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1. Safety

1

1.1.1. High Voltage Warning



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

1.1.2. Safety Instructions

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

1.1.3. Approvals



1.1.4. General Warning



Warning:

Touching the electrical parts may be fatal - even after the equipment has been disconnected from mains.

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 VLT Micro Drive, wait at least 4 minutes for all sizes.

Shorter time is allowed only if indicated on the nameplate for the specific unit.



Leakage Current
The earth leakage current from the VLT Micro Drive FC 51 exceeds 3.5 mA. According to IEC 61800-5-1 a reinforced Protective Earth connection must be ensured by means of a min. 10mm² Cu or an additional PE wire - with the same cable cross section as the Mains wiring - must be terminated separately.

Residual Current Device
This product can cause a D.C. 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 earthing of the VLT Micro Drive and the use of RCDs must always follow national and local regulations.



Motor overload protection is possible by setting Parameter 1-90 Motor thermal protection to the value ETR trip. For the North American market: ETR functions provide class 20 motor overload protection, in accordance with NEC.



Installation in high altitudes:
By altitudes above 2km, please contact Danfoss Drives regarding PELV.

1.1.5. IT Mains



IT Mains
Installation on isolated mains source, i.e. IT mains.
Max. supply voltage allowed when connected to mains: 440 V.

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

1.1.6. Avoid unintended Start

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

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

1.1.7. Disposal Instruction



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

1.1.8. Before Commencing Repair Work

1. Disconnect FC 51 from mains (and external DC supply, if present.)
2. Wait for 4 minutes for discharge of the DC-link.
3. Disconnect DC bus terminals and brake terminals (if present)
4. Remove motor cable

2. Mechanical Installation

2.1. Before Starting

2.1.1. Checklist

When unpacking the frequency converter, make sure that the unit is undamaged and complete. Check that the packaging contains the following:

- VLT Micro Drive FC 51
- Quick Guide

Optional: LCP and/or de-coupling plate.

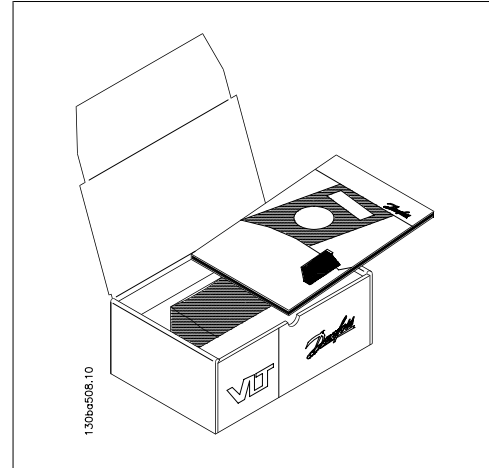


Illustration 2.1: Content of box.

2.2. Side-by-Side Installation

The Danfoss VLT Micro Drive can be mounted side-by-side for IP 20 rating units and requires 100 mm clearance above and below for cooling. Regarding surroundings in general, please see chapter 7. *Specifications*.

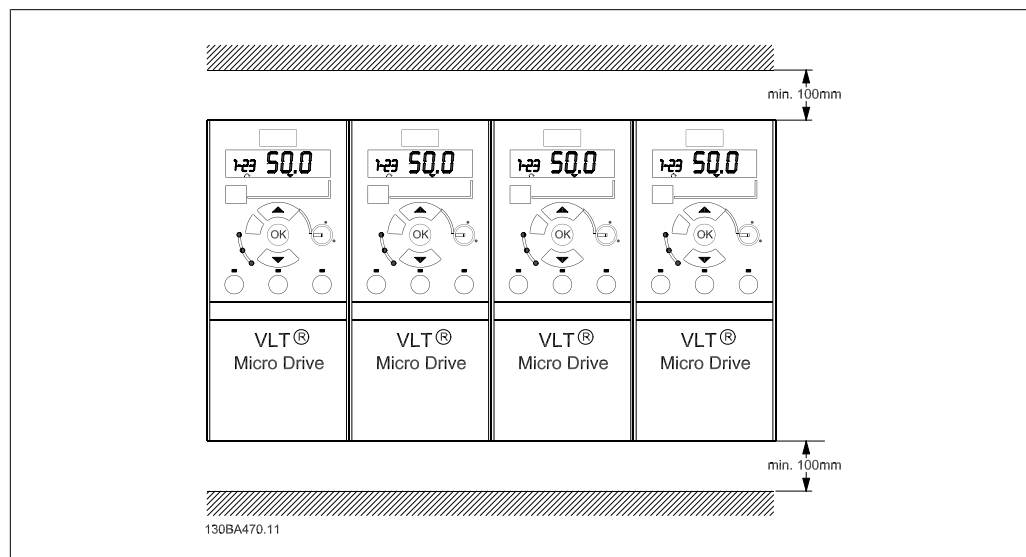


Illustration 2.2: Side-by-side installation.

2.3.1. Mechanical Dimensions

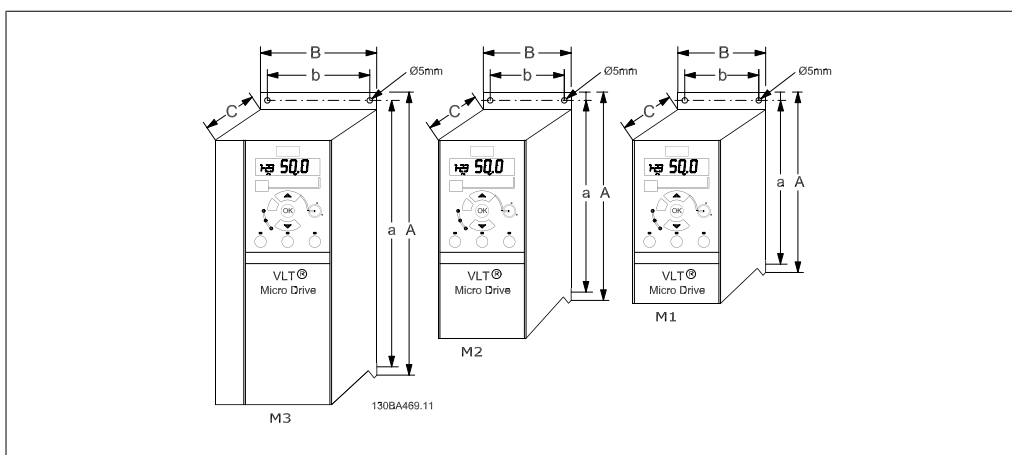


Illustration 2.3: Mechanical dimensions.



NB!

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

	Power (kW)			Height (mm)			Width (mm)		Depth ¹⁾ (mm)	Max. Weight
Frame	1 X 200-240 V	3 X 200 -240 V	3 X 380-480 V	A	A (incl. de- coupling 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	2)	2)	2)	2)	2)	2)	2)

Table 2.1: Mechanical Dimensions

¹⁾ For LCP with potentiometer, please add 7.6 mm.²⁾ These dimensions will be announced at a later point.

NB!

DIN rail mounting kit is available for M1. Please use ordering number 132B0111

3. Electrical Installation

3.1. How to Connect

3.1.1. Electrical Installation in General



NB!

All cabling must comply with national and local regulations on cable cross-sections and ambient temperature. Copper conductors required, (60-75° C) recommended.

Details of terminal tightening torques.

Frame	Power (kW)			Torque (Nm)					
	1 x 200-240 V	3 x 200-240 V	3 x 380-480 V	Line	Motor	DC connection/ Brake ¹⁾	Control Terminals	Earth	Relay
M1	0.18 - 0.75	0.25 - 0.75	0.37 - 0.75	1.4	0.7	-	0.15	3	0.5
M2	1.5	1.5	1.5 - 2.2	1.4	0.7	-	0.15	3	0.5
M3	2.2	2.2 - 3.7	3.0 - 7.5	1.4	0.7	-	0.15	3	0.5
¹⁾ Spade connectors									

Table 3.1: Tightening of terminals.

3.1.2. Fuses

Branch circuit protection:

In order to protect the installation against electrical and fire hazard, all branch circuits in an installation, switch gear, machines etc., must be short-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 frequency converter 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.

NonUL compliance:

If UL/cUL is not to be complied with, Danfoss recommends using the fuses mentioned in table 1.3, which will ensure compliance with EN50178:

In case of malfunction, not following the fuse recommendation may result in damage to the frequency converter.

FC 51	Bussmann	Bussmann	Bussmann	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut	Max. fuses non UL
1 X 200-240 V							
kW	Type RK1	Type J	Type T	Type RK1	Type CC	Type RK1	Type gG
0K18	-	KTN-R15	JKS-15	JJN-15	KLN-R15	ATM-R15	A2K-15R
0K37							15A
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	45A
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	15A
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-R30	JKS-30	JJN-30	KLN-R30	ATM-R30	A2K-30R	30A
3K7	KTN-R45	JKS-45	JJN-45	KLN-R45	-	A2K-45R	45A
3 x 380-480 V							
0K37	-	KTS-R10	JJS-10	KLS-R10	ATM-R10	A6K-10R	10A
0K75							
1K5	KTS-R15	JKS-15	JJS-15	KLS-R15	ATM-R15	A2K-15R	15A
2K2	KTS-R20	JKS-20	JJS-20	KLS-R20	ATM-R20	A6K-20R	20A
3K0	KTS-R25	JKS-25	JJS-25	KLS-R25	ATM-R25	A6K-25R	25A
4K0	KTS-R30	JKS-30	JJS-30	KLS-R30	ATM-R30	A6K-30R	30A
5K5	KTS-R35	JKS-35	JJS-35	KLS-R35	-	A6K-35R	35A
7K5	KTS-R45	JKS-45	JJS-45	KLS-R45	-	A6K-45R	45A

Table 3.2: Fuses

3.1.3. EMC-Correct Installation

Following these guidelines is advised, where compliance with EN 61000-6-3/4, EN 55011 or EN 61800-3 *First environment* is required. If the installation is in EN 61800-3 *Second environment*, then it is acceptable to deviate from these guidelines. It is however not recommended.

Good engineering practice to ensure EMC-correct electrical installation:

- Use only braided screened/armoured motor cables and control cables.
The screen should provide a minimum coverage of 80%. The screen material must be metal, not limited to but typically copper, aluminium, steel or lead. There are no special requirements for the mains cable.
- Installations using rigid metal conduits are not required to use screened cable, but the motor cable must be installed in conduit separate from the control and mains cables. Full connection of the conduit from the drive to the motor is required. The EMC performance of flexible conduits varies a lot and information from the manufacturer must be obtained.
- Connect the screen/armour/conduit to earth at both ends for motor cables and control cables.
- Avoid terminating the screen/armour with twisted ends (pigtailed). Such a termination increases the high frequency impedance of the screen, which reduces its effectiveness at high frequencies. Use low impedance cable clamps or glands instead.
- Ensure good electrical contact between the de-coupling plate and the metal chassis of the frequency converter, see Instruction MI.02.BX.YY
- Avoid using unscreened/unarmoured motor or control cables inside cabinets housing the drive(s), where possible.

3.2. Mains Connection

3.2.1. Connecting to Mains

Step 1: First mount earth cable.

Step 2: Mount wires in terminals L1/L, L2 and L3/N and tighten.

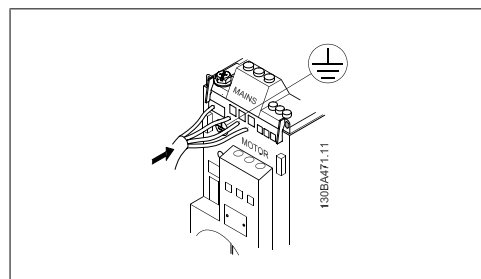


Illustration 3.1: Mounting of earth cable and mains wires.

For 3-phase connection, connect wires to all three terminals.

For single-phase connection, connect wires to terminals L1/L and L3/N.

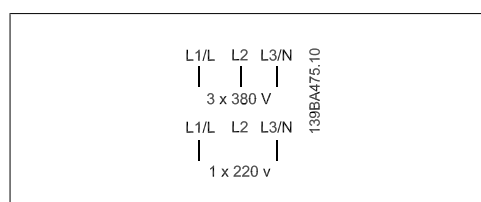


Illustration 3.2: Three-phase and single-phase wire connections.

3.3. Motor Connection

3.3.1. How to Connect the Motor

See the chapter *Specifications* for correct dimensioning of motor cable cross-section and length.

- 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.

All types of three-phased asynchronous standard motors can be connected to the frequency converter. Normally, small motors are star-connected (230/400 V, Δ/Y). Large motors are delta-connected (400/690 V, Δ/Y). Refer to motor nameplate for correct connection and voltage.

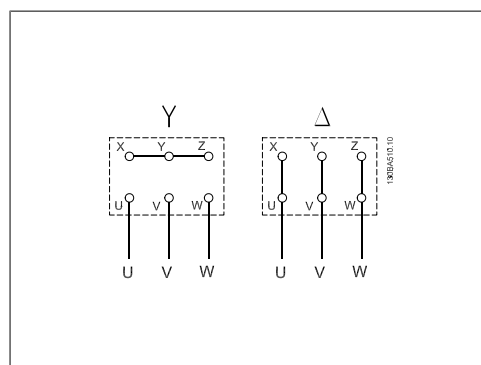


Illustration 3.3: Star and delta connections.

Step 1: First, mount the earth cable.

Step 2: Connect wires to terminals either in star or delta-connection. See motor name-plate for further information.

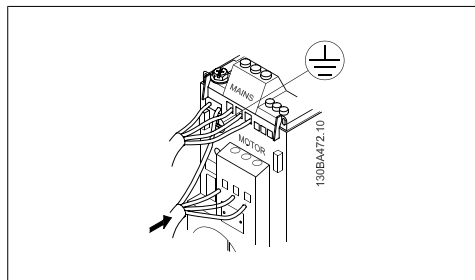


Illustration 3.4: Mounting of earth cable and motor wires.

For EMC correct installation, use optional de-coupling plate, see chapter *Options for VLT Micro Drive FC 51*.

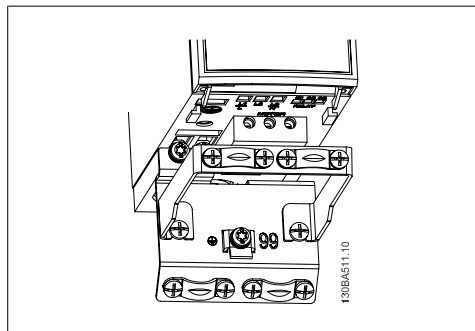


Illustration 3.5: VLT Micro Drive with de-coupling plate

3.4. Control Terminals

3.4.1. Access to Control Terminals

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

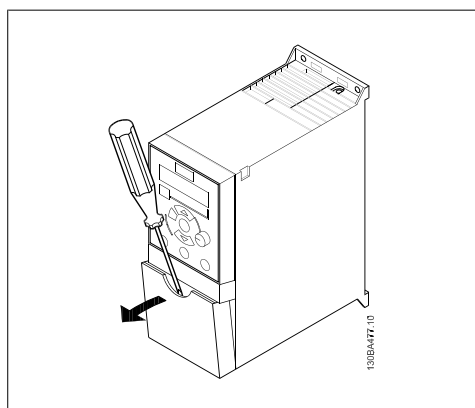


Illustration 3.6: Removing terminal cover.

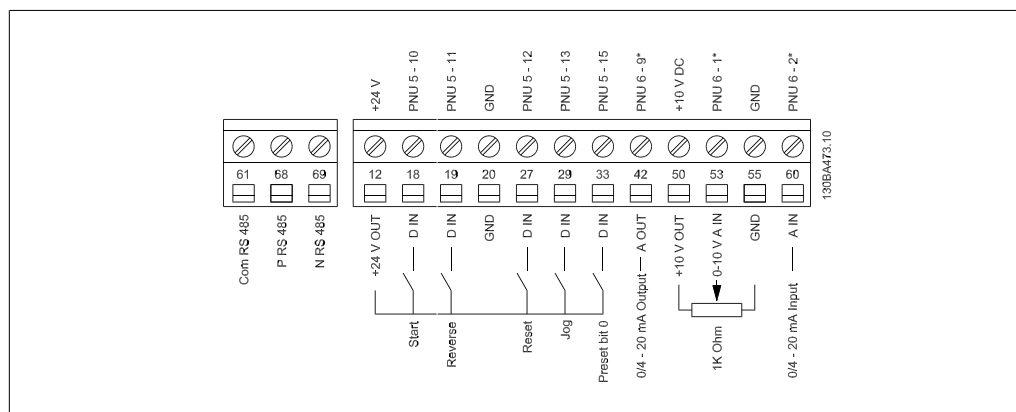


NB!

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

3.4.2. Connecting to Control Terminals

This illustration shows all control terminals of the VLT Micro Drive. Applying Start (term. 18) and an analog reference (term. 53 or 60) make the frequency converter run.



3.6. Power Circuit - Overview

3.6.1. Power Circuit - Overview

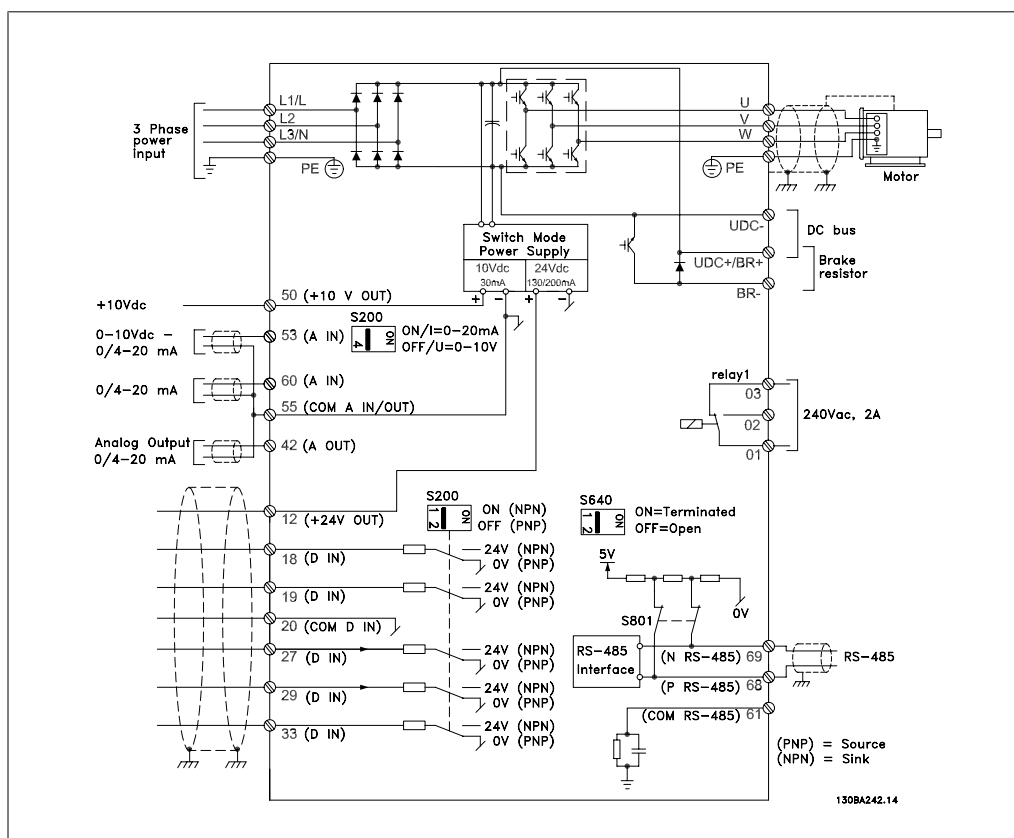


Illustration 3.10: Diagram showing all electrical terminals.

Brake not applicable for frame M1.

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.

3.6.2. Load sharing/ Brake

Use 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+.



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

4. Programming

4.1. How to Programme

4.1.1. Programming with MCT-10

The frequency converter can 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.danfoss.com, Business Area: Motion Controls.

Please refer to manual MG.10.RX.YY.

4.1.2. Programming with LCP 11 or LCP 12

The LCP is divided into four functional groups:

1. Numeric display.
2. Menu key.
3. Navigation keys.
4. Operation keys and indicator lights (LEDs).

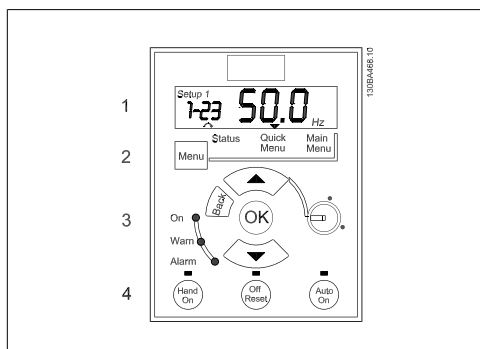


Illustration 4.1: LCP 12 with potentiometer

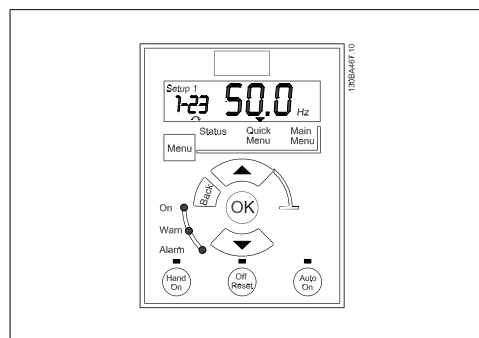


Illustration 4.2: LCP 11 without potentiometer

The display:

A number of information can be read from the display.

Set-up number shows the active set-up and the edit set-up. If the same set-up acts as both active and edit set-up, only that set-up number is shown (factory setting).

When active and edit set-up differ, both numbers are shown in the display (Setup 12). The number flashing, indicates the edit set-up.

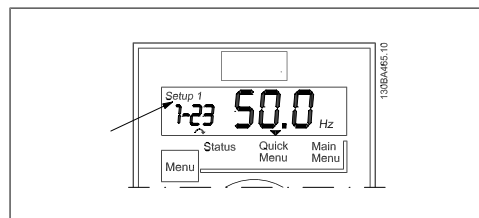


Illustration 4.3: Indicating Set-up

The small digits to the left are the selected parameter number .

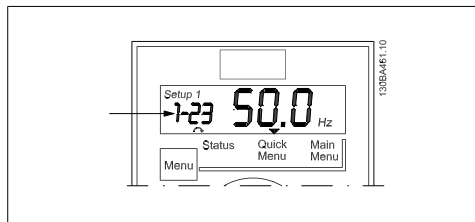


Illustration 4.4: Indicating selected par. no.

The large digits in the middle of the display show the value of the selected parameter.

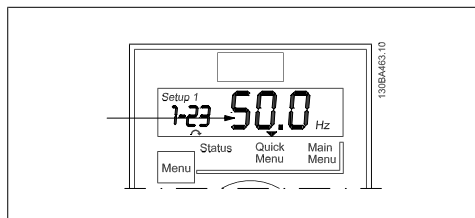


Illustration 4.5: Indicating value of selected par.

The right side of the display shows the unit of the selected parameter. This can be either Hz, A, V, kW, HP, %, s or RPM.

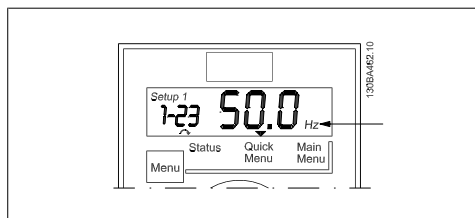


Illustration 4.6: Indicating unit of selected par.

Motor direction is shown to the bottom left of the display - indicated by a small arrow pointing either clockwise or counterclockwise.

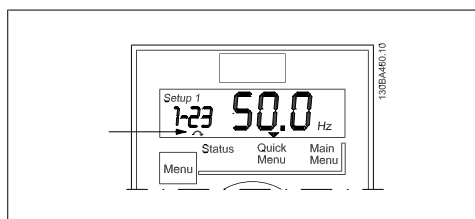


Illustration 4.7: Indicating motor direction

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

Status Menu:

The Status Menu is either in *Readout Mode* or *Hand on Mode*. In *Readout Mode* the value of the currently selected readout parameter is shown in the display.

In *Hand on Mode* the local LCP reference is displayed.

Quick Menu:

Displays Quick Menu parameters and their settings. Parameters in the Quick Menu can be accessed and edited from here. Most applications can be run by setting the parameters in the Quick Menus.

Main Menu:

Displays Main Menu parameters and their settings. All parameters can be accessed and edited here. A parameter overview is found later in this chapter. For detailed information on programming, please see *Programming Guide*, MG02CXYY.

Indicator lights:

- Green LED: Power is on the frequency converter.
- Yellow LED: Indicates a warning.
- Flashing red LED: Indicates an alarm.

Navigation Keys:

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

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

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

Operation Keys:

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

[Hand on]: Starts the motor and enables control of the frequency converter via the LCP.

[Off/ Reset]: The motor stops except in alarm mode. In that case the motor will be reset.

[Auto on]: The frequency converter is controlled either via control terminals or serial communication.

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

In *Auto Mode* the potentiometer acts as an extra programmable analog input.

In *Hand on Mode* the potentiometer controls local reference.

4.2. Status Menu

After power up the Status Menu is active. Use the [MENU] key to toggle between Status, Quick Menu and Main Menu.

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

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

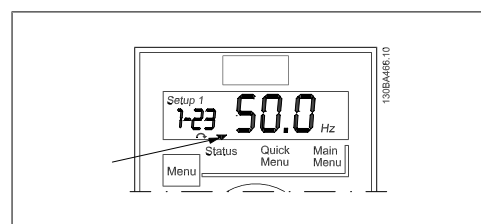


Illustration 4.8: Indicating Status mode

4.3. Quick Menu

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

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

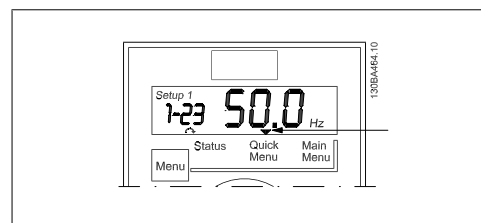


Illustration 4.9: Indicating Quick Menu mode

4.4. Quick Menu Parameters

4.4.1. Quick Menu Parameters - Basic Settings QM1

Below are descriptions of all parameters found in the Quick Menu.

* = Factory setting.

1-20 Motor Power [kW]/ [HP] ($P_{m.n}$)

Range:

Function:

Enter motor power from nameplate data.

[0.09 kW/0.12 HP -
11 kW/15 HP]

Two sizes down, one size up from nominal VLT rating.



NB!

Changing this parameter affects par. 1-22 to 1-25,
1-30, 1-33 and 1-35.

1-22 Motor Voltage ($U_{m.n}$)

Range:

Function:

230/400 [50 - 999 V]
V

Enter motor voltage from nameplate data.

1-23 Motor Frequency ($f_{m.n}$)

Range:

Function:

50 Hz* [20-400 Hz]

Enter motor frequency from nameplate data.

1-24 Motor Current ($I_{m.n}$)

Range:

Function:

M-type [0.01 - 26.00 A]
depend-
ent*

Enter motor current from nameplate data.

1-25 Motor Nominal Speed ($n_{m.n}$)

Range:

Function:

M-type [100 - 9999 RPM]
Depend-
ent*

Enter motor nominal speed from nameplate data.

1-29 Automatic Motor Tuning (AMT)

Option:

Function:

Use AMT to optimize motor performance.



NB!

This parameter cannot be changed while motor
runs.

1. Stop VLT – make sure motor is at standstill
2. Choose [2] Enable AMT
3. Apply start signal
 - Via LCP: Press Hand On
 - Or in Remote On mode: Apply start signal on terminal 18

[0] *	Off	AMT function is disabled.
[2]	Enable AMT	AMT function starts running.



NB!

To gain optimum tuning of frequency converter, run AMT on a cold motor.

4

3-02 Minimum Reference

Range:	Function:
0.00* [-4999 - 4999]	Enter value for minimum reference.
	The sum of all internal and external references are clamped (limited) to the minimum reference value, par. 3-02.

3-03 Maximum Reference

Range:	Function:
	Maximum Reference is adjustable in the range Minimum Reference - 4999.
50.00* [-4999 - 4999]	Enter value for Maximum Reference.
	The sum of all internal and external references are clamped (limited) to the maximum reference value, par. 3-03.

3-41 Ramp1 Ramp-up Time

Range:	Function:
3.00 s* [0.05 - 3600 s]	Enter ramp-up time from 0 Hz to rated motor frequency ($f_{M,N}$) set in par. 1-23.
	Choose a ramp-up time ensuring that torque limit is not exceeded, see par. 4-16.

3-42 Ramp1 Ramp-down Time

Range:	Function:
3.00* [0.05 - 3600 s]	Enter ramp down time from rated motor frequency ($f_{M,N}$) in par. 1-23 to 0 Hz.
	Choose a ramp down time that does not cause over-voltage in inverter due to regenerative operation of motor. Furthermore, regenerative torque must not exceed limit set in par. 4-17.

4.4.2. Quick Menu Parameters - PI Basic Settings QM2

The following is a brief description of the parameters for the PI Basic Settings. For a more detailed description, please see *VLT Micro Drive Programming Guide*, MG.02.CX.YY.

1-00 Configuration Mode

Range:	Function:
[]	Choose [3] Process Closed Loop

3-02 Min. Reference

Range:	Function:
[-4999 - 4999]	Sets limits for set-point and feedback.

3-03 Max. Reference

Range:	Function:
[-4999 - 4999]	Sets limits for set-point and feedback.

3-10 Preset Reference

Range:	Function:
[-100.00 - 100.00]	Preset [0] works as set-point.

4-12 Motor Speed Low Limit

Range:	Function:
[0.0 - 400 Hz]	Lowest possible output frequency.

4-14 Motor Speed High Limit

Range:	Function:
[0.0 - 400.00 Hz]	Highest possible output frequency.



NB!
Default 65 Hz should normally be reduced to 50 - 55 Hz.

6-22 Terminal 60 Low Current

Range:	Function:
[0.00 - 19.99 mA]	Normally set to 0 or 4 mA.

6-23 Terminal 60 High Current

Range:	Function:
[0.01 - 20.00 mA]	Normally (default) set to 20 mA.

6-24 Terminal 60 Low Feedback Value

Range:	Function:
[-4999 - 4999]	Value corresponding to P. 6-22 setting.

6-25 Terminal 60 High Feedback Value

Range:	Function:
[-4999 - 4999]	Value corresponding to P. 6-23 setting.

6-26 Terminal 60 Filter Time Constant

Range:	Function:
[0.01 - 10.00 s]	Noise suppressing filter.

7-20 Process CL Feedback Resource

Range:	Function:
[]	Choose [2] analog input 60.

7-30 Process PI Normal/ Inverse

Range:	Function:
[]	Most PI controllers are "Normal".

7-31 Process PI Anti Windup

Range:	Function:
[]	Leave <i>Enabled</i> normally.

7-32 Process PI Start Speed

Range:	Function:
[0.0 - 200.0 Hz]	Choose expected normal running speed.

7-33 Process PI Proportional Gain

Range:	Function:
[0.00 - 10.00]	Enter the P-factor.

7-34 Process PI Integral Time

Range:	Function:
[0.10 - 9999.00 s]	Enter the I-factor.

7-38 Process Feed Forward Factor

Range:	Function:
[0 - 400%]	Only applicable with changing set-points.

4.5. Main Menu

The Main Menu gives access to all parameters.

1. To enter the Main Menu, press [MENU] key until 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*.

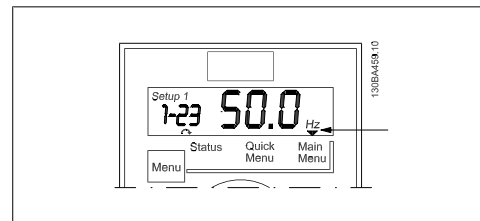


Illustration 4.10: Indicating Main Menu mode

5. Parameter Overview

Parameter Overview		
0-**- Operation/Display 0-0* 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 0-1* Set-up Handling 0-10 Active Set-up *[1] Setup 1 [2] Setup 2 [9] Multi Setup 0-11 Edit Set-up *[1] Setup 1 [2] Setup 2 [9] Active Setup 0-12 Link Setups [0] Not Linked *[20] Linked 0-4* LCP Keypad 0-40 [Hand on] Key on LCP [0] Disabled *[1] Enabled [0] [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 0-5* Copy/Save 0-50 LCP Copy *[0] No copy [1] All to LCP [2] All from LCP [3] Size indep. from LCP *[0] No copy [1] Copy from setup 1 [2] Copy from setup 2 [9] Copy from Factory setup 0-6* Password 0-60 (Main) Menu Password 0 - 999 * 0 1-**- Load/Motor	1-0* General Settings 1-00 Configuration Mode *[0] Speed open loop [3] Process 1-01 Motor Control Principle [0] U/f *[1] V/C+ 1-03 Torque Characteristics *[0] Constant torque [2] Automatic Energy Optim. 1-05 Local Mode Configuration [0] Speed Open Loop *[2] As config in param. 1-00 1-2* Motor Data 1-20 Motor Power [kW] [HP] 0.09 kW / 0.12 HP ... 11 kW / 15 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 - 26.00 A * Motortype dep. 1-25 Motor Nominal Speed 100 - 9999 rpm * Motortype dep. 1-29 Automatic Motor Tuning (AMT) *[0] Off [2] Enable AMT 1-3* 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 1-5* Load/Indep. Setting 1-50 Motor Magnetisation 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 1-60 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 1-7* 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 1-8* 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 1-9* Motor Temperature 1-90 Motor Thermal Protection *[0] No protection [1] Thermistor warning [2] Thermistor trip [4] Etr trip 1-93 Thermistor Resource *[0] None [1] Analog input 53 [6] Digital input 29 2-**- Brakes 2-0* DC-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 2-1* Brake Energy Funct. 2-10 Brake Function *[0] Off

3-17 Reference Resource 3	4-17 Torque Limit Generator Mode	5-11 Terminal 19 Digital Input	[70-73] Logic rule 0-3
[0] No function	0 - 400 % * 100 %	See par. 5-10. * [10] Reversing	[81] SL digital output B
[1] Analog input 53	4-5* <i>Adj. Warnings</i>	5-12 Terminal 27 Digital Input	5-5* <i>Pulse Input</i>
[2] Analog input 60	4-50 Warning Current Low	See par. 5-10. * [11] Reset	5-55 Terminal 33 Low Frequency
[8] Pulse input 33	0.00 - 26.00 A * 0.00 A	5-13 Terminal 29 Digital Input	20 - 4999 Hz * 20 Hz
*[11] Local bus ref	4-51 Warning Current High	See par. 5-10. * [14] Jog	5-56 Terminal 33 High Frequency
[21] Lcp Potentiometer	0.00 - 26.00 A * 26.00 A	5-15 Terminal 33 Digital Input	21 - 5000 Hz * 5000 Hz
3-18 Relative Scaling Ref. Resource	4-58 Missing Motor Phase Function	See par. 5-10. * [16] Preset ref bit 0	5-57 Term. 33 Low Ref./ Feedb. Value
*[0] No function	[0] Off	[26] Precise Stop Inverse	-4999 - 4999 * 0.000
[1] Analog input 53	*[1] On	[27] Start, Precise Stop	5-58 Term. 33 High Ref./ Feedb. Value
[2] Analog input 60	4-6* <i>Speed Bypass</i>	[32] Pulse Input	-4999 - 4999 * 50.000
[8] Pulse input 33	4-61 Bypass Speed From [Hz]	5-4* <i>Relays</i>	6-** <i>Analog In/Out</i>
[11] Local bus ref	0.0 - 400.0 Hz * 0.0 Hz	5-40 Function Relay	6-0* <i>Analog I/O Mode</i>
[21] Lcp Potentiometer	4-63 Bypass Speed To [Hz]	*[0] No operation	6-00 Live Zero Timeout Time
3-4* <i>Ramp 1</i>	0.0 - 400.0 Hz * 0.0 Hz	[1] Control ready	1 - 99 s * 10 s
3-40 Ramp 1 Type	5-1* <i>Digital Inputs</i>	[2] Drive ready	6-01 Live Zero TimeoutFunction
*[0] Linear	5-10 Terminal 18 Digital Input	[3] Drive ready, Remote	*[0] Off
[2] Sine2 ramp	[0] No function	[4] Enable / No warning	[1] Freeze output
3-41 Ramp 1 Ramp up Time	[1] Reset	[5] Drive running	[2] Stop
0.05 - 3600 s * 3.00 s	[2] Coast inverse	[6] Running / No warning	[3] Jogging
3-42 Ramp 1 Ramp Down Time	[3] Coast and reset inv.	[7] Run in range / No warning	[4] Max speed
0.05 - 3600 s * 3.00 s	[4] Quick stop inverse	[8] Run on ref / No warning	[5] Stop and trip
3-5* <i>Ramp 2</i>	[5] DC-brake inv.	[9] Alarm	6-1* <i>Analog Input 1</i>
3-50 Ramp 2 Type	[6] Stop inv	[10] Alarm or warning	6-10 Terminal 53 Low Voltage
*[0] Linear	*[8] Start	[12] Out of current range	0.00 - 9.99 V * 0.07 V
[2] Sine2 ramp	[9] Latched start	[13] Below current, low	6-11 Terminal 53 High Voltage
3-51 Ramp 2 Ramp up Time	[10] Reversing	[14] Above current, high	0.01 - 10.00 V * 10.00 V
0.05 - 3600 s * 3.00 s	[11] Start reversing	[21] Thermal warning	6-12 Terminal 53 Low Current
3-52 Ramp 2 Ramp down Time	[12] Enable start forward	[22] Ready, No thermal warning	0.00 - 19.99 mA * 0.14 mA
0.05 - 3600 s * 3.00 s	[13] Enable start reverse	[23] Remote ready, No thermal warning	6-13 Terminal 53 High Current
3-8* <i>Other Ramps</i>	[14] Jog	[24] Ready, Voltage ok	0.01 - 20.00 mA * 20.00 mA
3-80 Jog Ramp Time	[16-18] Preset ref bit 0-2	[25] Reverse	6-14 Term. 53 Low Ref./ Feedb. Value
0.05 - 3600 s * 3.00 s	[19] Freeze reference	[26] Bus ok	-4999 - 4999 * 0.000
3-81 Quick Stop Ramp Time	[20] Freeze output	[28] Brake, NoWarn	6-15 Term. 53 High Ref./ Feedb. Value
0.05 - 3600 s * 3.00 s	[21] Speed up	[29] Brake ready/NoFault	-4999 - 4999 * 50.000
4-** <i>Limits / Warnings</i>	[22] Speed down	[30] BrakeFault (IGBT)	6-16 Terminal 53 Filter Time Constant
4-1* <i>Motor Limits</i>	[23] Setup select bit 0	[32] Mech.brake control	0.01 - 10.00 s * 0.01 s
4-10 Motor Speed Direction	[28] Catch up	[36] Control word bit 11	6-19 Terminal 53 mode
[0] Clockwise	[29] Slow down	[51] Local ref. active	*[0] Voltage mode
[1] CounterClockwise	[34] Ramp bit 0	[52] Remote ref. active	[1] Current mode
[2] Both	[60] Counter A (up)	[53] No alarm	6-2 <i>Analog Input 2</i>
4-12 Motor Speed Low Limit [Hz]	[61] Counter A (down)	[54] Start cmd active	6-22 Terminal 60 Low Current
0.0 - 400.0 Hz * 0.0 Hz	[62] Reset counter A	[55] Running reverse	0.00 - 19.99 mA * 0.14 mA
4-14 Motor Speed High Limit [Hz]	[63] Counter B (up)	[56] Drive in hand mode	6-23 Terminal 60 High Current
0.1 - 400.0 Hz * 65.0 Hz	[64] Counter B (down)	[57] Drive in auto mode	0.01 - 20.00 mA * 20.00 mA
4-16 Torque Limit Motor Mode	[65] ResetCounter B	[60-63] Comparator 0-3	
0 - 400 % * 150 %			

6-24 Term. 60 Low Ref./Feedb. Value -4999 - 4999 * 0.000	7-31 Process PI Anti Windup [0] Disable *[1] Enable	8-33 FC Port Parity *[0] Even Parity, 1 Stop Bit [1] Odd Parity, 1 Stop Bit	[8] BelowLow
6-25 Term. 60 High Ref./Feedb. Value -4999 - 4999 * 50.00	7-32 Process PI Start Speed 0.0 - 200.0 Hz * 0.0 Hz	[2] No Parity, 1 Stop Bit	[9] AboveHigh
6-26 Terminal 60 Filter Time Constant 0.01 - 10.00 s * 0.01 s	7-33 Process PI Proportional Gain 0.00 - 10.00 * 0.01	[3] No Parity, 2 Stop Bits	[16] ThermalWarning
6-8* <i>LCP pot/meter</i>	7-34 Process PI Integral Time 0.10 - 9999 s * 9999 s	8-35 Minimum Response Delay 0.001-0.5 * 0.010 s	[17] MainOutOfRange
6-81 LCP potm. Low Reference -4999 - 4999 * 0.000	7-38 Process PI Feed Forward Factor 0 - 400 % * 0 %	0.100 - 10.00 s * 5.000 s	[18] Reversing
6-82 LCP potm. High Reference -4999 - 4999 * 50.00	7-39 On Reference Bandwidth 0 - 200 % * 5 %	8-5* <i>Digital/Bus</i>	[19] Warning
6-9* <i>Analog Output xx</i>	8-0* <i>Comm. and Options</i>	8-50 Coasting Select	[20] Alarm_Trip
6-90 Terminal 42 Mode *[0] 0-20 mA	8-01 Control Site	[0] DigitalInput	[21] Alarm_TripLock
[1] 4-20 mA	*[0] Digital and ControlWord	[1] Bus	[22-25] Comparator 0-3
[2] Digital Output	[1] Digital only	[2] LogicAnd	[26-29] LogicRule0-3
6-91 Terminal 42 Analog Output *[0] No operation	[2] ControlWord only	*[3] LogicOr	[33] DigitalInput_18
[10] Output Frequency	[0] None	8-51 Quick Stop Select	[34] DigitalInput_19
[11] Reference	*[1] FC RS485	See par. 8-50 * [3] LogicOr	[35] DigitalInput_27
[12] Feedback	8-03 Control Word Timeout Time 0.1 - 6500 s * 1.0 s	8-52 DC Brake Select	[36] DigitalInput_29
[13] Motor Current	8-04 Control Word Timeout Function *[0] Off	See par. 8-50 * [3] LogicOr	[38] DigitalInput_33
[16] Power	[1] Freeze Output	8-53 Start Select	*[39] StartCommand
[20] BusControl	[2] Stop	8-54 Reversing Select	[40] DriveStopped
See par. 5-40	[3] Jogging	See par. 8-50 * [3] LogicOr	13-02 Stop Event
[80] SL Digital Output A	[4] Max. Speed	8-55 Set-up Select	See par. 13-01 * [40] DriveStopped
6-93 Terminal 42 Output Min Scale 0.00 - 200.0 % * 0.00 %	[5] Stop and trip	8-56 Preset Reference Select	13-03 Reset SLC
6-94 Terminal 42 Output Max Scale 0.00 - 200.0 % * 100.0 %	8-06 Reset Control Word Timeout *[0] No Function	See par. 8-50 * [3] LogicOr	*[0] Do not reset
7-2* <i>Contrallers</i>	[1] Do reset	8-9* <i>Bus Jog / Feedback</i>	[1] Reset SLC
7-2* <i>Process Ctrl. Feedb</i>	8-3* <i>FC Port Settings</i>	0x8000 - 0x7FFF * 0	13-1* <i>Comparators</i>
7-20 Process CL Feedback 1 Resource	8-30 Protocol	13-0* <i>SLC Settings</i>	13-10 Comparator Operand
*[0] NoFunction	*[0] FC	13-00 SL Controller Mode	*[0] Disabled
[1] Analog Input 53	8-31 Address	*[0] On	[1] Reference
[2] Analog input 60	1 - 247 * 1	13-01 Start Event	[2] Feedback
[8] PulseInput33	8-32 FC Port Baud Rate	[0] False	[3] MotorSpeed
[11] LocalBusRef	[0] 2400 Baud	[1] True	[4] MotorCurrent
7-3* <i>Process PI</i>	[1] 4800 Baud	[2] Running	[6] MotorPower
Ctrl. 7-30 Process PI Normal/ Inverse Ctrl	*[2] 9600 Baud	[3] InRange	[7] MotorVoltage
*[0] Normal		[4] OnReference	[8] DCLinkVoltage
[1] Inverse		[7] OutOfCurrentRange	[12] AnalogInput53
			[13] AnalogInput60
			[18] PulseInput33
			[20] AlarmNumber
			[30] CounterA
			[31] CounterB
			13-11 Comparator Operator
			[0] Less Than

[1] Approximately equals	[31] StartTimer2	15-04 Over Temps	16-3 Drive Status
[2] Greater Than	[32] Set Digital Output A Low	15-05 Over Volts	16-30 DC Link Voltage
13-12 Comparator Value	[33] Set Digital Output B Low	15-06 Reset kWh Counter	16-36 Inv. Nom. Current
-9999 - 9999 * 0.0	[38] Set Digital Output A High	*[0] Do not reset	16-37 Inv. Max. Current
13-2* Timers	[39] Set Digital Output B High	[1] Reset counter	16-38 SL Controller State
13-20 SL Controller Timer	[60] ResetCounterA	15-07 Reset Running Hours Counter	16-5* Ref. / Feedb.
0.0 - 3600 s * 0.0 s	[61] ResetCounterB	*[0] Do not reset	16-50 External Reference
13-4* Logic Rules	14-* Special Functions	[1] Reset counter	16-51 Pulse Reference
13-40 Logic Rule Boolean 1	14-0* Inverter Switching	15-3* Fault Log	16-52 Feedback [Unit]
See par. 13-01 * [0] False	14-01 Switching Frequency	15-30 Fault Log: Error Code	16-6* Inputs / Outputs
[30] - [32] SL Time-out 0-2	[0] 2 kHz	15-4* Drive Identification	16-60 Digital Input 18,19,27,33
13-41 Logic Rule Operator 1	*[1] 4 kHz	15-40 FC Type	0 - 1111
*[0] Disabled	[2] 8 kHz	15-41 Power Section	16-61 Digital Input 29
[1] And	[4] 16 kHz	15-42 Voltage	0 - 1
[2] Or	14-03 Overmodulation	15-43 Software Version	16-62 Analog Input 53 (volt)
[3] And not	[0] Off	15-46 Frequency Converter Order. No	16-63 Analog Input 53 (current)
[4] Or not	*[1] On	15-48 LCP Id No	16-64 Analog Input 60
[5] Not and	14-1* Mains monitoring	15-51 Frequency Converter Serial No	16-65 Analog Output 42 [mA]
[6] Not or	14-12 Function at mains imbalance	16-* Data Readouts	16-68 Pulse Input [Hz]
[7] Not and not	*[0] Trip	16-0* General Status	16-71 Relay Output [bin]
[8] Not or not	[1] Warning	16-00 Control Word	16-72 Counter A
13-42 Logic Rule Boolean 2	[2] Disabled	0 - 0XFFFF	16-73 Counter B
See par. 13-40	14-2* Trip Reset	-4999 - 4999	16-8* Fieldbus / FC Port
13-43 Logic Rule Operator 2	14-20 Reset Mode	16-02 Reference %	0x8000 - 0x7FFF
See par. 13-41 * [0] Disabled	*[0] Manual reset	-200.0 - 200.0 %	16-9* Diagnosis Readouts
13-44 Logic Rule Boolean 3	[1-9] AutoReset 1-9	16-03 Status Word	0 - 0XFFFFFFF
See par. 13-40	[10] AutoReset 10	0 - 0XFFFF	16-90 Alarm Word
13-5* States	[11] AutoReset 15	16-05 Main Actual Value [%]	0 - 0XFFFFFFF
13-51 SL Controller Event	[12] AutoReset 20	16-1* Motor Status	16-92 Warning Word
See par. 13-40	[13] Infinite auto reset	16-10 Power [kW]	0 - 0XFFFFFFF
13-52 SL Controller Action	14-21 Automatic Restart Time	16-11 Power [hp]	16-94 Ext. Status Word
*[0] Disabled	0 - 600 s * 10 s	16-12 Motor Voltage [V]	0 - 0XFFFFFFF
[1] NoAction	14-22 Operation Mode	16-13 Frequency [Hz]	
[2] SelectSetup1	*[0] Normal Operation	16-14 Motor Current [A]	
[3] SelectSetup2	[2] Initialisation	16-15 Frequency [%]	
[10-17] SelectPresetRef0-7	14-26 Action At Inverter Fault	16-18 Motor Thermal [%]	
[18] SelectRamp1	*[0] Trip		
[19] SelectRamp2	[1] Warning		
[22] Run	14-4* Energy Optimising		
[23] RunReverse	14-41 AEO Minimum Magnetisation		
[24] Stop	40 - 75 % * 66 %		
[25] Qstop	15-* Drive Information		
[26] DCstop	15-0* Operating Data		
[27] Coast	15-00 Operating Days		
[28] FreezeOutput	15-01 Running Hours		
[29] StartTimer0	15-02 kWh Counter		
[30] StartTimer1	15-03 Power Ups		

6. Troubleshooting

No.	Description	Warning	Alarm	Trip Lock	Cause of Problem
2	Live zero error	X	X		Signal on terminal 53 or 60 is less than 50% of value set in par. 6-10, 6-12 and 6-22.
4	Mains phase loss ¹⁾	X	X	X	Missing phase on supply side, or too high voltage imbalance. Check supply voltage.
7	DC over voltage ¹⁾	X	X		Intermediate circuit voltage exceeds limit.
8	DC under voltage ¹⁾	X	X		Intermediate circuit voltage drops below "voltage warning low" limit.
9	Inverter overloaded	X	X		More than 100% load for too long.
10	Motor ETR over temperature	X	X		Motor is too hot due to more than 100% load for too long.
11	Motor thermistor over temperature	X	X		Thermistor or thermistor connection is disconnected.
12	Torque limit	X	X		Torque exceeds value set in either par. 4-16 or 4-17.
13	Over Current	X	X	X	Inverter peak current limit is exceeded.
14	Earth 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 frequency converter.
25	Brake resistor short-circuited		X	X	Brake resistor is short-circuited, thus brake function is disconnected.
27	Brake chopper short-circuited		X	X	Brake transistor is short-circuited, thus brake function is disconnected.
28	Brake check		X		Brake resistor is not connected/working
29	Power board over temp	X	X	X	Heat-sink 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.
47	Control Voltage Fault	X	X	X	24 V DC may be overloaded.
51	AMT check U_{nom} and I_{nom}		X		Wrong setting for motor voltage, motor current and motor voltage.
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 "release brake" current within "start delay" time window.
80	Drive Initialised to Default Value		X		All parameter settings are initialized to default settings.
¹⁾ These faults may be caused by mains distortions. Installing Danfoss Line Filter may rectify this problem.					

Table 6.1: Code list

7. Specifications

7.1. Mains Supply

7.1.1. Mains Supply 1 x 200 - 240 VAC

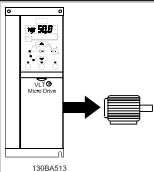
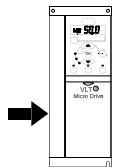
Normal overload 150% for 1 minute						
	Frame M1	Frame M1	Frame M1	Frame M2	Frame M3	
Frequency converter	P0K18	P0K37	P0K75	P1K5	P2K2	
Typical Shaft Output [kW]	0.18	0.37	0.75	1.5	2.2	
Typical Shaft Output [HP]	0.25	0.5	1	2	3	
Output current						
 130BA513	Continuous (3 x 200-240 V) [A]	1.2	2.2	4.2	6.8	TBD
	Intermittent (3 x 200-240 V) [A]	1.8	3.3	6.3	10.2	TBD
	Max. cable size:					
	(mains, motor) [mm ² /AWG]	4/10				
Max. input current						
 130BA512	Continuous (1 x 200-240 V) [A]	3.3	6.1	11.6	18.7	TBD
	Intermittent (1 x 200-240 V) [A]	4.5	8.3	15.6	26.4	TBD
	Max. pre-fuses [A]	See Section Fuses				
	Environment					
	Estimated power loss at rated load [W], Best case/Typical ¹⁾	12.5/15.5	20.0/25.0	36.5/44.0	61.0/67.0	TBD
	Weight enclosure IP20 [kg]	1.1	1.1	1.1	1.6	TBD
	Efficiency	95.6/94.5	96.5/95.6	96.6/96.0	97.0/96.7	TBD
	Best case/Typical ¹⁾	94.5	95.6	96.0	96.7	TBD

Table 7.1: Mains supply 1 x 200 - 240 VAC

7.1.2. Mains Supply 3 x 200 - 240 VAC

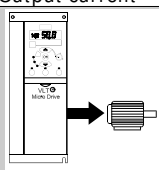
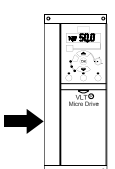
Normal overload 150% for 1 minute						
	Frame M1	Frame M1	Frame M1	Frame M2	Frame M3	Frame M3
Frequency converter	P0K25	P0K37	P0K75	P1K5	P2K2	P3K7
Typical Shaft Output [kW]	0.25	0.37	0.75	1.5	2.2	3.7
Typical Shaft Output [HP]	0.33	0.5	1	2	3	5
Output current						
 130BA513	Continuous (3 x 200-240 V) [A]	1.5	2.2	4.2	6.8	TBD
	Intermittent (3 x 200-240 V) [A]	2.3	3.3	6.3	10.2	TBD
	Max. cable size:					
	(mains, motor) [mm ² /AWG]	4/10				
Max. input current						
 130BA512	Continuous (3 x 200-240 V) [A]	2.4	3.5	6.7	10.9	TBD
	Intermittent (3 x 200-240 V) [A]	3.2	4.6	8.3	14.4	TBD
	Max. pre-fuses [A]	See Section <i>Fuses</i>				
	Environment					
	Estimated power loss at rated load [W], Best case/Typical ¹⁾	14.0/20.0	19.0/24.0	31.5/39.5	51.0/57.0	TBD
	Weight enclosure IP20 [kg]	1.1	1.1	1.1	1.6	TBD
	Efficiency	96.4/94.9	96.7/95.8	97.1/96.3	97.4/97.2	TBD
Best case/Typical ¹⁾						

Table 7.2: Mains supply 3 x 200 - 240 VAC

1. Power loss at rated load conditions.

7.1.3. Mains Supply 3 x 380 - 480 VAC

Normal overload 150% for 1 minute

Frequency converter Typical Shaft Output [kW]	P0K37 0.37	P0K75 0.75	P1K5 1.5	P2K2 2.2	P3K0 3.0	P4K0 4.0	P5K5 5.5	P7K5 7.5
Typical Shaft Output [HP]	0.5	1	2	3	4	5	7.5	10
IP 20	Frame M1	Frame M1	Frame M2	Frame M2	Frame M3	Frame M3	Frame M3	Frame M3
Output current	Frame M1	Frame M1	Frame M2	Frame M2	Frame M3	Frame M3	Frame M3	Frame M3
Continuous (3 x 380-440 V) [A]	1.2	2.2	3.7	5.3	TBD	TBD	TBD	TBD
Intermittent (3 x 380-440 V) [A]	1.8	3.3	5.6	8.0	TBD	TBD	TBD	TBD
Continuous (3 x 440-480 V) [A]	1.1	2.1	3.4	4.8	TBD	TBD	TBD	TBD
Intermittent (3 x 440-480 V) [A]	1.7	3.2	5.1	7.2	TBD	TBD	TBD	TBD
Max. cable size:								
(mains, motor) [mm ² / AWG]								
								4/10
Max. input current	Frame M1	Frame M1	Frame M2	Frame M2	Frame M3	Frame M3	Frame M3	Frame M3
Continuous (3 x 380-440 V) [A]	1.9	3.5	5.9	8.5	TBD	TBD	TBD	TBD
Intermittent (3 x 380-440 V) [A]	2.6	4.7	8.7	12.6	TBD	TBD	TBD	TBD
Continuous (3 x 440-480 V) [A]	1.7	3.0	5.1	7.3	TBD	TBD	TBD	TBD
Intermittent (3 x 440-480 V) [A]	2.3	4.0	7.5	10.8	TBD	TBD	TBD	TBD
Max. pre-fuses [A]								
Environment								
Estimated power loss at rated load [W]								
Best case/Typical ¹⁾	18.5/25.5	28.5/43.5	41.5/56.5	57.5/81.5	TBD	TBD	TBD	TBD
Weight enclosure IP20 [kg]	1.1	1.1	1.6	1.6	TBD	TBD	TBD	TBD
Efficiency								
Best case/Typical ¹⁾	96.8/95.5	97.4/96.0	98.0/97.2	97.9/97.1	TBD	TBD	TBD	TBD
1. Power loss at rated load conditions.								

Table 7.3: Mains supply 3 x 380 - 480 VAC

7.2. Other Specifications

Protection and Features:

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

Mains supply (L1/L, L2, L3/N):

Supply voltage	200-240 V $\pm 10\%$
Supply voltage	380-480 V $\pm 10\%$
Supply frequency	50/60 Hz
Max. imbalance temporary between mains phases	3.0 % of rated supply voltage
True Power Factor (λ)	≥ 0.4 nominal at rated load
Displacement Power Factor ($\cos\phi$) 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, screened/armoured (EMC correct installation)	15 m
Max. motor cable length, unscreened/unarmoured	50 m
Max. cross section to motor, mains, load sharing and brake *	
Maximum cross section to control terminals, rigid wire	1.5 mm ² /16 AWG (2 x 0.75 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

** See tables for mains supply for more information!*

Digital inputs (Pulse/enocder 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 Ω
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 level	0 - 10 V
Input resistance, R_i	approx. 10 k Ω
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
Accuracy on analog output	Max. error: 0.8 % of full scale
Resolution on analog output	8 bit

The analog output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

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

The RS-485 serial communication circuit is functionally separated from other central circuits and galvanically isolated from the supply voltage (PELV).

Control card, 24 V DC output:

Terminal number	12
Max. load	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 @ cos ϕ 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 @ cos ϕ 0.4)	250 V AC, 0.2A
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 $\pm$ 0.5 V
Max. load	25 mA

The 10 V DC supply is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Surroundings:

Enclosure	IP 20
Enclosure kit available	IP 21
Enclosure kit available	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. 40 °C

Derating for high ambient temperature, see section on special conditions

Minimum ambient temperature during full-scale operation	0 °C
Minimum ambient temperature at reduced performance	- 10 °C
Temperature during storage/transport	-25 - +65/70 °C
Maximum altitude above sea level without derating	1000 m
Maximum altitude above sea level with derating	3000 m

Derating for high altitude, see section on special conditions

EMC standards, Emission	EN 61800-3, EN 61000-6-3/4, EN 55011, IEC 61800-3
	EN 61800-3, EN 61000-6-1/2, EN 61000-4-2, EN 61000-4-3,
EMC standards, Immunity	EN 61000-4-4, EN 61000-4-5, EN 61000-4-6

See section on special conditions

7.3. Special Conditions

7.3.1. The Purpose of Derating

Derating must be taken into account when using the frequency converter at low air pressure (heights), at low speeds or at high ambient temperature. The required action is described in this section.

7.3.2. Derating for Ambient Temperature

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

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

The VLT Micro Drive FC 51 has been designed for operation at max 50 °C ambient temperature with one motor size smaller than nominal. Continuous operation at full load at 50 °C ambient temperature will reduce the lifetime of the frequency converter.

7.3.3. Derating for Low Air Pressure

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

For altitudes above 2000 m, please contact Danfoss Drives regarding PELV.

Below 1000 m altitude no de-rating is necessary but above 1000 m the ambient temperature or the maximum output current should be decreased.

Decrease the output by 1% per 100 m altitude above 1000 m or reduce the max. ambient temperature by 1 degree per 200 m

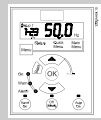
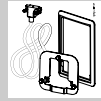
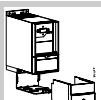
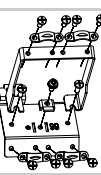
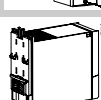
7.3.4. Derating for Running at Low Speeds

When a motor is connected to a frequency converter, it is necessary to 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 – below half the nominal motor speed – may require additional air cooling. Alternatively, choose a larger motor (one size up).

7.4. Options for VLT Micro Drive FC 51

7.4.1. Options for VLT Micro Drive FC 51

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. 3 m cable IP55 with LCP 11, IP21 with LCP 12	
132B0103	Nema Type 1 kit for M1 frame	
132B0104	Nema Type 1 kit for M2 frame	
132B0105	Nema 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	

Danfoss Line Filters and brake resistors are available upon request.

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