MAKING MODERN LIVING POSSIBLE

Quick Guide
VLT®HVAC Basic Drive FC 101

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VLT® THE REAL DRIVE

Contents

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1 Quick Guide

1.1 Safety

1.1.1 Warnings

⚠WARNING

High Voltage Warning

The voltage of the frequency converter is dangerous whenever it is connected to mains. Incorrect installation of the motor or frequency converter may cause damage to the equipment, serious injury or death. Consequently, it is essential to comply with the instructions in this manual as well as local and national rules and safety regulations.

⚠WARNING

DISCHARGE TIME!

Frequency converters contain DC-link capacitors that can remain charged even when the frequency converter is not powered. To avoid electrical hazards, disconnect AC mains, any permanent magnet type motors, and any remote DC-link power supplies, including battery backups, UPS and DC-link connections to other frequency converters. Wait for the capacitors to fully discharge before performing any service or repair work. The amount of wait time is listed in the *Discharge Time* table. Failure to wait the specified time after power has been removed before doing service or repair could result in death or serious injury.

Voltage [V]	Power range [kW]	Minimum waiting time [min]
3x200	0.25–3.7	4
3x200	5.5–11	15
3x400	0.37–7.5	4
3x400	11–90	15
3x600	2.2–7.5	4
3x600	11–90	15

Table 1.1 Discharge Time

CAUTION

Leakage Current:

The earth leakage current from the frequency converter exceeds 3.5 mA. According to IEC 61800-5-1 a reinforced Protective Earth connection must be ensured with a min. 10 mm^2 Cu or an additional PE wire - with the same cable cross section as the Mains wiring - must be terminated separately.

Residual Current Device:

This product can cause a DC current in the protective conductor. Where a residual current device (RCD) is used for extra protection, only an RCD of Type B (time delayed) shall be used on the supply side of this product. See also Danfoss Application Note on RCD, MN90G.

Protective earthing of the frequency converter and the use of RCDs must always follow national and local regulations.

Motor thermal protection

Motor overload protection is possible by setting *1-90 Motor Thermal Protection* to *[4] ETR trip*.

⚠WARNING

Installation at high altitudes

For altitudes above 2 km, contact Danfossregarding PELV.

1.1.2 Safety Instructions

- Make sure the frequency converter is properly connected to earth.
- Do not remove mains connections, motor connections or other power connections while the frequency converter is connected to power.
- Protect users against supply voltage.
- Protect the motor against overloading according to national and local regulations.
- The earth leakage current exceeds 3.5 mA.
- The [Off/Reset] key is not a safety switch. It does not disconnect the frequency converter from mains.

1.2 Introduction

1.2.1 Available Literature

This Quick Guide contains basic information necessary for installing and running the frequency converter. If more information is needed, literature can be found on the enclosed cd.

1.2.2 Approvals

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

Table 1.2 Approvals

The frequency converter complies with UL508C thermal memory retention requirements. For more information, refer to the section *Motor Thermal Protection* in the *Design Guide*.

1.2.3 IT Mains

⚠CAUTION

IT Mains

Installation on isolated mains source, that is, IT mains.
Max. supply voltage allowed when connected to mains: 440 V (3x380-480 V units).

On IP20 200-240 V 0.25-11 kW and 380-480 V IP20 0.37-22 kW, open the RFI switch by removing the screw on the side of the frequency converter when at IT grid.

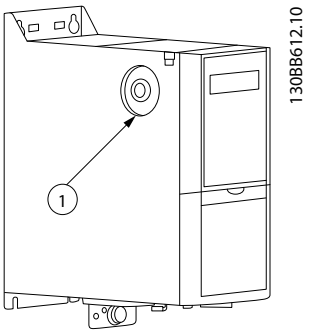


Illustration 1.1 IP20 200-240 V 0.25-11 kW, IP20 0.37-22 kW 380-480 V

1	EMC screw

Table 1.3 Legend to *Illustration 1.1*

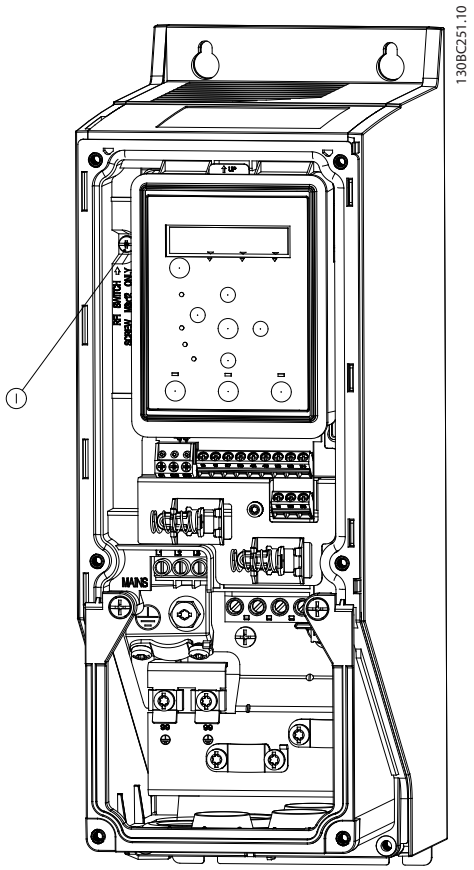


Illustration 1.2 IP54 400 V 0.75-18.5 kW

1	EMC screw

Table 1.4 Legend to *Illustration 1.2*

On all units, set *14-50 RFI Filter* to *[0] Off* when operating in IT mains.

1

⚠CAUTION

If reinserted, only use M3x12 screw.

1.2.4 Avoid Unintended Start

While the frequency converter is connected to mains, the motor can be started/stopped using digital commands, bus commands, references or via the LCP or LOP.

- Disconnect the frequency converter from mains whenever personal safety considerations make it necessary to avoid unintended start of any motors.
- To avoid unintended start, always press [Off/ Reset] before changing parameters.

1.2.5 Disposal Instruction

Equipment containing electrical components must 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.

1.3 Installation

1.3.1 Before Starting Repair Work

1. Disconnect from mains (and external DC supply, if present).
2. Wait as stated in *Table 1.1* for discharge of the DC-link.
3. Remove motor cable.

1.3.2 Side-by-Side Installation

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

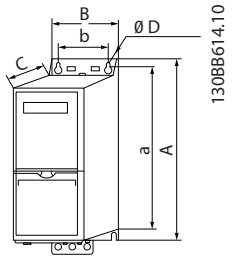
		Power [kW]			Clearance above/below [mm/inch]
Frame	**IP class**	**3x200-240 V**	**3x380-480 V**	**3x525-600 V**	
H1	IP20	0.25-1.5	0.37-1.5		100/4
H2	IP20	2.2	2.2-4		100/4
H3	IP20	3.7	5.5-7.5		100/4
H4	IP20	5.5-7.5	11-15		100/4
H5	IP20	11	18.5-22		100/4
H6	IP20	15-18.5	30-45	18.5-30	200/7.9
H7	IP20	22-30	55-75	37-55	200/7.9
H8	IP20	37-45	90	75-90	225/8.9
H9	IP20			2.2-7.5	100/4
H10	IP20			11-15	200/7.9

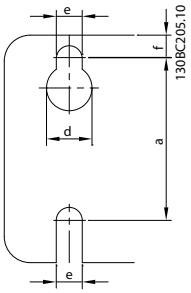
Table 1.5 Clearance

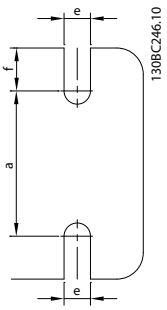
NOTICE

With IP21/Nema Type1 option kit mounted, a distance of 50 mm between the units is required.

1.3.3 Dimensions







Enclosure		Power [kW]			Height [mm]			Width [mm]		Depth [mm]	Mounting hole [mm]			Max. Weight
Frame	IP Class	3x200-240 V	3x380-480 V	3x525-600 V	A	A[1]	a	B	b	C	d	e	f	kg
H1	IP20	0.25-1.5	0.37-1.5		195	273	183	75	56	168	9	4.5	5.3	2.1
H2	IP20	2.2	2.2-4.0		227	303	212	90	65	190	11	5.5	7.4	3.4
H3	IP20	3.7	5.5-7.5		255	329	240	100	74	206	11	5.5	8.1	4.5
H4	IP20	5.5-7.5	11-15		296	359	275	135	105	241	12.6	7	8.4	7.9
H5	IP20	11	18.5-22		334	402	314	150	120	255	12.6	7	8.5	9.5
H6	IP20	15-18.5	30-45	18.5-30	518	595/635 (45 kW)	495	239	200	242	-	8.5	15	24.5
H7	IP20	22-30	55-75	37-55	550	630/690 (75 kW)	521	313	270	335	-	8.5	17	36
H8	IP20	37-45	90	75-90	660	800	631	375	330	335	-	8.5	17	51
H9	IP20			2.2-7.5	269	374	257	130	110	205	11	5.5	9	6.6
H10	IP20			11-15	399	419	380	165	140	248	12	6.8	7.5	12
I2	IP54		0.75-4.0		332	-	318.5	115	74	225	11	5.5	9	5.3
I3	IP54		5.5-7.5		368	-	354	135	89	237	12	6.5	9.5	7.2
I4	IP54		11-18.5		476	-	460	180	133	290	12	6.5	9.5	13.8
I6	IP54		22-37		650	-	624	242	210	260	19	9	9	27
I7	IP54		45-55		680	-	648	308	272	310	19	9	9.8	45
I8	IP54		75-90		770	-	739	370	334	335	19	9	9.8	65

Table 1.6 Dimensions

[1] *Including decoupling plate*

1

The dimensions are only for the physical units, but when installing in an application it is necessary to add space for free air passage both above and below the units. The amount of space for free air passage is listed in *Table 1.8*:

Enclosure		Clearance [mm]	
Frame	IP class	Above unit	Below unit
H1	20	100	100
H2	20	100	100
H3	20	100	100
H4	20	100	100
H5	20	100	100
H6	20	200	200
H7	20	200	200
H8	20	225	225
H9	20	100	100
H10	20	200	200
I2	54	100	100
I3	54	100	100
I4	54	100	100
I6	54	200	200
I7	54	200	200
I8	54	225	225

Table 1.7 Clearance Needed for Free Air Passage

1.3.4 Electrical Installation in General

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

Power [kW]				Torque [Nm]					
Frame	IP class	3x200-240 V	3x380-480 V	Line	Motor	DC connection	Control terminals	Earth	Relay
H1	IP20	0.25-1.5	0.37-1.5	1.4	0.8	0.8	0.5	0.8	0.5
H2	IP20	2.2	2.2-4	1.4	0.8	0.8	0.5	0.8	0.5
H3	IP20	3.7	5.5-7.5	1.4	0.8	0.8	0.5	0.8	0.5
H4	IP20	5.5-7.5	11-15	1.2	1.2	1.2	0.5	0.8	0.5
H5	IP20	11	18.5-22	1.2	1.2	1.2	0.5	0.8	0.5
H6	IP20	15-18	30-45	4.5	4.5	-	0.5	3	0.5
H7	IP20	22-30	55	10	10	-	0.5	3	0.5
H7	IP20	-	75	14	14	-	0.5	3	0.5
H8	IP20	37-45	90	24[2]	24[2]	-	0.5	3	0.5

Table 1.8 Enclosure H1-H8

Power [kW]			Torque [Nm]					
Frame	IP class	3x380-480 V	Line	Motor	DC connection	Control terminals	Earth	Relay
I2	IP54	0.75-4.0	1.4	0.8	0.8	0.5	0.8	0.5
I3	IP54	5.5-7.5	1.4	0.8	0.8	0.5	0.8	0.5
I4	IP54	11-18.5	1.4	0.8	0.8	0.5	0.8	0.5
I6	IP54	22-37	4.5	4.5	-	0.5	3	0.6
I7	IP54	45-55	10	10	-	0.5	3	0.6
I8	IP54	75-90	14/24[1]	14/24[1]	-	0.5	3	0.6

Table 1.9 Enclosure I1-I8

Power [kW]			Torque [Nm]					
Frame	IP class	3x525-600 V	Line	Motor	DC connection	Control terminals	Earth	Relay
H9	IP20	2.2-7.5	1.8	1.8	not recommended	0.5	3	0.6
H10	IP20	11-15	1.8	1.8	not recommended	0.5	3	0.6
H6	IP20	18.5-30	4.5	4.5	-	0.5	3	0.5
H7	IP20	37-55	10	10	-	0.5	3	0.5
H8	IP20	75-90	14/24[1]	14/24[1]	-	0.5	3	0.5

Table 1.10 Details of Tightening Torques

[1] *Cable dimensions ≤95 mm²*

[2] *Cable dimensions >95 mm²*

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1.3.5 Connecting to Mains and Motor

The frequency converter is designed to operate all standard three-phased asynchronous motors. For maximum cross-section on wires see *1.7 General Specifications*.

- Use a shielded/armored motor cable to comply with EMC emission specifications, and connect this cable to both the decoupling plate and the motor metal.
- Keep motor cable as short as possible to reduce the noise level and leakage currents.
- For further details on mounting of the decoupling plate, see *FC 101 De-coupling Plate Mounting Instruction*.
- Also see *EMC-Correct Installation in the VLT® HVAC Basic Design Guide*.

1. Mount the earth wires to earth terminal.
2. Connect motor to terminals U, V and W.
3. Mount mains supply to terminals L1, L2 and L3 and tighten.

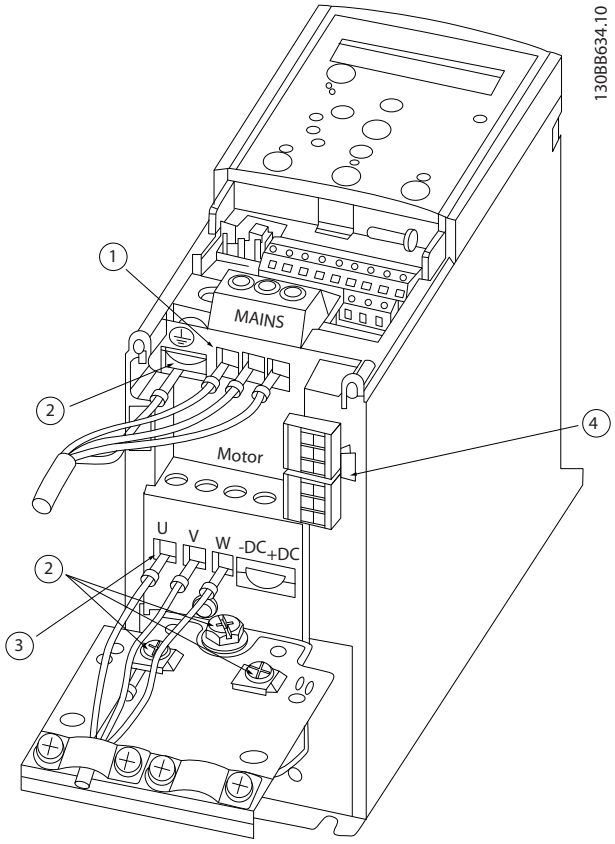

Illustration 1.3 H1-H5 Frame
IP20 200-240 V 0.25-11 kW and IP20 380-480 V 0.37-22 kW

1	Line
2	Earth
3	Motor
4	Relays

Table 1.11 Legend to *Illustration 1.3*

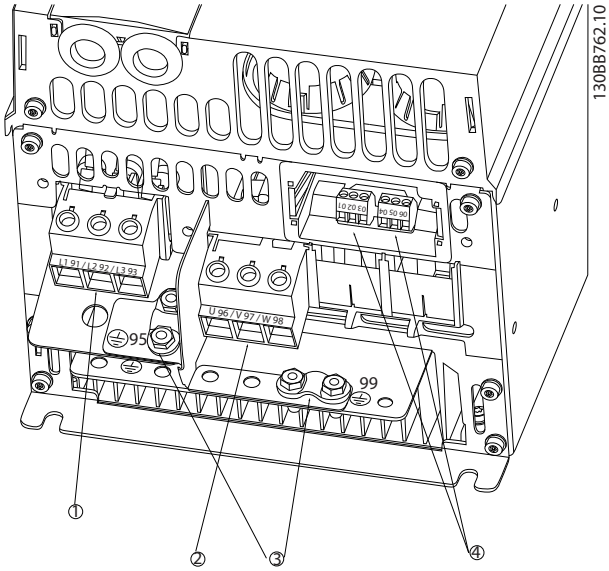

Illustration 1.4 H6 Frame
IP20 380-480 V 30-45 kW
IP20 200-240 V 15-18.5 kW
IP20 525-600 V 22-30 kW

1	Line
2	Motor
3	Earth
4	Relays

Table 1.12 Legend to *Illustration 1.4*

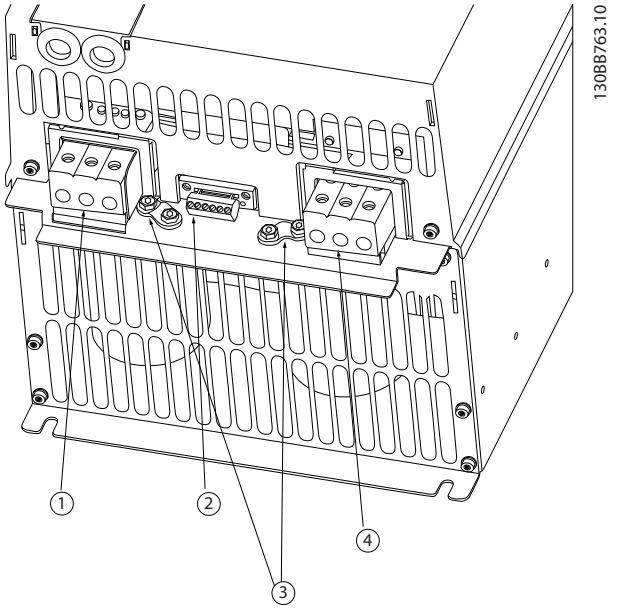

Illustration 1.5 H7 Frame
IP20 380-480 V 55-75 kW
IP20 200-240 V 22- 30 kW
IP20 525-600 V 45-55 kW

1	Line
2	Relays
3	Earth
4	Motor

Table 1.13 Legend to *Illustration 1.5*

1

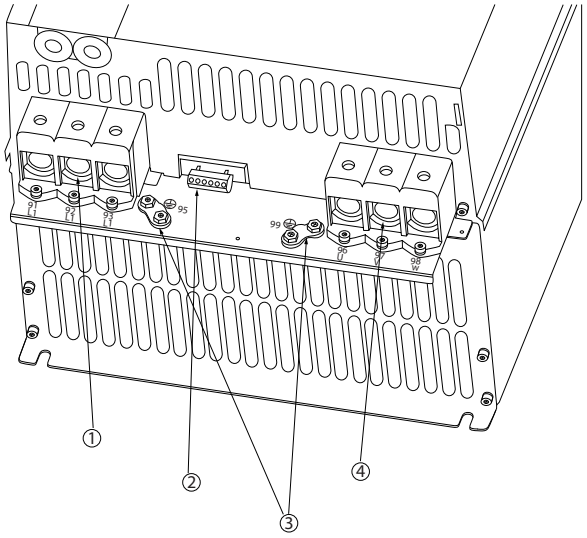

Illustration 1.6 H8 Frame
IP20 380-480 V 90 kW
IP20 200-240 V 37-45 kW
IP20 525-600 V 75-90 kW

1	Line
2	Relays
3	Earth
4	Motor

Table 1.14 Legend to

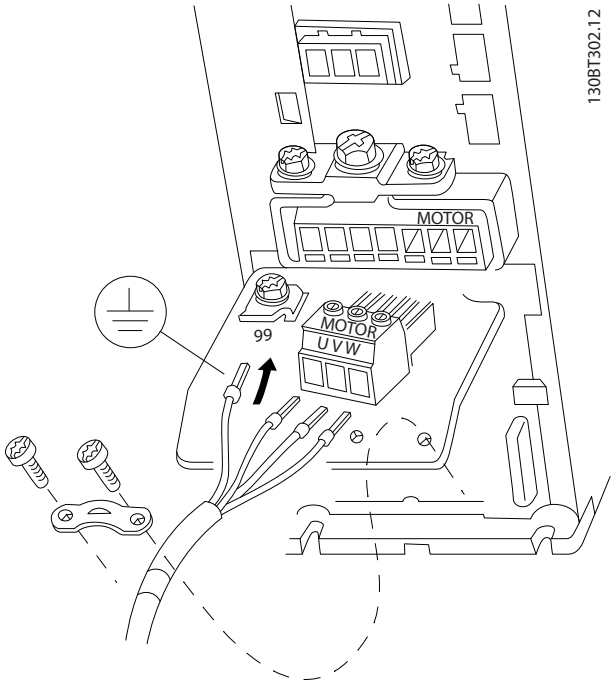

Illustration 1.7 H9 Frame
IP20 600 V 2.2-7.5 kW

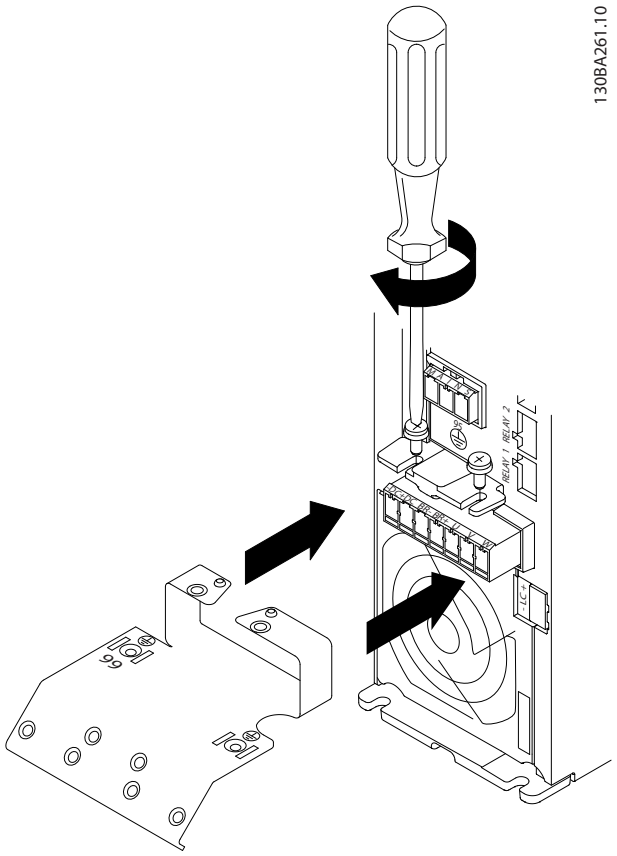

Illustration 1.8 Mount the two screws in the mounting plate, slide it into place and tighten fully

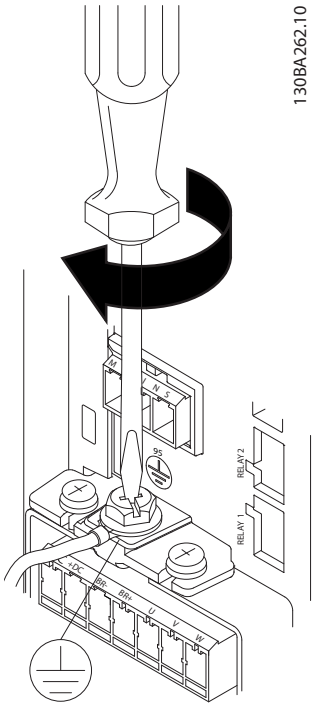

Illustration 1.9 When mounting cables, first mount and tighten earth cable

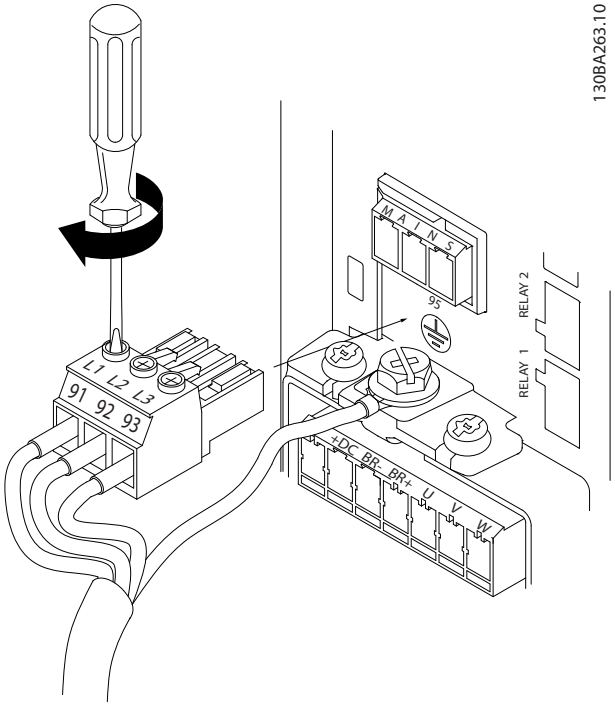

Illustration 1.10 Then mount mains plug and tighten wires

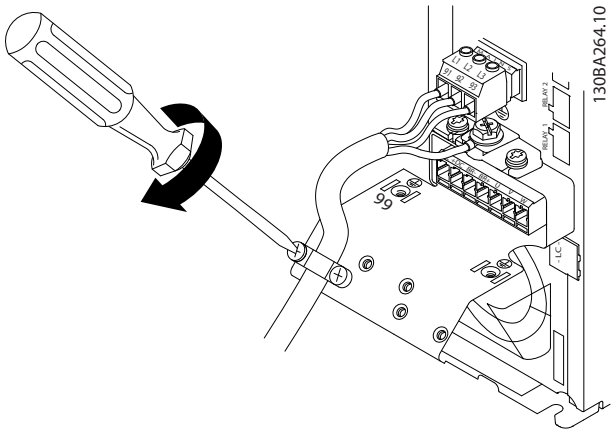

Illustration 1.11 Tighten support bracket on mains wires

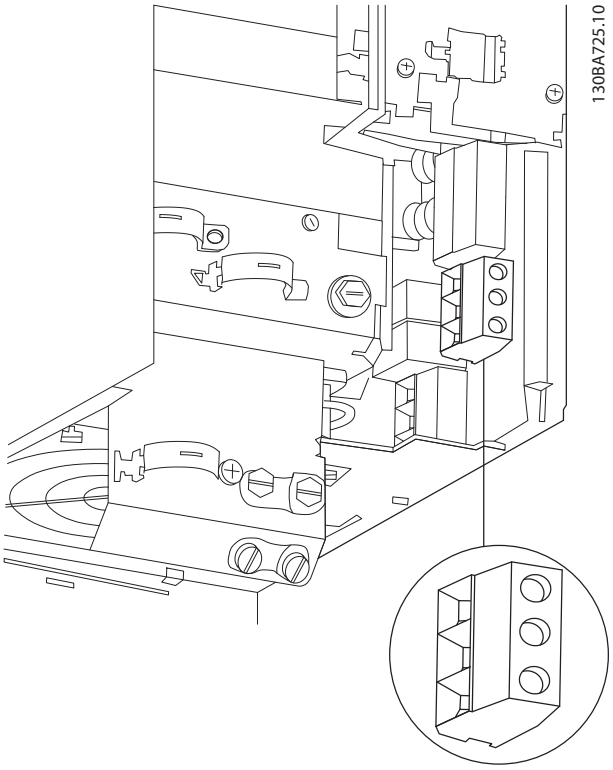

Illustration 1.12 H10 Frame
IP20 600 V 11-15 kW

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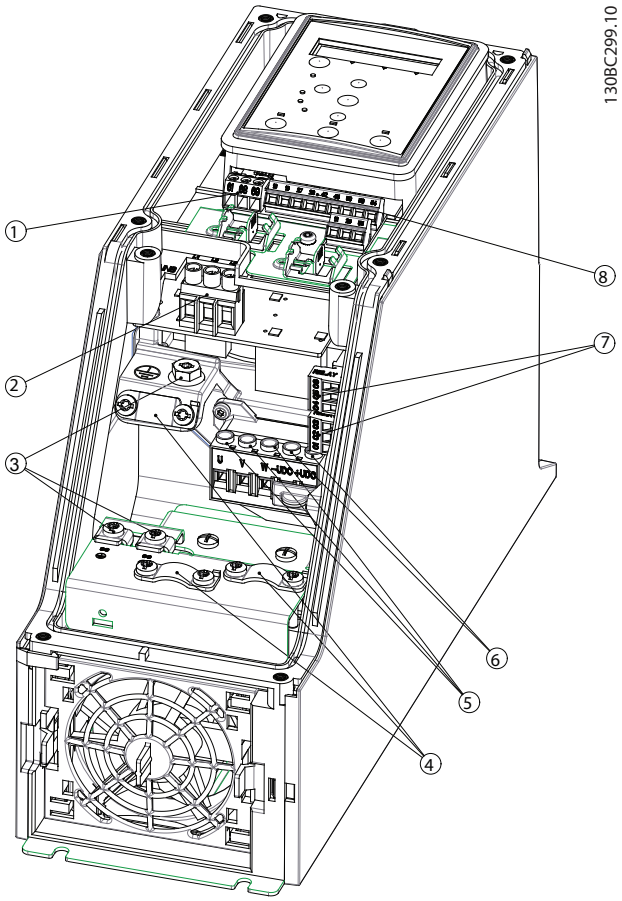

Illustration 1.13 I2 Frame
IP54 380-480 V 0.75-4.0 kW

1	RS-485
2	Line in
3	Earth
4	Wire clamps
5	Motor
6	UDC
7	Relays
8	I/O

Table 1.15 Legend to *Illustration 1.13*

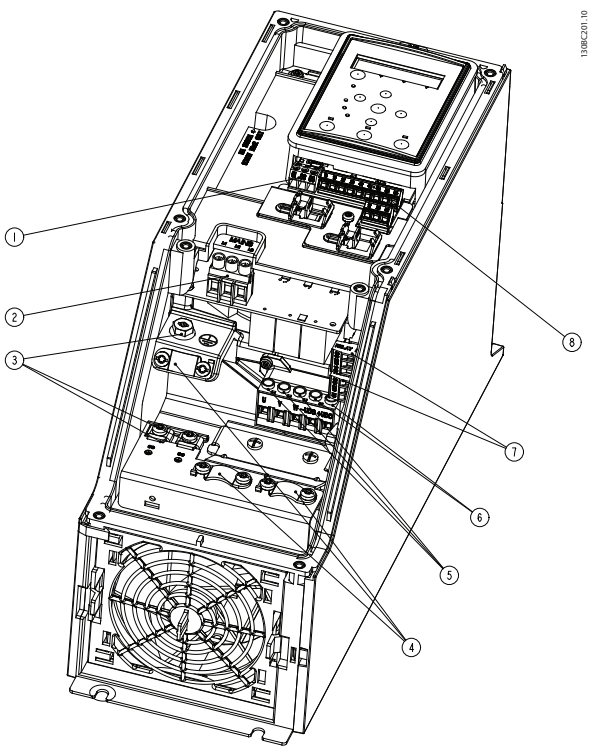

Illustration 1.14 I3 Frame
IP54 380-480 V 5.5-7.5 kW

1	RS-485
2	Line in
3	Earth
4	Wire clamps
5	Motor
6	UDC
7	Relays
8	I/O

Table 1.16 Legend to *Illustration 1.14*

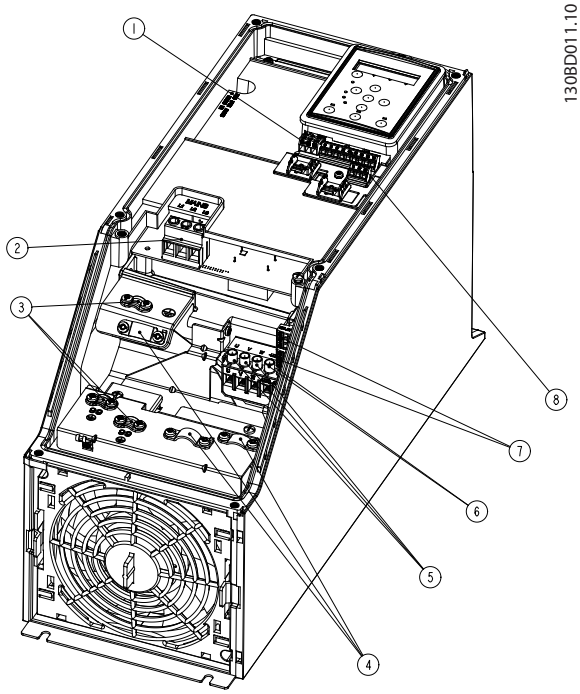

Illustration 1.15 I4 Frame
IP54 380-480 V 0.75-4.0 kW

1	RS-485
2	Line in
3	Earth
4	Wire clamps
5	Motor
6	UDC
7	Relays
8	I/O

Table 1.17 Legend to *Illustration 1.15*

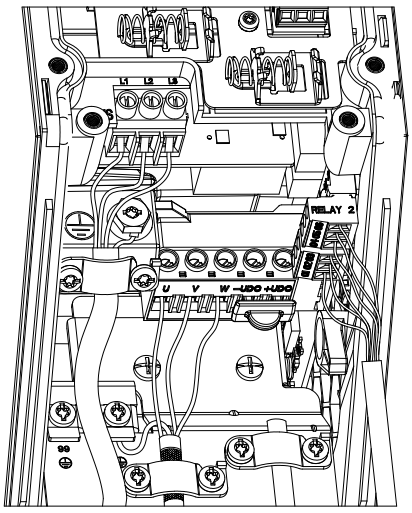

Illustration 1.16 IP54 I2-I3-I4 frame

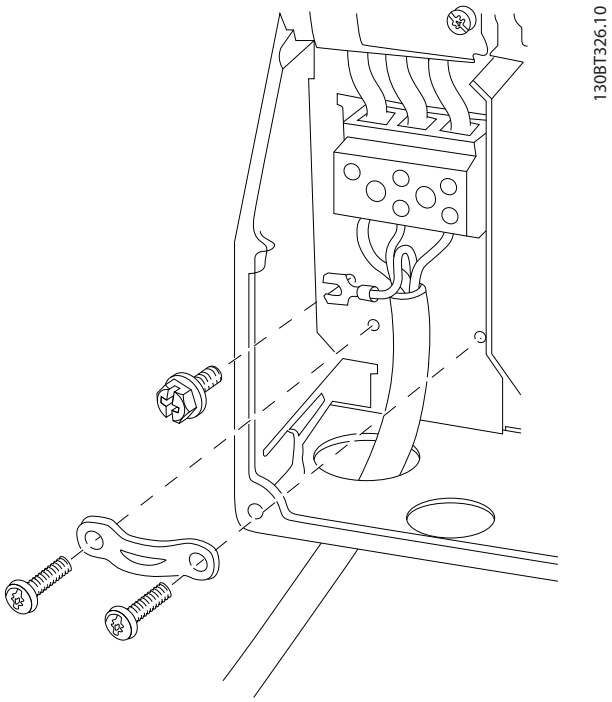

Illustration 1.17 I6 Frame
IP54 380-480 V 22-37 kW

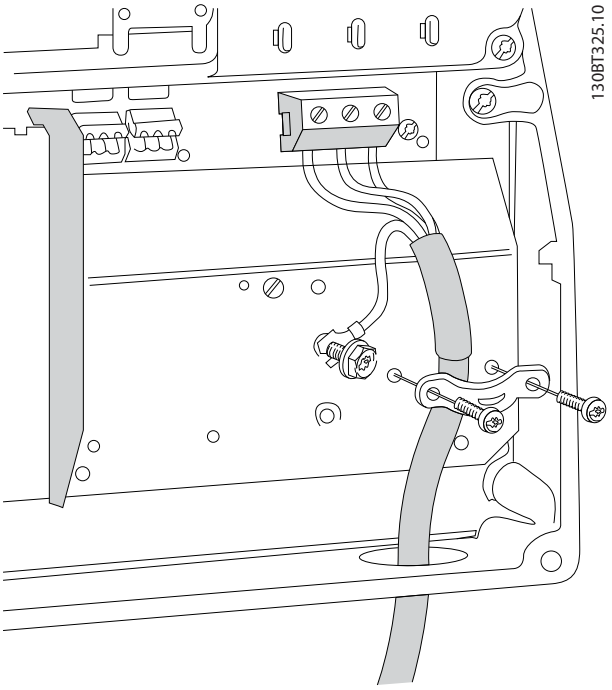

Illustration 1.18 I6 Frame
IP54 380-480 V 22-37 kW

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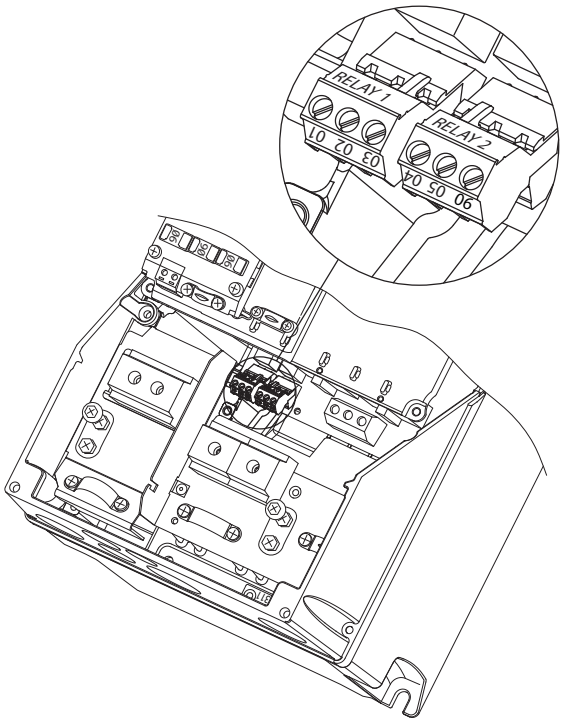

Illustration 1.19 I6 Frame
IP54 380-480 V 22-37 kW

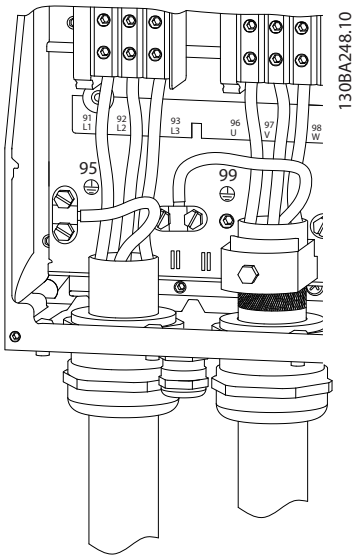

Illustration 1.20 I7, I8 Frame
IP54 380-480 V 45-55 kW
IP54 380-480 V 75-90 kW

1.3.6 Fuses and Circuit Breakers

Branch circuit protection
In order 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 1.19* and to protect service personnel or other equipment in case of an internal failure in the unit or short-circuit on DC-link. The frequency converter 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 100,000 A_{rms} (symmetrical), 480 V maximum.

UL/Non UL compliance
Use the circuit breakers or fuses listed in *Table 1.19*, 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 10,000 Arms (symmetrical), 480 V maximum.
In the event of malfunction, failure to follow the protection recommendation may result in damage to the frequency converter.

	Circuit Breaker		Fuse				
	UL	Non UL	UL				Non UL
			Bussmann	Bussmann	Bussmann	Bussmann	Max fuse
Power [kW]			Type RK5	Type RK1	Type J	Type T	Type G
3x200-240 V IP20							
0.25			FRS-R-10	KTN-R10	JKS-10	JJN-10	10
0.37			FRS-R-10	KTN-R10	JKS-10	JJN-10	10
0.75			FRS-R-10	KTN-R10	JKS-10	JJN-10	10
1.5			FRS-R-10	KTN-R10	JKS-10	JJN-10	10
2.2			FRS-R-15	KTN-R15	JKS-15	JJN-15	16
3.7			FRS-R-25	KTN-R25	JKS-25	JJN-25	25
5.5			FRS-R-50	KTN-R50	JKS-50	JJN-50	50
7.5			FRS-R-50	KTN-R50	JKS-50	JJN-50	50
11			FRS-R-80	KTN-R80	JKS-80	JJN-80	65
15	Cutler-Hammer	Moeller NZMB1-	FRS-R-100	KTN-R100	JKS-100	JJN-100	125
18.5	EGE3100FFG	A125	FRS-R-100	KTN-R100	JKS-100	JJN-100	125
22	Cutler-Hammer	Moeller NZMB1-	FRS-R-150	KTN-R150	JKS-150	JJN-150	160
30	JGE3150FFG	A160	FRS-R-150	KTN-R150	JKS-150	JJN-150	160
37	Cutler-Hammer	Moeller NZMB1-	FRS-R-200	KTN-R200	JKS-200	JJN-200	200
45	JGE3200FFG	A200	FRS-R-200	KTN-R200	JKS-200	JJN-200	200
3x380-480 V IP20							
0.37			FRS-R-10	KTS-R10	JKS-10	JJS-10	10
0.75			FRS-R-10	KTS-R10	JKS-10	JJS-10	10
1.5			FRS-R-10	KTS-R10	JKS-10	JJS-10	10
2.2			FRS-R-15	KTS-R15	JKS-15	JJS-15	16
3			FRS-R-15	KTS-R15	JKS-15	JJS-15	16
4			FRS-R-15	KTS-R15	JKS-15	JJS-15	16
5.5			FRS-R-25	KTS-R25	JKS-25	JJS-25	25
7.5			FRS-R-25	KTS-R25	JKS-25	JJS-25	25
11			FRS-R-50	KTS-R50	JKS-50	JJS-50	50
15			FRS-R-50	KTS-R50	JKS-50	JJS-50	50
18.5			FRS-R-80	KTS-R80	JKS-80	JJS-80	65
22			FRS-R-80	KTS-R80	JKS-80	JJS-80	65

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	Circuit Breaker		Fuse				
	UL	Non UL	UL				Non UL
			Bussmann	Bussmann	Bussmann	Bussmann	Max fuse
Power [kW]			Type RK5	Type RK1	Type J	Type T	Type G
30	Cutler-Hammer EGE3125FFG	Moeller NZMB1-A125	FRS-R-125	KTS-R125	JKS-R125	JJS-R125	80
37			FRS-R-125	KTS-R125	JKS-R125	JJS-R125	100
45			FRS-R-125	KTS-R125	JKS-R125	JJS-R125	125
55	Cutler-Hammer JGE3200FFG	Moeller NZMB1-A200	FRS-R-200	KTS-R200	JKS-R200	JJS-R200	150
75			FRS-R-200	KTS-R200	JKS-R200	JJS-R200	200
90	Cutler-Hammer JGE3250FFG	Moeller NZMB2-A250	FRS-R-250	KTS-R250	JKS-R250	JJS-R250	250
3x525-600 V IP20							
2.2			FRS-R-20	KTS-R20	JKS-20	JJS-20	20
3			FRS-R-20	KTS-R20	JKS-20	JJS-20	20
3.7			FRS-R-20	KTS-R20	JKS-20	JJS-20	20
5.5			FRS-R-20	KTS-R20	JKS-20	JJS-20	20
7.5			FRS-R-20	KTS-R20	JKS-20	JJS-20	30
11			FRS-R-30	KTS-R30	JKS-30	JJS-30	35
15			FRS-R-30	KTS-R30	JKS-30	JJS-30	35
18.5	Cutler-Hammer EGE3080FFG	Cutler-Hammer EGE3080FFG	FRS-R-80	KTN-R80	JKS-80	JJS-80	80
22			FRS-R-80	KTN-R80	JKS-80	JJS-80	80
30			FRS-R-80	KTN-R80	JKS-80	JJS-80	80
37	Cutler-Hammer JGE3125FFG	Cutler-Hammer JGE3125FFG	FRS-R-125	KTN-R125	JKS-125	JJS-125	125
45			FRS-R-125	KTN-R125	JKS-125	JJS-125	125
55			FRS-R-125	KTN-R125	JKS-125	JJS-125	125
75	Cutler-Hammer JGE3200FAG	Cutler-Hammer JGE3200FAG	FRS-R-200	KTN-R200	JKS-200	JJS-200	200
90			FRS-R-200	KTN-R200	JKS-200	JJS-200	200
3x380-480 V IP54							
0.75		PKZM0-16	FRS-R-10	KTS-R-10	JKS-10	JJS-10	16
1.5		PKZM0-16	FRS-R-10	KTS-R-10	JKS-10	JJS-10	16
2.2		PKZM0-16	FRS-R-15	KTS-R-15	JKS-15	JJS-15	16
3		PKZM0-16	FRS-R-15	KTS-R-15	JKS-15	JJS-15	16
4		PKZM0-16	FRS-R-15	KTS-R-15	JKS-15	JJS-15	16
5.5		PKZM0-25	FRS-R-25	KTS-R-25	JKS-25	JJS-25	25
7.5		PKZM0-25	FRS-R-25	KTS-R-25	JKS-25	JJS-25	25
11		PKZM4-63	FRS-R-50	KTS-R-50	JKS-50	JJS-50	63
15		PKZM4-63	FRS-R-50	KTS-R-50	JKS-50	JJS-50	63
18.5		PKZM4-63	FRS-R-80	KTS-R-80	JKS-80	JJS-80	63
22	Moeller NZMB1-A125		FRS-R-80	KTS-R-80	JKS-80	JJS-80	125
30			FRS-R-125	KTS-R-125	JKS-125	JJS-125	125
37			FRS-R-125	KTS-R-125	JKS-125	JJS-125	125
45	Moeller NZMB2-A160		FRS-R-125	KTS-R-125	JKS-125	JJS-125	160
55			FRS-R-200	KTS-R-200	JKS-200	JJS-200	160
75	Moeller NZMB2-A250		FRS-R-200	KTS-R-200	JKS-200	JJS-200	200
90			FRS-R-250	KTS-R-250	JKS-200	JJS-200	200

Table 1.18 Circuit Breaker and Fuses

1.3.7 EMC-Correct Electrical Installation

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

- Use only screened/armoured motor cables and screened/armoured control cables.
- Connect the screen to earth at both ends.
- Avoid installation with twisted screen ends (pigtails), since this ruins the screening effect at high frequencies. Use the cable clamps provided instead.
- Ensure the same potential between drive and ground potential of PLC.
- Use starwashers and galvanically conductive installation plates.

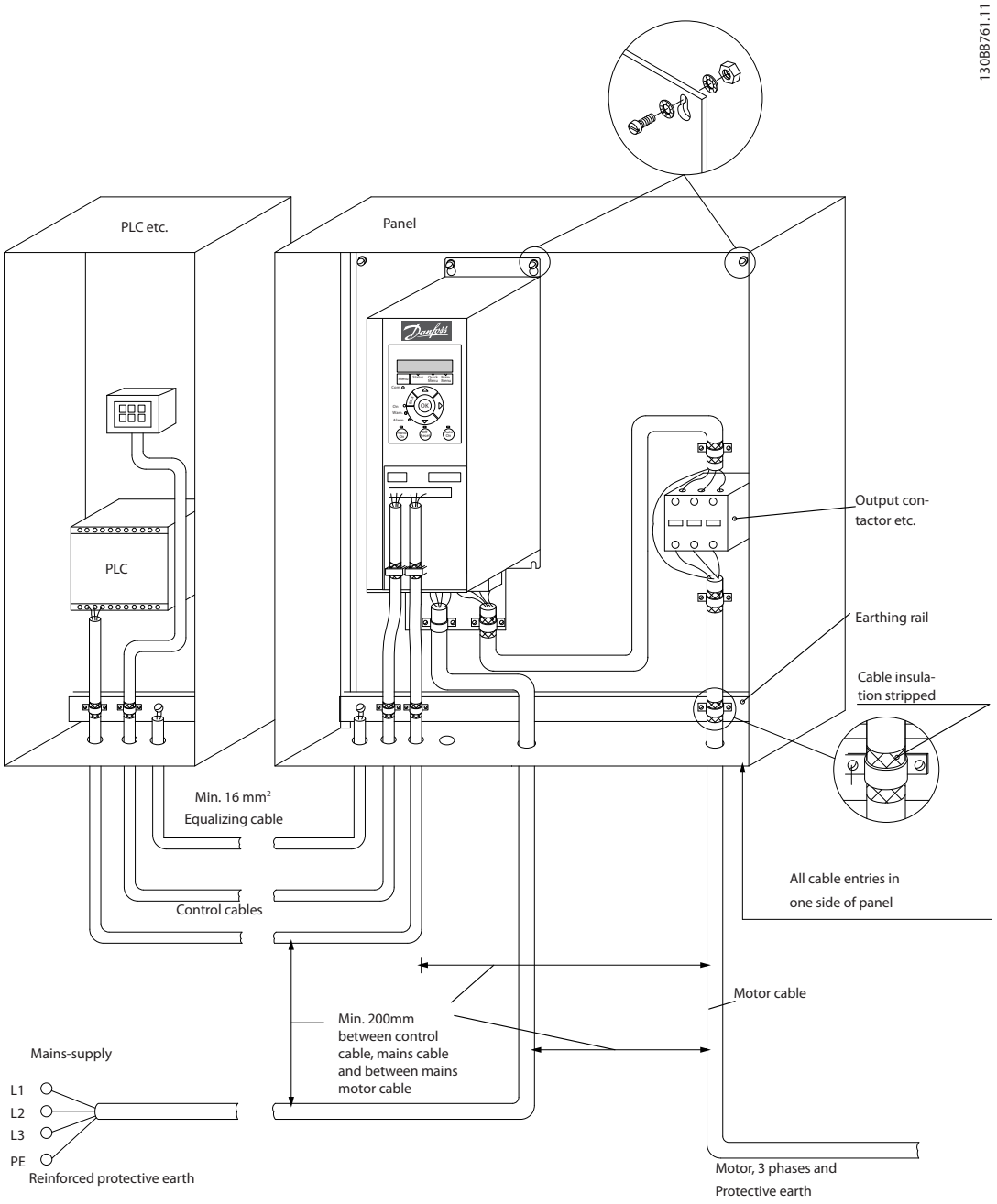

Illustration 1.21 EMC-correct Electrical Installation

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1.3.8 Control Terminals

IP20 200-240 V 0.25-11 kW and IP20 380-480 V 0.37-22 kW:

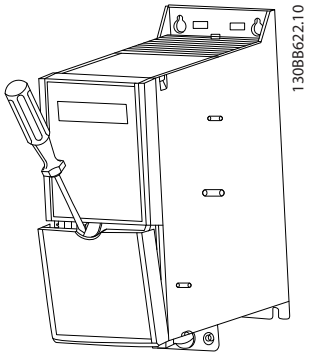

Illustration 1.22 Location of Control Terminals

1. Place a screwdriver behind the terminal cover to activate snap.
2. Tilt the screwdriver outwards to open the cover.

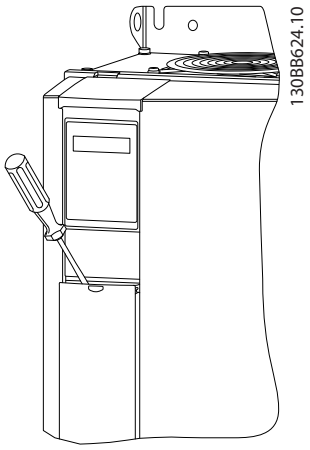

Illustration 1.23 IP20 380-480 V 30-90 kW

1. Place a screwdriver behind the terminal cover to activate snap.
2. Tilt the screwdriver outwards to open the cover.

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

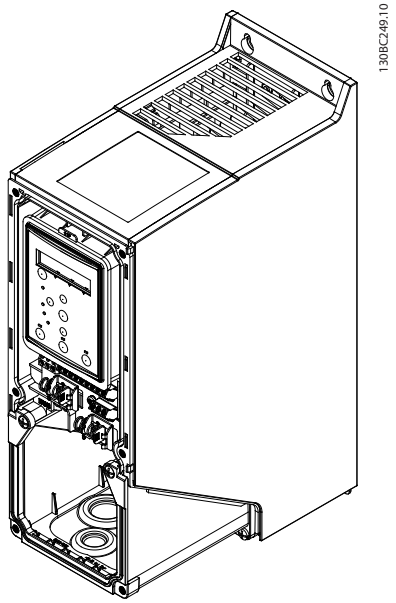

Illustration 1.24 IP54 400 V 0.75-7.5 kW

1. Remove the front cover.

Control terminals

Illustration 1.25 shows all control terminals of the frequency converter. Applying Start (term. 18), connection between terminal 12-27 and an analog reference (term. 53 or 54 and 55) make the frequency converter run.

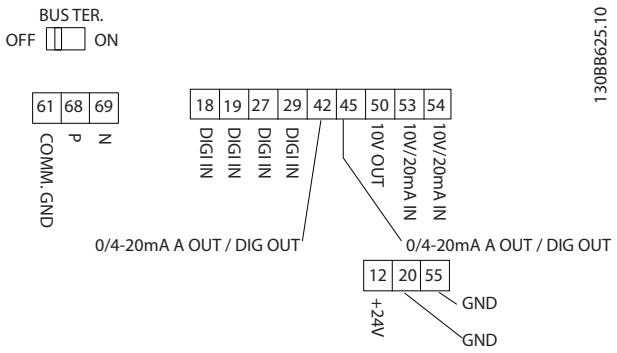

Illustration 1.25 Control Terminals

1.3.9 Electrical Overview

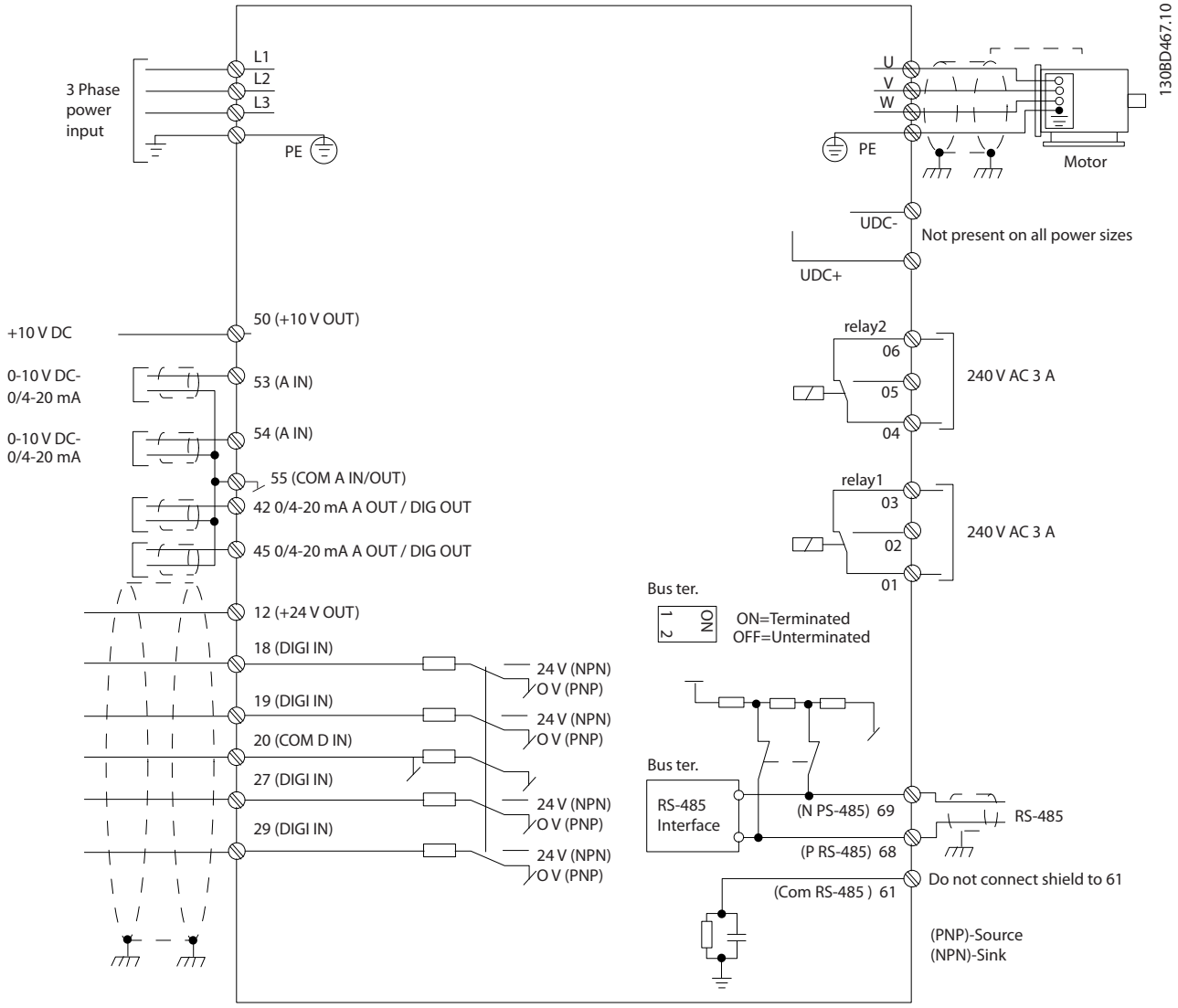

Illustration 1.26 Basic Wiring Schematic Drawing

NOTICE

There is no access to UDC- and UDC+ on the following units:
IP20 380-480 V 30-90 kW
IP20 200-240 V 15-45 kW
IP20 525-600 V 2.2-90 kW
IP54 380-480 V 22-90 kW

1

1.4 Programming

1.4.1 Programming with the Local Control Panel (LCP)

NOTICE

The frequency converter can also be programmed from a PC via RS-485 com-port by installing the MCT 10 Set-up Software. This software can either be ordered using code number 130B1000 or downloaded from the Danfoss web site: www.danfoss.com/BusinessAreas/DrivesSolutions/softwaredownload

1.4.2 Local Control Panel (LCP)

The LCP is divided into four functional sections.

A. Alphanumeric display

B. Menu key

C. Navigation keys and indicator lights (LEDs)

D. Operation keys and indicator lights (LEDs)

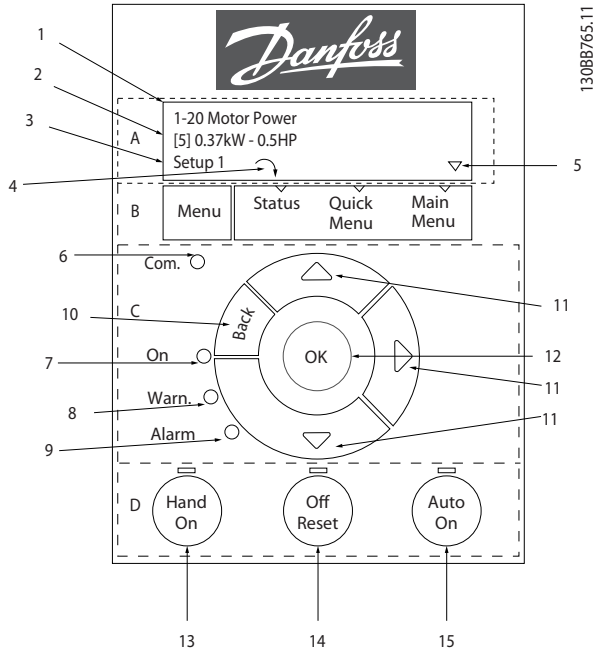

Illustration 1.27 Local Control Panel (LCP)

A. Alpha Numeric Display
The LCD-display is back-lit with 2 alpha-numeric lines. All data is displayed on the LCP.

Information 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 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 number flashing, 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 counterclockwise.
5	The triangle indicates if the LCP is in status, quick menu or main menu.

Table 1.19 Legend to *Illustration 1.27*

B. Menu key
Use the menu key to select between status, quick menu or main menu.

C. Navigation keys and indicator lights (LEDs)

6	Com LED: Flashes when bus communication is communicating.
7	Green LED/On: Control section is working.
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 maneuvering between parameter groups, parameters and within parameters. Can also be used for setting local reference.
12	[OK]: For selecting a parameter and for accepting changes to parameter settings

Table 1.20 Legend to *Illustration 1.27*

D. Operation keys and indicator lights (LEDs)

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

Table 1.21 Legend to *Illustration 1.27*

1.4.3 The Start-up Wizard for Open Loop Applications

The built-in wizard menu guides the installer through the set-up of the frequency converter in a clear and structured manner to set-up an open loop application. An open loop application is here an application with a start signal, analog reference (voltage or current) and optionally also relay signals (but no feed back signal from the process applied).

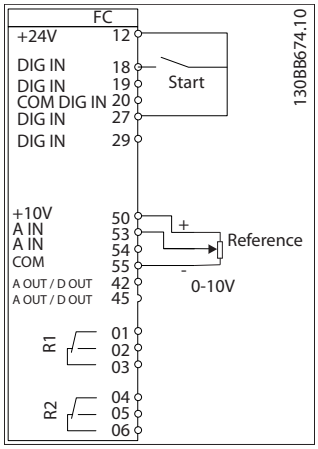

Illustration 1.28 Open Loop Application

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.

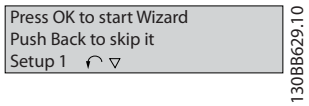

Illustration 1.29 Start-up/Quit Wizard

1

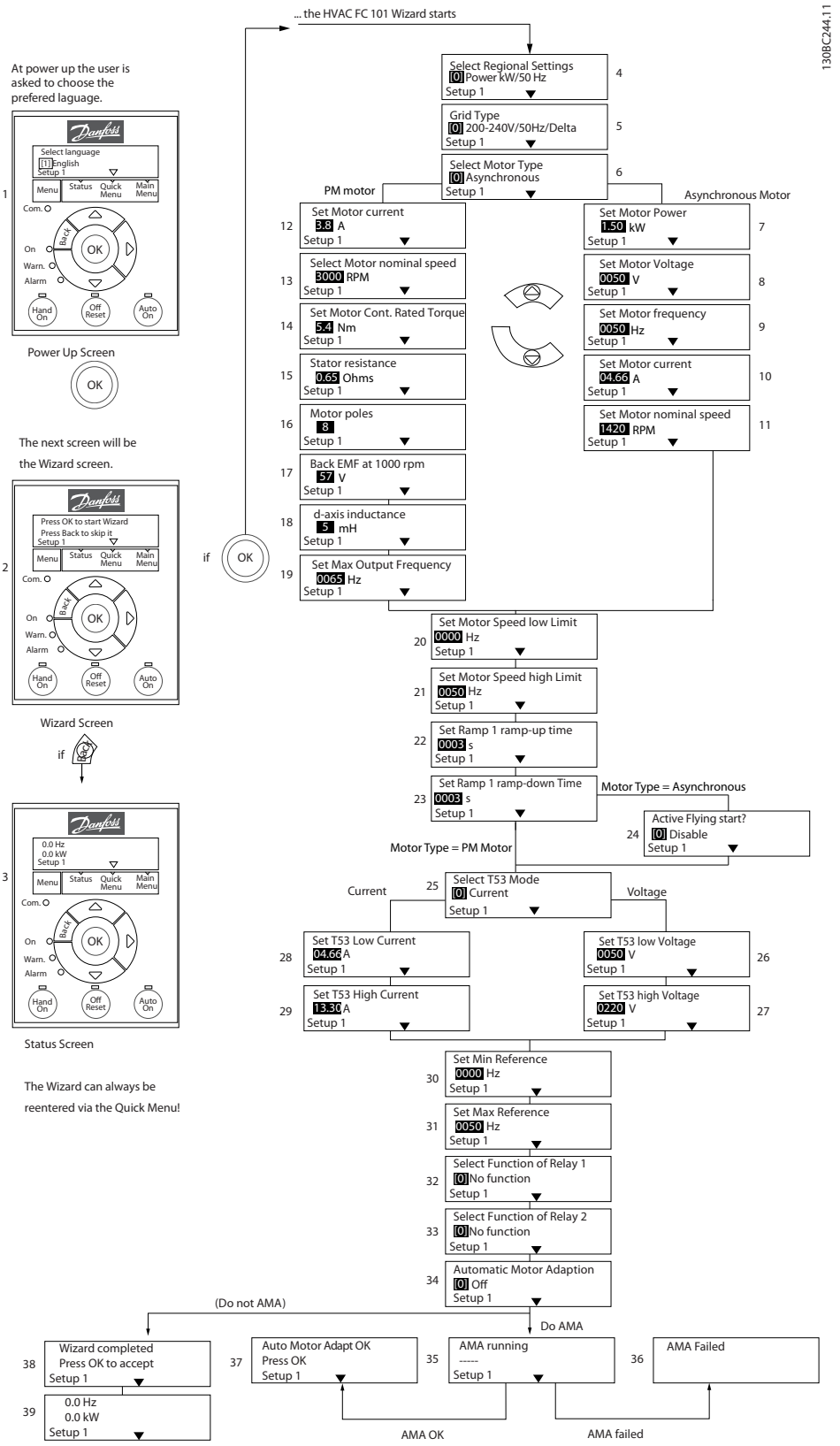

Illustration 1.30 Open Loop Applications

The Start-up Wizard for Open Loop Applications

Parameter	Option	Default	Function
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 operating mode for restart upon reconnection of the drive to mains voltage after power down
1-10 Motor Construction	*[0] Asynchron [1] PM, non salient SPM	[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) 1-39 Motor Poles 1-40 Back EMF at 1000 RPM 1-66 Min. Current at Low Speed 1-72 Start Function 1-73 Flying Start 4-19 Max Output Frequency 4-58 Missing Motor Phase Function
1-20 Motor Power	0.12-110 kW/0.16-150 hp	Size related	Enter motor power from nameplate data
1-22 Motor Voltage	50.0-1000.0 V	Size related	Enter motor voltage from nameplate data
1-23 Motor Frequency	20.0-400.0 Hz	Size related	Enter motor frequency from nameplate data

1

Parameter	Option	Default	Function
1-24 Motor Current	0.01-10000.00 A	Size related	Enter motor current from nameplate data
1-25 Motor Nominal Speed	100.0-9999.0 RPM	Size related	Enter motor nominal speed from nameplate data
1-26 Motor Cont. Rated Torque	0.1-1000.0	Size related	This parameter is available only when 1-10 Motor Construction Design is set to *[1] PM, non-salient SPM*. **NOTICE** **Changing this parameter will affect 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	Size related	Set the stator resistance value
1-37 d-axis Inductance (Ld)	0-1000	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.
1-39 Motor Poles	2-100	4	Enter the number of motor poles
1-40 Back EMF at 1000 RPM	10-9000	Size related	Line-Line RMS back EMF voltage at 1000 RPM
1-73 Flying Start			When PM is selected, Flying Start is enabled and can not disable
1-73 Flying Start	[0] Disabled [1] Enabled	0	Select *[1] Enable* to enable the drive to catch a motor spinning due to mains drop-out. Select *[0] Disable* if this function is not required. When is enabled *1-71 Start Delay* and *1-72 Start Function* have no function. is active in VVC^{plus} 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	65 Hz	Enter the maximum limit for high speed
4-19 Max Output Frequency	0-400	Size related	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	Enter the current that corresponds to the low reference value
6-13 Terminal 53 High Current	0-20 mA	20	Enter the current that corresponds to the high reference value

Parameter	Option	Default	Function
6-19 Terminal 53 mode	[0] Current [1] Voltage	1	Select if terminal 53 is used for current- or voltage input

Table 1.22 Open Loop Applications Set-up

1

Closed Loop Set-up Wizard

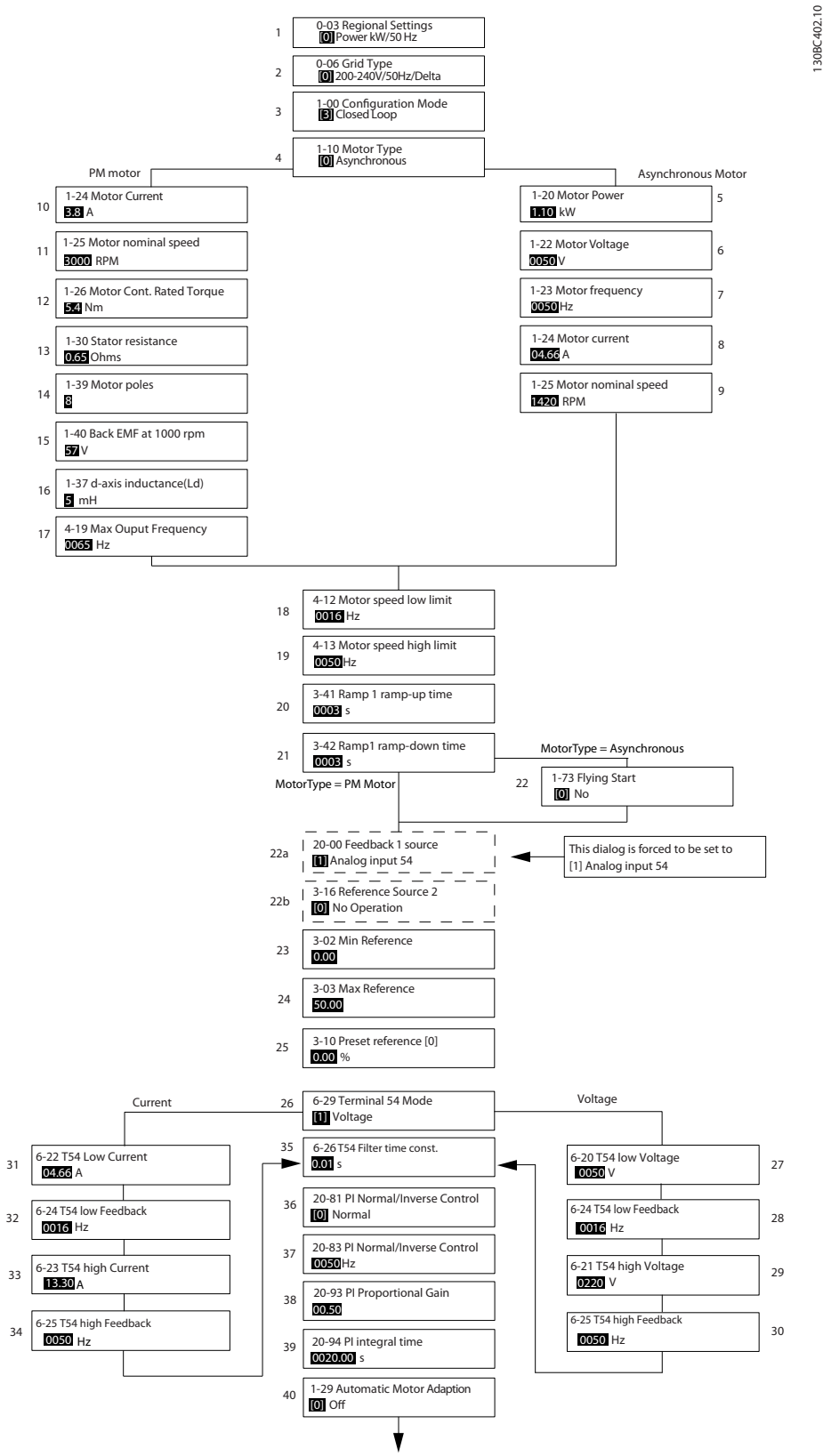

Illustration 1.31 Closed Loop

Parameter	Range	Default	Function
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 frequency converter to mains voltage after power down
1-00 Configuration Mode	[0] Open loop [3] Closed loop	0	Change this parameter to Closed loop
1-10 Motor Construction	*[0] Motor construction [1] PM, non salient SPM	[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 1-25 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) 1-39 Motor Poles 1-40 Back EMF at 1000 RPM 1-66 Min. Current at Low Speed 1-72 Start Function 1-73 Flying Start 4-19 Max Output Frequency 4-58 Missing Motor Phase Function
1-20 Motor Power	0.09-110 kW	Size related	Enter motor power from nameplate data
1-22 Motor Voltage	50.0-1000.0 V	Size related	Enter motor voltage from nameplate data
1-23 Motor Frequency	20.0-400.0 Hz	Size related	Enter motor frequency from nameplate data
1-24 Motor Current	0.0 -10000.00 A	Size related	Enter motor current from nameplate data
1-25 Motor Nominal Speed	100.0-9999.0 RPM	Size related	Enter motor nominal speed from nameplate data
1-26 Motor Cont. Rated Torque	0.1-1000.0	Size related	This parameter is available only when 1-10 Motor Construction Design is set to *[1] PM, non-salient SPM*. **NOTICE** **Changing this parameter affects settings of other parameters**
1-29 Automatic Motor Adaption (AMA)		Off	Performing an AMA optimizes motor performance
1-30 Stator Resistance (Rs)	0.000-99.990	Size related	Set the stator resistance value
1-37 d-axis Inductance (Ld)	0-1000	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.
1-39 Motor Poles	2-100	4	Enter the number of motor poles
1-40 Back EMF at 1000 RPM	10-9000	Size related	Line-Line RMS back EMF voltage at 1000 RPM

1

Parameter	Range	Default	Function
1-73 Flying Start	[0] Disabled [1] Enabled	0	Select *[1] Enable* to enable the frequency converter to catch a spinning motor. I.e. 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
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]	0.0-400 Hz	0.0 Hz	Enter the minimum limit for low speed
4-14 Motor Speed High Limit [Hz]	0-400 Hz	65 Hz	Enter the minimum limit for high speed
4-19 Max Output Frequency	0-400	Size related	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	Enter the current that corresponds to the high reference value
6-23 Terminal 54 High Current	0-20 mA	20	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 comstant
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	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 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.

Table 1.23 Closed Loop Set-up

Motor set-up

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

Parameter	Range	Default	Function
0-03 Regional Settings	[0] Interna-tional [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 drive to mains voltage after power down
1-10 Motor Construction	*[0] Motor construction [1] PM, non salient SPM	[0] Asynchron	
1-20 Motor Power	0.12-110 kW/ 0.16-150 hp	Size related	Enter motor power from nameplate data
1-22 Motor Voltage	50.0-1000.0 V	Size related	Enter motor voltage from nameplate data
1-23 Motor Frequency	20.0-400.0 Hz	Size related	Enter motor frequency from nameplate data
1-24 Motor Current	0.01-10000.00 A	Size related	Enter motor current from nameplate data
1-25 Motor Nominal Speed	100.0-9999.0 RPM	Size related	Enter motor nominal speed from nameplate data
1-26 Motor Cont. Rated Torque	0.1-1000.0	Size related	This parameter is available only when 1-10 Motor Construction Design is set to *[1] PM, non-salient SPM*. **NOTICE** **Changing this parameter affects settings of other parameters**
1-30 Stator Resistance (Rs)	0.000-99.990	Size related	Set the stator resistance value
1-37 d-axis Inductance (Ld)	0-1000	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.
1-39 Motor Poles	2-100	4	Enter the number of motor poles
1-40 Back EMF at 1000 RPM	10-9000	Size related	Line-Line RMS back EMF voltage at 1000 RPM
1-73 Flying Start	[0] Disabled [1] Enabled	0	Select Enable to enable the frequency converter 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]	0.0-400 Hz	0.0 Hz	Enter the minimum limit for low speed
4-14 Motor Speed High Limit [Hz]	0.0-400 Hz	65	Enter the maximum limit for high speed
4-19 Max Output Frequency	0-400	Size related	Enter the maximum output frequency value

Table 1.24 Motor Set-up

Changes Made

Changes Made lists all parameters changed from default settings.

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

1

To change parameter settings

1. Press [Menu] key to enter the Quick Menu until indicator in display is placed above Quick Menu.
2. Press [▲] [▼] to select wizard, closed loop setup, motor setup 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 “Main Menu”.

The Main Menu accesses all parameters.

1. Press [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.

1.4.4 Main Menu Structure

- **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 Setups
  - **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 Magnetisation at Zero Speed
    - 1-52 Min Speed Normal Magnetising [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**
    - 5-40 Function Relay
    - 5-41 On Delay, Relay
    - 5-42 Off Delay, Relay
  - **5-5* Pulse Input**
    - 5-50 Term. 29 Low Frequency
    - 5-51 Term. 29 High Frequency
    - 5-52 Term. 29 Low Ref./Feedb. Value
    - 5-53 Term. 29 High Ref./Feedb. Value
  - **5-9* Bus Controlled**
    - 5-90 Digital & Relay Bus Control
- **6-** Analog In/Out**
  - **6-0* Analog I/O Mode**
    - 6-00 Live Zero Timeout Time
    - 6-01 Live Zero Timeout Function
  - **6-1* Analog Input 53**
    - 6-10 Terminal 53 Low Voltage
    - 6-11 Terminal 53 High Voltage
    - 6-12 Terminal 53 Low Current
    - 6-13 Terminal 53 High Current
    - 6-14 Terminal 53 Low Ref./Feedb. Value
    - 6-15 Terminal 53 High Ref./Feedb. Value
    - 6-16 Terminal 53 Filter Time Constant
    - 6-19 Terminal 53 mode
  - **6-2* Analog Input 54**
    - 6-20 Terminal 54 Low Voltage
    - 6-21 Terminal 54 High Voltage
    - 6-22 Terminal 54 Low Current
    - 6-23 Terminal 54 High Current
    - 6-24 Terminal 54 Low Ref./Feedb. Value
    - 6-25 Terminal 54 High Ref./Feedb. Value
    - 6-26 Terminal 54 Filter Time Constant
    - 6-29 Terminal 54 mode
  - **6-7* Analog/Digital Output 45**
    - 6-70 Terminal 45 Mode
    - 6-71 Terminal 45 Analog Output
    - 6-72 Terminal 45 Digital Output
    - 6-73 Terminal 45 Output Min Scale
    - 6-74 Terminal 45 Output Max Scale
    - 6-76 Terminal 45 Output Bus Control
  - **6-9* Analog/Digital Output 42**
    - 6-90 Terminal 42 Mode
    - 6-91 Terminal 42 Analog Output
    - 6-92 Terminal 42 Digital Output
    - 6-93 Terminal 42 Output Min Scale
    - 6-94 Terminal 42 Output Max Scale
    - 6-96 Terminal 42 Output Bus Control
    - 6-98 Drive Type
- **8-** Comm. and Options**
  - **8-0* General Settings**
    - 8-01 Control Site
    - 8-02 Control Source
    - 8-03 Control Timeout Time
    - 8-04 Control Timeout Function
  - **8-3* FC Port Settings**
    - 8-30 Protocol
    - 8-31 Address
    - 8-32 Baud Rate
    - 8-33 Parity / Stop Bits
    - 8-35 Minimum Response Delay
    - 8-36 Maximum Response Delay
    - 8-37 Maximum Inter-char delay
  - **8-4* FC MC protocol set**
    - 8-43 PCD Read Configuration
  - **8-5* Digital/Bus**
    - 8-50 Coasting Select
    - 8-51 Quick Stop Select
    - 8-52 DC Brake Select
    - 8-53 Start Select
    - 8-54 Reversing Select
    - 8-55 Set-up Select
    - 8-56 Preset Reference Select
  - **8-7* BACnet**
    - 8-70 BACnet Device Instance
    - 8-72 MS/TP Max Masters
    - 8-73 MS/TP Max Info Frames
    - 8-74 "I am" Service
    - 8-75 Intialisation Password
  - **8-8* FC Port Diagnostics**
    - 8-80 Bus Message Count
    - 8-81 Bus Error Count
    - 8-82 Slave Messages Rcvd
    - 8-83 Slave Error Count
    - 8-84 Slave Messages Sent
    - 8-85 Slave Timeout Errors
    - 8-88 Reset FC port Diagnostics
  - **8-9* Bus Feedback**
    - 8-94 Bus Feedback 1
- **13-** Smart Logic**
  - **13-0* SLC Settings**
    - 13-00 SL Controller Mode
    - 13-01 Start Event
    - 13-02 Stop Event
    - 13-03 Reset SLC
  - **13-1* Comparators**
    - 13-10 Comparator Operand
    - 13-11 Comparator Operator
    - 13-12 Comparator Value
  - **13-2* Timers**
    - 13-20 SL Controller Timer
  - **13-4* Logic Rules**
    - 13-40 Logic Rule Boolean 1
    - 13-41 Logic Rule Operator 1
    - 13-42 Logic Rule Boolean 2
    - 13-43 Logic Rule Operator 2
    - 13-44 Logic Rule Boolean 3
  - **13-5* States**
    - 13-51 SL Controller Event
    - 13-52 SL Controller Action
- **14-** Special Functions**
  - **14-0* Inverter Switching**
    - 14-01 Switching Frequency
    - 14-03 Overmodulation
    - 14-08 Damping Gain Factor
  - **14-1* Mains On/Off**
    - 14-10 Mains Failure
    - 14-12 Function at Mains Imbalance
  - **14-2* Reset Functions**
    - 14-20 Reset Mode
    - 14-21 Automatic Restart Time
    - 14-22 Operation Mode
    - 14-23 Typecode Setting
    - 14-27 Action At Inverter Fault
    - 14-28 Production Settings
    - 14-29 Service Code
  - **14-4* Energy Optimising**
    - 14-40 VT Level
    - 14-41 AEO Minimum Magnetisation
  - **14-5* Environment**
    - 14-50 RFI Filter
    - 14-51 DC-Link Voltage Compensation
    - 14-52 Fan Control
    - 14-53 Fan Monitor
    - 14-55 Output Filter
  - **14-6* Auto Derate**
    - 14-63 Min Switch Frequency
- **15-** Drive Information**
  - **15-0* Operating Data**
    - 15-00 Operating hours
    - 15-01 Running Hours
    - 15-02 kWh Counter
    - 15-03 Power Up's
    - 15-04 Over Temp's
    - 15-05 Over Volt's
    - 15-06 Reset kWh Counter

15-07 Reset Running Hours Counter
15-3* Alarm Log
15-30 Alarm Log: Error Code
15-31 InternalFaultReason
15-4* Drive Identification
15-40 FC Type
15-41 Power Section
15-42 Voltage
15-43 Software Version
15-44 Ordered TypeCode
15-46 Drive Ordering No
15-47 Power Card Ordering No
15-48 LCP Id No
15-49 SW ID Control Card
15-50 SW ID Power Card
15-51 Drive Serial Number
15-53 Power Card Serial Number
15-9* Parameter Info
15-92 Defined Parameters
15-97 Application Type
15-98 Drive Identification
16- Data Readouts**
16-0* General Status
16-00 Control Word
16-01 Reference [Unit]
16-02 Reference [%]
16-03 Status Word
16-05 Main Actual Value [%]
16-09 Custom Readout
16-1* Motor Status
16-10 Power [kW]
16-11 Power [hp]
16-12 Motor Voltage
16-13 Frequency
16-14 Motor current
16-15 Frequency [%]
16-18 Motor Thermal
16-3* Drive Status
16-30 DC Link Voltage
16-34 Heatsink Temp.
16-35 Inverter Thermal
16-36 Inv. Nom. Current
16-37 Inv. Max. Current
16-38 SL Controller State
16-5* Ref. & Feedb.
16-50 External Reference
16-52 Feedback[Unit]
16-6* Inputs & Outputs
16-60 Digital Input
16-61 Terminal 53 Setting
16-62 Analog Input AI53
16-63 Terminal 54 Setting
16-64 Analog Input AI54
16-65 Analog Output AO42 [mA]
16-66 Digital Output
16-67 Pulse Input #29 [Hz]
16-71 Relay Output [bin]
16-72 Counter A
16-73 Counter B
16-79 Analog Output AO45
16-8* Fieldbus & FC Port
16-86 FC Port REF 1
16-9* Diagnosis Readouts
16-90 Alarm Word
16-91 Alarm Word 2
16-92 Warning Word
16-93 Warning Word 2
16-94 Ext. Status Word
16-95 Ext. Status Word 2
18- Info & Readouts**
18-1* Fire Mode Log
18-10 FireMode Log:Event
20- Drive Closed Loop**
20-0* Feedback
20-00 Feedback 1 Source
20-01 Feedback 1 Conversion
20-8* PI Basic Settings
20-81 PI Normal/ Inverse Control
20-83 PI Start Speed [Hz]
20-84 On Reference Bandwidth
20-9* PI Controller
20-91 PI Anti Windup
20-93 PI Proportional Gain
20-94 PI Integral Time
20-97 PI Feed Forward Factor
22- Appl. Functions**
22-4* Sleep Mode
22-40 Minimum Run Time
22-41 Minimum Sleep Time
22-43 Wake-Up Speed [Hz]
22-44 Wake-Up Ref./FB Diff
22-45 Setpoint Boost
22-46 Maximum Boost Time
22-47 Sleep Speed [Hz]
22-6* Broken Belt Detection
22-60 Broken Belt Function
22-61 Broken Belt Torque
22-62 Broken Belt Delay
24- Appl. Functions 2**
24-0* Fire Mode
24-00 FM Function
24-05 FM Preset Reference
24-09 FM Alarm Handling
24-1* Drive Bypass
24-10 Drive Bypass Function
24-11 Drive Bypass Delay Time
38- Debug only - see PNU 1429 (service-code) also**
38-0* All debug parameters
38-00 TestMonitorMode
38-01 Version And Stack
38-02 Protocol SW version
38-06 LCPEdit Set-up
38-07 EEPROMDdataVers
38-08 PowerDataVariantID
38-09 AMA Retry
38-10 DAC selection
38-12 DAC scale
38-20 MOC_TestUS16
38-21 MOC_TestS16
38-23 TestMocFunctions
38-24 DC Link Power Measurement
38-25 CheckSum
38-30 Analog Input 53 (%)
38-31 Analog Input 54 (%)
38-32 Input Reference 1
38-33 Input Reference 2
38-34 Input Reference Setting
38-35 Feedback (%)
38-36 Fault Code
38-37 Control Word
38-38 ResetCountersControl
38-39 Active Setup For BACnet
38-40 Name Of Analog Value 1 For BACnet
38-41 Name Of Analog Value 3 For BACnet
38-42 Name Of Analog Value 5 For BACnet
38-43 Name Of Analog Value 6 For BACnet
38-44 Name Of Binary Value 1 For BACnet
38-45 Name Of Binary Value 2 For BACnet
38-46 Name Of Binary Value 3 For BACnet
38-47 Name Of Binary Value 4 For BACnet
38-48 Name Of Binary Value 5 For BACnet
38-49 Name Of Binary Value 6 For BACnet
38-50 Name Of Binary Value 21 For BACnet
38-51 Name Of Binary Value 22 For BACnet
38-52 Name Of Binary Value 33 For BACnet
38-53 Bus Feedback 1 Conversion
38-54 Run Stop Bus Control
38-58 Inverter ETR counter
38-59 Rectifier ETR counter
38-60 DB_ErrorWarnings
38-61 Extended Alarm Word
38-69 AMA_DebugS32
38-74 AOCDebug0
38-75 AOCDebug1
38-76 AO42_FixedMode
38-77 AO42_FixedValue
38-78 DI_TestCounters
38-79 Protect Func. Counter
38-80 Highest Lowest Couple
38-81 DB_SendDebugCmd
38-82 MaxTaskRunningTime
38-83 DebugInformation
38-85 DB_OptionSelector
38-86 EEPROM_Address
38-87 EEPROM_Value
38-88 Logger Time Remain
38-90 LCP FC-Protocol select
38-91 Motor Power Internal
38-92 Motor Voltage Internal
38-93 Motor Frequency Internal
38-94 Lsigma
38-95 DB_SimulateAlarmWarningExStatus
38-96 Data Logger Password
38-97 Data Logging Period
38-98 Signal to Debug
38-99 Signed Debug Info
40- Debug only - Backup**
40-0* Debug parameters backup
40-00 TestMonitorMode_Backup

1.5 Acoustic Noise or Vibration

If the motor or the equipment driven by the motor - e.g. a fan blade - is making noise or vibrations at certain frequencies, try the following:

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

1.6 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 value set in 6-10 Terminal 53 Low Voltage, 6-12 Terminal 53 Low Current, 6-20 Terminal 54 Low Voltageor 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 supply side or too high voltage imbalance. Check supply voltage. See *14-12 Function at Mains Imbalance*
7	11	DC over volt	X	X		Intermediate circuit voltage exceeds limit.
8	10	DC under volt	X	X		Intermediate circuit voltage drops below “voltage warning low” limit.
9	9	Inverter overload	X	X		More than 100% load for too long.
10	8	Motor ETR over	X	X		Motor is too hot due to more than 100% load for too long. See *1-90 Motor Thermal Protection*
11	7	Motor th over	X	X		Thermistor or thermistor connection is disconnected. See *1-90 Motor Thermal Protection*.
13	5	Over Current	X	X	X	Inverter peak current limit is exceeded.
14	2	Earth 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 frequency converter. See parameter group *8-0* General Settings*
24	50	Fan Fault	X	X		The fan is not working (Only on 400 V 30-90 kW 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	Earth Fault		X	X	Discharge from output phases to ground, using the value of *15-31 Alarm Log Value* if possible.
47	23	Control Voltage Fault	X	X	X	24 V DC may be overloaded.
48	25	VDD1 supply low		X	X	Control voltage low. Contact the local Danfoss supplier
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 presumably wrong. Check the settings.

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Fault number	Alarm/ Warning Bit Number	Fault text	Warning	Alarm	Trip locked	Cause of problem
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 acceptable range
56		AMA user interrupt		X		The AMA has been interrupted by the user
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 frequency converter (via serial communication, digital I/O, or by pressing reset button on keypad).
66	26	Heat sink Temperature Low	X			This warning is based on the temperature sensor in the IGBT module (Only on 400 V 30-90 kW units).
69	1	Pwr. Card Temp	X	X	X	The temperature sensor on the power card is either too hot or too cold.
79		Illegal power section configu-ration	X	X		Internal fault. Contact the local Danfoss supplier.
80	29	Drive initialised		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 sparepart		X	X	The power or switch mode power supply has been exchanged. (Only on 400 V 30-90 kW units). Contact the local Danfoss supplier
251		New Typecode		X	X	The frequency converter has a new type code (Only on 400 V 30-90 kW units). Contact the local Danfoss supplier.

Table 1.25 Warnings and Alarms

1.7 General Specifications

1.7.1 Mains Supply 3x200-240 V AC

Frequency converter	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
Max. cable size in terminals (mains, 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 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
Max. 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
Max. mains fuses	See *1.3.6 Fuses and Circuit Breakers*														
Estimated power loss [W], Best case/typical[1)]	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]	2.	2.0	2.0	2.1	3.4	4.5	7.9	7.9	9.5	24.5	24.5	36.0	36.0	51.0	51.0
Efficiency [%], best case/ typical[1)]	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 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 1.26 3x200-240 V AC, PK25-P45K

1) At rated load conditions

1

1.7.2 Mains Supply 3x380-480 V AC

Frequency converter	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
Max. cable size in terminals (mains, motor) [mm²/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 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 (3x440-480 V) [A]	1.1	2.1	3.4	4.8	6.3	8.2	11.0	14.0	21.0	27.0
Intermittent (3x440-480 V) [A]	1.2	2.3	3.7	5.3	6.9	9.0	12.1	15.4	23.1	29.7
Max. 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 (3x440-480 V) [A]	1.0	1.8	2.9	3.9	5.3	6.8	9.4	12.6	18.4	24.7
Intermittent (3x440-480 V) [A]	1.1	2.0	3.2	4.3	5.8	7.5	10.3	13.9	20.2	27.2
Max. mains fuses	See *1.3.6 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]	2.0	2.0	2.1	3.3	3.3	3.4	4.3	4.5	7.9	7.9
Efficiency [%], best case/typical 1	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 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 (3x440-480 V) [A]	1.0	1.8	3.4	4.4	5.5	7.5	10.0	12.6	19.1	24.0
Intermittent (3x440-480 V) [A]	1.1	2.0	3.7	4.8	6.1	8.3	11.0	13.9	21.0	26.4

Table 1.27 3x380-480 V AC, PK37-P11K, H1-H4

Frequency converter	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
Max. cable size in terminals (mains, motor) [mm^2/AWG]	16/6	16/6	35/2	35/2	35/2	50/1	95/0	120/250MCM
Output current - 40 °C 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
Max. 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
Max. mains fuses								
Estimated power loss [W], best case/typical[1)]	412/456	475/523	733	922	1067	1133	1733	2141
Weight enclosure IP20 [kg]	9.5	9.5	24.5	24.5	24.5	36.0	36.0	51.0
Efficiency [%], best case/typical 1	98.1/97.9	98.1/97.9	97.8	97.7	98	98.2	97.8	97.9
Output current - 50 °C 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 1.28 3x380-480 V AC, P18K-P90K, H5-H8

1

Frequency converter	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
Max. cable size in terminals (mains, motor) [mm²/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 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
Max. 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
Max. mains fuses	See *1.3.6 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]	5.3	5.3	5.3	5.3	5.3	7.2	7.2	13.8	13.8	13.8
Efficiency [%], best case/typical 1	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 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 1.29 3x380-480 V AC, PK75-P18K, I2-I4

Frequency converter	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
Max. cable size in terminals (mains, motor) [mm²/AWG]	35/2	35/2	35/2	50/1	50/1	95/(3/0)	120/(4/0)
Output current							
40 °C 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
Max. 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
Max. mains fuses							
Estimated power loss [W], best case/typical[1)]	496	734	995	840	1099	1520	1781
Weight enclosure IP54 [kg]	27	27	27	45	45	65	65
Efficiency [%], best case/Typical 1	98.0	97.8	97.6	98.3	98.2	98.1	98.3
Output current - 50 °C 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 1.30 3x380-480 V AC, P11K-P90K, I6-I8

1

1.7.3 Mains Supply 3x525-600 V AC

Frequency converter	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
Max. cable size in terminals (mains, motor) [mm²/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 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
Max. 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
Max. mains fuses	See *1.3.6 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]	6.6	6.6	6.6	6.6	6.6	11.5	11.5	24.5	24.5	24.5	36.0	36.0	36.0	51.0	51.0
Efficiency [%], best case/typical 1	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 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 1.31 3x525-600 V AC, P2K2-P90K, H6-H10

1.7.4 EMC Test Results

The following test results have been obtained using a system with a frequency converter, a screened control cable, a control box with potentiometer, as well as a motor screened cable.

RFI Filter Type	Conduct emission. Maximum shielded cable length [m]						Radiated emission			
	Industrial environment				Housing, trades and light industries		Industrial environment		Housing, trades and light industries	
	EN 55011 Class A2		EN 55011 Class A1		EN 55011 Class B		EN 55011 Class A1		EN 55011 Class B	
	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 (Class A1)										
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 (Class A2)										
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 (Class A1/B)										
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 1.32 Test Results

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1.7.5 General Specifications

Protection and features

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

Mains 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
Max. imbalance temporary between mains 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	Max. 2 times/min.
Switching on the input supply L1, L2, L3 (power-ups) enclosure frame H6-H8, I6-I8	Max. 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 100.000 RMS symmetrical Amperes, 240/480 V maximum.	

Motor output (U, V, W)	
Output voltage	0-100% of supply voltage
Output frequency	0-200 Hz (VVC^{plus}), 0-400 Hz (u/f)
Switching on output	Unlimited
Ramp times	0.05-3600 s

Cable lengths and cross sections	
Max. motor cable length, screened/armoured (EMC correct installation)	See *1.7.4 EMC Test Results*
Max. motor cable length, unscreened/unarmoured	50 m
Max. cross section to motor, mains*	
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

*See *1.7.2 Mains Supply 3x380-480 V AC* for more information

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	Approx. 4 kΩ

Digital input 29 as thermistor input	Fault: >2.9 kΩ and no fault: <800 Ω
Digital input 29 as Pulse input	Max frequency 32 kHz Push-Pull-Driven & 5 kHz (O.C.)

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	approx. 10 kΩ
Max. voltage	20 V
Current level	0/4 to 20 mA (scalable)
Input resistance, R_i	<500 Ω
Max. current	29 mA

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

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

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

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

Control card, RS-485 serial communication[A)]	
Terminal number	68 (P, TX+, RX+), 69 (N, TX-, RX-)
Terminal number	61 Common for terminals 68 and 69

Control card, 24 V DC output	
Terminal number	12
Max. load	80 mA

Relay output	
Programmable relay output	2
Relay 01 and 02	01-03 (NC), 01-02 (NO), 04-06 (NC), 04-05 (NO)
Max. terminal load (AC-1)[1)] on 01-02/04-05 (NO) (Resistive load)	250 V AC, 3 A
Max. terminal load (AC-15)[1)] on 01-02/04-05 (NO) (Inductive load @ cosφ 0.4)	250 V AC, 0.2 A
Max. terminal load (DC-1)[1)] on 01-02/04-05 (NO) (Resistive load)	30 V DC, 2 A
Max. terminal load (DC-13)[1)] on 01-02/04-05 (NO) (Inductive load)	24 V DC, 0.1 A
Max. terminal load (AC-1)[1)] on 01-03/04-06 (NC) (Resistive load)	250 V AC, 3 A
Max. terminal load (AC-15)[1)] on 01-03/04-06 (NC) (Inductive load @ cosφ 0.4)	250 V AC, 0.2 A
Max. terminal load (DC-1)[1)] on 01-03/04-06	30 V DC, 2 A
(NC) (Resistive load)	Min. 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.

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Control card, 10 V DC output[A)]	
Terminal number	50
Output voltage	10.5 V ±0.5 V
Max. load	25 mA

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

Surroundings	
Enclosure	IP20
Enclosure kit available	IP21, TYPE 1
Vibration test	1.0 g
Max. 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
Test method according to IEC 60068-2-43 H2S (10 days)	
Ambient temperature	See max. output current at 40/50 °C in *1.7.2 Mains Supply 3x380-480 V AC*

Derating for high ambient temperature, see .

Minimum ambient temperature during full-scale operation	0 °C
Minimum ambient temperature at reduced performance, enclosure frame H1-H5	-20 °C
Minimum ambient temperature at reduced performance, enclosure frame H6-H10	-10 °C
Temperature during storage/transport	-30 to +65/70 °C
Maximum altitude above sea level without derating	1000 m
Maximum altitude above sea level with derating	3000 m
Derating for high altitude, see	
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

1.8 Special Conditions

1.8.1 Derating for Ambient Temperature and Switching Frequency

The ambient temperature measured over 24 hours should be at least 5 °C lower than the max. ambient temperature. If the frequency converter is operated at high ambient temperature, the continuous output current should be decreased. For derating curve, see *VLT® HVAC Basic Design Guide*.

1.8.2 Derating for Low Air Pressure

The cooling capability of air is decreased at low air pressure. For altitudes above 2000 m, contact Danfoss regarding PELV. Below 1000 m altitude no de-rating is necessary, but above 1000 m the ambient temperature or the maximum output current should be decreased. Decrease the output by 1% per 100 m altitude above 1000 m or reduce the max. ambient temperature by 1° per 200 m.

1.9 Options for VLT® HVAC Basic Drive FC 101

For options, see the *VLT® HVAC Basic Drive FC 101 Design Guide*.

1.10 MCT 10 Support

MCT 10 Set-up Software information is available at: www.danfoss.com/BusinessAreas/DrivesSolutions/fc101driveupdates

www.danfoss.com/drives

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