Danfoss FC 101 VLT HVAC Basic Drive User Guide

Operating Guide
VLT® HVAC Basic Drive FC 101
IEC/UL61800-5-1 Compliance

Contents

Introduction

This operating guide provides necessary information for qualified personnel to install and commission the AC drive. Read and follow the instructions to use the drive safely and professionally.
Do not dispose of equipment containing electrical components together with domestic waste.
Collect it separately in accordance with local and currently valid legislation.

Safety

Pay particular attention to the safety instructions and general warnings to avoid the risk of death, serious injury, and equipment or property damage.

⚠ **WARNING**

HIGH VOLTAGE
AC drives contain high voltage when connected to AC mains input, DC supply, or load sharing.
UNINTENDED START
The motor may start from control panel, I/O inputs, fieldbus, or VLT® Motion Control Tool MCT 10 at any time, when the
drive is connected to the AC mains, DC supply, or load sharing.
DISCHARGE TIME
The drive contains DC-link capacitors, which can remain charged even when the drive is not powered. High voltage can be
present even when the warning indicator lights are off.

- Stop the motor, disconnect AC mains and permanent magnet type motors, and remove DC-link supplies, including battery backups, UPS, and DC-link connections to other drives.
- Wait for the capacitors to discharge fully and measure it before performing any service or repair work.
- The minimum waiting time is 4 minutes for H1, H2, and H3 drives, and 15 minutes for H4 and H5 drives.

LEAKAGE CURRENT
Leakage currents of the drive exceed 3.5 mA. Make sure that the minimum size of the ground conductor complies with the local safety regulations for high touch current equipment.
NOTICE
It is not allowed to install FC101 types with UL61800-5-1 in an isolated mains source (IT mains or floating delta) or TT/TN-S mains with a grounded leg (grounded delta).

Installation

3.1 Product Label

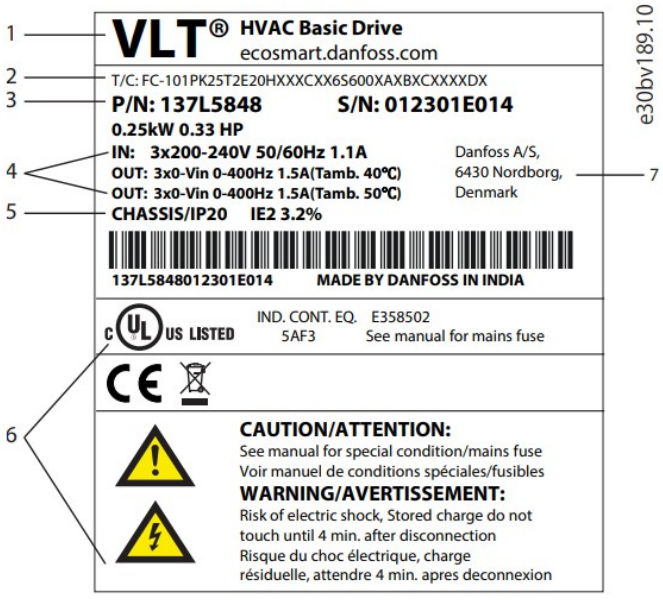

Illustration 1: Product Label (Example)

3.2 Mechanical Dimensions

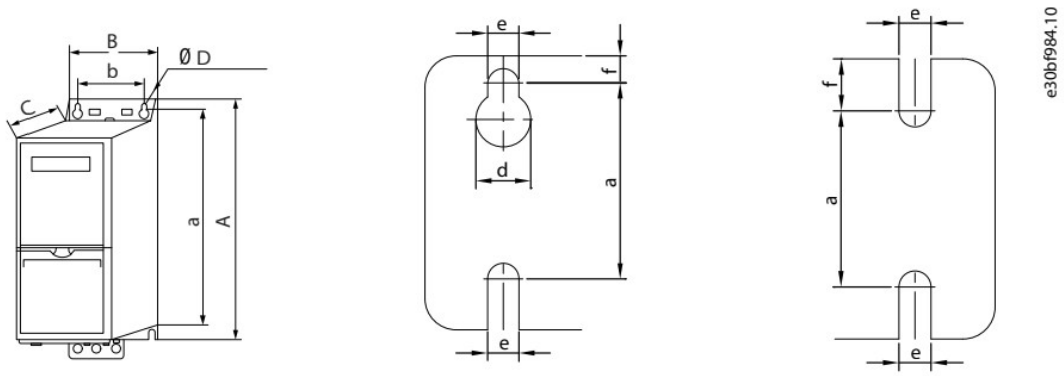

Illustration 2: Mechanical Dimensions

Table 1: Mechanical Dimensions, Enclosure Sizes H1–H5

Enclosure Size		**H1**	**H2**	**H3**	**H4**	**H5**
IP class		IP20	IP20	IP20	IP20	IP20
Power [kW (hp)]	3×200–240 V	0.25–1.5 (0.33–2.0)	2.2 (3.0)	3.7 (5.0)	5.5–7.5 (7.5–10)	11 (15)
	3×380–480 V	0.37–1.5 (0.5–2.0)	2.2–4.0 (3.0–5.0)	5.5–7.5 (7.5–10)	11–15 (15–20)	18.5–22 (25–30)
Height [mm (in)]	A	195 (7.7)	227 (8.9)	255 (10.0)	296 (11.7)	334 (13.1)
	A(1)	273 (10.7)	303 (11.9)	329 (13.0)	359 (14.1)	402 (15.8)
	a	183 (7.2)	212 (8.3)	240 (9.4)	275 (10.8)	314 (12.4)
Width [mm (in)]	B	75 (3.0)	90 (3.5)	100 (3.9)	135 (5.3)	150 (5.9)
	b	56 (2.2)	65 (2.6)	74 (2.9)	105 (4.1)	120 (4.7)
Depth [mm (in)]	C	168 (6.6)	190 (7.5)	206 (8.1)	241 (9.5)	255 (10)
Mounting hole [mm (in)]	d	9 (0.35)	11 (0.43)	11 (0.43)	12.6 (0.50)	12.6 (0.50)
	e	4.5 (0.18)	5.5 (0.22)	5.5 (0.22)	7 (0.28)	7 (0.28)
	f	5.3 (0.21)	7.4 (0.29)	8.1 (0.32)	8.4 (0.33)	8.5 (0.33)
Maximum weight kg (lb)		2.7 (6.0)	4.0 (8.8)	5.1 (11.2)	8.5 (18.7)	10.1 (22.3)

Note: (1) Including decoupling plate.

3.3 Connecting to Mains and Motor

1. Mount the ground cables to the ground terminal.
2. Connect the motor to terminals U, V, and W, and then tighten the screws according to the torques.
3. Connect the mains supply to terminals L1, L2, and L3, and then tighten the screws according to the torques described in the drive's design guide.

3.4 Relays and Terminals

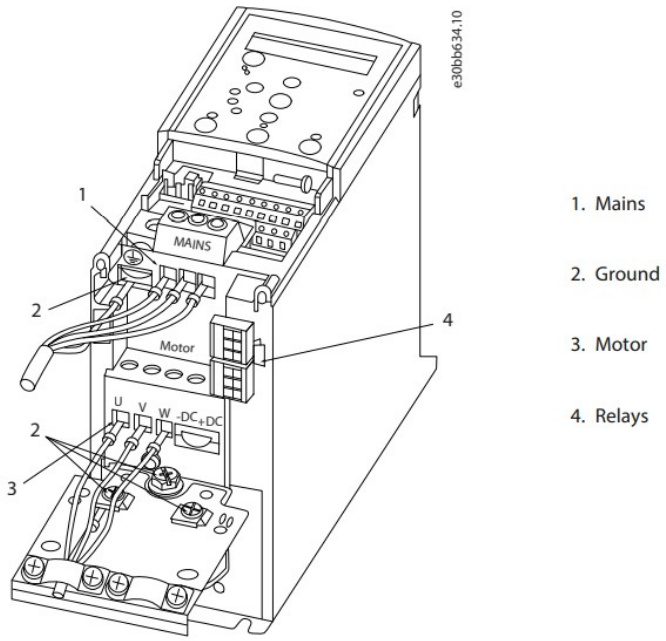

Illustration 3: Enclosure Sizes H1–H5, IP20, 200–240 V, 0.25–11 kW (0.33–15 hp), IP20, 380–480 V, 0.37–22 kW (0.5–30 hp)

NOTICE

Terminals +DC and -DC are protected by factory installed load share terminal insert which must NOT be removed.

3.5 Control Terminals

- Remove the terminal cover to access the control terminals.
- Use a flat-edged screwdriver to push down the lock lever of the terminal cover under the LCP, then remove the terminal cover as shown in illustration 4 Removing the Terminal Cover.

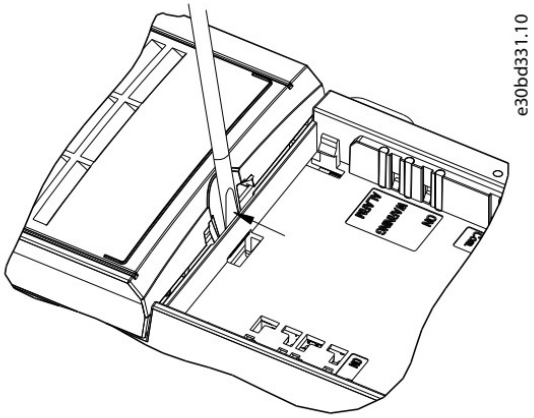

Illustration 4: Removing the Terminal Cover

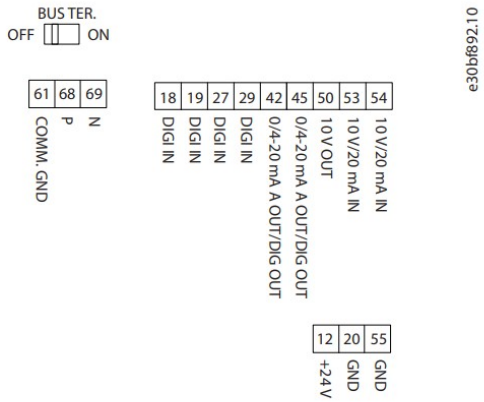

Illustration 5: Control Terminals

Illustration 5 Control Terminals shows all the drive control terminals. Applying start (terminal 18), connection between terminals 12-27, and an analog reference (terminal 53 or 54, and 55) make the drive run.

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

Programming

4.1 Local Control Panel (LCP)

The drive can be programmed from the LCP or from a PC via the RS485 COM port by installing the MCT 10 Setup Software.

The LCP is divided into 4 functional sections.

- A. Display

- B. Menu key
- C. Navigation keys and indicator lights
- D. Operation keys and indicator lights

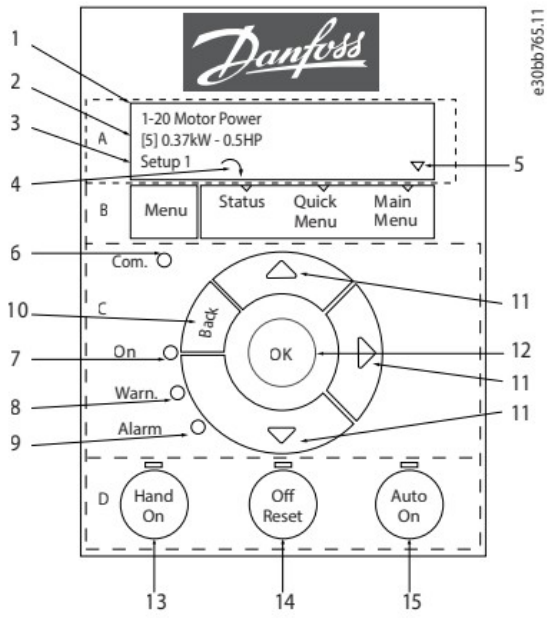

Illustration 6: Local Control Panel (LCP)

Table 2: Legend to Section A

A. Display

The LCD-display is illuminated with 2 alphanumeric lines. All data is shown on the LCP. The illustration 6 Local Control Panel (LCP) describes the information that can be read from the display.

1	Parameter number and name.
2	Parameter value.
3	Setup number shows the active setup and the edit setup. If the same setup acts as both active and edit se tup, only that setup number is shown (factory setting). When active and edit setup differ, both numbers ar e shown in the display (setup 12). The number flashing indicates the edit setup.
4	Motor direction is shown to the bottom left of the display – indicated by a small arrow pointing either clock wise or counter- clockwise.
5	The triangle indicates if the LCP is in Status, Quick Menu, or Main Menu.

B. Menu Key

Press [Menu] to select among Status, Quick Menu, or Main Menu.

C. Navigation keys and indicator lights

Table 3: Legend to Section C

6	Com. LED: Flashes during bus communication.
7	Green LED/On: Control section is working correctly.
8	Yellow LED/Warn.: Indicates a warning.
9	Flashing Red LED/Alarm: Indicates an alarm.
10	[Back]: For moving to the previous step or layer in the navigation structure.
11	[▲] [▼] [►]: For navigating among parameter groups and parameters, and within parameters. They can also be used for setting local reference.
12	[OK]: For selecting a parameter and for accepting changes to parameter settings.

Table 4: Legend to Section D
D. Operation keys and indicator lights

13	[Hand On]: Starts the motor and enables control of the drive via the LCP. **NOTICE** [2] Coast inverse is the default option for parameter 5-12 Terminal 27 Digital Input. If there is no 24 V supply to terminal 27, [Hand On] does not start the motor. Connect terminal 12 to terminal 27.
14	[Off/Reset]: Stops the motor (Off). If in alarm mode, the alarm is reset.
15	[Auto On]: The drive is controlled either via control terminals or serial communication.

4.2 Automatic Motor Adaptation (AMA)
Via running AMA in VVC+ mode, the drive builds a mathematical model of the motor to optimize compatibility between drive and motor, and thus enhances the motor control performance.
Procedure:

1. Set motor data according to the motor nameplate.
2. If needed, set motor cable length in parameter 1-42 Motor Cable Length.
3. Select [1] Enable Complete AMA or [2] Enable Reduced AMA in parameter 1-29 Automatic Motor Adaption (AMA), and press [Hand On] to activate the AMA function. After a normal sequence, the display shows: Press [OK] to finish AMA.
4. Press [OK], then the drive is ready for operation.

Troubleshooting

Table 5: Warnings and Alarms

Fault number	Warning/alarm bit number	Fault text	Warning	Alarm	Trip locked	Cause of problem
2	16	Live Zero Error	X	X	–	Signal on terminal 53 or 54 is less than 50% of the value set in parameter 6-10 Terminal 53 Low Voltage, parameter 6-12 Terminal 53 Low Current, parameter 6-20 Terminal 54 Low Voltage, or parameter 6-22 Terminal 54 Low Current. See also parameter group 6-0* Analog I/O Mode.

3	15/72	No motor	X	X	–	No motor is connected to the output of the drive.
4	14	Mains Ph. Loss	X	X	X	Missing phase on the supply side or too high volt age imbalance. ” Check the supply voltage. See parameter 14-12 Function at Mains Imbalance.
7	11	DC overvolt	X	X	–	DC-link voltage exceeds the limit.
8	10	DC undervolt	X	X	–	DC-link voltage drops below voltage warning low -limit.
9	9	Inverter Overld .	X	X	–	More than 100% load for a long time.
10	8	Motor ETR Ov erld.	X	X	–	Motor is too hot due to more than 100% load for a long time. See parameter 1-90 Motor Thermal Protection.
11	7	Motor Th. Over ld.	X	X	–	Thermistor or thermistor connection is disconnec ted. See parameter 1-90 Motor Thermal Protecti on.
13	5	Over Current	X	X	X	Inverter peak current limit is exceeded.
14	2	Earth Fault	X	X	X	Discharge from output phases to ground.
16	12	Short Circuit	–	X	X	Short circuit in motor or on motor terminals.
17	4	Ctrl.Word TO	X	X	–	No communication to drive. See parameter grou p 8-0* General Settings.
24	50	Fan Fault	X	X	–	The heat sink cooling fan is not working.
30	19	U phase loss	–	X	X	Motor phase U is missing. Check the phase. See parameter 4-58 Missing Motor Phase Function.
31	20	V phase loss	–	X	X	Motor phase V is missing. Check the phase. See parameter 4-58 Missing Motor Phase Function.
32	21	W phase loss	–	X	X	Motor phase W is missing. Check the phase. Se e parameter 4-58 Missing Motor Phase Function.
36	24	Mains Failure	X	X	–	This warning/alarm is only active if the supply vol tage to the drive is lost and parameter 14-10 Mai ns Failure is not set to [0] No Function.
38	17	Internal Fault	–	X	X	Contact the local supplier.
44	48	Earth Fault DE SAT	–	X	X	Discharge from output phases to ground, using t he value of parameter 15-31 InternalFaultReaso n if possible.
46	33	Gate drive Volt age Fault	–	X	X	Control voltage is low. Contact the local supplier.
47	23	24V Supply Lo w	X	X	X	24 V DC supply may be overloaded.
50	–	AMA calibratio n	–	X	–	Contact the local supplier.

51	15	AMA Unom/Inom	–	X	–	The setting of motor voltage, motor current, and motor power is wrong. Check the settings.
52	–	AMA low Inom	–	X	–	The motor current is too low. Check the settings.
53	–	AMA big motor	–	X	–	The motor is too big to perform AMA.
54	–	AMA small mot	–	X	–	The motor is too small to perform AMA.
55	–	AMA par. rang e	–	X	–	The parameter values found from the motor are outside the acceptable range.
56	–	AMA interrupt	–	X	–	The AMA has been interrupted by the user.
57	–	AMA timeout	–	X	–	Try to start the AMA again a number of times, unt il the AMA is carried out.
58	–	AMA internal	–	X	–	Contact the local supplier.
59	25/57	Current Limit	X	X	–	The current is higher than the value in parameter 4-18 Current Limit.
60	44	External Interlo ck	–	X	–	External interlock has been activated. To resume normal operation, apply 24 V DC to the terminal programmed for external interlock and reset the drive (via serial communication, digital I/O, or by pressing [Reset] key on the LCP).
69	1	Pwr. Card Tem p	X	X	X	The temperature sensor on the power card exce eds the upper or lower limits.
70	36	Illegal FC confi g	–	X	X	The control card and power card are not matche d.
79	–	Illegal PS confi g	X	X	–	Internal fault. Contact the local supplier.
80	29	Drive Initialized	–	X	–	All parameter settings are initialized to default se ttings.
87	47	Auto DC Braki ng	X	–	–	The drive is auto DC braking.
92	37	No Flow	X	X	–	A no-flow condition has been detected in the system. Parameter 22-23 No-Flow Function is set for alar m.
93	38	Dry Pump	X	X	–	A dry-pump condition has been detected in the s ystem. Parameter 22-26 Dry Pump Function is set for al arm.
94	39	End of Curve	X	X	–	An end-of-curve condition has been detected in t he system. Parameter 22-50 End of Curve Funct ion is set for alarm.
95	40	Broken Belt	X	X	–	Torque is below the torque level set for no load, i ndicating a broken belt. See parameter group 22 -6* Broken Belt Detection.

Fault number	Warning/alarm bit number	Fault text	Warning	Alarm	Trip locked	Cause of problem
99	54	Locked Rotor	–	X	–	The rotor is blocked.
101	47	Flow/Pressure info missing	–	X	–	Sensorless-pump table is missing or wrong. Download sensorless-pump table again.
126	–	Motor Rotating	–	X	–	High back EMF voltage. Stop the rotor of the PM motor.
127	61	Back EMF too High	X	–	–	This warning applies to PM motors only. When the back EMF exceeds 90% x Uinvmax (overvoltage threshold) and does not drop to normal level within 5 s, this warning is reported. The warning remains until the back EMF returns to a normal level.
159	36	Check Valve Failure	X	–	–	When the drive is not in operation, a broken check valve leads to the motor runs in reverse. Parameter 22-04 Check Valve Monitor is set for warning.
200	–	Fire Mode	X	–	–	Fire mode has been activated.
202	–	Fire Mode Limits Exceeded	X	–	–	Fire mode has suppressed 1 or more warranty voiding alarms.
250	35	New Sparepart	–	X	X	The power or switch mode power supply has been exchanged. Contact the local supplier.
251	34	New Typecode	–	X	X	The drive has a new type code. Contact the local supplier.

Specifications

Table 6: 3×200–240 V AC, 0.25–11 kW (0.33–15.0 hp)

Drive	PK25	PK37	PK75	P1K5	P2K2	P3K7	P5K5	P7K5	P11K
Typical shaft output [kW]	0.25	0.37	0.75	1.5	2.2	3.7	5.5	7.5	11.0
Typical shaft output [hp]	0.33	0.5	1.0	2.0	3.0	5.0	7.5	10.0	15.0
Protection rating IP20	H1	H1	H1	H1	H2	H3	H4	H4	H5
Maximum cable size in terminals (mains, motor) [mm² (AWG)]	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	4 (10)	16 (6)	16 (6)	16 (6)
Output current 40°C (104°F) ambient temperature									
Continuous (3×200–240 V) [A]	1.5	2.2	4.2	6.8	9.6	15.2	22.0	28.0	42.0
Intermittent (3×200–240 V) [A]	1.7	2.4	4.6	7.5	10.6	16.7	24.2	30.8	46.2
Maximum input current									
Continuous 3×200–240 V) [A]	1.1	1.6	2.8	5.6	8.6/7.2	14.1/12.0	21.0/18.0	28.3/24.0	41.0/38.2
Intermittent (3×200–240V) [A]	1.2	1.8	3.1	6.2	9.5/7.9	15.5/13.2	21.0/18.0	31.1/26.4	45.1/42.0
Weight enclosure protection rating IP20 [kg (lb)]	2.4 (5.3)	2.4 (5.3)	2.4 (5.3)	2.3 (5.1)	3.7 (8.2)	4.8 (10.6)	8.2 (18.1)	8.2 (18.1)	9.8 (21.6)
Output current 50°C (122°F) ambient temperature									
Continuous 3×200–240 V) [A]	1.5	1.9	3.5	6.8	9.6	13.0	19.8	23.0	33.0
Intermittent (3×200–240V) [A]	1.7	2.1	3.9	7.5	10.6	14.3	21.8	25.3	36.3

Ambient Conditions

Table 8: Clearance Required for Cooling

Protection rating	IP20
Temperature during operation	-20 to 50°C (-4 to 122 °F)
Temperature during storage/transport	-30 to +65/70 °C (-22 to +149/158°F)
Relative humidity	5–95% (IEC 60721-3-3; Class 3K3 (non-condensing) during operation
Altitude	Maximum altitude above sea level without derating 1000 m (3281 ft) Maximum altitude above sea level with derating 3000 m (9843 ft)
Contamination level	Aggressive environment (IEC 60721-3-3), coated (standard) enclosure sizes H1–H5 Class 3C3

Mounting Clearance

Table 9: Clearance Required for Cooling

Enclosure size	IP class	3×200–240 V	3×380–480 V	Clearance above/below [mm (in)]
H1	IP20	0.25–1.5 (0.33–2)	0.37–1.5 (0.5–2)	100 (4)
H2	IP20	2.2 (3)	2.2–4 (3–5)	100 (4)
H3	IP20	3.7 (5)	5.5–7.5 (7.5–10)	100 (4)
H4	IP20	5.5–7.5 (7.5–10)	11–15 (15–20)	100 (4)
H5	IP20	11 (15)	18.5–22 (25–30)	100 (4)

EMC Compatibility and Motor Cable Length

- The drive fulfils EN61800-3 Category C4 for conducted & radiated emissions.
- The drive is designed to operate with optimum performance within the maximum motor cable lengths defined in Table 10 Maximum Motor Cable Length.
- The RFI screw is mounted from factory and has no impact on EMC performance.

Table 10: Maximum Motor Cable Length

Maximum motor cable length	Shielded	50 m (164 ft)
	Unshielded	75 m (246 ft)

Fuses
The recommended fuses in Table 11 Fuses are suitable for use on a circuit capable of delivering 100,000 Arms (symmetrical), 240 V or 480 V depending on the drive voltage rating. With the proper fusing, the drive Short Circuit Current Rating (SCCR) is 100,000 Arms.
Table 11: Fuses

FC 101		UL Compliance (UL61800-5-1) Short Circuit Current Ratings (SCCR) 5kA and 100kA			CE Compliance 5 kA
Enclosure size	**Power rating [kW (hp)]**	**Listed Fuse RK 5/RK1/J/T/CC Amperes ratings (A)**	**Test cabinet size [Height x Width x Depth] [mm (in)]**	**Minimum Cabinet volume [L]**	**gG Amperes ratings (A)**
3x200Y/115-240Y/139 V					
H1	0.25–1.5 (0.33–2)	10	500 x 400 x 260 (19.7 x 15.7 x 10.2)	52	10
H2	2.2 (3)	15			16
H3	3.7 (5)	25			25
H4	5.5–7.5 (7.5–10)	50	800 x 400 x 300 (31.5 x 15.7 x 11.8)	96	50
H5	11 (15)	50			65
3x380Y/220-480Y/277 V					
H1	0.37–1.5 (0.5–2)	10	500 x 400 x 260 (19.7 x 15.7 x 10.2)	52	10
H2	2.2–4 (3–5)	15			16
H3	5.5–7.5 (7.5–10)	25			25
H4	11–15 (15–20)	50	800 x 400 x 300 (31.5 x 15.7 x 11.8)	96	50
H5	18.5–22 (25–30)	80			65

Accessories and Spare Parts
Table 12: Accessories and Spare Parts

Accessories	Code number
VLT® Control Panel LCP 31	132B0200
VLT® Control Panel LCP 32	132B9221
VLT® Mains-Free Interface	132B9222
LCP RJ 45 Plug Converter	132B0203
Mounting kit for LCP incl. fasteners, 3 m cable and gasket	132B0201

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

- The VLT® HVAC Basic Drive FC 101 Programming Guide provides information on how to program and includes complete parameter descriptions.
- The VLT® HVAC Basic Drive FC 101 Design Guide provides all technical information about the drive. It also

lists options and accessories.

The technical documentation is available in electronic form online at **www.danfoss.com**.

Danfoss A/S
Ulsnaes 1 DK-6300 Graasten **drives.danfoss.com**

AQ469326766176en-000102 / 130R1378
Danfoss A/S © 2024.03
M 0 0 4 3 1 0 1
130R1378

Documents / Resources

	**Danfoss FC 101 VLT HVAC Basic Drive** [pdf] User Guide FC 101 VLT HVAC Basic Drive, FC 101, VLT HVAC Basic Drive, HVAC Basic Drive, Basic Drive, Drive

References

- **Global AC drive manufacturer - Danfoss Drives | Danfoss**
- **MyDrive® ecoSmart**
- **Engineering Tomorrow | Danfoss**
- **User Manual**