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1. Safety

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.

1

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 addtional 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.

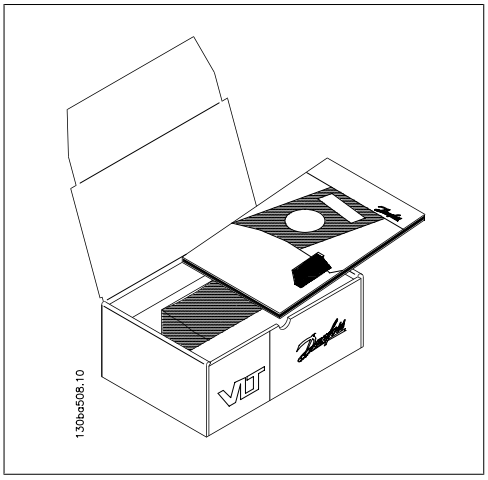

Illustration 2.1: Content of box.

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*.

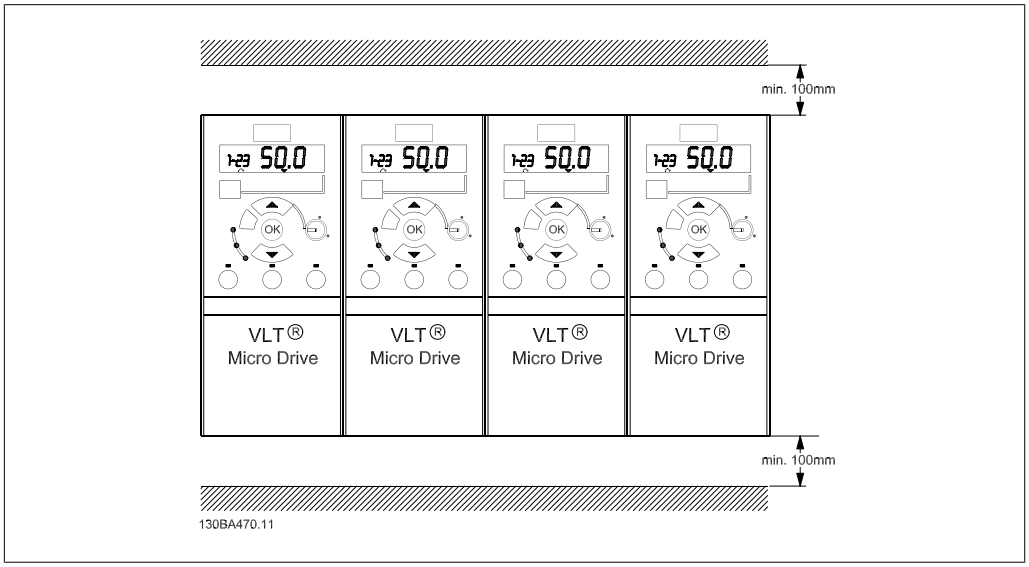

Illustration 2.2: Side-by-side installation.

2

2.3.1. Mechanical Dimensions

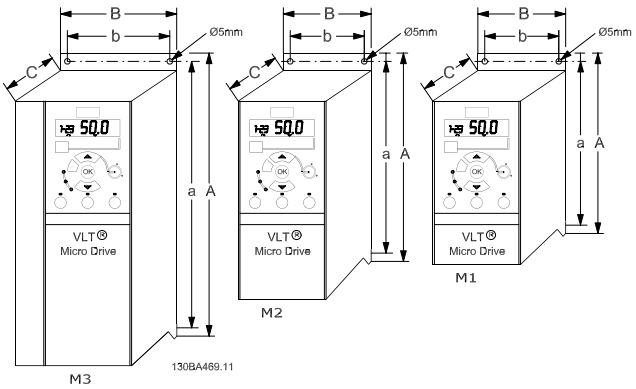

Illustration 2.3: Mechanical dimensions.

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.

	Power (kW)			Torque (Nm)					
Frame	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 - 0K37	KTN-R15	JKS-15	JJN-15	KLN-R15	ATM-R15	A2K-15R	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 - 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	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 (pigtails). 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.

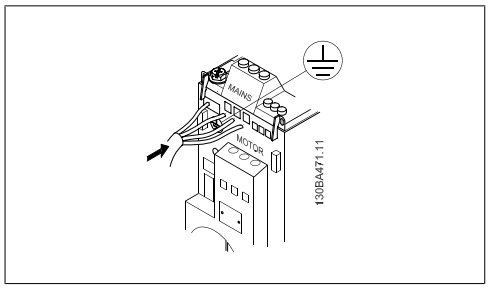

Illustration 3.1: Mounting of earth cable and mains wires.

For 3-phase connection, connect wires to all three terminals.
For single-phase connection, connect wires to terminals L1/L and L3/N.

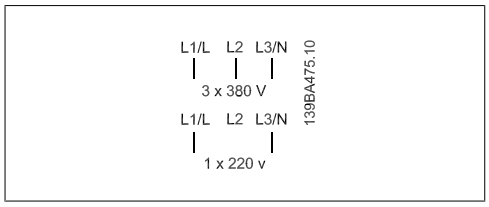

Illustration 3.2: Three-phase and single-phase wire connections.

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.

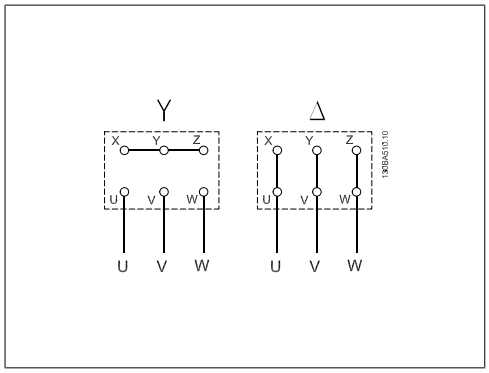

Illustration 3.3: Star and delta connections.

3

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.

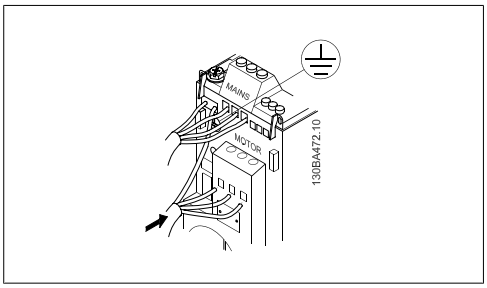

Illustration 3.4: Mounting of earth cable and motor wires.

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

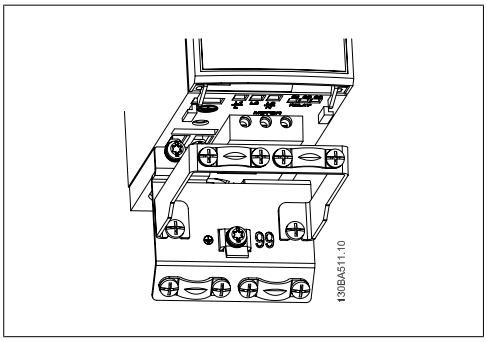

Illustration 3.5: VLT Micro Drive with de-coupling plate

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.

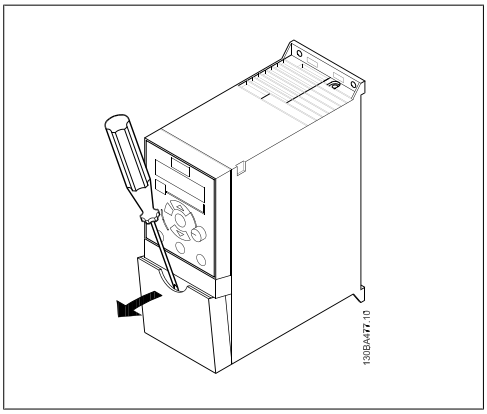

Illustration 3.6: Removing terminal cover.

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.

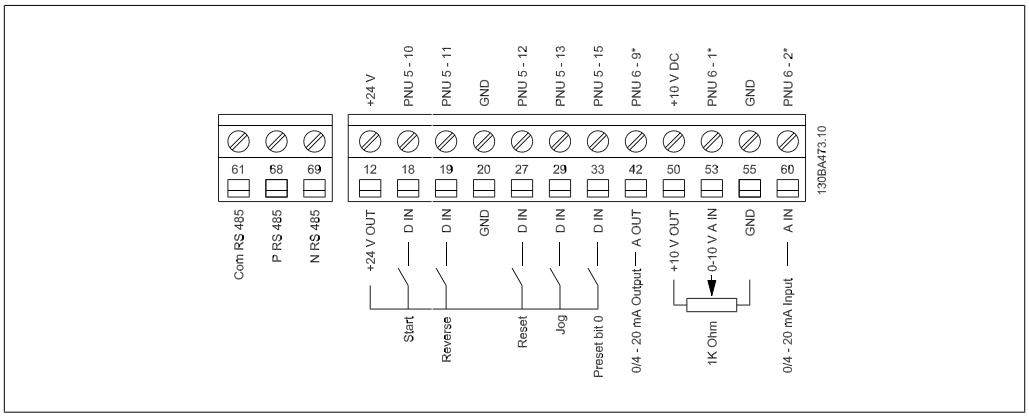

Illustration 3.7: Overview of control terminals in PNP-configuration and factory setting.

3.5. Switches

NB!
Do not operate switches with power on the frequency converter.

Bus termination:
Switch *BUS TER* pos. ON terminates the RS485 port, terminals 68, 69. See power circuit drawing.

Default setting = Off.

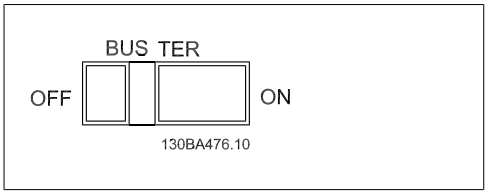

Illustration 3.8: S640 Bus termination.

S200 Switches 1-4:

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 3.3: Settings for S200 Switches 1-4

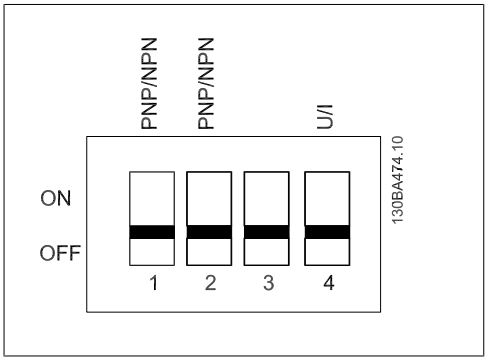

Illustration 3.9: S200 Switches 1-4.

NB!
Parameter 6-19 must be set according to Switch 4 position.

3.6. Power Circuit - Overview

3.6.1. Power Circuit - Overview

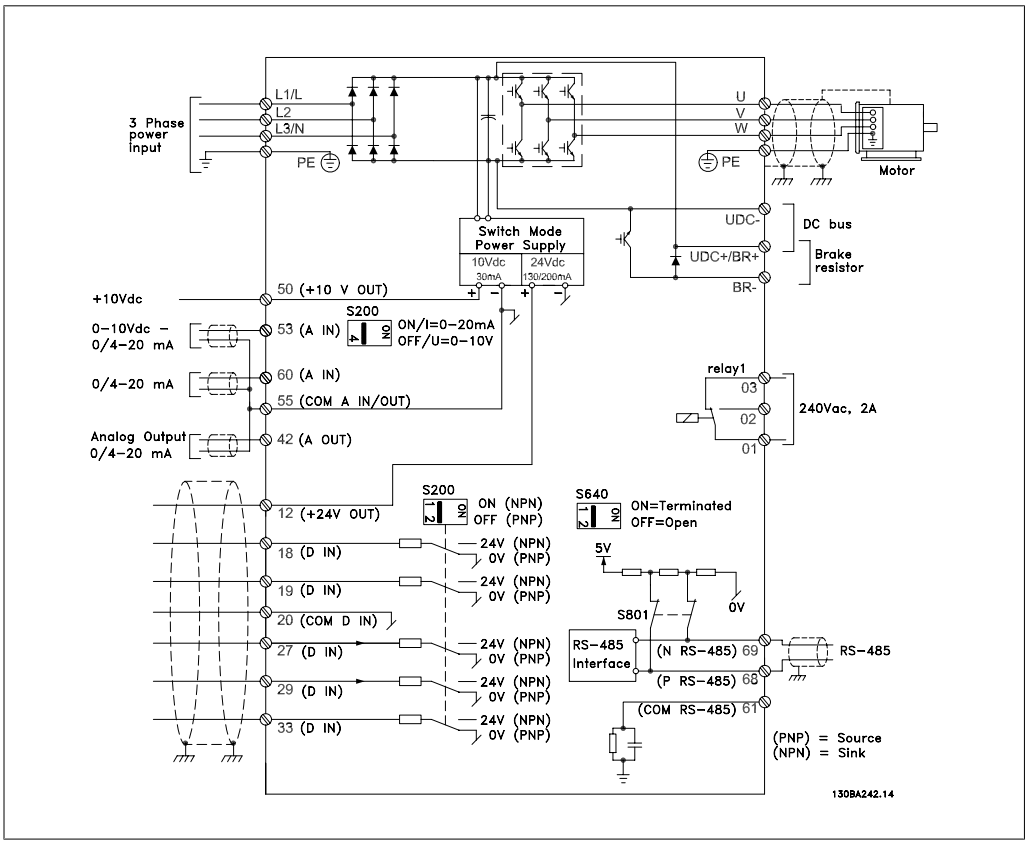

Illustration 3.10: Diagram showing all electrical terminals.

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).

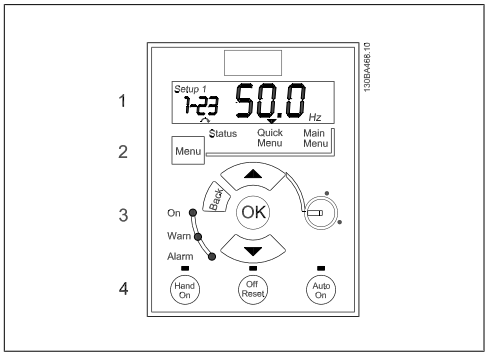

Illustration 4.1: LCP 12 with potentiometer

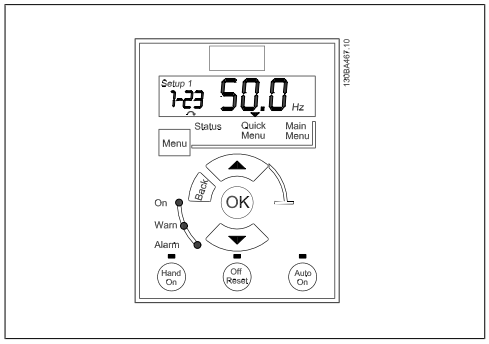

Illustration 4.2: LCP 11 without potentiometer

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.

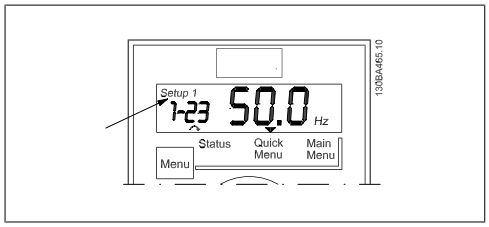

Illustration 4.3: Indicating Set-up

4

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

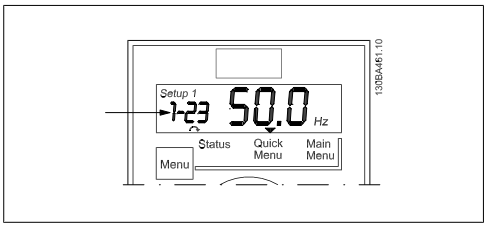

Illustration 4.4: Indicating selected par. no.

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

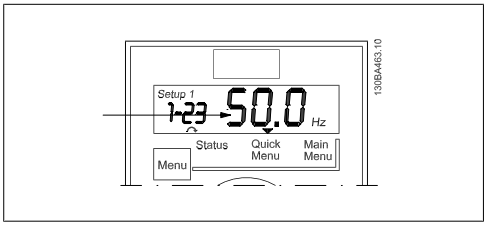

Illustration 4.5: Indicating value of selected par.

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.

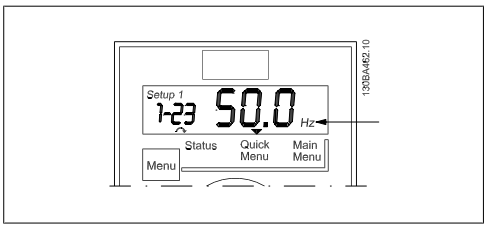

Illustration 4.6: Indicating unit of selected par.

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

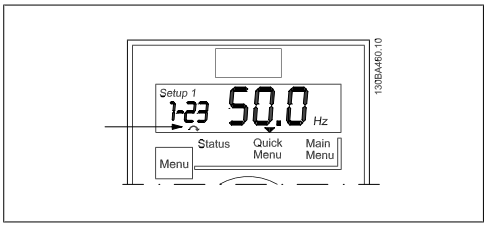

Illustration 4.7: Indicating motor direction

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".

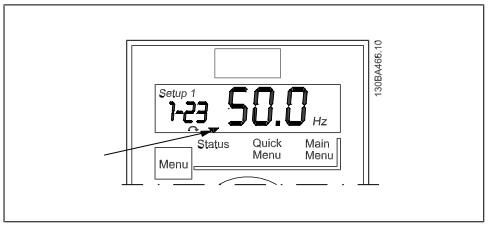

Illustration 4.8: Indicating Status mode

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*.

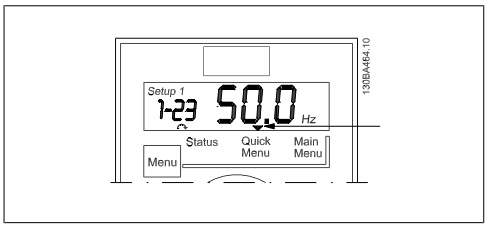

Illustration 4.9: Indicating Quick Menu mode

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.

4

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 V [50 - 999 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 dependent* [0.01 - 26.00 A] Enter motor current from nameplate data.

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

Range: **Function:**

M-type Dependent* [100 - 9999 RPM] 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.

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.

4

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 *Enabled* 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*.

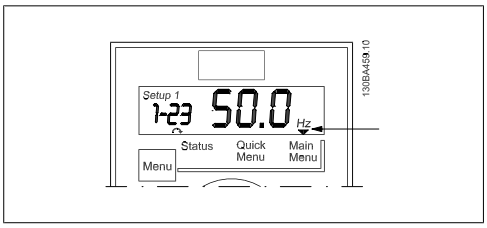

Illustration 4.10: Indicating Main Menu mode

5. Parameter Overview

Parameter Overwiev

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
0-41 [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
0-5* 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 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] 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 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
1-6* 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
1-7* 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] Termistor 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-** 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
[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 Over-voltage 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-** Reference / Ramps
3-0* 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
3-1* 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
3-4* 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
3-42 Ramp 1 Ramp Down Time
0.05 - 3600 s * 3.00 s
3-5* 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
3-52 Ramp 2 Ramp down Time
0.05 - 3600 s * 3.00 s
3-8* Other Ramps
3-80 Jog Ramp Time
0.05 - 3600 s * 3.00 s
3-81 Quick Stop Ramp Time
0.05 - 3600 s * 3.00 s
4-** Limits / Warnings
4-1* 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 %
4-5* Adj. Warnings
4-50 Warning Current Low
0.00 - 26.00 A * 0.00 A
4-51 Warning Current High
0.00 - 26.00 A * 26.00 A
4-58 Missing Motor Phase Function
[0] Off
*[1] On
4-6* 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
5-1* 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] Speed down
[23] Setup 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
5-4* Relays
5-40 Function Relay
*[0] No opreation
[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
5-5* Pulse Input
5-55 Terminal 33 Low Frequency
20 - 4999 Hz * 20 Hz
5-56 Terminal 33 High Frequency
21 - 5000 Hz * 5000 Hz
5-57 Term. 33 Low Ref./Feedb. Value
-4999 - 4999 * 0.000
5-58 Term. 33 High Ref./Feedb. Value
-4999 - 4999 * 50.000
6-** Analog In/Out
6-0* Analog I/O Mode
6-00 Live Zero Timeout Time
1 - 99 s * 10 s
6-01 Live Zero TimeoutFunction
*[0] Off
[1] Freeze output
[2] Stop
[3] Jogging
[4] Max speed
[5] Stop and trip
6-1* Analog Input 1
6-10 Terminal 53 Low Voltage
0.00 - 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
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
6-2* 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
6-8* LCP potmeter
6-81 LCP potm. Low Reference
-4999 - 4999 * 0.000
6-82 LCP potm. High Reference
-4999 - 4999 * 50.00
6-9* Analog Output xx
6-90 Terminal 42 Mode
*[0] 0-20 mA
[1] 4-20 mA
[2] Digital Output
6-91 Terminal 42 Analog Output
*[0] No operation
[10] Output Frequency
[11] Reference
[12] Feedback
[13] Motor Current
[16] Power
[20] BusControl
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-** Controllers
7-2* Process Ctrl. Feedb
7-20 Process CL Feedback 1 Resource
*[0] NoFunction
[1] Analog Input 53
[2] Analog input 60
[8] PulseInput33
[11] LocalBusRef
7-3* 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-** Comm. and Options
8-0* 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
8-3* 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
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
8-5* 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
8-9* Bus Jog / Feedback
8-94 Bus feedback 1
0x8000 - 0x7FFF * 0
13-** Smart Logic
13-0* 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
13-1* 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
13-2* Timers
13-20 SL Controller Timer
0.0 - 3600 s * 0.0 s
13-4* Logic Rules
13-40 Logic Rule Boolean 1
See par. 13-01 * [0] False
[30] - [32] SL Time-out 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
13-43 Logic Rule Operator 2
See par. 13-41 * [0] Disabled
13-44 Logic Rule Boolean 3
See par. 13-40
13-5* States
13-51 SL Controller Event
See par. 13-40
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-** Special Functions
14-0* 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
14-1* Mains monitoring
14-12 Function at mains imbalance
*[0] Trip
[1] Warning
[2] Disabled
14-2* 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] Initialisation
14-26 Action At Inverter Fault
*[0] Trip
[1] Warning
14-4* Energy Optimising
14-41 AEO Minimum Magnetisation
40 - 75 % * 66 %
15-** Drive Information
15-0* Operating Data
15-00 Operating Days
15-01 Running Hours
15-02 kWh Counter
15-03 Power Ups
15-04 Over Temps
15-05 Over Volts
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
15-3* Fault Log
15-30 Fault Log: Error Code
15-4* Drive Identification
15-40 FC Type
15-41 Power Section
15-42 Voltage
15-43 Software Version
15-46 Frequency Converter Order. No
15-48 LCP Id No
15-51 Frequency Converter Serial No
16-** Data Readouts
16-0* General Status
16-00 Control Word
0 - 0XFFFF
16-01 Reference [Unit]
-4999 - 4999
16-02 Reference %
-200.0 - 200.0 %
16-03 Status Word
0 - 0XFFFF
16-05 Main Actual Value [%]
-200.0 - 200.0 %
16-1* 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 [%]
16-3* Drive Status
16-30 DC Link Voltage
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0 - 1
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16-8* Fieldbus / FC Port
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0x8000 - 0x7FFF
16-9* Diagnosis Readouts
16-90 Alarm Word
0 - 0XFFFFFFFF
16-92 Warning Word
0 - 0XFFFFFFFF
16-94 Ext. Status Word
0 - 0XFFFFFFFF

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		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	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

7. Specifications

7.1. Mains Supply

7.1.1. Mains Supply 1 x 200 - 240 VAC

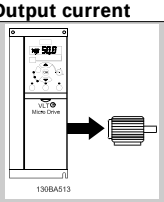
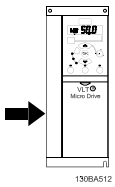
Normal overload 150 % for 1 minute						
		Frame M1	Frame M1	Frame M1	Frame M2	Frame M3
Frequency converter		P0K18	P0K37	P0K75	P1K5	P2K2
Typical Shaft Output [kW]		0.18	0.37	0.75	1.5	2.2
Typical Shaft Output [HP]		0.25	0.5	1	2	3
Output current						
	Continuous (3 x 200-240 V) [A]	1.2	2.2	4.2	6.8	TBD
	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						
	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 Best case/Typical[1)]	95.6/ 94.5	96.5/ 95.6	96.6/ 96.0	97.0/ 96.7	TBD

Table 7.1: Mains supply 1 x 200 - 240 VAC

7.1.2. Mains Supply 3 x 200 - 240 VAC

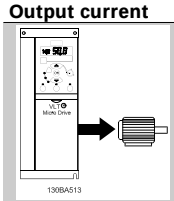
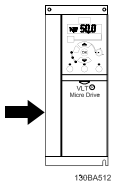
Normal overload 150 % for 1 minute							
		Frame M1	Frame M1	Frame M1	Frame M2	Frame M3	Frame M3
Frequency converter		P0K25	P0K37	P0K75	P1K5	P2K2	P3K7
Typical Shaft Output [kW]		0.25	0.37	0.75	1.5	2.2	3.7
Typical Shaft Output [HP]		0.33	0.5	1	2	3	5
Output current							
	Continuous (3 x 200-240 V) [A]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

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

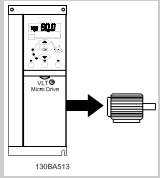
Normal overload 150% for 1 minute									
Frequency converter		P0K37	P0K75	P1K5	P2K2	P3K0	P4K0	P5K5	P7K5
Typical Shaft Output [kW]		0.37	0.75	1.5	2.2	3.0	4.0	5.5	7.5
Typical Shaft Output [HP]		0.5	1	2	3	4	5	7.5	10
IP 20		Frame M1	Frame M1	Frame M2	Frame M2	Frame M3	Frame M3	Frame M3	Frame M3
Output current									
	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) [mm²/ AWG]				4/10				
Max. input current									
	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]				See Section *Fuses*				
	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 ±10%
Supply voltage	380-480 V ±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 (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, 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 kΩ
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 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
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 @ 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, 0.2A
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 ±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
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

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.

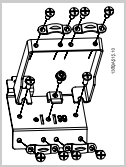
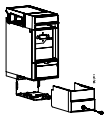
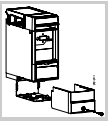
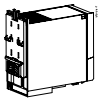
Below 1000 m altitude no de-rating is necessary but above 1000 m the ambient temperature or the maximum output current should be decreased.
Decrease the output by 1% per 100 m altitude above 1000 m or reduce the max. ambient temperature by 1 degree per 200 m

7.3.4. Derating for Running at Low Speeds

When a motor is connected to at 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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