MAKING MODERN LIVING POSSIBLE

Quick Guide

VLT® Micro Drive FC 51

VLT®
THE REAL DRIVE

1 Quick Guide

1.1 Safety

1.1.1 Warnings

	**High Voltage Warning:** The voltage of the adjustable frequency drive is dangerous whenever it is connected to AC line power. Incorrect installation of the motor or adjustable frequency drive 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:** Touching the electrical parts may be fatal - even after the equipment has been disconnected from line power. Also make sure that other voltage inputs have been disconnected (linkage of DC intermediate circuit). Be aware that there may be high voltage on the DC link even when the LEDs are turned off. Before touching any potentially live parts of the adjustable frequency drive, wait at least 4 minutes for all M1, M2 and M3 sizes. Wait at least 15 minutes for all M4 and M5 sizes.
	**Leakage Current:** The ground leakage current from the adjustable frequency drive exceeds 3.5 mA. According to IEC 61800-5-1, a reinforced protective ground connection must be ensured by means of a min. of 0.016 in² [10 mm²] Cu or an additional PE wire - with the same cable cross-section as the line power wiring, which 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, MN.90.GX.YY. Protective grounding of the adjustable frequency drive and the use of RCDs must always follow national and local regulations.
	**Motor Thermal Protection:** Motor overload protection is possible by setting Parameter 1-90 Motor thermal protection to the value ETR trip. For the North American market: Implemented ETR function provide class 20 motor overload protection, in accordance with NEC.
	**Installation at high altitudes:** For altitudes above 6,600 feet [2 km], please contact Danfoss regarding PELV.

1.1.2 Safety Instructions

- Make sure the adjustable frequency drive is properly grounded.
- Do not remove AC line input connections, motor connections or other power connections while the adjustable frequency drive is connected to line power.
- Protect users against supply voltage.
- Protect the motor against overloading according to national and local regulations.
- The ground leakage current exceeds 3.5 mA.
- The [OFF] key is not a safety switch. It does not disconnect the adjustable frequency drive from line power.

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1.2 Introduction

1.2.1 Available Literature

This Quick Guide contains the basic information necessary for installing and running the drive.

If more information is needed, the literature below can be downloaded from:
http: //www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations

Title	Literature no.
VLT Micro Drive FC 51 Instruction Manual	MG.02.AX.YY
VLT Micro Drive FC 51 Quick Guide	MG.02.BX.YY
VLT Micro Drive FC 51 Programming Guide	MG.02.CX.YY
FC 51 LCP Mounting Instruction	MI.02.AX.YY
FC 51 De-coupling Plate Mounting Instruction	MI.02.BX.YY
FC 51 Remote Mounting Kit Mounting Instruction	MI.02.CX.YY
FC 51 DIN Rail Kit Mounting Instruction	MI.02.DX.YY
FC 51 IP21 Kit Mounting Instruction	MI.02.EX.YY
FC 51 Nema1 Kit Mounting Instruction	MI.02.FX.YY

X = Revision Number, Y = Language code

1.2.2 Approvals

1.2.3 IT Line power

IT Line power
Installation on an isolated line power source, i.e., IT line power.
Max. supply voltage allowed when connected to line power: 440 V.

As an option, Danfoss offers recommended line filters for improved harmonics performance.

1.2.4 Avoiding Unintended Start

While the adjustable frequency drive is connected to line power, the motor can be started/stopped using digital commands, bus commands, references or via the Local Control Panel.

- Disconnect the adjustable frequency drive from line power whenever personal safety considerations make it necessary to avoid unintended start of any motors.
- To avoid unintended start, always activate the [OFF] key before changing parameters.

1.2.5 Disposal Instructions

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

1.3 Installation

1.3.1 Before Commencing Repair Work

1. Disconnect FC 51 from line power (and external DC supply, if present.)
2. Wait for 4 minutes (M1, M2 and M3) and 15 minutes (M4 and M5) for the DC link to discharge.
3. Disconnect the DC bus terminals and brake terminals (if present)
4. Remove motor cable

1.3.2 Side-by-Side Installation

The adjustable frequency drive can be mounted side-by-side for IP20 rating units and requires 3.4 in. [100 mm] clearance above and below for cooling. Please refer to the specifications near the end of this document for details on environmental ratings for the adjustable frequency drive.

1.3.3 Mechanical Dimensions

A template for drilling can be found on the flap of the packaging.

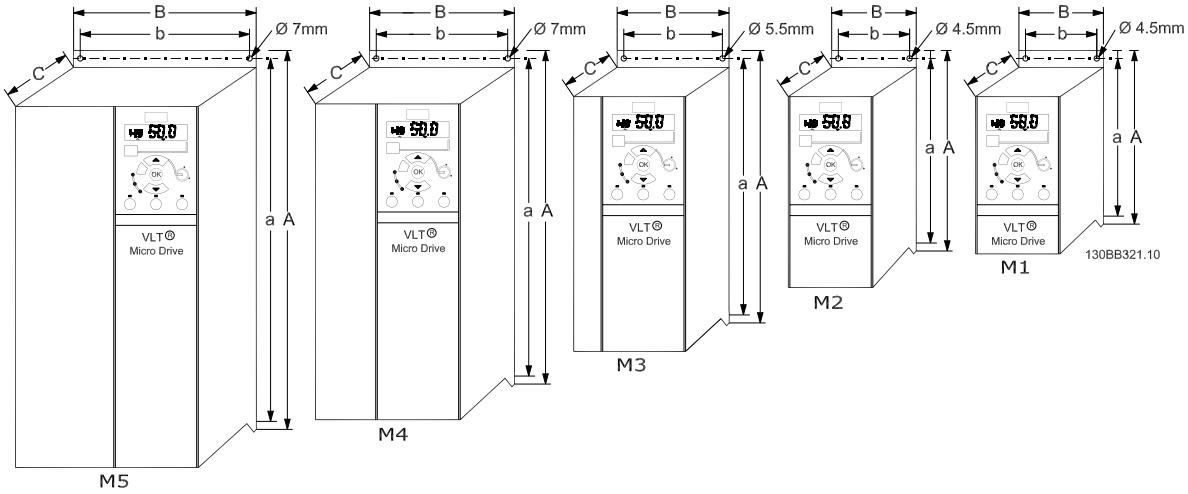

Figure 1.1: Mechanical dimensions.

	Power (kW)			Height (mm)			Width (mm)		Depth [1] (mm)	Max. Weight
Frame Size	1 X 200–240 V	3 X 200–240 V	3 X 380–480 V	A	A (incl. decoupling plate)	a	B	b	C	Kg
M1	0.18–0.75	0.25–0.75	0.37–0.75	150	205	140.4	70	55	148	1.1
M2	1.5	1.5	1.5–2.2	176	230	166.4	75	59	168	1.6
M3	2.2	2.2–3.7	3.0–7.5	239	294	226	90	69	194	3.0
M4			11.0–15.0	292	347.5	272.4	125	97	241	6.0
M5			18.5–22.0	335	387.5	315	165	140	248	9.5

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

Table 1.1: Mechanical Dimensions

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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, (140°–167°F [60°–75°C]) recommended.

Details of terminal tightening torques.

	Power (kW)			Torque (Nm)					
Frame Size	1 x 200–240 V	3 x 200–240 V	3 x 380–480 V	Line	Motor	DC connection/Brake	Control Terminals	Ground	Relay
M1	0.18–0.75	0.25–0.75	0.37–0.75	1.4	0.7	Spade[1)]	0.15	3	0.5
M2	1.5	1.5	1.5–2.2	1.4	0.7	Spade[1)]	0.15	3	0.5
M3	2.2	2.2–3.7	3.0–7.5	1.4	0.7	Spade[1)]	0.15	3	0.5
M4			11.0–15.0	1.25	1.25	1.25	0.15	3	0.5
M5			18.5–22.0	1.25	1.25	1.25	0.15	3	0.5

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

Table 1.2: Tightening of terminals.

1.3.5 Fuses

Branch circuit protection:
In order to protect the installation against electrical and fire hazards, all branch circuits in an installation, switch gear, machines, etc. must be short-circuited and overcurrent protected according to national/international regulations.

Short circuit protection:
Danfoss recommends using the fuses mentioned in the following tables to protect service personnel or other equipment in case of an internal failure in the unit or short circuit on DC link. The adjustable frequency drive provides full short circuit protection in case of a short circuit on the motor or brake output.

Overcurrent protection:
Provide overload protection to avoid overheating of the cables in the installation. Overcurrent protection must always be carried out according to national regulations. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 A_{rms} (symmetrical), 480 V maximum.

Non UL compliance:
If UL/cUL is not to be complied with, Danfoss recommends using the fuses mentioned in the table below, which will ensure compliance with EN50178/IEC61800-5-1:
In case of malfunction, not following the fuse recommendation may result in damage to the adjustable frequency drive.

FC 51	UL						Max. fuses non-UL
	Bussmann	Bussmann	Bussmann	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut	
1 X 200–240 V							
kW	Type RK1	Type J	Type T	Type RK1	Type CC	Type RK1	Type gG
0K18 - 0K37	KTN-R15	JKS-15	JJN-15	KLN-R15	ATM-R15	A2K-15R	16A
0K75	KTN-R25	JKS-25	JJN-25	KLN-R25	ATM-R25	A2K-25R	25A
1K5	KTN-R35	JKS-35	JJN-35	KLN-R35	-	A2K-35R	35A
2K2	KTN-R45	JKS-45	JJN-45	KLN-R45	-	A2K-45R	40A
3 x 200–240 V							
0K25	KTN-R10	JKS-10	JJN-10	KLN-R10	ATM-R10	A2K-10R	10A
0K37	KTN-R15	JKS-15	JJN-15	KLN-R15	ATM-R15	A2K-15R	16A
0K75	KTN-R20	JKS-20	JJN-20	KLN-R20	ATM-R20	A2K-20R	20A
1K5	KTN-R25	JKS-25	JJN-25	KLN-R25	ATM-R25	A2K-25R	25A
2K2	KTN-R40	JKS-40	JJN-40	KLN-R40	ATM-R40	A2K-40R	40A
3K7	KTN-R40	JKS-40	JJN-40	KLN-R40	-	A2K-40R	40A
3 x 380–480 V							
0K37–0K75	KTS-R10	JKS-10	JJS-10	KLS-R10	ATM-R10	A6K-10R	10A
1K5	KTS-R15	JKS-15	JJS-15	KLS-R15	ATM-R15	A2K-15R	16A
2K2	KTS-R20	JKS-20	JJS-20	KLS-R20	ATM-R20	A6K-20R	20A
3K0	KTS-R40	JKS-40	JJS-40	KLS-R40	ATM-R40	A6K405R	40A
4K0	KTS-R40	JKS-40	JJS-40	KLS-R40	ATM-R40	A6K-40R	40A
5K5	KTS-R40	JKS-40	JJS-40	KLS-R40	-	A6K-40R	40A
7K5	KTS-R40	JKS-40	JJS-40	KLS-R40	-	A6K-40R	40A
11K0	KTS-R60	JKS-60	JJS-60	KLS-R60	-	A6K-60R	63A
15K0	KTS-R60	JKS-60	JJS-60	KLS-R60	-	A6K-60R	63A
18K5	KTS-R60	JKS-60	JJS-60	KLS-R60	-	A6K-60R	80A
22K0	KTS-R60	JKS-60	JJS-60	KLS-R60	-	A6K-60R	80A

Table 1.3: Fuses

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1.3.6 Connecting to Line Power and Motor

The adjustable frequency drive is designed to operate all standard three-phased asynchronous motors.
The adjustable frequency drive is designed to accept line power/motor cables with a maximum cross-section of 0.006 in^2 [4 mm^2]/10 AWG (M1, M2 and M3) and maximum cross-section 0.0248 in^2 [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, please see instruction MI.02.BX.YY.
- Also see EMC-Correct Installation in Instruction Manual MG.02.AX.YY.

Step 1: First, mount the ground wires to the ground terminal.

Step 2: Connect motor to terminals U, V and W.

Step 3: Mount the line power supply to terminals L1/L, L2 and
L3/N (3-phase) or L1/L and L3/N (single-phase) and tighten.

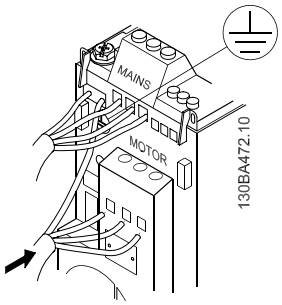

Figure 1.2: Mounting of ground cable, line power and motor wires.

1.3.7 Control Terminals

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

See back of terminal cover for outlines of control terminals and switches.

Do not operate switches with power on the adjustable frequency drive.
Parameter 6-19 must be set according to Switch 4 position.

Switch 1:	*OFF = PNP terminals 29 ON = NPN terminals 29
Switch 2:	*OFF = PNP terminal 18, 19, 27 and 33 ON = NPN terminal 18, 19, 27 and 33
Switch 3:	No function
Switch 4:	*OFF = Terminal 53 0-10 V ON = Terminal 53 0/4-20 mA

* = default setting

Table 1.4: Settings for S200 Switches 1-4

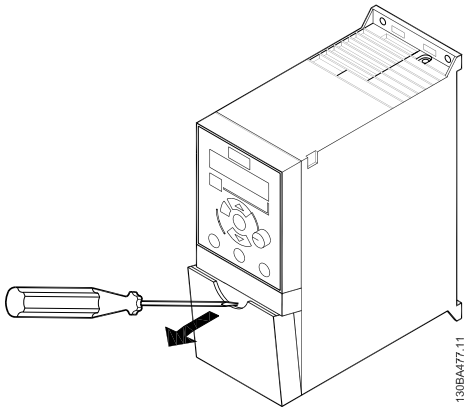

Figure 1.3: Removing the terminal cover.

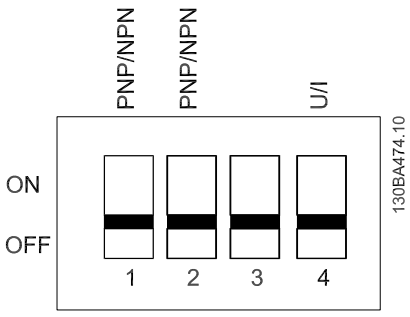

Figure 1.4: S200 Switches 1-4.

The illustration below shows all control terminals of the adjustable frequency drive. Applying Start (term. 18) and an analog reference (term. 53 or 60) makes the adjustable frequency drive run.

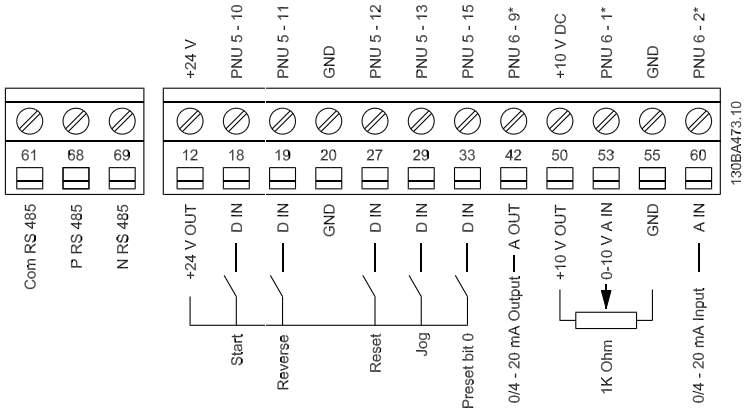

Figure 1.5: Overview of control terminals in the PNP configuration and factory settings.

1.3.8 Power Circuit - Overview

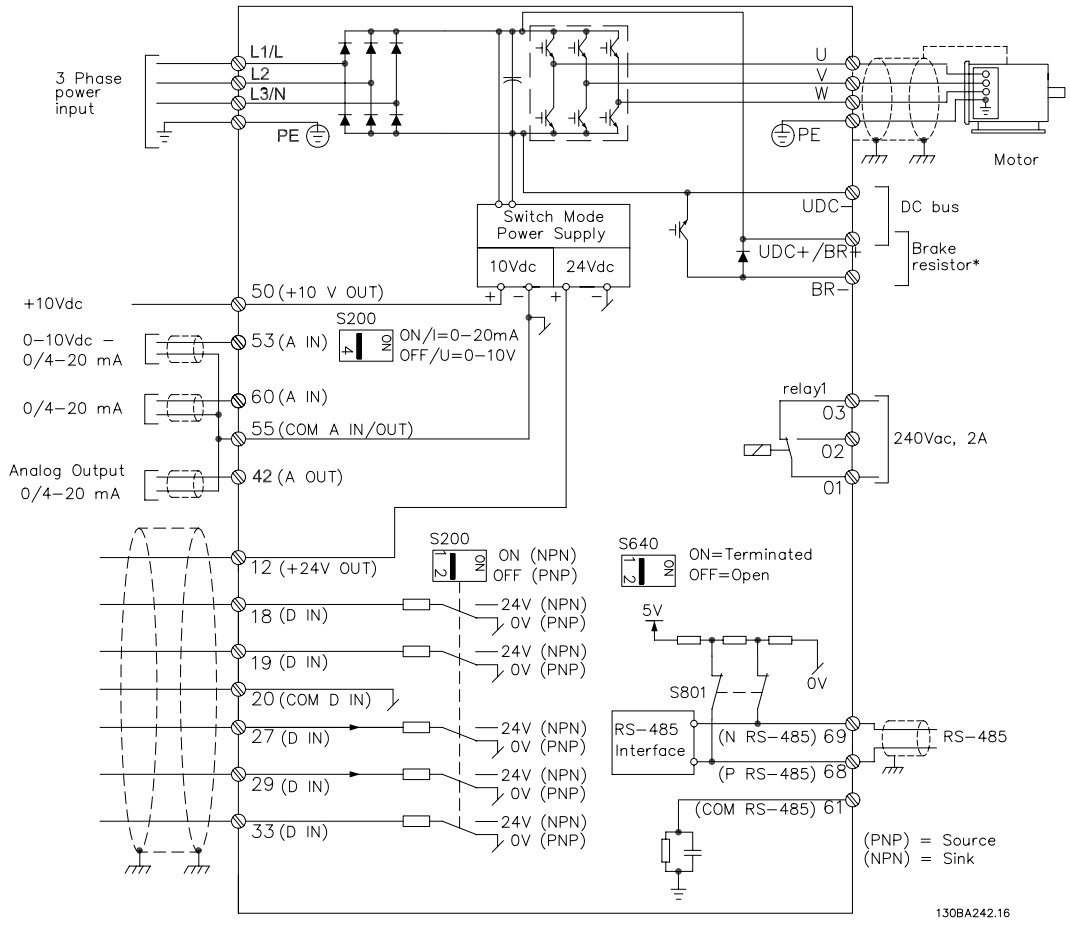

Figure 1.6: Diagram showing all electrical terminals.

* Brake (BR+ and BR-) are not applicable for frame M1.

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Brake resistors are available from Danfoss.
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.

1.3.9 Load sharing/Brake

Use 0.25 in [6.3 mm] insulated Faston plugs designed for high voltage for DC (load sharing and brake).
Contact Danfoss or see instruction no. MI.50.Nx.02 for load sharing and instruction no. MI.90.Fx.02 for brake.

Load sharing: Connect terminals -UDC and +UDC/+BR.
Brake: Connect terminals -BR and +UDC/+BR (Not applicable for frame M1).

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

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1.4 Programming

1.4.1 Programming with LCP

For detailed information on programming, please see *Programming Guide*, MG.02.CX.YY.

NOTE!
The adjustable frequency 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 website: www.danfoss.com/BusinessAreas/DrivesSolutions/softwaredownload

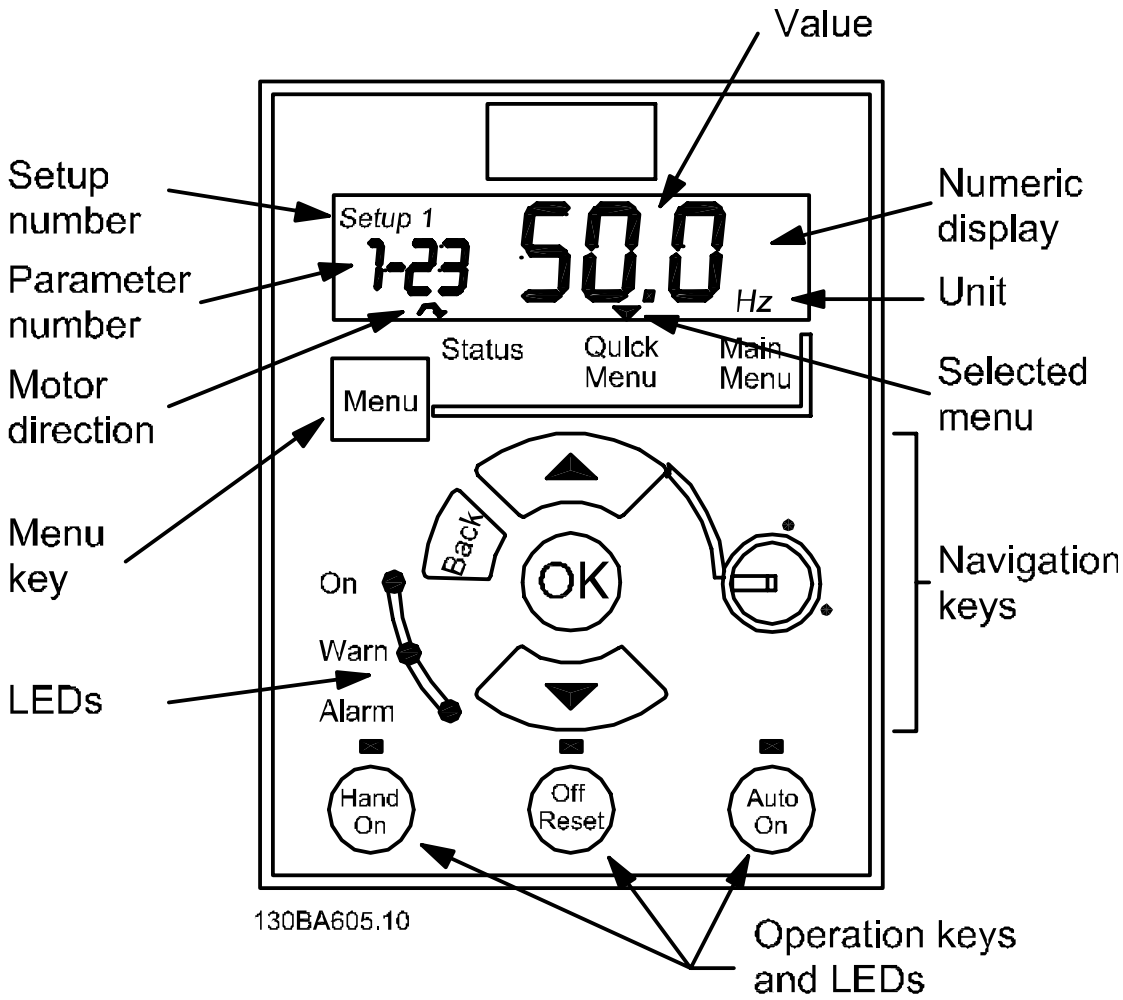


Figure 1.7: Description of LCP buttons and display

Use the [MENU] key to select one of the following menus:

Status:
For readouts only.

Quick Menu:
For access to Quick Menus 1 and 2, respectively.

Main Menu:
For access to all parameters.

Navigation Keys:
[Back]: For moving to the previous step or layer in the navigation structure.
Arrows [▲] [▼]: For navigating between parameter groups, parameters and within parameters.
[OK]: For selecting a parameter and for accepting changes to parameter settings.

1

Operation Keys:
A yellow light above the operation keys indicates the active key.
[Hand on]: Starts the motor and enables control of the adjustable frequency drive via the LCP.
[Off/Reset]: Stops the motor (off). If in alarm mode the alarm will be reset.
[Auto on]: The adjustable frequency drive is controlled either via control terminals or serial communication.
[Potentiometer] (LCP12): The potentiometer works in two ways depending on the mode in which the adjustable frequency drive is running.
In *Auto Mode*, the potentiometer acts as an extra programmable analog input.
In *Hand on Mode* the potentiometer controls local reference.

Arrows [▲] and [▼] toggle between the choices in each menu.

The display indicates the status mode with a small arrow above "Status".

The Quick Menu gives easy access to the most frequently used parameters.

1. To enter the Quick Menu, press the [MENU] key until the indicator in display is placed above *Quick Menu*.
2. Use [▲] [▼] to select either QM1 or QM2, then press [OK].
3. Use [▲] [▼] to browse through the parameters in the Quick Menu.
4. Press [OK] to select a parameter.
5. Use [▲] [▼] to change the value of a parameter setting.
6. Press [OK] to accept the change.
7. To exit, press either [Back] twice to enter *Status*, or press [Menu] once to enter *Main Menu*.

No	Name	Range	Default	Function
1-20	Motor Power [kW]/[HP]	[0.09kW/0.12HP–30kW/40HP]	Unit dependent	Enter motor power from nameplate data
1-22	Motor Voltage	[50–999V]	230/400	Enter motor voltage from nameplate data
1-23	Motor Frequency	[20–400 Hz]	50	Enter motor frequency form nameplate data
1-24	Motor Current	[0.01–100.00 A]	Unit dependent	Enter motor current from nameplate data
1-25	Motor nominal speed	[100–9999 RPM]	Unit dependent	Enter motor nominal speed from nameplate data
1-29	Automatic Motor Tuning (AMT)	[0] = off [2] = Enable AMT	[0] = off	Use AMT to optimize motor performance. 1. Stop VLT 2. Choose [2] 3. "Hand On"
3-02	Minimum reference	[-4999 - 4999]	0	Enter value for minimum reference
3-03	Maximum reference	[-4999 - 4999]	50.00	Enter value for maximum reference
3-41	Ramp-up time 1	[0.05–3600s]	3.00 (10.00[1)])	Ramp-up time from 0 to rated motor frequency par. 1-23
3-42	Ramp-down time 1	[0.05–3600s]	3.00 (10.00[1)])	Ramp-down time form rated motor frequency par. 1-23 to 0

[1)] M4 and M5 only

Table 1.5: Basic Settings Quick Menu 1

The main menu gives access to all parameters.

1. To enter the main menu, press the [MENU] key until the indicator in display is placed above *Main Menu*.
2. Use [▲] [▼] to browse through the parameter groups.
3. Press [OK] to select a parameter group.
4. Use [▲] [▼] to browse through the parameters in the specific group.
5. Press [OK] to select the parameter.
6. Use [▲] [▼] to set/change the parameter value.
7. Press [OK] to accept the value.
8. To exit, press either [Back] twice to enter *Quick Menu*, or press [Menu] once to enter *Status*.

Parameter Overview

0-XX Operation/Display
0-0X Basic Settings
0-03 Regional Settings
*[0] International
[1] US
0-04 Oper. State at Power-up (Hand)
[0] Resume
*[1] Forced stop, ref = old
[2] Forced stop, ref = 0
0-1X Set-up Handling
0-10 Active Set-up
*[1] Set-up 1
[2] Set-up 2
[9] Multi Set-up
0-11 Edit Set-up
*[1] Set-up 1
[2] Set-up 2
[9] Active Set-up
0-12 Link Set-ups
[0] Not Linked
*[20] Linked
0-31 Custom Readout Min Scale
0.00 – 9999.00 * 0.00
0-32 Custom Readout Max Scale
0.00–9999.00 * 100.0
0-4X LCP Keypad
0-40 [Hand on] Key on LCP
[0] Disabled
*[1] Enabled
0-41 [Off / Reset] Key on LCP
[0] Disable All
*[1] Enable All
[2] Enable Reset Only
0-42 [Auto on] Key on LCP
[0] Disabled
*[1] Enabled
0-5X Copy/Save
0-50 LCP Copy
*[0] No copy
[1] All to LCP
[2] All from LCP
[3] Size indep. from LCP
0-51 Set-up Copy
*[0] No copy
[1] Copy from set-up 1
[2] Copy from set-up 2
[9] Copy from Factory set-up
0-6X Password
0-60 (Main) Menu Password
0 - 999 * 0

1-XX Load/Motor
1-0X General Settings
1-00 Configuration Mode
*[0] Speed open-loop
[3] Process
1-01 Motor Control Principle
[0] U/f
*[1] VVC+
1-03 Torque Characteristics
*[0] Constant torque
[2] Automatic Energy Optim.
1-05 Local Mode Configuration
[0] Speed Open-loop
*[2] As config in par. 1-00
1-2X Motor Data
1-20 Motor Power [kW] [HP]
[1] 0.09 kW/0.12 HP
[2] 0.12 kW/0.16 HP
[3] 0.18 kW/0.25 HP
[4] 0.25 kW/0.33 HP
[5] 0.37 kW/0.50 HP
[6] 0.55 kW/0.75 HP
[7] 0.75 kW/1.00 HP
[8] 1.10 kW/1.50 HP
[9] 1.50 kW/2.00 HP
[10] 2.20 kW/3.00 HP
[11] 3.00 kW/4.00 HP
[12] 3.70 kW/5.00 HP
[13] 4.00 kW/5.40 HP
[14] 5.50 kW/7.50 HP
[15] 7.50 kW/10.00 HP
[16] 11.00 kW/15.00 HP
[17] 15.00 kW/20.00 HP
[18] 18.50 kW/25.00 HP
[19] 22.00 kW/29.50 HP
[20] 30.00 kW/40.00 HP
1-22 Motor Voltage
50–999 V * 230–400 V
1-23 Motor Frequency
20–400 Hz * 50 Hz
1-24 Motor Current
0.01–100.00 A * Motortype dep.
1-25 Motor Nominal Speed
100–9999 rpm * Motortype dep.
1-29 Automatic Motor Tuning (AMT)
*[0] Off
[2] Enable AMT
1-3X Adv. Motor Data
1-30 Stator Resistance (Rs)
[Ohm] * Dep. on motor data
1-33 Stator Leakage Reactance (X1)
[Ohm] * Dep. on motor data
1-35 Main Reactance (Xh)
[Ohm] * Dep. on motor data
1-5X Load Indep. Setting
1-50 Motor Magnetization at 0 Speed
0–300% * 100%
1-52 Min Speed Norm. Magnet. [Hz]
0.0–10.0 Hz * 0.0 Hz
1-55 U/f Characteristic - U
0–999.9 V
1-56 U/f Characteristic - F
0–400 Hz
1-6X Load Depen. Setting
1-60 Low Speed Load Compensation
0–199% * 100%
1-61 High Speed Load Compensation
0–199% * 100%
1-62 Slip Compensation
-400–399% * 100%
1-63 Slip Compensation Time Constant
0.05–5.00 s * 0.10 s
1-7X Start Adjustments
1-71 Start Delay
0.0–10.0 s * 0.0 s
1-72 Start Function
[0] DC hold / delay time
[1] DC brake / delay time
*[2] Coast / delay time
1-73 Flying Start
*[0] Disabled
[1] Enabled
1-8X Stop Adjustments
1-80 Function at Stop
*[0] Coast
[1] DC hold
1-82 Min Speed for Funct. at Stop [Hz]
0.0–20.0 Hz * 0.0 Hz
1-9XMotor Temperature
1-90 Motor Thermal Protection
*[0] No protection
[1] Thermistor warning
[2] Thermistor trip
[3] Etr warning
[4] Etr trip
1-93 Thermistor Resource
*[0] None
[1] Analog input 53
[6] Digital input 29
2-XX Brakes
2-0XDC Brake
2-00 DC Hold Current
0–150% * 50%
2-01 DC Brake Current
0–150% * 50%
2-02 DC Braking Time
0.0–60.0 s * 10.0 s
2-04 DC Brake Cut-in Speed
0.0–400.0 Hz * 0.0 Hz
2-1X Brake Energy Funct.
2-10 Brake Function
*[0] Off
[1] Resistor brake
[2] AC brake
2-11 Brake Resistor (ohm)
5–5000 * 5
2-16 AC Brake, Max current
0–150% * 100%
2-17 Overvoltage Control
*[0] Disabled
[1] Enabled (not at stop)
[2] Enabled
2-2* Mechanical Brake
2-20 Release Brake Current
0.00–100.0 A * 0.00 A
2-22 Activate Brake Speed [Hz]
0.0–400.0 Hz * 0.0 Hz
3-XX Reference / Ramps
3-0X Reference Limits
3-00 Reference Range
*[0] Min - Max
[1] -Max - +Max
3-02 Minimum Reference
-4999–4999 * 0.000
3-03 Maximum Reference
-4999–4999 * 50.00
3-1X References
3-10 Preset Reference
-100.0–100.0% * 0.00%
3-11 Jog Speed [Hz]
0.0–400.0 Hz * 5.0 Hz
3-12 Catch up/slow-down Value
0.00–100.0% * 0.00%

3-14 Preset Relative Reference
-100.0–100.0% * 0.00%
3-15 Reference Resource 1
[0] No function
*[1] Analog Input 53
[2] Analog input 60
[8] Pulse input 33
[11] Local bus ref
[21] LCP Potentiometer
3-16 Reference Resource 2
[0] No function
[1] Analog Input 53
*[2] Analog input 60
[8] Pulse input 33
*[11] Local bus ref
[21] LCP Potentiometer
3-17 Reference Resource 3
[0] No function
[1] Analog Input 53
[2] Analog input 60
[8] Pulse input 33
*[11] Local bus ref
[21] LCP Potentiometer
3-18 Relative Scaling Ref. Resource
*[0] No function
[1] Analog Input 53
[2] Analog input 60
[8] Pulse input 33
[11] Local bus ref
[21] LCP Potentiometer
3-4X Ramp 1
3-40 Ramp 1 Type
*[0] Linear
[2] Sine2 ramp
3-41 Ramp 1 Ramp-up Time
0.05–3600 s * 3.00 s (10.00 s[1])
3-42 Ramp 1 Ramp-down Time
0.05–3600 s * 3.00 s (10.00 s [1])
3-5X Ramp 2
3-50 Ramp 2 Type
*[0] Linear
[2] Sine2 ramp
3-51 Ramp 2 Ramp-up Time
0.05–3600 s * 3.00 s (10.00 s [1])
3-52 Ramp 2 Ramp-down Time
0.05–3600 s * 3.00 s (10.00 s[1])
3-8X Other Ramps
3-80 Jog Ramp Time
0.05–3600 s * 3.00 s (10.00 s[1])
3-81 Quick Stop Ramp Time
0.05–3600 s * 3.00 s (10.00 s[1])
4-XX Limits / Warnings
4-1X Motor Limits
4-10 Motor Speed Direction
[0] Clockwise
[1] CounterClockwise
*[2] Both
4-12 Motor Speed Low Limit [Hz]
0.0–400.0 Hz * 0.0 Hz
4-14 Motor Speed High Limit [Hz]
0.1–400.0 Hz * 65.0 Hz
4-16 Torque Limit Motor Mode
0–400% * 150%
4-17 Torque Limit Generator Mode
0–400% * 100%
4-5X Adj. Warnings
4-50 Warning Current Low
0.00–100.00 A * 0.00 A
4-51 Warning Current High
0.00–100.00 A * 100.00 A
4-58 Missing Motor Phase Function
[0] Off
*[1] On
4-6X Speed Bypass
4-61 Bypass Speed From [Hz]
0.0–400.0 Hz * 0.0 Hz
4-63 Bypass Speed To [Hz]
0.0–400.0 Hz * 0.0 Hz
5-1X Digital Inputs
5-10 Terminal 18 Digital Input
[0] No function
[1] Reset
[2] Coast inverse
[3] Coast and reset inv.
[4] Quick stop inverse
[5] DC brake inv.
[6] Stop inv
*[8] Start
[9] Latched start
[10] Reversing
[11] Start reversing
[12] Enable start forward
[13] Enable start reverse
[14] Jog
[16-18] Preset ref bit 0-2
[19] Freeze reference
[20] Freeze output
[21] Speed up
[22] Slow
[23] Set-up select bit 0
[28] Catch up
[29] Slow-down
[34] Ramp bit 0
[60] Counter A (up)
[61] Counter A (down)
[62] Reset counter A
[63] Counter B (up)
[64] Counter B (down)
[65] ResetCounter B
5-11 Terminal 19 Digital Input
See par. 5-10. * [10] Reversing
5-12 Terminal 27 Digital Input
See par. 5-10. * [1] Reset
5-13 Terminal 29 Digital Input
See par. 5-10. * [14] Jog
5-15 Terminal 33 Digital Input
See par. 5-10. * [16] Preset ref bit 0
[26] Precise Stop Inverse
[27] Start, Precise Stop
[32] Pulse Input
5-4X Relays
5-40 Function Relay
*[0] No operation
[1] Control ready
[2] Drive ready
[3] Drive ready, Remote
[4] Enable / No warning
[5] Drive 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
[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, NoWarn
[29] Brake ready/NoFault
[30] BrakeFault (IGBT)
[32] Mech.brake control
[36] Control word bit 11
[51] Local ref. active
[52] Remote ref. active
[53] No alarm
[54] Start cmd active
[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
5-5X 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 Term. 33 Low Ref./Feedb. Value
-4999–4999 * 0.000
5-58 Term. 33 High Ref./Feedb. Value
-4999–4999 * 50.000
6-XX Analog In/Out
6-0X 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
6-1X Analog Input 1
6-10 Terminal 53 Low Voltage
0.00–9.99 V * 0.07 V
6-11 Terminal 53 High Voltage
0.01–10.00 V * 10.00 V
6-12 Terminal 53 Low Current
0.00–19.99 mA * 0.14 mA

[1] M4 and M5 only

6-13 Terminal 53 High Current
0.01–20.00 mA * 20.00 mA
6-14 Term. 53 Low Ref./Feedb. Value
-4999–4999 * 0.000
6-15 Term. 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
6-2X Analog Input 2
6-22 Terminal 60 Low Current
0.00–19.99 mA * 0.14 mA
6-23 Terminal 60 High Current
0.01–20.00 mA * 20.00 mA
6-24 Term. 60 Low Ref./Feedb. Value
-4999–4999 * 0.000
6-25 Term. 60 High Ref./Feedb. Value
-4999–4999 * 50.00
6-26 Terminal 60 Filter Time Constant
0.01–10.00 s * 0.01 s
6-8X LCP potentiometer
6-81 LCP potm. Low Reference
-4999–4999 * 0.000
6-82 LCP potm. High Reference
-4999–4999 * 50.00
6-9X 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
[20] Bus Reference
6-92 Terminal 42 Digital Output
See par. 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%
7-XX Controllers
7-2X Process Ctrl. Feedb
7-20 Process CL Feedback 1 Resource
*[0] NoFunction
[1] Analog Input 53
[2] Analog input 60
[8] PulseInput33
[11] LocalBusRef
7-3X Process PI
Ctrl. 7-30 Process PI Normal/ Inverse Ctrl
*[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 s * 9999 s
7-38 Process PI Feed Forward Factor
0–400% * 0%
7-39 On Reference Bandwidth
0–200% * 5%
8-XX Comm. and Options
8-0X General Settings
8-01 Control Site
*[0] Digital and ControlWord
[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 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
8-3X FC Port Settings
8-30 Protocol
*[0] FC
[2] Modbus
8-31 Address
1–247 * 1
8-32 FC Port Baud Rate
[0] 2400 Baud
[1] 4800 Baud
*[2] 9600 Baud
[3] 19200 Baud
[4] 38400 Baud
8-33 FC Port Parity
*[0] Even Parity, 1 Stop Bit
[1] Odd Parity, 1 Stop Bit
[2] No Parity, 1 Stop Bit
[3] No Parity, 2 Stop Bits
8-35 Minimum Response Delay
0.001–0.5 * 0.010 s
8-36 Max Response Delay
0.100–10.00 s * 5.000 s
8-5X Digital/Bus
8-50 Coasting Select
[0] DigitalInput
[1] Bus
[2] LogicAnd
*[3] LogicOr
8-51 Quick Stop Select
See par. 8-50 * [3] LogicOr
8-52 DC Brake Select
See par. 8-50 * [3] LogicOr
8-53 Start Select
See par. 8-50 * [3] LogicOr
8-54 Reversing Select
See par. 8-50 * [3] LogicOr
8-55 Set-up Select
See par. 8-50 * [3] LogicOr
8-56 Preset Reference Select
See par. 8-50 * [3] LogicOr
8-9X Bus Jog / Feedback
8-94 Bus feedback 1
0x8000–0x7FFF * 0
13-XX Smart Logic
13-0X SLC Settings
13-00 SL Controller Mode
*[0] Off
[1] On
13-01 Start Event
[0] False
[1] True
[2] Running
[3] InRange
[4] OnReference
[7] OutOfCurrentRange
[8] BelowILow
[9] AboveIHigh
[16] ThermalWarning
[17] MainOutOfRange
[18] Reversing
[19] Warning
[20] Alarm_Trip
[21] Alarm_TripLock
[22-25] Comparator 0-3
[26-29] LogicRule0-3
[33] DigitalInput_18
[34] DigitalInput_19
[35] DigitalInput_27
[36] DigitalInput_29
[38] DigitalInput_33
*[39] StartCommand
[40] DriveStopped
13-02 Stop Event
See par. 13-01 * [40] DriveStopped
13-03 Reset SLC
*[0] Do not reset
[1] Reset SLC

13-1X Comparators
13-10 Comparator Operand
*[0] Disabled
[1] Reference
[2] Feedback
[3] MotorSpeed
[4] MotorCurrent
[6] MotorPower
[7] MotorVoltage
[8] DCLinkVoltage
[12] AnalogInput53
[13] AnalogInput60
[18] PulseInput33
[20] AlarmNumber
[30] CounterA
[31] CounterB
13-11 Comparator Operator
[0] Less Than
*[1] Approximately equals
[2] Greater Than
13-12 Comparator Value
-9999–9999 * 0.0
13-2X Timers
13-20 SL Controller Timer
0.0–3600 s * 0.0 s
13-4X Logic Rules
13-40 Logic Rule Boolean 1
See par. 13-01 * [0] False
[30] - [32] SL Timeout 0-2
13-41 Logic Rule Operator 1
*[0] Disabled
[1] And
[2] Or
[3] And not
[4] Or not
[5] Not and
[6] Not or
[7] Not and not
[8] Not or not
13-42 Logic Rule Boolean 2
See par. 13-40 * [0] False
13-43 Logic Rule Operator 2
See par. 13-41 * [0] Disabled
13-44 Logic Rule Boolean 3
See par. 13-40 * [0] False
13-5X States
13-51 SL Controller Event
See par. 13-40 * [0] False
13-52 SL Controller Action
*[0] Disabled
[1] NoAction
[2] SelectSetup1
[3] SelectSetup2
[10-17] SelectPresetRef0-7
[18] SelectRamp1
[19] SelectRamp2
[22] Run
[23] RunReverse
[24] Stop
[25] Qstop
[26] DCstop
[27] Coast
[28] FreezeOutput
[29] StartTimer0
[30] StartTimer1
[31] StartTimer2
[32] Set Digital Output A Low
[33] Set Digital Output B Low
[38] Set Digital Output A High
[39] Set Digital Output B High
[60] ResetCounterA
[61] ResetCounterB
14-XX Special Functions
14-0X Inverter Switching
14-01 Switching Frequency
[0] 2 kHz
*[1] 4 kHz
[2] 8 kHz
[4] 16 kHz
14-03 Overmodulation
[0] Off
*[1] On
14-1X Line power monitoring
14-12 Function at line imbalance
*[0] Trip
[1] Warning
[2] Disabled
14-2X Trip Reset
14-20 Reset Mode
*[0] Manual reset
[1-9] AutoReset 1-9
[10] AutoReset 10
[11] AutoReset 15
[12] AutoReset 20
[13] Infinite auto reset
14-21 Automatic Restart Time
0–600 s * 10 s
14-22 Operation Mode
*[0] Normal Operation
[2] Initialization
14-26 Action At Inverter Fault
*[0] Trip
[1] Warning
14-4X Energy Optimizing
14-41 AEO Minimum Magnetization
40–75% * 66%
15-XX Drive Information
15-0X Operating Data
15-00 Operating Days
15-01 Running Hours
15-02 kWh Counter
15-03 Power-ups
15-04 Overtemps
15-05 Overvolts
15-06 Reset kWh Counter
*[0] Do not reset
[1] Reset counter
15-07 Reset Running Hours Counter
*[0] Do not reset
[1] Reset counter
15-3X Fault Log
15-30 Fault Log: Error Code
15-4X Drive Identification
15-40 FC Type
15-41 Power Section
15-42 Voltage
15-43 Software Version
15-46 Adjustable Frequency Drive Order. No
15-48 LCP ID No
15-51 Adjustable Frequency Drive Serial No
16-XX Data Readouts
16-0X General Status
16-00 Control Word
0–0XFFFF
16-01 Reference [Unit]
-4999–4999 * 0.000
16-02 Reference %
-200.0–200.0% * 0.0%
16-03 Status Word
0–0XFFFF
16-05 Main Actual Value [%]
-200.0–200.0% * 0.0%
16-09 Custom Readout
Dep. on par. 0-31, 0-32 and 4-14
16-1X Motor Status
16-10 Power [kW]
16-11 Power [hp]
16-12 Motor Voltage [V]
16-13 Frequency [Hz]
16-14 Motor Current [A]
16-15 Frequency [%]
16-18 Motor Thermal [%]
16-3X 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
16-5X Ref. / Feedb.
16-50 External Reference
16-51 Pulse Reference
16-52 Feedback [Unit]
16-6X Inputs / Outputs
16-60 Digital Input 18,19, 27, 33
0–1111
16-61 Digital Input 29
0–1
16-62 Analog Input 53 (volt)
16-63 Analog Input 53 (current)
16-64 Analog Input 60
16-65 Analog Output 42 [mA]
16-68 Pulse Input [Hz]
16-71 Relay Output [bin]
16-72 Counter A
16-73 Counter B
16-8X Ser.Com.Bus / FC Port
16-86 FC Port REF 1
0x8000–0x7FFF
16-9X Diagnosis Readouts
16-90 Alarm Word
0–0XFFFFFFFF
16-92 Warning Word
0–0XFFFFFFFF
16-94 Ext. Status Word
0–0XFFFFFFFF***18-XX Extended Motor Data***
18-8X Motor Resistors
18-80 Stator Resistance (High resolution)
0.000–99.990 ohm * 0.000 ohm
18-81 Stator Leakage Reactance (High resolution)
0.000–99.990 ohm * 0.000 ohm

1.6 Troubleshooting

No.	Description	Warning	Alarm	Trip Lock	Error	Cause of Problem
2	Live zero error	X	X			Signal on terminal 53 or 60 is less than 50% of the value set in par. 6-10, 6-12 and 6-22.
4	Line phase loss1)	X	X	X		Missing phase on the supply side, or a voltage imbalance that is too high. Check supply voltage.
7	DC overvoltage1)	X	X			Intermediate circuit voltage exceeds the limit.
8	DC undervoltage1)	X	X			Intermediate circuit voltage drops below the "voltage warning low" limit.
9	Inverter overloaded	X	X			More than 100% load for too long.
10	Motor ETR overtemperature	X	X			Motor is too hot due to more than 100% load for too long.
11	Motor thermistor overtemperature	X	X			The thermistor or the thermistor connection is disconnected.
12	Torque limit	X				Torque exceeds the value set in either par. 4-16 or 4-17.
13	Overcurrent	X	X	X		Inverter peak current limit is exceeded.
14	Ground fault		X	X		Discharge from output phases to ground.
16	Short Circuit		X	X		Short-circuit in the motor or on the motor terminals.
17	Control word timeout	X	X			No communication to the adjustable frequency 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 overtemp	X	X	X		Heatsink cut-out 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 local Danfoss supplier.
44	Ground fault		X	X		Discharge from output phases to ground.
47	Control Voltage Fault		X	X		24 V DC may be overloaded.
51	AMT check U_{nom} and I_{nom}		X			Wrong setting for motor voltage and/or motor current.
52	AMT low I_{nom}		X			Motor current is too low. Check settings.
59	Current limit	X				VLT overload.
63	Mechanical Brake Low		X			Actual motor current has not exceeded the "release brake" current in 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 adjustable frequency drive.
85	Button disabled				X	See parameter group 0-4* *LCP*
86	Copy fail				X	An error occurred while copying from adjustable frequency drive to LCP or vice versa.
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 adjustable frequency 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 min/max limits				X	Occurs when trying to set a value outside the range.
nw run	**N**ot **W**hile **RUN**ning				X	Parameter can only be changed when the motor is stopped.
Err.	An incorrect password was entered				X	Occurs when using an incorrect password for changing a password-protected parameter.

1) These faults may be caused by line power distortions. Installing a Danfoss line filter may rectify this problem.

Table 1.6: Warnings and AlarmsCode list

1

1.7 Specifications

1.7.1 Line power Supply 1 x 200–240 V AC

Normal overload 150 % for 1 minute

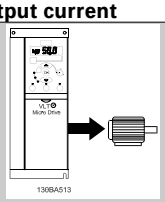
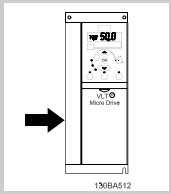
Adjustable frequency drive		PK18	PK37	PK75	P1K5	P2K2
Typical Shaft Output [kW]		0.18	0.37	0.75	1.5	2.2
Typical Shaft Output [HP]		0.25	0.5	1	2	3
IP 20		Frame M1	Frame M1	Frame M1	Frame M2	Frame M3
Output current						
	Continuous (1 x 200–240 V) [A]	1.2	2.2	4.2	6.8	9.6
	Intermittent (1 x 200–240 V) [A]	1.8	3.3	6.3	10.2	14.4
	Max. cable size:					
	(line power, motor) [mm² /AWG]			4/10		
Max. input current						
	Continuous (1 x 200–240 V) [A]	3.3	6.1	11.6	18.7	26.4
	Intermittent (1 x 200–240 V) [A]	4.5	8.3	15.6	26.4	37.0
	Max. electrical fuses [A]			See section Fuses.		
	Environment					
	Estimated power loss [W], Best case/ Typical[1)]	12.5/ 15.5	20.0/ 25.0	36.5/ 44.0	61.0/ 67.0	81.0/ 85.1
	Weight enclosure IP20 [kg]	1.1	1.1	1.1	1.6	3.0
	Efficiency [%], Best case/Typical[1)]	95.6/ 94.5	96.5/ 95.6	96.6/ 96.0	97.0/ 96.7	96.9/ 97.1

Table 1.7: Line Power Supply 1 x 200–240 V AC

1. At rated load conditions.

1.7.2 Line Power Supply 3 x 200–240 V AC

Normal overload 150 % for 1 minute

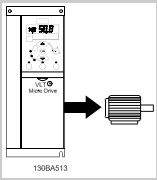
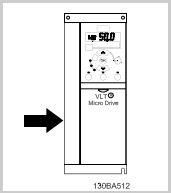
Adjustable frequency drive		PK25	PK37	PK75	P1K5	P2K2	P3K7
Typical Shaft Output [kW]		0.25	0.37	0.75	1.5	2.2	3.7
Typical Shaft Output [HP]		0.33	0.5	1	2	3	5
IP 20		Frame M1	Frame M1	Frame M1	Frame M2	Frame M3	Frame M3
Output current							
	Continuous (3 x 200–240 V) [A]	1.5	2.2	4.2	6.8	9.6	15.2
	Intermittent (3 x 200–240 V) [A]	2.3	3.3	6.3	10.2	14.4	22.8
	Max. cable size:						
	(line power, motor) [mm² /AWG]			4/10			
Max. input current							
	Continuous (3 x 200–240 V) [A]	2.4	3.5	6.7	10.9	15.4	24.3
	Intermittent (3 x 200–240 V) [A]	3.2	4.6	8.3	14.4	23.4	35.3
	Max. electrical fuses [A]			See section Fuses.			
	Environment						
	Estimated power loss [W], Best case/ Typical[1)]	14.0/ 20.0	19.0/ 24.0	31.5/ 39.5	51.0/ 57.0	72.0/ 77.1	115.0/ 122.8
	Weight enclosure IP20 [kg]	1.1	1.1	1.1	1.6	3.0	3.0
	Efficiency [%], Best case/Typical[1)]	96.4/ 94.9	96.7/ 95.8	97.1/ 96.3	97.4/ 97.2	97.2/ 97.4	97.3/ 97.4

Table 1.8: Line power supply 3 x 200–240 V AC

1. At rated load conditions.

1.7.3 Line Power Supply 3 x 380–480 V AC

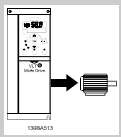
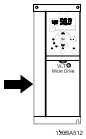
Normal overload 150% for 1 minute							
Adjustable frequency drive		PK37	PK75	P1K5	P2K2	P3K0	P4K0
Typical Shaft Output [kW]		0.37	0.75	1.5	2.2	3.0	4.0
Typical Shaft Output [HP]		0.5	1	2	3	4	5
IP 20		Frame M1	Frame M1	Frame M2	Frame M2	Frame M3	Frame M3
Output current							
	Continuous (3 x 380–440 V) [A]	1.2	2.2	3.7	5.3	7.2	9.0
	Intermittent (3 x 380–440 V) [A]	1.8	3.3	5.6	8.0	10.8	13.7
	Continuous (3 x 440–480 V) [A]	1.1	2.1	3.4	4.8	6.3	8.2
	Intermittent (3 x 440–480 V) [A]	1.7	3.2	5.1	7.2	9.5	12.3
	Max. cable size:						
	(line power, motor) [mm²/ AWG]	4/10					
Max. input current							
	Continuous (3 x 380–440 V) [A]	1.9	3.5	5.9	8.5	11.5	14.4
	Intermittent (3 x 380–440 V) [A]	2.6	4.7	8.7	12.6	16.8	20.2
	Continuous (3 x 440–480 V) [A]	1.7	3.0	5.1	7.3	9.9	12.4
	Intermittent (3 x 440–480 V) [A]	2.3	4.0	7.5	10.8	14.4	17.5
	Max. electrical fuses [A]	See section 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	75.0/ 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[1)]	96.8/ 95.5	97.4/ 96.0	98.0/ 97.2	97.9/ 97.1	98.0/ 97.2	98.0/ 97.3

Table 1.9: Line power supply 3 x 380–480 V AC

1. At rated load conditions.

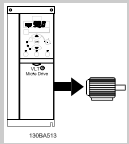
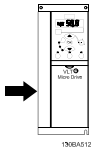
Normal overload 150% for 1 minute							
Adjustable frequency drive		P5K5	P7K5	P11K	P15K	P18K	P22K
Typical Shaft Output [kW]		5.5	7.5	11	15	18.5	22
Typical Shaft Output [HP]		7.5	10	15	20	25	30
IP 20		Frame M3	Frame M3	Frame M4	Frame M4	Frame M5	Frame M5
Output current							
	Continuous (3 x 380–440 V) [A]	12.0	15.5	23.0	31.0	37.0	43.0
	Intermittent (3 x 380–440 V) [A]	18.0	23.5	34.5	46.5	55.5	64.5
	Continuous (3 x 440–480 V) [A]	11.0	14.0	21.0	27.0	34.0	40.0
	Intermittent (3 x 440–480 V) [A]	16.5	21.3	31.5	40.5	51.0	60.0
	Max. cable size:						
	(line power, motor) [mm²/ AWG]	4/10		16/6			
Max. input current							
	Continuous (3 x 380–440 V) [A]	19.2	24.8	33.0	42.0	34.7	41.2
	Intermittent (3 x 380–440 V) [A]	27.4	36.3	47.5	60.0	49.0	57.6
	Continuous (3 x 440–480 V) [A]	16.6	21.4	29.0	36.0	31.5	37.5
	Intermittent (3 x 440–480 V) [A]	23.6	30.1	41.0	52.0	44.0	53.0
	Max. electrical fuses [A]	See section Fuses.					
	Environment						
	Estimated power loss [W], Best case/ Typical[1)]	131.0/ 166.8	175.0/ 217.5	290.0/ 342.0	387.0/ 454.0	395.0/ 428.0	467.0/ 520.0
	Weight enclosure IP20 [kg]	3.0	3.0				
	Efficiency [%], Best case/ Typical[1)]	98.0/ 97.5	98.0/ 97.5	97.8/ 97.4	97.7/ 97.4	98.1/ 98.0	98.1/ 97.9

Table 1.10: Line power supply 3 x 380–480 V AC

1. At rated load conditions.

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Protection and Features:

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

Line power supply (L1/L, L2, L3/N):	
Supply voltage	200–240 V ±10%
Supply voltage	380–480 V ±10%
Supply frequency	50/60 Hz
Max. imbalance temporary between line phases	3.0% of rated supply voltage
True Power Factor (λ)	≥ 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/min.
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 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+), 0–400 Hz (u/f)
Switching on output	Unlimited
Ramp times	0.05–3600 sec.

Cable lengths and cross-sections:	
Max. motor cable length, shielded/armored (EMC-correct installation)	50 ft [15 m]
Max. motor cable length, unshielded/unarmored	164 ft [50 m]
Max. cross-section to motor, line power*	
Connection to load sharing/brake (M1, M2, M3)	0.25 in [6.3 mm] insulated Faston plugs
Max. cross-section to load sharing/brake (M4, M5)	0.0248 in^2 [16 mm^2]/6AWG
Maximum cross-section to control terminals, rigid wire	0.023 in^2 [1.5 mm^2]/16 AWG (2 x 0.00112^2 in [0.75 mm^2])
Maximum cross-section to control terminals, flexible cable	0.0016 in^2 [1 mm^2]/18 AWG
Maximum cross-section to control terminals, cable with enclosed core	0.0008 in^2 [0.5 mm^2]/20 AWG
Minimum cross-section to control terminals	0.00039 in^2 [0.25 mm^2]

** See tables for line power supply for more information!*

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	approx. 4 k
Max. pulse frequency at terminal 33	5000 Hz

Min. pulse frequency at terminal 33	20 Hz
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	approx. 10 kΩ
Max. voltage	20 V
Current level	0/4 to 20 mA (scaleable)
Input resistance, R_i	approx. 200 Ω
Max. current	30 mA
Analog output:	
Number of programmable analog outputs	1
Terminal number	42
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: 0.8% of full scale
Resolution on analog output	8 bit
Control card, RS-485 serial communication:	
Terminal number	68 (P,TX+, RX+), 69 (N,TX-, RX-)
Terminal number 61	Common for terminals 68 and 69
Control card, 24 V DC output:	
Terminal number	12
Max. load (M1 and M2)	160 mA
Max. load (M3)	30 mA
Max. load (M4 and M5)	200 mA
Relay output:	
Programmable relay output	1
Relay 01 Terminal number	01-03 (break), 01-02 (make)
Max. terminal load (AC-1)[1)] on 01-02 (NO) (resistive load)	250 V AC, 2 A
Max. terminal load (AC-15)[1)] on 01-02 (NO) (inductive load @ cosφ 0.4)	250 V AC, 0.2 A
Max. terminal load (DC-1)[1)] on 01-02 (NO) (resistive load)	30 V DC, 2 A
Max. terminal load (DC-13)[1)] on 01-02 (NO) (inductive load)	24 V DC, 0.1A
Max. terminal load (AC-1)[1)] on 01-03 (NC) (resistive load)	250 V AC, 2 A
Max. terminal load (AC-15)[1)] on 01-03 (NC) (inductive load @ cosφ 0.4)	250 V AC, 0.2 A
Max. terminal load (DC-1)[1)] on 01-03 (NC) (resistive load)	30 V DC, 2 A
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 part 4 and 5

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

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

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Surroundings:	
Enclosure	IP 20
Enclosure kit available.	IP 21, 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	class 3C3
Test method according to IEC 60068-2-43 H2S (10 days)	
Ambient temperature	Max. 104°F [40°C]
Derating for high ambient temperature, see section on special conditions	
Minimum ambient temperature during full-scale operation	32°F [0°C]
Minimum ambient temperature at reduced performance	14°F [-10°C]
Temperature during storage/transport	-13°–149°/158°F [-25°–+65°/70°C]
Maximum altitude above sea level without derating	3280 ft [1000 m]
Maximum altitude above sea level with derating	9842 ft [3000 m]
Derating for high altitude, see section on special conditions.	
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
See section on special conditions	

1.8 Special Conditions

1.8.1 Derating for Ambient Temperature

The ambient temperature measured over 24 hours should be at least 9°F [5°C] lower than the max. ambient temperature.

If the adjustable frequency drive is operated at a high ambient temperature, the continuous output current should be decreased.

The adjustable frequency drive has been designed for operation at max 122°F [50°C] ambient temperature with one motor size smaller than nominal. Continuous operation at full load at 122°F [50°C] ambient temperature will reduce the lifetime of the adjustable frequency drive.

1.8.2 Derating for Low Air Pressure

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

For altitudes above 6,600 feet [2000 m], please contact Danfoss regarding PELV.

Below altitudes of 3,280 ft [1,000 m], no derating is necessary, but at 3,280 ft [1,000 m] and higher, the ambient temperature or maximum output current should be decreased.
Decrease the output by 1% per 328 ft [100 m] higher than an altitude of 3,289 ft [1000 m], or reduce the max. ambient temperature by 1 degree per 656 ft [200 m].

1.8.3 Derating for Running at Low Speeds

When a motor is connected to an adjustable frequency drive, it is necessary to make sure that the cooling of the motor is adequate.
A problem may occur at low speeds in constant torque applications. Running continuously at low speeds – below half the nominal motor speed – may require additional air cooling. Alternatively, choose a larger motor (one size up).

1.9 Options for VLT Micro Drive

Ordering No	Description
132B0100	VLT Control Panel LCP 11 w/o potentiometer
132B0101	VLT Control Panel LCP 12 with potentiometer
132B0102	Remote Mounting Kit for LCP incl. 10 ft [3 m] cable IP55 with LCP 11, IP21 with LCP 12
132B0103	Nema Type 1 kit for M1 frame
132B0104	Type 1 kit for M2 frame
132B0105	Type 1 kit for M3 frame
132B0106	De-coupling plate kit for M1 and M2 frames
132B0107	De-coupling plate kit for M3 frame
132B0108	IP21 for M1 frame
132B0109	IP21 for M2 frame
132B0110	IP21 for M3 frame
132B0111	DIN rail mounting kit for M1 frame
132B0120	Type 1 kit for M4 frame
132B0121	Type 1 kit for M5 frame
132B0122	De-coupling plate kit for M4 and M5 frames

Danfoss line filters and brake resistors are available upon request.

www.danfoss.com/drives

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132R0029 MG02B522 Rev. 2009-02-28