Operating Guide

VLT® Micro Drive FC 51

Contents

1 Introduction

1.1 Purpose of this Operating Guide

This Operating Guide provides information for safe installation and commissioning of the AC drive. It is intended for use by qualified personnel.

Read and follow the instructions to use the drive safely and professionally.

Pay particular attention to the safety instructions and general warnings. Always keep this Operating Guide with the drive.

VLT® is a registered trademark for Danfoss A/S.

1.2 Additional Resources

Other resources are available to understand advanced drive functions and programming.

- The Programming Guide provides greater detail on working with parameters and many application examples.

- The Design Guide provides detailed information about capabilities and functionality to design motor control systems.

- Instructions for operation with optional equipment and replacement of components.

Supplementary publications and manuals are available at: www.danfoss.com.

1.3 Type Approvals and Certifications

CE	c(UL)us		EHC	(089)

For more information on UL 508C thermal memory retention requirements, refer to the section *Motor Thermal Protection* in the product-specific Design Guide.

1.4 IT Mains

> **N O T I C E**
>
> **IT MAINS**
>
> Installation on isolated mains source, that is IT mains. Maximum supply voltage allowed when connected to mains: 440 V.

As an option, Danfoss offers recommended line filters for improved harmonics performance. See *chapter Options and Spare Parts*.

1.5 Disposal

	Do not dispose of equipment containing electrical components together with domestic waste.
	Collect it separately in accordance with local and currently valid legislation.

1.6 CE Declaration

ENGINEERING
TOMORROW

Danfoss A/S
6430 Nordborg
Denmark
CVR nr.: 20 16 57 15

Telephone: +45 7488 2222
Fax: +45 7449 0949

EU DECLARATION OF CONFORMITY

Danfoss A/S

Danfoss Drives A/S

declares under our sole responsibility that the

Product category: Frequency Converter

Type designation(s): FC-051PXXXYY**************************

Character XXX: K18, K25, K37, K55, K75, 1K5, 2K2, 3K0, 3K7, 4K0, 5K5, 7K5, 11K, 15K, 18K, 22K.
Character YY: S2, T2, T4.
* may be any number or letter indicating drive options which do not impact this DoC.
The meaning of the 39 characters in the type code string can be found in appendix 00729776.

Covered by this declaration is in conformity with the following directive(s), standard(s) or other normative document(s), provided that the product is used in accordance with our instructions.

Low Voltage Directive 2014/35/EU
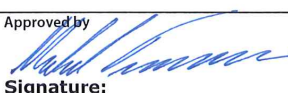
EN61800-5-1: 2007 + A1:2017   Adjustable speed electrical power drive systems – Part 5-1:
                                      Safety requirements – Electrical, thermal and energy.

EMC Directive 2014/30/EU

EN61800-3:2004 + A1:2012   Adjustable speed electrical power drive systems – Part 3: EMC
                                      requirements and specific test methods.

RoHS Directive 2011/65/EU including amendment 2015/863.

EN63000:2018   Technical documentation for the assessment of electrical and
                                      electronic products with respect to the restriction of
                                      hazardous substances

Date: 2020.09.15 Place of issue:	Issued by	Date: 2020.09.15 Place of issue:	Approved by
Graasten, DK	**Signature:** **Name: Gert Kjær** **Title: Senior Director, GDE**	Graasten, DK	**Signature:** **Name: Michael Termansen** **Title: VP, PD Center Denmark**

Danfoss only vouches for the correctness of the English version of this declaration. In the event of the declaration being translated into any other language, the translator concerned shall be liable for the correctness of the translation

ID No: 00729230
This doc. is managed by 500B0577

Revision No: A,4

Page 1 of 1

Classified as Business

2 Safety

2.1 Safety Symbols

The following symbols are used in this manual:

⚠ D A N G E R ⚠
Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ W A R N I N G ⚠
Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ C A U T I O N ⚠
Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

N O T I C E
Indicates information considered important, but not hazard-related (for example, messages relating to property damage).

2.2 Qualified Personnel

To allow trouble-free and safe operation of the unit, only qualified personnel with proven skills are allowed to transport, store, assemble, install, program, commission, maintain, and decommission this equipment.

Persons with proven skills:

- Are qualified electrical engineers, or persons who have received training from qualified electrical engineers and are suitably experienced to operate devices, systems, plant, and machinery in accordance with pertinent laws and regulations.

- Are familiar with the basic regulations concerning health and safety/accident prevention.

- Have read and understood the safety guidelines given in all manuals provided with the unit, especially the instructions given in the Operating Guide.

- Have good knowledge of the generic and specialist standards applicable to the specific application.

2.3 Safety Precautions

⚠ W A R N I N G
HIGH VOLTAGE AC drives contain high voltage when connected to AC mains input, DC supply, or load sharing. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury. –   Only qualified personnel must perform installation, start-up, and maintenance.

⚠ W A R N I N G
UNINTENDED START When the drive is connected to the AC mains, DC supply, or load sharing, the motor may start at any time, causing risk of death, serious injury, and equipment or property damage. The motor may start by activation of an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up software, or after a cleared fault condition. –   Press [Off] on the LCP before programming parameters. –   Disconnect the drive from the mains whenever personal safety considerations make it necessary to avoid unintended motor start. –   Check that the drive, motor, and any driven equipment are in operational readiness.

N O T I C E

The [Off/Reset] key is not a safety switch. It does not disconnect the drive from mains.

⚠ W A R N I N G ⚠

DISCHARGE TIME

The drive contains DC-link capacitors, which can remain charged even when the drive is not powered. High voltage can be present even when the warning indicator lights are off.

Failure to wait the specified time after power has been removed before performing service or repair work could result in death or serious injury.

- Stop the motor.

- Disconnect AC mains, permanent magnet type motors, and remote DC-link supplies, including battery back-ups, UPS, and DC-link connections to other drives.

- Wait for the capacitors to discharge fully. The minimum waiting time is specified in the table *Discharge time* and is also visible on the nameplate on top of the drive.

- Before performing any service or repair work, use an appropriate voltage measuring device to make sure that the capacitors are fully discharged.

Table 1: Discharge Time

Size	Minimum waiting time (minutes)
M1, M2, and M3	4
M4 and M5	15

Leakage current (>3.5 mA)

Follow national and local codes regarding protective earthing of equipment with a leakage current >3.5 mA. AC drive technology implies high frequency switching at high power. This generates a leakage current in the ground connection. A fault current in the drive at the output power terminals might contain a DC component, which can charge the filter capacitors and cause a transient ground current. The ground leakage current depends on various system configurations including RFI filtering, shielded motor cables, and drive power.

EN/IEC61800-5-1 (Power Drive System Product Standard) requires special care if the leakage current exceeds 3.5 mA. Reinforce Grounding in 1 of the following ways:

- Grounding wire of at least 10 mm^2 (8 AWG).

- 2 separate ground wires both complying with the dimensioning rules.

See EN 60364-5-54 § 543.7 for further information.

Using RCDs

Where residual current devices (RCDs), also known as earth leakage circuit breakers (ELCBs), are used, comply with the following:

- Use RCDs of type B that can detect AC and DC currents.

- Use RCDs with an inrush delay to prevent faults due to transient ground currents.

- Dimension RCDs according to the system configuration and environmental considerations.

Motor thermal protection

Motor overload protection is possible by setting *parameter 1-90 Motor Thermal Protection* to *[4] ETR trip*. For the North American market: Implemented ETR function provides class 20 motor overload protection, in accordance with NEC.

Installation at high altitudes

For altitudes above 2000 m (6562 ft), contact Danfoss regarding PELV.

2.4 Safety Instructions

- Make sure that the drive is properly grounded.

- Do not remove mains connections, motor connections, or other power connections while the drive is connected to power.

- Protect users against supply voltage.

- Protect the motor against overloading according to national and local regulations.

3 Installation

3.1 Before Commencing Repair Work

Procedure

1. Disconnect the drive from mains (and external DC supply, if present).
2. Wait for 4 minutes (M1, M2, and M3) and 15 minutes (M4 and M5) for discharge of the DC-link.
3. Disconnect the DC bus terminals and the brake terminals (if present).
4. Remove the motor cable.

3.2 Side-by-side Installation

The drive can be mounted side by side for IP20 rating units and requires 100 mm (3.9 in) clearance above and below for cooling. Refer to *chapter Specifications* for details on environmental ratings of the drive.

3.3 Mechanical Dimensions

A template for drilling is found on the flap of the packaging.
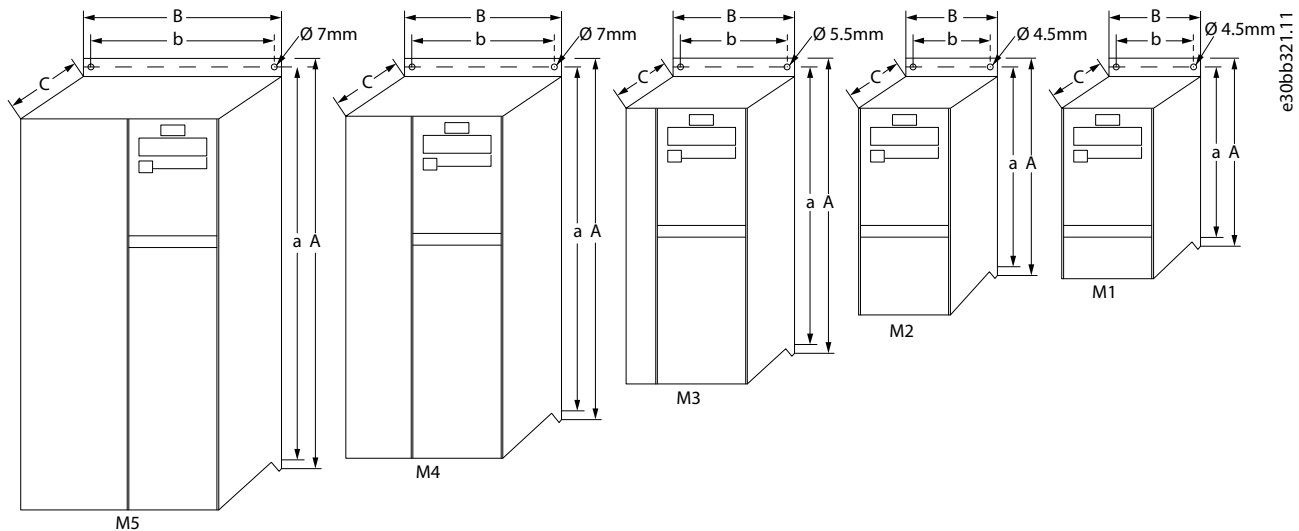
Illustration 1: Mechanical Dimensions

Table 2: Mechanical Dimensions

Enclo-sure	Power [kW (hp)]			Height [mm (in)]			Width [mm (in)]		Depth [mm (in)][(1)]	Maximum weight [kg (lb)]
	1x200–240 V	3x200–240 V	3x380–480 V	A	A (including de-coupling plate)	a	B	b	C	
M1	0.18–0.75 (0.24–1.0)	0.25–0.75 (0.34–1.0)	0.37–0.75 (0.5–1.0)	150 (5.9)	205 (8.1)	140.4 (5.5)	70 (2.8)	55 (2.2)	148 (5.8)	1.1 (2.4)
M2	1.5 (2.0)	1.5 (2.0)	1.5–2.2 (2.0–3.0)	176 (6.9)	230 (9.1)	166.4 (6.6)	75 (3.0)	59 (2.3)	168 (6.6)	1.6 (3.5)

Enclo-sure	Power [kW (hp)]			Height [mm (in)]			Width [mm (in)]		Depth [mm (in)][1]	Maximum weight [kg (lb)]
	1x200–240 V	3x200–240 V	3x380–480 V	A	A (includ-ing de-coupling plate)	a	B	b	C	
M3	2.2 (3.0)	2.2–3.7 (3.0–5.0)	3.0–7.5 (4.0–10)	239 (9.4)	294 (11.6)	226 (8.9)	90 (3.5)	69 (2.7)	194 (7.6)	3.0 (6.6)
M4	–	–	11.0–15.0 (15–20)	292 (11.5)	347.5 (13.7)	272.4 (10.7)	125 (4.9)	97 (3.8)	241 (9.5)	6.0 (13.2)
M5	–	–	18.5–22.0 (25–30)	335 (13.2)	387.5 (15.3)	315 (12.4)	165 (6.5)	140 (5.5)	248 (9.8)	9.5 (20.9)

[1] For LCP with potentiometer, add 7.6 mm (0.3 in).

3.4 Electrical Installation in General

> **N O T I C E**
>
> All cabling must comply with national and local regulations on cable cross-sections and ambient temperature. Copper conductors required, 60–75 °C (140–167 °F) recommended.

Table 3: Tightening of Terminals

Enclo-sure	Power [kW (hp)]			Torque [Nm (in-lb)]					
	1x200–240 V	3x200–240 V	3x380–480 V	Line	Motor	DC connec-tion/brake	Control terminals	Ground	Relay
M1	0.18–0.75 (0.24–1.0)	0.25–0.75 (0.34–1.0)	0.37–0.75 (0.5–1.0)	0.8 (7.1)	0.7 (6.2)	Spade[1]	0.15 (1.3)	3 (26.6)	0.5 (4.4)
M2	1.5 (2.0)	1.5 (2.0)	1.5–2.2 (2.0–3.0)	0.8 (7.1)	0.7 (6.2)	Spade[1]	0.15 (1.3)	3 (26.6)	0.5 (4.4)
M3	2.2 (3.0)	2.2–3.7 (3.0–5.0)	3.0–7.5 (4.0–10)	0.8 (7.1)	0.7 (6.2)	Spade[1]	0.15 (1.3)	3 (26.6)	0.5 (4.4)
M4	–	–	11.0–15.0 (15–20)	1.3 (11.5)	1.3 (11.5)	1.3 (11.5)	0.15 (1.3)	3 (26.6)	0.5 (4.4)
M5	–	–	18.5–22.0 (25–30)	1.3 (11.5)	1.3 (11.5)	1.3 (11.5)	0.15 (1.3)	3 (26.6)	0.5 (4.4)

[1] Spade connectors (6.3 mm (0.25 in) Faston plugs).

3.5 Fuses

3.5.1 Branch Circuit Protection

To prevent fire hazards, protect the branch circuits in an installation, switch gear, machines, and so on, against short circuits and overcurrent. Follow national and local regulations.

3.5.2 Short-circuit Protection

Use the Danfoss recommended fuses to protect service personnel or other equipment if there is an internal failure in the unit or short circuit on DC-link. If there is a short circuit on the motor or brake output, the drive provides full short-circuit protection.

3.5.3 Overcurrent Protection

To avoid overheating of the cables in the installation, provide overload protection. Always carry out overcurrent protection according to national regulations. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100000 A$_{rms}$ (symmetrical), 480 V maximum.

3.5.4 Non-UL Compliance

If UL/cUL is not to be complied with, use the fuses mentioned in this chapter, which ensure compliance with EN50178/IEC61800-5-1.

If there is a malfunction, not following the fuse recommendation may result in damage to the drive and the installation.

3.5.5 Recommendation of Fuses

Table 4: Fuses

FC 51	Maximum fuses UL						Maximum fuses non–UL
	Bussmann	**Bussmann**	**Bussmann**	**Littelfuse**	**Ferraz Shawmut**	**Ferraz Shawmut**	
kW	Type RK1	Type J	Type T	Type RK1	Type CC	Type RK1	Type gG
1x200–240 V							
PK18–PK37	KTN-R15	JKS-15	JJN-15	KLN-R15	ATM-R15	A2K-15R	16A
PK75	KTN-R25	JKS-25	JJN-25	KLN-R25	ATM-R25	A2K-25R	25A
P1K5	KTN-R35	JKS-35	JJN-35	KLN-R35	–	A2K-35R	35A
P2K2	KTN-R50	JKS-50	JJN-50	KLN-R50	–	A2K-50R	50A
3x200–240 V							
PK25	KTN-R10	JKS-10	JJN-10	KLN-R10	ATM-R10	A2K-10R	10A
PK37	KTN-R15	JKS-15	JJN-15	KLN-R15	ATM-R15	A2K-15R	16A
PK75	KTN-R20	JKS-20	JJN-20	KLN-R20	ATM-R20	A2K-20R	20A
P1K5	KTN-R25	JKS-25	JJN-25	KLN-R25	ATM-R25	A2K-25R	25A
P2K2	KTN-R40	JKS-40	JJN-40	KLN-R40	ATM-R40	A2K-40R	40A
P3K7	KTN-R40	JKS-40	JJN-40	KLN-R40	–	A2K-40R	40A
3x380–480 V							
PK37–PK75	KTS-R10	JKS-10	JJS-10	KLS-R10	ATM-R10	A6K-10R	10A
P1K5	KTS-R15	JKS-15	JJS-15	KLS-R15	ATM-R15	A2K-15R	16A
P2K2	KTS-R20	JKS-20	JJS-20	KLS-R20	ATM-R20	A6K-20R	20A
P3K0	KTS-R40	JKS-40	JJS-40	KLS-R40	ATM-R40	A6K-40R	40A
P4K0	KTS-R40	JKS-40	JJS-40	KLS-R40	ATM-R40	A6K-40R	40A
P5K5	KTS-R40	JKS-40	JJS-40	KLS-R40	–	A6K-40R	40A
P7K5	KTS-R40	JKS-40	JJS-40	KLS-R40	–	A6K-40R	40A
P11K	KTS-R60	JKS-60	JJS-60	KLS-R60	–	A6K-60R	63A

| FC 51	Maximum fuses UL						Maximum fuses non–UL
P15K	KTS-R60	JKS-60	JJS-60	KLS-R60	–	A6K-60R	63A
P18K	KTS-R60	JKS-60	JJS-60	KLS-R60	–	A6K-60R	80A
P22K	KTS-R60	JKS-60	JJS-60	KLS-R60	–	A6K-60R	80A

3.6 Connecting to Mains and Motor

The drive is designed to operate all standard 3-phased asynchronous motors.

The drive is designed to accept mains/ motor cables with a maximum cross-section of 4 mm^2/10 AWG (M1, M2, and M3), and a maximum cross-section of 16 mm^2/6 AWG (M4 and M5).

- 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 VLT® Micro Drive FC 51 Decoupling Mounting Plate Instructions.

- Also see the chapter EMC-correct Electrical Installation in the VLT® Micro Drive FC 51 Design Guide.

Mounting of Ground Cable, Mains, and Motor Wires
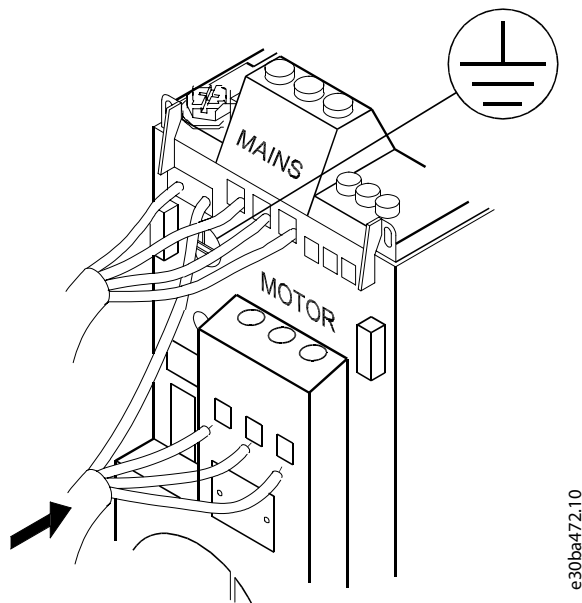
Illustration 2: Mounting of Ground Cable, Mains, and Motor Wires

- Mount the ground wires to the PE terminal.

- Connect motor to terminals U, V, and W.

- Mount mains supply to terminals L1/L, L2, and L3/N (3-phase) or L1/L and L3/N (single-phase) and tighten.

3.7 Control Terminals

All control cable terminals are located underneath the terminal cover in front of the drive. Remove the terminal cover using a screwdriver.

e30ba477.11
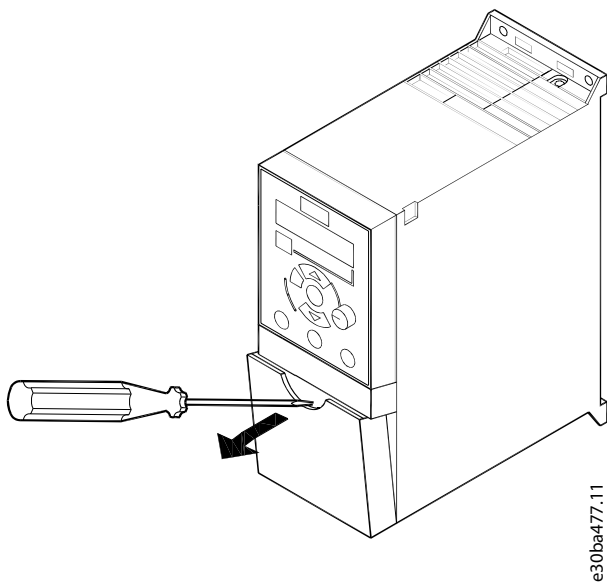
Illustration 3: Removing Terminal Cover

N O T I C E
See the back of the terminal cover for outlines of control terminals and switches.

N O T I C E
Do not operate switches with power on the drive.

N O T I C E
Set *parameter 6-19 Terminal 53 Mode* according to Switch 4 position.

Table 5: Settings for S200 Switches 1–4

Switch 1	Off=PNP terminals 29[1]
	On=NPN terminals 29
Switch 2	Off=PNP terminal 18, 19, 27, and 33[1]
	On=NPN terminal 18, 19, 27, and 33
Switch 3	No function
Switch 4	Off=Terminal 53 0–10 V[1]
	On=Terminal 53 0/4-20 mA

[1] This is the default setting.

Illustration 4: S200 Switches 1–4

The following illustration shows all control terminals of the drive. Applying start (terminal 18) and an analog reference (terminal 53 or 60) make the drive run.
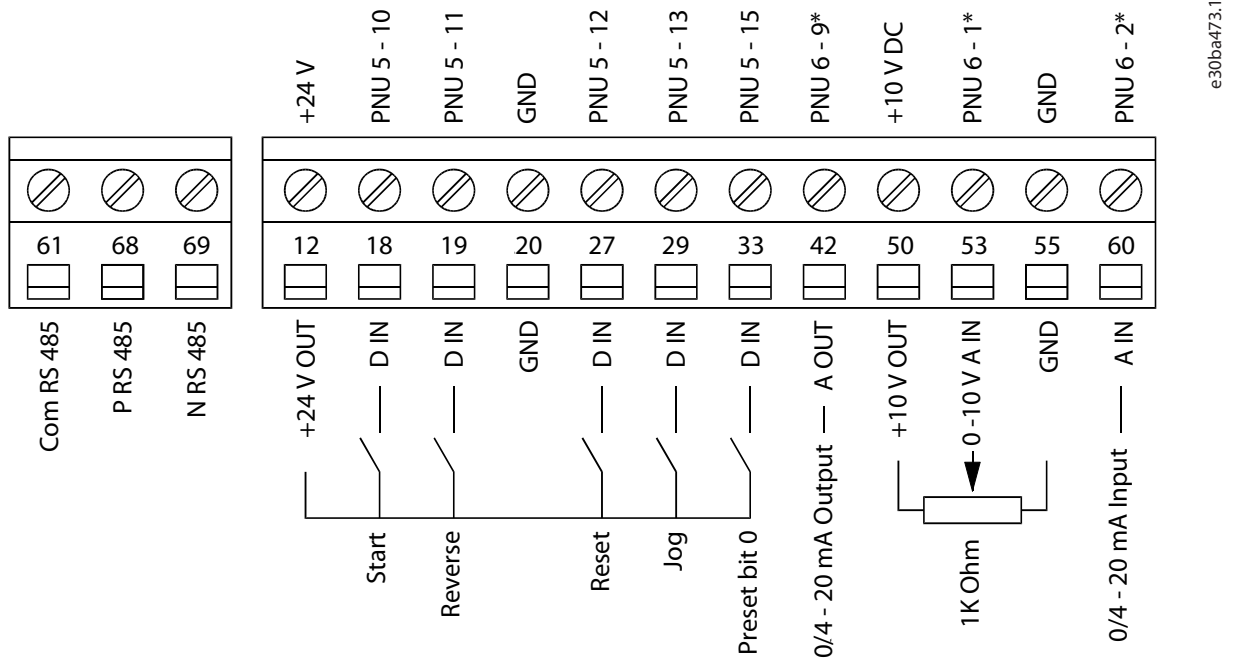
Illustration 5: Overview of Control Terminals in PNP-configuration with Factory Setting

3.8 Power Circuit
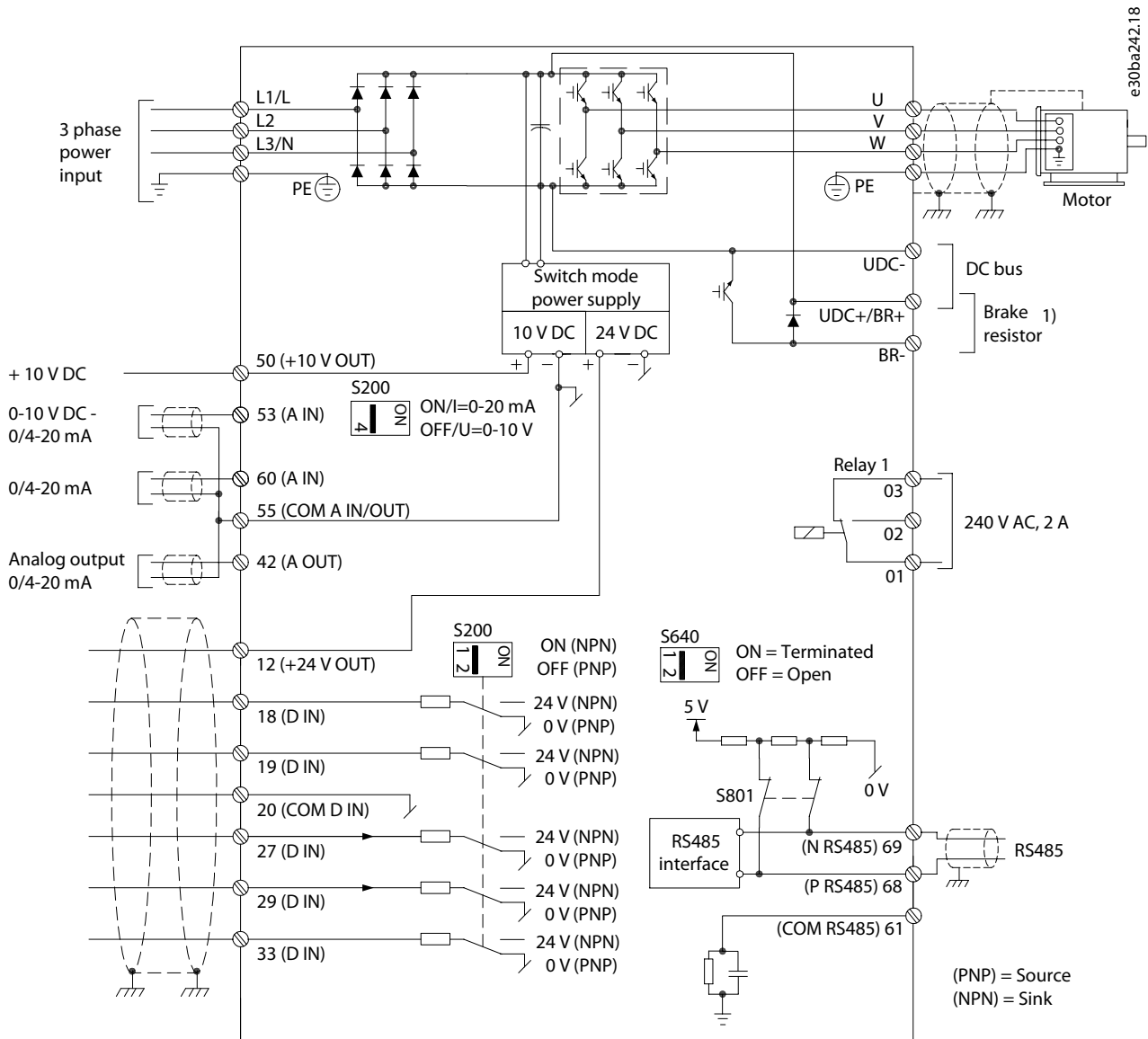
Illustration 6: Diagram Showing all Electrical Terminals

1) Brakes (BR+ and BR-) are not applicable for enclosure size M1.
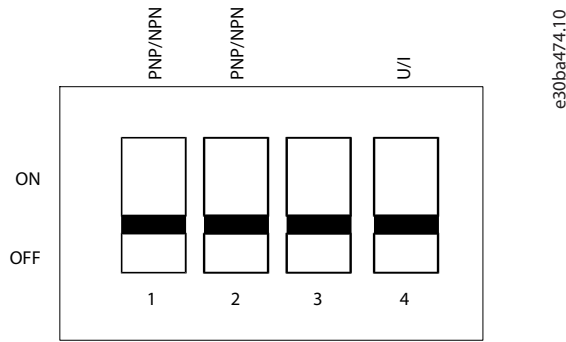
For information about brake resistors, see VLT® Brake Resistor MCE 101 Design Guide.

Improved power factor and EMC performance can be achieved by installing optional Danfoss line filters.

Danfoss power filters can also be used for load sharing. For more information about load sharing, see VLT® Micro Drive FC 51 Load Sharing application note.

3.9 Load Sharing/Brake

Use 6.3 mm (0.25 in) insulated Faston plugs designed for high voltage for DC (load sharing and brake).

Contact Danfoss or see Load sharing instruction VLT® 5000 for load sharing and VLT® 2800/5000/5000 FLUX/FCD 300 Brake for brake.

Load sharing

Connect terminals -UDC and +UDC/+BR.

Brake

Connect terminals -BR and +UDC/+BR (not applicable for enclosure size M1).

N O T I C E

Voltage levels of up to 850 V DC may occur between terminals +UDC/+BR and -UDC. Not short-circuit protected.

4 Programming

4.1 Local Control Panel (LCP)

For detailed information on programming, see VLT® Micro Drive FC 51 Programming Guide.

N O T I C E

The drive can also be programmed from a PC via RS485 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.dan-foss.com.
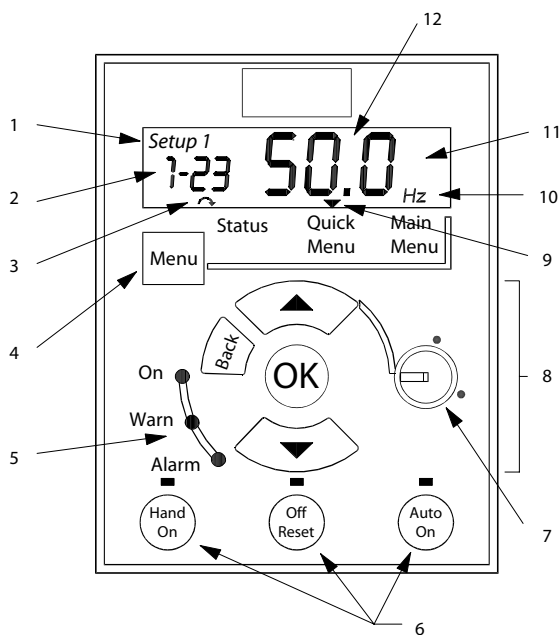
Illustration 7: Description of LCP Keys and Display

1	Set-up number		7	Potentiometer (LCP 12)
2	Parameter number		8	Navigation keys
3	Motor direction		9	Selected menu
4	Menu key		10	Unit
5	Indicator lights		11	Numeric display
6	Operation keys and LED		12	Value

Press [Menu] to select 1 of the following menus:

Status

For readouts only.

Quick Menu

For access to Quick Menus 1 and 2.

Main Menu

For access to all parameters.

Navigation keys

[**Back**]: For moving to the previous step or layer in the navigation structure.

[▲] [▼]: For manoeuvring between parameter groups, parameters, and within parameters.

[**OK**]: For selecting a parameter and for accepting changes to parameter settings.

Pressing [OK] for more than 1 s enters Adjust mode. In Adjust mode, it is possible to make fast adjustment by pressing [▲] [▼] combined with [OK].

Press [▲] [▼] to change value. Press [OK] to shift between digits quickly.

To exit Adjust mode, press [OK] more than 1 s again with changes saving or press [Back] without changes saving.

Operation keys

A yellow indicator light above the operation keys indicates the active key.

[Hand On]: Starts the motor and enables control of the drive via the LCP.

[Off/Reset]: The motor stops. If in alarm mode, the motor resets.

[Auto On]: The drive is controlled either via control terminals or serial communication.

[Potentiometer] (LCP12): The potentiometer works in 2 ways depending on the mode in which the drive is running.

In auto-on mode, the potentiometer acts as an extra programmable analog input.

In hand-on mode, the potentiometer controls local reference.

4.2 Programming on Automatic Motor Tuning (AMT)

Run AMT to optimize compatibility between the drive and the motor in VVC$^+$ mode.

- The drive builds a mathematical model of the motor for regulating output motor current thus enhancing motor performance.

- Run this procedure on a cold motor for best results. To run AMT, use the numeric LCP (NLCP). There are 2 AMT modes for drives.

N O T I C E

In mode 2, the rotor rotates during the AMT progress.

- Do not add any load on the motor in this AMT progress.

4.2.1 Mode 1

Procedure

1. Enter the main menu.
2. Go to *parameter group 1-** Load and Motor*.
3. Press [OK].
4. Set motor parameters using nameplate data for *parameter group 1-2* Motor Data*.
5. Go to *parameter 1-29 Automatic Motor Tuning (AMT)*.
6. Press [OK].
7. Select *[2] Enable AMT*.
8. Press [OK].
9. The test runs automatically and indicates when it is complete.

4.2.2 Mode 2

Procedure

1. Enter the main menu.
2. Go to *parameter group 1-** Load and Motor*.
3. Press [OK].
4. Set motor parameters using nameplate data for *parameter group 1-2* Motor Data*.
5. Go to *parameter 1-29 Automatic Motor Tuning (AMT)*.
6. Press [OK].
7. Select *[3] Complete AMT with Rotating motor*.
8. Press [OK].
9. The test runs automatically and indicates when it is complete.

5 Parameter Overview

5.1 Parameter List

Table 6: Parameter List

0-** Operation/Display	*[0] No copy	[18] 18.50 kW-25.00 hp	0.05–5.00 s *0.10 s
0-0* Basic Settings	[1] Copy from set-up 1	[19] 22.00 kW-30.00 hp	1-7* Start Adjustments
0-03 Regional Settings	[2] Copy from set-up 2	[20] 30.00 kW-40.00 hp	1-71 Start Delay
*[0] International	[9] Copy from Factory set-up	1-22 Motor Voltage	0.0–10.0 s *0.0 s
[1] US	0-6* Password	50-999 V *Motortype dep.	1-72 Start Function
0-04 Operating State at Power-up (Hand)	0-60 Main/Quick Menu Password	1-23 Motor Frequency	[0] DC hold/delay time
[0] Resume	0–999 *0	20–400 Hz *Motortype dep.	[1] DC brake/delay time
*[1] Forced stop, ref=old	0-61 Access to Main/Quick Menu w/o Password	1-24 Motor Current	*[2] Coast/delay time
[2] Forced stop, ref=0	*[0] Full access	0.01–26.00 A *Motortype dep.	1-73 Flying Start
0-1* Set-up Operations	[1] LCP:Read Only	1-25 Motor Nominal Speed	*[0] Disabled
0-10 Active Set-up	[2] LCP:No Access	100–9999 rpm *Motortype dep.	[1] Enabled
*[1] Set-up 1	1-** Load and Motor	1-29 Automatic Motor Tuning (AMT)	1-8* Stop Adjustments
[2] Set-up 2	1-0* General Settings	*[0] Off	1-80 Function at Stop
[9] Multi Set-up	1-00 Configuration Mode	[2] Enable AMT	*[0] Coast
0-11 Edit Set-up	*[0] Speed open loop	[3] Complete AMT with Rotating motor	[1] DC hold
*[1] Set-up 1	[3] Process	1-3* Adv. Motor Data	1-82 Min Speed for Function at Stop [Hz]
[2] Set-up 2	1-01 Motor Control Principle	1-30 Stator Resistance (Rs)	0.0–20.0 Hz *0.0 Hz
[9] Active Set-up	[0] U/f	[Ohm] * Dep. on motor data	1-9*Motor Temperature
0-12 Link Setups	*[1] VVC+	1-33 Stator Leakage Reactance (X1)	1-90 Motor Thermal Protection
[0] Not Linked	1-03 Torque Characteristics	[Ohm] * Dep. on motor data	*[0] No protection
*[20] Linked	*[0] Constant torque	1-35 Main Reactance (Xh)	[1] Thermistor warning
0-3* LCP Readout	[2] Auto Energy Optimization	[Ohm] * Dep. on motor data	[2] Thermistor trip
0-31 Custom Readout Min Value	1-05 Hand Mode Configuration	1-5* Load Indep. Setting	[3] ETR warning 1
0.00–9999.00 * 0.00	[0] Speed Open Loop	1-50 Motor Magnetisation at Zero Speed	[4] ETR trip 1
0-32 Custom Readout Max Value	*[2] As mode par 1-00	0–300% *100%	1-93 Thermistor Resource
0.00–9999.00 * 100.0	1-2* Motor Data	1-52 Min Speed Normal Magnetising [Hz]	*[0] None
0-4* LCP Keypad	1-20 Motor Power	0.0–10.0 Hz *0.0Hz	[1] Analog input 53
0-40 [Hand on] Key on LCP	[1] 0.09 kW-0.12 hp	1-55 U/f Characteristic - U	[6] Digital input 29
[0] Disabled	[2] 0.12 kW-0.16 hp	0-999.9 V *0 V	2-** Brakes
*[1] Enabled	[3] 0.18 kW-0.25 hp	1-56 U/f Characteristic - F	2-0* DC-Brake
0-41 [Off / Reset] Key on LCP	[4] 0.25 kW-0.33 hp	0-1000 Hz *0 Hz	2-00 DC Hold Current
[0] Disable All	[5] 0.37 kW-0.50 hp	1-6* Load Depen. Setting	0–150% *50%
*[1] Enable All	[6] 0.55 kW-0.75 hp	1-60 Low Speed Load Compensation	2-01 DC Brake Current
[2] Enable Reset Only	[7] 0.75 kW-1.00 hp	0–199% *100%	0–150% *50%
0-42 [Auto on] Key on LCP	[8] 1.10 kW-1.50 hp	1-61 High Speed Load Compensation	2-02 DC Braking Time
[0] Disabled	[9] 1.50 kW-2.00 hp	0–199% *100%	0.0–60.0 s *10.0 s
*[1] Enabled	[10] 2.20 kW-3.00 hp	1-62 Slip Compensation	2-04 DC Brake Cut In Speed
0-5* Copy/Save	[11] 3.00 kW-4.00 hp	-400–399% *100%	0.0–400.0 Hz *0.0Hz
0-50 LCP Copy	[12] 3.70 kW-5.00 hp	1-63 Slip Compensation Time Constant	2-1* Brake Energy Funct.
*[0] No copy	[13] 4.00 kW-5.40 hp		2-10 Brake Function
[1] All to LCP	[14] 5.50 kW-7.50 hp		*[0] Off
[2] All from LCP	[15] 7.50 kW-10.00 hp		[1] Resistor brake
[3] Size indep. from LCP	[16] 11.00 kW-15.00 hp		[2] AC brake
0-51 Set-up Copy	[17] 15.00 kW-20.00 hp		2-11 Brake Resistor (ohm)

Table 7: Parameter List

Min/Max/default: Powersize dep.	[21] LCP Potentiometer	4-14 Motor Speed High Limit [Hz]	[5] DC-brake inverse
2-14 Brake Voltage reduce	3-17 Reference Resource 3	0.1–400.0 Hz *65.0 Hz	[6] Stop inverse
0-100 *0	[0] No function	4-16 Torque Limit Motor Mode	*[8] Start
2-16 AC Brake, Max current	[1] Analog Input 53	0–400% *150%	[9] Latched start
0-150% *100%	[2] Analog input 60	4-17 Torque Limit Generator Mode	[10] Reversing
2-17 Overvoltage Control	[8] Pulse input 33	0–400% *100%	[11] Start reversing
*[0] Disabled	*[11] Local bus reference	4-4* Adj. Warnings 2	[12] Enable start forward
[1] Enabled (not at stop)	[21] LCP Potentiometer	4-40 Warning Freq. Low	[13] Enable start reverse
[2] Enabled	3-18 Relative Scaling Reference Resource	0.00–Value of 4-41 Hz *0.0 Hz	[14] Jog
2-2* Mechanical Brake	*[0] No function	4-41 Warning Freq. High	[16-18] Preset ref bit 0-2
2-20 Release Brake Current	[1] Analog in 53	Value of 4-40–400.0 Hz *400.00 Hz	[19] Freeze reference
0.00–100.0 A *0.00 A	[2] Analog in 60	4-5* Adj. Warnings	[20] Freeze output
2-22 Activate Brake Speed [Hz]	[8] Pulse input 33	4-50 Warning Current Low	[21] Speed up
0.0–400.0 Hz *0.0 Hz	[11] Local bus reference	0.00–100.00 A *0.00 A	[22] Speed down
3-** Reference / Ramps	[21] Lcp Potentiometer	4-51 Warning Current High	[23] Set-up select bit 0
3-0* Reference Limits	3-4* Ramp 1	0.0–100.00 A *100.00 A	[28] Catch up
3-00 Reference Range	3-40 Ramp 1 Type	4-54 Warning Reference Low	[29] Slow down
*[0] Min - Max	*[0] Linear	-4999.000–Value of 4-55 * -4999.000	[34] Ramp bit 0
[1] -Max - +Max	[2] Sine2 ramp	4-55 Warning Reference High	[60] Counter A (up)
3-02 Minimum Reference	3-41 Ramp 1 Ramp up Time	Value of 4-54–4999.000 *4999.000	[61] Counter A (down)
-4999–4999 *0.000	0.05–3600 s *3.00 s (10.00 s)[1]	4-56 Warning Feedback Low	[62] Reset counter A
3-03 Maximum Reference	3-42 Ramp 1 Ramp Down Time	-4999.000–Value of 4-57 * -4999.000	[63] Counter B (up)
-4999–4999 *50.00	0.05–3600 s *3.00s (10.00s)[1]	4-57 Warning Feedback High	[64] Counter B (down)
3-1* References	3-5* Ramp 2	Value of 4-56–4999.000 *4999.000	[65] Reset counter B
3-10 Preset Reference	3-50 Ramp 2 Type	4-58 Missing Motor Phase Function	5-11 Terminal 19 Digital Input
-100.0–100.0% *0.00%	*[0] Linear	[0] Off	See par. 5-10. * [10] Reversing
3-11 Jog Speed [Hz]	[2] Sine2 ramp	*[1] On	5-12 Terminal 27 Digital Input
0.0–400.0 Hz *5.0 Hz	3-51 Ramp 2 Ramp up Time	4-6* Speed Bypass	See par. 5-10. * [1] Reset
3-12 Catch up/slow Down Value	0.05–3600 s *3.00s (10.00s)[1]	4-61 Bypass Speed From [Hz]	5-13 Terminal 29 Digital Input
0.00–100.0% * 0.00%	3-52 Ramp 2 Ramp down Time	0.0–400.0 Hz *0.0 Hz	See par. 5-10. * [14] Jog
3-14 Preset Relative Reference	0.05–3600 s *3.00s (10.00s)[1]	4-63 Bypass Speed To [Hz]	5-15 Terminal 33 Digital Input
-100.0–100.0% *0.00%	3-8* Other Ramps	0.0–400.0 Hz *0.0 Hz	See par. 5-10. * [16] Preset ref bit 0
3-15 Reference Resource 1	3-80 Jog Ramp Time	5-** Digital In/Out	[26] Precise Stop Inverse
[0] No function	0.05–3600 s *3.00s (10.00s)[1]	5-1* Digital Inputs	[27] Start, Precise Stop inverse
*[1] Analog Input 53	3-81 Quick Stop Ramp Time	5-10 Terminal 18 Digital Input	[32] Pulse Input
[2] Analog input 60	0.05–3600 s *3.00 s (10.00s)[1]	[0] No function	5-3* Digital Outputs
[8] Pulse input 33	4-** Limits/Warnings	[1] Reset	5-34 On Delay, Terminal 42 Digital Output
[11] Local bus reference	4-1* Motor Limits	[2] Coast inverse	0.00–600.00 s * 0.01 s
[21] LCP Potentiometer	4-10 Motor Speed Direction	[3] Coast and reset inverse	5-35 Off Delay, Terminal 42 Digital Output
3-16 Reference Resource 2	[0] Clockwise	[4] Quick stop inverse	0.00–600.00 s * 0.01 s
[0] No function	[1] Counter clockwise		5-4* Relays
[1] Analog in 53	*[2] Both directions		5-40 Function Relay
*[2] Analog in 60	4-12 Motor Speed Low Limit [Hz]		*[0] No operation
[8] Pulse input 33	0.0–400.0 Hz *0.0 Hz		[1] Control ready
[11] Local bus reference			[2] Drive ready

---

[1] M4 and M5 only.

Table 8: Parameter List

[3] Drive ready/remote control

[4] Enable/no warning

[5] VLT running

[6] Running/no warning

[7] Run in range/no warning

[8] Run on ref/no warning

[9] Alarm

[10] Alarm or warning

[12] Out of current range

[13] Below current, low

[14] Above current, high

[16] Below frequency, low

[17] Above frequency, high

[19] Below feedback, low

[20] Above feedback, high

[21] Thermal warning

[22] Ready, no thermal warning

[23] Remote ready, no thermal warning

[24] Ready, Voltage OK

[25] Reverse

[26] Bus OK

[28] Brake, no brake warning

[29] Brake ready, no fault

[30] BrakeFault (IGBT)

[32] Mech brake control

[36] Control word bit 11

[41] Below reference, low

[42] Above reference, high

[51] Local ref. active

[52] Remote ref. active

[53] No alarm

[54] Start command activ

[55] Running reverse

[56] Drive in hand mode

[57] Drive in auto mode

[60-63] Comparator 0-3

[70-73] Logic rule 0-3

[81] SL digital output B

5-41 On Delay, Relay

0.00–600.00 s *0.01 s

5-42 Off Delay, Relay

0.00–600.00 s *0.01 s

5-5* Pulse Input

5-55 Terminal 33 Low Frequency

20–4999 Hz *20 Hz

5-56 Terminal 33 High Frequency

21–5000 Hz *5000 Hz

5-57 Terminal 33 Low Ref./ Feedb. Value

-4999–4999 *0.000

5-58 Terminal 33 High Ref./ Feedb. Value

-4999–4999 *50.000

6-** Analog In/Out

6-0* Analog I/O Mode

6-00 Live Zero Timeout Time

1-99 s *10 s

6-01 Live Zero TimeoutFunction

*[0] Off

[1] Freeze output

[2] Stop

[3] Jogging

[4] Max. speed

[5] Stop and trip

6-1* Analog Input 1

6-10 Terminal 53 Low Voltage

0.00–10.00 V *0.07 V

6-11 Terminal 53 High Voltage

0.01–10.00 V *10.00 V

6-12 Terminal 53 Low Current

0.00-20.00 *0.14

6-13 Terminal 53 High Current

0.01–20.00 mA *20.00 mA

6-14 Terminal 53 Low Ref./ Feedb. Value

-4999-4999 *0.000

6-15 Terminal 53 High Ref./ Feedb. Value

-4999-4999 *50.000

6-16 Terminal 53 Filter Time Constant

0.01–10.00 s *0.01 s

6-19 Terminal 53 mode

*[0] Voltage mode

[1] Current mode 4

6-2* Analog Input 2

6-21 Reserved for testing

0-1 *0

6-22 Terminal 60 Low Current

0.00–20.00 mA *0.14 mA

6-23 Terminal 60 High Current

0.00–20.00 mA *20.00 mA

6-24 Terminal 60 Low Ref./ Feedb. Value

-4999-4999 *0.000

6-25 Terminal 60 High Ref./ Feedb. Value

-4999–4999 *50.00

6-26 Terminal 60 Filter Time Constant

0.01–10.00 s *0.01 s

6-8* LCP potmeter

6-80 LCP Potmeter Enable

[0] Disabled

*[1] Enable

6-81 LCP potmeter Low Ref.

-4999–4999 *0.000

6-82 LCP potmeter High Ref.

-4999–4999 *50.00

6-9* Analog Output xx

6-90 Terminal 42 Mode

*[0] 0-20 mA

[1] 4-20 mA

[2] Digital Output

6-91 Terminal 42 Analog Output

*[0] No operation

[10] Output Frequency

[11] Reference

[12] Feedback

[13] Motor Current

[16] Power

[19] DC Link Voltage

[20] Bus Reference

6-92 Terminal 42 Digital Output

See parameter 5-40

*[0] No Operation

[80] SL Digital Output A

6-93 Terminal 42 Output Min Scale

0.00-200.0% *0.00%

6-94 Terminal 42 Output Max Scale

0.00-200.0% *100.0%

6-98 Drive Type

9-9 *9

7-** Controllers

7-2* Process Ctrl. Feedb

7-20 Process CL Feedback 1 Resource

*[0] No function

[1] Analog in 53

[2] Analog in 60

[8] Pulse input 33

[11] Local bus

7-3* Process PI Ctrl.

7-30 Process PI Normal/ Inverse Control

*[0] Normal

[1] Inverse

7-31 Process PI Anti Windup

[0] Disable

*[1] Enable

7-32 Process PI Start Speed

0.0–200.0 Hz *0.0 Hz

7-33 Process PI Proportional Gain

0.00–10.00 *0.01

7-34 Process PI Integral Time

0.10–9999.00 s *9999.00 s

7-38 Process PI Feed Forward Factor

0–400% *0%

7-39 On Reference Bandwidth

0–200% *5%

8-** Comm. and Options

8-0* Comm. General Settings

8-01 Control Site

*[0] Digital and ctrl.word

[1] Digital only

[2] Controlword only

8-02 Control Word Source

[0] None

*[1] FC RS485

8-03 Control Word Timeout Time

0.1–6500.0 s *1.0 s

8-04 Control Word Timeout Function

*[0] Off

[1] Freeze Output

[2] Stop

[3] Jogging

[4] Max. Speed

[5] Stop and trip

8-06 Reset Control Word Timeout

*[0] No Function

[1] Do reset

8-3* FC Port Settings

8-30 Protocol

*[0] FC

[2] Modbus RTU

8-31 Address

1-247 *1

8-32 FC Port Baud Rate

[0] 2400 Baud

[1] 4800 Baud

Table 9: Parameter List

*[2] 9600 Baud	[9] [1609] Custom Readout	8-8* FC Port Diagnostics	[2] Feedback
[3] 19200 Baud	[10] [1610] Power [kW]	8-80 Bus Message Count	[3] Motor speed
[4] 38400 Baud	[11] [1611] Power [hp]	0-65535 *0	[4] Motor current
8-33 FC Port Parity	[12] [1612] Motor Voltage	8-81 Bus Error Count	[6] Motor power
*[0] Even Parity, 1 Stop Bit	[13] [1613] Frequency	0-65535 *0	[7] Motor voltage
[1] Odd Parity, 1 Stop Bit	[14] [1614] Motor Current	8-82 Slave Messages Rcvd	[8] DC-link voltage
[2] No Parity, 1 Stop Bit	[15] [1615] Frequency [%]	0-65535 *0	[12] Analog in 53
[3] No Parity, 2 Stop Bits	[16] [1618] Motor Thermal	8-83 Slave Error Count	[13] Analog in 60
8-35 Minimum Response Delay	[17] [1630] DC Link Voltage	0-65535 *0	[18] Pulse input 33
0.001–0.500 *0.010 s	[18] [1634] Heatsink Temp.	8-9* Bus Jog / Feedback	[20] Alarm number
8-36 Max Response Delay	[19] [1635] Inverter Thermal	8-94 Bus feedback 1	[30] Counter A
0.100–10.000 s *5.000 s	[20] [1638] SL Controller State	-32768-32767 *0	[31] Counter B
8-4* FC MC protocol set	[21] [1650] External Reference	13-** Smart Logic	13-11 Comparator Operator
8-42 FC Port PCD Write Configuration	[22] [1651] Pulse Reference	13-0* SLC Settings	[0] Less Than
*[0] None	[23] [1652] Feedback [Unit]	13-00 SL Controller Mode	*[1] Approx. Equal
[1] [302] Minimum Reference	[24] [1660] Digital Input 18, 19, 27, 33	*[0] Off	[2] Greater Than
[2] [303] Maximum Reference	[25] [1661] Digtial Input 29	[1] On	13-12 Comparator Value
[3] [312] Catch up/Slow Down Value	[26] [1662] Analog Input 53 (V)	13-01 Start Event	-9999–9999 *0.0
[4] [341] Ramp 1 Ramp up time	[27] [1663] Analog Input 53 (mA)	[0] False	13-2* Timers
[5] [342] Ramp 1 Ramp down time	[28] [1664] Analog Input 60	[1] True	13-20 SL Controller Timer
[6] [351] Ramp 2 Ramp up time	[29] [1665] Analog Output 42 [mA]	[2] Running	0.0–3600 s *0.0 s
[7] [352] Ramp 2 Ramp down time	[30] [1668] Freq. Input 33 [Hz]	[3] In range	13-4* Logic Rules
[8] [380] Jog Ramp Time	[31] [1671] Relay Output [bin]	[4] On reference	13-40 Logic Rule Boolean 1
[9] [381] Quick Stop Time	[32] [1672] Counter A	[7] Out of current range	See par. 13-01 *[0] False
[10] [412] Motor Speed Low Limit [Hz]	[33] [1673] Counter B	[8] Below I low	[30] - [32] SL Time-out 0-2
[11] [414] Motor Speed High Limit [Hz]	[34] [1690] Alarm Word	[9] Above I high	13-41 Logic Rule Operator 1
[12] [416] Torque Limit Motor Mode	[35] [1692] Warning Word	[16] Thermal warning	*[0] Disabled
[13] [417] Torque Limit Generator Mode	[36] [1694] Ext. Status Word	[17] Mains out of range	[1] AND
[14] FC Port CTW	8-5* Digital/Bus	[18] Reversing	[2] OR
[15] FC Port REF	8-50 Coasting Select	[19] Warning	[3] AND NOT
8-43 FC Port PCD Read Configuration	[0] DigitalInput	[20] Alarm (trip)	[4] OR NOT
*[0] None	[1] Bus	[21] Alarm (triplock)	[5] NOT AND
[1] [1500] Operation Hours	[2] Logic AND	[22-25] Comparator 0-3	[6] NOT OR
[2] [1501] Running Hours	*[3] Logic OR	[26-29] Logic rule 0-3	[7] NOT AND NOT
[3] [1502] kWh Counter	8-51 Quick Stop Select	[33] Digital input 18	[8] NOT OR NOT
[4] [1600] Control Word	See par. 8-50 * [3] Logic OR	[34] Digital input 19	13-42 Logic Rule Boolean 2
[5] [1601] Reference [Unit]	8-52 DC Brake Select	[35] Digital input 27	See par. 13-40 * [0] False
[6] [1602] Reference %	See par. 8-50 *[3] Logic OR	[36] Digital input 29	13-43 Logic Rule Operator 2
[7] [1603] Status Word	8-53 Start Select	[38] Digital input 33	See par. 13-41 *[0] Disabled
[8] [1605] Main Actual Value [%]	See par. 8-50 *[3] Logic OR	*[39] Start command	13-44 Logic Rule Boolean 3
	8-54 Reversing Select	[40] Drive stopped	See par. 13-40 * [0] False
	See par. 8-50 *[3] Logic OR	13-02 Stop Event	13-5* States
	8-55 Set-up Select	See parameter 13-01	13-51 SL Controller Event
	See par. 8-50 *[3] Logic OR	* [40] Drive stopped	See par. 13-40 *[0] False
	8-56 Preset Reference Select	13-03 Reset SLC	13-52 SL Controller Action
	See parameter 8-50 * [3] Logic OR	*[0] Do not reset	*[0] Disabled
		[1] Reset SLC	[1] No action
		13-1* Comparators	[2] Select set-up 1
		13-10 Comparator Operand	[3] Select set-up 2
		*[0] Disabled	[10-17] Select preset ref 0-7
		[1] Reference	[18] Select ramp 1

Table 10: Parameter List

[19] Select ramp 2	*[0] No action	0-2000 *0	16-51 Pulse Reference
[22] Run	[1] Service reset	15-97 Application Type	-200.0-200.0% *0.0 %
[23] Run reverse	14-29 Service Code	0-0xFFFFFFFF *0	16-52 Feedback
[24] Stop	0-0x7FFFFFFF *0	15-98 Drive Identification String	-4999.000-4999.000 *0.000
[25] Qstop	14-4* Energy Optimising	16-** Data Readouts	16-6* Inputs/Outputs
[26] Dcstop	14-41 AEO Minimum Magnet-isation	16-0* General Status	16-60 Digital input 18, 19, 27, 33
[27] Coast	40–75 %*66 %	16-00 Control Word	0-0x1111 *0
[28] Freeze output	14-9* Fault Settings	0-65535 *0	16-61 Digital input 29
[29] Start timer 0	14-90 Fault level	16-01 Reference [Unit]	0-0x01 *0
[30] Start timer 1	*[3] Trip Lock	-4999.000–4999.000 *0.000	16-62 Analog Input 53 (V)
[31] Start timer 2	[4] Trip with delayed reset	16-02 Reference %	0.00-10.00 V *0.00 V
[32] Set digital output A low	15-** Drive Information	-200.0–200.0% *0.0%	16-63 Analog Input 53 (mA)
[33] Set digital output B low	15-0* Operating Data	16-03 Status Word	0.00-20.00 mA *0.00 mA
[38] Set digital output A high	15-00 Operating Time	0-65535 *0	16-64 Analog Input 60
[39] Set digital output B high	0-9999 *0	16-05 Main Actual Value [%]	0.00-20.00 mA *0.00 mA
[60] Reset Counter A	15-01 Running Hours	-200.0–200.0% *0.0%	16-65 Analog Output 42 [mA]
[61] Reset Counter B	0-60000 *0	16-09 Custom Readout	0.00-20.00 mA *0.00 mA
14-** Special Functions	15-02 kWh Counter	Dep. on par. 0-31, 0-32	16-68 Pulse Input 33
14-0* Inverter Switching	0-65535 *0	16-1* Motor Status	20-5000 Hz *20 Hz
14-01 Switching Frequency	15-03 Power Up's	16-10 Power [kW]	16-71 Relay Output [bin]
[0] 2.0 kHz	0-2147483647 *0	0.000-65.535 kW *0.000 kW	0-1 *0
*[1] 4.0 kHz	15-04 Over Temp's	16-11 Power [hp]	16-72 Counter A
[2] 8.0 kHz	0-65535 *0	0.000-65.535 Hp *0.000 Hp	-32768-32767 *0
[4] 16.0 kHz	15-05 Over Volt's	16-12 Motor Voltage	16-73 Counter B
14-03 Overmodulation	0-65535 *0	0-65535 V *0 V	-32768-32767 *0
[0] Off	15-06 Reset kWh Counter	16-13 Frequency	16-8* Fieldbus/FC Port
*[1] On	*[0] Do not reset	0.0-6553.5 Hz *0.0 Hz	16-86 FC Port REF 1
14-1* Mains monitoring	[1] Reset counter	16-14 Motor Current	-32768-32767 *0
14-12 Function at Mains Im-balance	15-07 Reset Running Hours Counter	0.00-655.35 A *0.00 A	0x8000-0x7FFFF
*[0] Trip	*[0] Do not reset	16-15 Frequency [%]	16-9* Diagnosis Readouts
[1] Warning	[1] Reset counter	0.0-6553.5% *0.0 %	16-90 Alarm Word
[2] Disabled	15-3* Fault Log	16-18 Motor Thermal	0-0xFFFFFFFFUL *0
14-2* Trip Reset	15-30 Fault Log: Error Code	0-100 % *0 %	16-92 Warning Word
14-20 Reset Mode	0-255 *0	16-3* Drive Status	0-0x7FFFFFFFUL *0
*[0] Manual reset	15-4* Drive Identification	16-30 DC Link Voltage	16-94 Ext. Status Word
[1-10] Automatic reset x (1-10)	15-40 FC Type	0-65535 V *0 V	0-0x7FFFFFFFUL *0
[11] Automatic reset x 15	15-41 Power Section	16-34 Heat sink Temp.	18-** Extended Motor Data
[12] Automatic reset x 20	15-42 Voltage	0-255 *0	18-8* Motor Resistors
[13] Infinite auto reset	15-43 Software Version	16-35 Inverter Thermal	18-80 Stator Resistance (Rs in high resolution)
[14] Reset at power-up	15-46 Frequency Converter Ordering No	0-255% *0%	0.000–99.990 ohm *0.000 ohm
14-21 Automatic Restart Time	15-48 LCP Id No	16-36 Inv.Nom. Current	18-81 Stator Leakage Reac-tance (X1 in high resolution)
0–600s * 10s	15-49 Software ID Control Card	0.00-655.35 A *0.00 A	0.000–999.900 ohm *0.000 ohm
14-22 Operation Mode	15-50 Software ID Power Card	16-37 Inv. Max. Current	
*[0] Normal Operation	15-51 Frequency Converter Serial Number	0.00-655.35 A *0.00 A	
[2] Initialisation	15-9* Parameter Info	16-38 SL Controller State	
14-26 Action At Inverter Fault	15-92 Parameter List	0-255 *0	
[0] Trip		16-5* Ref./Feedb.	
*[1] Warning		16-50 External Reference	
14-28 Production Settings		-200.0-200.0% *0.0 %	

6 Troubleshooting

6.1 Warnings and Alarms

Table 11: Warnings and Alarms

Number	Description	Warning	Alarm	Trip lock	Error	Cause of problem
2	Live zero error	X	X	–	–	Signal on terminal 53 or 54 is less than 50% of the value set in: • *Parameter 6-10 Terminal 53 Low Voltage*. • *Parameter 6-12 Terminal 53 Low Current*. • *Parameter 6-22 Terminal 54 Low Current*.
4	Mains phase loss[1]	X	X	X	–	Missing phase on the supply side or too high voltage imbalance. Check the supply voltage.
7	DC overvoltage[1]	X	X	–	–	DC-link voltage exceeds the limit.
8	DC undervoltage[1]	X	X	–	–	DC-link voltage drops below voltage warning low-limit.
9	Inverter overload	X	X	–	–	More than 100% load for a long time.
10	Motor ETR overtemperature	X	X	–	–	Motor is too hot due to more than 100% load for a long time.
11	Motor thermistor over-temperature	X	X	–	–	Thermistor or thermistor connection is disconnected.
12	Torque limit	X	–	–	–	Torque exceeds value set in either *parameter 4-16 Torque Limit Motor Mode* or *parameter 4-17 Torque Limit Generator Mode*.
13	Overcurrent	X	X	X	–	Inverter peak current limit is exceeded.
14	Ground fault	X	X	X	–	Discharge from output phases to ground.
16	Short circuit	–	X	X	–	Short circuit in motor or on motor terminals.
17	Control word timeout	X	X	–	–	No communication to drive.
25	Brake resistor short-circuited	–	X	X	–	Brake resistor is short-circuited, thus the brake function is disconnected.
27	Brake chopper short-circuited	–	X	X	–	Brake transistor is short-circuited, thus the brake function is disconnected.
28	Brake check	–	X	–	–	Brake resistor is not connected/working.
29	Power board over temp	X	X	X	–	Heat sink cutout temperature has been reached.
30	Motor phase U missing	–	X	X	–	Motor phase U is missing. Check the phase.
31	Motor phase V missing	–	X	X	–	Motor phase V is missing. Check the phase.
32	Motor phase W missing	–	X	X	–	Motor phase W is missing. Check the phase.
38	Internal fault	–	X	X	–	Contact the local Danfoss supplier.
47	Control voltage fault	–	X	X	–	24 V DC supply is overloaded.

Number	Description	Warning	Alarm	Trip lock	Error	Cause of problem
51	AMA check U_{nom} and I_{nom}	–	X	–	–	Wrong setting for motor voltage and/or motor current.
52	AMA low I_{nom}	–	X	–	–	The motor current is too low. Check the settings.
59	Current limit	X	–	–	–	The drive is overloaded.
63	Mechanical brake low	–	X	–	–	Actual motor current has not exceeded the release brake current within the start delay time window.
80	Drive initialized to default value	–	X	–	–	All parameter settings are initialized to default settings.
84	The connection between drive and LCP is lost	–	–	–	X	No communication between LCP and drive.
85	Key disabled	–	–	–	X	See *parameter group 0-4* LCP*.
86	Copy fail	–	–	–	X	An error occurred while copying from drive to LCP, or from LCP to drive.
87	LCP data invalid	–	–	–	X	Occurs when copying from LCP if the LCP contains erroneous data - or if no data was uploaded to the LCP.
88	LCP data not compatible	–	–	–	X	Occurs when copying from LCP if data are moved between drives with major differences in software versions.
89	Parameter read only	–	–	–	X	Occurs when trying to write to a read-only parameter.
90	Parameter database busy	–	–	–	X	LCP and RS485 connection are trying to update parameters simultaneously.
91	Parameter value is not valid in this mode	–	–	–	X	Occurs when trying to write an illegal value to a parameter.
92	Parameter value exceeds the minimum/maximum limits	–	–	–	X	Occurs when trying to set a value outside the range.
nw run	Not while running	–	–	–	X	Parameters can only be changed when the motor is stopped.
Err.	A wrong password was entered	–	–	–	X	Occurs when using a wrong password for changing a password-protected parameter.

¹ These faults are caused by mains distortions. Install a Danfoss line filter to rectify this problem.

7 Specifications

7.1 Mains Supply 1x200–240 V AC

Table 12: Mains Supply 1x200–240 V AC

Normal overload 150% for 1 minute					
Drive	**PK18**	**PK37**	**PK75**	**P1K5**	**P2K2**
Typical shaft output [kW]	**0.18**	**0.37**	**0.75**	**1.5**	**2.2**
Typical shaft output [hp]	0.25	0.5	1	2	3
Enclosure protection rating IP20	M1	M1	M1	M2	M3
Output current					
Continuous (3x200–240 V AC) [A]	1.2	2.2	4.2	6.8	9.6
Intermittent (3x200–240 V AC) [A]	1.8	3.3	6.3	10.2	14.4
Maximum cable size					
(Mains, motor) [mm^2/AWG]	4/10				
Maximum input current					
Continuous (1x200–240 V) [A]	3.3	6.1	11.6	18.7	26.4
Intermittent (1x200–240 V) [A]	4.5	8.3	15.6	26.4	37
Maximum mains fuses [A]	See *chapter Fuses*.				
Environment					
Estimated power loss [W], Best case/typical[1]	12.5/ 15.5	20/ 25	36.5/ 44	61/ 67	81/ 85.1
Weight enclosure IP20 [kg]	1.1	1.1	1.1	1.6	3.0
Efficiency [%], Best case/typical[2]	95.6/ 94.5	96.5/ 95.6	96.6/ 96	97/ 96.7	96.9/ 97.1

[1] Applies for dimensioning of 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 Danfoss [MyDrive® ecoSmart](#).

[2] Efficiency measured at nominal current. For energy efficiency class, see [8.12 Surroundings](#). For part load losses, see Danfoss [MyDrive® ecoSmart](#).

7.2 Mains Supply 3x200–240 V AC

Table 13: Mains Supply 3x200–240 V AC

Normal overload 150% for 1 minute						
Drive	**PK25**	**PK37**	**PK75**	**P1K5**	**P2K2**	**P3K7**
Typical shaft output [kW]	**0.25**	**0.37**	**0.75**	**1.5**	**2.2**	**3.7**
Typical shaft output [hp]	0.33	0.5	1	2	3	5
Enclosure protection rating IP20	M1	M1	M1	M2	M3	M3
Output current						

Continuous (3x200–240 V AC) [A]	1.5	2.2	4.2	6.8	9.6	15.2
Intermittent (3x200–240 V AC) [A]	2.3	3.3	6.3	10.2	14.4	22.8
Maximum cable size						
(Mains, motor) [mm^2/AWG]	4/10					
Maximum input current						
Continuous (3x200–240 V) [A]	2.4	3.5	6.7	10.9	15.4	24.3
Intermittent (3x200–240 V) [A]	3.2	4.6	8.3	14.4	23.4	35.3
Maximum mains fuses [A]	See *chapter Fuses*.					
Environment						
Estimated power loss [W], Best case/typical[1]	14/ 20	19/ 24	31.5/ 39.5	51/ 57	72/ 77.1	115/ 122.8
Weight enclosure IP20 [kg]	1.1	1.1	1.1	1.6	3.0	3.0
Efficiency [%], Best case/typical[2]	96.4/ 94.9	96.7/ 95.8	97.1/ 96.3	97.4/ 97.2	97.2/ 97.4	97.3/ 97.4

[1] Applies for dimensioning of 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 Danfoss MyDrive® ecoSmart.

[2] Efficiency measured at nominal current. For energy efficiency class, see 8.12 Surroundings. For part load losses, see Danfoss MyDrive® ecoSmart.

7.3 Mains Supply 3x380–480 V AC

Table 14: Mains Supply 3x380–480 V AC

Normal overload 150% for 1 minute						
Drive	**PK37**	**PK75**	**P1K5**	**P2K2**	**P3K0**	**P4K0**
Typical shaft output [kW]	**0.37**	**0.75**	**1.5**	**2.2**	**3.0**	**4.0**
Typical shaft output [hp]	0.5	1	2	3	4	5.5
Enclosure protection rating IP20	M1	M1	M2	M2	M3	M3
Output current						
Continuous (3x380–440 V) [A]	1.2	2.2	3.7	5.3	7.2	9.0
Intermittent (3x380–440 V) [A]	1.8	3.3	5.6	8.0	10.8	13.7
Continuous (3x440–480 V) [A]	1.1	2.1	3.4	4.8	6.3	8.2
Intermittent (3x440–480 V) [A]	1.7	3.2	5.1	7.2	9.5	12.3
Maximum cable size						
(Mains, motor) [mm^2/AWG]	4/10					
Maximum input current						
Continuous (3x380–440 V) [A]	1.9	3.5	5.9	8.5	11.5	14.4
Intermittent (3x380–440 V) [A]	2.6	4.7	8.7	12.6	16.8	20.2

Continuous (3x440–480 V) [A]	1.7	3.0	5.1	7.3	9.9	12.4
Intermittent (3x440–480 V) [A]	2.3	4.0	7.5	10.8	14.4	17.5
Maximum mains fuses [A]	See *chapter Fuses*.					
Environment						
Estimated power loss [W], Best case/typical[1]	18.5/ 25.5	28.5/ 43.5	41.5/ 56.5	57.5/ 81.5	75/ 101.6	98.5/ 133.5
Weight enclosure IP20 [kg]	1.1	1.1	1.6	1.6	3.0	3.0
Efficiency [%], Best case/typical[2]	96.8/ 95.5	97.4/ 96	98/ 97.2	97.9/ 97.1	98/ 97.2	98/ 97.3

[1] Applies for dimensioning of 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 Danfoss MyDrive® ecoSmart.

[2] Efficiency measured at nominal current. For energy efficiency class, see 8.12 Surroundings. For part load losses, see Danfoss MyDrive® ecoSmart.

Table 15: Mains Supply 3x380–480 V AC

Normal overload 150% for 1 minute						
Drive	**P5K5**	**P7K5**	**P11K**	**P15K**	**P18K**	**P22K**
Typical shaft output [kW]	**5.5**	**7.5**	**11**	**15**	**18.5**	**22**
Typical shaft output [hp]	7.5	10	15	20	25	30
Enclosure protection rating IP20	M3	M3	M4	M4	M5	M5
Output current						
Continuous (3x380–440 V) [A]	12	15.5	23	31	37	43
Intermittent (3x380–440 V) [A]	18	23.5	34.5	46.5	55.5	64.5
Continuous (3x440–480 V) [A]	11	14	21	27	34	40
Intermittent (3x440–480 V) [A]	16.5	21.3	31.5	40.5	51	60
Maximum cable size						
(Mains, motor) [mm²/AWG]	4/10		16/6			
Maximum input current						
Continuous (3x380–440 V) [A]	19.2	24.8	33	42	34.7	41.2
Intermittent (3x380–440 V) [A]	27.4	36.3	47.5	60	49	57.6
Continuous (3x440–480 V) [A]	16.6	21.4	29	36	31.5	37.5
Intermittent (3x440–480 V) [A]	23.6	30.1	41	52	44	53
Maximum mains fuses [A]	See *chapter Fuses*.					
Environment						
Estimated power loss [W],	131/	175/	290/	387/	395/	467/

Best case/typical[1]	166.8	217.5	342	454	428	520
Weight enclosure IP20 [kg]	3.0	3.0	–	–	–	–
Efficiency [%], Best case/typical[2]	98/ 97.5	98/ 97.5	97.8/ 97.4	97.7/ 97.4	98.1/ 98	98.1/ 97.9

[1] Applies for dimensioning of 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 Danfoss MyDrive® ecoSmart.

[2] Efficiency measured at nominal current. For energy efficiency class, see 8.12 Surroundings. For part load losses, see Danfoss MyDrive® ecoSmart.

8 General Technical Data

8.1 Protection and Features

- Electronic motor thermal protection against overload.

- Temperature monitoring of the heat sink ensures that the drive trips if there is overtemperature.

- The drive is protected against short circuits between motor terminals U, V, W.

- When a motor phase is missing, the drive trips and issues an alarm.

- When a mains phase is missing, the drive trips or issues a warning (depending on the load).

- Monitoring of the DC-link voltage ensures that the drive trips when the DC-link voltage is too low or too high.

- The drive is protected against ground faults on motor terminals U, V, W.

8.2 Mains Supply (L1/L, L2, L3/N)

Mains supply (L1/L, L2, L3/N)	
Supply voltage	200–240 V ±10%
Supply voltage	380–480 V ±10%
Supply frequency	50/60 Hz
Maximum imbalance temporary between mains phases	3.0% of rated supply voltage
True power factor	≥0.4 nominal at rated load
Displacement power factor (cosφ) near unity	(>0.98)
Switching on input supply L1/L, L2, L3/N (power-ups)	Maximum 2 times/minute
Environment according to EN60664-1	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.

8.3 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

8.4 Cable Length and Cross-section

Maximum motor cable length, shielded/armored (EMC-correct installation)	15 m (49 ft)
Maximum motor cable length, unshielded/unarmored	50 m (164 ft)
Maximum cross-section to motor, mains	See *chapter Specifications* for more information.
Connection to load sharing/brake (M1, M2, M3)	6.3 mm insulated Faston plugs
Maximum cross-section to load sharing/brake (M4, M5)	16 mm^2/6 AWG
Maximum cross-section to control terminals, rigid wire	1.5 mm^2/16 AWG (2x0.75 mm^2)
Maximum cross-section to control terminals, flexible cable	1 mm^2/18 AWG
Maximum cross-section to control terminals, cable with enclosed core	0.5 mm^2/20 AWG
Minimum cross-section to control terminals	0.25 mm^2/24 AWG

8.5 Digital Inputs (Pulse/encoder Inputs)

Programmable digital inputs (pulse/encoder)	5 (1)
Terminal number	18, 19, 27, 29, 33
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 4000 Ω
Maximum pulse frequency at terminal 33	5000 Hz
Minimum pulse frequency at terminal 33	20 Hz

8.6 Analog Inputs

Number of analog inputs	2
Terminal number	53, 60
Voltage mode (terminal 53)	Switch S200=OFF(U)
Current mode (terminal 53 and 60)	Switch S200=ON(I)
Voltage level	0–10 V
Input resistance, R_i	Approximately 10000 Ω
Maximum voltage	20 V
Current level	0/4–20 mA (scalable)
Input resistance, R_i	Approximately 200 Ω
Maximum current	30 mA

8.7 Analog Outputs

Number of programmable analog outputs	1
Terminal number	42
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: 0.8% of full scale
Scan interval	4 ms
Resolution on analog output	8 bit

8.8 RS485 Serial Communication

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

8.9 Control Card, 24 V DC Output

Terminal number	12
Maximum load (M1 and M2)	100 mA
Maximum load (M3)	50 mA
Maximum load (M4 and M5)	80 mA

8.10 Relay Output

Programmable relay output	1
Relay 01 terminal number	01–03 (break), 01–02 (make)
Maximum terminal load (AC-1)[1] on 01–02 (NO) (Resistive load)	250 V AC, 2 A
Maximum terminal load (AC-15)[1] on 01–02 (NO) (Inductive load @ cosφ 0.4)	250 V AC, 0.2 A

Maximum terminal load (DC-1)[1] on 01–02 (NO) (Resistive load)	30 V DC, 2 A
Maximum terminal load (DC-13)[1] on 01–02 (NO) (Inductive load)	24 V DC, 0.1 A
Maximum terminal load (AC-1)[1] on 01–03 (NC) (Resistive load)	250 V AC, 2 A
Maximum terminal load (AC-15)[1] on 01–03 (NC) (Inductive load @ cosφ 0.4)	250 V AC, 0.2 A
Maximum terminal load (DC-1)[1] on 01–03 (NC) (Resistive load)	30 V DC, 2 A
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 part 4 and 5.

8.11 Control Card, +10 V DC Output

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

N O T I C E

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

8.12 Surroundings

Enclosure protection rating	IP20
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	Class 3C3
Test method according to IEC 60068-2-43 H2S (10 days)	
Ambient temperature[1]	Maximum 40 °C (104 °F)
Minimum ambient temperature during full-scale operation	0 °C (32 °F)
Minimum ambient temperature at reduced performance	-10 °C (14 °F)
Temperature during storage/transport	-25 to +65/70 °C (-13 to +149/158 °F)
Maximum altitude above sea level without derating[1]	1000 m (3280 ft)
Maximum altitude above sea level with derating[1]	3000 m (9842 ft)
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 61000-6-1/2, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6
Energy efficiency class[2]	IE2

---

[1] Refer to *chapter Special Conditions* for:

- Derating for high ambient temperature.
- Derating for high altitude.

[2] Determined according to EN 50598-2 at:

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

---

9 Special Conditions

9.1 Derating for Ambient Temperature

The ambient temperature measured over 24 hours should be at least 5 °C (9 °F) lower than the maximum ambient temperature.

If the drive is operated at high ambient temperature, decrease the continuous output current.

The drive has been designed for operation at maximum 50 °C (122 °F) ambient temperature with 1 motor size smaller than nominal. Continuous operation at full load at 50 °C (122 °F) ambient temperature reduces the lifetime of the drive.

9.2 Derating for Low Air Pressure

The cooling capability of air is decreased at low air pressure.

> ⚠ **C A U T I O N** ⚠
>
> **INSTALLATION AT HIGH ALTITUDE**
> For altitudes above 2000 m (6560 ft), contact Danfoss regarding PELV.

Below 1000 m (3280 ft) altitude, no derating is necessary, but above 1000 m (3280 ft), decrease the ambient temperature or the maximum output current.

Decrease the output by 1% per 100 m (328 ft) altitude above 1000 m (3280 ft), or reduce the maximum ambient temperature by 1 °C (1.8 °F) per 200 m (656 ft).

9.3 Derating for Running at Low Speeds

When a motor is connected to a drive, check that the cooling of the motor is adequate.

A problem may occur at low speeds in constant torque applications. Running continuously at low speeds – less than half the nominal motor speed – may require extra air cooling. Alternatively, select a larger motor (1 size up).

10 Options and Spare Parts

10.1 List of Options and Spare Parts

Table 16: List of Options and Spare Parts

Ordering number	Description
132B0100	VLT® Control Panel LCP 11 w/o potentiometer
132B0101	VLT® Control Panel LCP 12 with potentiometer
132B0102	LCP Remote Mounting Kit , w/3 m (10 ft) cable, IP55 with LCP 11, IP21 with LCP 12
132B0103	IP20 to NEMA Type 1 conversion kit, M1
132B0104	IP20 to NEMA Type 1 conversion kit, M2
132B0105	IP20 to NEMA Type 1 conversion kit, M3
132B0106	Decoupling plate mounting kit, M1 and M2
132B0107	Decoupling plate mounting kit, M3
132B0108	IP20 to IP21/Type1 conversion kit, M1
132B0109	IP20 to IP21/Type1 conversion kit, M2
132B0110	IP20 to IP21/Type1 conversion kit, M3
132B0111	DIN rail mounting kit, M1/M2
132B0120	IP20 to Nema 1 conversion kit, M4
132B0121	IP20 to Nema 1 conversion kit, M5
132B0122	Decoupling plate mounting kit, M4, M5
132B0126	Enclosure size M1 spare parts kits
132B0127	Enclosure size M2 spare parts kits
132B0128	Enclosure size M3 spare parts kits
132B0129	Enclosure size M4 spare parts kits
132B0130	Enclosure size M5 spare parts kits
132B0131	Blank cover
130B2522	VLT® Line Filter MCC 107 for 132F0001
130B2522	VLT® Line Filter MCC 107 for 132F0002
130B2533	VLT® Line Filter MCC 107 for 132F0003
130B2525	VLT® Line Filter MCC 107 for 132F0005
130B2530	VLT® Line Filter MCC 107 for 132F0007
130B2523	VLT® Line Filter MCC 107 for 132F0008
130B2523	VLT® Line Filter MCC 107 for 132F0009
130B2523	VLT® Line Filter MCC 107 for 132F0010

Ordering number	Description
130B2526	VLT® Line Filter MCC 107 for 132F0012
130B2531	VLT® Line Filter MCC 107 for 132F0014
130B2527	VLT® Line Filter MCC 107 for 132F0016
130B2523	VLT® Line Filter MCC 107 for 132F0017
130B2523	VLT® Line Filter MCC 107 for 132F0018
130B2524	VLT® Line Filter MCC 107 for 132F0020
130B2526	VLT® Line Filter MCC 107 for 132F0022
130B2529	VLT® Line Filter MCC 107 for 132F0024
130B2531	VLT® Line Filter MCC 107 for 132F0026
130B2528	VLT® Line Filter MCC 107 for 132F0028
130B2527	VLT® Line Filter MCC 107 for 132F0030

Danfoss line filters and brake resistors are available upon request.

Index