. For part load losses, see www.danfoss.com/vltenergyefficiency.

6.1.2 3x380–480 V AC

Adjustable frequency drive	PK37	PK75	P1K5	P2K2	P3K0	P4K0	P5K5	P7K5	P11K	P15K
Typical shaft output [kW]	0.37	0.75	1.5	2.2	3.0	4.0	5.5	7.5	11.0	15.0
Typical shaft output [HP]	0.5	1.0	2.0	3.0	4.0	5.0	7.5	10.0	15.0	20.0
IP20 frame	H1	H1	H1	H2	H2	H2	H3	H3	H4	H4
Maximum cable size in terminals (line power, motor) [mm^2 (AWG)]	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	16 (6)	16 (6)
Output current - 40 °C (104 °F) ambient temperature										
Continuous (3x380–440 V) [A]	1.2	2.2	3.7	5.3	7.2	9.0	12.0	15.5	23.0	31.0
Intermittent (3x380–440 V) [A]	1.3	2.4	4.1	5.8	7.9	9.9	13.2	17.1	25.3	34.0
Continuous (3x441–480 V) [A]	1.1	2.1	3.4	4.8	6.3	8.2	11.0	14.0	21.0	27.0
Intermittent (3x441–480 V) [A]	1.2	2.3	3.7	5.3	6.9	9.0	12.1	15.4	23.1	29.7
Maximum input current										
Continuous (3x380–440 V) [A]	1.2	2.1	3.5	4.7	6.3	8.3	11.2	15.1	22.1	29.9
Intermittent (3x380–440 V) [A]	1.3	2.3	3.9	5.2	6.9	9.1	12.3	16.6	24.3	32.9
Continuous (3x441–480 V) [A]	1.0	1.8	2.9	3.9	5.3	6.8	9.4	12.6	18.4	24.7
Intermittent (3x441–480 V) [A]	1.1	2.0	3.2	4.3	5.8	7.5	10.3	13.9	20.2	27.2
Maximum electrical fuses	See *chapter 3.2.4 Fuses and Circuit Breakers*									
Estimated power loss [W], best case/typical[1)]	13/15	16/21	46/57	46/58	66/83	95/118	104/131	159/198	248/274	353/379
Weight enclosure IP20 [kg (lb)]	2.0 (4.4)	2.0 (4.4)	2.1 (4.6)	3.3 (7.3)	3.3 (7.3)	3.4 (7.5)	4.3 (9.5)	4.5 (9.9)	7.9 (17.4)	7.9 (17.4)
Efficiency [%], best case/typical[2)]	97.8/97.3	98.0/97.6	97.7/97.2	98.3/97.9	98.2/97.8	98.0/97.6	98.4/98.0	98.2/97.8	98.1/97.9	98.0/97.8
Output current - 50 °C (122 °F) ambient temperature										
Continuous (3x380–440 V) [A]	1.04	1.93	3.7	4.85	6.3	8.4	10.9	14.0	20.9	28.0
Intermittent (3x380–440 V) [A]	1.1	2.1	4.07	5.4	6.9	9.2	12.0	15.4	23.0	30.8
Continuous (3x441–480 V) [A]	1.0	1.8	3.4	4.4	5.5	7.5	10.0	12.6	19.1	24.0
Intermittent (3x441–480 V) [A]	1.1	2.0	3.7	4.8	6.1	8.3	11.0	13.9	21.0	26.4

Table 6.2 3x380–480 V AC, 0.37–15 kW (0.5–20 HP), Enclosure Type H1–H4

1) Applies for dimensioning of adjustable frequency drive cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included. For power loss data according to EN 50598-2, refer to www.danfoss.com/vltenergyefficiency.

2) Efficiency measured at nominal current. For energy efficiency class, see chapter 6.4.13 Ambient Conditions. For part load losses, see www.danfoss.com/vltenergyefficiency.

Adjustable frequency drive	P18K	P22K	P30K	P37K	P45K	P55K	P75K	P90K
Typical shaft output [kW]	18.5	22.0	30.0	37.0	45.0	55.0	75.0	90.0
Typical shaft output [HP]	25.0	30.0	40.0	50.0	60.0	70.0	100.0	125.0
IP20 frame	H5	H5	H6	H6	H6	H7	H7	H8
Maximum cable size in terminals (line power, motor) [mm^2 (AWG)]	16 (6)	16 (6)	35 (2)	35 (2)	35 (2)	50 (1)	95 (0)	120 (250 MCM)
Output current - 40 °C (104 °F) ambient temperature								
Continuous (3x380–440 V) [A]	37.0	42.5	61.0	73.0	90.0	106.0	147.0	177.0
Intermittent (3x380–440 V) [A]	40.7	46.8	67.1	80.3	99.0	116.0	161.0	194.0
Continuous (3x440–480 V) [A]	34.0	40.0	52.0	65.0	80.0	105.0	130.0	160.0
Intermittent (3x440–480 V) [A]	37.4	44.0	57.2	71.5	88.0	115.0	143.0	176.0
Maximum input current								
Continuous (3x380–440 V) [A]	35.2	41.5	57.0	70.0	84.0	103.0	140.0	166.0
Intermittent (3x380–440 V) [A]	38.7	45.7	62.7	77.0	92.4	113.0	154.0	182.0
Continuous (3x440–480 V) [A]	29.3	34.6	49.2	60.6	72.5	88.6	120.9	142.7
Intermittent (3x440–480 V) [A]	32.2	38.1	54.1	66.7	79.8	97.5	132.9	157.0
Maximum electrical fuses								
Estimated power loss [W], best case/typical[1)]	412/456	475/523	733	922	1067	1133	1733	2141
Weight enclosure IP20 [kg (lb)]	9.5 (20.9)	9.5 (20.9)	24.5 (54)	24.5 (54)	24.5 (54)	36.0 (79.4)	36.0 (79.4)	51.0 (112.4)
Efficiency [%], best case/typical[2)]	98.1/97.9	98.1/97.9	97.8	97.7	98	98.2	97.8	97.9
Output current - 50 °C (122 °F) ambient temperature								
Continuous (3x380–440 V) [A]	34.1	38.0	48.8	58.4	72.0	74.2	102.9	123.9
Intermittent (3x380–440 V) [A]	37.5	41.8	53.7	64.2	79.2	81.6	113.2	136.3
Continuous (3x440–480 V) [A]	31.3	35.0	41.6	52.0	64.0	73.5	91.0	112.0
Intermittent (3x440–480 V) [A]	34.4	38.5	45.8	57.2	70.4	80.9	100.1	123.2

Table 6.3 3x380–480 V AC, 18.5–90 kW (25–125 HP), Enclosure Type H5–H8

1) Applies for dimensioning of adjustable frequency drive cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included. For power loss data according to EN 50598-2, refer to www.danfoss.com/vltenergyefficiency.

2) Efficiency measured at nominal current. For energy efficiency class, see chapter 6.4.13 Ambient Conditions. For part load losses, see www.danfoss.com/vltenergyefficiency.

Adjustable frequency drive	PK75	P1K5	P2K2	P3K0	P4KO	P5K5	P7K5	P11K	P15K	P18K
Typical shaft output [kW]	0.75	1.5	2.2	3.0	4.0	5.5	7.5	11	15	18.5
Typical shaft output [HP]	1.0	2.0	3.0	4.0	5.0	7.5	10.0	15	20	25
IP54 frame	I2	I2	I2	I2	I2	I3	I3	I4	I4	I4
Maximum cable size in terminals (line power, motor) [mm^2 (AWG)]	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	16 (6)	16 (6)	16 (6)
Output current										
40 °C (104 °F) ambient temperature										
Continuous (3x380–440 V) [A]	2.2	3.7	5.3	7.2	9.0	12.0	15.5	23.0	31.0	37.0
Intermittent (3x380–440 V) [A]	2.4	4.1	5.8	7.9	9.9	13.2	17.1	25.3	34.0	40.7
Continuous (3x440–480 V) [A]	2.1	3.4	4.8	6.3	8.2	11.0	14.0	21.0	27.0	34.0
Intermittent (3x440–480 V) [A]	2.3	3.7	5.3	6.9	9.0	12.1	15.4	23.1	29.7	37.4
Maximum input current										
Continuous (3x380–440 V) [A]	2.1	3.5	4.7	6.3	8.3	11.2	15.1	22.1	29.9	35.2
Intermittent (3x380–440 V) [A]	2.3	3.9	5.2	6.9	9.1	12.3	16.6	24.3	32.9	38.7
Continuous (3x440–480 V) [A]	1.8	2.9	3.9	5.3	6.8	9.4	12.6	18.4	24.7	29.3
Intermittent (3 x 440–480 V) [A]	2.0	3.2	4.3	5.8	7.5	10.3	13.9	20.2	27.2	32.2
Maximum electrical fuses	See *chapter 3.2.4 Fuses and Circuit Breakers*									
Estimated power loss [W], best case/typical[1)]	21/ 16	46/ 57	46/ 58	66/ 83	95/ 118	104/ 131	159/ 198	248/ 274	353/ 379	412/ 456
Weight enclosure IP54 [kg (lb)]	5.3 (11.7)	5.3 (11.7)	5.3 (11.7)	5.3 (11.7)	5.3 (11.7)	7.2 (15.9)	7.2 (15.9)	13.8 (30.4)	13.8 (30.4)	13.8 (30.4)
Efficiency [%], best case/typical[2)]	98.0/ 97.6	97.7/ 97.2	98.3/ 97.9	98.2/ 97.8	98.0/ 97.6	98.4/ 98.0	98.2/ 97.8	98.1/ 97.9	98.0/ 97.8	98.1/ 97.9
Output current - 50 °C (122 °F) ambient temperature										
Continuous (3x380–440 V) [A]	1.93	3.7	4.85	6.3	7.5	10.9	14.0	20.9	28.0	33.0
Intermittent (3x380–440 V) [A]	2.1	4.07	5.4	6.9	9.2	12.0	15.4	23.0	30.8	36.3
Continuous (3x440–480 V) [A]	1.8	3.4	4.4	5.5	6.8	10.0	12.6	19.1	24.0	30.0
Intermittent (3x440–480 V) [A]	2.0	3.7	4.8	6.1	8.3	11.0	13.9	21.0	26.4	33.0

Table 6.4 3x380–480 V AC, 0.75–18.5 kW (1-25 HP), Enclosure Type I2–I4

1) Applies for dimensioning of adjustable frequency drive cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included. For power loss data according to EN 50598-2, refer to www.danfoss.com/vltenergyefficiency.

2) Efficiency measured at nominal current. For energy efficiency class, see chapter 6.4.13 Ambient Conditions. For part load losses, see www.danfoss.com/vltenergyefficiency.

Adjustable frequency drive	P22K	P30K	P37K	P45K	P55K	P75K	P90K
Typical shaft output [kW]	22.0	30.0	37.0	45.0	55.0	75.0	90.0
Typical shaft output [HP]	30.0	40.0	50.0	60.0	70.0	100.0	125.0
IP54 frame	I6	I6	I6	I7	I7	I8	I8
Maximum cable size in terminals (line power, motor) [mm^2 (AWG)]	35 (2)	35 (2)	35 (2)	50 (1)	50 (1)	95 (3/0)	120 (4/0)
Output current							
40 °C (104 ° F) ambient temperature							
Continuous (3x380–440 V) [A]	44.0	61.0	73.0	90.0	106.0	147.0	177.0
Intermittent (3x380–440 V) [A]	48.4	67.1	80.3	99.0	116.6	161.7	194.7
Continuous (3x440–480 V) [A]	40.0	52.0	65.0	80.0	105.0	130.0	160.0
Intermittent (3x440–480 V) [A]	44.0	57.2	71.5	88.0	115.5	143.0	176.0
Maximum input current							
Continuous (3x380–440 V) [A]	41.8	57.0	70.3	84.2	102.9	140.3	165.6
Intermittent (3x380–440 V) [A]	46.0	62.7	77.4	92.6	113.1	154.3	182.2
Continuous (3x440–480 V) [A]	36.0	49.2	60.6	72.5	88.6	120.9	142.7
Intermittent (3 x 440–480 V) [A]	39.6	54.1	66.7	79.8	97.5	132.9	157.0
Maximum electrical fuses							
Estimated power loss [W], best case/typical[1)]	496	734	995	840	1099	1520	1781
Weight enclosure IP54 [kg (lb)]	27 (59.5)	27 (59.5)	27 (59.5)	45 (99.2)	45 (99.2)	65 (143.3)	65 (143.3)
Efficiency [%], best case/typical[2)]	98.0	97.8	97.6	98.3	98.2	98.1	98.3
Output current - 50 °C (122 °F) ambient temperature							
Continuous (3x380–440 V) [A]	35.2	48.8	58.4	63.0	74.2	102.9	123.9
Intermittent (3x380–440 V) [A]	38.7	53.9	64.2	69.3	81.6	113.2	136.3
Continuous (3x440–480 V) [A]	32.0	41.6	52.0	56.0	73.5	91.0	112.0
Intermittent (3x440–480 V) [A]	35.2	45.8	57.2	61.6	80.9	100.1	123.2

Table 6.5 3x380–480 V AC, 22–90 kW (30–125 HP), Enclosure Type I6–I8

1) Applies for dimensioning of adjustable frequency drive cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included. For power loss data according to EN 50598-2, refer to www.danfoss.com/vltenergyefficiency.

2) Efficiency measured at nominal current. For energy efficiency class, see chapter 6.4.13 Ambient Conditions. For part load losses, see www.danfoss.com/vltenergyefficiency.

6.1.3 3x525–600 V AC

Adjustable frequency drive	P2K2	P3K0	P3K7	P5K5	P7K5	P11K	P15K	P18K	P22K	P30K	P37K	P45K	P55K	P75K	P90K
Typical shaft output [kW]	2.2	3.0	3.7	5.5	7.5	11.0	15.0	18.5	22.0	30.0	37	45.0	55.0	75.0	90.0
Typical shaft output [HP]	3.0	4.0	5.0	7.5	10.0	15.0	20.0	25.0	30.0	40.0	50.0	60.0	70.0	100.0	125.0
IP20 frame	H9	H9	H9	H9	H9	H10	H10	H6	H6	H6	H7	H7	H7	H8	H8
Maximum cable size in terminals (line power, motor) [mm^2 (AWG)]	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	10 (8)	10 (8)	35 (2)	35 (2)	35 (2)	50 (1)	50 (1)	50 (1)	95 (0)	120 (4/0)
Output current - 40 °C (104 ° F) ambient temperature															
Continuous (3x525–550 V) [A]	4.1	5.2	6.4	9.5	11.5	19.0	23.0	28.0	36.0	43.0	54.0	65.0	87.0	105.0	137.0
Intermittent (3x525–550 V) [A]	4.5	5.7	7.0	10.5	12.7	20.9	25.3	30.8	39.6	47.3	59.4	71.5	95.7	115.5	150.7
Continuous (3x551–600 V) [A]	3.9	4.9	6.1	9.0	11.0	18.0	22.0	27.0	34.0	41.0	52.0	62.0	83.0	100.0	131.0
Intermittent (3x551–600 V) [A]	4.3	5.4	6.7	9.9	12.1	19.8	24.2	29.7	37.4	45.1	57.2	68.2	91.3	110.0	144.1
Maximum input current															
Continuous (3x525–550 V) [A]	3.7	5.1	5.0	8.7	11.9	16.5	22.5	27.0	33.1	45.1	54.7	66.5	81.3	109.0	130.9
Intermittent (3x525–550 V) [A]	4.1	5.6	6.5	9.6	13.1	18.2	24.8	29.7	36.4	49.6	60.1	73.1	89.4	119.9	143.9
Continuous (3x551–600 V) [A]	3.5	4.8	5.6	8.3	11.4	15.7	21.4	25.7	31.5	42.9	52.0	63.3	77.4	103.8	124.5
Intermittent (3x551–600 V) [A]	3.9	5.3	6.2	9.2	12.5	17.3	23.6	28.3	34.6	47.2	57.2	69.6	85.1	114.2	137.0
Maximum electrical fuses	See *chapter 3.2.4 Fuses and Circuit Breakers*														
Estimated power loss [W], best case/typical[1)]	65	90	110	132	180	216	294	385	458	542	597	727	1092	1380	1658
Weight enclosure IP54 [kg (lb)]	6.6 (14.6)	6.6 (14.6)	6.6 (14.6)	6.6 (14.6)	6.6 (14.6)	11.5 (25.3)	11.5 (25.3)	24.5 (54)	24.5 (54)	24.5 (54)	36.0 (79.3)	36.0 (79.3)	36.0 (79.3)	51.0 (112.4)	51.0 (112.4)
Efficiency [%], best case/typical[2)]	97.9	97	97.9	98.1	98.1	98.4	98.4	98.4	98.4	98.5	98.5	98.7	98.5	98.5	98.5
Output current - 50 °C (122 °F) ambient temperature															
Continuous (3x525–550 V) [A]	2.9	3.6	4.5	6.7	8.1	13.3	16.1	19.6	25.2	30.1	37.8	45.5	60.9	73.5	95.9
Intermittent (3x525–550 V) [A]	3.2	4.0	4.9	7.4	8.9	14.6	17.7	21.6	27.7	33.1	41.6	50.0	67.0	80.9	105.5
Continuous (3x551–600 V) [A]	2.7	3.4	4.3	6.3	7.7	12.6	15.4	18.9	23.8	28.7	36.4	43.3	58.1	70.0	91.7
Intermittent (3x551–600 V) [A]	3.0	3.7	4.7	6.9	8.5	13.9	16.9	20.8	26.2	31.6	40.0	47.7	63.9	77.0	100.9

Table 6.6 3x525–600 V AC, 2.2–90 kW (3–125 HP), Enclosure Type H6–H10

1) Applies for dimensioning of adjustable frequency drive cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included. For power loss data according to EN 50598-2, refer to www.danfoss.com/vltenergyefficiency.

2) Efficiency measured at nominal current. For energy efficiency class, see chapter 6.4.13 Ambient Conditions. For part load losses, see www.danfoss.com/vltenergyefficiency.

6.2 EMC Emission Test Results

The following test results have been obtained using a system with an adjustable frequency drive, a shielded control cable, a control box with potentiometer, and a shielded motor cable.

RFI filter type	Conduct emission. Maximum shielded cable length (ft [m])						Radiated emission			
	Industrial environment									
EN 55011	Class A Group 2 Industrial environment		Class A Group 1 Industrial environment		Class B Housing, trades and light industries		Class A Group 1 Industrial environment		Class B Housing, trades and light industries	
EN/IEC 61800-3	Category C3 Second environment Industrial		Category C2 First environment Home and office		Category C1 First environment Home and office		Category C2 First environment Home and office		Category C1 First environment Home and office	
	Without external filter	With external filter	Without external filter	With external filter	Without external filter	With external filter	Without external filter	With external filter	Without external filter	With external filter
H4 RFI filter (EN55011 A1, EN/IEC61800-3 C2)										
0.25–11 kW 3x200–240 V IP20	–	–	25	50	–	20	Yes	Yes	–	No
0.37–22 kW 3x380–480 V IP20	–	–	25	50	–	20	Yes	Yes	–	No
H2 RFI filter (EN 55011 A2, EN/IEC 61800-3 C3)										
15–45 kW 3x200–240 V IP20	25	–	–	–	–	–	No	–	No	–
30–90 kW 3x380–480 V IP20	25	–	–	–	–	–	No	–	No	–
0.75–18.5 kW 3x380–480 V IP54	25	–	–	–	–	–	Yes	–	–	–
22–90 kW 3x380–480 V IP54	25	–	–	–	–	–	No	–	No	–
H3 RFI filter (EN55011 A1/B, EN/IEC 61800-3 C2/C1)										
15–45 kW 3x200–240 V IP20	–	–	50	–	20	–	Yes	–	No	–
30–90 kW 3x380–480 V IP20	–	–	50	–	20	–	Yes	–	No	–
0.75–18.5 kW 3x380–480 V IP54	–	–	25	–	10	–	Yes	–	–	–
22–90 kW 3x380–480 V IP54	–	–	25	–	10	–	Yes	–	No	–

Table 6.7 EMC Emission Test Results

6.3 Special Conditions

6.3.1 Derating for Ambient Temperature and Switching Frequency

The ambient temperature measured over 24 hours should be at least 5 °C (9° F) lower than the maximum ambient temperature that is specified for the adjustable frequency driver. If the adjustable frequency drive is operated at a high ambient temperature, the continuous output current should be decreased. For derating curve, see *VLT® HVAC Basic Drive Design Guide*.

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6.3.2 Derating for Low Air Pressure and High Altitudes

The cooling capability of air is decreased at low air pressure. For altitudes above 2000 m (6562 ft), contact Danfoss regarding PELV. Below 1000 m (3281 ft) altitude, no derating is necessary. Above 1000 m (3281 ft), the ambient temperature or the maximum output current should be decreased. Decrease the output by 1 % per 100 m (328 ft) altitude above 1000 m (3281 ft) or reduce the maximum ambient temperature by 1 °C per 200 m (656 ft).

6.4 General Technical Data

6.4.1 Protection and Features

- Electronic thermal motor protection against overload.
- Temperature monitoring of the heatsink ensures that the adjustable frequency drive trips in case of overtemperature.
- The adjustable frequency drive is protected against short-circuits between motor terminals U, V, W.
- When a motor phase is missing, the adjustable frequency drive trips and issues an alarm.
- When a line power phase is missing, the adjustable frequency drive trips or issues a warning (depending on the load).
- Monitoring of the intermediate circuit voltage ensures that the adjustable frequency drive trips when the intermediate circuit voltage is too low or too high.
- The adjustable frequency drive is protected against ground faults on motor terminals U, V, W.

6.4.2 Line power supply (L1, L2, L3)

Supply voltage	200–240 V ±10%
Supply voltage	380–480 V ±10%
Supply voltage	525–600 V ±10%
Supply frequency	50/60 Hz
Maximum imbalance temporary between line power phases	3.0% of rated supply voltage
True power factor (λ)	≥0.9 nominal at rated load
Displacement power factor (cosφ) near unity	(>0.98)
Switching on the input supply L1, L2, L3 (power-ups) enclosure frame H1–H5, I2, I3, I4	Maximum 2 times/min.
Switching on the input supply L1, L2, L3 (power-ups) enclosure frame H6–H8, I6–I8	Maximum 1 time/min.
Environment according to EN 60664-1	Overvoltage category III/pollution degree 2

The unit is suitable for use on a circuit capable of delivering not more than 100000 RMS symmetrical Amperes, 240/480 V maximum.

6.4.3 Motor Output (U, V, W)

Output voltage	0–100% of supply voltage
Output frequency	0–200 Hz (VVC$^+$), 0–400 Hz (u/f)
Switching on output	Unlimited
Ramp times	0.05-3600 s

6.4.4 Cable Lengths and Cross–sections

Maximum motor cable length, shielded/armored (EMC-compatible installation)	See *chapter 6.2.1 EMC Emission Test Results*
Maximum motor cable length, non-shielded/unarmored	50 m (164 ft)
Maximum cross-section to motor, line power[1)]	
Cross-section DC terminals for filter feedback on enclosure frame H1–H3, I2, I3, I4	4 mm^2/11 AWG
Cross-section DC terminals for filter feedback on enclosure frame H4–H5	16 mm^2/6 AWG
Maximum cross-section to control terminals, rigid wire	2.5 mm^2/14 AWG
Maximum cross-section to control terminals, flexible cable	2.5 mm^2/14 AWG
Minimum cross-section to control terminals	0.05 mm^2/30 AWG

1) See *chapter 6.1.2 3x380–480 V AC* for more information

6.4.5 Digital Inputs

Programmable digital inputs	4
Terminal number	18, 19, 27, 29
Logic	PNP or NPN
Voltage level	0–24 V DC
Voltage level, logic 0 PNP	<5 V DC
Voltage level, logic 1 PNP	>10 V DC
Voltage level, logic 0 NPN	>19 V DC
Voltage level, logic 1 NPN	<14 V DC
Maximum voltage on input	28 V DC
Input resistance, R_i	Approximately 4 kΩ
Digital input 29 as thermistor input	Fault: >2.9 kΩ and no fault: <800 Ω
Digital input 29 as Pulse input	Maximum frequency 32 kHz push-pull-driven & 5 kHz (O.C.)

6.4.6 Analog Inputs

Number of analog inputs	2
Terminal number	53, 54
Terminal 53 mode	Parameter 6-19: 1=voltage, 0=current
Terminal 54 mode	Parameter 6-29: 1=voltage, 0=current
Voltage level	0–10 V
Input resistance, R_i	approximately 10 kΩ
Maximum voltage	20 V
Current level	0/4 to 20 mA (scalable)
Input resistance, R_i	<500 Ω
Maximum current	29 mA
Resolution on analog input	10 bit

6.4.7 Analog Output

Number of programmable analog outputs	2
Terminal number	42, 45[1)]
Current range at analog output	0/4–20 mA
Maximum load to common at analog output	500 Ω
Maximum voltage at analog output	17 V
Accuracy on analog output	Maximum error: 0.4% of full scale
Resolution on analog output	10 bit

1) Terminal 42 and 45 can also be programmed as digital outputs.

6.4.8 Digital Output

Number of digital outputs	2
Terminal number	42, 45[1)]
Voltage level at digital output	17 V
Maximum output current at digital output	20 mA
Maximum load at digital output	1 kΩ

1) Terminals 42 and 45 can also be programmed as analog output.

6.4.9 Control Card, RS-485 Serial Communication

Terminal number	68 (P, TX+, RX+), 69 (N, TX-, RX-)
Terminal number	61 common for terminals 68 and 69

6.4.10 Control Card, 24 V DC Output

Terminal number	12
Maximum load	80 mA

6.4.11 Relay Output

Programmable relay output	2
Relay 01 and 02	01-03 (NC), 01-02 (NO), 04-06 (NC), 04-05 (NO)
Maximum terminal load (AC-1)[1] on 01-02/04-05 (NO) (Resistive load)	250 V AC, 3 A
Maximum terminal load (AC-15)[1] on 01-02/04-05 (NO) (Inductive load @ cosφ 0.4)	250 V AC, 0.2 A
Maximum terminal load (DC-1)[1] on 01-02/04-05 (NO) (Resistive load)	30 V DC, 2 A
Maximum terminal load (DC-13)[1] on 01-02/04-05 (NO) (Inductive load)	24 V DC, 0.1 A
Maximum terminal load (AC-1)[1] on 01-03/04-06 (NC) (Resistive load)	250 V AC, 3 A
Maximum terminal load (AC-15)[1] on 01-03/04-06 (NC) (Inductive load @ cosφ 0.4)	250 V AC, 0.2 A
	30 V DC, 2 A
Maximum terminal load (DC-1)[1] on 01-03/04-06 (NC) (Resistive load)	Minimum terminal load on 01-03 (NC), 01-02 (NO) 24 V DC 10 mA, 24 V AC 20 mA
Environment according to EN 60664-1	Overvoltage category III/pollution degree 2

1) IEC 60947 parts 4 and 5.

6.4.12 Control Card, 10 V DC Output[1]

Terminal number	50
Output voltage	10.5 V ±0.5 V
Maximum load	25 mA

1) All inputs, outputs, circuits, DC supplies and relay contacts are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

6.4.13 Ambient Conditions

Enclosure	IP20, IP54
Enclosure kit available.	IP21, TYPE 1
Vibration test	1.0 g
Maximum relative humidity	5%–95% (IEC 60721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60721-3-3), coated (standard) frame H1–H5	Class 3C3
Aggressive environment (IEC 60721-3-3), non-coated frame H6–H10	Class 3C2
Aggressive environment (IEC 60721-3-3), coated (optional) frame H6–H10	Class 3C3
Aggressive environment (IEC 60721-3-3), non-coated frame I2–I8	Class 3C2
Test method according to IEC 60068-2-43 H2S (10 days)	
Ambient temperature[1]	See maximum output current at 40/50 °C (104/122 °F) in *chapter 6.1.2 3x380–480 V AC*
Minimum ambient temperature during full-scale operation	0 °C (32 °F)
Minimum ambient temperature at reduced performance	-20 °C (-4 °F)
Minimum ambient temperature at reduced performance	-10 °C (14 °F)

Temperature during storage/transport	-30 to +65/70 °C (-22 to +149/158 °F)
Maximum altitude above sea level without derating	1000 m (3281 ft)
Maximum altitude above sea level with derating	3000 m (9842 ft)
Derating for high altitude, see *chapter 6.3.2 Derating for Low Air Pressure and High Altitudes*	
Safety standards	EN/IEC 61800-5-1, UL 508C
EMC standards, Emission	EN 61800-3, EN 61000-6-3/4, EN 55011, IEC 61800-3
EMC standards, Immunity	EN 61800-3, EN 61000-3-12, EN 61000-6-1/2, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6
Energy efficiency class	IE2

1) Refer to special conditions in the design guide for:

- *Derating for high ambient temperature*
- *Derating for high altitude*

2) Determined according to EN50598-2 at:

- *Rated load*
- *90% rated frequency*
- *Switching frequency factory setting*
- *Switching pattern factory setting*

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