# Design Guide



VLT® 5000

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## Software version

**VLT 5000 Series**
Design Guide
Software version: 3.9x



This Design Guide can be used for all VLT 5000 Series frequency converters with software version 3.9x.
The software version number can be seen from parameter 624.
CE and C-tick labelling do not cover VLT 5001-5062, 525-600 V units.



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



The Protective Extra Low Voltage (PELV) requirements stated in IEC 61800-5-1 are not fulfilled at altitudes above 2000 m (6562 ft.). For 200V frequency converters the requirements are not fulfilled at altitudes above 5000 m (16 404 ft.). Please contact Danfoss Drives for further information.

## ■ Safety regulations

1. The frequency converter must be disconnected from mains if repair work is to be carried out. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.
2. The [STOP/RESET] key on the control panel of the frequency converter does not disconnect the equipment from mains and is thus not to be used as a safety switch.
3. Correct protective earthing of the equipment must be established, the user must be protected against supply voltage, and the motor must be protected against overload in accordance with applicable national and local regulations.
4. The earth leakage currents are higher than 3.5 mA.
5. Protection against motor overload is not included in the factory setting. If this function is desired, set parameter 128 to data value *ETR trip* or data value *ETR warning*.
   Note: The function is initialised at 1.16 x rated motor current and rated motor frequency. For the North American market: The ETR functions provide class 20 motor overload protection in accordance with NEC.
6. Do not remove the plugs for the motor and main supply while the frequency converter is connected to mains. Check that the mains supply has been disconnected and that the necessary time has expired before removing motor and mains plugs.
7. Please note that the frequency converter has more voltage inputs than L1, L2 and L3, when loadsharing (linking of DC intermediate circuit) and external 24 V DC have been installed. Check that all voltage inputs have been disconnected and that the necessary time has passed before repair work is commenced.

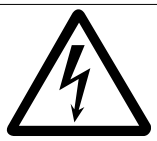
■ **Warning against unintended start**

1. The motor can be brought to a stop by means of digital commands, bus commands, references or a local stop, while the frequency converter is connected to mains.
   If personal safety considerations make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient.
2. While parameters are being changed, the motor may start. Consequently, the stop key [STOP/RESET] must always be activated, following which data can be modified.
3. A motor that has been stopped may start if faults occur in the electronics of the frequency converter, or if a temporary overload or a fault in the supply mains or the motor connection ceases.

■ **Use on isolated mains**

See section *RFI Switch* regarding use on isolated mains.

It is important to follow the recommendations regarding installation on IT-mains, since sufficient protection of the complete installation must be observed. Not taking care using relevant monitoring devices for IT-mains may result in damage.



**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, such as external 24 V DC, load-sharing (linkage of DC intermediate circuit), as well as the motor connection for kinetic back-up.

| | |
|---|---|
| VLT 5001 - 5006, 200-240 V: | wait at least 4 minutes |
| VLT 5008 - 5052, 200-240 V: | wait at least 15 minutes |
| VLT 5001 - 5006, 380-500 V: | wait at least 4 minutes |
| VLT 5008 - 5062, 380-500 V: | wait at least 15 minutes |
| VLT 5072 - 5302, 380-500 V: | wait at least 20 minutes |
| VLT 5352 - 5552, 380-500 V: | wait at least 40 minutes |
| VLT 5001 - 5005, 525-600 V | wait at least 4 minutes |
| VLT 5006 - 5022, 525-600 V: | wait at least 15 minutes |
| VLT 5027 - 5062, 525-600 V: | wait at least 30 minutes |
| VLT 5042 - 5352, 525-690 V: | wait at least 20 minutes |
| VLT 5402 - 5602, 525-690 V: | wait at least 30 minutes |

## Introduction

This Design Guide is intended as a tool for use when designing a plant or system that includes VLT 5000 Series. Specific technical publications on the VLT 5000 Series: Operating Instructions and Design Guide.

| | |
|---|---|
| Operating Instructions: | Gives instructions in optimum installation, commissioning and service. |
| Design Guide: | Gives all required information for design purposes, and gives a good insight into the technology, product range, technical data, etc. |

The Operating Instructions include a Quick Setup instruction and are delivered with the unit.

When reading through this Design Guide, you will come across various symbols that require special attention.

The symbols used are the following:



Indicates a general warning



**NB!**
Indicates something to be noted by the reader



Indicates a high-voltage warning

## Available literature

Below is a list of the literature available for VLT 5000. It must be noted that there may be deviations from one country to another.

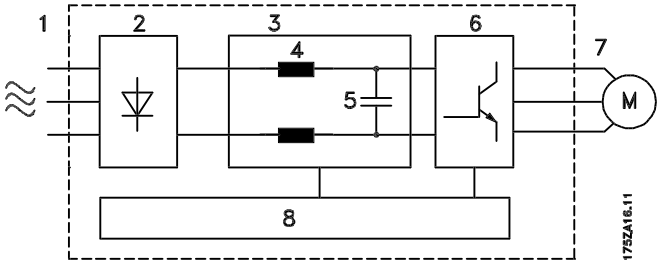
| **Supplied with the unit:** | |
|---|---|
| Operating instructions | MG.51.AX.YY |
| High Power Installation Guide | MI.90.JX.YY |
| **Communication with VLT 5000:** | |
| VLT 5000 Profibus manual | MG.10.EX.YY |
| VLT 5000 DeviceNet manual | MG.50.HX.YY |
| VLT 5000 LonWorks manual | MG.50.MX.YY |
| VLT 5000 Modbus manual | MG.10.MX.YY |
| VLT 5000 Interbus manual | MG.10.OX.YY |
| **Application options for VLT 5000:** | |
| VLT 5000 SyncPos option manual | MG.10.EX.YY |
| VLT 5000 Positioning controller manual | MG.50.PX.YY |
| VLT 5000 Synchronising controller manual | MG.10.NX.YY |
| Ring spinning option | MI.50.ZX.02 |
| Wobble function option | MI.50.JX.02 |
| Winder and Tension control option | MG.50.KX.02 |
| **Instructions for VLT 5000:** | |
| Loadsharing | MI.50.NX.02 |
| VLT 5000 Brake resistors | MI.90.FX.YY |
| Brake resistors for horizontal applications (VLT 5001 - 5011) (Only in English and German) | MI.50.SX.YY |
| LC filter modules | MI.56.DX.YY |
| Converter for encoder inputs (5V TTL to 24 V DC) (Only in combined English/German) | MI.50.IX.51 |
| Back Plate to VLT 5000 Series | MN.50.XX.02 |
| **Various literature for VLT 5000:** | |
| Design Guide | MG.51.BX.YY |
| Incorporating a VLT 5000 Profibus in a Simatic S5 SYSTEM | MC.50.CX.02 |
| Incorporating a VLT 5000 Profibus in a Simatic S7 SYSTEM | MC.50.AX.02 |
| Hoist and the VLT 5000 series | MN.50.RX.02 |
| **Miscellaneous (only in English):** | |
| Protection against electrical hazards | MN.90.GX.02 |
| Choice of prefuses | MN.50.OX.02 |
| VLT on IT mains | MN.90.CX.02 |
| Filtering of harmonic currents | MN.90.FX.02 |
| Handling aggressive environments | MN.90.IX.02 |
| CI-TI™ contactors - VLT® frequency converters | MN.90.KX.02 |
| VLT® frequency converters and UniOP operator panels | MN.90.HX.02 |

X = version number
YY = language version

## Control principle

A frequency converter rectifies AC voltage from mains into DC voltage, after which this DC voltage is converted into a AC current with a variable amplitude and frequency.

The motor is thus supplied with variable voltage and frequency, which enables infinitely variable speed control of three-phased, standard AC motors.




1. Mains voltage
3 x 200 - 240 V AC, 50 / 60 Hz.
3 x 380 - 500 V AC, 50 / 60 Hz.
3 x 525 - 600 V AC, 50 / 60 Hz.
3 X 525 - 690 V AC, 50 / 60 Hz.

2. Rectifier
A three-phase rectifier bridge that rectifies AC current into DC current.

3. Intermediate circuit
DC voltage = 1.35 x mains voltage [V].

4. Intermediate circuit coils
Smooth the intermediate circuit current and limit the load on mains and components (mains transformer, wires, fuses and contactors).

5. Intermediate circuit capacitors
Smooth the intermediate circuit voltage.

6. Inverter
Converts DC voltage into variable AC voltage with a variable frequency.

7. Motor voltage
Variable AC voltage, 0-100% of mains supply voltage.
Variable frequency: 0.5-132/0.5-1000 Hz.

8. Control card
This is where to find the computer that controls the inverter which generates the pulse pattern by which the DC voltage is converted into variable AC voltage with a variable frequency.

VVC plus control principle
The frequency converter features an inverter control SYSTEM called VVC$^{plus}$, which is a further development of the Voltage Vector Control (VVC) known i.e. from Danfoss VLT 3000 Series.

VVC$^{plus}$ controls an induction motor by energizing it with a variable frequency and a voltage that matches it. If the motor load is changed, the magnetisation of the motor changes too, and so does its speed. Consequently, the motor current is measured continuously and the actual voltage requirement and slip of the motor are calculated from a motor model. Motor frequency and voltage are adjusted to ensure that the motor operating point remains optimum under varying conditions.

The development of the VVC$^{plus}$ principle is the result of a wish to maintain robust, sensorless regulation that is tolerant to different motor characteristics without motor derating being required.

First and foremost, the current measurement and the motor model have been improved. The current is split into magnetising and torque-generating parts and provides for much better and quicker estimation of the actual motor loads. It is now possible to compensate for rapid load changes. Full torque as well as extremely accurate speed control can now be obtained even at low speeds or even at standstill.

In a "special motor mode", permanent magnet synchronous motors and/or parallel motors can be used.

Good torque control properties, smooth transitions to and from current limit operation and robust pull-out torque protection are ensured.

After automatic motor adaptation, VVC$^{plus}$ will help to ensure extremely accurate motor control.

Advantages of the VVC$^{plus}$ control SYSTEM:

- Accurate speed control, now even at low speed
- Quick response from received signal to full motor shaft torque
- Good compensation for step loads
- Controlled transition from normal operation to current limit operation (and vice versa)
- Reliable pull-out torgue protection throughout the speed range, also in the case of field weakening
- Great tolerance towards varying motor data
- Torque control, comprising control of both the torque-generating and the magnetising component of the current
- Full holding torque (closed loop)

As standard, the frequency converter comes with a number of integral components that would normally have to be acquired separately. These integral components (RFI filter, DC coils, screen clamps and serial communication port) are space-savers that simplify installation, since the frequency converter fulfills most requirements without any supplementary components.

Programmable control inputs and signal outputs in four Setups

The frequency converter uses a digital technique which makes it possible to program the different control inputs and signal outputs and to select four different user-defined Setups for all parameters.

For the user, it is easy to program the desired functions by means of the control panel on the frequency converter or the RS 485 user interface.

Protection against mains interference
The frequency converter is protected against the transients that occur in the mains supply, e.g. when switching power factor correction or when fuses blow.

The rated motor voltage and full torque can be maintained all the way down to 10% undervoltage in the mains supply.

Minor interference on mains
Since as standard the frequency converter features intermediate circuit coils, there is only a small amount of harmonic mains supply interference. This ensures a good power factor and lower peak current, which reduces the load on the mains installation.

Advanced VLT protection
Current measurement on all three motor phases provides perfect protection of the frequency converter against earthing and short-circuiting faults on the motor connection.

Constant monitoring of all three motor phases enables switching on the motor output, e.g. by means of a contactor.

Efficient monitoring of the three mains supply phases ensures that the unit stops in the case of phase failure. This avoids overloading the inverter and the capacitors in the intermediate circuit, which would dramatically reduce the service life of the frequency converter.

As standard, the frequency converter features integral thermal protection. If a situation of thermal overload occurs, this function cuts out the inverter.

Reliable galvanic isolation
In the frequency converter, all control terminals as well as terminals 1-5 (AUX relays) are supplied by or connected to circuits that comply with PELV requirements in relation to the mains potential.

Advanced motor protection
The frequency converter features integrated electronic, thermal motor protection.

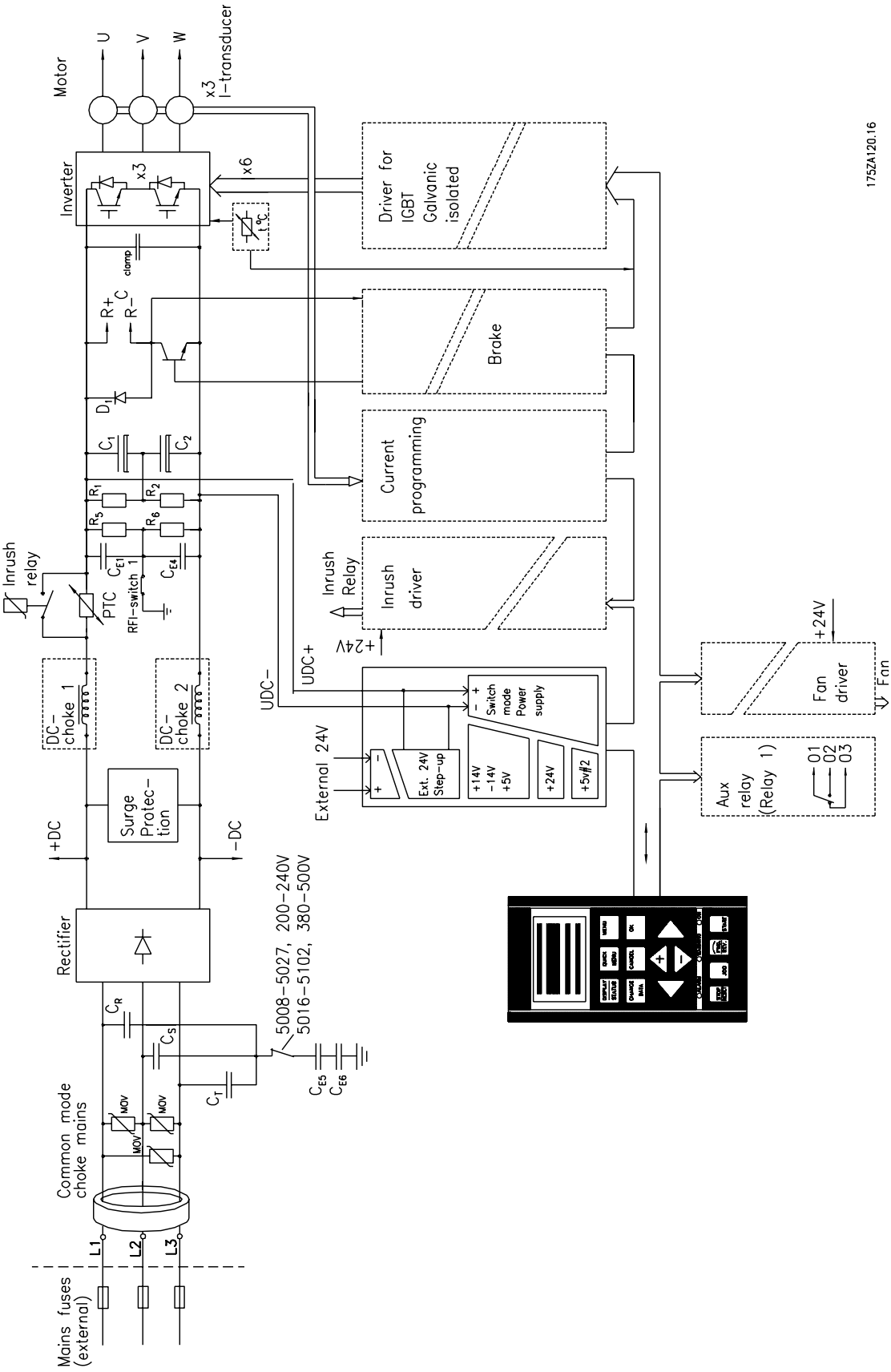
The frequency converter calculates the motor temperature on the basis of current, frequency and time.

As opposed to the traditional bimetallic protection, electronic protection takes account of the reduction in cooling at low frequencies that comes from reduced fan speed (motors with internal ventilation).

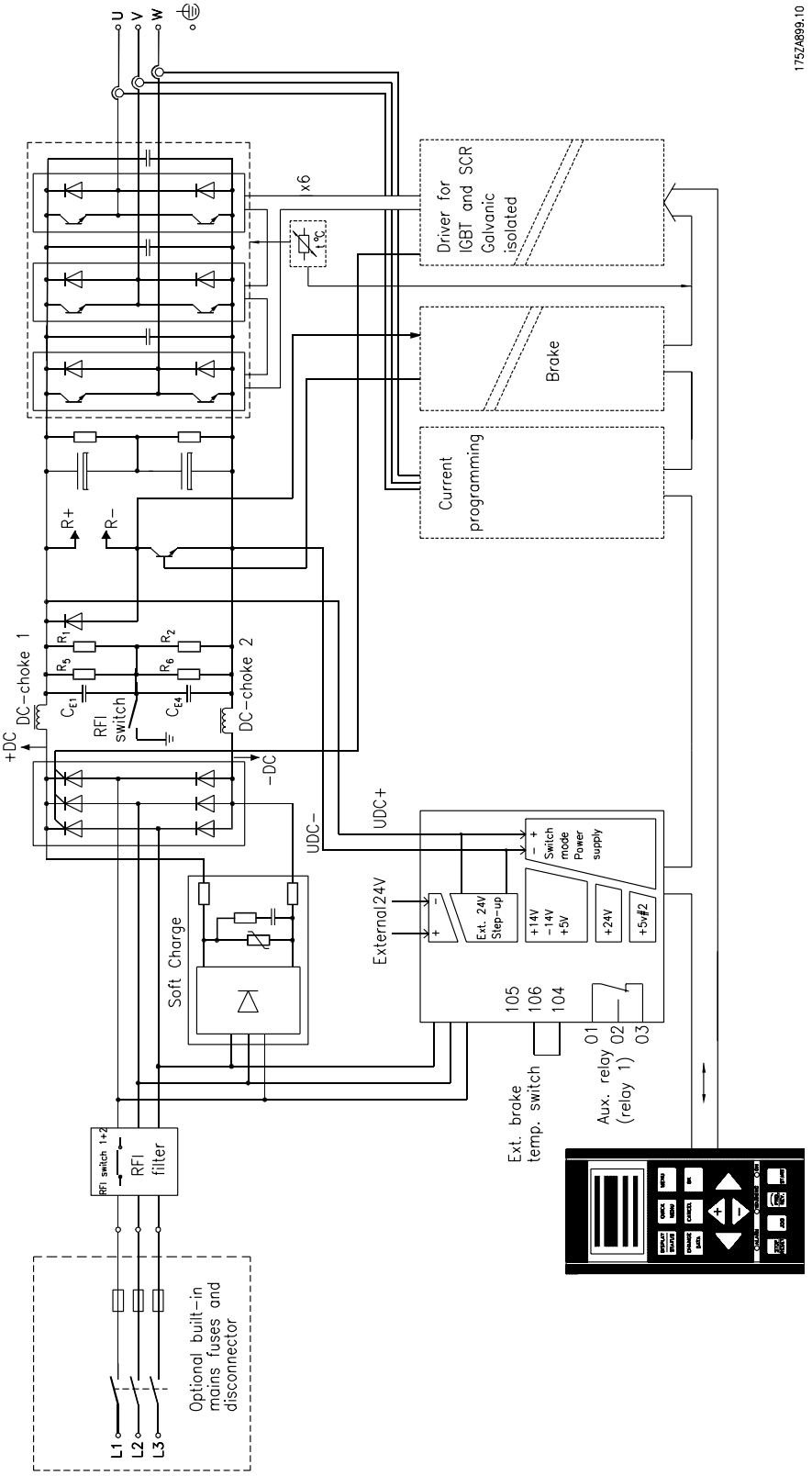
Thermal motor protection is comparable to a normal motor thermistor.

To obtain maximum protection against overheating of the motor if the motor is covered or blocked, or if the fan fails, a thermistor can be integrated and connected to the thermistor input of the frequency converter (terminals 53/54), see parameter 128 of the Operating Instructions.

■ **Key Diagram for VLT 5001–5027 200-240 V, VLT 5001–5102 380-500V, VLT 5001–5062 525-600 V**



## Key Diagram for VLT 5122-5552 380-500 V and VLT 5042-5602 525-690 V




Note: The RFI switch has no function in the 525-690 V drives.

## How to select your frequency converter

A frequency converter must be selected on the basis of the given motor current at maximum load on the unit. The rated output current $I_{VLT,N}$ must be equal to or higher than the required motor current.

The frequency converter is supplied for four mains voltage ranges: 200-240 V, 380-500 V, 525-600 V and 525-690 V.

## Normal/high overload torque mode

This function enables the frequency converter to perform a constant 100% torque, using an oversize motor. The choice between a normal or a high overload torque characteristic is made in parameter 101.

This is also where to choose between a high/normal constant torque characteristic (CT) or a high/normal VT torque characteristic.

If a high torque characteristic is chosen, a rated motor with the frequency converter obtains up to 160% torque for 1 min. in both CT and VT.

If a normal torque characteristic is chosen, an oversize motor allows up to 110% torque performance for up to 1 min. in both CT and VT. This function is used mainly for pumps and fans, since these applications do not require an overload torque.

The advantage of choosing a normal torque characteristic for an oversize motor is that the frequency converter will be able constantly to yield 100% torque, without derating as a result of a bigger motor.



**NB!**
This function cannot be chosen for VLT 5001-5006, 200-240 Volts, and VLT 5001-5011, 380-500 Volts.

## Type code ordering number string

The VLT 5000 series frequency converter is offered in a large number of variants. On the basis of your order, the frequency converter is given an ordering number that can be seen from the nameplate on the unit. The number may look as follows:

**VLT5008PT5B20EBR3DLF10A10C0**

This means that the frequency converter is configured as a:

- 5,5 kW unit at 160% torque (Position 1-7 - VLT 5008)
- Process control card (Position 8 - P)
- 380-500 V three phase supply (Position 9-10 - T5)
- Bookstyle IP20 enclosure (Position 11-13 - B20)
- Extended hardware version with brake (Position 14-15 - EB)
- Built in RFI filter (Position 16-17 - R3)
- Supplied with display (Position 18-19 - DL)
- Built in Profibus option (Position 20-22 - F10)
- Built in programmable SyncPos controller (Position 23-25 - A10)
- Uncoated printed circuit boards (Position 26-27 - C0)

Variants and options possible

In the following you will find an overview of possible variants that can be put together. Please refer to the description of the designation below.

VLT 5001-5052, 200-240 V units
Typecode designation: T2

| Powersize (kW) | | Type | Enclosure | | | | | HW variant | | | RFI filter | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Torque 110% | 160% | | C00 | B20 | C20 | CN1 | C54 | ST | SB | EB | R0 | R1 | R3 |
| | | 9-10 | 11-13 | 11-13 | 11-13 | 11-13 | 11-13 | 14-15 | 14-15 | 14-15 | 16-17 | 16-17 | 16-17 |
| 0.75 | | 5001 | | x | x | | x | x | x | x | | | x |
| 1.1 | | 5002 | | x | x | | x | x | x | x | | | x |
| 1.5 | | 5003 | | x | x | | x | x | x | x | | | x |
| 2.2 | | 5004 | | x | x | | x | x | x | x | | | x |
| 3 | | 5005 | | x | x | | x | x | x | x | | | x |
| 3.7 | | 5006 | | x | x | | x | x | x | x | | x | |
| 7.5 | 5.5 | 5008 | | | x | | x | x | x | x | x | | x |
| 11 | 7.5 | 5011 | | | x | | x | x | x | x | x | | x |
| 15 | 11 | 5016 | | | x | | x | x | x | x | x | | x |
| 18.5 | 15 | 5022 | | | x | | x | x | x | x | x | | x |
| 22 | 18.5 | 5027 | | | x | | x | x | x | x | x | | x |
| 30 | 22 | 5032 | x | | | x | x | x | x | x | x | x | |
| 37 | 30 | 5042 | x | | | x | x | x | x | x | x | x | |
| 45 | 37 | 5052 | x | | | x | x | x | x | x | x | x | |

| | | | |
|---|---|---|---|
| C00 | Compact IP00 | DE | Extended with brake, disconnect and fuses |
| B20 | Bookstyle IP20 | DX | Extended without brake, with disconnect and fuses |
| C20 | Compact IP20 | PS | Standard with 24 V supply |
| CN1 | Compact Nema1 | PB | Standard with 24 V supply, brake, fuse and disconnect |
| C54 | Compact IP54 | PD | Standard with 24 V supply, fuse and disconnect |
| ST | Standard | PF | Standard with 24 V supply and fuse |
| SB | Standard with brake | R0 | Without filter |
| EB | Extended with brake | R1 | Class A1 filter |
| EX | Extended without brake | R3 | Class A1 and B filter |

## VLT 5001-5552, 380-500 V units
## Typecode designation: T5

| Powersize (kW) | | Type | Enclosure | | | | | HW variant | | | | | | | | | | RFI filter | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Torque | | | C00 | B20 | C20 | CN1 | C54 | ST | SB | EB | EX | DE | DX | PS | PB | PD | PF | R0 | R1 | R3 | R6 |
| 110% | 160% | | | | | | | | | | | | | | | | | | | | |
| | | 9-10 | 11-13 | 11-13 | 11-13 | 11-13 | 11-13 | 14-15 | 14-15 | 14-15 | 14-15 | 14-15 | 14-15 | 14-15 | 14-15 | 14-15 | 14-15 | 16-17 | 16-17 | 16-17 | 16-17 |
| | 0.75 | 5001 | | x | x | | x | x | x | x | | | | | | | | | | x | |
| | 1.1 | 5002 | | x | x | | x | x | x | x | | | | | | | | | | x | |
| | 1.5 | 5003 | | x | x | | x | x | x | x | | | | | | | | | | x | |
| | 2.2 | 5004 | | x | x | | x | x | x | x | | | | | | | | | | x | |
| | 3 | 5005 | | x | x | | x | x | x | x | | | | | | | | | | x | |
| | 3.7 | 5006 | | x | x | | x | x | x | x | | | | | | | | | | x | |
| | 5.5 | 5008 | | x | x | | x | x | x | x | | | | | | | | | | x | |
| | 7.5 | 5011 | | x | x | | x | x | x | x | | | | | | | | | x | | |
| 15 | 11 | 5016 | | | x | | x | x | x | x | | | | | | | | x | | x | |
| 18.5 | 15 | 5022 | | | x | | x | x | x | x | | | | | | | | x | | x | |
| 22 | 18.5 | 5027 | | | x | | x | x | x | x | | | | | | | | x | | x | |
| 30 | 22 | 5032 | | | x | | x | x | x | x | | | | | | | | x | | x | |
| 37 | 30 | 5042 | | | x | | x | x | x | x | | | | | | | | x | | x | |
| 45 | 37 | 5052 | | | x | | x | x | x | x | | | | | | | | x | | x | |
| 55 | 45 | 5062 | | | x | | x | x | x | x | | | | | | | | x | | x | |
| 75 | 55 | 5072 | | | x | | x | x | x | x | | | | | | | | x | | x | |
| 90 | 75 | 5102 | | | x | | x | x | x | x | | | | | | | | x | | x | |
| 110 | 90 | 5122 | x | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | x |
| 132 | 110 | 5152 | x | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | x |
| 160 | 132 | 5202 | x | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | x |
| 200 | 160 | 5252 | x | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | x |
| 250 | 200 | 5302 | x | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | x |
| 315 | 250 | 5352 | x | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | |
| 355 | 315 | 5452 | x | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | |
| 400 | 355 | 5502 | x | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | |
| 450 | 400 | 5552 | x | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | |

| | |
|---|---|
| C00 | Compact IP00 |
| B20 | Bookstyle IP20 |
| C20 | Compact IP20 |
| CN1 | Compact Nema1 |
| C54 | Compact IP54 |
| ST | Standard |
| SB | Standard with brake |
| EB | Extended with brake |
| EX | Extended without brake |
| DE | Extended with brake, disconnect and fuses |
| DX | Extended without brake, with disconnect and fuses |
| PS | Standard with 24 V supply |
| PB | Standard with 24 V supply, brake, fuse and disconnect |
| PD | Standard with 24 V supply, fuse and disconnect |
| PF | Standard with 24 V supply and fuse |
| R0 | Without filter |
| R1 | Class A1 filter |
| R3 | Class A1 and B filter |
| R6 | Filter for marine installations |



MG.52.B2.02 - VLT® is a registered Danfoss trademark

VLT 5001-5062, 525-600 V units
Typecode designation: T6

| Powersize (kW) | | Type | Enclosure | | | HW variant | | RFI filter |
|---|---|---|---|---|---|---|---|---|
| Torque | | | C00 | C20 | CN1 | ST | EB | R0 |
| 110% | 160% | | | | | | | |
| | | 9-10 | 11-13 | 11-13 | 11-13 | 14-15 | 14-15 | 16-17 |
| 1.1 | 0.75 | 5001 | | x | | x | x | x |
| 1.5 | 1.1 | 5002 | | x | | x | x | x |
| 2.2 | 1.5 | 5003 | | x | | x | x | x |
| 3.0 | 2.2 | 5004 | | x | | x | x | x |
| 4.0 | 3.0 | 5005 | | x | | x | x | x |
| 5.5 | 4.0 | 5006 | | x | | x | x | x |
| 7.5 | 5.5 | 5008 | | x | | x | x | x |
| 7.5 | 7.5 | 5011 | | x | | x | x | x |
| 15 | 11 | 5016 | | x | | x | x | x |
| 18.5 | 15 | 5022 | | x | | x | x | x |
| 22 | 18.5 | 5027 | | x | | x | x | x |
| 30 | 22 | 5032 | | x | | x | x | x |
| 37 | 30 | 5042 | | x | | x | x | x |
| 45 | 37 | 5052 | | x | | x | x | x |
| 55 | 45 | 5062 | | x | | x | x | x |

VLT 5042-5602, 525-690 V units
Typecode designation: T7

| Power size (kW) | | Type | Enclosure | | | Hardware variant | | | | | | | | | | RFI filter | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Torque | | | C00 | CN1 | C54 | ST | SB | EB | EX | DE | DX | PS | PB | PD | PF | R0 | R1[1] |
| 110 % | 160 % | | | | | | | | | | | | | | | | |
| | | 9-10 | 11-13 | 11-13 | 11-13 | 14-15 | 14-15 | 14-15 | 14-15 | 14-15 | 14-15 | 14-15 | 14-15 | 14-15 | 14-15 | 16-17 | 16-17 |
| 45 | 37 | 5042 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 55 | 45 | 5052 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 75 | 55 | 5062 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 90 | 75 | 5072 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 110 | 90 | 5102 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 132 | 110 | 5122 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 160 | 132 | 5152 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 200 | 160 | 5202 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 250 | 200 | 5252 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 315 | 250 | 5302 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 400 | 315 | 5352 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 500 | 400 | 5402 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 560 | 500 | 5502 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |
| 630 | 560 | 5602 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | |

1. R1 is not available with DX, PF and PD variants.

Voltage (position 9-10)

The drives are available in three voltage ratings. Please be aware that some drives at 500 V supply match a motor power size larger than 400 V - please refer to the individual technical data.

- T2 - 200-240 V three phase supply voltage
- T5 - 380-500 V three phase supply voltage
- T6 - 525-600 V three phase supply voltage
- T7 - 525-690 V three phase supply voltage

Enclosure variants (position 11-13)

Bookstyle units are available for use in control cabinets - the slim design allows many units in one cabinet. Compact units are designed for mounting on walls or machines. Higher power units are also available as IP00 units for installation in control cabinets.

- C00 - Compact IP00 enclosure
- B20 - Bookstyle IP20 enclosure
- C20 - Compact IP20 enclosure

- CN1 - Compact Nema1 enclosure also fulfilling IP20/21 specifications
- C54 - Compact IP54 enclosure also fulfilling NEMA12 demands

Hardware variants (position 14-15)
The hardware variants differ depending on power size.

- ST - Standard hardware
- SB - Standard hardware and additional brake chopper
- EB - Extended hardware (24 V external supply for backup of control card and load sharing connections) and an additional brake chopper
- EX - Extended hardware (24 V external supply for backup of control card and load sharing connections)
- DE - Extended hardware (24 V external supply for backup of control card and load sharing connections), brake chopper, disconnect and fuses
- DX - Extended hardware (24 V external supply for backup of control card and load sharing connections), disconnect and fuses
- PS - Standard hardware with 24 V external supply for backup of control card
- PB - Standard hardware with 24 V external supply for backup of control card, brake chopper, fuse and disconnect option
- PD - Standard hardware with 24 V external supply for backup of control card, mains fuse and disconnect option
- PF - Standard hardware with 24 V external supply for backup of control card and built in main fuses

RFI filter variants (position 16-17)
Different RFI filter variants offer the possibility to comply with class A1 and class B according to EN55011.

- R0 - No filter performance specified
- R1 - Compliance with class A1 filter
- R3 - Compliance with class B and A1
- R6 - Compliance with marine approvals (VLT 5122-5302, 380-500 V)

Compliance depends on cable length. Please be aware that some power sizes always have built in filters from factory.

Display (position 18-19)
The control unit (display and keypad)

- D0 - No display in the unit (not possible for IP54 enclosures as well as IP21 VLT 5352-5552, 380-480 V and VLT 5402 - 5602, 525-690 V)
- DL - Display supplied with the unit

Field bus option (position 20-22)
A wide selection of high performance field bus options is available

- F0 - No field bus option built in
- F10 - Profibus DP V0/V1 12 Mbaud
- F13 - Profibus DP V0/FMS 12 Mbaud
- F20 - Modbus Plus
- F30 - DeviceNet
- F40 - LonWorks - Free topology
- F41 - LonWorks - 78 kbps
- F42 - LonWorks - 1,25 Mbps
- F50 - Interbus

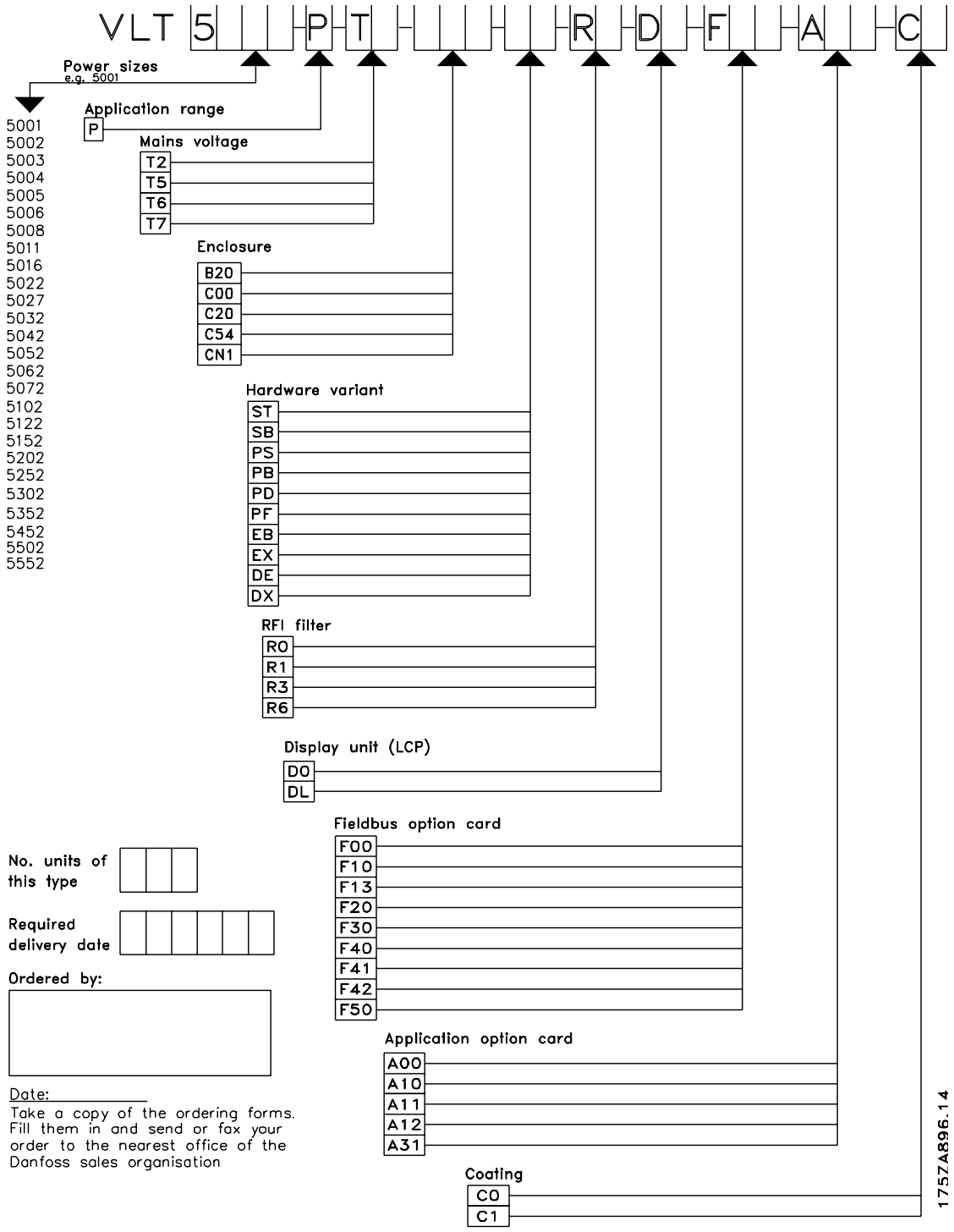
Application options (position 23-25)
Several application options are available to enhance the functionality of the frequency converter

- A00 - No option built in
- A10 - SyncPos programmable controller (not possible with Modbus Plus and LonWorks)
- A11 - Synchronising controller (not possible with Modbus Plus and LonWorks)
- A12 - Positioning controller (not possible with Modbus Plus and LonWorks)
- A31 - Additional relays - 4 relays for 250 VAC (not possible with field bus options)

Coating (position 26-27)
To increase protection of the drive against aggressive environments it is possible to order coated printed circuit boards.

- C0 - Non coated boards (VLT 5352-5552, 380-500 V and VLT 5042-5602, 525-690 V) only available with coated boards)
- C1 - Coated boards

## ■ Ordering form VLT 5000 Series - Typecode



## Selection of modules and accessories

Danfoss offers a wide range of modules and accessories for VLT 5000 Series.

## Sine-wave filter module

The sine-wave filter reduces the voltage rise time (dU/dt) and the ripple current (ΔI) to the motor, thereby making current and voltage almost sinusoidal. The acoustic motor noise is therefore reduced to a minimum.

See also instructions MI.56.DX.51.

## LCP control unit

Control unit with display and keypad for programming VLT frequency converters. Available as an option for IP 00 and IP 20 units.
Enclosure: IP 65.

## Remote-mounting kits for LCP

The remote kit option makes it possible to move the display from the frequency converter e.g. to the front panel of an integrated cabinet.

| Technical data | |
|---|---|
| Enclosure: | IP 65 front |
| Max. cable length between VLT and unit: | 3 m |
| Communication std: | RS 422 |

Reference is also made to instructions MI.56.AX.51 (IP 20) and MI.56.GX.52 (IP 54).

## IP 4x top cover

IP 4x top cover is an optional enclosure element available for IP 20 Compact units.
If an IP 4x top cover is used, an IP 20 unit is upgraded to comply with enclosure IP 4x from the top. In practice, this means that the unit complies with IP 40 on upper, horizontal surfaces.
A top cover is available for the following Compact units:
VLT type 5001-5006, 200-240 V
VLT type 5001-5011, 380-500 V
VLT type 5001-5011, 525-600 V

## Terminal cover

Using a terminal cover, it is possible to field mount an IP 20 unit, type VLT 5008-5052.
A terminal cover is available for the following compact units:
VLT type 5008-5027, 200-240 V
VLT type 5016-5102, 380-500 V
VLT type 5016-5062, 525-600 V

## Contactors

Danfoss also manufactures a complete range of contactors.

## Brake resistors

Brake resistors are used in applications where high dynamics are needed or a high inertia load has to be stopped. The brake resistor is used to remove the energy, see also Instructions MI.50.SX.YY and MI.90.FX.YY.

## Harmonic filter

Harmonic currents do not directly affect the electricity consumption but has an impact on following conditions:

Higher total current to be handled by the installations

- Increases load on transformer (sometimes it will require a larger transformer, particular at retrofit)
- Increases heat losses in transformer and installation
- In some cases demands larger cables, switches and fuses

Higher voltage distortion due to higher current

- Increase risk for disturbing electronic equipment connected to same grid

A high percentage of rectifier load from eg frequency converters, will increase the harmonic current, which must be reduced to avoid the above consequences. Therefore the frequency converter has as standard, built in DC coils reducing the total current with about 40% (compared to devices without any arrangement for harmonic suppression), down to 40-45% ThiD.

In some cases there is a need for further suppression (eg retrofit with frequency converters). For this purpose Danfoss can offer two advanced harmonic filters AHF05 and AHF10, bringing the harmonic current down to around 5% and 10% respectively. For further details see instruction MG.80.BX.YY.

## PC Software tools

**PC Software - MCT 10**

All drives are equipped with a serial communication port. We provide a PC tool for communication between PC and frequency converter, VLT Motion Control Tool MCT 10 Set-up Software.

**MCT 10 Set-up Software**

MCT 10 has been designed as an easy to use interactive tool for setting parameters in our frequency converters.

The MCT 10 Set-up Software will be useful for:

- Planning a communication network off-line. MCT 10 contains a complete frequency converter database
- Commissioning frequency converters on line
- Saving settings for all frequency converters
- Replacing a drive in a network
- Expanding an existing network
- Future developed drives will be supported

MCT 10 Set-up Software support Profibus DP-V1 via a Master class 2 connection. It makes it possible to on line read/write parameters in a frequency converter via the Profibus network. This will eliminate the need for an extra communication network.

**The MCT 10 Set-up Software Modules**

The following modules are included in the software package:




**MCT 10 Set-up Software**
Setting parameters
Copy to and from frequency converters
Documentation and print out of parameter settings incl. diagrams

**SyncPos**
Creating SyncPos programme

**Ordering number:**

Please order your CD containing MCT 10 Set-up Software using code number 130B1000.

**MCT 31**

The MCT 31 harmonic calculation PC tool enables easy estimation of the harmonic distortion in a given application. Both the harmonic distortion of Danfoss frequency converters as well as non-Danfoss frequency converters with different additional harmonic reduction measurements, such as Danfoss AHF filters and 12-18-pulse rectifiers, can be calculated.

**Ordering number:**

Please order your CD containing the MCT 31 PC tool using code number 130B1031.

## Modbus RTU

MODBUS RTU (Remote Terminal Unit) Protocol is a messaging structure developed by Modicon in 1979, used to establish master-slave/client-server communication between intelligent devices.

MODBUS is used to monitor and program devices; to communicate intelligent devices with sensors and instruments; to monitor field devices using PCs and HMIs.

MODBUS is often applied in Gas and Oil applications, but also in building, infrastructure, transportation and energy, applications are making use of its benefits.

## ■ Line reactors for load sharing applications

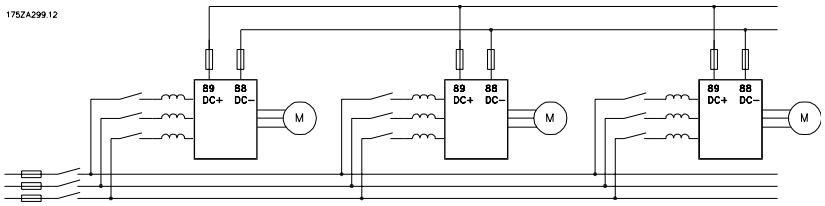
Line reactors are used when connecting frequency converters together in a load sharing application.

### 200 - 240 V units

| VLT type | Nominal power at CT [kW] | Input current [A] | Voltage drop [%] | Inductivity [mH] | Ordering number |
|---|---|---|---|---|---|
| 5001 | 0.75 | 3.4 | 1.7 | 1.934 | 175U0021 |
| 5002 | 1.10 | 4.8 | 1.7 | 1.387 | 175U0024 |
| 5003 | 1.50 | 7.1 | 1.7 | 1.050 | 175U0025 |
| 5004 | 2.20 | 9.5 | 1.7 | 0.808 | 175U0026 |
| 5005 | 3.0 | 11.5 | 1.7 | 0.603 | 175U0028 |
| 5006 | 4.0 | 14.5 | 1.7 | 0.490 | 175U0029 |
| 5008 | 5.5 | 32.0 | 1.7 | 0.230 | 175U0030 |
| 5011 | 7.5 | 46.0 | 1.7 | 0.167 | 175U0032 |
| 5016 | 11.0 | 61.0 | 1.7 | 0.123 | 175U0034 |
| 5022 | 15.0 | 73.0 | 1.7 | 0.102 | 175U0036 |
| 5027 | 18.5 | 88.0 | 1.7 | 0.083 | 175U0047 |

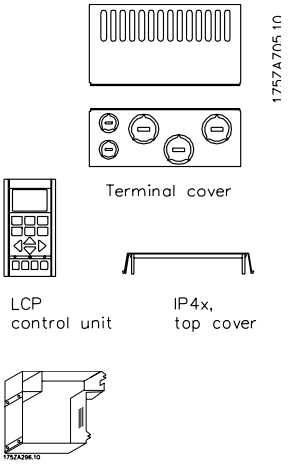
### 380 - 500 V units

| VLT type | Nominal power at CT [kW] | Input current [A] | Voltage drop [%] | Inductivity [mH] | Ordering number |
|---|---|---|---|---|---|
| 5001 | 0.75 | 2.3 | 1 | 3.196 | 175U0015 |
| 5002 | 1.1 | 2.6 | 1 | 2.827 | 175U0017 |
| 5003 | 1.5 | 3.8 | 1 | 1.934 | 175U0021 |
| 5004 | 2.2 | 5.3 | 1 | 1.387 | 175U0024 |
| 5005 | 3 | 7.0 | 1 | 1.050 | 175U0025 |
| 5006 | 4 | 9.1 | 1 | 0.808 | 175U0026 |
| 5008 | 5.5 | 12.2 | 1 | 0.603 | 175U0028 |
| 5011 | 7.5 | 15.0 | 1 | 0.490 | 175U0029 |
| 5016 | 11 | 32.0 | 1 | 0.230 | 175U0030 |
| 5022 | 15 | 37.5 | 1 | 0.196 | 175U0031 |
| 5027 | 18.5 | 44.0 | 1 | 0.167 | 175U0032 |
| 5032 | 22 | 60.0 | 1 | 0.123 | 175U0034 |
| 5042 | 30 | 72.0 | 1 | 0.102 | 175U0036 |
| 5052 | 37 | 89.0 | 1 | 0.083 | 175U0047 |
| 5062 | 45 | 104.0 | 1 | 0.070 | 175U1009 |
| 5072 | 55 | 144.6 | 1 | 0.051 | 175U0070 |
| 5102 | 75 | 174.1 | 1 | 0.042 | 175U0071 |

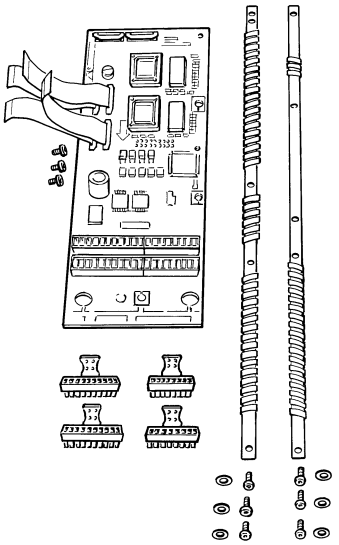



See also instruction MI.50.NX.YY for further information.

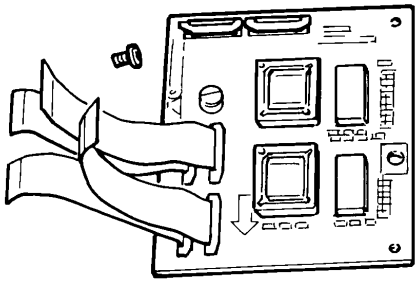
## ■ Accessories for VLT 5000 Series




IP 20 bottom cover



Application option



Memory option

■ **Ordering numbers, misc. hardware:**

| Type | Description | Ordering no. |
|---|---|---|
| IP 4x top cover/NEMA 1 kit[1)] | Option, VLT 5001-5006, 200-240 V | 175Z0928 |
| IP 4x top cover/NEMA 1 kit[1)] | Option, VLT 5001-5011, 380-500 V and 525-600 V | 175Z0928 |
| NEMA 12 bonding plate[2)] | Option, VLT 5001-5006, 200-240 V | 175H4195 |
| NEMA 12 bonding plate[2)] | Option, VLT 5001-5011, 380-500 V | 175H4195 |
| IP 20 terminal cover | Option, VLT 5008-5016, 200-240 V | 175Z4622 |
| IP 20 terminal cover | Option, VLT 5022-5027, 200-240 V | 175Z4623 |
| IP 20 terminal cover | Option, VLT 5016-5032, 380-500 V and 525-600 V | 175Z4622 |
| IP 20 terminal cover | Option, VLT 5042-5062, 380-500 V and 525-600 V | 175Z4623 |
| IP 20 terminal cover | Option, VLT 5072-5102, 380-500 V | 175Z4280 |
| IP 20 bottom cover | VLT 5032-5052, 200 - 240 V | 176F1800 |
| Terminal Adapter Kit | VLT 5032-5052, 200 - 240 V IP 00/Nema 1(IP 20), ST | 176F1805 |
| Terminal Adapter Kit | VLT 5032-5052, 200 - 240 V IP 00/Nema 1(IP 20), SB | 176F1806 |
| Terminal Adapter Kit | VLT 5032-5052, 200 - 240 V IP 00/Nema 1(IP 20), EB | 176F1807 |
| Terminal Adapter Kit | VLT 5032-5052, 200 - 240 V IP 54, ST | 176F1808 |
| Terminal Adapter Kit | VLT 5032-5052, 200 - 240 V IP 54, SB | 176F1809 |
| Encoder converter / 5 V TTL Linedriver / 24 V DC | | 175Z1929 |

**Rittal Installation Kits**

| Type | Description | Order No. |
|---|---|---|
| Rittal TS8 enclosure for IP00[3)] | Installation kit for 1800mm high enclosure, VLT5122-5152; 380-500V, VLT 5042-5152, 525-690V | 176F1824 |
| Rittal TS8 enclosure for IP00[3)] | Installation kit for 2000mm high enclosure, VLT5122-5152, 380-500V; VLT 5042-5152, 525-690V | 176F1826 |
| Rittal TS8 enclosure for IP00[3)] | Installation kit for 1800mm high enclosure, VLT5202-5302, 380-500V; VLT 5202-5352, 525-690V | 176F1823 |
| Rittal TS8 enclosure for IP00[3)] | Installation kit for 2000mm high enclosure, VLT5202-5302, 380-500V; VLT 5202-5352, 525-690V | 176F1825 |
| Rittal TS8 enclosure for IP00[3)] | Installation kit for 2000mm high enclosure, VLT5352-5552, 380-500V; VLT 5402-5602, 525-690V | 176F1850 |
| Floor stand for IP21 and IP54 enclosure[3)] | Option, VLT5122-5302, 380-500V; VLT 5042-5352, 525-690V | 176F1827 |
| Mains shield kit | Protection kit:: VLT 5122-5302, 380-500 V VLT 5042-5352, 525-690 V | 176F0799 |
| | Protection kit:: VLT 5352-5552, 380-500 V; VLT 5402-5602, 525-690 V | 176F1851 |

[1)] IP 4xNEMA top cover is for Compact IP 20 units only and is only intended for horizontal surfaces that comply with IP 4x. The kit also contains a bonding plate (UL).

[2)] NEMA 12 bonding plate (UL) is for compact IP 54 units only.

[3)] For details: See High Power Installation Guide, MI.90.JX.YY.

■ **Ordering numbers, control card options, etc.: LCP:**

| Type | Description | Ordering no. | |
|---|---|---|---|
| IP 65 LCP option | Separate LCP, only for IP 20 units | 175Z0401 | |
| LCP remote-mounting kit/ IP00/IP20/NEMA 1 | Remote-mounting kit for LCP, for IP 00/20 units | 175Z0850 | incl. 3 m cable |
| LCP remote-mounting kit IP 54 | Remote-mounting kit for LCP, for IP 54 units | 175Z7802 | incl. 3 m cable |
| Cable for LCP | Separate cable | 175Z0929 | 3 m cable |

LCP: Control unit with display and keypad. Supplied excl. LCP.

**Fieldbus options and accessories:**

**Profibus:**

| | | Uncoated | Coated |
|---|---|---|---|
| Type | Description | Ordering no. | Ordering no. |
| Profibus option DP V0/V1 | incl. memory option | 175Z0404 | 175Z2625 |
| Profibus option DP V0/V1 | excl. memory option | 175Z0402 | |
| Profibus option DP V0/FMS | incl. memory option | 175Z3722 | 175Z3723 |

| Type | Description | Ordering no. |
|---|---|---|
| Profibus Sub D9 Connector for IP 20 / IP 00 | VLT 5001-5027, 200-240 V<br>VLT 5001-5102, 380-500 V<br>VLT 5001-5062, 525-600 V | 175Z3568 |
| | VLT 5032-5052, 200-240 V | 176F1822 |

**LonWorks:**

| | | | |
|---|---|---|---|
| LonWorks option, Free topology | incl. memory option | 176F1500 | 176F1503 |
| LonWorks option, Free topology | excl. memory option | 176F1512 | |
| LonWorks option, 78 KBPS | incl. memory option | 176F1501 | 176F1504 |
| LonWorks option, 78 KBPS | excl. memory option | 176F1513 | |
| LonWorks option, 1.25 MBPS | incl. memory option | 176F1502 | 176F1505 |
| LonWorks option, 1.25 MBPS | excl. memory option | 176F1514 | |

**DeviceNet:**

| | | | |
|---|---|---|---|
| DeviceNet option | incl. memory option | 176F1580 | 176F1581 |
| DeviceNet option | excl. memory option | 176F1584 | |

**Modbus:**

| | | | |
|---|---|---|---|
| Modbus Plus for Compact units | incl. memory option | 176F1551 | 176F1553 |
| Modbus Plus for Compact units | excl. memory option | 176F1559 | |
| Modbus Plus for Bookstyle units | incl. memory option | 176F1550 | 176F1552 |
| Modbus Plus for Bookstyle units | excl. memory option | 176F1558 | |
| Modbus RTU | Not factory mounted | 175Z3362 | |

**Interbus:**

| | | | |
|---|---|---|---|
| Interbus | incl. memory option | 175Z3122 | 175Z3191 |
| Interbus | excl. memory option | 175Z2900 | |

**Application options:**

| | | | |
|---|---|---|---|
| Programmable SyncPos controller | Application option | 175Z0833 | 175Z3029 |
| Synchronising controller | Application option | 175Z3053 | 175Z3056 |
| Positioning controller | Application option | 175Z3055 | 175Z3057 |
| Relay card option | Application option | 175Z2500 | 175Z2901 |
| Winder Option | Not factory mounted, SW version 3.40 | 175Z3245 | |
| Ring Spinning Option | Not factory mounted, SW version 3.41 | 175Z3463 | |
| Wobble Option | Not factory mounted, SW version 3.41 | 175Z3467 | |

Options can be ordered as factory built-in options, see ordering information.
For information on fieldbus and application option combatibility with older software versions, please contact your Danfoss supplier.
If the Fieldbus options are to be used without application option a version with memory option must be ordered.

## Output Filters

The high speed switching of the frequency converter produces some secondary effects, which influence the motor and the enclosed environment. These side effects are addressed by two different filter types, -the du/dt and the Sine-wave filter.

**dU/dt filters**

Motor insulation stresses are often caused by the combination of rapid voltage and current increase. The rapid energy changes can also be reflected back to the DC-line in the inverter and cause shut down. The du/dt filter is designed to reduce the voltage rise time/the rapid energy change in the motor and by that intervention avoid premature aging and flashover in the motor insulation. du/dt filters have a positive influence on the radiation of magnetic noise in the cable that connects the drive to the motor. The voltage wave form is still pulse shaped but the du/dt ratio is reduced in comparison with the installation without filter.

**Sine-wave filters**

Sine-wave filters are designed to let only low frequencies pass. High frequencies are consequently shunted away which results in a sinusoidal phase to phase voltage waveform and sinusoidal current waveforms.
With the sinusoidal waveforms the use of special frequency converter motors with reinforced insulation is no longer needed. The acoustic noise from the motor is also damped as a consequence of the wave condition.
Besides the features of the du/dt filter, the sine-wave filter also reduces insulation stress and bearing currents in the motor thus leading to prolonged motor lifetime and longer periods between services. Sine-wave filters enable use of longer motor cables in applications where the motor is installed far from the drive. The length is unfortunately limited because the filter does not reduce leakage currents in the cables.

## Ordering Numbers: Sine Wave Filter Modules, 200-500 VAC

**Mains supply 3 x 200 to 500 V**

| Minimum switching frequency | Maximum output frequency | Part No. IP20 | Part No. IP00 | Rated filter current at 50Hz |
|---|---|---|---|---|
| 5 kHz | 120 Hz | 130B2439 | 130B2404 | 2.5 A |
| 5 kHz | 120 Hz | 130B2441 | 130B2406 | 4.5 A |
| 5 kHz | 120 Hz | 130B2443 | 130B2408 | 8 A |
| 5 kHz | 120 Hz | 130B2444 | 130B2409 | 10 A |
| 5 kHz | 120 Hz | 130B2446 | 130B2411 | 17 A |
| 4 kHz | 60 Hz | 130B2447 | 130B2412 | 24 A |
| 4 kHz | 60 Hz | 130B2448 | 130B2413 | 38 A |
| 4 kHz | 60 Hz | 130B2307 | 130B2281 | 48 A |
| 3 kHz | 60 Hz | 130B2308 | 130B2282 | 62 A |
| 3 kHz | 60 Hz | 130B2309 | 130B2283 | 75 A |
| 3 kHz | 60 Hz | 130B2310 | 130B2284 | 115 A |
| 3 kHz | 60 Hz | 130B2311 | 130B2285 | 180 A |
| 3 kHz | 60 Hz | 130B2312 | 130B2286 | 260 A |
| 3 kHz | 60 Hz | 130B2313 | 130B2287 | 410 A |
| 3 kHz | 60 Hz | 130B2314 | 130B2288 | 480 A |
| 2 kHz | 60 Hz | 130B2315 | 130B2289 | 660 A |
| 2 kHz | 60 Hz | 130B2316 | 130B2290 | 750 A |
| 2 kHz | 60 Hz | 130B2317 | 130B2291 | 880 A |
| 2 kHz | 60 Hz | 130B2318 | 130B2292 | 1200 A |



**NB!**

When using Sine-wave filters, the switching frequency should comply with filter specifications in *par. 411 Switching Frequency*.

## Ordering Numbers: Sine-Wave Filter Modules, 525-600 VAC

**Mains supply 3 x 525 to 690 V**

| Minimum switching frequency | Maximum output frequency | Part No. IP20 | Part No. IP00 | Rated filter current at 50Hz |
|---|---|---|---|---|
| 2 kHz | 60 Hz | 130B2341 | 130B2321 | 13 A |
| 2 kHz | 60 Hz | 130B2342 | 130B2322 | 28 A |
| 2 kHz | 60 Hz | 130B2343 | 130B2323 | 45 A |
| 2 kHz | 60 Hz | 130B2344 | 130B2324 | 76 A |
| 2 kHz | 60 Hz | 130B2345 | 130B2325 | 115 A |
| 2 kHz | 60 Hz | 130B2346 | 130B2326 | 165 A |
| 2 kHz | 60 Hz | 130B2347 | 130B2327 | 260 A |
| 2 kHz | 60 Hz | 130B2348 | 130B2329 | 303 A |
| 1.5 kHz | 60 Hz | 130B2270 | 130B2241 | 430 A |
| 1.5 kHz | 60 Hz | 130B2271 | 130B2242 | 530 A |
| 1.5 kHz | 60 Hz | 130B2381 | 130B2337 | 660 A |
| 1.5 kHz | 60 Hz | 130B2382 | 130B2338 | 765 A |
| 1.5 kHz | 60 Hz | 130B2383 | 130B2339 | 940 A |
| 1.5 kHz | 60 Hz | 130B2384 | 130B2340 | 1320 A |

**NB!**
When using Sine-wave filters, the switching frequency should comply with filter specifications in *par. 14-01 Switching Frequency*.

## Ordering Numbers: du/dt Filters, 380-480 VAC

**Mains supply 3x380 to 3x480 V**

| Minimum switching frequency | Maximum output frequency | Part No. IP20 | Part No. IP00 | Rated filter current at 50 Hz |
|---|---|---|---|---|
| 4 kHz | 60 Hz | 130B2396 | 130B2385 | 24 A |
| 4 kHz | 60 Hz | 130B2397 | 130B2386 | 45 A |
| 3 kHz | 60 Hz | 130B2398 | 130B2387 | 75 A |
| 3 kHz | 60 Hz | 130B2399 | 130B2388 | 110 A |
| 3 kHz | 60 Hz | 130B2400 | 130B2389 | 182 A |
| 3 kHz | 60 Hz | 130B2401 | 130B2390 | 280 A |
| 3 kHz | 60 Hz | 130B2402 | 130B2391 | 400 A |
| 3 kHz | 60 Hz | 130B2277 | 130B2275 | 500 A |
| 2 kHz | 60 Hz | 130B2278 | 130B2276 | 750 A |
| 2 kHz | 60 Hz | 130B2405 | 130B2393 | 910 A |
| 2 kHz | 60 Hz | 130B2407 | 130B2394 | 1500 A |
| 2 kHz | 60 Hz | 130B2410 | 130B2395 | 2300 A |

## Ordering Numbers: du/dt Filters, 525-600 VAC

**Mains supply 3x525 to 3x600 V**

| Minimum switching frequency | Maximum output frequency | Part No. IP20 | Part No. IP00 | Rated filter current at 50 Hz |
|---|---|---|---|---|
| 4 kHz | 60 Hz | 130B2423 | 130B2414 | 28 A |
| 4 kHz | 60 Hz | 130B2424 | 130B2415 | 45 A |
| 3 kHz | 60 Hz | 130B2425 | 130B2416 | 75 A |
| 3 kHz | 60 Hz | 130B2426 | 130B2417 | 115 A |
| 3 kHz | 60 Hz | 130B2427 | 130B2418 | 165 A |
| 3 kHz | 60 Hz | 130B2428 | 130B2419 | 260 A |
| 3 kHz | 60 Hz | 130B2429 | 130B2420 | 310 A |
| 3 kHz | 60 Hz | 130B2278 | 130B2235 | 430 A |
| 2 kHz | 60 Hz | 130B2239 | 130B2236 | 530 A |
| 2 kHz | 60 Hz | 130B2274 | 130B2280 | 630 A |
| 2 kHz | 60 Hz | 130B2430 | 130B2421 | 765 A |
| 2 kHz | 60 Hz | 130B2431 | 130B2422 | 1350 A |

## ■ Brake resistors, VLT 5001 - 5052 / 200 - 240 V

### Standard brake resistors

| | 10% duty cycle | | | 40% duty cycle | | |
|---|---|---|---|---|---|---|
| VLT | Resistance [ohm] | Power [kW] | Code No. | Resistance [ohm] | Power [kW] | Code No. |
| 5001 | 145 | 0.065 | 175U1820 | 145 | 0.260 | 175U1920 |
| 5002 | 90 | 0.095 | 175U1821 | 90 | 0.430 | 175U1921 |
| 5003 | 65 | 0.250 | 175U1822 | 65 | 0.80 | 175U1922 |
| 5004 | 50 | 0.285 | 175U1823 | 50 | 1.00 | 175U1923 |
| 5005 | 35 | 0.430 | 175U1824 | 35 | 1.35 | 175U1924 |
| 5006 | 25 | 0.8 | 175U1825 | 25 | 3.00 | 175U1925 |
| 5008 | 20 | 1.0 | 175U1826 | 20 | 3.50 | 175U1926 |
| 5011 | 15 | 1.8 | 175U1827 | 15 | 5.00 | 175U1927 |
| 5016 | 10 | 2.8 | 175U1828 | 10 | 9.0 | 175U1928 |
| 5022 | 7 | 4.0 | 175U1829 | 7 | 10.0 | 175U1929 |
| 5027 | 6 | 4.8 | 175U1830 | 6 | 12.7 | 175U1930 |
| 5032 | 4.7 | 6 | 175U1954 | Not available | Not available | Not available |
| 5042 | 3.3 | 8 | 175U1955 | Not available | Not available | Not available |
| 5052 | 2.7 | 10 | 175U1956 | Not available | Not available | Not available |

See instruction MI.90.FX.YY for further information.

### Flatpack brake resistors for horizontal conveyors

| VLT type | Motor [kW] | Resistor [ohm] | Size | Order number | Max. duty cycle [%] |
|---|---|---|---|---|---|
| 5001 | 0.75 | 150 | 150 Ω 100 W | 175U1005 | 14.0 |
| 5001 | 0.75 | 150 | 150 Ω 200 W | 175U0989 | 40.0 |
| 5002 | 1.1 | 100 | 100 Ω 100 W | 175U1006 | 8.0 |
| 5002 | 1.1 | 100 | 100 Ω 200 W | 175U0991 | 20.0 |
| 5003 | 1.5 | 72 | 72 Ω 200 W | 175U0992 | 16.0 |
| 5004 | 2.2 | 47 | 50 Ω 200 W | 175U0993 | 9.0 |
| 5005 | 3 | 35 | 35 Ω 200 W | 175U0994 | 5.5 |
| 5005 | 3 | 35 | 72 Ω 200 W | 2 x 175U0992[1] | 12.0 |
| 5006 | 4 | 25 | 50 Ω 200 W | 2 x 175U0993[1] | 11.0 |
| 5008 | 5.5 | 20 | 40 Ω 200 W | 2 x 175U0996[1] | 6.5 |
| 5011 | 7.5 | 13 | 27 Ω 200 W | 2 x 175U0995[1] | 4.0 |

1. Order 2 pcs.

Mounting angle for flatpack resistor 100 W 175U0011
Mounting angle for flatpack resistor 200 W 175U0009
Mounting frame for 1 resistor narrow (slim bookstyle) 175U0002
Mounting frame for 2 resistors narrow (slim bookstyle) 175U0004
Mounting frame for 2 resistors broad (wide bookstyle) 175U0003

See *Instruction MI.50.BX.YY* for further information.

## ■ Ordering numbers, Brake resistors, VLT 5001 - 5552 / 380 - 500 V

### Standard brake resistors

| | 10% duty cycle | | | 40% duty cycle | | |
|---|---|---|---|---|---|---|
| VLT | Resistance [ohm] | Power [kW] | Code No. | Resistance [ohm] | Power [kW] | Code No. |
| 5001 | 620 | 0.065 | 175U1840 | 620 | 0.260 | 175U1940 |
| 5002 | 425 | 0.095 | 175U1841 | 425 | 0.430 | 175U1941 |
| 5003 | 310 | 0.250 | 175U1842 | 310 | 0.80 | 175U1942 |
| 5004 | 210 | 0.285 | 175U1843 | 210 | 1.35 | 175U1943 |
| 5005 | 150 | 0.430 | 175U1844 | 150 | 2.0 | 175U1944 |
| 5006 | 110 | 0.60 | 175U1845 | 110 | 2.4 | 175U1945 |
| 5008 | 80 | 0.85 | 175U1846 | 80 | 3.0 | 175U1946 |
| 5011 | 65 | 1.0 | 175U1847 | 65 | 4.5 | 175U1947 |
| 5016 | 40 | 1.8 | 175U1848 | 40 | 5.0 | 175U1948 |
| 5022 | 30 | 2.8 | 175U1849 | 30 | 9.3 | 175U1949 |
| 5027 | 25 | 3.5 | 175U1850 | 25 | 12.7 | 175U1950 |
| 5032 | 20 | 4.0 | 175U1851 | 20 | 13.0 | 175U1951 |
| 5042 | 15 | 4.8 | 175U1852 | 15 | 15.6 | 175U1952 |
| 5052 | 12 | 5.5 | 175U1853 | 12 | 19.0 | 175U1953 |
| 5062 | 9.8 | 15 | 175U2008 | 9.8 | 38.0 | 175U2007 |
| 5072 | 7.3 | 13 | 175U0069 | 7.3 | 38.0 | 175U0068 |
| 5102 | 5.7 | 15 | 175U0067 | 6.0 | 45.0 | 175U0066 |
| 5122[2)] | 3.8 | 22 | 175U1960 | | | |
| 5152[2)] | 3.2 | 27 | 175U1961 | | | |
| 5202[2)] | 2.6 | 32 | 175U1962 | | | |
| 5252[2)] | 2.1 | 39 | 175U1963 | | | |
| 5302[2)] | 1.65 | 56 | 2 x 175U1061[1)] | | | |
| 5352-5552[2)] | 1.3 | 72 | 2 x 175U1062[1) 3)] | | | |

1. Order 2 pcs. Connect in parallel.
2. Resistors selected for 300 second cycle.
3. Rating fulfilled up to VLT 5452, the torque is reduced for VLT 5502 and VLT 5552.

See *Instruction MI.90.FX.YY* for further information.

### Flatpack brake resistors for horizontal conveyors

| VLT type | Motor [kW] | Resistor [ohm] | Size | Order number | Max. duty cycle [%] |
|---|---|---|---|---|---|
| 5001 | 0.75 | 630 | 620 Ω 100 W | 175U1001 | 14.0 |
| 5001 | 0.75 | 630 | 620 Ω 200 W | 175U0982 | 40.0 |
| 5002 | 1.1 | 430 | 430 Ω 100 W | 175U1002 | 8.0 |
| 5002 | 1.1 | 430 | 430 Ω 200 W | 175U0983 | 20.0 |
| 5003 | 1.5 | 320 | 310 Ω 200 W | 175U0984 | 16.0 |
| 5004 | 2.2 | 215 | 210 Ω 200 W | 175U0987 | 9.0 |
| 5005 | 3 | 150 | 150 Ω 200 W | 175U0989 | 5.5 |
| 5005 | 3 | 150 | 300 Ω 200 W | 2 x 175U0985[1] | 12.0 |
| 5006 | 4 | 120 | 240 Ω 200 W | 2 x 175U0986[1] | 11.0 |
| 5008 | 5.5 | 82 | 160 Ω 200 W | 2 x 175U0988[1] | 6.5 |
| 5011 | 7.5 | 65 | 130 Ω 200 W | 2 x 175U0990[1] | 4.0 |

1. Order 2 pcs.

Mounting angle for flatpack resistor 100 W 175U0011.

Mounting angle for flatpack resistor 200 W 175U0009.

Mounting frame for 1 resistor narrow (slim bookstyle) 175U0002.

Mounting frame for 2 resistors narrow (slim bookstyle) 175U0004.

Mounting frame for 2 resistors broad (wide bookstyle) 175U0003.

See *Instruction MI.50.BX.YY* for further information.

For 525-600 V and 525-690 V please contact Danfoss.

## Ordering numbers, Harmonic filters

Harmonic filters are used to reduce mains harmonics

- AHF 010: 10% current distortion
- AHF 005: 5% current distortion

**380-415 V, 50Hz**

| $I_{AHF,N}$ | Typical Motor Used [kW] | Danfoss ordering number | | VLT 5000 |
|---|---|---|---|---|
| | | AHF 005 | AHF 010 | |
| 10 A | 4, 5.5 | 175G6600 | 175G6622 | 5006, 5008 |
| 19 A | 7.5 | 175G6601 | 175G6623 | 5011 |
| 26 A | 11 | 175G6602 | 175G6624 | 5016 |
| 35 A | 15, 18.5 | 175G6603 | 175G6625 | 5022, 5027 |
| 43 A | 22 | 175G6604 | 175G6626 | 5032 |
| 72 A | 30, 37 | 175G6605 | 175G6627 | 5042, 5052 |
| 101 A | 45. 55 | 175G6606 | 175G6628 | 5062, 5072 |
| 144 A | 75 | 175G6607 | 175G6629 | 5102 |
| 180 A | 90 | 175G6608 | 175G6630 | 5122 |
| 217 A | 110 | 175G6609 | 175G6631 | 5152 |
| 289 A | 132, 160 | 175G6610 | 175G6632 | 5202, 5252 |
| 324 A | | 175G6611 | 175G6633 | |
| 370 A | 200 | 175G6688 | 175G6691 | 5302 |
| Higher ratings can be achieved by paralleling the filter units | | | | |
| 434 A | 250 | Two 217 A units | | 5352 |
| 578 A | 315 | Two 289 A units | | 5452 |
| 613 A | 355 | 289 A and 324 A units | | 5502 |
| 648 A | 400 | Two 324 A units | | 5552 |

Please note that the matching of the typical Danfoss frequency converter and filter is pre-calculated based on 400 V and assuming typical motor load (4 or 2 pole motor): VLT 5000 series is based on a max. 160 % torque application. The pre-calculated filter current may be different than the input current ratings of VLT 5000 as stated in the respective operating instructions, as these numbers are based on different operating conditions.

**440-480 V, 60Hz**

| $I_{AHF,N}$ | Typical Motor Used [HP] | Danfoss ordering number | | VLT 5000 |
|---|---|---|---|---|
| | | AHF 005 | AHF 010 | |
| 19 A | 10, 15 | 175G6612 | 175G6634 | 5011, 5016 |
| 26 A | 20 | 175G6613 | 175G6635 | 5022 |
| 35 A | 25, 30 | 175G6614 | 175G6636 | 5027, 5032 |
| 43 A | 40 | 175G6615 | 175G6637 | 5042 |
| 72 A | 50, 60 | 175G6616 | 175G6638 | 5052, 5062 |
| 101 A | 75 | 175G6617 | 175G6639 | 5072 |
| 144 A | 100, 125 | 175G6618 | 175G6640 | 5102, 5122 |
| 180 A | 150 | 175G6619 | 175G6641 | 5152 |
| 217 A | 200 | 175G6620 | 175G6642 | 5202 |
| 289 A | 250 | 175G6621 | 175G6643 | 5252 |
| 324 A | 300 | 175G6689 | 175G6692 | 5302 |
| 370 A | 350 | 175G6690 | 175G6693 | 5352 |
| Higher ratings can be achieved by paralleling the filter units | | | | |
| 506 A | 450 | 217 A and 289 A units | | 5452 |
| 578 A | 500 | Two 289 A units | | 5502 |
| 648 A | 600 | Two 324 A units | | 5552 |

Please note that the matching of the typical Danfoss frequency converter and filter is pre-calculated based on 480 V and assuming typical motor load (4 or 2 pole motor): VLT 5000 series is based on a max. 160 % torque application. The pre-calculated filter current may be different than the input current ratings of VLT 5000 as stated in the respective operating instructions, as these numbers are based on different operating conditions.

**500 V, 50 Hz**

| $I_{AHF,N}$ | Typical Motor Used [kW] | Danfoss ordering number | | |
|---|---|---|---|---|
| | | AHF 005 | AHF 010 | VLT 5000 |
| 10 A | 4, 5.5 | 175G6644 | 175G6656 | 5006, 5008 |
| 19 A | 7.5, 11 | 175G6645 | 175G6657 | 5011, 5016 |
| 26 A | 15, 18.5 | 175G6646 | 175G6658 | 5022, 5027 |
| 35 A | 22 | 175G6647 | 175G6659 | 5032 |
| 43 A | 30 | 175G6648 | 175G6660 | 5042 |
| 72 A | 37, 45 | 175G6649 | 175G6661 | 5052, 5062 |
| 101 A | 55, 75 | 175G6650 | 175G6662 | 5062, 5072 |
| 144 A | 90, 110 | 175G6651 | 175G6663 | 5102, 5122 |
| 180 A | 132 | 175G6652 | 175G6664 | 5152 |
| 217 A | 160 | 175G6653 | 175G6665 | 5202 |
| 289 A | 200 | 175G6654 | 175G6666 | 5252 |
| 324 A | 250 | 175G6655 | 175G6667 | 5302 |
| Higher ratings can be achieved by paralleling the filter units | | | | |
| 434 A | 315 | Two 217 A units | | 5352 |
| 469 A | 355 | 180 A and 289 A units | | 5452 |
| 578 A | 400 | Two 289 A units | | 5502 |
| 648 A | 500 | Two 324 A units | | 5552 |

Please note that the matching of the typical Danfoss frequency converter and filter is pre-calculated based on 500 V and assuming typical motor load. VLT 5000 series is based on a 160 % torque application. The pre-calculated filter current may be varying from the input current ratings of VLT 5000 as stated in the respective operating instructions, as these numbers are based on different operating conditions. For further combinations, please consult MG.80.BX.YY.

**690 V, 50 Hz**

| I AHF,N | Typical motor used (kW) | Ordering no. AHF 005 | Ordering no. AHF 010 | VLT 5000 160% | VLT 5000 110% |
|---|---|---|---|---|---|
| 43 | 37, 45 | 130B2328 | 130B2293 | 5042, 5042 | 5042 |
| 72 | 55, 75 | 130B2330 | 130B2295 | 5062, 5072 | 5052, 5062 |
| 101 | 90 | 130B2331 | 130B2296 | 5102 | 5072 |
| 144 | 110, 132 | 130B2333 | 130B2298 | 5122, 5152 | 5102, 5122 |
| 180 | 160 | 130B2334 | 130B2299 | 5202 | 5152 |
| 217 | 200 | 130B2335 | 130B2300 | 5252 | 5202 |
| 289 | 250 | 130B2331 & 130B2333 | 130B2301 | 5302 | 5252 |
| 324 | 315 | 130B2333 & 130B2334 | 130B2302 | 5352 | 5302 |
| 370 | 400 | 130B2334 & 130B2335 | 130B2304 | | 5352 |
| 469 | 500 | 130B2333 & 2 x 130B2334 | 130B2299 & 130B2301 | 5502 | 5402 |
| 578 | 560 | 3 x 130B2334 | 2 x 130B2301 | 5602 | 5502 |
| 613 | 630 | 3 x 130B2335 | 130B2301 & 130B2302 | | 5602 |

## ■ General technical data

| Mains supply (L1, L2, L3): | |
|---|---|
| Supply voltage 200-240 V units | 3 x 200/208/220/230/240 V ±10% |
| Supply voltage 380-500 V units | 3 x 380/400/415/440/460/500 V ±10% |
| Supply voltage 525-600 V units | 3 x 525/550/575/600 V ±10% |
| Supply voltage 525-690 V units | 3 x 525/550/575/600/690 V ±10% |
| Supply frequency | 48-62 Hz +/- 1 % |

*See the section on special conditions in the Design Guide*

| Max imbalance of supply voltage: | |
|---|---|
| VLT 5001-5011, 380-500 V and 525-600 V and VLT 5001-5006, 200-240 V | ±2.0% of rated supply voltage |
| VLT 5016-5062, 380-500 V and 525-600 V and VLT 5008-5027, 200-240 V | ±1.5% of rated supply voltage |
| VLT 5072-5552, 380-500 V and VLT 5032-5052, 200-240 V | ±3.0% of rated supply voltage |
| VLT 5042-5602, 525-690 V | ±3.0% of rated supply voltage |
| True Power factor (λ) | 0.90 nominal at rated load |
| Displacement Power Factor (cos φ) | near unity (>0.98) |
| No. of switchings on supply input L1, L2, L3 | approx. 1 time/min. |

*See the section on special conditions in the Design Guide*

| VLT output data (U, V, W): | |
|---|---|
| Output voltage | 0-100% of supply voltage |
| Output frequency VLT 5001-5027, 200-240 V | 0-132 Hz, 0-1000 Hz |
| Output frequency VLT 5032-5052, 200-240 V | 0-132 Hz, 0-450 Hz |
| Output frequency VLT 5001-5052, 380-500 V | 0-132 Hz, 0-1000 Hz |
| Output frequency VLT 5062-5302, 380-500 V | 0-132 Hz, 0-450 Hz |
| Output frequency VLT 5352-5552, 380-500 V | 0-132 Hz, 0-300 Hz |
| Output frequency VLT 5001-5011, 525-600 V | 0-132 Hz, 0-700 Hz |
| Output frequency VLT 5016-5052, 525-600 V | 0-132 Hz, 0-1000 Hz |
| Output frequency VLT 5062, 525-600 V | 0-132 Hz, 0-450 Hz |
| Output frequency VLT 5042-5302, 525-690 V | 0-132 Hz, 0-200 Hz |
| Output frequency VLT 5352-5602, 525-690 V | 0-132 Hz, 0-150 Hz |
| Rated motor voltage, 200-240 V units | 200/208/220/230/240 V |
| Rated motor voltage, 380-500 V units | 380/400/415/440/460/480/500 V |
| Rated motor voltage, 525-600 V units | 525/550/575 V |
| Rated motor voltage, 525-690 V units | 525/550/575/690 V |
| Rated motor frequency | 50/60 Hz |
| Switching on output | Unlimited |
| Ramp times | 0.05-3600 sec. |

| Torque characteristics: | |
|---|---|
| Starting torque, VLT 5001-5027, 200-240 V and VLT 5001-5552, 380-500 V | 160% for 1 min. |
| Starting torque, VLT 5032-5052, 200-240 V | 150% for 1 min. |
| Starting torque, VLT 5001-5062, 525-600 V | 160% for 1 min. |
| Starting torque, VLT 5042-5602, 525-690 V | 160% for 1 min. |
| Starting torque | 180% for 0.5 sec. |
| Acceleration torque | 100% |
| Overload torque, VLT 5001-5027, 200-240 V and VLT 5001-5552, 380-500 V, VLT 5001-5062, 525-600 V, and VLT 5042-5602, 525-690 V | 160% |
| Overload torque, VLT 5032-5052, 200-240 V | 150% |
| Arresting torque at 0 rpm (closed loop) | 100% |

*The torque characteristics given are for the frequency converter at the high overload torque level (160%). At the normal overload torque (110%), the values are lower.*

**Braking at high overload torque level**

| | Cycle time (s) | Braking duty cycle at 100% torque | Braking duty cycle at over torque (150/160%) |
|---|---|---|---|
| **200-240 V** | | | |
| 5001-5027 | 120 | Continuous | 40% |
| 5032-5052 | 300 | 10% | 10% |
| **380-500 V** | | | |
| 5001-5102 | 120 | Continuous | 40% |
| 5122-5252 | 600 | Continuous | 10% |
| 5302 | 600 | 40% | 10% |
| 5352-5552 | 600 | 40%[1)] | 10%[2)] |
| **525-600 V** | | | |
| 5001-5062 | 120 | Continuous | 40% |
| **525-690 V** | | | |
| 5042-5352 | 600 | 40% | 10% |
| 5402-5602 | 600 | 40%[3)] | 10%[4)] |

1) VLT 5502 at 90% torque. At 100% torque the braking duty cycle is 13%. At mains rating 441-500 V 100% torque the braking duty cycle is 17%.
VLT 5552 at 80% torque. At 100% torque the braking duty cycle is 8%.
2) Based on 300 second cycle:
For VLT 5502 the torque is 145%.
For VLT 5552 the torque is 130%.
3) VLT 5502 at 80% torque.
VLT 5602 at 71% torque.
4) Based on 300 second cycle.
For VLT 5502 the torque is 128%.
For VLT 5602 the torque is 114%.

| Control card, digital inputs: | |
|---|---|
| Number of programmable digital inputs | 8 |
| Terminal nos. | 16, 17, 18, 19, 27, 29, 32, 33 |
| Voltage level | 0-24 V DC (PNP positive logics) |
| Voltage level, logical '0' | < 5 V DC |
| Voltage level, logical '1' | >10 V DC |
| Maximum voltage on input | 28 V DC |
| Input resistance, $R_i$ | 2 kΩ |
| Scanning time per input | 3 msec. |

*Reliable galvanic isolation: All digital inputs are galvanically isolated from the supply voltage (PELV). In addition, the digital inputs can be isolated from the other terminals on the control card by connecting an external 24 V DC supply and opening switch 4. VLT 5001-5062, 525-600 V do not meet PELV.*

| Control card, analogue inputs: | |
|---|---|
| No. of programmable analogue voltage inputs/thermistor inputs | 2 |
| Terminal nos. | 53, 54 |
| Voltage level | 0 - ±10 V DC (scalable) |
| Input resistance, $R_i$ | 10 kΩ |
| No. of programmable analogue current inputs | 1 |
| Terminal no. | 60 |
| Current range | 0/4 - ±20 mA (scalable) |
| Input resistance, $R_i$ | 200 Ω |
| Resolution | 10 bit + sign |
| Accuracy on input | Max. error 1% of full scale |
| Scanning time per input | 3 msec. |
| Terminal no. ground | 55 |

*Reliable galvanic isolation: All analogue inputs are galvanically isolated from the supply voltage (PELV)* as well as other inputs and outputs.*
** VLT 5001-5062, 525-600 V do not meet PELV.*

| Control card, pulse/encoder input: | |
|---|---|
| No. of programmable pulse/encoder inputs | 4 |
| Terminal nos. | 17, 29, 32, 33 |
| Max. frequency on terminal 17 | 5 kHz |
| Max. frequency on terminals 29, 32, 33 | 20 kHz (PNP open collector) |
| Max. frequency on terminals 29, 32, 33 | 65 kHz (Push-pull) |
| Voltage level | 0-24 V DC (PNP positive logics) |
| Voltage level, logical '0' | < 5 V DC |
| Voltage level, logical '1' | >10 V DC |
| Maximum voltage on input | 28 V DC |
| Input resistance, $R_i$ | 2 kΩ |
| Scanning time per input | 3 msec. |
| Resolution | 10 bit + sign |
| Accuracy (100-1 kHz), terminals 17, 29, 33 | Max. error: 0.5% of full scale |
| Accuracy (1-5 kHz), terminal 17 | Max. error: 0.1% of full scale |
| Accuracy (1-65 kHz), terminals 29, 33 | Max. error: 0.1% of full scale |

*Reliable galvanic isolation: All pulse/encoder inputs are galvanically isolated from the supply voltage (PELV)*. In addition, pulse and encoder inputs can be isolated from the other terminals on the control card by connecting an external 24 V DC supply and opening switch 4.*
** VLT 5001-5062, 525-600 V do not meet PELV.*

| Control card, digital/pulse and analogue outputs: | |
|---|---|
| No. of programmable digital and analogue outputs | 2 |
| Terminal nos. | 42, 45 |
| Voltage level at digital/pulse output | 0 - 24 V DC |
| Minimum load to ground (terminal 39) at digital/pulse output | 600 Ω |
| Frequency ranges (digital output used as pulse output) | 0-32 kHz |
| Current range at analogue output | 0/4 - 20 mA |
| Maximum load to ground (terminal 39) at analogue output | 500 Ω |
| Accuracy of analogue output | Max. error: 1.5% of full scale |
| Resolution on analogue output. | 8 bit |

*Reliable galvanic isolation: All digital and analogue outputs are galvanically isolated from the supply voltage (PELV)*, as well as other inputs and outputs.*
** VLT 5001-5062, 525-600 V do not meet PELV.*

| Control card, 24 V DC supply: | |
|---|---|
| Terminal nos. | 12, 13 |
| Max. load (short-circuit protection) | 200 mA |
| Terminal nos. ground | 20, 39 |

*Reliable galvanic isolation: The 24 V DC supply is galvanically isolated from the supply voltage (PELV)*, but has the same potential as the analogue outputs.*
** VLT 5001-5062, 525-600 V do not meet PELV.*

| Control card, RS 485 serial communication: | |
|---|---|
| Terminal nos. | 68 (TX+, RX+), 69 (TX-, RX-) |

*Reliable galvanic isolation: Full galvanic isolation.*

| Relay outputs: [1] | |
|---|---|
| No. of programmable relay outputs | 2 |
| Terminal nos., control card (resistive load only) | 4-5 (make) |
| Max. terminal load (AC1) on 4-5, control card | 50 V AC, 1 A, 50 VA |

| | |
|---|---|
| Max. terminal load (DC1 (IEC 947)) on 4-5, control card | 25 V DC, 2 A / 50 V DC, 1 A, 50 W |
| Max. terminal load (DC1) on 4-5, control card for UL/cUL applications | 30 V AC, 1 A / 42.5 V DC, 1A |
| Terminal nos., power card (resistive and inductive load) | 1-3 (break), 1-2 (make) |
| Max. terminal load (AC1) on 1-3, 1-2, power card | 250 V AC, 2 A, 500 VA |
| Max. terminal load (DC1 (IEC 947)) on 1-3, 1-2, power card | 25 V DC, 2 A / 50 V DC, 1A, 50 W |
| Min. terminal load (AC/DC) on 1-3, 1-2, power card | 24 V DC, 10 mA / 24 V AC, 100 mA |

1) Rated values for up to 300,000 operations.
At inductive loads the number of operations are reduced by 50%, alternatively the current can be reduced by 50%, thus the 300,000 operations are maintained.

| Brake resistor terminals (only SB, EB, DE and PB units): | |
|---|---|
| Terminal nos. | 81, 82 |

| External 24 Volt DC supply: | |
|---|---|
| Terminal nos. | 35, 36 |
| Voltage range | 24 V DC ±15% (max. 37 V DC for 10 sec.) |
| Max. voltage ripple | 2 V DC |
| Power consumption | 15 W - 50 W (50 W for start-up, 20 msec.) |
| Min. pre-fuse | 6 Amp |

*Reliable galvanic isolation: Full galvanic isolation if the external 24 V DC supply is also of the PELV type.*

| Cable lengths, cross-sections and connectors: | |
|---|---|
| Max. motor cable length, screened cable | 150 m |
| Max. motor cable length, unscreened cable | 300 m |
| Max. motor cable length, screened cable VLT 5011 380-500 V | 100 m |
| Max. motor cable length, screened cable VLT 5011 525-600 V and VLT 5008, normal overload mode, 525-600 V | 50 m |
| Max. brake cable length, screened cable | 20 m |
| Max. loadsharing cable length, screened cable | 25 m from frequency converter to DC bar. |

*Max. cable cross-section for motor, brake and loadsharing, see Electrical data*

| Max. cable cross-section for 24 V external DC supply | |
|---|---|
| - VLT 5001-5027 200-240 V; VLT 5001-5102 380-500 V; VLT 5001-5062 525-600 V | 4 $mm^2$ /10 AWG |
| - VLT 5032-5052 200-240 V; VLT 5122-5552 380-500 V; VLT 5042-5602 525-690 V | 2.5 $mm^2$ /12 AWG |
| Max. cross-section for control cables | 1.5 $mm^2$ /16 AWG |
| Max. cross-section for serial communication | 1.5 $mm^2$ /16 AWG |

*If UL/cUL is to be complied with, copper cable with temperature class 60/75°C must be used (VLT 5001 - 5062 380 - 500 V, 525 - 600 V and VLT 5001 - 5027 200 - 240 V).*
*If UL/cUL is to be complied with, copper cable with temperature class 75°C must be used (VLT 5072 - 5552 380 - 500 V, VLT 5032 - 5052 200 - 240 V, VLT 5042 - 5602 525 - 690 V).*
*Connectors are for use of both copper and aluminium cables, unless other is specified.*

| Accuracy of display readout (parameters 009-012): | |
|---|---|
| Motor current [6] 0-140% load | Max. error: ±2.0% of rated output current |
| Torque % [7], -100 - 140% load | Max. error: ±5% of rated motor size |
| Output [8], power HP [9], 0-90% load | Max. error: ±5% of rated output |

| Control characteristics: | |
|---|---|
| Frequency range | 0 - 1000 Hz |
| Resolution on output frequency | ±0.003 Hz |
| System response time | 3 msec. |

| | |
|---|---|
| Speed, control range (open loop) | 1:100 of synchro. speed |
| Speed, control range (closed loop) | 1:1000 of synchro. speed |
| Speed, accuracy (open loop) | < 1500 rpm: max. error ± 7.5 rpm |
| Speed, accuracy (closed loop) | < 1500 rpm: max. error ± 1.5 rpm |
| Torque control accuracy (open loop) | 0- 150 rpm: max. error ±20% of rated torque |
| Torque control accuracy (speed feedback) | Max. error ±5% of rated torque |

*All control characteristics are based on a 4-pole asynchronous motor*

Externals:

| | |
|---|---|
| Enclosure (dependent on power size) | IP 00, IP 20, IP 21, Nema 1, IP 54 |
| Vibration test | 0.7 g RMS 18-1000 Hz random. 3 directions for 2 hours (IEC 68-2-34/35/36) |
| Max. relative humidity | 93 % (IEC 68-2-3) for storage/transport |
| Max. relative humidity | 95 % non condensing (IEC 721-3-3; class 3K3) for operation |
| Aggressive environment (IEC 721 - 3 - 3) | Uncoated class 3C2 |
| Aggressive environment (IEC 721 - 3 - 3) | Coated class 3C3 |
| Ambient temperature IP 20/Nema 1 (high overload torque 160%) | Max. 45°C (24-hour average max. 40°C) |
| Ambient temperature IP 20/Nema 1 (normal overload torque 110%) | Max. 40°C (24-hour average max. 35°C) |
| Ambient temperature IP 54 (high overload torque 160%) | Max. 40°C (24-hour average max. 35°C) |
| Ambient temperature IP 54 (normal overload torque 110%) | Max. 40°C (24-hour average max. 35°C) |
| Ambient temperature IP 20/54 VLT 5011 500 V | Max. 40°C (24-hour average max. 35°C) |
| Ambient temperature IP 54 VLT 5042-5602, 525-690 V; and 5122-5552, 380-500 V (high overload torque 160%) | Max. 45°C (24-hour average max. 40°C) |

*Derating for high ambient temperature, see the Design Guide*

| | |
|---|---|
| Min. ambient temperature in full operation | 0°C |
| Min. ambient temperature at reduced performance | -10°C |
| Temperature during storage/transport | -25 - +65/70°C |
| Max. altitude above sea level | 1000 m |

*Derating for altitude over 1000 m above sealevel, see the Design Guide*

| | |
|---|---|
| EMC standards applied, Emission | EN 61000-6-3, EN 61000-6-4, EN 61800-3, EN 55011 |
| | EN 61000-6-2, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4 |
| EMC standards applied, Immunity | EN 61000-4-5, EN 61000-4-6, VDE 0160/1990.12 |

*See section on special conditions in the Design Guide*
*VLT 5001-5062, 525 - 600 V do not comply with EMC or Low Voltage Directives.*
*IP54 units are not intended for direct outdoor installation. The IP54 rating does not relate to other exposures as sun, icing, wind blown driving rain. Under such circumstances Danfoss recommends to install the units in an enclosure designed for these environmental conditions. Alternatively, an installation at minimum 0.5 m above surface and covered by a shed is recommended*

VLT 5000 Series protection:

Electronic motor thermal protection against overload.

Temperature monitoring of heat-sink ensures that the frequency converter cuts out if the temperature reaches 90° C for IP 00, IP 20 and Nema 1. For IP 54, the cut-out temperature is 80°C. An overtemperature can only be reset when the temperature of the heat-sink has fallen below 60°C.

For the units mentioned below, the limits are as follows:

- VLT 5122, 380-500 V, cuts out at 75°C and can be reset if the temperature has fallen below 60°C.
- VLT 5152, 380-500 V, cuts out at 80°C and can be reset if the temperature has fallen below 60°C.
- VLT 5202, 380-500 V, cuts out at 95°C and can be reset if the temperature has fallen below 65°C.
- VLT 5252, 380-500 V, cuts out at 95°C and can be reset if the temperature has fallen below 65°C.
- VLT 5302, 380-500 V, cuts out at 105°C and can be reset if the temperature has fallen below 75°C.
- VLT 5352-5552, 380-500 V, cut out at 85°C and can be reset if the temperature has fallen below 60°C.
- VLT 5042-5122, 525-690 V, cut out at 75°C and can be reset if the temperature has fallen below 60°C.
- VLT 5152, 525-690 V, cuts out at 80°C and can be reset if the temperature has fallen below 60°C.
- VLT 5202-5352, 525-690 V, cut out at 100°C and can be reset if the temperature has fallen below 70°C.
- VLT 5402-5602, 525-690 V, cut out at 75°C and can be reset if the temperature has fallen below 60°C.

The frequency converter is protected against short-circuiting on motor terminals U, V, W.

The frequency converter is protected against earth fault on motor terminals U, V, W.

Monitoring of the intermediate circuit voltage ensures that the frequency converter cuts out if the intermediate circuit voltage becomes too high or too low.

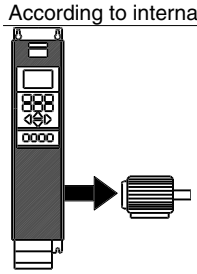
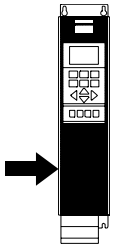
If a motor phase is missing, the frequency converter cuts out, see parameter 234 *Motor phase monitor.*

If there is a mains fault, the frequency converter is able to carry out a controlled decelleration.

If a mains phase is missing, the frequency converter will cut out when a load is placed on the motor.

## Electrical data

## Bookstyle and Compact, Mains supply 3 x 200 - 240 V

| According to international requirements | VLT type | 5001 | 5002 | 5003 | 5004 | 5005 | 5006 |
|---|---|---|---|---|---|---|---|
|  Output current | $I_{VLT,N}$ [A] | 3.7 | 5.4 | 7.8 | 10.6 | 12.5 | 15.2 |
| | $I_{VLT,\ MAX}$ (60 s) [A] | 5.9 | 8.6 | 12.5 | 17 | 20 | 24.3 |
| Output (240 V) | $S_{VLT,N}$ [kVA] | 1.5 | 2.2 | 3.2 | 4.4 | 5.2 | 6.3 |
| Typical shaft output | $P_{VLT,N}$ [kW] | 0.75 | 1.1 | 1.5 | 2.2 | 3.0 | 3.7 |
| Typical shaft output | $P_{VLT,N}$ [HP] | 1 | 1.5 | 2 | 3 | 4 | 5 |
| Max. cable cross-section to motor, brake and loadsharing [mm $^2$ ]/[AWG]$^2$ ) | | 4/10 | 4/10 | 4/10 | 4/10 | 4/10 | 4/10 |
|  Rated input current | (200 V)$I_{L,N}$ [A] | 3.4 | 4.8 | 7.1 | 9.5 | 11.5 | 14.5 |
| Max. cable cross-section power [mm$^2$ ]/[AWG] $^2$ ) | | 4/10 | 4/10 | 4/10 | 4/10 | 4/10 | 4/10 |
| Max. pre-fuses | [-]/UL[1)] [A] | 16/10 | 16/10 | 16/15 | 25/20 | 25/25 | 35/30 |
| Efficiency[3)] | | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 |
| Weight IP 20 EB Bookstyle | [kg] | 7 | 7 | 7 | 9 | 9 | 9.5 |
| Weight IP 20 EB Compact | [kg] | 8 | 8 | 8 | 10 | 10 | 10 |
| Weight IP 54 Compact | [kg] | 11.5 | 11.5 | 11.5 | 13.5 | 13.5 | 13.5 |
| Power loss at max. load. | [W] | 58 | 76 | 95 | 126 | 172 | 194 |
| Enclosure | | IP 20/ IP54 | IP 20/ IP54 | IP 20/ IP54 | IP 20/ IP54 | IP 20/ IP54 | IP 20/ IP54 |

1. For type of fuse see section *Fuses.*
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.

## ■ Compact, Mains supply 3 x 200 - 240 V

| According to international requirements | VLT type | | 5008 | 5011 | 5016 | 5022 | 5027 |
|---|---|---|---|---|---|---|---|
| Normal overload torque (110 %): | | | | | | | |
| Output current | $I_{VLT,N}$ [A] | | 32 | 46 | 61.2 | 73 | 88 |
| | $I_{VLT,\ MAX}$ (60 s) [A] | | 35.2 | 50.6 | 67.3 | 80.3 | 96.8 |
| Output (240 V) | $S_{VLT,N}$ [kVA] | | 13.3 | 19.1 | 25.4 | 30.3 | 36.6 |
| Typical shaft output | $P_{VLT,N}$ [kW] | | 7.5 | 11 | 15 | 18.5 | 22 |
| Typical shaft output | $P_{VLT,N}$ [HP] | | 10 | 15 | 20 | 25 | 30 |
| High overload torque (160 %): | | | | | | | |
| Output current | $I_{VLT,N}$ [A] | | 25 | 32 | 46 | 61.2 | 73 |
| | $I_{VLT,\ MAX}$ (60 s) [A] | | 40 | 51.2 | 73.6 | 97.9 | 116.8 |
| Output (240 V) | $S_{VLT,N}$ [kVA] | | 10 | 13 | 19 | 25 | 30 |
| Typical shaft output | $P_{VLT,N}$ [kW] | | 5.5 | 7.5 | 11 | 15 | 18.5 |
| Typical shaft output | $P_{VLT,N}$ [HP] | | 7.5 | 10 | 15 | 20 | 25 |
| Max. cable cross-section to motor, brake and loadsharing [mm² /AWG][2) 5)] | | IP 54 | 16/6 | 16/6 | 35/2 | 35/2 | 50/0 |
| | | IP 20 | 16/6 | 35/2 | 35/2 | 35/2 | 50/0 |
| Min. cable cross-section to motor, brake and loadsharing[4)] [mm² /AWG][2)] | | | 10/8 | 10/8 | 10/8 | 10/8 | 16/6 |
| Rated input current | (200 V) $I_{L,N}$ [A] | | 32 | 46 | 61 | 73 | 88 |
| Max. cable cross-section, power [mm² ]/[AWG][2) 5)] | | IP 54 | 16/6 | 16/6 | 35/2 | 35/2 | 50/0 |
| | | IP 20 | 16/6 | 35/2 | 35/2 | 35/2 | 50/0 |
| Max. pre-fuses | [-]/UL[1)] [A] | | 50 | 60 | 80 | 125 | 125 |
| Efficiency[3)] | | | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 |
| Weight IP 20 EB | [kg] | | 21 | 25 | 27 | 34 | 36 |
| Weight IP 54 | [kg] | | 38 | 40 | 53 | 55 | 56 |
| Power loss at max. load. - high overload torque (160 %) | [W] | | 340 | 426 | 626 | 833 | 994 |
| - normal overload torque (110 %) | [W] | | 426 | 545 | 783 | 1042 | 1243 |
| Enclosure | | | IP 20/ IP 54 | IP 20/ IP 54 | IP 20/ IP 54 | IP 20/ IP 54 | IP 20/ IP 54 |

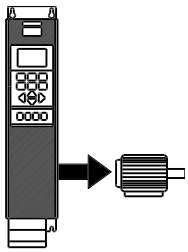
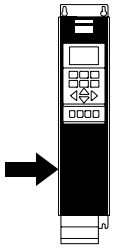
1. For type of fuse see section *Fuses*
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals to comply with IP 20. Always comply with national and local regulations on min. cable cross-section.
5. Aluminium cables with cross-section above 35 mm² must be connected by use of a Al-Cu connector.

## ■ Compact, Mains supply 3 x 200 - 240 V

| According to international requirements | | VLT type | 5032 | 5042 | 5052 |
|---|---|---|---|---|---|
| | **Normal overload torque (110 %):** | | | | |
| Output current | $I_{VLT,N}$ [A] (200-230 V) | | 115 | 143 | 170 |
| | $I_{VLT,MAX}$ (60 s) [A] (200-230 V) | | 127 | 158 | 187 |
| | $I_{VLT,N}$ [A] (231-240 V) | | 104 | 130 | 154 |
| | $I_{VLT,MAX}$ (60 s) [A] (231-240 V) | | 115 | 143 | 170 |
| Output | $S_{VLT,N}$ [kVA] (208 V) | | 41 | 52 | 61 |
| | $S_{VLT,N}$ [kVA] (230 V) | | 46 | 57 | 68 |
| | $S_{VLT,N}$ [kVA] (240 V) | | 43 | 54 | 64 |
| Typical shaft output | [HP] (208 V) | | 40 | 50 | 60 |
| Typical shaft output | [kW] (230 V) | | 30 | 37 | 45 |
| | **High overload torque (160 %):** | | | | |
| Output current | $I_{VLT,N}$ [A] (200-230 V) | | 88 | 115 | 143 |
| | $I_{VLT,MAX}$ [A] (200-230 V) | | 132 | 173 | 215 |
| | $I_{VLT,N}$ [A] (231-240 V) | | 80 | 104 | 130 |
| | $I_{VLT,MAX}$ [A] (231-240 V) | | 120 | 285 | 195 |
| Output | $S_{VLT,N}$ [kVA] (208 V) | | 32 | 41 | 52 |
| | $S_{VLT,N}$ [kVA] (230 V) | | 35 | 46 | 57 |
| | $S_{VLT,N}$ [kVA] (240 V) | | 33 | 43 | 54 |
| Typical shaft output | [HP] (208 V) | | 30 | 40 | 50 |
| | [kW] (230 V) | | 22 | 30 | 37 |
| Max. cable cross-section to motor and loadsharing | [mm² ][4,6] | | | 120 | |
| | [AWG][2,4,6] | | | 300 mcm | |
| Max. cable cross-section to brake | [mm² ][4,6] | | | 25 | |
| | [AWG][2,4,6] | | | 4 | |
| | **Normal overload torque (110 %):** | | | | |
| Rated input current | $I_{L,N}$ [A] (230 V) | | 101.3 | 126.6 | 149.9 |
| | **Normal overload torque (150 %):** | | | | |
| Rated input current | $I_{L,N}$ [A] (230 V) | | 77,9 | 101,3 | 126,6 |
| Max. cable cross-section power supply | [mm²][4,6] | | | 120 | |
| | [AWG][2,4,6] | | | 300 mcm | |
| Min. cable cross-section to motor, power supply, brake and loadsharing | [mm²][4,6] | | | 6 | |
| | [AWG][2,4,6] | | | 8 | |
| Max. pre-fuses (mains) [-]/UL | [A][1] | | 150/150 | 200/200 | 250/250 |
| Efficiency[3] | | | | 0,96-0,97 | |
| Power loss | Normal overload [W] | | 1089 | 1361 | 1612 |
| | High overload [W] | | 838 | 1089 | 1361 |
| Weight | IP 00 [kg] | | 101 | 101 | 101 |
| Weight | IP 20 Nema1 [kg] | | 101 | 101 | 101 |
| Weight | IP 54 Nema12 [kg] | | 104 | 104 | 104 |
| Enclosure | | IP 00 / Nema 1 (IP 20) / IP 54 | | | |

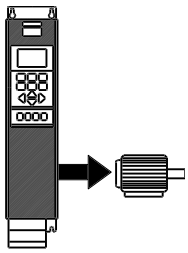
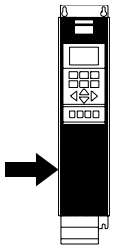
1. For type of fuse see section *Fuses*
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Max. cable cross-section is the maximum possible cable cross-section allowed to be fitted on the terminals. Min. cable cross-section is the minimum allowed cross-section. Always comply with national and local regulations on min. cable cross-section.
5. Weight without shipping container.
6. Connection stud: M8 Brake: M6.

## ■ Bookstyle and Compact, Mains supply 3 x 380 - 500 V

| According to international requirements | | VLT type | 5001 | 5002 | 5003 | 5004 |
|---|---|---|---|---|---|---|
|  | Output current | $I_{VLT,N}$ [A] (380-415 V) | 2.2 | 2.8 | 4.1 | 5.6 |
| | | $I_{VLT, MAX}$ (60 s) [A] (380-415 V) | 3.5 | 4.5 | 6.5 | 9 |
| | | $I_{VLT,N}$ [A] (440-500 V) | 1.9 | 2.6 | 3.4 | 4.8 |
| | | $I_{VLT, MAX}$ (60 s) [A] (440-500 V) | 3 | 4.2 | 5.5 | 7.7 |
| | Output | $S_{VLT,N}$ [kVA] (380-415 V) | 1.7 | 2.1 | 3.1 | 4.3 |
| | | $S_{VLT,N}$ [kVA] (440-500 V) | 1.6 | 2.3 | 2.9 | 4.2 |
| | Typical shaft output | $P_{VLT,N}$ [kW] | 0.75 | 1.1 | 1.5 | 2.2 |
| | Typical shaft output | $P_{VLT,N}$ [HP] | 1 | 1.5 | 2 | 3 |
| | Max. cable cross-section to motor, brake and loadsharing [mm² ]/[AWG]² ) | | 4/10 | 4/10 | 4/10 | 4/10 |
|  | Rated input current | $I_{L,N}$ [A] (380 V) | 2.3 | 2.6 | 3.8 | 5.3 |
| | | $I_{L,N}$ [A] (460 V) | 1.9 | 2.5 | 3.4 | 4.8 |
| | Max. cable cross-section, power [mm² ]/[AWG][2)] | | 4/10 | 4/10 | 4/10 | 4/10 |
| | Max. pre-fuses [-]/UL[1)] [A] | | 16/6 | 16/6 | 16/10 | 16/10 |
| | Efficiency [3)] | | 0.96 | 0.96 | 0.96 | 0.96 |
| | Weight IP 20 EB Bookstyle [kg] | | 7 | 7 | 7 | 7.5 |
| | Weight IP 20 EB Compact [kg] | | 8 | 8 | 8 | 8.5 |
| | Weight IP 54 Compact [kg] | | 11.5 | 11.5 | 11.5 | 12 |
| | Power loss at max. load | [W] | 55 | 67 | 92 | 110 |
| | Enclosure | | IP 20/ IP 54 | IP 20/ IP 54 | IP 20/ IP 54 | IP 20/ IP 54 |

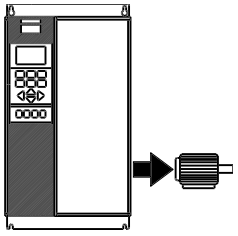
1. For type of fuse see section *Fuses*.
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.

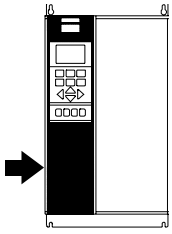
## Bookstyle and Compact, Mains supply 3 x 380 - 500 V

| According to international requirements | | VLT type | 5005 | 5006 | 5008 | 5011 |
|---|---|---|---|---|---|---|
|  | Output current | $I_{VLT,N}$ [A] (380-415 V) | 7.2 | 10 | 13 | 16 |
| | | $I_{VLT,MAX}$ (60 s) [A] (380-415 V) | 11.5 | 16 | 20.8 | 25.6 |
| | | $I_{VLT,N}$ [A] (440-500 V) | 6.3 | 8.2 | 11 | 14.5 |
| | | $I_{VLT,MAX}$ (60 s) [A] (440-500 V) | 10.1 | 13.1 | 17.6 | 23.2 |
| | Output | $S_{VLT,N}$ [kVA] (380-415 V) | 5.5 | 7.6 | 9.9 | 12.2 |
| | | $S_{VLT,N}$ [kVA] (440-500 V) | 5.5 | 7.1 | 9.5 | 12.6 |
| | Typical shaft output | $P_{VLT,N}$ [kW] | 3.0 | 4.0 | 5.5 | 7.5 |
| | Typical shaft output | $P_{VLT,N}$ [HP] | 4 | 5 | 7.5 | 10 |
| | Max. cable cross-section to motor, brake and loadsharing [mm² ]/[AWG]² ) | | 4/10 | 4/10 | 4/10 | 4/10 |
|  | Rated input current | $I_{L,N}$ [A] (380 V) | 7 | 9.1 | 12.2 | 15.0 |
| | | $I_{L,N}$ [A] (460 V) | 6 | 8.3 | 10.6 | 14.0 |
| | Max. cable cross-section power [mm² ]/[AWG][2)] | | 4/10 | 4/10 | 4/10 | 4/10 |
| | Max. pre-fuses [-]/UL[1)] [A] | | 16/15 | 25/20 | 25/25 | 35/30 |
| | Efficiency [3)] | | 0.96 | 0.96 | 0.96 | 0.96 |
| | Weight IP 20 EB Bookstyle [kg] | | 7.5 | 9.5 | 9.5 | 9.5 |
| | Weight IP 20 EB Compact [kg] | | 8.5 | 10.5 | 10.5 | 10.5 |
| | Weight IP 54 EB Compact [kg] | | 12 | 14 | 14 | 14 |
| | Power loss at max. load. | [W] | 139 | 198 | 250 | 295 |
| | Enclosure | | IP 20/ IP 54 | IP 20/ IP 54 | IP 20/ IP 54 | IP 20/ IP 54 |

1. For type of fuse see section *Fuses*.
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.

## ■ Compact, Mains supply 3 x 380 - 500 V





| According to international requirements | VLT type | | 5016 | 5022 | 5027 |
|---|---|---|---|---|---|
| Normal overload torque (110 %): | | | | | |
| Output current | $I_{VLT,N}$ [A] (380-415 V) | | 32 | 37.5 | 44 |
| | $I_{VLT,MAX}$ (60 s) [A] (380-415 V) | | 35.2 | 41.3 | 48.4 |
| | $I_{VLT,N}$ [A] (440-500 V) | | 27.9 | 34 | 41.4 |
| | $I_{VLT,MAX}$ (60 s) [A] (440-500 V) | | 30.7 | 37.4 | 45.5 |
| Output | $S_{VLT,N}$ [kVA] (380-415 V) | | 24.4 | 28.6 | 33.5 |
| | $S_{VLT,N}$ [kVA] (440-500 V) | | 24.2 | 29.4 | 35.8 |
| Typical shaft output | $P_{VLT,N}$ [kW] | | 15 | 18.5 | 22 |
| Typical shaft output | $P_{VLT,N}$ [HP] | | 20 | 25 | 30 |
| High overload torque (160 %): | | | | | |
| Output current | $I_{VLT,N}$ [A] (380-415 V) | | 24 | 32 | 37.5 |
| | $I_{VLT,MAX}$ (60 s) [A] (380-415 V) | | 38.4 | 51.2 | 60 |
| | $I_{VLT,N}$ [A] (440-500 V) | | 21.7 | 27.9 | 34 |
| | $I_{VLT,MAX}$ (60 s) [A] (440-500 V) | | 34.7 | 44.6 | 54.4 |
| Output | $S_{VLT,N}$ [kVA] (380-415 V) | | 18.3 | 24.4 | 28.6 |
| | $S_{VLT,N}$ [kVA] (440-500 V) | | 18.8 | 24.2 | 29.4 |
| Typical shaft output | $P_{VLT,N}$ [kW] | | 11 | 15 | 18.5 |
| Typical shaft output | $P_{VLT,N}$ [HP] | | 15 | 20 | 25 |
| Max. cable cross-section to motor, | | IP 54 | 16/6 | 16/6 | 16/6 |
| brake and loadsharing [mm² ]/[AWG][2)] | | IP 20 | 16/6 | 16/6 | 35/2 |
| Min. cable cross-section to motor, brake and loadsharing [mm2]/[AWG][2) 4)] | | | 10/8 | 10/8 | 10/8 |
| Rated input current | $I_{L,N}$ [A] (380 V) | | 32 | 37.5 | 44 |
| | $I_{L,N}$ [A] (460 V) | | 27.6 | 34 | 41 |
| Max. cable cross-section, | | IP 54 | 16/6 | 16/6 | 16/6 |
| power [mm ² ]/[AWG] | | IP 20 | 16/6 | 16/6 | 35/2 |
| Max. pre-fuses | [-]/UL[1)] [A] | | 63/40 | 63/50 | 63/60 |
| Efficiency[3)] | | | 0.96 | 0.96 | 0.96 |
| Weight IP 20 EB | [kg] | | 21 | 22 | 27 |
| Weight IP 54 | [kg] | | 41 | 41 | 42 |
| Power loss at max. load. | | | | | |
| - high overload torque (160 %) | [W] | | 419 | 559 | 655 |
| - normal overload torque (110 %) | [W] | | 559 | 655 | 768 |
| Enclosure | | | IP 20/ IP 54 | IP 20/ IP 54 | IP 20/ IP 54 |

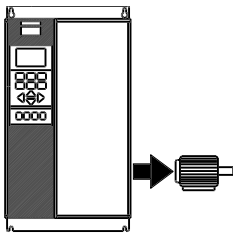
1. For type of fuse see section *Fuses.*
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals to comply with IP 20. Always comply with national and local regulations on min. cable cross-section.

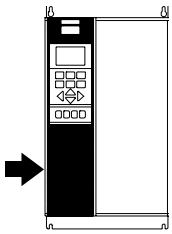
## Compact, Mains supply 3 x 380 - 500 V

| According to international requirements | | VLT type | | 5032 | 5042 | 5052 |
|---|---|---|---|---|---|---|
| | Normal overload torque (110 %): | | | | | |
| | Output current | $I_{VLT,N}$ [A] (380-415 V) | | 61 | 73 | 90 |
| | | $I_{VLT, MAX}$ (60 s) [A] (380-415 V) | | 67.1 | 80.3 | 99 |
| | | $I_{VLT,N}$ [A] (440-500 V) | | 54 | 65 | 78 |
| | | $I_{VLT, MAX}$ (60 s) [A] (440-500 V) | | 59.4 | 71.5 | 85.8 |
| | Output | $S_{VLT,N}$ [kVA] (380-415 V) | | 46.5 | 55.6 | 68.6 |
| | | $S_{VLT,N}$ [kVA] (440-500 V) | | 46.8 | 56.3 | 67.5 |
| | Typical shaft output | $P_{VLT,N}$ [kW] | | 30 | 37 | 45 |
| | Typical shaft output | $P_{VLT,N}$ [HP] | | 40 | 50 | 60 |
| | High overload torque (160 %): | | | | | |
| | Output current | $I_{VLT,N}$ [A] (380-415 V) | | 44 | 61 | 73 |
| | | $I_{VLT, MAX}$ (60 s) [A] (380-415 V) | | 70.4 | 97.6 | 116.8 |
| | | $I_{VLT,N}$ [A] (440-500 V) | | 41.4 | 54 | 65 |
| | | $I_{VLT, MAX}$ (60 s) [A] (440-500 V) | | 66.2 | 86 | 104 |
| | Output | $S_{VLT,N}$ [kVA] (380-415 V) | | 33.5 | 46.5 | 55.6 |
| | | $S_{VLT,N}$ [kVA] (440-500 V) | | 35.9 | 46.8 | 56.3 |
| | Typical shaft output | $P_{VLT,N}$ [kW] | | 22 | 30 | 37 |
| | Typical shaft output | $P_{VLT,N}$ [HP] | | 30 | 40 | 50 |
| | Max. cable cross-section to motor, | | IP 54 | 35/2 | 35/2 | 50/0 |
| | brake and loadsharing [mm² ]/[AWG][2) 5)] | | IP20 | 35/2 | 35/2 | 50/0 |
| | Min. cable cross-section to motor, brake and loadsharing [mm² ]/[AWG][2) 4)] | | | 10/8 | 10/8 | 16/6 |
| | Rated input current | $I_{L,N}$ [A] (380 V) | | 60 | 72 | 89 |
| | | $I_{L,N}$ [A] (460 V) | | 53 | 64 | 77 |
| | Max. cable cross-section | | IP 54 | 35/2 | 35/2 | 50/0 |
| | power[mm ² ]/[AWG][2) 5)] | | IP 20 | 35/2 | 35/2 | 50/0 |
| | Max. pre-fuses | [-]/UL[1)] [A] | | 80/80 | 100/100 | 125/125 |
| | Efficiency[3)] | | | 0.96 | 0.96 | 0.96 |
| | Weight IP 20 EB | [kg] | | 28 | 41 | 42 |
| | Weight IP 54 | [kg] | | 54 | 56 | 56 |
| | Power loss at max. load. | | | | | |
| | - high overload torque (160 %) | [W] | | 768 | 1065 | 1275 |
| | - normal overload torque (110 %) | [W] | | 1065 | 1275 | 1571 |
| | Enclosure | | | IP 20/ IP 54 | IP 20/ IP 54 | IP 20/ IP 54 |

1. For type of fuse see section *Fuses.*
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals to comply with IP 20. Always comply with national and local regulations on min. cable cross-section.
5. Aluminium cables with cross-section above 35 mm² must be connected by use of a Al-Cu connector.

## Compact, Mains supply 3 x 380 - 500 V

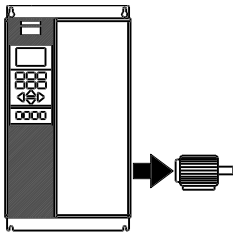


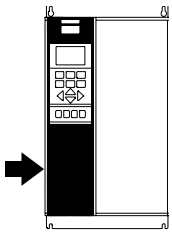


| According to international requirements | VLT type | | 5062 | 5072 | 5102 |
|---|---|---|---|---|---|
| Normal overload torque (110 %): | | | | | |
| Output current | $I_{VLT,N}$ [A] (380-415 V) | | 106 | 147 | 177 |
| | $I_{VLT, MAX}$ (60 s) [A] (380-415 V) | | 117 | 162 | 195 |
| | $I_{VLT,N}$ [A] (440-500 V) | | 106 | 130 | 160 |
| | $I_{VLT, MAX}$ (60 s) [A] (440-500 V) | | 117 | 143 | 176 |
| Output | $S_{VLT,N}$ [kVA] (380-415 V) | | 80.8 | 102 | 123 |
| | $S_{VLT,N}$ [kVA] (440-500 V) | | 91.8 | 113 | 139 |
| Typical shaft output | $P_{VLT,N}$ [kW] (400 V) | | 55 | 75 | 90 |
| | $P_{VLT,N}$ [HP] (460 V) | | 75 | 100 | 125 |
| | $P_{VLT,N}$ [kW] (500 V) | | 75 | 90 | 110 |
| High overload torque (160 %): | | | | | |
| Output current | $I_{VLT,N}$ [A] (380-415 V) | | 90 | 106 | 147 |
| | $I_{VLT, MAX}$ (60 s) [A] (380-415 V) | | 135 | 159 | 221 |
| | $I_{VLT,N}$ [A] (440-500 V) | | 80 | 106 | 130 |
| | $I_{VLT, MAX}$ (60 s) [A] (440-500 V) | | 120 | 159 | 195 |
| Output | $S_{VLT,N}$ [kVA] (380-415 V) | | 68.6 | 73.0 | 102 |
| | $S_{VLT,N}$ [kVA] (440-500 V) | | 69.3 | 92.0 | 113 |
| Typical shaft output | $P_{VLT,N}$ [kW] (400 V) | | 45 | 55 | 75 |
| | $P_{VLT,N}$ [HP] (460 V) | | 60 | 75 | 100 |
| | $P_{VLT,N}$ [kW] (500 V) | | 55 | 75 | 90 |
| Max. cable cross-section to motor, | | IP 54 | 50/0[5] | 150/300 mcm[6] | 150/300 mcm[6] |
| brake and loadsharing [mm² ]/[AWG][2] | | IP20 | 50/0[5] | 120/250 mcm[5] | 120/250 mcm[5] |
| Min. cable cross-section to motor, brake and loadsharing [mm² ]/[AWG][4] | | | 16/6 | 25/4 | 25/4 |
| Rated input current | $I_{L,N}$ [A] (380 V) | | 104 | 145 | 174 |
| | $I_{L,N}$ [A] (460 V) | | 104 | 128 | 158 |
| Max. cable cross-section | | IP 54 | 50/0[5] | 150/300 mcm | 150/300 mcm |
| power[mm ² ]/[AWG][2] | | IP 20 | 50/0[5] | 120/250 mcm[5] | 120/250 mcm[5] |
| Max. pre-fuses | [-]/UL[1] [A] | | 160/150 | 225/225 | 250/250 |
| Efficiency[3] | | | >0.97 | >0.97 | >0.97 |
| Weight IP 20 EB | [kg] | | 43 | 54 | 54 |
| Weight IP 54 | [kg] | | 60 | 77 | 77 |
| Power loss at max. load. - high overload torque (160 %) | [W] | | 1122 | 1058 | 1467 |
| - normal overload torque (110 %) | [W] | | 1322 | 1467 | 1766 |
| Enclosure | | | IP20/ IP 54 | IP20/ IP 54 | IP20/ IP 54 |

1. For type of fuse see section *Fuses.*
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals to comply with IP 20. Always comply with national and local regulations on min. cable cross-section.
5. Aluminium cables with cross-section above 35 mm² must be connected by use of a Al-Cu connector.
used.
6. Brake and loadsharing: 95 mm² / AWG 3/0

## ■ Compact, Mains supply 3 x 380 - 500 V

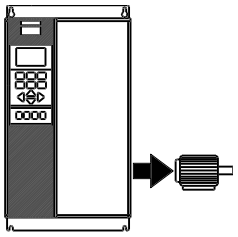


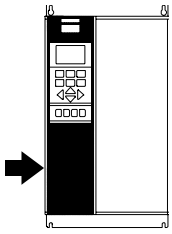


| According to international requirements | | VLT type | 5122 | 5152 | 5202 | 5252 | 5302 |
|---|---|---|---|---|---|---|---|
| **Normal overload current (110 %):** | | | | | | | |
| Output current | $I_{VLT,N}$ [A] (380-415 V) | | 212 | 260 | 315 | 395 | 480 |
| | $I_{VLT,MAX}$ (60 s) [A] (380-415 V) | | 233 | 286 | 347 | 434 | 528 |
| | $I_{VLT,N}$ [A] (440-500 V) | | 190 | 240 | 302 | 361 | 443 |
| | $I_{VLT,MAX}$ (60 s) [A] (440-500 V) | | 209 | 264 | 332 | 397 | 487 |
| Output | $S_{VLT,N}$ [kVA] (400 V) | | 147 | 180 | 218 | 274 | 333 |
| | $S_{VLT,N}$ [kVA] (460 V) | | 151 | 191 | 241 | 288 | 353 |
| | $S_{VLT,N}$ [kVA] (500 V) | | 165 | 208 | 262 | 313 | 384 |
| Typical shaft output | [kW] (400 V) | | 110 | 132 | 160 | 200 | 250 |
| | [HP] (460 V) | | 150 | 200 | 250 | 300 | 350 |
| | [kW] (500 V) | | 132 | 160 | 200 | 250 | 315 |
| **High overload torque (160 %):** | | | | | | | |
| Output current | $I_{VLT,N}$ [A] (380-415 V) | | 177 | 212 | 260 | 315 | 395 |
| | $I_{VLT,MAX}$ (60 s) [A] (380-415 V) | | 266 | 318 | 390 | 473 | 593 |
| | $I_{VLT,N}$ [A] (441-500 V) | | 160 | 190 | 240 | 302 | 361 |
| | $I_{VLT,MAX}$ (60 s) [A] (440-500 V) | | 240 | 285 | 360 | 453 | 542 |
| Output | $S_{VLT,N}$ [kVA] (400 V) | | 123 | 147 | 180 | 218 | 274 |
| | $S_{VLT,N}$ [kVA] (460 V) | | 127 | 151 | 191 | 241 | 288 |
| | $S_{VLT,N}$ [kVA] (500 V) | | 139 | 165 | 208 | 262 | 313 |
| Typical shaft output | [kW] (400 V) | | 90 | 110 | 132 | 160 | 200 |
| | [HP] (460 V) | | 125 | 150 | 200 | 250 | 300 |
| | [kW] (500 V) | | 110 | 132 | 160 | 200 | 250 |
| Max. cable cross-section to motor | [mm²][4,6] | | 2 x 70 | | 2 x 185 | | |
| | [AWG][2,4,6] | | 2 x 2/0 | | 2 x 350 mcm | | |
| Max. cable cross-section to loadsharing and brake | [mm²][4,6] | | 2 x 70 | | 2 x 185 | | |
| | [AWG][2,4,6] | | 2 x 2/0 | | 2 x 350 mcm | | |
| **Normal overload current (110 %):** | | | | | | | |
| Rated input current | $I_{L,N}$ [A] (380-415 V) | | 208 | 256 | 317 | 385 | 467 |
| | $I_{L,N}$ [A] (440-500 V) | | 185 | 236 | 304 | 356 | 431 |
| **High overload torque (160 %):** | | | | | | | |
| Rated input current | $I_{L,N}$ [A] (380-415 V) | | 174 | 206 | 256 | 318 | 389 |
| | $I_{L,N}$ [A] (440-500 V) | | 158 | 185 | 236 | 304 | 356 |
| Max. cable cross-section power supply | [mm²][4,6] | | 2 x 70 | | 2 x 185 | | |
| | [AWG][2,4,6] | | 2 x 2/0 | | 2 x 350 mcm | | |
| Max. pre-fuses (mains) [-]/ UL | [A][1] | | 300/ 300 | 350/ 350 | 450/ 400 | 500/ 500 | 630/ 600 |
| Efficiency[3] | | | 0,98 | | | | |
| Power loss | Normal overload [W] | | 2619 | 3309 | 4163 | 4977 | 6107 |
| | High overload [W] | | 2206 | 2619 | 3309 | 4163 | 4977 |
| Weight | IP 00 [kg] | | 82 | 91 | 112 | 123 | 138 |
| Weight | IP 21/Nema1 [kg] | | 96 | 104 | 125 | 136 | 151 |
| Weight | IP 54/Nema12 [kg] | | 96 | 104 | 125 | 136 | 151 |
| Enclosure | IP 00, IP 21/Nema 1 and IP 54/Nema12 | | | | | | |

1. For type of fuse see section *Fuses*
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Max. cable cross-section is the maximum possible cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.
5. Weight without shipping container.
6. Connection bolt power supply and motor: M10; Brake and loadsharing: M8

## Compact, Mains supply 3 x 380 - 500 V





| According to international requirements | VLT type | 5352 | 5452 | 5502 | 5552 |
|---|---|---|---|---|---|
| **Normal overload current (110 %):** | | | | | |
| Output current | $I_{VLT,N}$ [A] (380-415 V) | 600 | 658 | 745 | 800 |
| | $I_{VLT,MAX}$ (60 s) [A] (380-415 V) | 660 | 724 | 820 | 880 |
| | $I_{VLT,N}$ [A] (440-500 V) | 540 | 590 | 678 | 730 |
| | $I_{VLT,MAX}$ (60 s) [A] (440-500 V) | 594 | 649 | 746 | 803 |
| Output | $S_{VLT,N}$ [kVA] (400 V) | 416 | 456 | 516 | 554 |
| | $S_{VLT,N}$ [kVA] (460 V) | 430 | 470 | 540 | 582 |
| | $S_{VLT,N}$ [kVA] (500 V) | 468 | 511 | 587 | 632 |
| Typical shaft output | [kW] (400 V) | 315 | 355 | 400 | 450 |
| | [HP] (460 V) | 450 | 500 | 550/600 | 600 |
| | [kW] (500 V) | 355 | 400 | 500 | 530 |
| **High overload torque (160 %):** | | | | | |
| Output current | $I_{VLT,N}$ [A] (380-415 V) | 480 | 600 | 658 | 695 |
| | $I_{VLT,MAX}$ (60 s) [A] (380-415 V) | 720 | 900 | 987 | 1042 |
| | $I_{VLT,N}$ [A] (440-500 V) | 443 | 540 | 590 | 678 |
| | $I_{VLT,MAX}$ (60 s) [A] (440-500 V) | 665 | 810 | 885 | 1017 |
| Output | $S_{VLT,N}$ [kVA] (400 V) | 333 | 416 | 456 | 482 |
| | $S_{VLT,N}$ [kVA] (460 V) | 353 | 430 | 470 | 540 |
| | $S_{VLT,N}$ [kVA] (500 V) | 384 | 468 | 511 | 587 |
| Typical shaft output | [kW] (400 V) | 250 | 315 | 355 | 400 |
| | [HP] (460 V) | 350 | 450 | 500 | 550 |
| | [kW] (500 V) | 315 | 355 | 400 | 500 |
| Max. cable cross-section to motor and loadsharing | [mm²][4,6] | | 4x240 | | |
| | [AWG][2,4,6] | | 4x500 mcm | | |
| Max. cable cross-section to brake | [mm²][4,6] | | 2x185 | | |
| | [AWG][2,4,6] | | 2x350 mcm | | |
| **Normal overload current (110 %):** | | | | | |
| Rated input current | $I_{L,N}$ [A] (380-415 V) | 590 | 647 | 733 | 787 |
| | $I_{L,N}$ [A] (440-500 V) | 531 | 580 | 667 | 718 |
| **High overload torque (160 %):** | | | | | |
| Rated input current | $I_{L,N}$ [A] (380-415 V) | 472 | 590 | 647 | 684 |
| | $I_{L,N}$ [A] (440-500 V) | 436 | 531 | 580 | 667 |
| Max. cable cross-section power supply | [mm²][4,6] | 4x240 | | | |
| | [AWG][2,4,6] | 4x500 mcm | | | |
| Max. pre-fuses (mains) [-]/UL | [A][1] | 700/700 | 900/900 | 900/900 | 900/900 |
| Efficiency[3] | | 0,98 | | | |
| Power loss | Normal overload [W] | 7630 | 7701 | 8879 | 9428 |
| | High overload [W] | 6005 | 6960 | 7691 | 7964 |
| Weight | IP 00 [kg] | 221 | 234 | 236 | 277 |
| Weight | IP 21/Nema1 [kg] | 263 | 270 | 272 | 313 |
| Weight | IP 54/Nema12 [kg] | 263 | 270 | 272 | 313 |
| Enclosure | | IP 00, IP 21/Nema 1 and IP 54/Nema12 | | | |

1. For type of fuse see section *Fuses*
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Max. cable cross-section is the maximum possible cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.
5. Weight without shipping container.
6. Connection bolt power supply, motor and loadsharing: M10 (compression lug), 2xM8 (box lug), M8 (brake)

## ■ Compact, Mains supply 3 x 525 - 600 V

| According to international requirements | | VLT type | 5001 | 5002 | 5003 | 5004 |
|---|---|---|---|---|---|---|
| Normal overload torque (110 %): | | | | | | |
| Output current | $I_{VLT,N}$ [A] (550 V) | | 2.6 | 2.9 | 4.1 | 5.2 |
| | $I_{VLT, MAX}$ (60 s) [A] (550 V) | | 2.9 | 3.2 | 4.5 | 5.7 |
| | $I_{VLT,N}$ [A] (575 V) | | 2.4 | 2.7 | 3.9 | 4.9 |
| | $I_{VLT, MAX}$ (60 s) [A] (575 V) | | 2.6 | 3.0 | 4.3 | 5.4 |
| Output | $S_{VLT,N}$ [kVA] (550 V) | | 2.5 | 2.8 | 3.9 | 5.0 |
| | $S_{VLT,N}$ [kVA] (575 V) | | 2.4 | 2.7 | 3.9 | 4.9 |
| Typical shaft output | $P_{VLT,N}$ [kW] | | 1.1 | 1.5 | 2.2 | 3 |
| Typical shaft output | $P_{VLT,N}$ [HP] | | 1.5 | 2 | 3 | 4 |
| **Highl overload torque (160%):** | | | | | | |
| Output current | $I_{VLT,N}$ [A] (550 V) | | 1.8 | 2.6 | 2.9 | 4.1 |
| | $I_{VLT, MAX}$ (60 s) [A] (550 V) | | 2.9 | 4.2 | 4.6 | 6.6 |
| | $I_{VLT,N}$ [A] (575 V) | | 1.7 | 2.4 | 2.7 | 3.9 |
| | $I_{VLT, MAX}$ (60 s) [A] (575 V) | | 2.7 | 3.8 | 4.3 | 6.2 |
| Output | $S_{VLT,N}$ [kVA] (550 V) | | 1.7 | 2.5 | 2.8 | 3.9 |
| | $S_{VLT,N}$ [kVA] (575 V) | | 1.7 | 2.4 | 2.7 | 3.9 |
| Typical shaft output | $P_{VLT,N}$ [kW] | | 0.75 | 1.1 | 1.5 | 2.2 |
| Typical shaft output | $P_{VLT,N}$ [HP] | | 1 | 1.5 | 2 | 3 |
| Max. cable cross-section to motor, brake and loadsharing [mm² ]/[AWG][2)] | | | 4/10 | 4/10 | 4/10 | 4/10 |
| **Normal overload torque (110 %):** | | | | | | |
| Rated input current | $I_{L,N}$ [A] (550 V) | | 2.5 | 2.8 | 4.0 | 5.1 |
| | $I_{L,N}$ [A] (600 V) | | 2.2 | 2.5 | 3.6 | 4.6 |
| **High overload torque ( 160 %):** | | | | | | |
| Rated input current | $I_{L,N}$ [A] (550 V) | | 1.8 | 2.5 | 2.8 | 4.0 |
| | $I_{L,N}$ [A] (600 V) | | 1.6 | 2.2 | 2.5 | 3.6 |
| Max. cable cross-section, power [mm² ]/[AWG][2)] | | | 4/10 | 4/10 | 4/10 | 4/10 |
| Max. pre-fuses | [-]/UL[1)] [A] | | 3 | 4 | 5 | 6 |
| Efficiency [3)] | | | 0.96 | 0.96 | 0.96 | 0.96 |
| Weight IP 20 EB | [kg] | | 10.5 | 10.5 | 10.5 | 10.5 |
| Power loss at max. load. | [W] | | 63 | 71 | 102 | 129 |
| Enclosure | | | IP 20 / Nema 1 | | | |

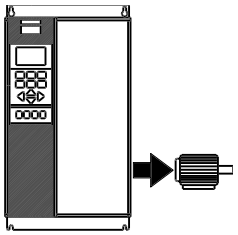
1. For type of fuses see section *Fuses*.
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.

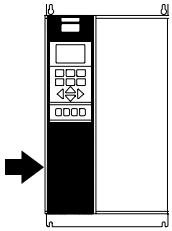
## Compact, Mains supply 3 x 525 - 600 V

| According to international requirements | | VLT type | 5005 | 5006 | 5008 | 5011 |
|---|---|---|---|---|---|---|
| | Normal overload torque (110 %): | | | | | |
| Output current | | $I_{VLT,N}$ [A] (550 V) | 6.4 | 9.5 | 11.5 | 11.5 |
| | | $I_{VLT,MAX}$ (60 s) [A] (550 V) | 7.0 | 10.5 | 12.7 | 12.7 |
| | | $I_{VLT,N}$ [A] (575 V) | 6.1 | 9.0 | 11.0 | 11.0 |
| | | $I_{VLT,MAX}$ (60 s) [A] (575 V) | 6.7 | 9.9 | 12.1 | 12.1 |
| Output | | $S_{VLT,N}$ [kVA] (550 V) | 6.1 | 9.0 | 11.0 | 11.0 |
| | | $S_{VLT,N}$ [kVA] (575 V) | 6.1 | 9.0 | 11.0 | 11.0 |
| Typical shaft output | | $P_{VLT,N}$ [kW] | 4 | 5.5 | 7.5 | 7.5 |
| Typical shaft output | | $P_{VLT,N}$ [HP] | 5 | 7.5 | 10.0 | 10.0 |
| **Highl overload torque (160%):** | | | | | | |
| Output current | | $I_{VLT,N}$ [A] (550 V) | 5.2 | 6.4 | 9.5 | 11.5 |
| | | $I_{VLT,MAX}$ (60 s) [A] (550 V) | 8.3 | 10.2 | 15.2 | 18.4 |
| | | $I_{VLT,N}$ [A] (575 V) | 4.9 | 6.1 | 9.0 | 11.0 |
| | | $I_{VLT,MAX}$ (60 s) [A] (575 V) | 7.8 | 9.8 | 14.4 | 17.6 |
| Output | | $S_{VLT,N}$ [kVA] (550 V) | 5.0 | 6.1 | 9.0 | 11.0 |
| | | $S_{VLT,N}$ [kVA] (575 V) | 4.9 | 6.1 | 9.0 | 11.0 |
| Typical shaft output | | $P_{VLT,N}$ [kW] | 3 | 4 | 5.5 | 7.5 |
| Typical shaft output | | $P_{VLT,N}$ [HP] | 4 | 5 | 7.5 | 10 |
| Max. cable cross-section to motor, brake and loadsharing [mm² ]/[AWG][2)] | | | 4/10 | 4/10 | 4/10 | 4/10 |
| | **Normal overload torque (110 %):** | | | | | |
| Rated input current | | $I_{L,N}$ [A] (550 V) | 6.2 | 9.2 | 11.2 | 11.2 |
| | | $I_{L,N}$ [A] (600 V) | 5.7 | 8.4 | 10.3 | 10.3 |
| | **High overload torque ( 160 %):** | | | | | |
| Rated input current | | $I_{L,N}$ [A] (550 V) | 5.1 | 6.2 | 9.2 | 11.2 |
| | | $I_{L,N}$ [A] (600 V) | 4.6 | 5.7 | 8.4 | 10.3 |
| Max. cable cross-section, power [mm² ]/[AWG][2)] | | | 4/10 | 4/10 | 4/10 | 4/10 |
| Max. pre-fuses | | [-]/UL[1)] [A] | 8 | 10 | 15 | 20 |
| Efficiency [3)] | | | 0.96 | 0.96 | 0.96 | 0.96 |
| Weight IP 20 EB | | [kg] | 10.5 | 10.5 | 10.5 | 10.5 |
| Power loss at max. load. | | [W] | 160 | 236 | 288 | 288 |
| Enclosure | | | IP 20 / Nema 1 | | | |

1. For type of fuses see section *Fuses*.
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.

## ■ Compact, Mains supply 3 x 525 - 600 V





| According to international requirements | | VLT type | 5016 | 5022 | 5027 |
|---|---|---|---|---|---|
| Normal overload torque (110 %): | | | | | |
| Output current | $I_{VLT,N}$ [A] (550 V) | | 23 | 28 | 34 |
| | $I_{VLT,MAX}$ (60 s) [A] (550 V) | | 25 | 31 | 37 |
| | $I_{VLT,N}$ [A] (575 V) | | 22 | 27 | 32 |
| | $I_{VLT,MAX}$ (60 s) [A] (575 V) | | 24 | 30 | 35 |
| Output | $S_{VLT,N}$ [kVA] (550 V) | | 22 | 27 | 32 |
| | $S_{VLT,N}$ [kVA] (575 V) | | 22 | 27 | 32 |
| Typical shaft output | $P_{VLT,N}$ [kW] | | 15 | 18.5 | 22 |
| Typical shaft output | $P_{VLT,N}$ [HP] | | 20 | 25 | 30 |
| High overload torque (160 %): | | | | | |
| Output current | $I_{VLT,N}$ [A] (550 V) | | 18 | 23 | 28 |
| | $I_{VLT,MAX}$ (60 s) [A] (550 V) | | 29 | 37 | 45 |
| | $I_{VLT,N}$ [A] (575 V) | | 17 | 22 | 27 |
| | $I_{VLT,MAX}$ (60 s) [A] (575 V) | | 27 | 35 | 43 |
| Output | $S_{VLT,N}$ [kVA] (550 V) | | 17 | 22 | 27 |
| | $S_{VLT,N}$ [kVA] (575 V) | | 17 | 22 | 27 |
| Typical shaft output | $P_{VLT,N}$ [kW] | | 11 | 15 | 18.5 |
| Typical shaft output | $P_{VLT,N}$ [HP] | | 15 | 20 | 25 |
| Max. cable cross-section to motor, brake and loadsharing [mm² ]/[AWG][2)] | | | 16<br>6 | 16<br>6 | 35<br>2 |
| Min. cable cross-section to motor, brake and loadsharing [mm2]/[AWG][4)] | | | 0.5<br>20 | 0.5<br>20 | 10<br>8 |
| **Normal overload torque (110 %):** | | | | | |
| Rated input current | $I_{L,N}$ [A] (550 V) | | 22 | 27 | 33 |
| | $I_{L,N}$ [A] (600 V) | | 21 | 25 | 30 |
| **High overload torque (160 %):** | | | | | |
| Rated input current | $I_{L,N}$ [A] (550 V) | | 18 | 22 | 27 |
| | $I_{L,N}$ [A] (600 V) | | 16 | 21 | 25 |
| Max. cable cross-section, power [mm² ]/[AWG][2)] | | | 16<br>6 | 16<br>6 | 35<br>2 |
| Max. pre-fuses | [-]/UL[1)] [A] | | 30 | 35 | 45 |
| Efficiency[3)] | | | 0.96 | 0.96 | 0.96 |
| Weight IP 20 EB | [kg] | | 23 | 23 | 30 |
| Power loss at max. load | [W] | | 576 | 707 | 838 |
| Enclosure | | | IP 20 / Nema 1 | | |

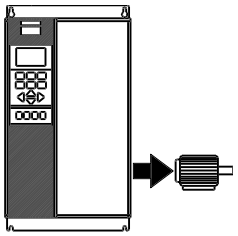
1. For type of fuse see section *Fuses*
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals to comply with IP 20. Always comply with national and local regulations on min. cable cross-section.

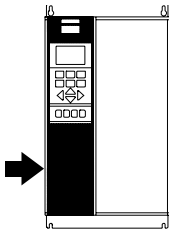
## Compact, Mains supply 3 x 525 - 600 V

| According to international requirements | | VLT type | 5032 | 5042 | 5052 | 5062 |
|---|---|---|---|---|---|---|
| | Normal overload torque (110 %): | | | | | |
| | Output current | $I_{VLT,N}$ [A] (550 V) | 43 | 54 | 65 | 81 |
| | | $I_{VLT,MAX}$ (60 s) [A] (550 V) | 47 | 59 | 72 | 89 |
| | | $I_{VLT,N}$ [A] (575 V) | 41 | 52 | 62 | 77 |
| | | $I_{VLT,MAX}$ (60 s) [A] (575 V) | 45 | 57 | 68 | 85 |
| | Output | $S_{VLT,N}$ [kVA] (550 V) | 41 | 51 | 62 | 77 |
| | | $S_{VLT,N}$ [kVA] (575 V) | 41 | 52 | 62 | 77 |
| | Typical shaft output | $P_{VLT,N}$ [kW] | 30 | 37 | 45 | 55 |
| | Typical shaft output | $P_{VLT,N}$ [HP] | 40 | 50 | 60 | 75 |
| | High overload torque (160 %): | | | | | |
| | Output current | $I_{VLT,N}$ [A] (550 V) | 34 | 43 | 54 | 65 |
| | | $I_{VLT,MAX}$ (60 s) [A] (550 V) | 54 | 69 | 86 | 104 |
| | | $I_{VLT,N}$ [A] (575 V) | 32 | 41 | 52 | 62 |
| | | $I_{VLT,MAX}$ (60 s) [A] (575 V) | 51 | 66 | 83 | 99 |
| | Output | $S_{VLT,N}$ [kVA] (550 V) | 32 | 41 | 51 | 62 |
| | | $S_{VLT,N}$ [kVA] (575 V) | 32 | 41 | 52 | 62 |
| | Typical shaft output | $P_{VLT,N}$ [kW] | 22 | 30 | 37 | 45 |
| | Typical shaft output | $P_{VLT,N}$ [HP] | 30 | 40 | 50 | 60 |
| | Max. cable cross-section to motor, | | 35 | 50 | 50 | 50 |
| | brake and loadsharing [mm² ]/[AWG][2) 5)] | | 2 | 1/0 | 1/0 | 1/0 |
| | Min. cable cross-section to motor, | | 10 | 16 | 16 | 16 |
| | brake and loadsharing [mm² ]/[AWG][4)] | | 8 | 6 | 6 | 6 |
| | **Normal overload torque (110 %):** | | | | | |
| | Rated input current | $I_{L,N}$ [A] (550 V) | 42 | 53 | 63 | 79 |
| | | $I_{L,N}$ [A] (600 V) | 38 | 49 | 58 | 72 |
| | **High overload torque (160 %):** | | | | | |
| | Rated input current | $I_{L,N}$ [A] (550 V) | 33 | 42 | 53 | 63 |
| | | $I_{L,N}$ [A] (600 V) | 30 | 38 | 49 | 58 |
| | Max. cable cross-section | | 35 | 50 | 50 | 50 |
| | power[mm ² ]/[AWG][2) 5)] | | 2 | 1/0 | 1/0 | 1/0 |
| | Max. pre-fuses | [-]/UL[1)] [A] | 60 | 75 | 90 | 100 |
| | Efficiency[3)] | | 0.96 | 0.96 | 0.96 | 0.96 |
| | Weight IP 20 EB | [kg] | 30 | 48 | 48 | 48 |
| | Power loss at max. load | [W] | 1074 | 1362 | 1624 | 2016 |
| | Enclosure | | IP 20 / Nema 1 | | | |

1. For type of fuse see section *Fuses*
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals to comply with IP 20. Always comply with national and local regulations on min. cable cross-section.
5. Aluminium cables with cross-section above 35 mm² must be connected by use of a Al-Cu connector.

## ■ Mains supply 3 x 525 - 690 V

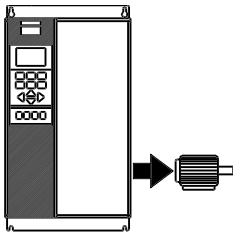


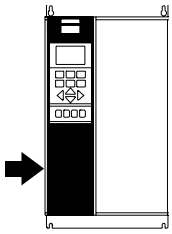


| According to international requirements | | VLT type | 5042 | 5052 | 5062 | 5072 | 5102 |
|---|---|---|---|---|---|---|---|
| **Normal overload torque (110 %):** | | | | | | | |
| Output current | $I_{VLT,N}$ [A] (525-550 V) | | 56 | 76 | 90 | 113 | 137 |
| | $I_{VLT,MAX}$ (60 s) [A] (525-550 V) | | 62 | 84 | 99 | 124 | 151 |
| | $I_{VLT,N}$ [A] (551-690 V) | | 54 | 73 | 86 | 108 | 131 |
| | $I_{VLT,MAX}$ (60 s) [A] (551-690 V) | | 59 | 80 | 95 | 119 | 144 |
| Output | $S_{VLT,N}$ [kVA] (550 V) | | 53 | 72 | 86 | 108 | 131 |
| | $S_{VLT,N}$ [kVA] (575 V) | | 54 | 73 | 86 | 108 | 130 |
| | $S_{VLT,N}$ [kVA] (690 V) | | 65 | 87 | 103 | 129 | 157 |
| Typical shaft output | [kW] (550 V) | | 37 | 45 | 55 | 75 | 90 |
| | [HP] (575 V) | | 50 | 60 | 75 | 100 | 125 |
| | [kW] (690 V) | | 45 | 55 | 75 | 90 | 110 |
| **High overload torque (160 %):** | | | | | | | |
| Output current | $I_{VLT,N}$ [A] (525-550 V) | | 48 | 56 | 76 | 90 | 113 |
| | $I_{VLT,MAX}$ (60 s) [A] (525-550 V) | | 77 | 90 | 122 | 135 | 170 |
| | $I_{VLT,N}$ [A] (551-690 V) | | 46 | 54 | 73 | 86 | 108 |
| | $I_{VLT,MAX}$ (60 s) [A] (551-690 V) | | 74 | 86 | 117 | 129 | 162 |
| Output | $S_{VLT,N}$ [kVA] (550 V) | | 46 | 53 | 72 | 86 | 108 |
| | $S_{VLT,N}$ [kVA] (575 V) | | 46 | 54 | 73 | 86 | 108 |
| | $S_{VLT,N}$ [kVA] (690 V) | | 55 | 65 | 87 | 103 | 129 |
| Typical shaft output | [kW] (550 V) | | 30 | 37 | 45 | 55 | 75 |
| | [HP] (575 V) | | 40 | 50 | 60 | 75 | 100 |
| | [kW] (690 V) | | 37 | 45 | 55 | 75 | 90 |
| Max. cable cross-section to motor | [mm²][4,6] | | | | 2 x 70 | | |
| | [AWG][2,4,6] | | | | 2 x 2/0 | | |
| Max. cable cross-section to loadsharing and brake | [mm²][4,6] | | | | 2 x 70 | | |
| | [AWG][2,4,6] | | | | 2 x 2/0 | | |
| **Normal overload torque (110 %):** | | | | | | | |
| Rated input current | $I_{L,N}$ [A] (550 V) | | 60 | 77 | 89 | 110 | 130 |
| | $I_{L,N}$ [A] (575 V) | | 58 | 74 | 85 | 106 | 124 |
| | $I_{L,N}$ [A] (690 V) | | 58 | 77 | 87 | 109 | 128 |
| **High overload torque (160 %):** | | | | | | | |
| Rated input current | $I_{L,N}$ [A] (550 V) | | 53 | 60 | 77 | 89 | 110 |
| | $I_{L,N}$ [A] (575 V) | | 51 | 58 | 74 | 85 | 106 |
| | $I_{L,N}$ [A] (690 V) | | 50 | 58 | 77 | 87 | 109 |
| Max. cable cross-section power supply | [mm²][4,6] | | | | 2 x 70 | | |
| | [AWG][2,4,6] | | | | 2 x 2/0 | | |
| Max. pre-fuses (mains) [-]/ UL | [A][1] | | 125 | 160 | 200 | 200 | 250 |
| Efficiency[3] | | | 0.97 | 0.97 | 0.98 | 0.98 | 0.98 |
| Power loss | Normal overload [W] | | 1458 | 1717 | 1913 | 2262 | 2662 |
| | High overload [W] | | 1355 | 1459 | 1721 | 1913 | 2264 |
| Weight | IP 00 [kg] | | | | 82 | | |
| Weight | IP 21/Nema1 [kg] | | | | 96 | | |
| Weight | IP 54/Nema12 [kg] | | | | 96 | | |
| Enclosure | | | IP 00, IP 21/Nema 1 and IP 54/Nema12 | | | | |

1. For type of fuse see section *Fuses*
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Max. cable cross-section is the maximum possible cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.
5. Weight without shipping container.
6. Connection bolt power supply and motor: M10; Brake and loadsharing: M8

## ■ mains supply 3 x 525 - 690 V

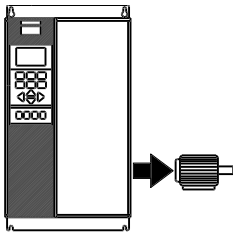


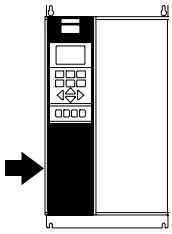


| According to international requirements | | VLT type | 5122 | 5152 | 5202 | 5252 | 5302 | 5352 |
|---|---|---|---|---|---|---|---|---|
| **Normal overload torque (110 %):** | | | | | | | | |
| Output current | $I_{VLT,N}$ [A] (525-550 V) | | 162 | 201 | 253 | 303 | 360 | 418 |
| | $I_{VLT,MAX}$ (60 s) [A] (525-550 V) | | 178 | 221 | 278 | 333 | 396 | 460 |
| | $I_{VLT,N}$ [A] (551-690 V) | | 155 | 192 | 242 | 290 | 344 | 400 |
| | $I_{VLT,MAX}$ (60 s) [A] (551-690 V) | | 171 | 211 | 266 | 319 | 378 | 440 |
| Output | $S_{VLT,N}$ [kVA] (550 V) | | 154 | 191 | 241 | 289 | 343 | 398 |
| | $S_{VLT,N}$ [kVA] (575 V) | | 154 | 191 | 241 | 289 | 343 | 398 |
| | $S_{VLT,N}$ [kVA] (690 V) | | 185 | 229 | 289 | 347 | 411 | 478 |
| Typical shaft output | [kW] (550 V) | | 110 | 132 | 160 | 200 | 250 | 315 |
| | [HP] (575 V) | | 150 | 200 | 250 | 300 | 350 | 400 |
| | [kW] (690 V) | | 132 | 160 | 200 | 250 | 315 | 400 |
| **High overload torque (160 %):** | | | | | | | | |
| Output current | $I_{VLT,N}$ [A] (525-550 V) | | 137 | 162 | 201 | 253 | 303 | 360 |
| | $I_{VLT,MAX}$ (60 s) [A] (525-550 V) | | 206 | 243 | 302 | 380 | 455 | 540 |
| | $I_{VLT,N}$ [A] (551-690 V) | | 131 | 155 | 192 | 242 | 290 | 344 |
| | $I_{VLT,MAX}$ (60 s) [A] (551-690 V) | | 197 | 233 | 288 | 363 | 435 | 516 |
| Output | $S_{VLT,N}$ [kVA] (550 V) | | 131 | 154 | 191 | 241 | 289 | 343 |
| | $S_{VLT,N}$ [kVA] (575 V) | | 130 | 154 | 191 | 241 | 289 | 343 |
| | $S_{VLT,N}$ [kVA] (690 V) | | 157 | 185 | 229 | 289 | 347 | 411 |
| Typical shaft output | [kW] (550 V) | | 90 | 110 | 132 | 160 | 200 | 250 |
| | [HP] (575 V) | | 125 | 150 | 200 | 250 | 300 | 350 |
| | [kW] (690 V) | | 110 | 132 | 160 | 200 | 250 | 315 |
| Max. cable cross-section to motor | | [mm²][4,6] | 2 x 70 | | | 2 x 185 | | |
| | | [AWG][2,4,6] | 2 x 2/0 | | | 2 x 350 mcm | | |
| Max. cable cross-section to loadsharing and brake | | [mm²][4,6] | 2 x 70 | | | 2 x 185 | | |
| | | [AWG][2,4,6] | 2 x 2/0 | | | 2 x 350 mcm | | |
| **Normal overload torque (110 %):** | | | | | | | | |
| Rated input current | $I_{L,N}$ [A] (550 V) | | 158 | 198 | 245 | 299 | 355 | 408 |
| | $I_{L,N}$ [A] (575 V) | | 151 | 189 | 234 | 286 | 339 | 390 |
| | $I_{L,N}$ [A] (690 V) | | 155 | 197 | 240 | 296 | 352 | 400 |
| **High overload torque (160 %):** | | | | | | | | |
| Rated input current | $I_{L,N}$ [A] (550 V) | | 130 | 158 | 198 | 245 | 299 | 355 |
| | $I_{L,N}$ [A] (575 V) | | 124 | 151 | 189 | 234 | 286 | 339 |
| | $I_{L,N}$ [A] (690 V) | | 128 | 155 | 197 | 240 | 296 | 352 |
| Max. cable cross-section power supply | | [mm²][4,6] | 2 x 70 | | | 2 x 185 | | |
| | | [AWG][2,4,6] | 2 x 2/0 | | | 2 x 350 mcm | | |
| Max. pre-fuses (mains) [-]/UL | | [A][1] | 315 | 350 | 350 | 400 | 500 | 550 |
| Efficiency[3] | | | | | 0,98 | | | |
| Power loss | Normal overload [W] | | 3114 | 3612 | 4292 | 5155 | 5821 | 6149 |
| | High overload [W] | | 2664 | 2952 | 3451 | 4275 | 4875 | 5185 |
| Weight | IP 00 [kg] | | 82 | 91 | 112 | 123 | 138 | 151 |
| Weight | IP 21/Nema1 [kg] | | 96 | 104 | 125 | 136 | 151 | 165 |
| Weight | IP 54/Nema12 [kg] | | 96 | 104 | 125 | 136 | 151 | 165 |
| Enclosure | | | IP 00, IP 21/Nema 1 and IP 54/Nema12 | | | | | |

1. For type of fuse see section *Fuses*
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Max. cable cross-section is the maximum possible cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.
5. Weight without shipping container.
6. Connection bolt power supply and motor: M10; Brake and loadsharing: M8

## ■ Compact, Mains supply 3 x 525 - 690 V





| According to international requirements | | VLT type | 5402 | 5502 | 5602 |
|---|---|---|---|---|---|
| **Normal overload current (110 %):** | | | | | |
| Output current | $I_{VLT,N}$ [A] | (525-550 V) | 523 | 596 | 630 |
| | $I_{VLT,MAX}$ (60 s) [A] | (525-550 V) | 575 | 656 | 693 |
| | $I_{VLT,N}$ [A] | (551-690 V) | 500 | 570 | 630 |
| | $I_{VLT,MAX}$ (60 s) [A] | (551-690 V) | 550 | 627 | 693 |
| Output | $S_{VLT,N}$ [kVA] | (550 V) | 498 | 568 | 600 |
| | $S_{VLT,N}$ [kVA] | (575 V) | 498 | 568 | 627 |
| | $S_{VLT,N}$ [kVA] | (690 V) | 598 | 681 | 753 |
| Typical shaft output | [kW] | (550 V) | 400 | 450 | 500 |
| | [HP] | (575 V) | 500 | 600 | 650 |
| | [kW] | (690 V) | 500 | 560 | 630 |
| **High overload torque (160 %):** | | | | | |
| Output current | $I_{VLT,N}$ [A] | (525-550 V) | 429 | 523 | 596 |
| | $I_{VLT,MAX}$ (60 s) [A] | (525-550 V) | 644 | 785 | 894 |
| | $I_{VLT,N}$ [A] | (551-690 V) | 410 | 500 | 570 |
| | $I_{VLT,MAX}$ (60 s) [A] | (551-690 V) | 615 | 750 | 855 |
| Output | $S_{VLT,N}$ [kVA] | (550 V) | 409 | 498 | 568 |
| | $S_{VLT,N}$ [kVA] | (575 V) | 408 | 498 | 568 |
| | $S_{VLT,N}$ [kVA] | (690 V) | 490 | 598 | 681 |
| Typical shaft output | [kW] | (550 V) | 315 | 400 | 450 |
| | [HP] | (575 V) | 400 | 500 | 600 |
| | [kW] | (690 V) | 400 | 500 | 560 |
| Max. cable cross-section to motor and loadsharing | [mm²][4,6] | | | 4x240 | |
| | [AWG][2,4,6] | | | 4x500 mcm | |
| Max. cable cross-section to brake | [mm²][4,6] | | | 2x185 | |
| | [AWG][2,4,6] | | | 2x350 mcm | |
| **Normal overload current (110 %):** | | | | | |
| Rated input current | $I_{L,N}$ [A] | (525-550 V) | 504 | 574 | 607 |
| | $I_{L,N}$ [A] | (551-690 V) | 482 | 549 | 607 |
| **High overload torque (160 %):** | | | | | |
| Rated input current | $I_{L,N}$ [A] | (525-550 V) | 413 | 504 | 574 |
| | $I_{L,N}$ [A] | (551-690 V) | 395 | 482 | 549 |
| Max. cable cross-section power supply | [mm²][4,6] | | | 4x240 | |
| | [AWG][2,4,6] | | | 4x500 mcm | |
| Max. pre-fuses (mains) [-]/ UL | [A][1] | | 700/700 | 900/900 | 900/900 |
| Efficiency[3] | | | | 0,98 | |
| Power loss | Normal overload [W] | | 7249 | 8727 | 9673 |
| | High overload [W] | | 5818 | 7671 | 8715 |
| Weight | IP 00 [kg] | | 221 | 236 | 277 |
| Weight | IP 21/Nema1 [kg] | | 263 | 272 | 313 |
| Weight | IP 54/Nema12 [kg] | | 263 | 272 | 313 |
| Enclosure | IP 00, IP 21/Nema 1 and IP 54/Nema12 | | | | |

1. For type of fuse see section *Fuses*
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Max. cable cross-section is the maximum possible cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.
5. Weight without shipping container.
6. Connection bolt power supply, motor and loadsharing: M10 (compression lug), 2xM8 (box lug), M8 (brake)

## ■ Fuses

### UL compliance

To comply with UL/cUL approvals, pre-fuses according to the table below must be used.

**200-240 V**

| VLT | Bussmann | SIBA | Littel fuse | Ferraz-Shawmut |
|---|---|---|---|---|
| 5001 | KTN-R10 | 5017906-010 | KLN-R10 | ATM-R10 or A2K-10R |
| 5002 | KTN-R10 | 5017906-010 | KLN-R10 | ATM-R10 or A2K-10R |
| 5003 | KTN-R25 | 5017906-016 | KLN-R15 | ATM-R15 or A2K-15R |
| 5004 | KTN-R20 | 5017906-020 | KLN-R20 | ATM-R20 or A2K-20R |
| 5005 | KTN-R25 | 5017906-025 | KLN-R25 | ATM-R25 or A2K-25R |
| 5006 | KTN-R30 | 5012406-032 | KLN-R30 | ATM-R30 or A2K-30R |
| 5008 | KTN-R50 | 5014006-050 | KLN-R50 | A2K-50R |
| 5011 | KTN-R60 | 5014006-063 | KLN-R60 | A2K-60R |
| 5016 | KTN-R85 | 5014006-080 | KLN-R80 | A2K-80R |
| 5022 | KTN-R125 | 2028220-125 | KLN-R125 | A2K-125R |
| 5027 | KTN-R125 | 2028220-125 | KLN-R125 | A2K-125R |
| 5032 | KTN-R150 | 2028220-160 | L25S-150 | A25X-150 |
| 5042 | KTN-R200 | 2028220-200 | L25S-200 | A25X-200 |
| 5052 | KTN-R250 | 2028220-250 | L25S-250 | A25X-250 |

**380-500 V**

| | Bussmann | SIBA | Littel fuse | Ferraz-Shawmut |
|---|---|---|---|---|
| 5001 | KTS-R6 | 5017906-006 | KLS-R6 | ATM-R6 or A6K-6R |
| 5002 | KTS-R6 | 5017906-006 | KLS-R6 | ATM-R6 or A6K-6R |
| 5003 | KTS-R10 | 5017906-010 | KLS-R10 | ATM-R10 or A6K-10R |
| 5004 | KTS-R10 | 5017906-010 | KLS-R10 | ATM-R10 or A6K-10R |
| 5005 | KTS-R15 | 5017906-016 | KLS-R15 | ATM-R15 or A6K-15R |
| 5006 | KTS-R20 | 5017906-020 | KLS-R20 | ATM-R20 or A6K-20R |
| 5008 | KTS-R25 | 5017906-025 | KLS-R25 | ATM-R25 or A6K-25R |
| 5011 | KTS-R30 | 5012406-032 | KLS-R30 | A6K-30R |
| 5016 | KTS-R40 | 5012406-040 | KLS-R40 | A6K-40R |
| 5022 | KTS-R50 | 5014006-050 | KLS-R50 | A6K-50R |
| 5027 | KTS-R60 | 5014006-063 | KLS-R60 | A6K-60R |
| 5032 | KTS-R80 | 2028220-100 | KLS-R80 | A6K-180R |
| 5042 | KTS-R100 | 2028220-125 | KLS-R100 | A6K-100R |
| 5052 | KTS-R125 | 2028220-125 | KLS-R125 | A6K-125R |
| 5062 | KTS-R150 | 2028220-160 | KLS-R150 | A6K-150R |
| 5072 | FWH-220 | 2028220-200 | L50S-225 | A50-P225 |
| 5102 | FWH-250 | 2028220-250 | L50S-250 | A50-P250 |
| 5122* | FWH-300/170M3017 | 2028220-315 | L50S-300 | A50-P300 |
| 5152* | FWH-350/170M3018 | 2028220-315 | L50S-350 | A50-P350 |
| 5202* | FWH-400/170M4012 | 206xx32-400 | L50S-400 | A50-P400 |
| 5252* | FWH-500/170M4014 | 206xx32-500 | L50S-500 | A50-P500 |
| 5302* | FWH-600/170M4016 | 206xx32-600 | L50S-600 | A50-P600 |
| 5352 | 170M4017 | 2061032,700 | | 6.9URD31D08A0700 |
| 5452 | 170M6013 | 2063032,900 | | 6.9URD33D08A0900 |
| 5502 | 170M6013 | 2063032,900 | | 6.9URD33D08A0900 |
| 5552 | 170M6013 | 2063032,900 | | 6.9URD33D08A0900 |

* Circuit Breakers manufactured by General Electric, Cat. No. SKHA36AT0800, with rating plugs listed below can be used to meet UL-requirements:

| | | |
|---|---|---|
| 5122 | rating plug No. | SRPK800 A 300 |
| 5152 | rating plug No. | SRPK800 A 400 |
| 5202 | rating plug No. | SRPK800 A 400 |
| 5252 | rating plug No. | SRPK800 A 500 |
| 5302 | rating plug No. | SRPK800 A 600 |

**525-600 V**

| | Bussmann | SIBA | Littel fuse | Ferraz-Shawmut |
|---|---|---|---|---|
| 5001 | KTS-R3 | 5017906-004 | KLS-R003 | A6K-3R |
| 5002 | KTS-R4 | 5017906-004 | KLS-R004 | A6K-4R |
| 5003 | KT-R5 | 5017906-005 | KLS-R005 | A6K-5R |
| 5004 | KTS-R6 | 5017906-006 | KLS-R006 | A6K-6R |
| 5005 | KTS-R8 | 5017906-008 | KLS-R008 | A6K-8R |
| 5006 | KTS-R10 | 5017906-010 | KLS-R010 | A6K-10R |
| 5008 | KTS-R15 | 5017906-016 | KLS-R015 | A6K-15R |
| 5011 | KTS-R20 | 5017906-020 | KLS-R020 | A6K-20R |
| 5016 | KTS-R30 | 5017906-030 | KLS-R030 | A6K-30R |
| 5022 | KTS-R35 | 5014006-040 | KLS-R035 | A6K-35R |
| 5027 | KTS-R45 | 5014006-050 | KLS-R045 | A6K-45R |
| 5032 | KTS-R60 | 5014006-063 | KLS-R060 | A6K-60R |
| 5042 | KTS-R75 | 5014006-080 | KLS-R075 | A6K-80R |
| 5052 | KTS-R90 | 5014006-100 | KLS-R090 | A6K-90R |
| 5062 | KTS-R100 | 5014006-100 | KLS-R100 | A6K-100R |

**525-600 V (UL) and 525-690 V (CE) drives**

| | Bussmann | SIBA | FERRAZ-SHAWMUT |
|---|---|---|---|
| 5042 | 170M3013 | 2061032,125 | 6.6URD30D08A0125 |
| 5052 | 170M3014 | 2061032,16 | 6.6URD30D08A0160 |
| 5062 | 170M3015 | 2061032,2 | 6.6URD30D08A0200 |
| 5072 | 170M3015 | 2061032,2 | 6.6URD30D08A0200 |
| 5102 | 170M3016 | 2061032,25 | 6.6URD30D08A0250 |
| 5122 | 170M3017 | 2061032,315 | 6.6URD30D08A0315 |
| 5152 | 170M3018 | 2061032,35 | 6.6URD30D08A0350 |
| 5202 | 170M4011 | 2061032,35 | 6.6URD30D08A0350 |
| 5252 | 170M4012 | 2061032,4 | 6.6URD30D08A0400 |
| 5302 | 170M4014 | 2061032,5 | 6.6URD30D08A0500 |
| 5352 | 170M5011 | 2062032,55 | 6.6URD32D08A550 |
| 5402 | 170M4017 | 2061032,700 | 6.9URD31D08A0700 |
| 5502 | 170M6013 | 2063032,900 | 6.9URD33D08A0900 |
| 5602 | 170M6013 | 2063032,900 | 6.9URD33D08A0900 |

KTS-fuses from Bussmann may substitute KTN for 240 V drives.
FWH-fuses from Bussmann may substitute FWX for 240 V drives.

KLSR fuses from LITTEL FUSE may substitute KLNR fuses for 240 V drives.
L50S fuses from LITTEL FUSE may substitute L25S fuses for 240 V drives.

A6KR fuses from FERRAZ SHAWMUT may substitute A2KR for 240 V drives.
A50X fuses from FERRAZ SHAWMUT may substitute A25X for 240 V drives.

**Non UL compliance**

If UL/cUL is not to be complied with, we recommend the above mentioned fuses or:

| | | |
|---|---|---|
| VLT 5001-5027 | 200-240 V | type gG |
| VLT 5032-5052 | 200-240 V | type gR |
| VLT 5001-5062 | 380-500 V | type gG |
| VLT 5072-5102 | 380-500 V | type gR |
| VLT 5122-5302 | 380-500 V | type gG |
| VLT 5352-5552 | 380-500 V | type gR |
| VLT 5001-5062 | 525-600 V | type gG |

Not following the recommendation may result in unnecessary damage of the drive in case of malfunction. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100000 $A_{rms}$ (symmetrical), 500/600 V maximum.

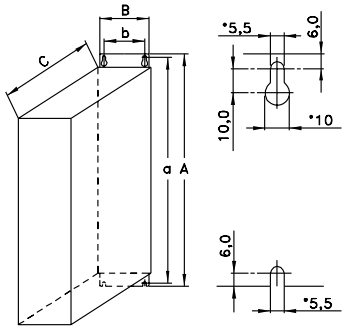
## ■ Mechanical dimensions

All the below listed measurements are in mm.

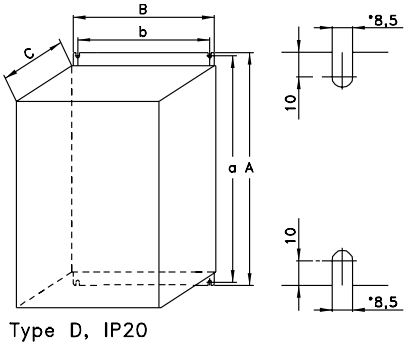
| | A | B | C | D | a | b | ab/be | Type |
|---|---|---|---|---|---|---|---|---|
| **Bookstyle IP 20** | | | | | | | | |
| 5001 - 5003 200 - 240 V<br>5001 - 5005 380 - 500 V | 395 | 90 | 260 | | 384 | 70 | 100 | A |
| 5004 - 5006 200 - 240 V<br>5006 - 5011 380 - 500 V | 395 | 130 | 260 | | 384 | 70 | 100 | A |
| **Compact IP 00** | | | | | | | | |
| 5032 - 5052 200 - 240 V | 800 | 370 | 335 | | 780 | 270 | 225 | B |
| 5122 - 5152 380 - 500 V | 1046 | 408 | 373[1)] | | 1001 | 304 | 225 | J |
| 5202 - 5302 380 - 500 V | 1327 | 408 | 373[1)] | | 1282 | 304 | 225 | J |
| 5352 - 5552 380 - 500 V | 1547 | 585 | 494[1)] | | 1502 | 304 | 225 | I |
| 5042 - 5152 525 - 690 V | 1046 | 408 | 373[1)] | | 1001 | 304 | 225 | J |
| 5202 - 5352 525 - 690 V | 1327 | 408 | 373[1)] | | 1282 | 304 | 225 | J |
| 5402 - 5602 525 - 690 V | 1547 | 585 | 494[1)] | | 1502 | 304 | 225 | I |
| **Compact IP 20** | | | | | | | | |
| 5001 - 5003 200 - 240 V<br>5001 - 5005 380 - 500 V | 395 | 220 | 160 | | 384 | 200 | 100 | C |
| 5004 - 5006 200 - 240 V<br>5006 - 5011 380 - 500 V<br>5001 - 5011 525 - 600 V (IP 20 and Nema 1) | 395 | 220 | 200 | | 384 | 200 | 100 | C |
| 5008 200 - 240 V<br>5016 - 5022 380 - 500 V<br>5016 - 5022 525 - 600 V (Nema 1) | 560 | 242 | 260 | | 540 | 200 | 200 | D |
| 5011 - 5016 200 - 240 V<br>5027 - 5032 380 - 500 V<br>5027 - 5032 525 - 600 V (Nema 1) | 700 | 242 | 260 | | 680 | 200 | 200 | D |
| 5022 - 5027 200 - 240 V<br>5042 - 5062 380 - 500 V<br>5042 - 5062 525 - 600 V (Nema 1) | 800 | 308 | 296 | | 780 | 270 | 200 | D |
| 5072 - 5102 380 - 500 V | 800 | 370 | 335 | | 780 | 330 | 225 | D |
| **Compact Nema 1/IP20/IP21** | | | | | | | | |
| 5032 - 5052 200 - 240 V | 954 | 370 | 335 | | 780 | 270 | 225 | E |
| 5122 - 5152 380 - 500 V | 1208 | 420 | 373[1)] | | 1154 | 304 | 225 | J |
| 5202 - 5302 380 - 500 V | 1588 | 420 | 373[1)] | | 1535 | 304 | 225 | J |
| 5352 - 5552 380 - 500 V | 2000 | 600 | 494[1)] | | - | - | 225 | H |
| 5042 - 5152 525 - 690 V | 1208 | 420 | 373[1)] | | 1154 | 304 | 225 | J |
| 5202 - 5352 525 - 690 V | 1588 | 420 | 373[1)] | | 1535 | 304 | 225 | J |
| 5402 - 5602 525 - 690 V | 2000 | 600 | 494[1)] | | - | - | 225 | H |
| **Compact IP 54/Nema 12** | | | | | | | | |
| 5001 - 5003 200 - 240 V<br>5001 - 5005 380 - 500 V | 460 | 282 | 195 | 85 | 260 | 258 | 100 | F |
| 5004 - 5006 200 - 240 V<br>5006 - 5011 380 - 500 V | 530 | 282 | 195 | 85 | 330 | 258 | 100 | F |
| 5008 - 5011 200 - 240 V<br>5016 - 5027 380 - 500 V | 810 | 350 | 280 | 70 | 560 | 326 | 200 | F |
| 5016 - 5027 200 - 240 V<br>5032 - 5062 380 - 500 V | 940 | 400 | 280 | 70 | 690 | 375 | 200 | F |
| 5032 - 5052 200 - 240 V | 937 | 495 | 421 | - | 830 | 374 | 225 | G |
| 5072 - 5102 380 - 500 V | 940 | 400 | 360 | 70 | 690 | 375 | 225 | F |
| 5122 - 5152 380 - 500 V | 1208 | 420 | 373[1)] | - | 1154 | 304 | 225 | J |
| 5202 - 5302 380 - 500 V | 1588 | 420 | 373[2)] | | 1535 | 304 | 225 | J |
| 5352 - 5552 380 - 500 V | 2000 | 600 | 494[1)] | - | - | - | 225 | H |
| 5042 - 5152 525 - 690 V | 1208 | 420 | 373[1)] | - | 1154 | 304 | 225 | J |
| 5202 - 5352 525 - 690 V | 1588 | 420 | 373[1)] | | 1535 | 304 | 225 | J |
| 5402 - 5602 525 - 690 V | 2000 | 600 | 494[1)] | | - | - | 225 | H |

ab: Minimum space above enclosure
be: Minimum space below enclosure
1) With disconnect, add 44 mm.

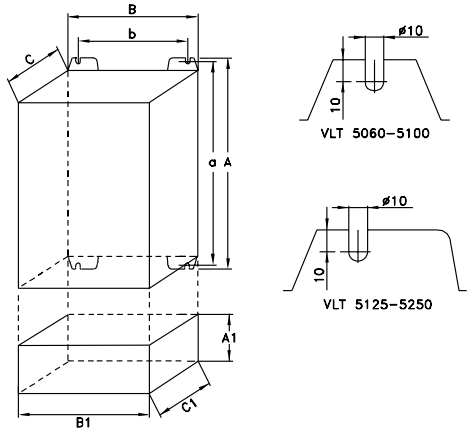
## ■ Mechanical dimensions, cont.



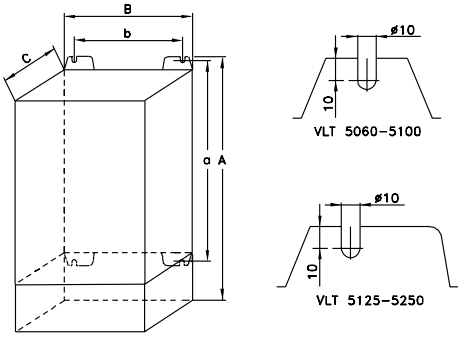

Type A, IP20



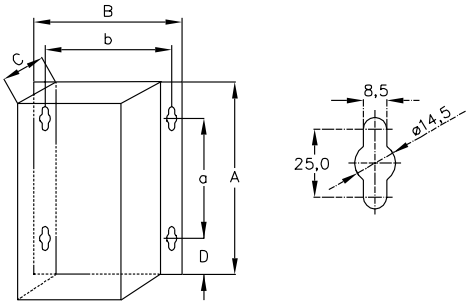

Type D, IP20



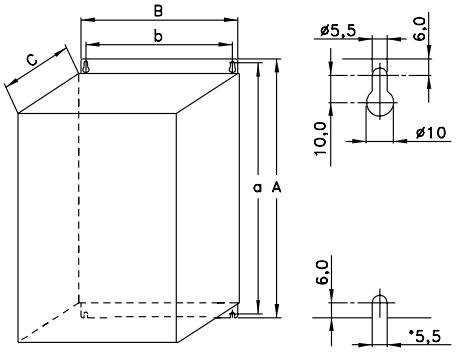

Type B, IP00
With option and enclosure IP20



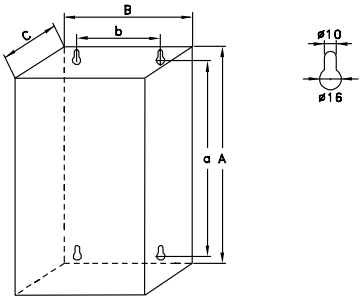

Type E, IP20/NEMA 1 with terminals




Type F, IP54



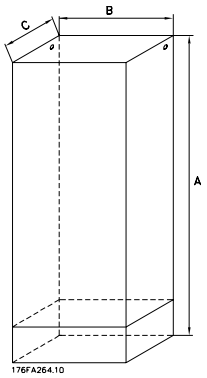

Type C, IP20



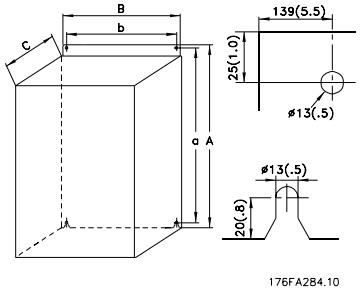

Type G, IP54

175ZA577.12

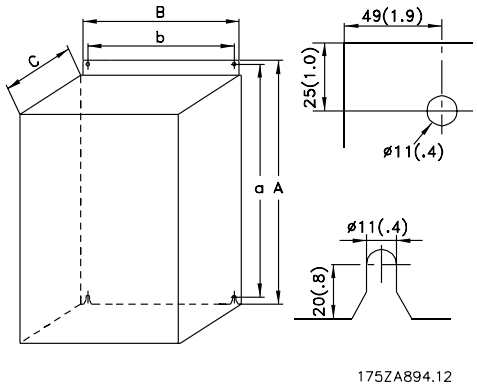
■ **Mechanical dimensions (cont.)**




Type H, IP 20, IP 54




Type I, IP 00




Type J, IP 00, IP 21, IP 54

## Mechanical installation



Please pay attention to the requirements that apply to integration and field mounting kit, see the below list. The information given in the list must be observed to avoid serious damage or injury, especially when installing large units.

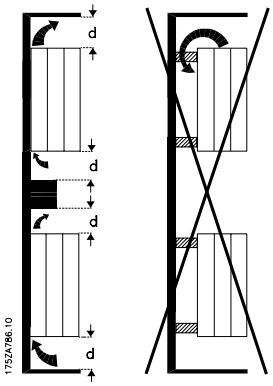
The frequency converter *must* be installed vertically.

The frequency converter is cooled by means of air circulation. For the unit to be able to release its cooling air, the *minimum* distance over and below the unit must be as shown in the illustration below.
To protect the unit from overheating, it must be ensured that the ambient temperature *does not rise above the max. temperature stated for the frequency converter* and that the 24-hour average temperature *is not exceeded* . The max. temperature and 24-hour average can be seen from the *General Technical Data*.
If the ambient temperature is in the range of 45°C -55° C, derating of the frequency converter will become relevant, see *Derating for ambient temperature*.
The service life of the frequency converter will be reduced if derating for ambient temperature is not taken into account.

## Installation of VLT 5001-5602

All frequency converters must be installed in a way that ensures proper cooling.

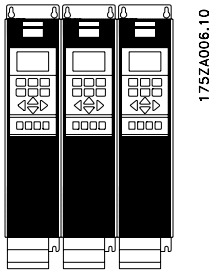
Cooling

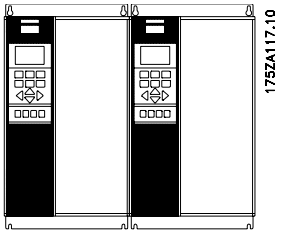


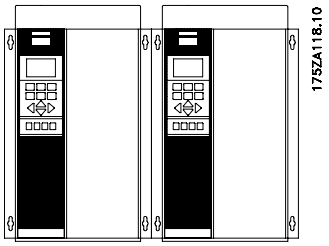

All Bookstyle and Compact units require a minimum space above and below the enclosure.

### Side by side/flange by flange

All frequency converters can be mounted side by side/ flange by flange.



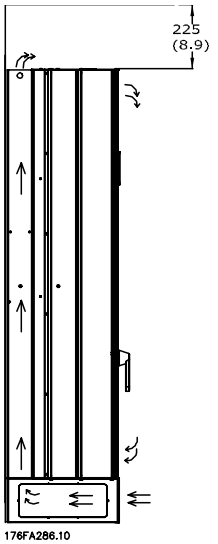




| | d [mm] | Comments |
|---|---|---|
| Bookstyle | | |
| VLT 5001-5006, 200-240 V | 100 | Installation on a plane, vertical surface (no spacers) |
| VLT 5001-5011, 380-500 V | 100 | |
| | | |
| Compact (all enclosure types) | | |
| VLT 5001-5006, 200-240 V | 100 | Installation on a plane, vertical surface (no spacers) |
| VLT 5001-5011, 380-500 V | 100 | |
| VLT 5001-5011, 525-600 V | 100 | |
| | | |
| VLT 5008-5027, 200-240 V | 200 | Installation on a plane, vertical surface (no spacers) |
| VLT 5016-5062, 380-500 V | 200 | |
| VLT 5072-5102, 380-500 V | 225 | |
| VLT 5016-5062, 525-600 V | 200 | |
| | | |
| VLT 5032-5052, 200-240 V | 225 | Installation on a plane, vertical surface (no spacers)<br>IP 54 filter mats must be changed when they are dirty. |
| VLT 5122-5302, 380-500 V | 225 | |
| VLT 5042-5352, 525-690 V | 225 | |
| VLT 5352-5552, 380-500 V | 225 | IP 00 above and below enclosure<br>IP 21/IP 54 only above enclosure |
| VLT 5402-5602, 525-690 V | 225 | |

## ■ Installation of VLT 5352-5552 380-500 V and VLT 5402-5602 525-690 V Compact Nema 1 (IP 21) and IP 54

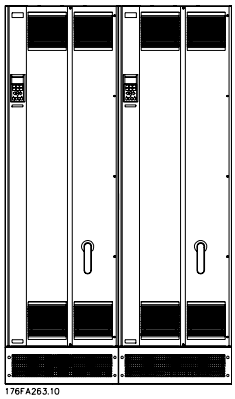
Cooling




All units in the above-mentioned series require a minimum space of 225 mm above the enclosure and must be installed on a flat level surface. This applies to both Nema 1 (IP 21) and IP 54 units.
Gaining access requires a minimum space of 579 mm in front of the frequency converter.

Filter mats in IP 54 units have to be changed regularly depending on the operating environment.

**Side-by-side**




Compact Nema 1 (IP 21) and IP 54

All Nema 1 (IP 21) and IP 54 units in the above-mentioned series can be installed side by side without any space between them, since these units do not require cooling on the sides.

**NB!**
IP54 units are not intended for direct outdoor installation. The IP54 rating does not relate to other exposures as sun, icing, wind blown driving rain. Under such circumstances Danfoss recommends to install the units in an enclosure designed for these environmental conditions. Alternatively, an installation at minimum 0.5 m above surface and covered by a shed is recommended.

## Electrical installation

The voltage on the frequency converter is dangerous when the unit is connected to mains. Incorrect installation of the motor or the frequency converter may lead to material damage or serious injury or it may be fatal. Consequently, the instructions in this manual as well as national and local rules and safety regulations must be complied with.

Touching the electrical parts may be fatal, even after the mains supply has been disconnected.

Using VLT 5001-5006, 200-240 V and 380-500 V: wait at least 4 minutes.

Using VLT 5008-5052, 200-240 V: wait at least 15 minutes.

Using VLT 5008-5062, 380-500 V: wait at least 15 minutes.

Using VLT 5072-5302, 380-500 V: wait at least 20 minutes.

Using VLT 5352-5552, 380-500 V: wait at least 40 minutes.

Using VLT 5001-5005, 525-600 V: wait at least 4 minutes.

Using VLT 5006-5022, 525-600 V: wait at least 15 minutes.

Using VLT 5027-5062, 525-600 V: wait at least 30 minutes.

Using VLT 5042-5352, 525-690 V: wait at least 20 minutes.

Using VLT 5402-5602, 525-690 V: wait at least 30 minutes.

**NB!**
It is the user's or certified electrician's responsibility to ensure correct earthing and protection in accordance with applicable national and local norms and standards.

## High voltage test

A high voltage test can be carried out by short- circuiting terminals U, V, W, $L_1$, $L_2$ and $L_3$ and energizing by max. 2.15 kV DC for one second between this short-circuit and the chassis.

**NB!**
The RFI switch must be closed (position ON) when high voltage tests are carried out (see section *RFI Switch)*.
The mains and motor connection must be interrupted in the case of high voltage tests of the total installation if the leakage currents are too high.

## Safety earthing

**NB!**
The frequency converter has a high leakage current and must be earthed appropriately for safety reasons. Use earth terminal (see section *Electrical installation, power cables*), which enables reinforced earthing.
Apply national safety regulations.

## Extra protection (RCD)

ELCB relays, multiple protective earthing or earthing can be used as extra protection, provided that local safety regulations are complied with.

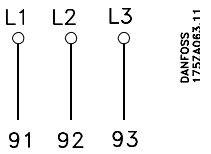
In the case of an earth fault, a DC content may develop in the faulty current.

If ELCB relays are used, local regulations must be observed. Relays must be suitable for protection of 3-phase equipment with a bridge rectifier and for a brief discharge on power-up.

See also the section *Special Conditions* in the Design Guide.

## Electrical installation - mains supply

Connect the three mains phases to terminals $L_1$, $L_2$, $L_3$.




## Electrical installation - motor cables

**NB!**
If an unscreened cable is used, some EMC requirements are not complied with, see the Design Guide.

If the EMC specifications regarding emission are to be complied with, the motor cable must be screened, unless otherwise stated for the RFI filter in question. It is important to keep the motor cable as short as possible so as to reduce the noise level and leakage currents to a minimum.
The motor cable screen must be connected to the metal cabinet of the frequency converter and to the metal cabinet of the motor. The screen connections are to be made with the biggest possible surface (cable clamp). This is enabled by different installation devices in the different frequency converters.

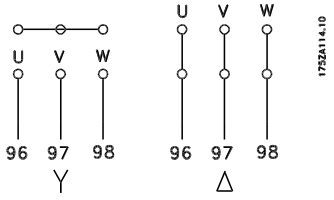
Installation with twisted screen ends (pigtails) is to be avoided, since these spoil the screening effect at higher frequencies.
If it is necessary to break the screen to install a motor isolator or motor contactor, the screen must be continued at the lowest possible HF impedance.

The frequency converter has been tested with a given length of cable and a given cross-section of that cable. If the cross-section is increased, the cable capacitance - and thus the leakage current - increases, and the cable length must be reduced correspondingly.

When frequency converters are used together with sine-wave filters to reduce the acoustic noise from a motor, the switching frequency must be set according to the sine-wave filter instruction in *Parameter 411.* When setting the switching frequency higher than 3 kHz, the output current is derated in SFAVM mode. By changing *Parameter 446* to 60° AVM mode, the frequency at which the current is derated is moved upwards. Please see *Design Guide.*

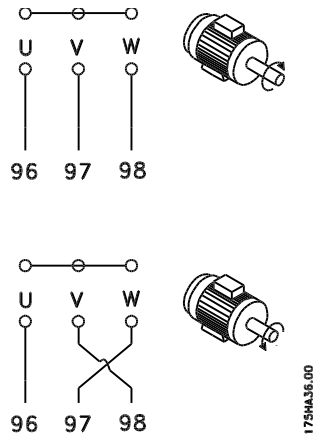
## ■ Connection of motor

All types of 3-phased asynchronous standard motors can be used with the VLT 5000 Series.




Normally, small motors are star-connected (200/400 V, Δ/Y).
Large motors are delta-connected (400/690 V, Δ/Y).

## ■ Direction of motor rotation

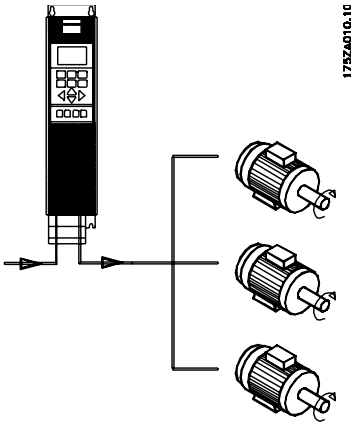



The factory setting is for clockwise rotation with the frequency transformer output connected as follows.

Terminal 96 connected to U-phase
Terminal 97 connected to V-phase
Terminal 98 connected to W-phase

The direction of motor rotation can be changed by switching two phases in the motor cable.

## ■ Parallel coupling of motors




Frequency converters are able to control several motors connected in parallel. If the motors are to have different rpm values, the motors must have different rated rpm values. Motor rpm is changed simultaneously, which means that the ratio between the rated rpm values is maintained across the range.

The total current consumption of the motors is not to exceed the maximum rated output current $I_{VLT,N}$ for the frequency converter.

Problems may arise at the start and at low rpm values if the motor sizes are widely different. This is because the relatively high ohmic resistance in small motors

calls for a higher voltage at the start and at low rpm values.

In systems with motors connected in parallel, the electronic thermal relay (ETR) of the frequency converter cannot be used as motor protection for the individual motor. Consequently, additional motor protection is required, such as thermistors in each motor (or individual thermal relays) suitable for frequency converter use.

Please note that the individual motor cable for each motor must be summed and is not to exceed the total motor cable length permitted.

### ■ Motor thermal protection

The electronic thermal relay in UL-approved frequency converters has received the UL-approval for single motor protection when parameter 128 has been set for *ETR Trip* and parameter 105 has been programmed to the rated motor current (see motor nameplate).

### ■ Electrical installation - brake cable

(Only standard with brake and extended with brake. Typecode: SB, EB, DE, PB).

| No. | Function |
|---|---|
| 81, 82 | Brake resistor terminals |

The connection cable to the brake resistor must be screened. Connect the screen by means of cable clamps to the conductive back plate at the frequency converter and to the metal cabinet of the brake resistor.
Size the brake cable cross-section to match the brake torque. See also Brake instructions, MI.90.FX.YY and MI.50.SX.YY for further information regarding safe installation.

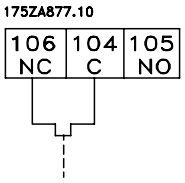
**NB!**
Please note that voltages up to 1099 V DC, depending on the supply voltage, may occur on the terminals.

### ■ Electrical installation - brake resistor temperature switch

Torque: 0.5-0.6 Nm
Screw size: M3

| No. | Function |
|---|---|
| 106, 104, 105 | Brake resistor temperature switch. |

**NB!**
This function is only available on VLT 5032-5052, 200-240 V; VLT 5122-5552, 380-500 V; and VLT 5042-5602, 525-690 V.
If the temperature of the brake resistor gets too high and the thermal switch drops out, the frequency converter will stop braking. The motor will start coasting.
A KLIXON switch must be installed that is 'normally closed'. If this function is not used, 106 and 104 must be short-circuited together.

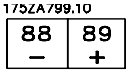



### ■ Electrical installation - loadsharing

(Only extended with typecode EB, EX, DE, DX).

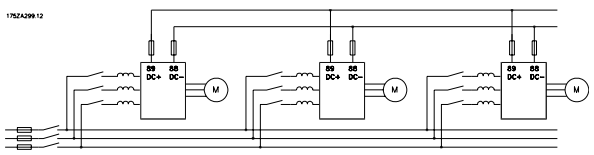
| No. | Function |
|---|---|
| 88, 89 | Loadsharing |

**Terminals for loadsharing**




The connection cable must be screened and the max. length from the frequency converter to the DC bar is 25 metres.
Load sharing enables linking of the DC intermediate circuits of several frequency converters.

**NB!**
Please note that voltages up to 1099 V DC may occur on the terminals.
Load sharing calls for extra equipment. For further information please consult Loadsharing Instructions MI.50.NX.XX.



## Tightening-up torques and screw sizes

The table shows the torque required when fitting terminals to the frequency converter. For VLT 5001-5027 200-240 V, VLT 5001-5102 380-500 V and VLT 5001-5062 525-600 V, the cables must be fastened with screws. For VLT 5032 - 5052 200-240 V, VLT 5122-5552 380-500 V, VLT 5042-5602 525-690 V the cables must be fastened with bolts.
These figures apply to the following terminals:

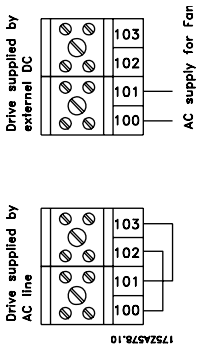
| | | |
|---|---|---|
| Mains terminals | Nos | 91, 92, 93<br>L1, L2, L3 |
| Motor terminals | Nos | 96, 97, 98<br>U, V, W |
| Earth terminal | No | 94, 95, 99 |
| Brake resistor terminals | | 81, 82 |
| Loadsharing | | 88, 89 |

| VLT type | | Torque [Nm] | Screw/ Boltsize | Tool |
|---|---|---|---|---|
| **200-240 V** | | | | |
| 5001-5006 | | 0,6 | M3 | Slotted screw |
| 5008 | IP20 | 1,8 | M4 | Slotted screw |
| 5008-5011 | IP54 | 1,8 | M4 | Slotted screw |
| 5011-5022 | IP20 | 3 | M5 | 4 mm Allen wrench |
| 5016-5022[31)] | IP54 | 3 | M5 | 4 mm Allen wrench |
| 5027 | | 6 | M6 | 4 mm Allen wrench |
| 5032-5052 | | 11,3 | M8 (bolt and stud) | |
| **380-500 V** | | | | |
| 5001-5011 | | 0,6 | M3 | Slotted screw |
| 5016-5022 | IP20 | 1,8 | M4 | Slotted screw |
| 5016-5027 | IP54 | 1,8 | M4 | Slotted screw |
| 5027-5042 | IP20 | 3 | M5 | 4 mm Allen wrench |
| 5032-5042[3)] | IP54 | 3 | M5 | 4 mm Allen wrench |
| 5052-5062 | | 6 | M6 | 5 mm Allen wrench |
| 5072-5102 | IP20 | 15 | M6 | 6 mm Allen wrench |
| | IP54[2)] | 24 | M8 | 8 mm Allen wrench |
| 5122-5302[4)] | | 19 | M10 bolt | 16 mm wrench |
| 5352-5552[5)] | | 19 | M10 bolt (compression lug) | 16 mm wrench |
| **525-600 V** | | | | |
| 5001-5011 | | 0,6 | M3 | Slotted screw |
| 5016-5027 | | 1,8 | M4 | Slotted screw |
| 5032-5042 | | 3 | M5 | 4 mm Allen wrench |
| 5052-5062 | | 6 | M6 | 5 mm Allen wrench |
| **525-690 V** | | | | |
| 5042-5352[4)] | | 19 | M10 bolt | 16 mm wrench |
| 5402-5602[5)] | | 19 | M10 bolt (compression lug) | 16 mm wrench |

1) Brake terminals: 3,0 Nm, Nut: M6
2) Brake and loadsharing: 14 Nm, M6 Allen screw
3) IP54 with RFI - Line terminals 6Nm, Screw: M6 - 5 mm Allen wrench
4) Loadsharing and brake terminals: 9,5 Nm; Bolt M8
5) Brake terminals: 9,5 Nm; Bolt M8.

## Electrical installation - external fan supply

Torque 0,5-0,6 Nm
Screwsize: M3




Available in 5122-5552, 380-500 V; 5042-5602, 525-690 V, 5032-5052, 200-240 V in all enclosure types.
Only for IP54 units in the power range VLT 5016-5102, 380-500 V and VLT 5008-5027, 200-240 V AC. If the drive is supplied by the DC bus (loadsharing), the internal fans are not supplied with AC power. In this case they must be supplied with an external AC supply.

## Electrical installation - 24 Volt external DC supply

(Only extended versions. Typecode: PS, PB, PD, PF, DE, DX, EB, EX).

Torque: 0.5 - 0.6 Nm
Screw size: M3

| No. | Function |
|---|---|
| 35, 36 | 24 V external DC supply |

External 24 V DC supply can be used as low-voltage supply to the control card and any option cards installed. This enables full operation of the LCP (incl. parameter setting) without connection to mains. Please note that a warning of low voltage will be given when 24 V DC has been connected; however, there will be no tripping. If 24 V external DC supply is connected or switched on at the same time as the mains supply, a time of min. 200 msec. must be set in parameter 120 *Start delay.*
A pre-fuse of min. 6 Amp, slow-blow, can be fitted to protect the external 24 V DC supply. The power consumption is 15-50 W, depending on the load on the control card.

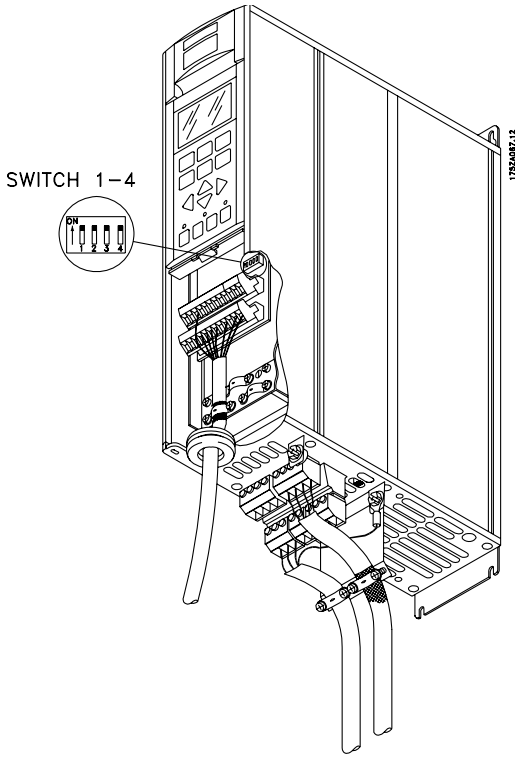
**NB!**
Use 24 V DC supply of type PELV to ensure correct galvanic isolation (type PELV) on the control terminals of the frequency converter.

## Electrical installation - relay outputs

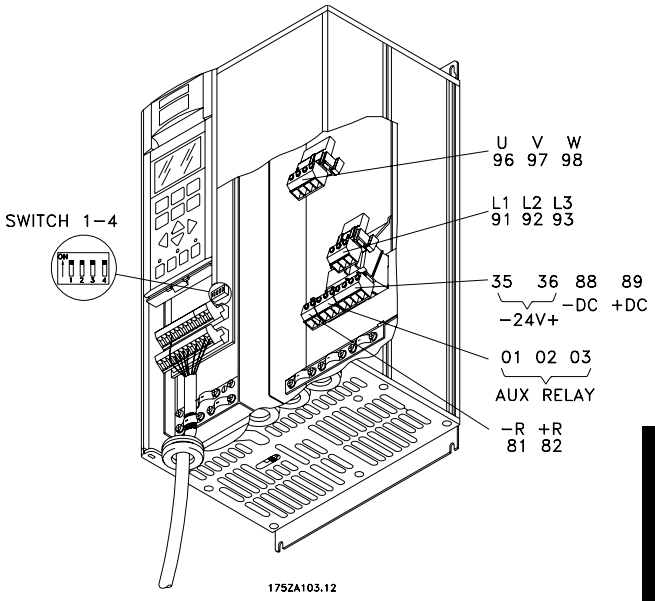
Torque: 0.5 - 0.6 Nm
Screw size: M3

| No. | Function |
|---|---|
| 1-3 | Relay output, 1+3 break, 1+2 make See parameter 323 of the Operating Instructions. See also *General technical data.* |
| 4, 5 | Relay output, 4+5 make See parameter 326 of the Operating Instructions. See also *General technical data.* |

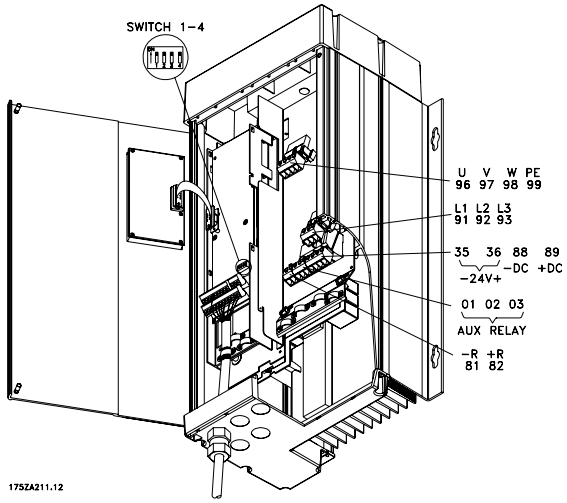
## ■ Electrical installation, power cables



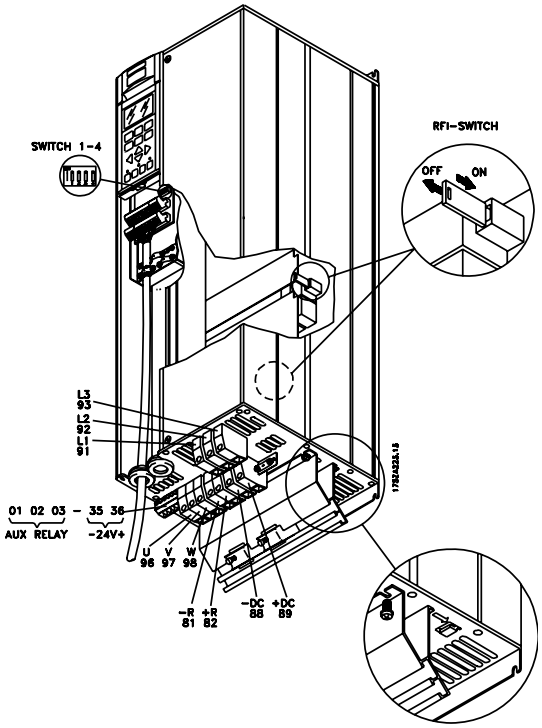

**Bookstyle**
**VLT 5001-5006 200-240 V**
**VLT 5001-5011 380-500 V**



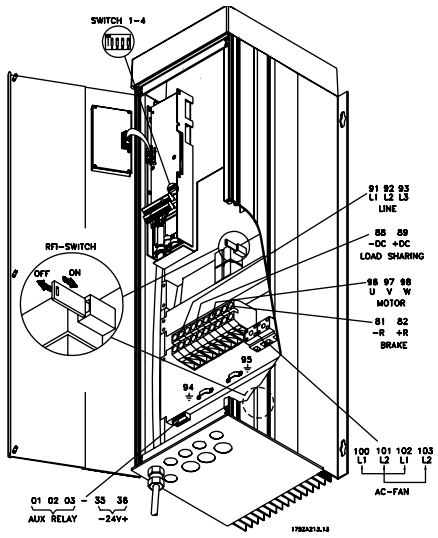

**Compact IP 20/Nema 1**



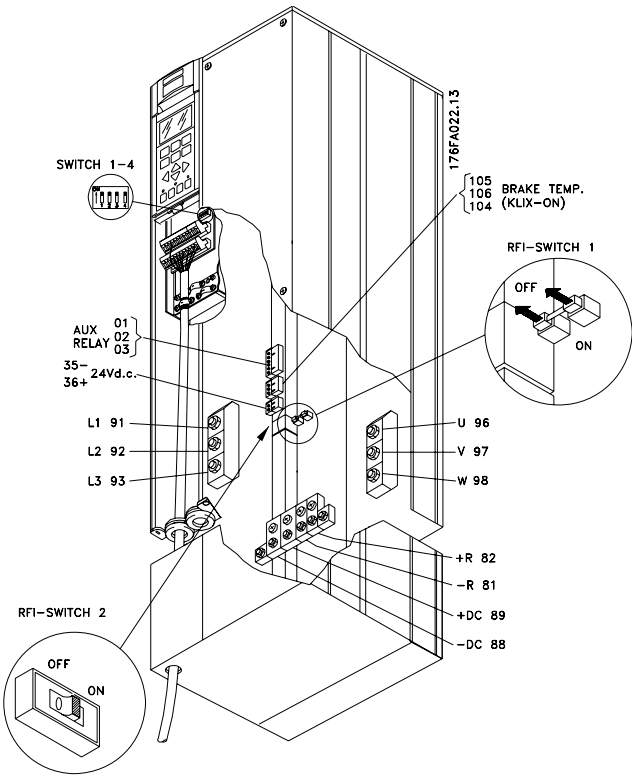

**Compact IP 54**
**VLT 5001-5006 200-240 V**
**VLT 5001-5011 380-500 V**
**VLT 5001-5011 525-600 V**



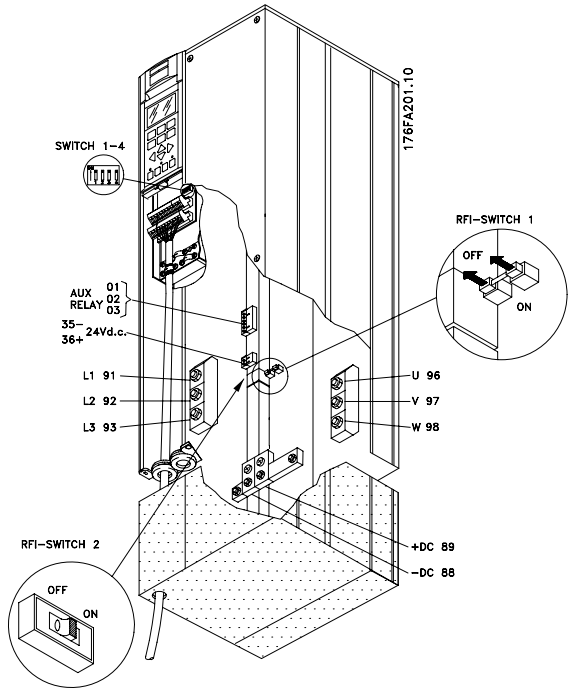

**Compact IP 20/Nema 1**
**VLT 5008-5027 200-240 V**
**VLT 5016-5062 380-500 V**
**VLT 5016-5062 525-600 V**

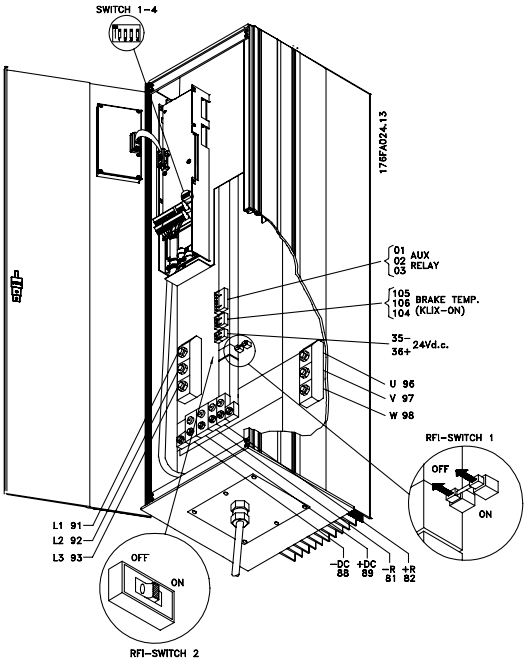



Compact IP 54
VLT 5008-5027 200-240 V
VLT 5016-5062 380-500 V

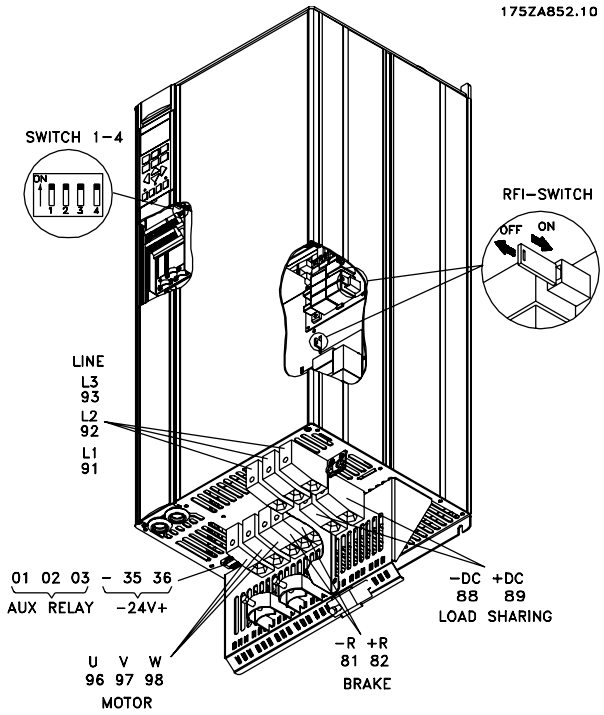



Compact IP 00/NEMA 1 (IP 20)
VLT 5032-5052 200-240 V

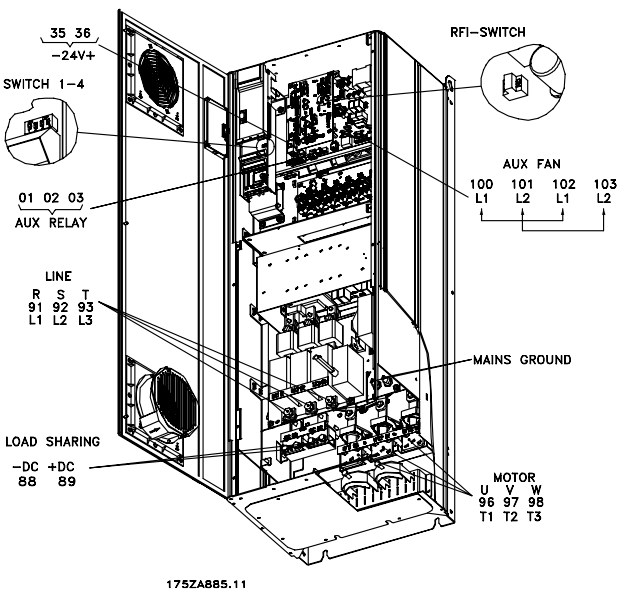


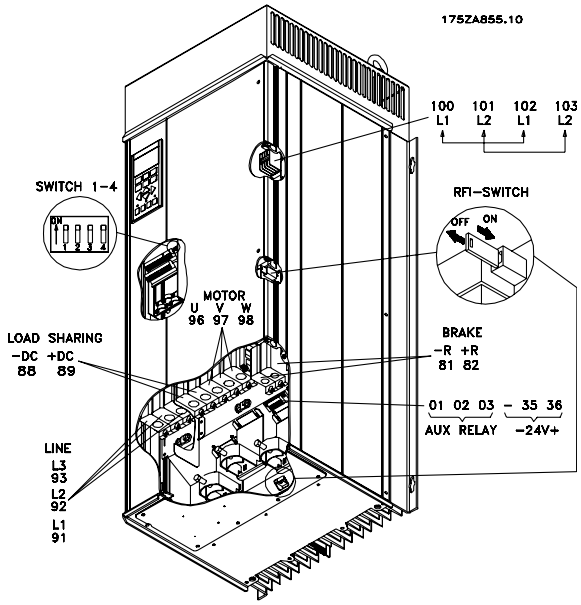

Compact IP 54
VLT 5032-5052 200-240 V



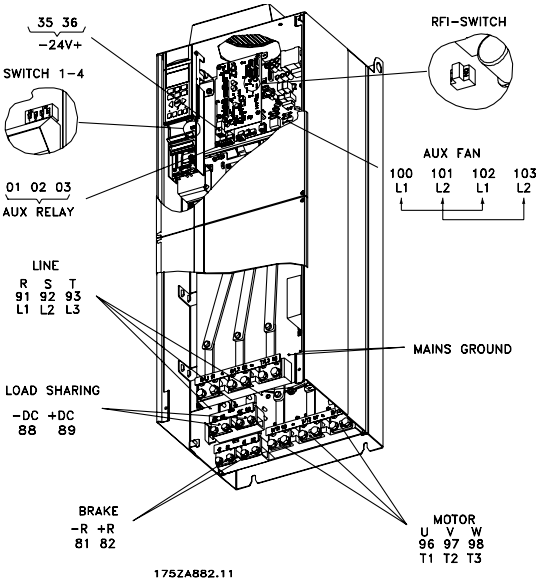

Compact IP 20
VLT 5072-5102 380-500 V



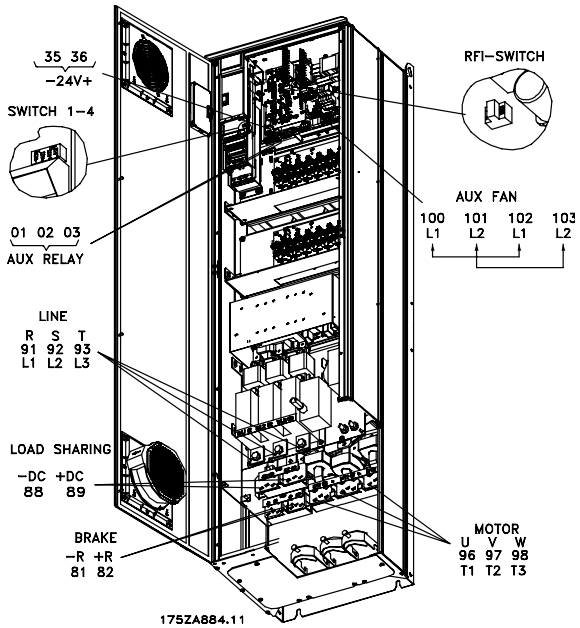

Compact IP 21/IP 54 with disconnect and fuse
VLT 5122-5152 380-500 V, VLT 5042-5152 525-690 V
NOTE: The RFI switch has no function in the 525-690 V drives



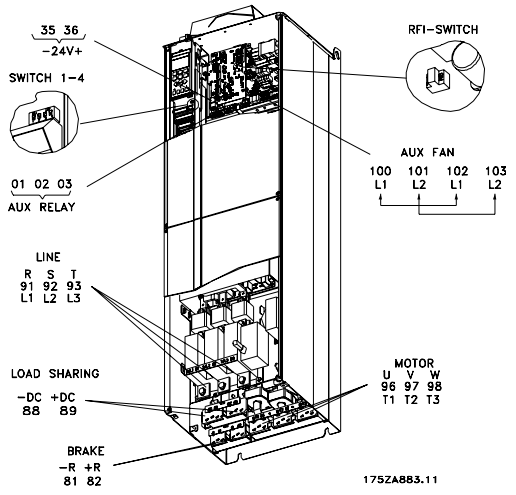

Compact IP 54
VLT 5072-5102 380-500 V



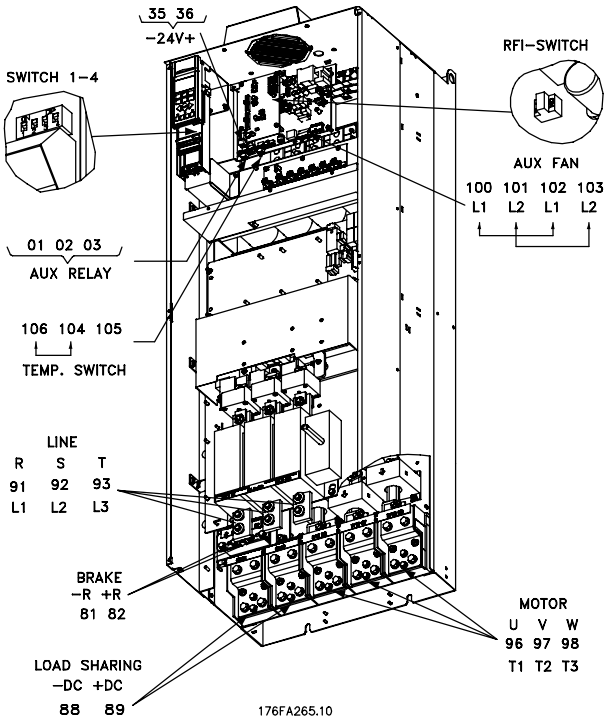

**Compact IP 00 without disconnect and fuse**
**VLT 5122-5152 380-500 V, VLT 5042-5152 525-690 V**



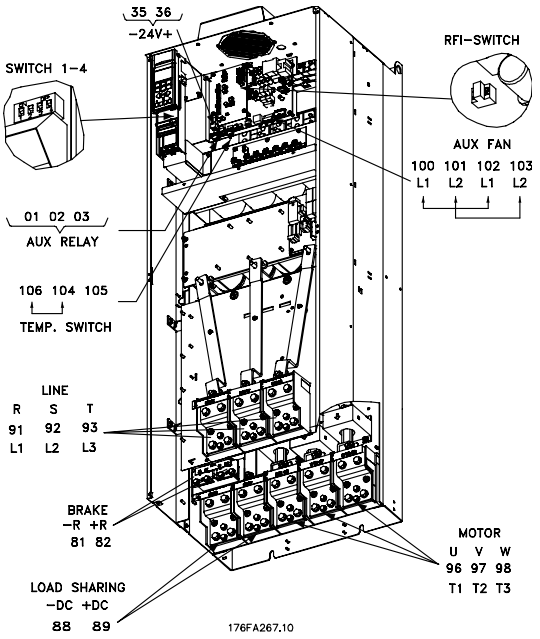

**Compact IP 21/IP 54 with disconnect and fuse**
**VLT 5202-5302 380-500 V, VLT 5202-5352 525-690 V**
Note: The RFI switch has no function in the 525-690 V drives



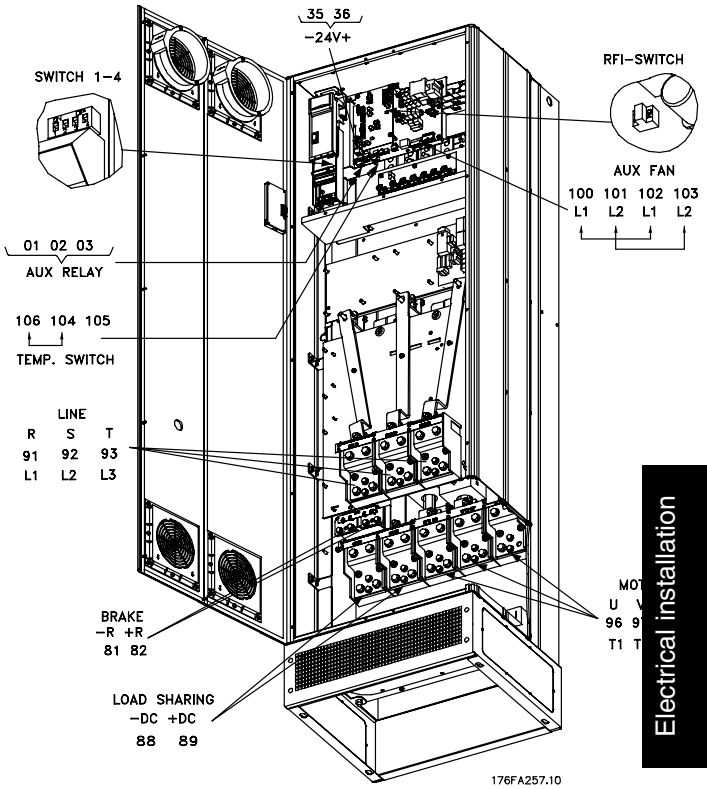

**Compact IP 00 with disconnect and fuse**
**VLT 5202-5302 380-500 V, VLT 5202-5352 525-690 V**



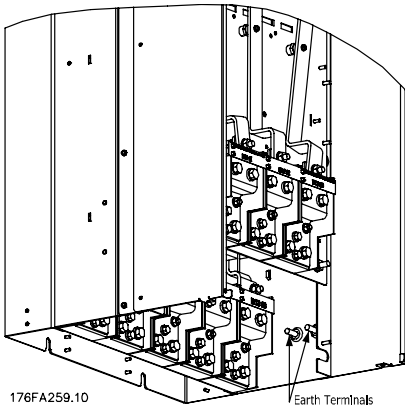

**Compact IP 00 with disconnect and fuse**
**VLT 5352-5552 380-500 V, VLT 5402-5602 525-690 V**



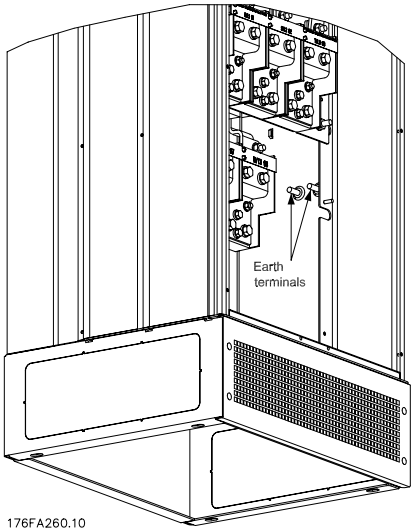

**Compact IP 00 without disconnect and fuse**
**VLT 5352-5552 380-500 V, VLT 5402-5602 525-690 V**
Note: The RFI switch has no function in the 525-690 V drives




**Compact IP 21/IP 54 without disconnect and fuse**
**VLT 5352-5552 380-500 V, VLT 5402-5602, 525-690 V**
Note: The RFI switch has no function in the 525-690 V drives.

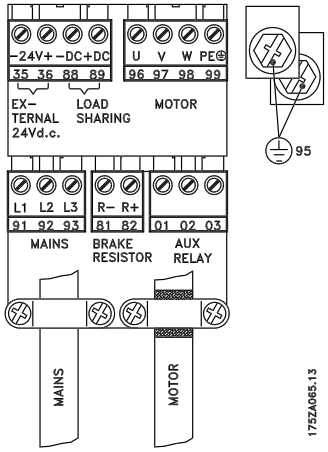



**Position of earth terminals, IP 00**

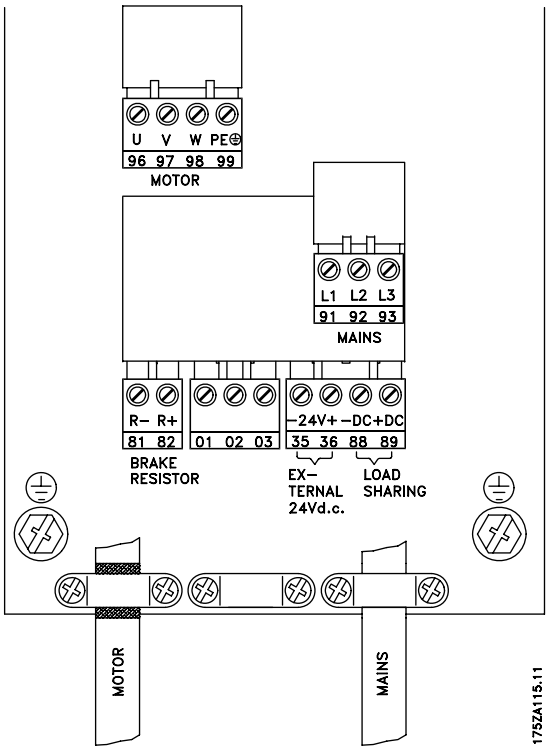



**Position of earth terminals, IP 21/ IP 54**

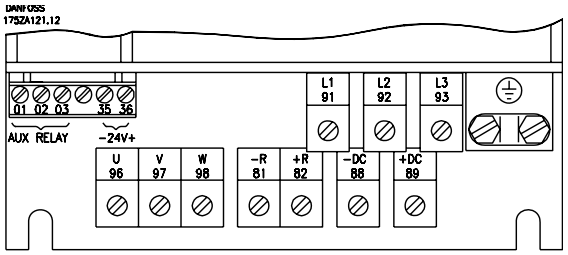
## ■ Electrical installation, power cables



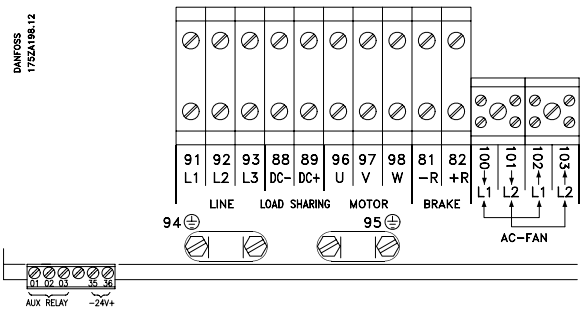

**Bookstyle**
**VLT 5001-5006 200-240 V**
**VLT 5001-5011 380-500 V**



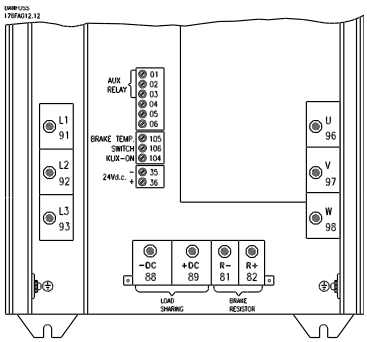

**Compact IP 54**
**VLT 5001-5006 200-240 V**
**VLT 5001-5011 380-500 V**
**VLT 5001-5011 525-600 V**



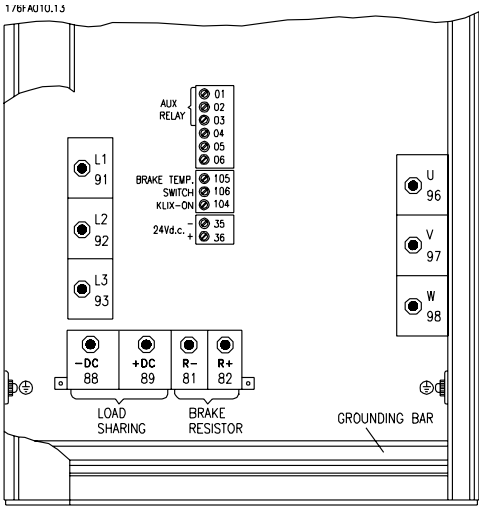

**Compact IP 00/NEMA 1**
**VLT 5008-5027 200-240 V**
**VLT 5016-5102 380-500 V**
**VLT 5016-5062 525-600 V**



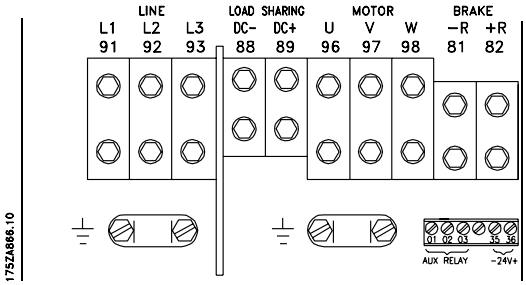

**Compact IP 54**
**VLT 5008-5027 200-240 V**
**VLT 5016-5062 380-500 V**




**Compact IP 00/NEMA 1 (IP20)**
**VLT 5032-5052 200-240 V**



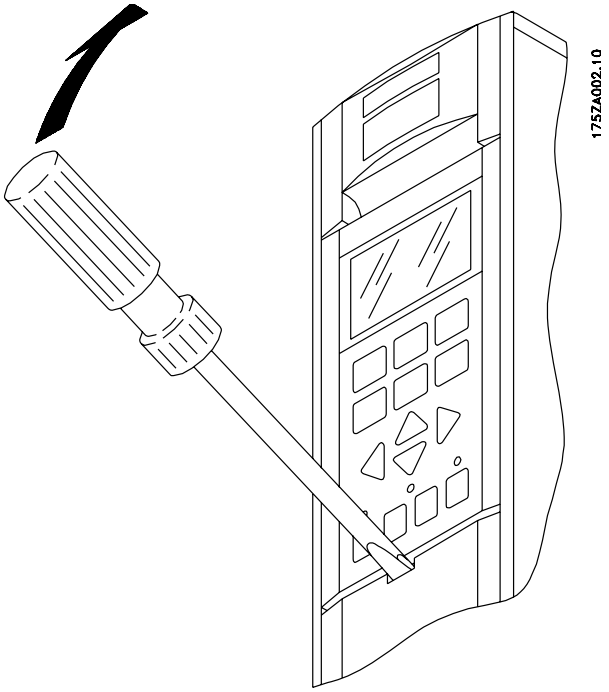

**Compact IP 54**
**VLT 5032-5052 200-240 V**




**Compact IP 54**
**VLT 5072-5102 380-500 V**

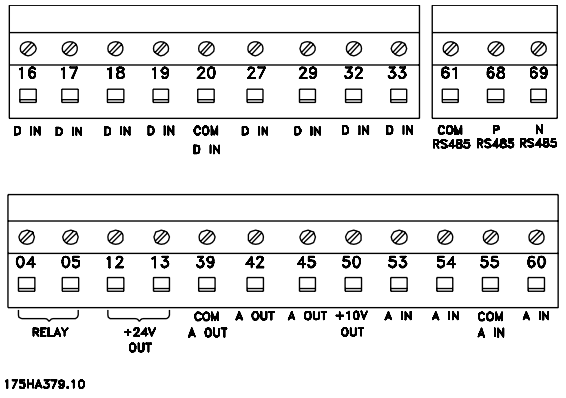
## Electrical installation - control cables

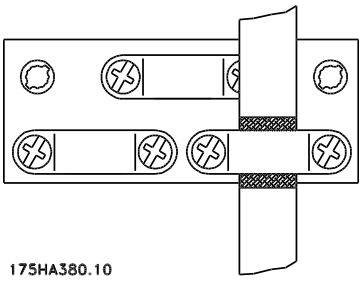
All terminals for the control cables are located under the protective cover of the frequency converter. The protective cover (see drawing) can be removed by means of a pointed object - a screwdriver or similar.




Once the protective cover has been removed, the actual EMC-correct installation can start. See drawings in the section, *EMC correct installation*.

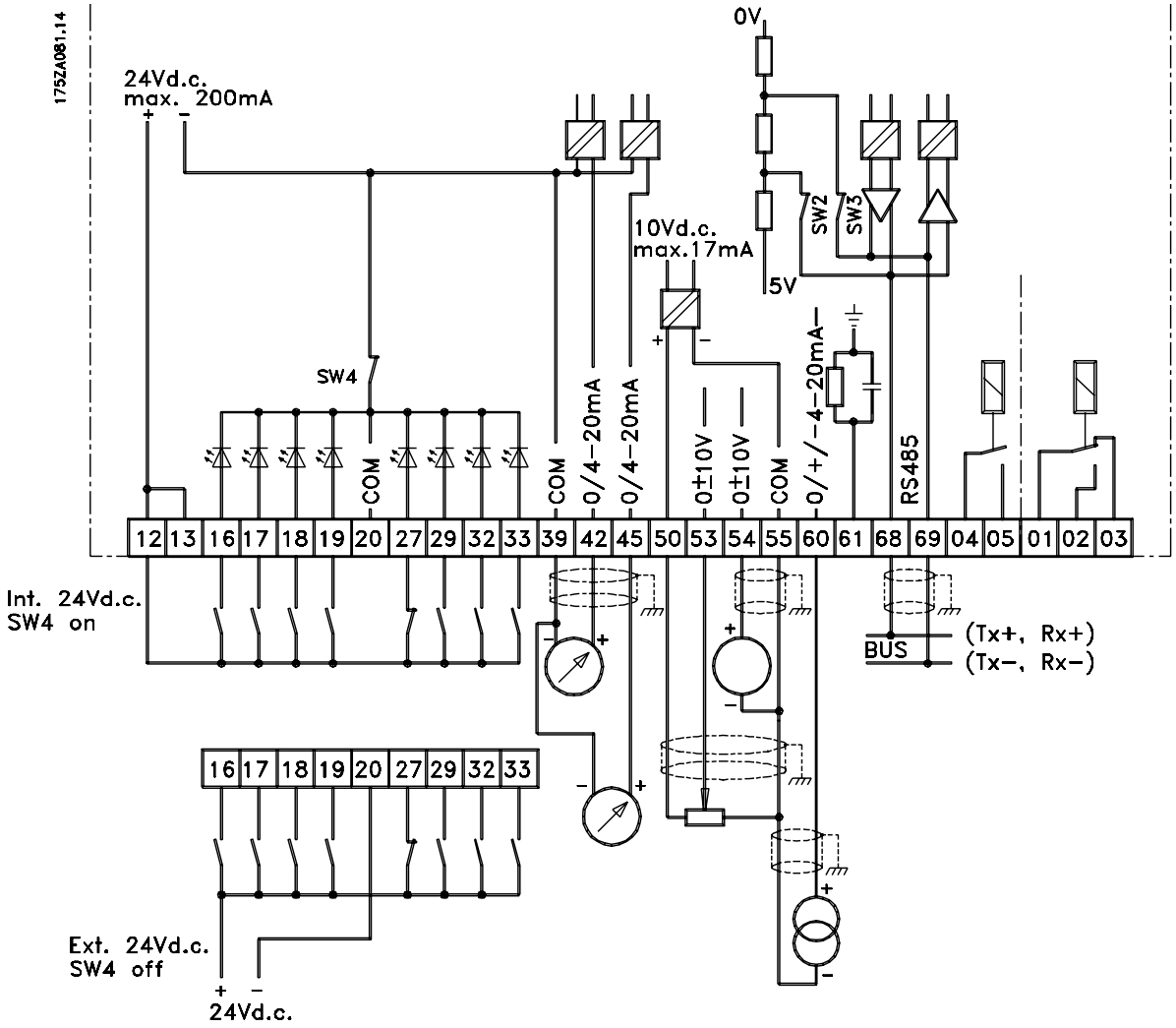
Tightening-up torque: 0.5-0.6 Nm
Screw size: M3
See section *earthing of braided screened/armoured control cables.*




| No. | Function |
|---|---|
| 12, 13 | Voltage supply to digital inputs For the 24 V DC to be usable for the digital inputs, switch 4 on the control card must be closed. position "ON". |
| 16-33 | Digital inputs/encoder inputs |
| 20 | Ground for digital inputs |
| 39 | Ground for analogue/digital outputs |
| 42, 45 | Analogue/digital outputs for indicating frequency, reference, current and torque |
| 50 | Supply voltage to potentiometer and thermistor 10 V DC |
| 53, 54 | Analogue reference input, voltage 0 - ±10 V |
| 55 | Ground for analogue reference inputs |
| 60 | Analogue reference input, current 0/4-20 mA |
| 61 | Termination for serial communication. See section *Bus connection.* This terminal is normally not to be used. |
| 68, 69 | RS 485 interface, serial communication. Where the frequency converter is connected to a bus, switches 2 and 3 (switches 1- 4) must be closed on the first and the last frequency converter. On the remaining frequency converters, switches 2 and 3 must be open. The factory setting is closed (position “ON”). |

## ■ Electrical installation - Signal Input/Output




Conversion of analogue inputs

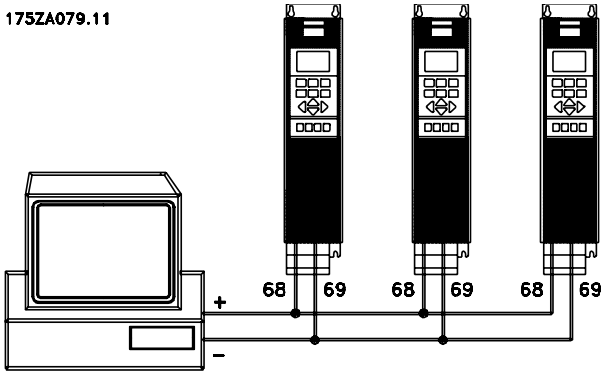
Current input signal to voltage input

| | |
|---|---|
| 0-20 mA ⇒ 0-10 V | Connect 510 ohms resistor between input terminal 53 and 55 and adjust minimum and maximum values in parameters 309, and 310 or 54 and 55 and adjust minimum and maximum values in parameters 312 and 313. |
| 4-20 mA ⇒ 2-10 V | |

## Electrical installation - bus connection

The serial bus connection in accordance with the RS 485 (2-conductor) norm is connected to terminals 68/69 of the frequency converter (signals P and N). Signal P is the positive potential (TX+,RX+), while signal N is the negative potential (TX-,RX-).

If more than one frequency converter is to be connected to a given master, use parallel connections.




In order to avoid potential equalizing currents in the screen, the cable screen can be earthed via terminal 61, which is connected to the frame via an RC-link.

Bus termination

The bus must be terminated by a resistor network at both ends. For this purpose, set switches 2 and 3 on the control card for "ON".

## DIP Switches 1-4

The dipswitch is located on the control card.
It is used for serial communication, terminals 68 and 69.
The switching position shown is the factory setting.




Switch 1 has no function.
Switches 2 and 3 are used for terminating an RS 485 interface, serial communication.
Switch 4 is used for separating the common potential for the internal 24 V DC supply from the common potential of the external 24 V DC supply.

**NB!**
Please note that when Switch 4 is in position "OFF", the external 24 V DC supply is galvanically isolated from the frequency converter.

## Electrical installation - EMC precautions

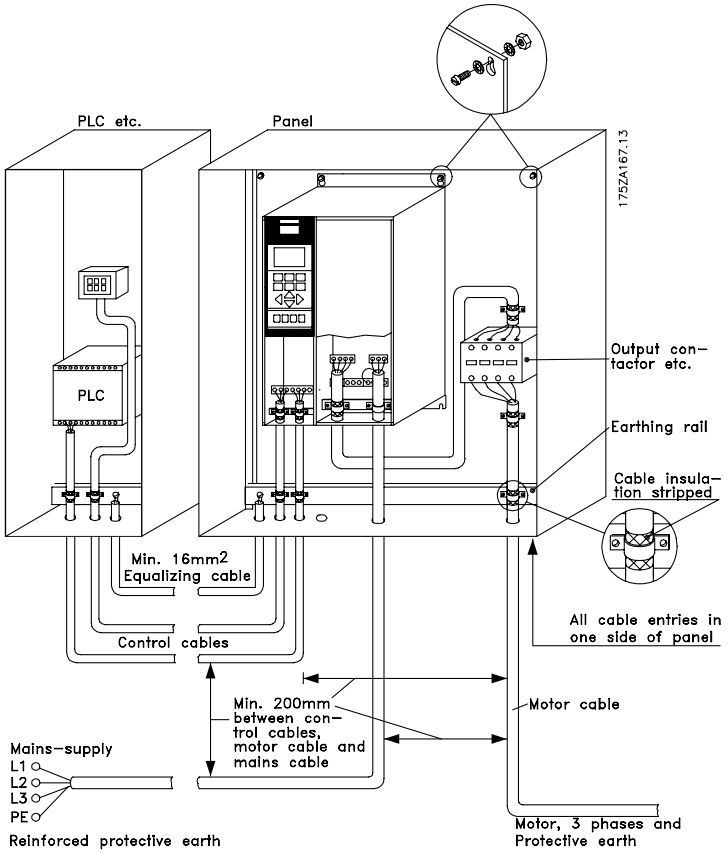
The following is a guideline to good engineering practice, when installing drives. Following these guidelines is advised, where compliance with EN 61000-6-3, EN 61000-6-4, EN 55011 or EN 61800-3 *First environment* is required. If the installation is in EN 61800-3 *Second environment,* i.e. industrial networks or in an installation that has its own transformer, it is acceptable to deviate from these guidelines. It is however not recommended. See also *CE labelling, Emission* and *EMC test results* under special conditions in the Design Guide for further details.

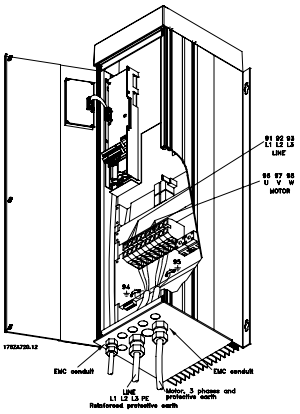
**Good engineering practice to ensure EMC-correct electrical installation:**

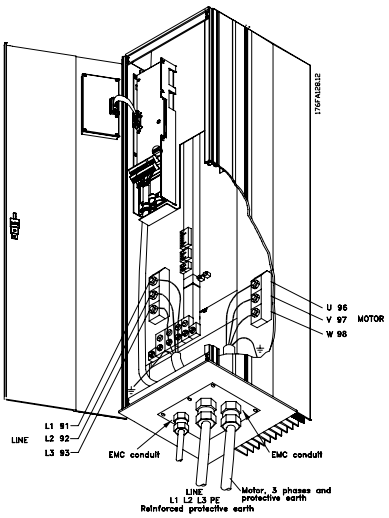
- Use only braided screened/armoured motor cables and braided screened/armoured control cables. The screen should provide a minimum coverage of 80%. The screen material must be metal, not limited to but typically copper, aluminium, steel or lead. There are no special requirements for the mains cable.
- 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 as well as for control cables. In some cases, it is not possible to connect the screen in both ends. In these cases, it is important to connect the screen at the frequency converter. See also *Earthing of braided screened/armoured 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 EMC cable glands instead.
- It is important to ensure good electrical contact between the mounting plate on which the frequency converter is installed and the metal chassis of the frequency converter. However, this does not apply to IP 54 units as they are designed for wall-mounting and VLT 5122-5552 380-500 V, 5042-5602 525-690 V and VLT 5032-5052 200-240 V in IP20/ NEMA 1 enclosure and IP 54/NEMA 12 enclosure.
- Use starwashers and galvanically conductive installation plates to secure good electrical connections for IP00 and IP20 installations.
- Avoid using unscreened/unarmoured motor or control cables inside cabinets housing the drive(s), whenever this can be avoided.
- An uninterrupted high frequency connection between the frequency converter and the motor units is required for IP54 units.

The illustration shows an example of an EMC-correct electrical installation of an IP 20 frequency converter; the frequency converter has been fitted in an installation cabinet with an output contactor and connected to a PLC, which in this example is installed in a separate cabinet. In IP 54 units and VLT 5032-5052, 200-240 V in IP20/IP21/NEMA 1 enclosure screened cables are connected by using EMC conduits to ensure proper EMC performance. See illustration. Other ways of making the installation may have as good an EMC performance, provided the above guide lines to engineering practice are followed.

Please note, that when the installation is not carried through according to the guideline as well as when unscreened cables and control wires are used, some emission requirements are not complied with, although the immunity requirements are fulfilled. See the section *EMC test results* in the Design Guide for further details.



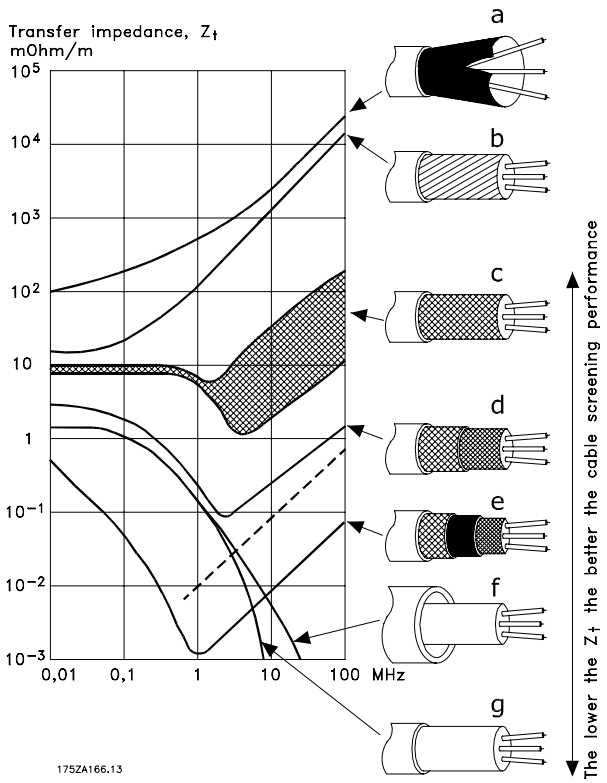




## ■ Use of emc-correct cables

Braided screened/armoured cables are recommended to optimise EMC immunity of the control cables and the EMC emission from the motor cables.

The ability of a cable to reduce the in- and outgoing radiation of electric noise depends on the transfer impedance ($Z_T$). The screen of a cable is normally designed to reduce the transfer of electric noise; however, a screen with a lower transfer impedance ($Z_T$) value is more effective than a screen with a higher transfer impedance ($Z_T$).




Transfer impedance ($Z_T$) is rarely stated by cable manufacturers, but it is often possible to estimate transfer impedance ($Z_T$) by assessing the physical design of the cable.

Transfer impedance ($Z_T$) can be assessed on the basis of the following factors:

- The conductibility of the screen material.
- The contact resistance between the individual screen conductors.
- The screen coverage, i.e. the physical area of the cable covered by the screen - often stated as a percentage value.
- Screen type, i.e. braided or twisted pattern.

Aluminium-clad with copper wire.

Twisted copper wire or armoured steel wire cable.

Single-layer braided copper wire with varying percentage screen coverage.
This is the typical Danfoss reference cable.

Double-layer braided copper wire.

Twin layer of braided copper wire with a magnetic, screened/ armoured intermediate layer.

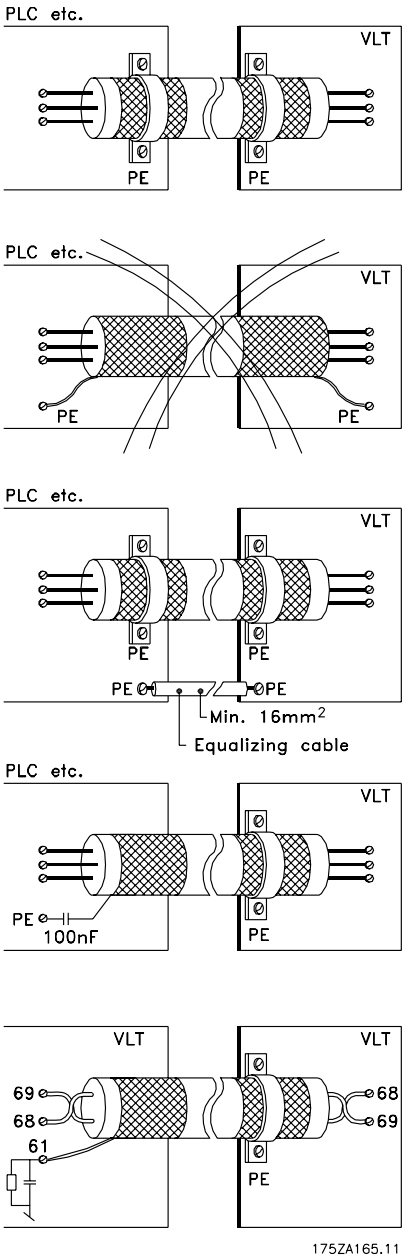
Cable that runs in copper tube or steel tube.

Lead cable with 1.1 mm wall thickness.

## Electrical installation - earthing of control cables

Generally speaking, control cables must be braided screened/armoured and the screen must be connected by means of a cable clampat both ends to the metal cabinet of the unit.

The drawing below indicates how correct earthing is carried out and what to be done if in doubt.




**Correct earthing**

Control cables and cables for serial communication must be fitted with cable clamps at both ends to ensure the best possible electrical contact

**Wrong** earthing

Do not use twisted cable ends (pigtails), since these increase the screen impedance at high frequencies.

**Protection with respect to earth potential between PLC and VLT**

If the earth potential between the frequency converter and the PLC (etc.) is different, electric noise may occur that will disturb the whole system. This problem can be solved by fitting an equalising cable, to be placed next to the control cable. Minimum cable cross-section: 16 $mm^2$.

**For 50/60 Hz earth loops**

If very long control cables are used, 50/60 Hz earth loops may occur. This problem can be solved by connecting one end of the screen to earth via a 100nF capacitor (keeping leads short).

**Cables for** serial communication

Low-frequency noise currents between two frequency converters can be eliminated by connecting one end of the screen to terminal 61. This terminal is connected to earth via an internal RC link. It is recommended to use twisted-pair cables to reduce the differential mode interference between the conductors.

## ■ RFI switch

Mains supply isolated from earth:

If the frequency converter is supplied from an isolated mains source (IT mains) or TT/TN-S mains with grounded leg, the RFI switch is recommended to be turned off (OFF)[1]. For further reference, see IEC 364-3. In case optimum EMC performance is needed, parallel motors are connected or the motor cable length is above 25 m, it is recommended to set the switch in ON position.

In OFF position, the internal RFI capacities (filter capacitors) between the chassis and the intermediate circuit are cut off to avoid damage to the intermediate circuit and to reduce the earth capacity currents (according to IEC 61800-3).

Please also refer to the application note *VLT on IT mains*, MN.90.CX.02. It is important to use isolation monitors that are capable for use together with power electronics (IEC 61557-8).

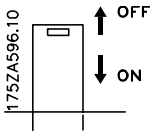
[1] Not possible with 5042-5602, 525-690 V units.

**NB!**
The RFI switch is not to be operated with mains connected to the unit. Check that the mains supply has been disconnected before operating the RFI switch.

**NB!**
Open RFI switch is only allowed at factory set switching frequencies.

**NB!**
The RFI switch connects the capacitors galvanically to earth.

The red switches are operated by means of e.g. a screwdriver. They are set in the OFF position when they are pulled out and in ON position when they are pushed in. Factory setting is ON.




Mains supply connected to earth:

The RFI switch must be in ON position in order for the frequency converter to comply with the EMC standard.

Position of RFI switches




**Bookstyle IP 20**
**VLT 5001 - 5006 200 - 240 V**
**VLT 5001 - 5011 380 - 500 V**



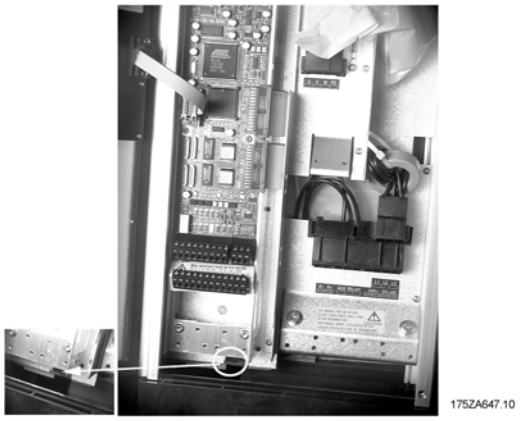

**Compact IP 20/NEMA 1**
**VLT 5001 - 5006 200 - 240 V**
**VLT 5001 - 5011 380 - 500 V**
**VLT 5001 - 5011 525 - 600 V**




**Compact IP 20/NEMA 1**
**VLT 5008 200 - 240 V**
**VLT 5016 - 5022 380 - 500 V**
**VLT 5016 - 5022 525 - 600 V**




**Compact IP 20/NEMA 1**
**VLT 5011 - 5016 200 - 240 V**
**VLT 5027 - 5032 380 - 500 V**
**VLT 5027 - 5032 525 - 600 V**




**Compact IP 54**
**VLT 5001 - 5006 200 - 240 V**
**VLT 5001 - 5011 380 - 500 V**




**Compact IP 20/NEMA 1**
**VLT 5022 - 5027 200 - 240 V**
**VLT 5042 - 5102 380 - 500 V**
**VLT 5042 - 5062 525 - 600 V**

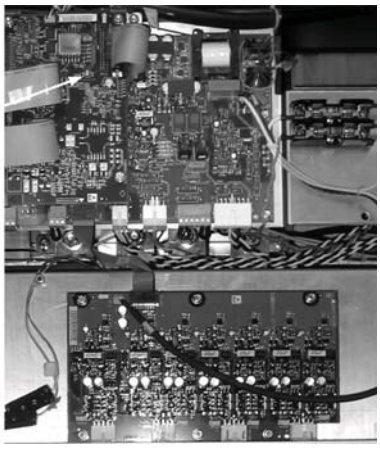



**Compact IP 54**
**VLT 5008 - 5011 200 - 240 V**
**VLT 5016 - 5027 380 - 500 V**

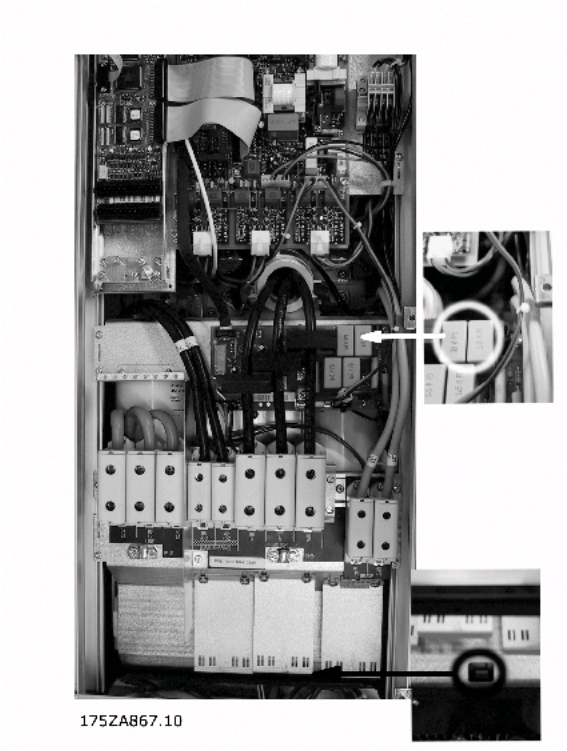



**Compact IP 54**
**VLT 5016 - 5027 200 - 240 V**
**VLT 5032 - 5062 380 - 500 V**



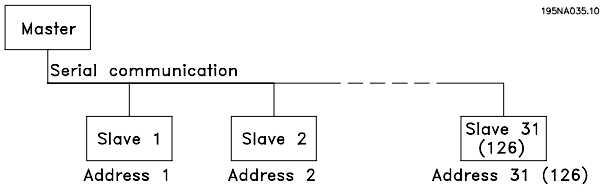
**All enclosure types**
**VLT 5122-5552 380 - 500 V**




**Compact IP 54**
**VLT 5072 - 5102 380 - 500 V**

## Serial communication

## Protocols




## Telegram Traffic

Control and response telegrams

Telegram traffic in a master-slave SYSTEM is controlled by the master. A maximum of 31 slaves can be connected to a master, unless repeaters are used. If repeaters are used, a maximum of 126 slaves can be connected to a master.

The master constantly sends telegrams addressed to the slaves and waits for response telegrams from them. The slave's response time is a maximum of 50 ms.

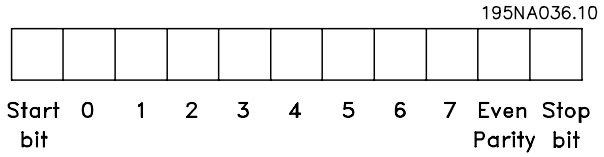
Only a slave that has received an error-free telegram, addressed to that slave can send a response telegram.

Broadcast

A master can send the same telegram simultaneously to all slaves connected to the bus. During this broadcast communication the slave does not send any response telegrams back to the master as to whether the telegram has been correctly received. Broadcast communication is set up in address format (ADR), see *Telegram structure*.

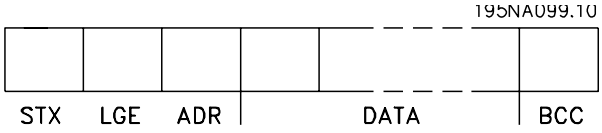
Content of a character (byte)

Each character transferred begins with a start bit. Then 8 data bits are transferred, corresponding to a byte. Each character is secured via a parity bit, which is set at "1" when it reaches parity (i.e. when there is an equal number of 1's in the 8 data bits and the parity bit in total). A character is completed by a stop bit, thus consisting of 11 bits in all.




## Telegram Structure

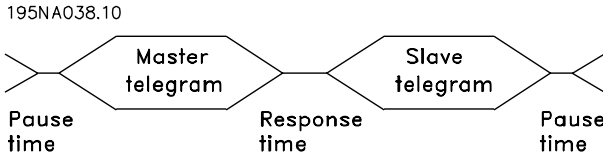
Each telegram begins with a start character (STX) = 02 Hex, followed by a byte that denotes the length of the telegram (LGE) and a byte that denotes the address of the frequency converter (ADR). Then follows a number of data bytes (variable, depending on the type of telegram). The telegram is completed by a data control byte (BCC).




Telegram timing

The communication speed between a master and a slave depends on the baud rate. The frequency converter's baud rate must be the same as the master's baud rate and be selected in parameter 501 *Baudrate*.

After a response telegram from the slave, there must be a pause of at least 2 characters (22 bits) before the master can send a new telegram. At a baud rate of 9600 baud there must be a pause of at least 2.3 ms. When the master has completed the telegram, the slave's response time back to the master will be a maximum of 20 ms, and there will be pause of at least 2 characters.

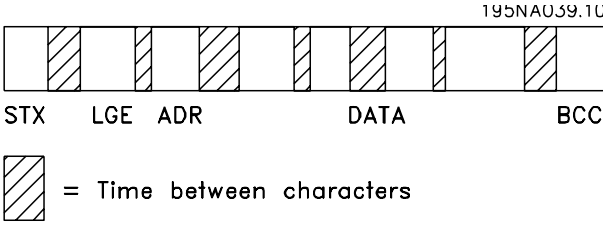



Pause time, min: 2 characters

Response time, min: 2 characters

Response time, max: 20 ms

The time between the individual characters in a telegram may not exceed 2 characters and the telegram must be completed within 1.5 x nominal telegram time. At a baud rate of 9600 baud and a telegram length of 16 bytes the telegram will be completed after 27.5 msec.




Telegram length (LGE)

The telegram length is the number of data bytes plus the address byte ADR plus the data control byte BCC.

The length of telegrams with 4 data bytes is:
LGE = 4 + 1 + 1 = 6 bytes
The length of telegrams with 12 data bytes is:
LGE = 12 + 1 + 1 = 14 bytes

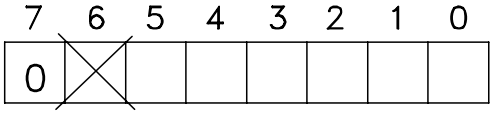
The length of telegrams containing texts is 10+n bytes. 10 represents the fixed characters, while the 'n' is variable (depending on the length of the text).

Frequency converter address (ADR)

Two different address formats are used, with the frequency converter's address range being either 1-31 or 1-126.

1. Address format 1-31

The byte for address range 1-31 has the following pro-




file: 195NA040.10

Bit 7 = 0 (address format 1-31 active)

Bit 6 is not used

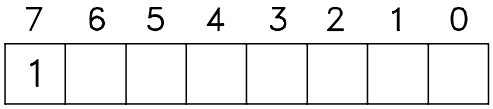
Bit 5 = 1: Broadcast, address bits (0-4) are not used

Bit 5 = 0: No Broadcast

Bit 0-4 = Frequency converter address 1-31

2. Address format 1-126

The byte for address range 1 - 126 has the following




profile: 195NA041.10

Bit 7 = 1 (address format 1-126 active)

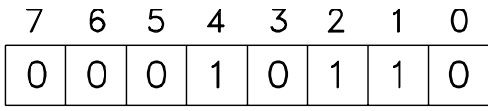
Bit 0-6 = Frequency converter address 1-126

Bit 0-6 = 0 Broadcast

The slave sends the address byte back unchanged in the response telegram to the master.

Example:

writing to frequency converter address 22 (16H) with address format 1-31:

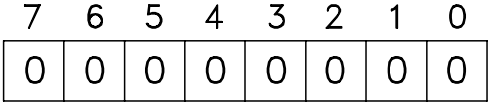



195NA042.10

Data control byte (BCC)

The data control byte is explained in this example:

Before the first byte in the telegram is received, the Calculated CheckSum (BCS) is 0.




195NA043.10

When the first byte (02H) has been received:

BCS = BCC EXOR “first byte”

(EXOR = exclusive-or)

| | |
|---|---|
| BCS | = 0 0 0 0 0 0 0 0 (00 H) |
| | EXOR |
| 1. byte | = 0 0 0 0 0 0 1 0 (02H) |
| BCC | = 0 0 0 0 0 0 1 0 (02H) |

Each subsequent byte gates with BCS EXOR and produces a new BCC, e.g.:

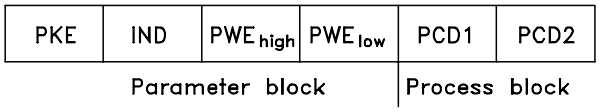
| | |
|---|---|
| BCS | = 0 0 0 0 0 0 1 0 (02H) |
| | EXOR |
| 2nd byte | = 1 1 0 1 0 1 1 0 (D6H) |
| BCC | = 1 1 0 1 0 1 0 0 (D4H) |

## ■ Data Character (byte)

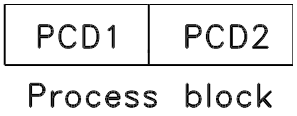
The structure of data blocks depends on the type of telegram. There are three types of telegram, and the type of telegram applies for both control telegrams (masterslave) and response telegrams (slavemaster). The three types of telegram are:

- Parameter block, used to transfer parameters between master and slave. The data block is made up of 12 bytes (6 words) and also contains the process block.

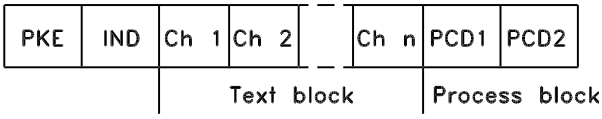
195NA044.10



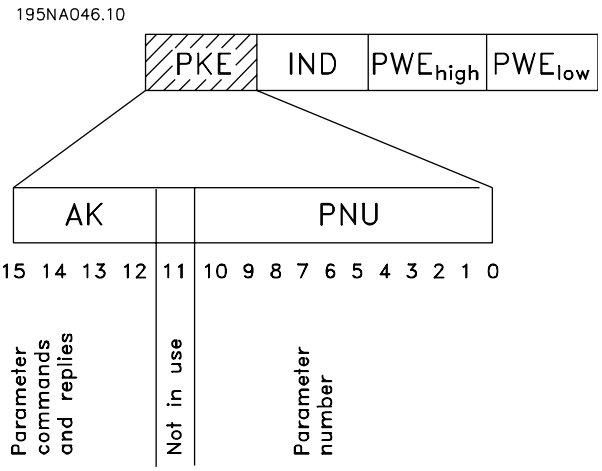

- The process block is made up of a data block of four bytes (2 words) and contains:
  - Control word and reference value
  - Status word and present output frequency (from slave to master)




- Text block, which is used to read or write texts via the data block.



Parameter commands and responses (AK)




Bits no. 12-15 are used to transfer parameter commands from master to slave and the slave's processed responses back to the master.

| Parameter commands masterslave | | | | |
|---|---|---|---|---|
| Bit no. | | | | |
| 15 | 14 | 13 | 12 | Parameter command |
| 0 | 0 | 0 | 0 | No command |
| 0 | 0 | 0 | 1 | Read parameter value |
| 0 | 0 | 1 | 0 | Write parameter value in RAM (word) |
| 0 | 0 | 1 | 1 | Write parameter value in RAM (double word) |
| 1 | 1 | 0 | 1 | Write parameter value in RAM and EEprom (double word) |
| 1 | 1 | 1 | 0 | Write parameter value in RAM and EEprom (word) |
| 1 | 1 | 1 | 1 | Read/write text |

| Response slavemaster | | | | |
|---|---|---|---|---|
| Bit no. | | | | Response |
| 15 | 14 | 13 | 12 | |
| 0 | 0 | 0 | 0 | No response |
| 0 | 0 | 0 | 1 | Parameter value transferred (word) |
| 0 | 0 | 1 | 0 | Parameter value transferred (double word) |
| 0 | 1 | 1 | 1 | Command cannot be performed |
| 1 | 1 | 1 | 1 | Text transferred |

If the command cannot be performed the slave sends this response: 0111 *Command cannot be performed* and gives the following fault report in the parameter value (PWE):

| Response (0111) | Fault report |
|---|---|
| 0 | The parameter number used does not exist |
| 1 | There is no write access to the defined parameter |
| 2 | Data value exceeds the parameter's limits |
| 3 | The sub index used does not exist |
| 4 | The parameter is not the array type |
| 5 | The data type does not match the defined parameter |
| 17 | Data change in the defined parameter is not possible in the frequency converter's present mode. Certain parameters can only be changed when the motor is turned off |
| 130 | There is no bus access to the defined parameter |
| 131 | Data change is not possible because factory Setup is selected |

Parameter number (PNU)

Bits no. 0-10 are used to transfer parameter numbers. The relevant parameter's function is defined in the parameter description in the section entitled *Programming*.

Index



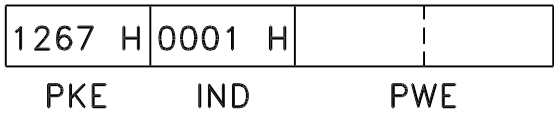

Index is used together with the parameter number to read/write-access parameters that have an index, e.g. parameter 615 *Error code* . The index is made up of 2 bytes, one lowbyte and one highbyte, but only the lowbyte is used as an index.

Example - Index:

The first error code (index [1]) in parameter 615 *Error code* must be read.

PKE = 1267 Hex (read parameter 615 *Error code*.)

IND = 0001 Hex - Index no. 1.




The frequency converter will respond in the parameter value block (PWE) with a fault code value from 1 - 99. See *Summary of Warnings and Alarms* to identify the fault code.

Parameter value (PWE)




The parameter value block consists of 2 words (4 bytes), and the value depends on the defined command (AK). If the master prompts for a parameter value, the PWE block does not contain a value.

If you wish the master to change a parameter value (write), the new value is written in the PWE block and sent to the slave.

If the slave responds to a parameter request (read command), the present parameter value in the PWE block is transferred and returned to the master.

If a parameter contains not a numerical value, but several data options, e.g. parameter 001 *Language* where [0] corresponds to *English* , and [3] corresponds to *Danish*, the data value is selected by entering the value in the PWE block. See *Example - Selecting a data value*.

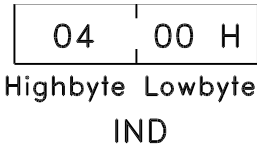
Via serial communication it is only possible to read parameters that have data type 9 (text string). Parameter 621 - 635 *Nameplate data* is data type 9. For example, in parameter 621 *Unit type* it is possible to read the unit size and mains voltage range.

When a text string is transferred (read) the length of the telegram is variable, as the texts are of different lengths. The telegram length is defined in the telegram's second byte, known as LGE.

To be able to read a text via the PWE block the parameter command (AK) must be set to 'F' Hex.

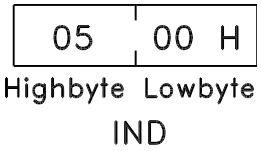
The index character is used to indicate whether it is a read or write command.

In a read command the index must have the following format:




Some frequency converters have parameters to which a text may be written. To be able to write a text via the PWE block the parameter command (AK) must be set to 'F' Hex.

For a write command the text must have the following format:




Data types supported by frequency converter:

| Data types | Description |
|---|---|
| 3 | Integer 16 |
| 4 | Integer 32 |
| 5 | Unsigned 8 |
| 6 | Unsigned 16 |
| 7 | Unsigned 32 |
| 9 | Text string |
| 10 | Byte string |
| 13 | Time difference |
| 33 | Reserved |
| 35 | Bit sequence |

Unsigned means that there is no operational sign in the telegram.

Example - Write a parameter value:

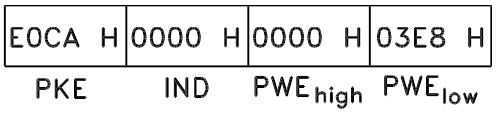
Parameter 202 *Output frequency high limit, $f_{MAX}$* to be changed to 100 Hz. The value must be recalled after a mains failure, so it is written in EEPROM.

PKE = E0CA Hex - Write for parameter 202 *Output frequency high limit, $f_{MAX}$*

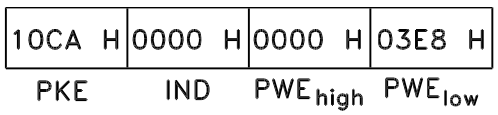
IND = 0000 Hex

$PWE_{HIGH}$ = 0000 Hex

$PWE_{LOW}$ = 03E8 Hex - Data value 1000, corresponding to 100 Hz, see conversion.




The response from the slave to the master will be:




Example - Selection of a data value:

You wish to select kg/hour [20] in parameter 416 *Process units*. The value must be recalled after a mains failure, so it is written in EEPROM.

PKE = E19F Hex - Write for parameter 416 *Process units*

IND = 0000 Hex

$PWE_{HIGH}$ = 0000 Hex

$PWE_{LOW}$ = 0014 Hex - Select data option kg/hour [20]

| E1AO H | 0000 H | 0000 H | 0014 H |
|---|---|---|---|
| PKE | IND | $PWE_{high}$ | $PWE_{low}$ |

The response from the slave to the master will be:

| 11AO H | 0000 H | 0000 H | 0014 H |
|---|---|---|---|
| PKE | IND | $PWE_{high}$ | $PWE_{low}$ |

*Example - Reading a parameter value:*
The value in parameter 207 *Ramp up time 1* is required.
The master sends the following request:

PKE = 10CF Hex - read parameter 207 *Ramp up time 1*

IND = 0000 Hex

$PWE_{HIGH}$ = 0000 Hex

$PWE_{LOW}$ = 0000 Hex

| 10CF H | 0000 H | 0000 H | 0000 H |
|---|---|---|---|
| PKE | IND | $PWE_{high}$ | $PWE_{low}$ |

If the value in parameter 207 *Ramp-up time 1* is 10 sec., the response from the slave to the master will be:

| 10CF H | 0000 H | 0000 H | 000A H |
|---|---|---|---|
| PKE | IND | $PWE_{high}$ | $PWE_{low}$ |

Conversion:
Under the section entitled *Factory Settings* the various attributes of each parameter are displayed. As a parameter value can only be transferred as a whole number, a conversion factor must be used to transfer decimals.

Example:
Parameter 201 *Output frequency, low limit* $f_{MIN}$ has a conversion factor of 0.1. If you wish to preset the minimum frequency to 10 Hz, the value 100 must be transferred, as a conversion factor of 0.1 means that the value transferred is multiplied by 0.1. The value 100 will thus be perceived as 10.0.

| Conversion table | |
|---|---|
| Conversion index | Conversion factor |
| 74 | 0.1 |
| 2 | 100 |
| 1 | 10 |
| 0 | 1 |
| -1 | 0.1 |
| -2 | 0.01 |
| -3 | 0.001 |
| -4 | 0.0001 |
| -5 | 0.00001 |

## ■ Process Words

The block of process words is divided into two blocks of 16 bits, which always occur in the defined sequence.

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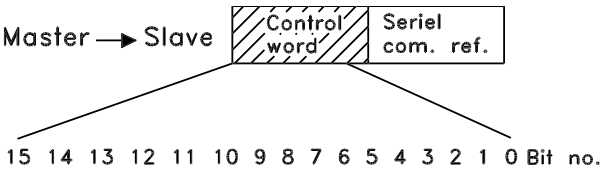
| PCD1 | PCD2 |
|---|---|

| | PCD 1 | PCD 2 |
|---|---|---|
| Control telegram (master ⇒ slave) | Control word | Reference-value |
| Control telegram (slave ⇒ master) | Status word | Present outp. frequency |

## ■ Control Word According to FC Profile

To select FC protocol in the control word, parameter 512 *Telegram Profile* must be set to *FC protocol* [1].

The control word is used to send commands from a master (e.g. a PC) to a slave (frequency converter).




| Bit | Bit = 0 | Bit =1 |
|---|---|---|
| 00 | Preset reference choise lsb | |
| 01 | Preset reference choise msb | |
| 02 | DC brake | Ramp |
| 03 | Coasting | Enable |
| 04 | Quick stop | Ramp |
| 05 | Freeze output | Ramp enable |
| 06 | Ramp stop | Start |
| 07 | No function | Reset |
| 08 | No function | Jog |
| 09 | Ramp 1 | Ramp 2 |
| 10 | Data not valid | Valid |
| 11 | No function | Relay 01 activated |
| 12 | No function | Relay 04 activated |
| 13 | Choice of Setup (lsb) | |
| 14 | Choice of Setup (msb) | |
| 15 | No function | Reversing |

Bit 00/01:
Bit 00/01 is used to select between the two pre-programmed references (parameters 215-218 *Preset reference*) according to the following table:

| Preset ref. | Parameter | Bit 01 | Bit 00 |
|---|---|---|---|
| 1 | 215 | 0 | 0 |
| 2 | 216 | 0 | 1 |
| 3 | 217 | 1 | 0 |
| 4 | 218 | 1 | 1 |

**NB!**
In parameter 508 *Selection of preset reference* a selection is made to define how Bit 00/01 gates with the corresponding function on the digital inputs.

Bit 02, DC brake:
Bit 02 = '0' leads to DC braking and stop. Braking current and duration are set in parameters 125 and 126.
Bit 02 = '1' leads to ramping.

Bit 03, Coasting stop:
Bit 03 = '0' causes the frequency converter to immediately "let go" of the motor (the output transistors are "shut off"), so that it coasts to a standstill.
Bit 03 = '1' causes the frequency converter to be able start the motor if the other starting conditions have been fulfilled. Note: In parameter 502 *Coasting stop* a selection is made to define how Bit 03 gates with the corresponding function on a digital input.

Bit 04, Quick stop:
Bit 04 = '0' causes a stop, in which the motor's speed is ramped down to stop via parameter 212 *Quick stop ramp-down time*.

Bit 05, Freeze output frequency:
Bit 05 = '0' causes the present output frequency (in Hz) to freeze. The frozen output frequency can now only be changed by means of the digital inputs programmed to *Speed up* and *Speed down*.

**NB!**
If *Freeze output* is active, the frequency converter cannot be stopped via Bit 06 *Start* or via a digital input. The frequency converter can only be stopped by the following:

- Bit 03 Coasting stop
- Bit 02 DC braking
- Digital input programmed to *DC braking*, *Coasting stop* or *Reset and coasting stop*.

Bit 06, Ramp stop/start:
Bit 06 = '0' causes a stop, in which the motor's speed is ramped down to stop via the selected *ramp down* parameter.
Bit 06 = '1' causes the frequency converter to be able to start the motor, if the other starting conditions have been fulfilled. Note: In parameter 505 *Start* a selection is made to define how Bit 06 Ramp stop/start gates with the corresponding function on a digital input.

Bit 07, Reset:
Bit 07 = '0' does not cause a reset.
Bit 07 = '1' causes the reset of a trip. Reset is activated on the signal's leading edge, i.e. when changing from logic '0' to logic '1'.

Bit 08, Jog:
Bit 08 = '1' causes the output frequency to be determined by parameter 213 *Jog frequency*.

Bit 09, Selection of ramp 1/2:
Bit 09 = “0” means that ramp 1 is active (parameters 207/208). Bit 09 = “1” means that ramp 2 (parameters 209/210) is active.

Bit 10, Data not valid/Data valid:
Is used to tell the frequency converter whether the control word is to be used or ignored. Bit 10 = '0' causes the control word to be ignored, Bit 10 = '1' causes the control word to be used. This function is relevant, because the control word is always contained in the telegram, regardless of which type of telegram is used, i.e. it is possible to turn off the control word if you do not wish to use it in connection with updating or reading parameters.

Bit 11, Relay 01:
Bit 11 = "0" Relay not activated.
Bit 11 = "1" Relay 01 activated, provided *Control word bit* has been chosen in parameter 323.

Bit 12, Relay 04:
Bit 12 = "0" Relay 04 has not been activated.
Bit 12 = "1" Relay 04 has been activated, provided *Control word bit* has been chosen in parameter 326.

Bit 13/14, Selection of Setup:
Bits 13 and 14 are used to choose from the four menu Setups according to the following table:

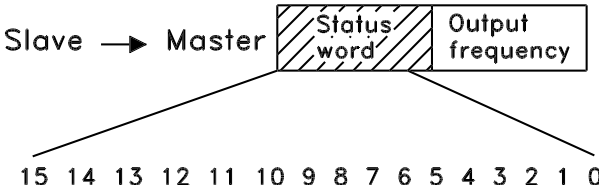
| Setup | Bit 14 | Bit 13 |
|---|---|---|
| 1 | 0 | 0 |
| 2 | 0 | 1 |
| 3 | 1 | 0 |
| 4 | 1 | 1 |

The function is only possible when *Multi-Setups* is selected in parameter 004 *Active Setup* .

Note: I parameter 507 *Selection of Setup* a selection is made to define how Bit 13/14 gates with the corresponding function on the digital inputs.

Bit 15 Reversing:
Bit 15 = '0' causes no reversing.
Bit 15 = '1' causes reversing.
Note: In the factory setting reversing is set to *digital* in parameter 506 *Reversing*. Bit 15 only causes reversing when either *Ser. communication*, *Logic or* or *Logic and* is selected.

## ■ Status Word according to FC Profile




The status word is used to inform the master (e.g. a PC) of the slave's (frequency converter) mode. Slave-Master.

| Bit | Bit = 0 | Bit =1 |
|---|---|---|
| 00 | Control not ready | Ready |
| 01 | VLT not ready | Ready |
| 02 | Coasting | Enable |
| 03 | No fault | Trip |
| 04 | Reserved | |
| 05 | Reserved | |
| 06 | Reserved | |
| 07 | No warning | Warning |
| 08 | Speed ref. | Speed = ref. |
| 09 | Local control | Bus control |
| 10 | Out of range | Frequency OK |
| 11 | Not running | Running |
| 12 | Brake test OK | Brake test failed |
| 13 | Voltage OK | Above limit |
| 14 | Torque OK | Above limit |
| 15 | | Thermal warning |

Bit 00, Control not ready/ready:
Bit 00 = '0' means that the frequency converter has tripped.
Bit 00 = '1' means that the frequency converter controls are ready, but that the power component is not necessarily receiving any power supply (in case of external 24 V supply to controls).

Bit 01, Drive ready:
Bit 01 = '1'. The frequency converter is ready for operation, but there is an active coasting command via the digital inputs or via serial communication.

Bit 02, Coasting stop:
Bit 02 = '0'. The frequency converter has released the motor.
Bit 02 = '1'. The frequency converter can start the motor when a start command is given.

Bit 03, No trip/trip:
Bit 03 = '0' means that the frequency converter is not in fault mode.
Bit 03 = '1' means that the frequency converter is tripped, and that it needs a reset signal for operation to be reestablished.

Bit 04, Not used:
Bit 04 is not used in the status word.

Bit 05, Not used:
Bit 05 is not used in the status word.

Bit 06, Not used:
Bit 06 is not used in the status word.

Bit 07, No warning/warning:
Bit 07 = '0' means that there are no warnings.
Bit 07 = '1' means that a warning has occurred.

Bit 08, Speed ref/speed = ref.:
Bit 08 = '0' means that the motor is running, but that the present speed is different from the preset speed reference. It might, for example, be the case while the speed is being ramped up/down during start/stop.
Bit 08 = '1' means that the motor's present speed is the same as the preset speed reference.

Bit 09, Local operation/serial communication control:
Bit 09 = '0' means that [STOP/RESET] is activated on the control unit, or that *Local control* in parameter 002 *Local/remote operation* is selected. It is not possible to control the frequency converter via serial communication.
Bit 09 = '1' means that it is possible to control the frequency converter via serial communication.

Bit 10, Outside frequency range:
Bit 10 = '0', if the output frequency has reached the value in parameter 201 *Output frequency low limit* or parameter 202 *Output frequency high limit*. Bit 10 = "1" means that the output frequency is within the defined limits.

Bit 11, Running/not running:
Bit 11 = '0' means that the motor is not running.
Bit 11 = '1' means that the frequency converter has a start signal or that the output frequency is greater than 0 Hz.

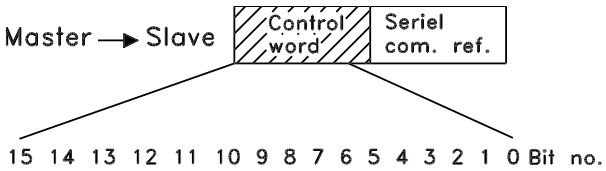
Bit 12, Brake test:
Bit 12 = '0' means brake test OK.
Bit 12 = '1' means brake test failed.

Bit 13, Voltage warning high/low:
Bit 13 = '0' means that there are no voltage warnings.
Bit 13 = '1' means that the DC voltage in the frequency converter's intermediate circuit is too low or too high.

Bit 14, Torque OK/ above limit:
Bit 14 = '0' means that the motor current is lower than the torque limit selected in parameter 221.
Bit 14 = '1' means that the the torque limit in parameter 221 has been exceeded.

Bit 15, Thermal warning:
Bit 15 = '0' means that there is no thermal warning.
Bit 15 = '1' means that the temperature limit has been exceeded either in the motor, in the frequency converter, or from a thermistor connected to an analog input.

### ■ Control word according to Fieldbus Profile




To select *Profidrive* in the control word, parameter 512 *Telegram Profile* must be set to *Profidrive* [0].

The control word is used to send commands from a master (e.g. a PC) to a slave (frequency converter). Master ⇒ Slave.

| Bit | Bit = 0 | Bit =1 |
|---|---|---|
| 00 | OFF 1 | ON 1 |
| 01 | OFF 2 | ON 2 |
| 02 | OFF 3 | ON 3 |
| 03 | Coasting stop | |
| 04 | Quick stop | |
| 05 | Freeze outp. freq. | |
| 06 | Ramp stop | Start |
| 07 | | Reset |
| 08 | | Bus jog 1 |
| 09 | | Bus jog 2 |
| 10 | Data not valid | Data not valid |
| 11 | | Slow down |
| 12 | | Catch-up |
| 13 | Select Setup (lsb) | |
| 14 | Select Setup (msb) | |
| 15 | | Reversing |

Bit 00-01-02, OFF1-2-3/ON1-2-3:
Bit 00-01-02 = '0' causes ramp stop, which uses the ramp time in parameters 207/208 or 209/210.
If *Relay 123* is selected in parameter 323 *Relay output*, the output relay will be activated when the output frequency is 0 Hz.
Bit 00-01-02 = '1' means that the frequency converter can start the motor if the other starting conditions are fulfilled.

Bit 03, Coasting stop:
See description under *Control word according to FC protocol.*

Bit 04, Quick stop:
See description under *Control word according to FC protocol.*

Bit 05, Freeze output frequency:
See description under *Control word according to FC protocol.*

Bit 06, Ramp stop/start:
See description under *Control word according to FC protocol.*

Bit 07, Reset:
See description under *Control word according to FC protocol.*

Bit 08, Jog 1:
Bit 08 = "1" means that the output frequency is determined by parameter 09 *Bus jog 1*.

Bit 09, Jog 2:
Bit 09 = "1" means that the output frequency is determined by parameter 510 *Bus jog 2*.

Bit 10, Data not valid/Data valid:
See description under *Control word according to FC protocol.*

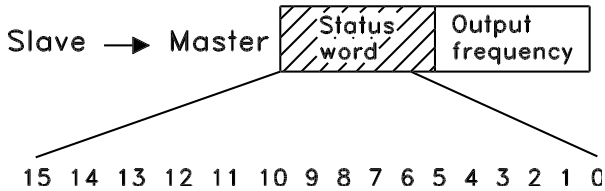
Bit 11, Slow-down:
Used to reduce the speed reference by the value in parameter 219 *Catch-up/slow-down reference*.
Bit 11 = '0' does not cause any change to the reference.
Bit 11 = '1' means that the reference is reduced.

Bit 12, Catch-up:
Used to increase the speed reference by the value in parameter 219 *Catch-up/slow-down reference*.
Bit 12 = '0' does not cause any change to the reference.
Bit 12 = '1' means that the reference is increased.
If both *Slow down* and *Catch-up* are activated (Bits 11 and 12 = "1"), slow down has the highest priority, i.e. that the speed reference is reduced.

Bit 13/14, Selection of Setup:
See description under *Control word according to FC protocol.*

Bit 15 Reversing:
See description under *Control word according to FC protocol.*

## ■ Status word according to Fieldbus Profile




The status word is used to inform the master (e.g. a PC) of the slave's (frequency converter) mode. Slave-Master.

| Bit | Bit = 0 | Bit =1 |
|---|---|---|
| 00 | | Control ready |
| 01 | | Drive ready |
| 02 | Coasting stop | |
| 03 | No trip | Trip |
| 04 | ON 2 | OFF 2 |
| 05 | ON 3 | OFF 3 |
| 06 | Start enable | Start disable |
| 07 | | Warning |
| 08 | Speed ref. | Speed =ref. |
| 09 | Local control | Ser. communi. |
| 10 | Outside frequency range | Frequency limit OK |
| 11 | | Motor running |
| 12 | | |
| 13 | | Voltage warn. |
| 14 | | Current limit |
| 15 | | Thermal warn. |

Bit 00, Control not ready/ready:
Bit 00 = '0' means that the Bit 00, 01 or 02 in the control word are '0' (OFF1, OFF2 or OFF3) or the frequency converter is not ready for operation.
Bit 00 = '1' means that the frequency converter is ready for operation.

Bit 01, Drive ready:
See description under *Status word according to FC protocol.*

Bit 02, Coasting stop:
Bit 02 = '0' means that Bits 00, 02 or 03 in the control word are "0" (OFF1, OFF3 or Coasting stop).
Bit 02 = '1' means that Bits 00, 01, 02 and 03 in the control word are "1", and that the frequency converter has not tripped.

Bit 03, No trip/trip:
See description under *Status word according to FC protocol.*

Bit 04, ON 2/OFF 2:
Bit 04 = '0' means that Bit 01 in the control word = '1'.
Bit 04 = '1' means that Bit 01 in the control word = '0'.

Bit 05, ON 3/OFF 3:
Bit 05 = '0' means that Bit 02 in the control word = '1'.
Bit 05 = '1' means that Bit 02 in the control word = '0'.

Bit 06, Start enable/start disable:
Bit 06 = '1' after reset of a trip, after activation of OFF2 or OFF3 and after connection of mains voltage. *Start disable* is reset by setting Bit 00 in the control word to '0', and Bit 01, 02 and 10 are set to '1'.

Bit 07, Warning:
See description under *Status word according to FC protocol.*

Bit 08, Speed:
See description under *Status word according to FC protocol.*

Bit 09, No warning/warning:
See description under *Status word according to FC protocol.*

Bit 10, Speed ref/speed = ref.:
See description under *Status word according to FC protocol.*

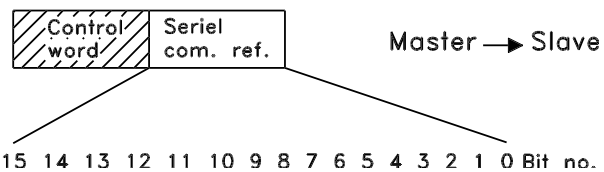
Bit 11, Running/not running:
See description under *Status word according to FC protocol.*

Bit 13, Voltage warning high/low:
See description under *Status word according to FC protocol.*

Bit 14, Current limit:
See description under *Status word according to FC protocol.*

Bit 15, Thermal warning:
See description under *Status word according to FC protocol.*

## ■ Serial communication reference

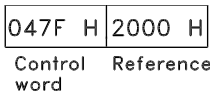



The serial communication reference is transferred to the frequency converter as a 16-bit word. The value is transferred in whole numbers 0 - ±32767 (±200%). 16384 (4000 Hex) corresponds to 100%.

The serial communication reference has the following format: 0-16384 (4000 Hex) ≅ 0-100% (Par. 204 *Minimum ref.* - Par. 205 *Maximum ref.*).

It is possible to change the direction of rotation via the serial reference. This is done by converting the binary reference value to 2' complement. See example.

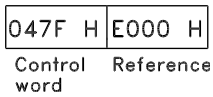
Example - Control word and serial communication ref.:
The frequency converter is to receive a start command and the reference is to be set to 50% (2000 Hex) of the reference range.
Control word = 047F Hex ⇒ Start command.
Reference = 2000 Hex ⇒ 50% reference.



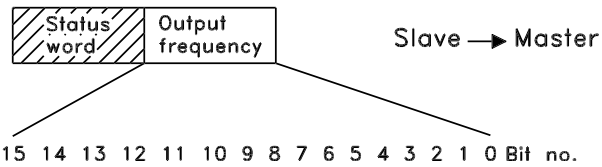

The frequency converter is to receive a start command and the reference is to be set to -50% (-2000 Hex) of the reference range.
The reference value is first converted to 1' complement, and then 1 is added binarily to obtain 2' complement:

| | |
|---|---|
| 2000 Hex | 0010 0000 0000 0000 0000 |
| 1' complement | 1101 1111 1111 1111 1111 |
| | + 1 |
| 2' complement | 1110 0000 0000 0000 0000 |

Control word = 047F Hex ⇒ Start command.
Reference = E000 Hex ⇒ -50% reference.




## ■ Present output frequency




The value of the frequency converter's present output frequency is transferred as a 16-bit word. The value is transferred as whole numbers 0 - ±32767 (±200%). 16384 (4000 Hex) corresponds to 100%.

Output frequency has the following format:
0-16384 (4000 Hex) • 0-100% (Par. 201 *Output frequency low limit* - Par. 202 *Output frequency high limit*).

Example - Status word and current output frequency:
The master receives a status message from the frequency converter that the current output frequency is 50% of the output frequency range.
Par. 201 *Output frequency low limit* = 0 Hz
Par. 202 *Output frequency high limit* = 50 Hz

Status word = 0F03 Hex.

Output frequency = 2000 Hex ⇒ 50% of the frequency range, corresponding to 25 Hz.

| 0F03 H | 2000 H |
|---|---|
| Status word | Output frequency |

## Telegram example

### Example 1: For Controlling the Drive and Reading Parameters

This telegram reads parameter 520, motor current.

Telegram to the frequency converter:

| stx | lge | adr | pke | | ind | | pwe, high | | pwe, low | | pcd 1 | | pcd 2 | | bcc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02 | 0E | 01 | 12 | 08 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 17 |

All numbers are in hex format.

The response from the frequency converter will correspond to the command above, but *pwe,high* and *pwe,low* will contain the actual value of parameter 520 multiplied by 100. This means that if the actual output current is 5.24 A then the value coming from the frequency converter is 524.

Response from the frequency converter:

| stx | lge | adr | pke | | ind | | pwe, high | | pwe, low | | pcd 1 | | pcd 2 | | bcc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02 | 0E | 01 | 22 | 08 | 00 | 00 | 00 | 00 | 02 | 0C | 06 | 07 | 00 | 00 | 28 |

All numbers are in hex format.

*Pcd 1* and *pcd 2* from example 2 can be used and added to the example which means that it will be possible to control the drive and read the current at the same time.

### Example 2: Only for Controlling the Drive

This telegram sets the control word to 047C Hex (Start command) with a speed reference of 2000 Hex (50%).



**NB!**
Parameter 512 is set to FC Drive.

Telegram to the frequency converter:

| stx | lge | adr | pcd 1 | | pcd 2 | | bcc |
|---|---|---|---|---|---|---|---|
| 02 | 06 | 04 | 04 | 7C | 20 | 00 | 58 |

All numbers are in hex format.

The response from the frequency converter gives information of the status of the drive when it received the command. By sending the command again, the *pcd1* will change to the new status.

Response from the frequency converter:

| stx | lge | adr | pcd 1 | | pcd 2 | | bcc |
|---|---|---|---|---|---|---|---|
| 02 | 06 | 04 | 06 | 07 | 00 | 00 | 01 |

All numbers are in hex format.

## Read parameter description elements

With *Read Parameter Description Elements* it is possible to read the characteristics of a parameter which could be eg. *Name, Default value, conversion*, etc.

The table below shows the available parameter description elements:

| Index | Description |
|---|---|
| 1 | Basic characteristics |
| 2 | No of elements (array types) |
| 4 | Unit of measure |
| 6 | Name |
| 7 | Lower limit |
| 8 | Upper limit |
| 20 | Default value |
| 21 | Additional characteristics |

In the following example *Read Parameter Description Elements* is chosen on parameter 001, *Language*, and the requested element is index 1 *Basic characteristics*.

**Basis characteristics (index 1):**

The Basic characteristics command is split up in two parts representing basic behaviour and datatype. The Basic characteristics return a 16 bit value to the master in $PWE_{LOW}$.

The basic behaviour indicates whether eg. text is available or the parameter is an array as single bit information in the high byte of $PWE_{LOW}$.

The datatype part indicates if a parameter is signed 16, unsigned 32 in the low byte of $PWE_{LOW}$.

PWE high basic behaviour:

| Bit | Description |
|---|---|
| 15 | Active parameter |
| 14 | Array |
| 13 | Parameter value can only be reset |
| 12 | Parameter value different from factory setting |
| 11 | Text available |
| 10 | Additional text available |
| 9 | Read only |
| 8 | Upper and lower limit not relevant |
| 0-7 | Data type |

*Active parameter* is only active when communicating through Profibus.
*Array* means that the parameter is an array.
If bit 13 is true, the parameter can only be reset, not written to.
If bit 12 is true, the parameter value is different from the factory setting.
Bit 11 indicates that text is available.

Bit 10 indicates that additional text is available. Eg. parameter 001, *Language*, contains text for index field 0, *English*, and for index field 1, *German*.
If bit 9 is true, the parameter value is read-only and cannot be changed.
If bit 8 is true, upper and lower limits of the parameter value are not relevant.

$PWE_{LOW}$ datatype

| Dec. | Datatype |
|---|---|
| 3 | Signed 16 |
| 4 | Signed 32 |
| 5 | Unsigned 8 |
| 6 | Unsigned 16 |
| 7 | Unsigned 32 |
| 9 | Visible string |
| 10 | Byte string |
| 13 | Time difference |
| 33 | Reserved |
| 35 | Bit sequence |

**Example**

In this example, the master reads the Basic characteristics of parameter 001, *Language*. The following telegram must be sent to the frequency converter:

| STX | LGE | ADR | PKE | IND | $PWE_{HIGH}$ | $PWE_{LOW}$ | PCD1 | PCD2 | BCC |
|---|---|---|---|---|---|---|---|---|---|
| 02 | 0E | 01 | 40 01 | 00 01 | 00 00 | 00 00 | XX XX | XX XX | XX |

STX = 02 Start byte
LGE = 0E Length of remaining telegram
ADR = Sends the frequency converter on Address 1, Danfoss format
PKE = 4001; 4 in the PKE field indicates a *Read Parameter Description* and 01 indicates parameter number 001, *Language*
IND = 0001; 1 indicates that *Basic characteristics* are required.

The response from the frequency converter will be:

| STX | LGE | ADR | PKE | IND | $PWE_{HIGH}$ | $PWE_{LOW}$ | PCD1 | PCD2 | BCC |
|---|---|---|---|---|---|---|---|---|---|
| 02 | 0E | 01 | 30 01 | 00 01 | 00 00 | 04 05 | XX XX | XX XX | XX |

PKE = 02 Start byte IND = 0001; 1 indicates that *Basic characteristics* are sent
$PWE_{LOW}$ = 0405; 04 indicates that Basic behaviour as bit 10 corresponds to *Additional text*. 05 is the datatype which corresponds to *Unsigned 8*.

**No of elements (index 2):**
This function indicates the Number of elements (array) of a parameter. The answer to the master will be in $PWE_{LOW}$.

**Conversion and Unit of measurement (index 4):**
The Conversion and unit of measurement command indicates the conversion of a parameter and the unit of measurement. The answer to the master will be in $PWE_{LOW}$. The conversion index will be in the high byte of $PWE_{LOW}$ and the unit index will be in the low byte of $PWE_{LOW}$. Note that conversion index is signed 8 and unit index is unsigned 8, see tables below.

The unit index defines the “Unit of measure”. The conversion index defines how the value should be scaled to get the basic representation of the “Unit of measure”. Basic representation is where conversion index equals “0”.

Example:
A parameter has a “unit index” of 9 and a “conversion index” of 2. The raw (integer) value read is 23. This means that we have a parameter of the unit “Power” and the raw value should be multiplied by 10 to the power of 2 and the unit is W. $23 \times 10^2 = 2300$ W

Table for conversion and unit of measurement

| Unit index | Unit of measure | Designation | Conversion index |
|---|---|---|---|
| 0 | Dimension less | | 0 |
| 4 | Time | s | 0 |
| | | h | 74 |
| 8 | Energy | j | 0 |
| | | kWh | |
| 9 | Power | W | 0 |
| | | kW | 3 |
| 11 | Speed | 1/s | 0 |
| | | 1/min (RPM) | 67 |
| 16 | Torque | Nm | 0 |
| 17 | Temperature | K | 0 |
| | | °C | 100 |
| 21 | Voltage | V | 0 |
| 22 | Current | A | 0 |
| 24 | Ratio | % | 0 |
| 27 | Relative change | % | 0 |
| 28 | Frequency | Hz | 0 |

| Conversion index | Conversion factor |
|---|---|
| 0 | 1 |
| 1 | 10 |
| 2 | 100 |
| 3 | 1000 |
| -1 | 0.1 |
| -2 | 0.01 |
| -3 | 0.001 |
| 67 | 1/60 |
| 74 | 3600 |
| 75 | 3600000 |
| 100 | 1 |

**Name (index 6):**
The Name returns a string value in ASCII format, containing the name of the parameter.

**Example:**

In this example the master reads the name of parameter 001, *Language*.

The following telegram must be sent to the frequency converter:

| STX | LGE | ADR | PKE | IND | $PWE_{HIGH}$ | $PWE_{LOW}$ | PCD1 | PCD2 | BCC |
|---|---|---|---|---|---|---|---|---|---|
| 02 | 0E | 01 | 40 01 | 00 06 | 00 00 | 00 00 | XX XX | XX XX | XX |

STX = 02 Start byte
LGE = 0E Length of remaining telegram
ADR = Sends the frequency converter on Address 1, Danfoss format
PKE = 4001; 4 in the PKE field indicates a *Read Parameter Description* and 01 indicates parameter number 001, *Language*
IND = 0006; 6 indicates that *Names* is required.

The response from the frequency converter will be:

| STX | LGE | ADR | PKE | IND | PVA | PCD1 | PCD2 | BCC |
|---|---|---|---|---|---|---|---|---|
| 02 | 12 | 01 | 30 01 | 00 06 | 4C41 4E47 5541 4745 | XXXX | XXXX | XX |

PKE = 3001; 3 are the response for *Name* and 01 indicates the parameter number 001, *Language*
IND = 00 06; 06 indicates that *Name* is sent.
PVA = 4C 41 4E 47 55 41 47 45
L A N G U A G E

The parameter value channel is now set up to a visible string which returns an ASCII character for each letter in the parameter name.

**Lower limit (index 7):**
The Lower limit returns the minimum allowed value of a parameter. The data type of Lower limit is the same as for the parameter itself.

**Upper limit (index 8):**
The Upper limit returns the maximum allowed value of a parameter. The data type of Upper limit is the same is for the parameter itself.

**Default value (index 20):**
The Default value returns the default value of a parameter, which is the factory setting. The data type of Default value is the same as for the parameter itself.

**Additional characteristics (index 21):**
The command can be used for getting some additional information on a parameter, eg. *No bus Access, Power Unit dependency, etc.*. The Additional characteristics returns an answer in $PWE_{LOW}$. If a bit is logic '1', the condition is true according to the table below:

| Bit | Description |
|---|---|
| 0 | Special Default Value |
| 1 | Special Upper Limit |
| 2 | Special Lower Limit |
| 7 | LCP Access LSB |
| 8 | LCP Access MSB |
| 9 | NoBusAccess |
| 10 | Std Bus Read Only |
| 11 | Profibus Read Only |
| 13 | ChangeRunning |
| 15 | PowerUnitDependency |

If one of bit 0 *Special Default Value*, bit 1 *Special Upper Limit* and bit 2 *Special Lower Limit* are true, the parameter has power unit depending values.

Bit 7 and 8 indicates the attributes for the LCP access, see table.

| Bit 8 | Bit 7 | Description |
|---|---|---|
| 0 | 0 | No access |
| 0 | 1 | Read only |
| 1 | 0 | Read/write |
| 1 | 1 | Write with lock |

Bit 9 indicates *No bus Access*.
Bits 10 and 11 indicates that this parameter can only be read over the bus.
If bit 13 is true, the parameter cannot be changed while running.
If bit 15 is true, the parameter is depending on the power unit.

### Additional Text

With this feature it is possible to read additional text if bit 10, *Additional text available*, is true in Basic characteristics.

To read out additional text, the parameter command (PKE) must be set to F hex, see *Databytes*.

The index-field is used for pointing out which element to be read. Valid indexes are in the range of 1 through 254. The index must be calculated after the following equation:
Index = Parameter value + 1 (see table below).

| Value | Index | Text |
|---|---|---|
| 0 | 1 | English |
| 1 | 2 | Deutsch |
| 2 | 3 | Français |
| 3 | 4 | Dansk |
| 4 | 5 | Espanol |
| 5 | 6 | Italiano |

**Example:**
In this example, the Master reads additional text in parameter 001, *Language*. The telegram is set up to read datavalue [0] which corresponds to *English*. The following telegram must be sent to the VLT frequency converter:

| STX | LGE | ADR | PKE | IND | $PWE_{HIGH}$ | $PWE_{LOW}$ | PCD1 | PCD2 | BCC |
|---|---|---|---|---|---|---|---|---|---|
| 02 | 0E | 01 | F0 01 | 00 01 | 00 00 | 00 00 | XX XX | XX XX | XX |

STX = 02 Start byte
LGE = 0E Length of the remaining telegram
ADR = Send the VLT frequency converter on Address 1, Danfoss format
PKE = F001; F in the PKE field indicates a *Read text* and 01 indicates parameter number 001, *Language*.
IND = 0001; 1 indicates that text to parameter value [0] is required

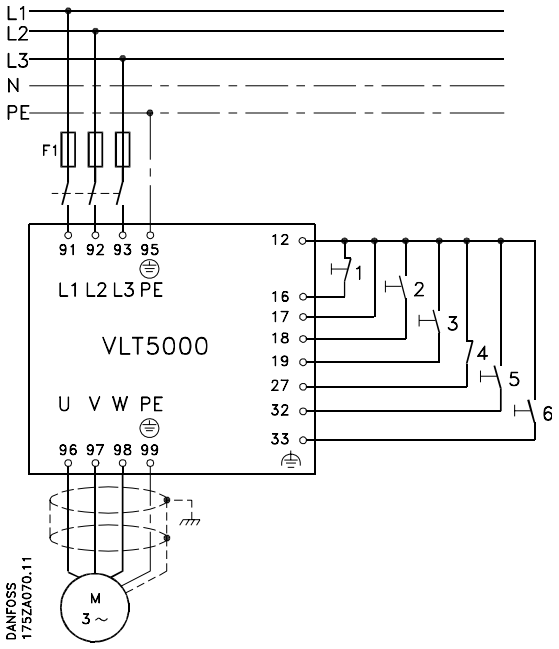
The response from the VLT frequency converter will be:

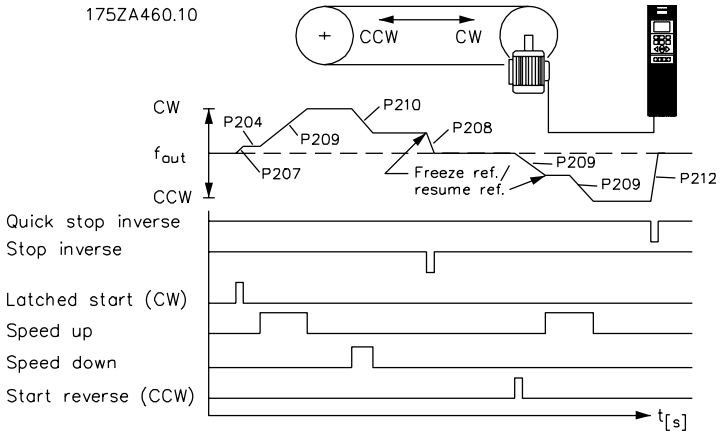
| STX | LGE | ADR | PKE | IND | PVA | PCD1 | PCD2 | BCC |
|---|---|---|---|---|---|---|---|---|
| 02 | 11 | 01 | F0 01 | 00 01 | 454E 474C 4953 48 | XX XX | XX XX | XX |

PKE = F001; F is the response for *Text transfer* and 01 indicates parameter number 001, *Language*.
IND = 0001; 1 indicates that index [1] is sent
PVA = 45 4E 47 4C 49 53 48
E N G L I S H

The parameter value channel is now set up to a visible string, which returns an ASCII character for each letter in the index name.

## ■ Conveyor belt




A conveyor belt is to be controlled using the digital inputs. Start the conveyor belt going to the right (clockwise) via switch 2 and to the left (anti-clockwise) via switch 3. The reference will increase as long as switch 5 (speed up) is active and will be reduced when switch 6 (speed down) is active.
A stop via the ramp can be activated by means of contact 1; quick-stop by means of switch 4.

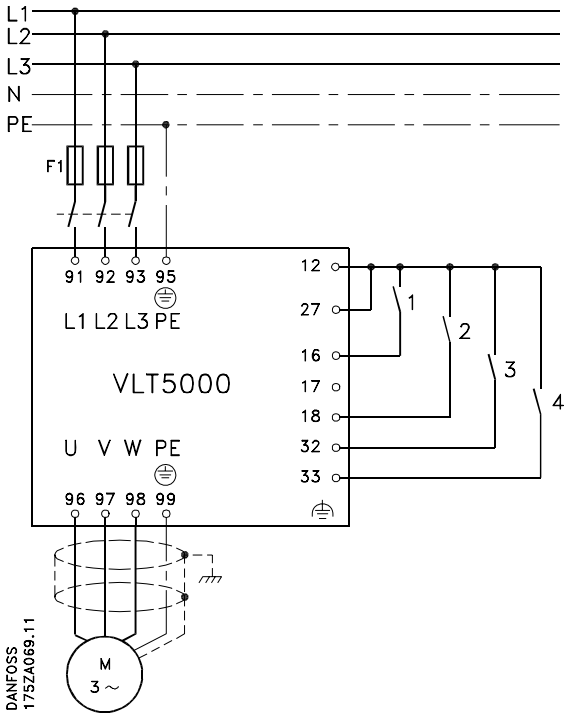
1. Pulse stop (inverse)
2. Pulse start to the right
3. Pulse start to the left
4. Quick-stop
5. Speed up
6. Speed down

The following must be programmed in order shown:

| Function: | Parameter: | Setting: | Data value: |
|---|---|---|---|
| Rotation, frequency/direction | 200 | Both directions, 0-132 Hz | [1] |
| Minimum reference | 204 | 3-10 (Hz) | |
| Ramp-up time 1 | 207 | 10-20 sec. | |
| Ramp-down time 1 | 208 | 10-20 sec. | |
| Ramp-up time 2 | 209 | 10-20 sec. | |
| Ramp-down time 2 | 210 | 10-20 sec. | |
| Digital input, term. 16 | 300 | Stop (inverse) | [2] |
| Digital input, term. 17 | 301 | Freeze reference | [7] |
| Digital input, term. 18 | 302 | Pulse start | [2] |
| Digital input, term. 19 | 303 | Start reversing | [2] |
| Digital input, term. 27 | 304 | Quick-stop (inverse) | [2] |

All other settings are based on factory settings. However, motor data (nameplate data) must always be entered in parameters 102-106.

## ■ Pump

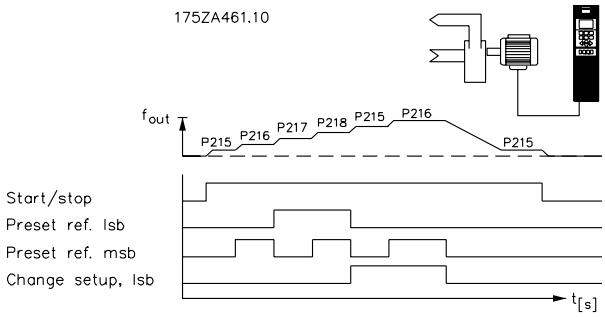



A pump is to run at six different speeds, determined by shifting between the preset references.

| Switch no.: | | | |
|---|---|---|---|
| 1 | 3 | 4 | |
| 0 | 0 | 0 | Preset reference 1 |
| 0 | 0 | 1 | Preset reference 2 |
| 0 | 1 | 0 | Preset reference 3 |
| 0 | 1 | 1 | Preset reference 4 |
| 1 | 0 | 0 | Preset reference 5 |
| 1 | 0 | 1 | Preset reference 6 |

When switch 1 is active, a setup change to setup 2 is made.
Start/stop by means of switch 2

1. Choice of Setup, lsb
2. Start/stop
3. Preset reference, lsb
4. Preset reference, msb

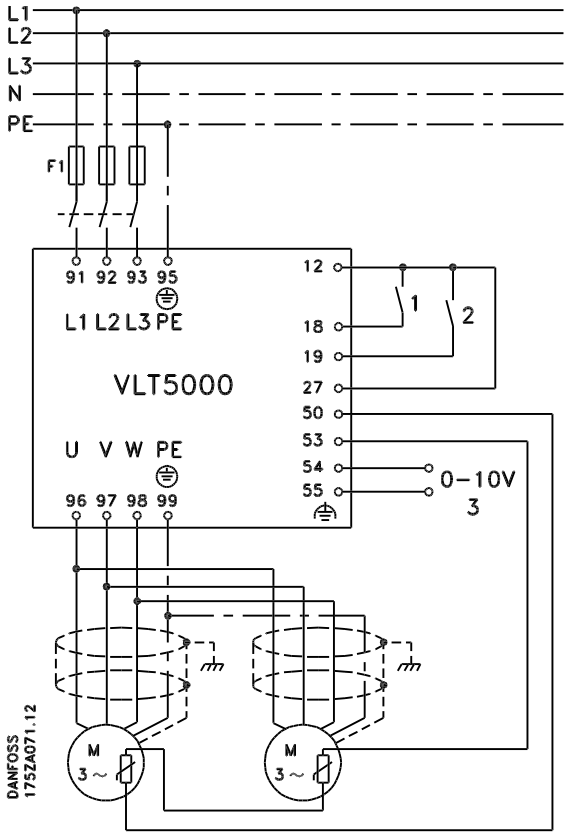


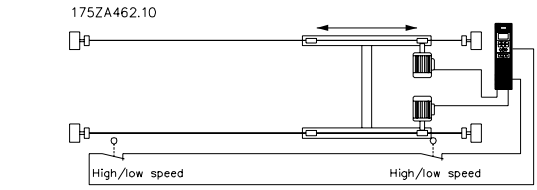

The following must be programmed in order shown:

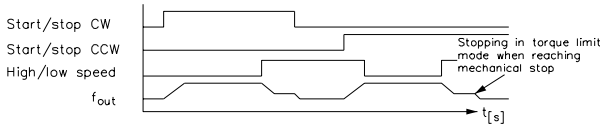
| Function: | Parameter: | Setting: | Data value: |
|---|---|---|---|
| Active Setup | 004 | Multi-Setup | [5] |
| Digital input, term. 16 | 300 | Choice of Setup, lsb | [10] |
| Digital input, term. 32 | 306 | Preset reference, lsb | [6] |
| Digital input, term. 33 | 307 | Preset reference, msb | [6] |
| Setup copying | 006 | Copy to Setup 2 from # | [2] |
| Edit Setup | 005 | Setup 1 | [1] |
| Maximum reference | 205 | 60 | |
| Preset reference 1 | 215 | 10% | |
| Preset reference 2 | 216 | 20% | |
| Preset reference 3 | 217 | 30% | |
| Preset reference 4 | 218 | 40% | |
| Edit Setup | 005 | Setup 2 | [2] |
| Maximum reference | 205 | 60 | |
| Preset reference 5 | 215 | 70% | |
| Preset reference 6 | 216 | 100% | |

All other settings are based on factory settings. However, motor data (nameplate data) must always be entered in parameters 102-106.

## ■ Gantry Crane




A portal gantry with two identical motors is controlled by an external 0-10 Volt signal. The direction of rotation (right or left) is controlled by means of switch 2, while start/stop is carried out using switch 1.

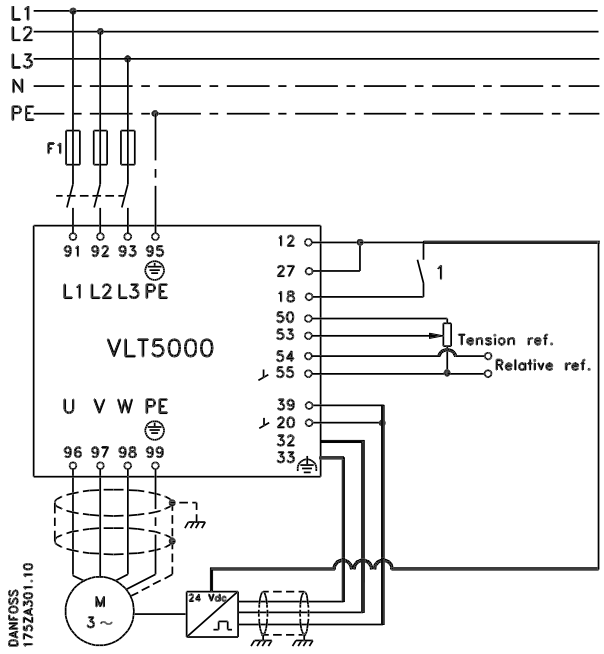
1. Start
2. Reversing
3. Speed reference signal

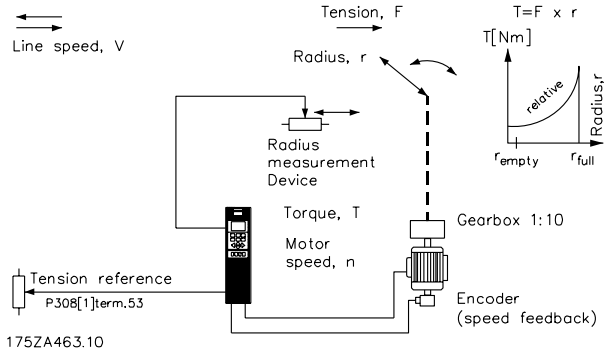
The following must be programmed in order shown:

| Function: | Parameter: | Setting: | Data value: |
|---|---|---|---|
| Torque characteristics | 101 | Normal/special motor character | [15] |
| Rotation, frequency/direction | 200 | Both directions, 0 - 132 Hz | [1] |
| Analogue input, term. 53 | 308 | Thermistor | [4] |
| Motor thermal protection | 128 | Thermistor warning/Thermistor trip | [1] or [2] |
| Analogue input, term. 54 | 311 | Reference | [1] |
| Terminal 18, digital input | 302 | Start | [1] |
| Terminal 27, digital input | 304 | Coasting stop inverse | [0] |
| Terminal 42, output | 319 | Torque limit and stop | [27] |

All other settings are based on factory settings. However, motor data (nameplate data) must always be entered in parameters 102-106.

## ■ Torque control, speed feedback




A winder winds material onto a roll or unwinds material from a roll at a constant tension.
A device measures the radius of the roll and adjusts the motor torque to ensure that the tension is constant. The measuring device must have a non-linear output signal.

The following must be programmed in order shown:

| Function: | Parameter: | Setting: | Data value: |
|---|---|---|---|
| Configuration | 100 | Torque control, speed feedback[5] | |
| Rotation, frequency/direction | 200 | Both directions, 0-132 Hz [1] | |
| Reference/feedback range | 203 | -Max. - +Max. | [1] |
| Minimum reference | 204 | Set to min. torque (Nm) | |
| Maximum reference | 205 | Set to max. torque (Nm) | |
| Reference function | 214 | Relative | [1] |
| Terminal 32, encoder input A | 306 | Encoder feedback, input A | [25] |
| Terminal 33, encoder input B | 307 | Encoder feedback, input B | [24] |
| Encoder feedback, pulses/rev. | 329 | Set to encoder pulses per rev. | |
| Terminal 53, analogue input | 308 | Reference | [1] |
| Terminal 54, analogue input | 311 | Relative reference | [4] |
| Speed PID lowpass filter | 421 | 10 msec. | |

## VLT 5000 controllers

VLT 5000 has three inbuilt controllers: one for speed control, one for process control and one for torque control.
Speed control and process control are in the form of a PID controller that requires a feedback to an input. Torque control is in the form of a PI controller that does not require a feedback, since the torque is calculated by the VLT frequency converter on the basis of the current measured.

Setting of speed and process controller
With respect to both PID controllers, there are a number of settings which are made in the same parameters; however, the choice of controller type will affect the choices to be made under the common parameters.
In parameter 100 *Configuration*, a choice is made of controller, *Speed control, closed loop* or *Process control, closed loop*.

Feedback signal:
A feedback range must be set for both controllers. This feedback range at the same time limits the possible reference range, which means that if the sum of all references is outside the feedback range, the reference will be limited to being within this range. The feedback range is set in the units that belong to the application (Hz, RPM, bar, °C, etc.). Setting is effected directly in a parameter for the individual input terminal, thereby deciding whether it should be used for feedback in connection with one of the controllers. Inputs that are not used can be disabled, which will ensure that they do not disturb control. If feedback has been selected on two terminals at the same time, these two signals will be added up.

Reference:
For both controllers, it is possible to set four preset references. These can be set between -100% and +100% of the maximum reference or the sum of the external references. External references can be analogue signals, pulse signals and/or serial communication.
All references will be added and the sum will be the reference for subsequent regulation.
It is possible to limit the reference range to a range smaller than the feedback range. This can be an advantage if it is to be avoided that an unintended change of an external reference makes the sum of references move too far away from the optimum reference. As with the feedback range, the reference range is set in the units that belong to the applications in question.

Speed control:
This PID control has been optimized for use in applications with a need to maintain a given motor speed.

The parameters that are specific to the speed controller are parameters 417 to 421.

PID for process control:
This PID control has been optimized for process control. This controller does not have a feedforward facility, but a number of special features that are relevant to process control.

There is a choice of whether normal control is required, in which the speed is increased in the case of an error between the reference and the feedback, or whether inverse control is to be applied, in which the speed is reduced in the case of an error.
There is also a choice of whether the integrator is to continue integrating in the case of an error, even if VLT 5000 is at the minimum/maximum frequency or at the current limit. If VLT 5000 is in such a borderline situation, any attempt to change the motor speed will be restricted by this limit. The integrator comes from the works preset to stop integrating. Integration will be adjusted to a gain that corresponds to the given output frequency.
In certain applications, it is either difficult or completely impossible to measure such a factor as the level. In such cases, it can be necessary to allow the integrator to continue integrating on the fault, even if the motor speed cannot be changed. This will make the integrator work as a kind of counter, i.e. once the feedback indicates that the speed must be changed in a direction away from the borderline situation, the integration will give this change a delay that depends on the time for which the integrator has overcompensated for the previous error.

Furthermore, it is possible to program a starting frequency in which VLT 5000 will wait without activating the controller until this frequency has been reached. This makes it possible, for example, to quickly build up the necessary static pressure in a pumping SYSTEM.

PID process control, continued:
The Proportional gain, Integration time and Differentiation time of the process controller are set in individual parameters, and the setting ranges are adapted to process control requirements.

As in speed control, it is possible to limit the influence of the differentiator in relation to swift changes in the error between the reference and the feedback signal.

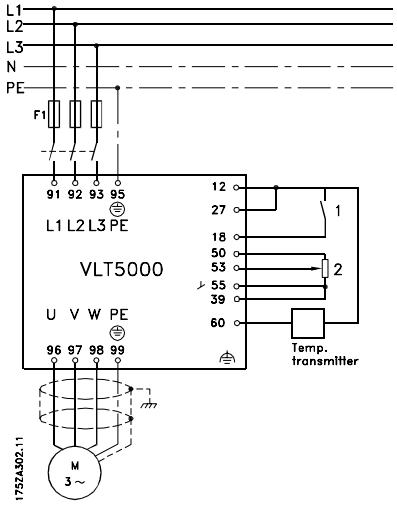
Also available is a lowpass filter for the process controller. This can be set to remove a much greater share of the feedback signal oscillations than the lowpass filter of the speed controller does. This is because most fans and pump applications react relatively slowly, which is why it can be an advantage to feed as stable a signal as possible to the process controller.

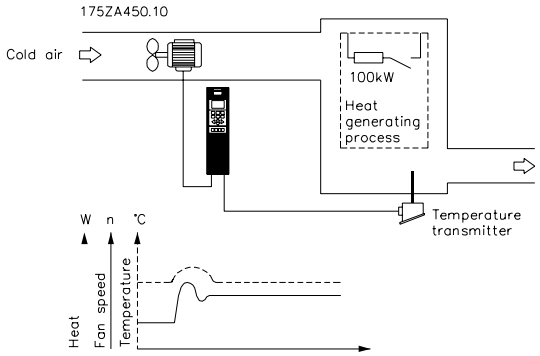
The parameters that are specific to the process controller are parameters 437 to 444.

Setting of torque controller (open loop):
This control is selected if *Torque control, open loop* has been selected in 100 *Configuration*.
When this mode has been selected, the reference will use the Nm unit.
Control is in the form of a PI that requires no feedback, since the torque is calculated on the basis of the current measurement of VLT 5000. The proportional gain is set as a percentage in parameter 433 *Torque proportional gain* and the integration time is set in parameter 434 *Torque integration time*. However, both these have been set at the works and normally require no modification.

## ■ PID for process control

The following is an example of a process controller used in a ventilation system.




In a ventilation system, the temperature is to be settable from - 5 - 35°C with a potentiometer of 0-10 Volt. The set temperature must be kept constant, for which purpose the integrated process controller is to be used.

The control is of the inverse type, which means that when the temperature increases, the ventilation speed is increased as well, so as to generate more air. When the temperature drops, the speed is reduced.

The transmitter used is a temperature sensor with a working range of -10-40°C, 4-20 mA.

Min./Max. speed 10/50 Hz.

**NB!**
The example shows a two-wire transmitter.

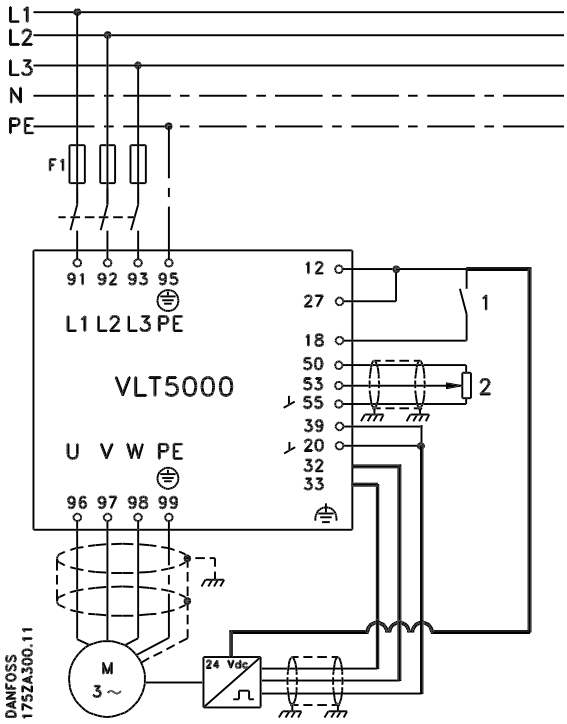
1. Start/Stop
2. Temperature reference -5-35°C, 0-10 V (set-point)
3. Temperature transmitter -10-40°C, 4-20 mA (feedback).

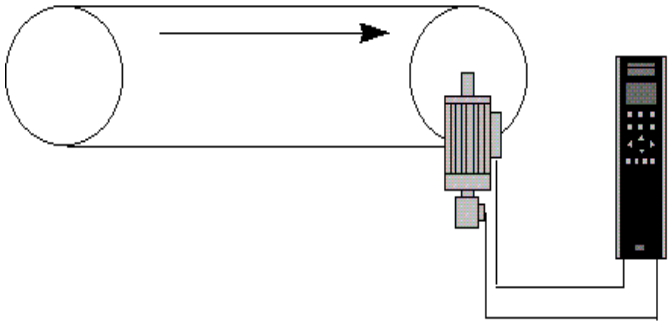
The following must be programmed in order shown - see explanation of settings in the Operating Instructions:

| Function: | Parameter no. | Setting | Data value no. |
|---|---|---|---|
| Activation of process controller | 100 | *Process control, closed loop* | [3] |
| Feedback signal | 314 | *Feedback signal* | [2] |
| Terminal 60, min. scale | 315 | 4 mA | |
| Terminal 60, max. scale | 316 | 20 mA (factory setting) | |
| Minimum feedback | 414 | -10°C | |
| Maximum feedback | 415 | 40°C | |
| Process units | 416 | °C | [10] |
| Reference | 308 | *Reference* (factory setting) | [1] |
| Terminal 53, min. scale | 309 | 0 Volt (factory setting) | |
| Terminal 53, max. scale | 310 | 10 Volt (factory setting) | |
| Minimum reference | 204 | -5°C | |
| Maximum reference | 205 | 35°C | |
| Inverse control | 437 | *Inverse* | [1] |
| Min. frequency | 201 | 10 Hz | |
| Max. frequency | 202 | 50 Hz | |
| Proportional gain | 440 | *Application-dependent (e.g. 1.0)* | |
| Integration time | 441 | *Application-dependent (e.g. 5 sec.)* | |

## ■ PID for speed control

Below are given a couple of examples of programming of VLT 5000 PID speed control.



175ZA451.10

A conveyor belt that carries heavy items must be maintained at a regular speed, which is set by means of a potentiometer within the range of 0-1500 rpm, 0-10 Volts. The speed selected must be kept constant and the integrated PID speed controller is to be applied.
This is a case of normal control, which means that when the load increases, the power supplied to the conveyor belt motor increases in order to keep the speed constant. Correspondingly, when the load falls, the power is reduced.
The feedback used is an encoder with a resolution of 1024 pulses/rev. push-pull.

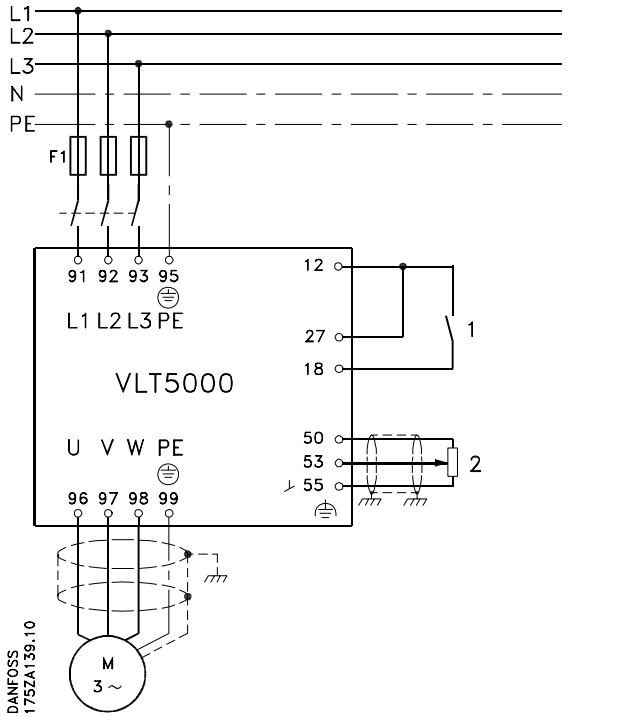
1. Start/Stop
2. Speed reference 0-1500 rpm, 0-10 Volts
3. Encoder 1024 pulses/rev. push-pull.

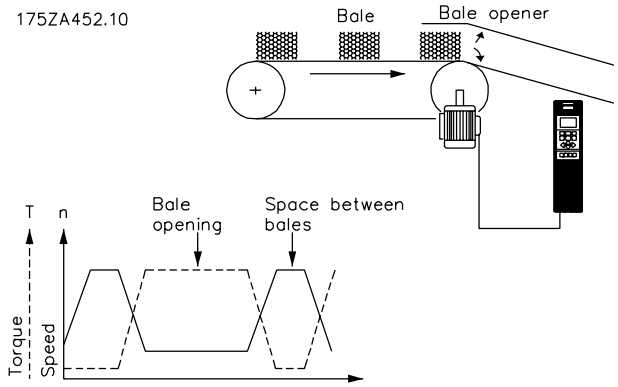
The following must be programmed in order shown - see explanation of settings in the Operating Instructions:

| Function: | Parameter no. | Setting | Data value no. |
|---|---|---|---|
| Activation of process controller | 100 | *Speed control, closed loop* | [1] |
| Feedback signal | 314 | *Feedback signal* | [2] |
| Terminal 32 | 306 | Encoder feedback, input B | [24] |
| Terminal 33 | 307 | Encoder feedback, input A | [25] |
| Minimum feedback | 414 | 0 rpm | |
| Maximum feedback | 415 | 1650 rpm (max. ref. + 10%) | |
| Reference | 308 | *Reference* (factory setting) | [1] |
| Terminal 53, min. scale | 309 | 0 Volt (factory setting) | |
| Terminal 53, max. scale | 310 | 10 Volt (factory setting) | |
| Minimum reference | 204 | 0 rpm | |
| Maximum reference | 205 | 1500 rpm | |
| Min. speed | 201 | 0 Hz | |
| Max. speed | 202 | 75 Hz | |
| Proportional gain | 417 | *Application-dependent* | |
| Integration time | 418 | *Application-dependent* | |
| Differentiation time | 419 | *Application-dependent* | |

## ■ PID for torque controller (open loop)

Below is given an example of programming of VLT 5000 torque controller.




A conveyor belt is used for carrying bales forward to a shredder at constant force, regardless of the conveyor belt speed. If there is a space between bales, the conveyor belt must move the next bale to the shredder as quickly as possible.

1. Start/stop.
2. Reference [Nm]

Optimisation of the torque controller

The basic settings have now been made and the factory setting has been optimised for most processes. It is rarely necessary to optimize the *torque proportional gain* in parameter 433 and the *torque integration time* in parameter 434.

In the cases where the factory setting has to be changed, it is recommended to change this setting by a maximum factor of +/- 2.

Feedback

The feedback signal is an estimated torque, calculated by the VLT frequency converter on the basis of the current values measured.

Reference

The reference is always in Nm.
A minimum and a maximum reference can be set (204 and 205) which limit the sum of all references. The reference range cannot go beyond the feedback range.

The following must be programmed in order shown:

| Function: | Parameter no. | Setting | Data value no. |
|---|---|---|---|
| Activation of process controller | 100 | *Torque control, open loop* | [4] |
| Torque proportional gain | 433 | 100% (factory setting) | |
| Torque integration time | 434 | 0.02 sec (factory setting) | |
| Reference | 308 | *Reference* (factory setting) | [1] |
| Terminal 53, min. scale | 309 | 0 volt (factory setting) | |
| Terminal 53, max. scale | 310 | 10 volt (factory setting) | |
| Min. speed | 201 | 0 Hz | |
| Max. speed | 202 | 50 Hz | |

## Galvanic Isolation (PELV)

PELV offers protection by way of extra low voltage. Protection against electric shock is considered to be ensured when the electrical supply is of the PELV type and the installation is made as described in local/national regulations on PELV supplies.

All control terminals and relay terminals 01-03 comply with PELV (Protective Extra Low Voltage) (Does not apply to 525-600 V units).

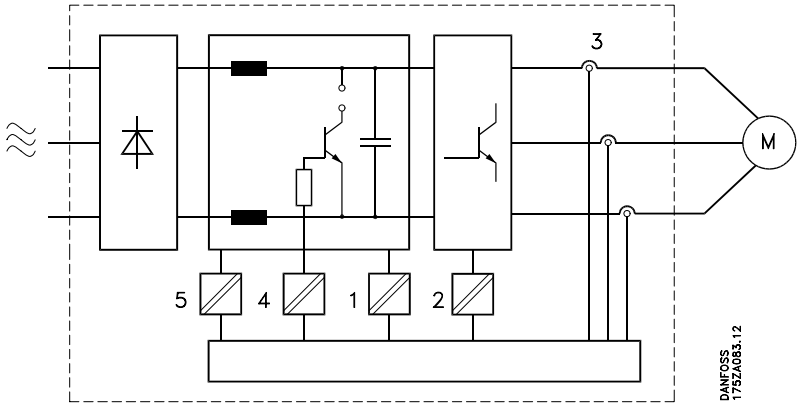
Galvanic (ensured) isolation is obtained by fulfilling requirements concerning higher isolation and by providing the relevant creapage/clearance distances. These requirements are described in the EN 50178 standard.

The components that make up the electrical isolation, as described below, also comply with the requirements concerning higher isolation and the relevant test as described in EN 50178.

The galvanic isolation can be shown in five locations (see drawing below), namely:

1. Power supply (SMPS) incl. signal isolation of $U_{DC}$, indicating the intermediate current voltage.
2. Gate drive that runs the IGBTs (trigger transformers/opto-couplers).
3. Current transducers (Hall effect current transducers).
4. Opto-coupler, brake module.
5. Opto-coupler, 24 V external supply.

Galvanic isolation




## Earth leakage current

Earth leakage current is primarily caused by the capacitance between motor phases and the motor cable screen. When an RFI filter is used, this contributes additional leakage current, as the filter circuit is connected to earth through capacitors.

The size of the leakage current to the ground depends on the following factors, in order of priority:

1. Length of motor cable
2. Motor cable with or without screen
3. Switching frequency
4. RFI filter used or not
5. Motor grounded on site or not

The leakage current is of importance to safety during handling/operation of the frequency converter if (by mistake) the frequency converter has not been earthed.

**NB!**

Since the leakage current is >3.5 mA, reinforced earthing must be established, which is required if EN 50178 is to be complied with. For 3-phased frequency converters, only fault current relays which are suitable for protection against DC currents (Din VDE 0664) are to be used. RCD fault current relays type B comply with these requirements according to the norm IEC 755-2.

The following requirements must be complied with:

- Suitable for protecting equipment with a direct current content (DC) in the fault current (3-phase rectifier)
- Suitable for power-up with short pulse-shaped charging current to earth
- Suitable for a high leakage current.

## Extreme Running Conditions

Short circuit

The frequency converter is protected against short circuits by means of current measurement in each of the three motor phases. A short circuit between two output phases will cause an overcurrent in the inverter. However, each transistor of the inverter will be turned off individually when the short circuit current exceeds the permitted value.

After 5-10 s the driver card turns off the inverter and the frequency converter will display a fault code, although depending on impedance and motor frequency.

Earth fault

The inverter cuts out within a few s in case of an earth fault on a motor phase, although depending on impedance and motor frequency.

Switching on the output

Switching on the output between the motor and the frequency converter is fully permitted. It is not possible to damage VLT 5000 Series in any way by switching on the output. However, fault messages may appear.

Motor-generated overvoltage

The voltage in the intermediate circuit is increased when the motor acts as a generator. This occurs in two cases:

1. The load drives the motor (at constant output frequency from the frequency converter), ie. the load generates energy.
2. During deceleration ("ramp-down") if the moment of inertia is high, the load is low and the ramp-down time is too short for the energy to be dissipated as a loss in the requency converter, the motor and the installation.

The control unit attempts to correct the ramp if possible.

The inverter turns off to protect the transistors and the intermediate circuit capacitors when a certain voltage level is reached.

Mains drop-out

During a mains drop-out, the frequency converter continues until the intermediate circuit voltage drops below the minimum stop level, which is typically 15% below the frequency converter's lowest rated supply voltage.

The time before the inverter stops depends on the mains voltage before the drop-out and on the motor load.

Static overload

When the frequency converter is overloaded (the torque limit in parameter 221/222 has been reached), the controls will reduce the output frequency in an attempt to reduce the load.

If the overload is excessive, a current may occur that makes the frequency converter cut out after approx. 1.5 sec.

Operation within the torque limit can be limited in time (0-60 s) in parameter 409.

## Peak voltage on motor

When a transistor in the inverter is opened, the voltage across the motor increases by a dU/dt ratio that depends on:

- the motor cable (type, cross-section, length screened or unscreened)
- inductance

The natural induction causes an overshot $U_{PEAK}$ in the motor voltage before it stabilises itself at a level which depends on the voltage in the intermediate circuit. The rise time and the peak voltage $U_{PEAK}$ affect the service life of the motor. If the peak voltage is too high, motors without phase coil insulation are the ones that will primarily be affected. If the motor cable is short (a few metres), the rise time and peak voltage are lower.
If the motor cable is long (100 m), the rise time and peak voltage will increase.

If very small motors are used without phase coil insulation, it is recommended to fit a sine-wave filter after the frequency converter.
Typical values for the rise time and peak voltage $U_{PEAK}$ are measured on the motor terminals between two phases.

To obtain approximate values for cable lengths and voltages not mentioned below, use the following rules of thumb:

1. Rise time increases/decreases proportionally with cable length.
2. $U_{PEAK}$ = DC link voltage x 1.9
   (DC link voltage = Mains voltage x 1.35).
3. $$\left.\frac{dU}{dt}\right| = \frac{0.5 \times U_{PEAK}}{Risetime}$$

Data are measured according to IEC 60034-17.

VLT 5001-5011 / 380-500 V

| Cable length | Mains voltage | Rise time | Peak voltage | dU/dt |
|---|---|---|---|---|
| 50 metres | 500 V | 0.5 µsec. | 1230 V | 1968 V/µsec. |
| 150 metres | 500 V | 1 µsec. | 1270 V | 1270 V/µsec. |
| 50 metres | 380 V | 0.6 µsec. | 1000 V | 1333 V/µsec. |
| 150 metres | 380 V | 1.33 µsec. | 1000 V | 602 V/µsec. |

VLT 5016-5102 / 380-500 V

| Cable length | Mains voltage | Rise time | Peak voltage | dU/dt |
|---|---|---|---|---|
| 32 metres | 380 V | 0.27 µsec. | 950 V | 2794 V/µsec. |
| 70 metres | 380 V | 0.60 µsec. | 950 V | 1267 V/µsec. |
| 132 metres | 380 V | 1.11 µsec. | 950 V | 685 V/µsec. |

VLT 5122-5302 / 380-500 V

| Cable length | Mains voltage | Rise time | Peak voltage | dU/dt |
|---|---|---|---|---|
| 70 metres | 400 V | 0.34 µsec. | 1040 V | 2447 V/µsec. |

VLT 5352-5552 / 380-500 V

| Cable length | Mains voltage | Rise time | Peak voltage | dU/dt |
|---|---|---|---|---|
| 29 metres | 500 V | 0.71 µsec. | 1165 V | 1389 V/µsec. |
| 29 metres | 400 V | 0.61 µsec. | 942 V | 1233 V/µsec. |

VLT 5001-5011 / 525-600 V

| Cable length | Mains voltage | Rise time | Peak voltage | dU/dt |
|---|---|---|---|---|
| 35 metres | 600 V | 0.36 µsec. | 1360 V | 3022 V/µsec. |

VLT 5016-5062 / 525-600 V

| Cable length | Mains voltage | Rise time | Peak voltage | dU/dt |
|---|---|---|---|---|
| 35 metres | 575 V | 0.38 µsec. | 1430 V | 3011 V/µsec. |

VLT 5042-5352 / 525-690 V

| Cable length | Mains voltage | Rise time | Peak voltage | dU/dt |
|---|---|---|---|---|
| 25 metres | 690 V | 0.59 µsec. | 1425 | 1983 V/µsec. |
| 25 metres | 575 V | 0.66 µsec. | 1159 | 1428 V/µsec. |
| 25 metres | 690 V[1)] | 1.72 µsec. | 1329 | 640 V/µsec. |

1) With Danfoss dU/dt filter.

VLT 5402-5602 / 525-690 V

| Cable length | Mains voltage | Rise time | Peak voltage | dU/dt |
|---|---|---|---|---|
| 25 metres | 690 V | 0.57 µsec. | 1540 | 2.230 V/µsec. |
| 25 metres | 575 V | 0.25 µsec. | | 2.510 V/µsec. |
| 25 metres | 690 V[1)] | 1.13 µsec. | 1629 | 1.150 V/µsec. |

1) With Danfoss dU/dt filter.

## Switching on the input

Switching on the input depends on the mains voltage in question and on whether Quick discharge of the intermediate capacitor has been selected. The table below states the waiting time between cut-ins.

| Mains voltage | 380 V | 415 V | 460 V | 500 V | 690 V |
|---|---|---|---|---|---|
| Without quick discharge | 48 s | 65 s | 89 s | 117 s | 120 s |
| With quick discharge | 74 s | 95 s | 123 s | 158 s | |

## Acoustic noise

The acoustic interference from the frequency converter comes from two sources:

1. DC intermediate circuit coils.
2. Integral fan.

Below are the typical values measured at a distance of 1 m from the unit at full load:

| | |
|---|---|
| **VLT 5001-5006 200 - 240 V, VLT 5001-5011 380 - 500 V** | |
| IP 20 units: | 50 dB(A) |
| IP 54 units: | 62 dB(A) |
| **VLT 5008-5027 200 - 240 V, VLT 5016-5102 380 - 500 V** | |
| IP 20 units: | 61 dB(A) |
| IP 20 unit (VLT 5062-5102): | 67 dB(A) |
| IP 54 units: | 66 dB(A) |
| **VLT 5032-5052 / 200 - 240 V** | |
| IP 20/NEMA 1 units: | 70 dB(A) |
| IP 54 units: | 65 dB(A) |
| **VLT 5122-5302 / 380 - 500 V** | |
| IP 21/NEMA 1 units: | 73 dB(A) |
| IP 54 units: | 73 dB(A) |
| **VLT 5352 / 380 - 500 V** | |
| IP 00/ IP 21 /NEMA 1 units: | 80 dB(A) |
| IP 54 units: | 80 dB(A) |
| **VLT 5452-5552 / 380 - 500 V** | |
| All enclosure types: | 83 dB(A) |
| **VLT 5001-5011 / 525 - 600 V** | |
| IP 20/NEMA 1 units: | 62 dB(A) |
| **VLT 5016-5062 / 525 - 600 V** | |
| IP 20/NEMA 1 units: | 66 dB(A) |
| **VLT 5042-5352 / 525 - 690 V** | |
| IP 21/NEMA 1 units: | 74 dB(A) |
| IP 54 units: | 74 dB(A) |
| **VLT 5402 / 525 - 690 V** | |
| All enclosure types: | 80 dB(A) |
| **VLT 5502-5602 / 525 - 690 V** | |
| All enclosure types: | 83 dB(A) |

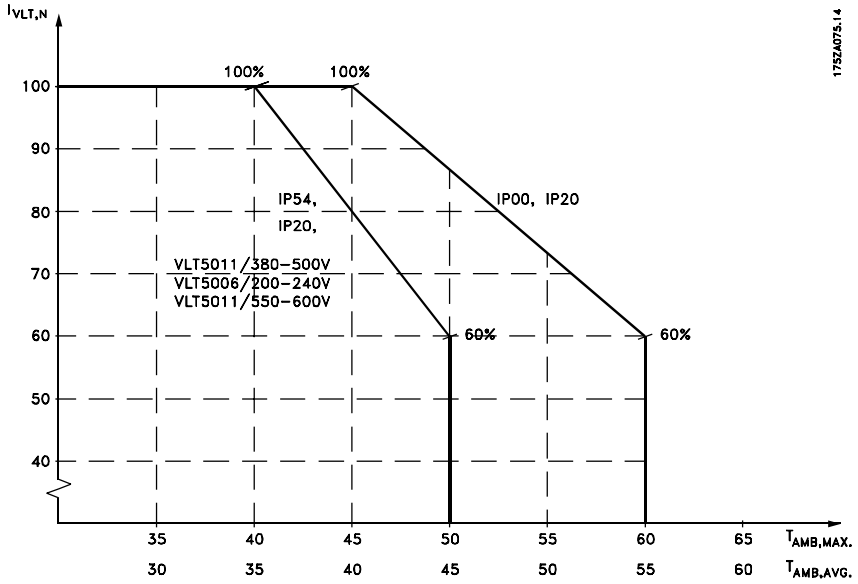
Measured 1 meter from the unit at full load.

## Derating

### Derating for ambient temperature

The ambient temperature ($T_{AMB,MAX}$) is the maximum temperature allowed. The average ($T_{AMB,AVG}$) measured over 24 hours must be at least 5C lower.

If the frequency converter is operated at temperatures above 45C, a derating of the continuous output current is necessary.




- **The current of VLT 5122-5552, 380-500 V and VLT 5042-5352, 525-690 V, is to be derated 1% / C above 45C maximum (160% overload) and 40C maximum (110% overload). Max. temperature is 55° C.**
- **The current of VLT 5402-5602, 525-690 V, is to be derated 1.5% / C above 45C maximum (160% overload) and 40C maximum (110% overload). Max. temperature is 55° C.**

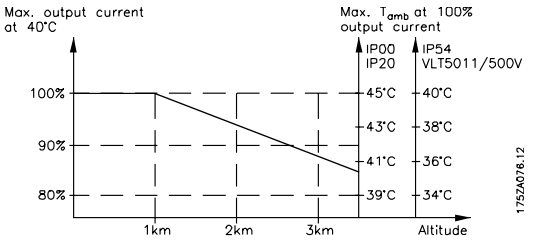
### Derating for Air Pressure

The Protective Extra Low Voltage (PELV) requirements stated in IEC 61800-5-1 are not fulfilled at altitudes above 2000 m (6562 ft.). For 200V frequency converters the requirements are not fulfilled at altitudes above 5000 m (16 404 ft.). Please contact Danfoss Drives for further information.

Below 1000 m altitude no derating is necessary.

Above 1000 m the ambient temperature ($T_{AMB}$) or max. output current ($I_{VLT,MAX}$) must be derated in accordance with the diagram below:

1. Derating of output current versus altitude at $T_{AMB}$ = max. 45°C
2. Derating of max. $T_{AMB}$ versus altitude at 100% output current.



## Derating for Running at Low Speed

When a motor is connected to a frequency converter, it is necessary to check whether the cooling of the motor is adequate.

At low RPM values, the motor fan is not able to supply the required volume of air for cooling. This problem occurs when the load torque is constant (e.g. a conveyor belt) across the regulating range. The reduced ventilation available decides the size of the torque that can be permitted under a continuous load. If the motor is to run continuously at an RPM value lower than half the rated value, the motor must be supplied with additional air for cooling.

Instead of such extra cooling, the load level of the motor can be reduced. This can be done by choosing a bigger motor. However, the design of the frequency converter sets limits as to the size of motor that can be connected to it.

## Derating for Installing Long Motor Cables or Cables with Larger Cross-section

The frequency converter has been tested using 300 m unscreened cable and 150 m screened cable.

The frequency converter has been designed to work using a motor cable with a rated cross-section. If a cable with a larger cross-section is to be used, it is recommended to reduce the output current by 5% for every step the cross-section is increased.

(Increased cable cross-section leads to increased capacity to earth, and thus an increased earth leakage current).

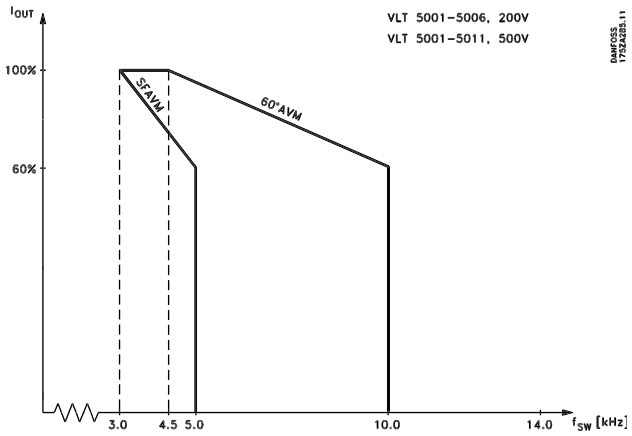
## Derating for high switching frequency

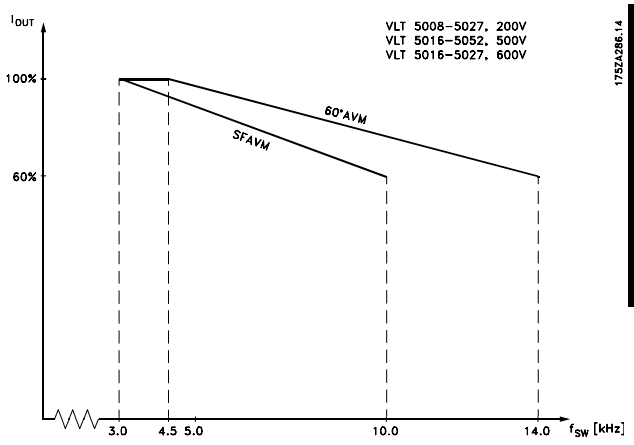
A higher switching frequency (to be set in parameter 411) leads to higher losses in the electronics of the frequency converter.

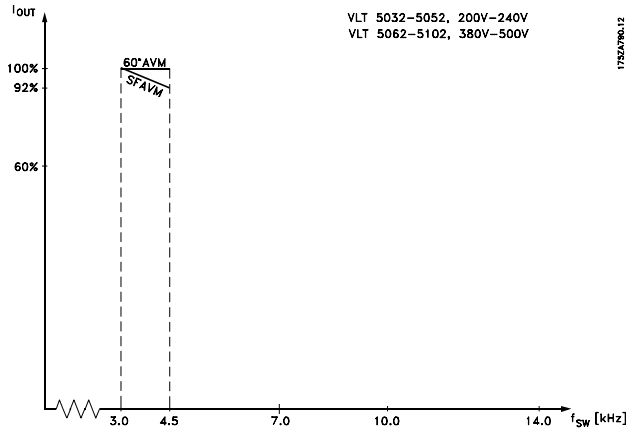
If *SFAVM* has been selected in parameter 446, the frequency converter will automatically derate the rated output current $I_{VLT,N}$ when the switching frequency exceeds 3.0 kHz.

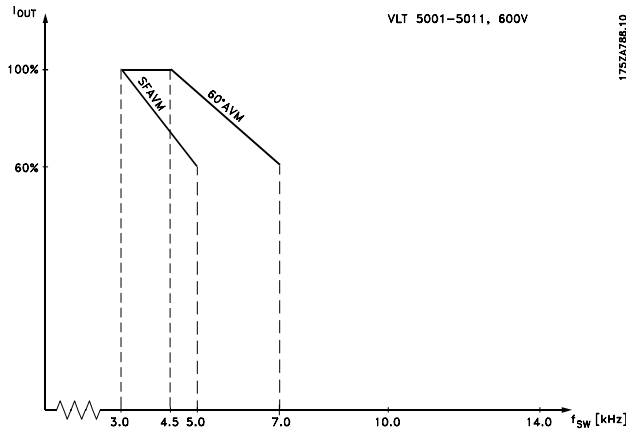
If *60°AVM* is selected, the frequency converter will automatically derate when the switching frequency exceeds 4.5 kHz. In both cases, the reduction is carried out linearly, down to 60% of $I_{VLT,N}$. The table gives the min., max. and factory-set switching frequencies for frequency converter. The switching pattern can be changed in parameter 446 and the switching frequency in parameter 411.

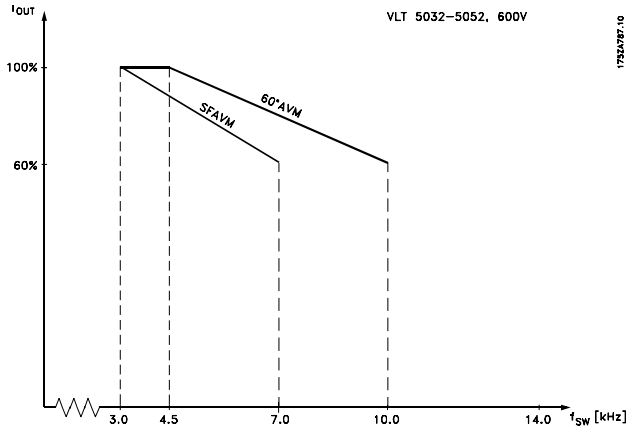
| | SFAVM | | | 60 deg. AVM | | |
|---|---|---|---|---|---|---|
| | Min. [kHz] | Max. [kHz] | Fac. [kHz] | Min. [kHz] | Max. [kHz] | Fac. [kHz] |
| VLT 5001-5006, 200 V | 3.0 | 5.0 | 3.0 | 3.0 | 10.0 | 4.5 |
| VLT 5008-5027, 200 V | 3.0 | 10.0 | 3.0 | 3.0 | 14.0 | 4.5 |
| VLT 5032-5052, 200 V | 3.0 | 4.5 | 3.0 | 3.0 | 4.5 | 4.5 |
| VLT 5001-5011, 500 V | 3.0 | 5.0 | 3.0 | 3.0 | 10.0 | 4.5 |
| VLT 5016-5052, 500 V | 3.0 | 10.0 | 3.0 | 3.0 | 14.0 | 4.5 |
| VLT 5062-5102, 500 V | 3.0 | 4.5 | 3.0 | 3.0 | 4.5 | 4.5 |
| VLT 5122-5302, 500 V | 3.0 | 3.0 | 3.0 | 3.0 | 4.5 | 4.5 |
| VLT 5352-5552, 500 V | 1.5 | 2.0 | 2.0 | 1.5 | 3.0 | 3.0 |
| VLT 5001-5011, 600 V | 3.0 | 5.0 | 3.0 | 4.5 | 7.0 | 4.5 |
| VLT 5016-5027, 600 V | 3.0 | 10.0 | 3.0 | 3.0 | 14.0 | 4.5 |
| VLT 5032-5052, 600 V | 3.0 | 7.0 | 3.0 | 3.0 | 10.0 | 4.5 |
| VLT 5062, 600 V | 3.0 | 4.5 | 3.0 | 3.0 | 4.5 | 4.5 |
| VLT 5042-5302, 690 V | 1.5 | 2.0 | 2.0 | 1.5 | 3.0 | 3.0 |
| VLT 5352-5602, 690 V | 1.5 | 1.5 | 1.5 | 1.5 | 2.0 | 2.0 |



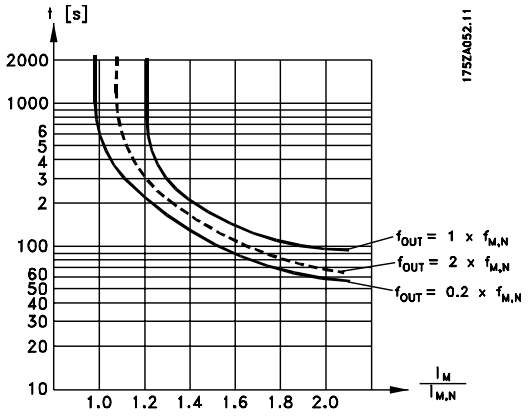

VLT 5032-5052, 200V-240V
VLT 5062-5102, 380V-500V
175ZA790.12
$I_{OUT}$
100%
92%
60%
60°AVM
SFAVM
3.0
4.5
7.0
10.0
14.0
$f_{SW}$ [kHz]


VLT 5001-5011, 600V
175ZA788.10
$I_{OUT}$
100%
60%
SFAVM
60°AVM
3.0
4.5
5.0
7.0
10.0
14.0
$f_{SW}$ [kHz]


VLT 5032-5052, 600V
175ZA787.10
$I_{OUT}$
100%
60%
60°AVM
SFAVM
3.0
4.5
7.0
10.0
14.0
$f_{SW}$ [kHz]

## Motor thermal protection

The motor temperature is calculated on the basis of motor current, output frequency and time. See parameter 128 in the Operating Instructions.




## Vibration and Shock

The frequency converter has been tested according to a procedure based on the following standards:

| | |
|---|---|
| IEC 68-2-6: | Vibration (sinusoidal) - 1970 |
| IEC 68-2-34: | Random vibration broad-band - general requirements |
| IEC 68-2-35: | Random vibration broad-band - high reproducibility |
| IEC 68-2-36: | Random vibration broad-band - medium reproducibility |

The frequency converter complies with requirements that correspond to conditions when the unit is mounted on the walls and floors of production premises, as well as in panels bolted to walls or floors.

## Air Humidity

The frequency converter has been designed to meet the IEC 68-2-3 standard, EN 50178 pkt. 9.4.2.2/DIN 40040, class E, at 40°C.

## Aggressive environments

In common with all electronic equipment, a frequency converter contains a large number of mechanical and electronic components, all of which are vulnerable to environmental effects to some extent.



The frequency converter should not therefore be installed in environ- ments with airborne liquids, particles or gases capable of affecting and damaging the electronic components. Failure to take the necessary protective measures increases the risk of stoppages, thus reducing the life of the frequency converter.

Liquids can be carried through the air and condense in the frequency converter. In addition to this, liquids may cause corrosion of components and metal parts. Steam, oil and salt water may cause corrosion of components and metal parts. In such environments, equipment with enclosure rating IP 54 is recommended. As an extra protection, coated printet circuit boads can be orded as an option.

Airborne Particles such as dust particles may cause mechanical, electrical or thermal failure in the frequency converter. A typical indicator of excessive levels of airborne particles is dust particles around the frequency converter fan. In very dusty environments, equipment with enclosure rating IP 54 or a cabinet for IP 00/ IP 20/Nema 1 equipment is recommended.

In environments with high temperatures and humidity, corrosive gases such as sulphur, nitrogen and chlorine compounds will cause chemical processes on the frequency converter components.

Such chemical reactions will rapidly affect and damage the electronic components. In such environments, it is recommended that equipment is mounted in a cabinet with fresh air ventilation, keeping aggressive gases away from the frequency converter.
An extra protection in such areas a conformal coating of the printed ircuit boards can be ordered as an option.



**NB!**
Mounting frequency converters in aggressive environments will increase the risk of stoppages and furthermore considerably reduce the life of the converter.

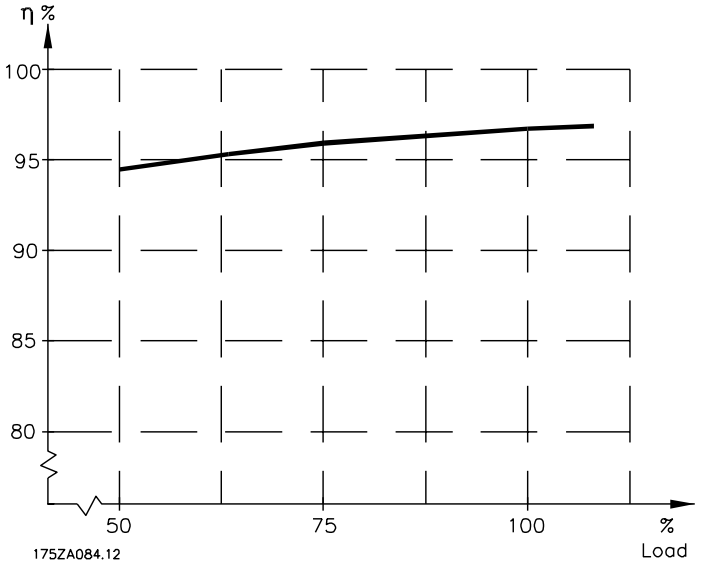
Before the installation of the frequency converter, the ambient air should be checked for liquids, particles and gases. This may be done by observing existing installations in this environment. Typical indicators of harmful airborne liquids are water or oil on metal parts, or corrosion of metal parts.

Excessive dust particle levels are often found on installation cabinets and existing electrical installations. One indicator of aggressive airborne gases is blackening of copper rails and cable ends on existing installations.

See also Instruction MN.90.IX.YY

## ■ Efficiency

To reduce energy consumption it is very important to optimize the efficiency of a system. The efficiency of each single element in the system should be as high as possible.




Efficiency of VLT 5000 Series ($\eta_{VLT}$)

The load on the frequency converter has little effect on its efficiency. In general, the efficiency is the same at the rated motor frequency $f_{M,N}$, regardless of whether the motor supplies 100% of the rated shaft torque or only 75%, i.e. in case of part loads.

This also means that the efficieny of the frequency converter does not change even if other U/f characteristics are chosen.
However, the U/f characteristics influence the efficiency of the motor.

The efficiency declines a little when the switching frequency is set to a value of above 4 kHz (3 kHz for VLT 5005) (parameter 411). The rate of efficiency will also be slightly reduced if the mains voltage is 500 V, or if the motor cable is longer than 30 m.

Efficiency of the motor ($\eta_{MOTOR}$)

The efficiency of a motor connected to the frequency converter depends on the sine shape of the current. In general, the efficiency is just as good as with mains operation. The efficiency of the motor depends on the type of motor.

In the range of 75-100% of the rated torque, the efficiency of the motor is practically constant, both when it is controlled by the frequency converter and when it runs directly on mains.

In small motors, the influence from the U/f characteristic on efficiency is marginal; however, in motors from 11 kW and up, the advantages are significant.

In general, the switching frequency does not affect the efficiency of small motors. Motors from 11 kW and up have their efficiency improved (1-2%). This is because the sine shape of the motor current is almost perfect at high switching frequency.

Efficiency of the system ($\eta_{SYSTEM}$)

To calculate the system efficiency, the efficiency of VLT 5000 Series ($\eta_{VLT}$) is multiplied by the efficiency of the motor ($\eta_{MOTOR}$):

$$\eta_{SYSTEM} = \eta_{VLT} \times \eta_{MOTOR}$$

Based on the graph on this page, it is possible to calculate the efficiency of the system at different loads.

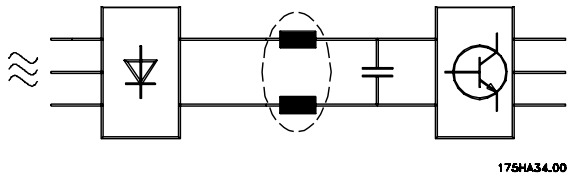
## Mains Supply Interference/Harmonics

A frequency converter takes up a non-sinusoidal current from mains, which increases the input current $I_{RMS}$. A non-sinusoidal current can be transformed by means of a Fourier analysis and split up into sine wave currents with different frequencies, i.e. different harmonic currents $I_N$ with 50 Hz as the basic frequency:

| Harmonic currents | $I_1$ | $I_5$ | $I_7$ |
|---|---|---|---|
| Hz | 50 Hz | 250 Hz | 350 Hz |

The harmonics do not affect the power consumption directly, but increase the heat losses in the installation (transformer, cables). Consequently, in plants with a rather high percentage of rectifier load, it is important to maintain harmonic currents at a low level to avoid overload of the transformer and high temperature in the cables.

Some of the harmonic currents might disturb communication equipment connected to the same transformer or cause resonance in connection with power-factor correction batteries.




Harmonic currents compared to the RMS input current:

| | Input current |
|---|---|
| $I_{RMS}$ | 1.0 |
| $I_1$ | 0.9 |
| $I_5$ | 0.4 |
| $I_7$ | 0.2 |
| $I_{11\text{-}49}$ | < 0.1 |

To ensure low, harmonic currents, the frequency converter has intermediate circuit coils as standard. This normally reduces the input current $I_{RMS}$ by 40%.

The voltage distortion on the mains supply depends on the size of the harmonic currents multiplied by the mains impedance for the frequency in question. The total voltage distortion THD is calculated on the basis of the individual voltage harmonics using the following formula:

$$THD\% = \frac{\sqrt{U\frac{2}{5} + U\frac{2}{7} + ..... + U\frac{2}{\eta}}}{U_1} \quad (U_\eta\% \ of \ U)$$

See also Application Note MN.90.FX.02.

## Power Factor

The power factor is the relation between $I_1$ and $I_{RMS}$.

The power factor for 3-phase control:

$$Power \ factor = \frac{\sqrt{3} \times U \times I_1 \times cos\varphi_1}{\sqrt{3} \times U \times I_{RMS}}$$

$$\frac{I_1 \times cos\varphi_1}{I_{RMS}} = \frac{I_1}{I_{RMS}} \ since \ cos \ \varphi = 1$$

The power factor indicates the extent to which the frequency converter imposes a load on the mains supply. The lower the power factor, the higher the $I_{RMS}$ for the same kW performance.

In addition, a high power factor indicates that the different harmonic currents are low.

$$I_{RMS} = \sqrt{I\frac{2}{1} + I\frac{2}{5} + I\frac{2}{7} + ..... + I\frac{2}{n}}$$

## CE labelling

**What is CE labelling?**

The purpose of CE labelling is to avoid technical obstacles to trade within EFTA and the EU. The EU has introduced the CE label as a simple way of showing whether a product complies with the relevant EU directives. The CE label says nothing about the specifications or quality of the product. Frequency converters are regulated by three EU directives:

**•The machinery directive (98/37/EEC)**

All machines with critical moving parts are covered by the machinery directive, which came into force on 1 January 1995. Since a frequency converter is largely electrical, it does not fall under the machinery directive. However, if a frequency converter is supplied for use in a machine, we provide information on safety aspects relating to the frequency converter. We do this by means of a manufacturer's declaration.

**•The low-voltage directive (73/23/EEC)**

Frequency converters must be CE labelled in accordance with the low-voltage directive, which came into force on 1 January 1997. The directive applies to all electrical equipment and appliances used in the 50 - 1000 Volt AC and the 75 - 1500 Volt DC voltage ranges. Danfoss CE labels in accordance with the directive and issues a declaration of conformity upon request.

**•The EMC directive (89/336/EEC)**

EMC is short for electromagnetic compatibility. The presence of electromagnetic compatibility means that the mutual interference between different components/appliances is so small that the functioning of the appliances is not affected.

The EMC directive came into force on 1 January 1996. Danfoss CE labels in accordance with the directive and issues a declaration of conformity upon request. In order that EMC-correct installation can be carried out, this manual gives detailed instructions for installation. In addition, we specify the standards which our different products comply with. We offer the filters that can be seen from the specifications and provide other types of assistance to ensure the optimum EMC result.

In the great majority of cases, the frequency converter is used by professionals of the trade as a complex component forming part of a larger appliance, system or installation. It must be noted that the responsibility for the final EMC properties of the appliance, system or installation rests with the installer.

## What is covered

The EU "Guidelines on the Application of Council Directive 89/336/EEC" outline three typical situations of using a frequency converter. For each of these situations, explanations are offered as to whether the situation in question is covered by the EMC directive and must be CE labelled.

1. The frequency converter is sold directly to the end-consumer. The frequency converter is for example sold to a DIY market. The end-consumer is a layman. He installs the frequency converter himself for use with a hobby machine, a kitchen appliance, etc. For such applications, the VLT frequency converter must be CE labelled in accordance with the EMC directive.
2. The frequency converter is sold for installation in a plant. The plant is built up by professionals of the trade. It could be a production plant or a heating/ventilation plant designed and installed by professionals of the trade. Neither the frequency converter nor the finished plant has to be CE labelled under the EMC directive. However, the unit must comply with the basic EMC requirements of the directive. The installer can ensure this by using components, appliances and systems that are CE labelled under the EMC directive.
3. The frequency converter is sold as part of a complete system. The system is being marketed as complete. It could be e.g. an air-conditioning system. The complete system must be CE labelled in accordance with the EMC directive. The manufacturer who supplies the system can ensure CE labelling under the EMC directive either by using CE labelled components or by testing the EMC of the system. If he chooses to use only CE labelled components, he does not have to test the entire system.

## Danfoss VLT frequency converter and CE labeling

CE labelling is a positive feature when used for its original purpose, i.e. to facilitate trade within the EU and EFTA.

However, CE labelling may cover many different specifications. This means that is has to be checked what a given CE label specifically covers.

The specifications covered can in fact be widely different. That is why a CE label can give the installer a

false feeling of security when using a frequency converter as a component in a system or an appliance.

We CE label our VLT frequency converters in accordance with the low-voltage directive. This means that as long as the VLT frequency converter is installed correctly, we guarantee that it complies with the low-voltage directive. We issue a declaration of conformity that confirms our CE labelling in accordance with the low-voltage directive.

The CE label also applies to the EMC directive, on condition that the instructions given in the Operating Instructions for EMC-correct installation and filtering have been followed. On this basis, a declaration of conformity in accordance with the EMC directive is issued.

The Operating Instructions give detailed instructions for installation to ensure that your installation is EMC-correct. Furthermore, we specify which norms that are complied with by our different products.

We offer the filters that can be seen from the specifications and gladly provide other types of assistance that can help you obtain the best EMC result.

### ■ Compliance with EMC directive 89/336/EEC

In the great majority of cases, the VLT frequency converter is used by professionals of the trade as a complex component forming part of a larger appliance, system or installation. It must be noted that the responsibility for the final EMC properties of the appliance, system or installation rests with the installer. As an aid to the installer, Danfoss has prepared EMC installation guidelines for the Power Drive System. The standards and test levels stated for Power Drive Systems are complied with, provided the right EMC-correct instructions for installation have been followed, see electrical installation.

## General aspects of EMC emissions

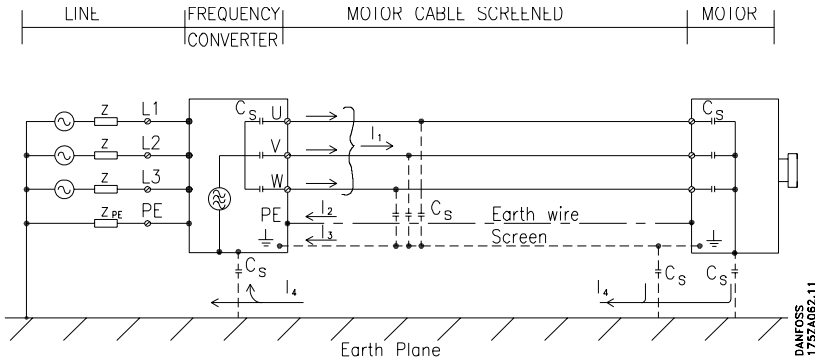
Electrical interference at frequences in the range 150 kHz to 30 MHz are usually conducted. Airborne interference from the drive system in the range 30 MHz to 1 GHz is generated from the inverter, the motor cable and the motor.

As the sketch below shows, capacitive currents in the motor cable together with a high dV/dt from the motor voltage generate leakage currents.

The use of a screened motor cable increases the leakage current (see figure below). This is because screened cables have higher capacitance to earth than unscreened cables. If the leakage current is not filtered, it will cause greater interference on the mains in the radio frequency range below approx. 5 MHz. Since the leakage current ($I_1$) is carried back to the unit through the screen ($I_3$), there will in principle only be a small electro-magnetic field ($I_4$) from the screened motor cable according to the below figure.

The screen reduces the radiated interference, but increases the low-frequency interference on the mains. The motor cable screen must be connected to the VLT enclosure as well as on the motor enclosure. The best way of doing this is by using integrated screen clamps so as to avoid twisted screen ends (pigtails). These increase the screen impedance at higher frequencies, which reduces the screen effect and increases the leakage current ($I_4$).

If a screened cable is used for Profibus, standard bus, relay, control cable, signal interface and brake, the screen must be mounted on the enclosure at both ends. In some situations, however, it will be necessary to break the screen to avoid current loops.




In the cases when the screen is to be placed on a mounting plate for the VLT frequency converter, the mounting plate must be made of metal, because the screen currents are to be conveyed back to the unit. It is also important to ensure good electrical contact from the mounting plate through the mounting screws to the VLT frequency converter chassis.

With respect to installation, it is generally less complicated to use unscreened cables than screened ones.

**NB!**

Please note, however, that when unscreened cables are used, some emission requirements are not complied with, although the immunity requirements are complied with.

In order to reduce the interference level from the system overall (unit + installation) as far as possible, it is important to make motor and brake cables as short as possible. Cables with a sensitive signal level must not be alongside motor and brake cables. Radio interference higher than 50 MHz (airborne) will be generated especially by the control electronics.

EMC Test Results **(Emission)**

The following test results have been obtained using a system with a VLT frequency converter (with options if relevant), a screened control cable, a control box with potentiometer, as well as a motor and motor cable.

| VLT 5001-5011/380-500V<br>VLT 5001-5006/200-240 V | Emission | | | | |
|---|---|---|---|---|---|
| | Basic standard | EN 55011 Class A1 | | EN 55011 Class B1 | |
| Setup | Motor cable | Conducted<br>150 kHz-30 MHz | Radiated<br>30 MHz-1 GHz | Conducted<br>150 kHz-30 MHz | Radiated<br>30 MHz-1 GHz |
| VLT 5000 with RFI filter option | 300 m unscreened/unarmoured | Yes [3] | No | No | No |
| | 50 m br. screened/armoured (Bookstyle 20m) | Yes | Yes | Yes [2] | No |
| | 150m br. screened/armoured | Yes [1] | Yes [1] | No | No |
| VLT 5000 with RFI filter option<br>(+ sine-wave filter) | 300 m unscreened/unarmoured | Yes | No | No | No |
| | 50 m br. screened/armoured | Yes | Yes | Yes [2] | No |
| | 150m br. screened/armoured | Yes | Yes | No | No |

1) For VLT 5011/380-500 V and VLT 5006/200-240 V this is only complied with if a maximum braided screened/armoured cable of 100 m is used.
2) Does not apply to 5011/380-500 V and 5006/200-240 V
3) Depending on installation conditions

| VLT 5016-5552/380-500 V<br>VLT 5008-5052/200-240 V<br>VLT 5042-5602/525-690 V | Emission | | | | |
|---|---|---|---|---|---|
| | Basic standard | EN 55011 Class A1 | | EN 55011 Class B | |
| Setup | Motor cable | Conducted<br>150 kHz-30 MHz | Radiated<br>30 MHz-1 GHz | Conducted<br>150 kHz-30 MHz | Radiated<br>30 MHz-1 GHz |
| VLT 5000 without<br>RFI filter option [4] [5] | 300 unscreened/unarmoured | No | No | No | No |
| | 150 m br. screened/armoured | No | Yes [6] | No | No |
| VLT 5000<br>with RFI filter option | 300 m unscreened/unarmoured | Yes [2] [6] | No | No | No |
| | 50 m br. screened/armoured | Yes | Yes [6] | Yes [1] [3] [6] | No |
| | 150 m br. screened/armoured | Yes [6] | Yes [6] | No | No |

1) Does not apply to VLT 5122-5552 / 380-500 V.
2) Depending on installation conditions.
3) VLT 5032-5052 / 200-240 V with external filter.
4) VLT 5122-5552, 380-500 V, fulfils class A-2 at 50 m screened cable without RFI filter (typecode R0).
5) VLT 5042-5352, 525-690 V, fulfils class A2 at 150 m screened cable without RFI filter (R0), and class A1 at 30 m screened cable with RFI filter (R1).
VLT 5402-5602, 525-690 V, fulfils A2 at 150 m screened cable without RFI filter (R0)
6) Does not apply to VLT 5042-5602, 525-690 V.
In order to minimise the conducted noise to the mains supply and the radiated noise from the frequency converter SYSTEM, the motor cables should be as short as possible and the screen ends should be made in accordance with the section on electrical install

## Required compliance levels

| Standard / environment | Housing, trades and light industries | | Industrial environment | |
|---|---|---|---|---|
| | Conducted | Radiated | Conducted | Radiated |
| EN 61000-6-3 (generic) | Class B | Class B | | |
| EN 61000-6-4 | | | Class A-1 | Class A-1 |
| EN 61800-3 (restricted) | Class A-1 | Class A-1 | Class A-1 | Class A-1 |
| EN 61800-3 (unrestricted) | Class B | Class B | Class A-2 | Class A-2 |

EN 55011: Threshold values and measuring methods for radio interference from industrial, scientific and medical (ISM) high-frequency equipment.
Class A-1: Equipment used in a industrial environment. Unrestricted distribution.
Class A-2: Equipment used in an industrial environment. Restricted distribution.
Class B: Equipment used in areas with a public supply network (dwellings, commerce and light industries). Unrestricted distribution.

## EMC Immunity

In order to document immunity against electrical interference from electrical phenomena, the following immunity tests have been made on a system consisting of a frequency converter (with options, if relevant), a screened control cable and a control box with potentiometer, motor cable, and motor.

The tests were performed in accordance with the following basic standards:

- **EN 61000-4-2 (IEC 61000-4-2): Electrostatic discharges (ESD)**Simulation of electrostatic discharges from human beings.
- **EN 61000-4-3 (IEC 61000-4-3): Incoming electromagnetic field radiation, amplitude modulated**Simulation of the effects of radar and radio communication equipment as well as mobile communications.
- **EN 61000-4-4 (IEC 61000-4-4): Burst transients** Simulation of interference brought about by switching with a contactor, relays or similar devices.
- **EN 61000-4-5 (IEC 61000-4-5): Surge transients** Simulation of transients brouht e.g. by lightning that strikes near installations.
- **VDE 0160 class W2 test pulse: Mains transients** Simulation of high-energy transients brought about by main fuse breakage, switching of power factor correction capacitors, etc.
- **EN 61000-4-6 (IEC 61000-4-6): RF Common mode** Simulation of the effect from radio-transmitting equipment connected to connection cables.

See following EMC immunity form.

## Immunity continued

| Basic standard | Burst IEC 61000-4-4 | Surge IEC 61000-4-5 | | ESD IEC 61000-4-2 | Radiated electromagnetic field IEC 61000-4-3 | Mains distortion VDE 0160 | RF common mode voltage IEC 61000-4-6 |
|---|---|---|---|---|---|---|---|
| Acceptance criterion | B | B | | B | A | | A |
| Port connection | CM | DM | CM | | | CM | CM |
| Line | OK | OK | | | | OK | OK |
| Motor | OK | | | | | | OK |
| Control lines | OK | | OK | | | | OK |
| Application and Fieldbus options | OK | | OK | | | | OK |
| Signal interface<3 m | OK | | | | | | |
| Enclosure | | | | OK | OK | | OK |
| Load sharing | OK | | | | | | OK |
| Standard bus | OK | | OK | | | | OK |
| Brake | OK | | | | | | OK |
| External 24 V DC | OK | | OK | | | | OK |

DM: Differential mode
CM: Common mode
CCC: Capacitive clamp coupling
DCN: Direct coupling network

## Immunity continued

| Basic specifications | Burst IEC 61000-4-4 | Surge IEC 61000-4-5 | ESD IEC 61000-4-2 | Radiated electromagnetic field IEC 61000-4-3 | Mains distortion VDE 0160 | RF common mode voltage IEC 61000-4-6 |
|---|---|---|---|---|---|---|
| Line | 4kV/5 kHz/DCN | 2 kV/2Ω 4 kV/12Ω | | | 2,3 x $U_N$ [2] | 10 $V_{RMS}$ |
| Motor | 4kV/5 kHz/CCC | | | | | 10 $V_{RMS}$ |
| Control lines | 2kV/5 kHz/CCC | 2 kV/2Ω[1] | | | | 10 $V_{RMS}$ |
| Application and Fieldbus options | 2kV/5 kHz/CCC | 2 kV/2Ω[1] | | | | 10 $V_{RMS}$ |
| Signal interface <3 m | 1kV/5 kHz/CCC | | | | | 10 $V_{RMS}$ |
| Enclosure | | | 8 kV AD 6 kV CD | 10 V/m | | |
| Load sharing | 4kV/5 kHz/CCC | | | | | 10 $V_{RMS}$ |
| Standard bus | 2kV/5 kHz/CCC | – 4 kV/2Ω[1] | | | | 10 $V_{RMS}$ |
| Brake | 4kV/5 kHz/CCC | | | | | 10 $V_{RMS}$ |
| External 24 V DC | 2kV/5 kHz/CCC | – 4 kV/2Ω[1] | | | | 10 $V_{RMS}$ |

DM: Differential mode
CM: Common mode
CCC: Capacitive clamp coupling
DCN: Direct coupling network

1. Injection on cable shield.

2. 2,3 x $U_N$: max. test pulse 380 $V_{AC}$: Class 2/1250 $V_{PEAK}$, 415 $V_{AC}$: Class 1/1350 $V_{PEAK}$

## Definitions

**VLT:**

$I_{VLT,MAX}$
The maximum output current.

$I_{VLT,N}$
The rated output current supplied by the frequency converter.

$U_{VLT\ MAX}$
The maximum output voltage.

**Output:**

$I_M$
The current transmitted to the motor.

$U_M$
The voltage transmitted to the motor.

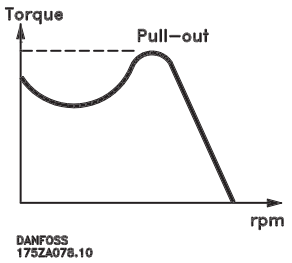
$f_M$
The frequency transmitted to the motor.

$f_{JOG}$
The frequency transmitted to the motor when the jog function is activated (via digital terminals or the keypad).

$f_{MIN}$
The minimum frequency transmitted to the motor.

$f_{MAX}$
The maximum frequency transmitted to the motor.

Break-away torque:




$\eta_{VLT}$
The efficiency of the frequency converter is defined as the ratio between the power output and the power input.

**Input:**

Control command:
By means of LCP and the digital inputs, it is possible to start and stop the connected motor.
Functions are divided into two groups, with the following priorities:

| | |
|---|---|
| Group 1 | Reset, Coasting stop, Reset and Coasting stop, Quick-stop, DC braking, Stop and the "Stop" key. |
| Group 2 | Start, Pulse start, Reversing, Start reversing, Jog and Freeze output |

Group 1 functions are called Start-disable commands. The difference between group 1 and group 2 is that in group 1 all stop signals must be cancelled for the motor to start. The motor can then be started by means of a single start signal in group 2.
A stop command given as a group 1 command results in the display indication STOP.
A missing stop command given as a group 2 command results in the display indication STAND BY.

Start-disable command:
A stop command that belongs to group 1 of the control commands - see this group.

Stop command:
See Control commands.

**Motor:**

$I_{M,N}$
The rated motor current (nameplate data).

$f_{M,N}$
The rated motor frequency (nameplate data).

$U_{M,N}$
The rated motor voltage (nameplate data).

$P_{M,N}$
The rated power delivered by the motor (nameplate data).

$n_{M,N}$
The rated motor speed (nameplate data).

$T_{M,N}$
The rated torque (motor).

**References:**

preset ref.
A firmly defined reference which can be set from -100% to +100% of the reference range. There are four preset references, which can be selected via the digital terminals.

analogue ref.
A signal transmitted to input 53, 54 or 60. Can be voltage or current.

pulse ref.
A signal transmitted to the digital inputs (terminal 17 or 29).

binary ref.
A signal transmitted to the serial communication port.

$Ref_{MIN}$
The smallest value which the reference signal may have. Set in parameter 204.

$Ref_{MAX}$
The maximum value which the reference signal may have. Set in parameter 205.

**Miscellaneous:**

ELCB:
Earth Leakage Circuit Breaker.

lsb:
Least significant bit.
Used in serial communication.

msb
Most significant bit.
Used in serial communication.

PID:
The PID regulator maintains the desired speed (pressure, temperature, etc.) by adjusting the output frequency to match the varying load.

Trip:
A state which occurs in different situations, e.g. if the frequency converter is subjected to an overtemperature. A trip can be cancelled by pressing reset or, in some cases, automatically.

Trip locked:
A state which occurs in different situations, e.g. if the frequency converter is subject to an overtemperature. A locked trip can be cancelled by cutting off mains and restarting the frequency converter.

Initialising:
If initialising is carried out, the frequency converter returns to the factory setting.

Setup:
There are four Setups, in which it is possible to save parameter settings. It is possible to change between the four parameter Setups and to edit one Setup, while another Setup is active.

LCP:
The control panel, which makes up a complete interface for control and programming of VLT 5000 Series. The control panel is detachable and may, as an alternative, be installed up to 3 metres away from the frequency converter, i.e. in a front panel, by means of the installation kit option.

VVC $^{plus}$
If compared with standard voltage/frequency ratio control, $VVC^{plus}$ improves the dynamics and the stability, both when the speed reference is changed and in relation to the load torque.

Slip compensation:
Normally, the motor speed will be affected by the load, but this load dependence is unwanted. The frequency converter compensates for the slip by giving the frequency a supplement that follows the measured effective current.

Thermistor:
A temperature-dependent resistor placed where the temperature is to be monitored (frequency converter or motor).

Analogue inputs:
The analogue inputs can be used for controlling various functions of the frequency converter.
There are two types of analogue inputs:
Current input, 0-20 mA
Voltage input, 0-10 V DC.

Analogue outputs:
There are two analogue outputs, which are able to supply a signal of 0-20 mA, 4-20 mA or a digital signal.

Digital inputs:
The digital inputs can be used for controlling various functions of the frequency converter.

Digital outputs:
There are four digital outputs, two of which activate a relay switch. The outputs are able to supply a 24 V DC (max. 40 mA) signal.

Brake resistor:
The brake resistor is a module capable of absorbing the brake power that is generated in regenerative braking. This regenerative braking power increases the intermediate circuit voltage and a brake chopper ensures that the power is transmitted to the brake resistor.

Pulse encoder:
An external, digital pulse transmitter used for feeding back information on motor speed. The encoder is used in applications where great accuracy in speed control is required.

AWG:
Means American Wire Gauge, i.e. the American measuring unit for cable cross-section.

Manual initialisation:
Press the [CHANGE DATA] + [MENU] + [OK] keys at the same time to carry out manual initialisation.

60° AVM
Switching pattern called 60° A synchronous V ector M odulation.

SFAVM
Switching pattern called S tator F lux oriented A synchronous V ector M odulation.

Automatic motor adjustment, AMA:
Automatic motor adjustment algorithm, which determines the electrical parameters for the connected motor, at standstill.

On-line/off-line parameters:
On-line parameters are activated immediately after the data value is changed. Off-line parameters are not activated until OK has been entered on the control unit.

VT characteristics:
Variable torque characteristics, used for pumps and fans.

CT characteristics:
Constant torque characteristics, used for all applications, such as conveyor belts and cranes. CT characteristics are not used for pumps and fans.

MCM:
Stands for Mille Circular Mil, an American measuring unit for cable cross-section. 1 MCM ≡ 0.5067 $mm^2$.

## Factory Settings

| PNU # | Parameter description | Factory setting | Range | Changes during operation | 4-Setup | Conversion index | Data type |
|---|---|---|---|---|---|---|---|
| 001 | Language | English | | Yes | No | 0 | 5 |
| 002 | Local/remote control | Remote control | | Yes | Yes | 0 | 5 |
| 003 | Local reference | 000.000 | | Yes | Yes | -3 | 4 |
| 004 | Active setup | Setup 1 | | Yes | No | 0 | 5 |
| 005 | Programming setup | Active setup | | Yes | No | 0 | 5 |
| 006 | Copying of setups | No copying | | No | No | 0 | 5 |
| 007 | LCP copy | No copying | | No | No | 0 | 5 |
| 008 | Display scaling of motor frequency | 1 | 0.01 - 500.00 | Yes | Yes | -2 | 6 |
| 009 | Display line 2 | Frequency [Hz] | | Yes | Yes | 0 | 5 |
| 010 | Display line 1.1 | Reference [%] | | Yes | Yes | 0 | 5 |
| 011 | Display line 1.2 | Motor current [A] | | Yes | Yes | 0 | 5 |
| 012 | Display line 1.3 | Power [kW] | | Yes | Yes | 0 | 5 |
| 013 | Local control/configura | LCP digital control/as par.100 | | Yes | Yes | 0 | 5 |
| 014 | Local stop | Possible | | Yes | Yes | 0 | 5 |
| 015 | Local jog | Not possible | | Yes | Yes | 0 | 5 |
| 016 | Local reversing | Not possible | | Yes | Yes | 0 | 5 |
| 017 | Local reset of trip | Possible | | Yes | Yes | 0 | 5 |
| 018 | Lock for data change | Not locked | | Yes | Yes | 0 | 5 |
| 019 | Operating state at power-up, local control | Forced stop, use saved ref. | | Yes | Yes | 0 | 5 |
| 027 | Warning readout | Warning in line 1/2 | | Yes | No | 0 | 5 |

Changes during operation:

"Yes" means that the parameter can be changed, while the frequency converter is in operation. "No" means that the frequency converter must be stopped before a change can be made.

4-Setup:

"Yes" means that the parameter can be programmed individually in each of the four setups, i.e. the same parameter can have four different data values. "No" means that the data value will be the same in all four setups.

Conversion index:

This number refers to a conversion figure to be used when writing or reading by means of a frequency converter.

| Conversion index | Conversion factor |
|---|---|
| 74 | 0.1 |
| 2 | 100 |
| 1 | 10 |
| 0 | 1 |
| -1 | 0.1 |
| -2 | 0.01 |
| -3 | 0.001 |
| -4 | 0.0001 |

Data type:

Data type shows the type and length of the telegram.

| Data type | Description |
|---|---|
| 3 | Integer 16 |
| 4 | Integer 32 |
| 5 | Unsigned 8 |
| 6 | Unsigned 16 |
| 7 | Unsigned 32 |
| 9 | Text string |

| PNU # | Parameter description | Factory setting | Range | Changes during operation | 4-Setup | Conversion index | Data type |
|---|---|---|---|---|---|---|---|
| 100 | Configuration | Speed control, open loop | | No | Yes | 0 | 5 |
| 101 | Torque characteristics | High - constant torque | | Yes | Yes | 0 | 5 |
| 102 | Motor power | Depends on the unit | 0.18-600 kW | No | Yes | 1 | 6 |
| 103 | Motor voltage | Depends on the unit | 200 - 600 V | No | Yes | 0 | 6 |
| 104 | Motor frequency | 50 Hz / 60 Hz | | No | Yes | 0 | 6 |
| 105 | Motor current | Depends on the unit | 0.01-$I_{VLT,MAX}$ | No | Yes | -2 | 7 |
| 106 | Rated motor speed | Depends on the unit | 100-60000 rpm | No | Yes | 0 | 6 |
| 107 | Automatic motor adaptation, AMA | Adaptation off | | No | No | 0 | 5 |
| 108 | Stator resistor | Depends on the unit | | No | Yes | -4 | 7 |
| 109 | Stator reactance | Depends on the unit | | No | Yes | -2 | 7 |
| 110 | Motor magnetizing, 0 rpm | 100 % | 0 - 300 % | Yes | Yes | 0 | 6 |
| 111 | Min. frequency normal magnetizing | 1.0 Hz | 0.1 - 10.0 Hz | Yes | Yes | -1 | 6 |
| 112 | | | | | | | |
| 113 | Load compensation at low speed | 100 % | 0 - 300 % | Yes | Yes | 0 | 6 |
| 114 | Load compensation at high speed | 100 % | 0 - 300 % | Yes | Yes | 0 | 6 |
| 115 | Slip compensation | 100 % | -500 - 500 % | Yes | Yes | 0 | 3 |
| 116 | Slip compensation time constant | 0.50 s | 0.05 - 1.00 s | Yes | Yes | -2 | 6 |
| 117 | Resonance dampening | 100 % | 0 - 500 % | Yes | Yes | 0 | 6 |
| 118 | Resonance dampening time constant | 5 ms | 5 - 50 ms | Yes | Yes | -3 | 6 |
| 119 | High starting torque | 0.0 sec. | 0.0 - 0.5 s | Yes | Yes | -1 | 5 |
| 120 | Start delay | 0.0 sec. | 0.0 - 10.0 s | Yes | Yes | -1 | 5 |
| 121 | Start function | Coasting in start delay time | | Yes | Yes | 0 | 5 |
| 122 | Function at stop | Coasting | | Yes | Yes | 0 | 5 |
| 123 | Min. frequency for activating function at stop | 0.0 Hz | 0.0 - 10.0 Hz | Yes | Yes | -1 | 5 |
| 124 | DC holding current | 50 % | 0 - 100 % | Yes | Yes | 0 | 6 |
| 125 | DC braking current | 50 % | 0 - 100 % | Yes | Yes | 0 | 6 |
| 126 | DC braking time | 10.0 sec. | 0.0 - 60.0 sec. | Yes | Yes | -1 | 6 |
| 127 | DC brake cut-in frequency | Off | 0.0-par. 202 | Yes | Yes | -1 | 6 |
| 128 | Motor thermal protection | No protection | | Yes | Yes | 0 | 5 |
| 129 | External motor fan | No | | Yes | Yes | 0 | 5 |
| 130 | Start frequency | 0.0 Hz | 0.0-10.0 Hz | Yes | Yes | -1 | 5 |
| 131 | Initial voltage | 0.0 V | 0.0-par. 103 | Yes | Yes | -1 | 6 |
| 145 | Minimum DC brake time | 0 sec. | 0 - 10 sec. | Yes | Yes | -1 | 6 |

| PNU # | Parameter description | Factory setting | Range | Changes during operation | 4-Setup | Conversion index | Data type |
|---|---|---|---|---|---|---|---|
| 200 | Output frequency range/direction | Only clockwise, 0-132 Hz | | No | Yes | 0 | 5 |
| 201 | Output frequency low limit | 0.0 Hz | 0.0 - $f_{MAX}$ | Yes | Yes | -1 | 6 |
| 202 | Output frequency high limit | 66 / 132 Hz | $f_{MIN}$ - par. 200 | Yes | Yes | -1 | 6 |
| 203 | Reference/feedback area | Min - max | | Yes | Yes | 0 | 5 |
| 204 | Minimum reference | 0.000 | -100,000.000-$Ref_{MAX}$ | Yes | Yes | -3 | 4 |
| 205 | Maximum reference | 50.000 | $Ref_{MIN}$ -100,000.000 | Yes | Yes | -3 | 4 |
| 206 | Ramp type | Linear | | Yes | Yes | 0 | 5 |
| 207 | Ramp-up time 1 | Depends on unit | 0.05 - 3600 | Yes | Yes | -2 | 7 |
| 208 | Ramp-down time 1 | Depends on unit | 0.05 - 3600 | Yes | Yes | -2 | 7 |
| 209 | Ramp-up time 2 | Depends on unit | 0.05 - 3600 | Yes | Yes | -2 | 7 |
| 210 | Ramp-down time 2 | Depends on unit | 0.05 - 3600 | Yes | Yes | -2 | 7 |
| 211 | Jog ramp time | Depends on unit | 0.05 - 3600 | Yes | Yes | -2 | 7 |
| 212 | Quick stop ramp-down time | Depends on unit | 0.05 - 3600 | Yes | Yes | -2 | 7 |
| 213 | Jog frequency | 10.0 Hz | 0.0 - par. 202 | Yes | Yes | -1 | 6 |
| 214 | Reference function | Sum | | Yes | Yes | 0 | 5 |
| 215 | Preset reference 1 | 0.00 % | - 100.00 - 100.00 % | Yes | Yes | -2 | 3 |
| 216 | Preset reference 2 | 0.00 % | - 100.00 - 100.00 % | Yes | Yes | -2 | 3 |
| 217 | Preset reference 3 | 0.00 % | - 100.00 - 100.00 % | Yes | Yes | -2 | 3 |
| 218 | Preset reference 4 | 0.00 % | - 100.00 - 100.00 % | Yes | Yes | -2 | 3 |
| 219 | Catch up/slow down value | 0.00 % | 0.00 - 100 % | Yes | Yes | -2 | 6 |
| 220 | | | | | | | |
| 221 | Torque limit for motor mode | 160 % | 0.0 % - xxx % | Yes | Yes | -1 | 6 |
| 222 | Torque limit for regenerative operation | 160 % | 0.0 % - xxx % | Yes | Yes | -1 | 6 |
| 223 | Warning: Low current | 0.0 A | 0.0 - par. 224 | Yes | Yes | -1 | 6 |
| 224 | Warning: High current | $I_{VLT,MAX}$ | Par. 223 - $I_{VLT,MAX}$ | Yes | Yes | -1 | 6 |
| 225 | Warning: Low frequency | 0.0 Hz | 0.0 - par. 226 | Yes | Yes | -1 | 6 |
| 226 | Warning: High frequency | 132.0 Hz | Par. 225 - par. 202 | Yes | Yes | -1 | 6 |
| 227 | Warning: Low feedback | -4000.000 | -100,000.000 - par. 228 | Yes | | -3 | 4 |
| 228 | Warning: High feedback | 4000.000 | Par. 227 - 100,000.000 | Yes | | -3 | 4 |
| 229 | Frequency bypass, bandwidth | OFF | 0 - 100 % | Yes | Yes | 0 | 6 |
| 230 | Frequency bypass 1 | 0.0 Hz | 0.0 - par. 200 | Yes | Yes | -1 | 6 |
| 231 | Frequency bypass 2 | 0.0 Hz | 0.0 - par. 200 | Yes | Yes | -1 | 6 |
| 232 | Frequency bypass 3 | 0.0 Hz | 0.0 - par. 200 | Yes | Yes | -1 | 6 |
| 233 | Frequency bypass 4 | 0.0 Hz | 0.0 - par. 200 | Yes | Yes | -1 | 6 |
| 234 | Motor phase monitor | Enable | | Yes | Yes | 0 | 5 |

| PNU # | Parameter description | Factory setting | Range | Changes during operation | 4-Setup | Conversion index | Data type |
|---|---|---|---|---|---|---|---|
| 300 | Terminal 16, input | Reset | | Yes | Yes | 0 | 5 |
| 301 | Terminal 17, input | Freeze reference | | Yes | Yes | 0 | 5 |
| 302 | Terminal 18 Start, input | Start | | Yes | Yes | 0 | 5 |
| 303 | Terminal 19, input | Reversing | | Yes | Yes | 0 | 5 |
| 304 | Terminal 27, input | Coasting stop, inverse | | Yes | Yes | 0 | 5 |
| 305 | Terminal 29, input | Jog | | Yes | Yes | 0 | 5 |
| 306 | Terminal 32, input | Choice of setup, msb/speed up | | Yes | Yes | 0 | 5 |
| 307 | Terminal 33, input | Choice of setup, lsb/speed down | | Yes | Yes | 0 | 5 |
| 308 | Terminal 53, analogue input voltage | Reference | | Yes | Yes | 0 | 5 |
| 309 | Terminal 53, min. scaling | 0.0 V | 0.0 - 10.0 V | Yes | Yes | -1 | 5 |
| 310 | Terminal 53, max. scaling | 10.0 V | 0.0 - 10.0 V | Yes | Yes | -1 | 5 |
| 311 | Terminal 54, analogue input voltage | No operation | | Yes | Yes | 0 | 5 |
| 312 | Terminal 54, min. scaling | 0.0 V | 0.0 - 10.0 V | Yes | Yes | -1 | 5 |
| 313 | Terminal 54, max. scaling | 10.0 V | 0.0 - 10.0 V | Yes | Yes | -1 | 5 |
| 314 | Terminal 60, analogue input current | Reference | | Yes | Yes | 0 | 5 |
| 315 | Terminal 60, min. scaling | 0.0 mA | 0.0 - 20.0 mA | Yes | Yes | -4 | 5 |
| 316 | Terminal 60, max. scaling | 20.0 mA | 0.0 - 20.0 mA | Yes | Yes | -4 | 5 |
| 317 | Time out | 10 sec. | 1 - 99 sec. | Yes | Yes | 0 | 5 |
| 318 | Function after time out | Off | | Yes | Yes | 0 | 5 |
| 319 | Terminal 42, output | 0 - $I_{MAX}$ Þ 0-20 mA | | Yes | Yes | 0 | 5 |
| 320 | Terminal 42, output, pulse scaling | 5000 Hz | 1 - 32000 Hz | Yes | Yes | 0 | 6 |
| 321 | Terminal 45, output | 0 - $f_{MAX}$ Þ 0-20 mA | | Yes | Yes | 0 | 5 |
| 322 | Terminal 45, output, pulse scaling | 5000 Hz | 1 - 32000 Hz | Yes | Yes | 0 | 6 |
| 323 | Relay 01, output | Ready - no thermal warning | | Yes | Yes | 0 | 5 |
| 324 | Relay 01, ON delay | 0.00 sec. | 0.00 - 600 sec. | Yes | Yes | -2 | 6 |
| 325 | Relay 01, OFF delay | 0.00 sec. | 0.00 - 600 sec. | Yes | Yes | -2 | 6 |
| 326 | Relay 04, output | Ready - remote control | | Yes | Yes | 0 | 5 |
| 327 | Pulse reference, max. frequency | 5000 Hz | | Yes | Yes | 0 | 6 |
| 328 | Pulse feedback, max. frequency | 25000 Hz | | Yes | Yes | 0 | 6 |
| 329 | Encoder feedback pulse/rev. | 1024 pulses/rev. | 1 - 4096 pulses/ rev. | Yes | Yes | 0 | 6 |
| 330 | Freeze reference/output function | No operation | | Yes | No | 0 | 5 |
| 345 | Encoder loss timeout | 1 sec. | 0 - 60 sec | Yes | Yes | -1 | 6 |
| 346 | Encoder loss function | OFF | | Yes | Yes | 0 | 5 |
| 357 | Terminal 42, Output minimum scaling | 0 % | 000 - 100% | Yes | Yes | 0 | 6 |
| 358 | Terminal 42, Output maximum scaling | 100% | 000 - 500% | Yes | Yes | 0 | 6 |
| 359 | Terminal 45, Output minimum scaling | 0 % | 000 - 100% | Yes | Yes | 0 | 6 |
| 360 | Terminal 45, Output maximum scaling | 100% | 000 - 500% | Yes | Yes | 0 | 6 |
| 361 | Encoder loss threshold | 300% | 000 - 600 % | Yes | Yes | 0 | 6 |

| PNU # | Parameter description | Factory setting | Range | Changes during operation | 4-Setup | Conversion index | Data type |
|---|---|---|---|---|---|---|---|
| 400 | Brake function/overvoltage control | Off | | Yes | No | 0 | 5 |
| 401 | Brake resistor, ohm | Depends on the unit | | Yes | No | -1 | 6 |
| 402 | Brake power limit, kW | Depends on the unit | | Yes | No | 2 | 6 |
| 403 | Power monitoring | On | | Yes | No | 0 | 5 |
| 404 | Brake check | Off | | Yes | No | 0 | 5 |
| 405 | Reset function | Manual reset | | Yes | Yes | 0 | 5 |
| 406 | Automatic restart time | 5 sec. | 0 - 10 sec. | Yes | Yes | 0 | 5 |
| 407 | Mains Failure | No function | | Yes | Yes | 0 | 5 |
| 408 | Quick discharge | Not possible | | Yes | Yes | 0 | 5 |
| 409 | Trip delay torque | Off | 0 - 60 sec. | Yes | Yes | 0 | 5 |
| 410 | Trip delay-inverter | Depends on type of unit | 0 - 35 sec. | Yes | Yes | 0 | 5 |
| 411 | Switching frequency | Depends on type of unit | 1.5 - 14 kHz | Yes | Yes | 2 | 6 |
| 412 | Output frequency dependent switching frequency | Not possible | | Yes | Yes | 0 | 5 |
| 413 | Overmodulation function | On | | Yes | Yes | -1 | 5 |
| 414 | Minimum feedback | 0.000 | -100,000.000 - $FB_{HIGH}$ | Yes | Yes | -3 | 4 |
| 415 | Maximum feedback | 1500.000 | $FB_{LOW}$ - 100,000.000 | Yes | Yes | -3 | 4 |
| 416 | Process unit | % | | Yes | Yes | 0 | 5 |
| 417 | Speed PID proportional gain | 0.015 | 0.000 - 0.150 | Yes | Yes | -3 | 6 |
| 418 | Speed PID integration time | 8 ms | 2.00 - 999.99 ms | Yes | Yes | -4 | 7 |
| 419 | Speed PID differentiation time | 30 ms | 0.00 - 200.00 ms | Yes | Yes | -4 | 6 |
| 420 | Speed PID diff. gain ratio | 5.0 | 5.0 - 50.0 | Yes | Yes | -1 | 6 |
| 421 | Speed PID low-pass filter | 10 ms | 5 - 200 ms | Yes | Yes | -4 | 6 |
| 422 | U 0 voltage at 0 Hz | 20.0 V | 0.0 - parameter 103 | Yes | Yes | -1 | 6 |
| 423 | U 1 voltage | parameter 103 | 0.0 - $U_{VLT, MAX}$ | Yes | Yes | -1 | 6 |
| 424 | F 1 frequency | parameter 104 | 0.0 - parameter 426 | Yes | Yes | -1 | 6 |
| 425 | U 2 voltage | parameter 103 | 0.0 - $U_{VLT, MAX}$ | Yes | Yes | -1 | 6 |
| 426 | F 2 frequency | parameter 104 | par.424-par. 428 | Yes | Yes | -1 | 6 |
| 427 | U 3 voltage | parameter 103 | 0.0 - $U_{VLT, MAX}$ | Yes | Yes | -1 | 6 |
| 428 | F 3 frequency | parameter 104 | par.426 -par. 430 | Yes | Yes | -1 | 6 |
| 429 | U 4 voltage | parameter 103 | 0.0 - $U_{VLT, MAX}$ | Yes | Yes | -1 | 6 |

| PNU # | Parameter description | Factory setting | Range | Changes during operation | 4-Setup | Conversion index | Data type |
|---|---|---|---|---|---|---|---|
| 430 | F 4 frequency | parameter 104 | par.426-par.432 | Yes | Yes | -1 | 6 |
| 431 | U 5 voltage | parameter 103 | .0 - $U_{VLT, MAX}$ | Yes | Yes | -1 | 6 |
| 432 | F 5 frequency | parameter 104 | par.426 - 1000 Hz | Yes | Yes | -1 | 6 |
| 433 | Torque proportional gain | 100% | 0 (Off) - 500% | Yes | Yes | 0 | 6 |
| 434 | Torque integral time | 0.02 sec. | 0.002 - 2.000 sec. | Yes | Yes | -3 | 7 |
| 437 | Process PID Normal/inverse control | Normal | | Yes | Yes | 0 | 5 |
| 438 | Process PID anti windup | On | | Yes | Yes | 0 | 5 |
| 439 | Process PID start frequency | parameter 201 | $f_{min - fmax}$ | Yes | Yes | -1 | 6 |
| 440 | Process PID proportional gain | 0.01 | 0.00 - 10.00 | Yes | Yes | -2 | 6 |
| 441 | Process PID integral time | 9999.99 sec. (OFF) | 0.01 - 9999.99 sec. | Yes | Yes | -2 | 7 |
| 442 | Process PID differentiation time | 0.00 sec. (OFF) | 0.00 - 10.00 sec. | Yes | Yes | -2 | 6 |
| 443 | Process PID diff. gain limit | 5.0 | 5.0 - 50.0 | Yes | Yes | -1 | 6 |
| 444 | Process PID lowpass filter time | 0.01 | 0.01 - 10.00 | Yes | Yes | -2 | 6 |
| 445 | Flying start | Disable | | Yes | Yes | 0 | 5 |
| 446 | Switching pattern | SFAVM | | Yes | Yes | 0 | 5 |
| 447 | Torque compensation | 100% | -100 - +100% | Yes | Yes | 0 | 3 |
| 448 | Gear ratio | 1 | 0.001 - 100.000 | No | Yes | -2 | 4 |
| 449 | Friction loss | 0% | 0 - 50% | No | Yes | -2 | 6 |
| 450 | Mains voltage at mains fault | Depends on unit | Depends on unit | Yes | Yes | 0 | 6 |
| 453 | Speed closed loop gear ratio | 1 | 0.01-100 | No | Yes | 0 | 4 |
| 454 | Dead time compensation | On | | No | No | 0 | 5 |
| 455 | Frequency range monitor | Enable | | | | 0 | 5 |
| 457 | Phase loss function | Trip | | Yes | Yes | 0 | 5 |
| 483 | Dynamic DC Link compensation | On | | No | No | 0 | 5 |

| PNU # | Parameter description | Factory setting | Range | Changes during operation | 4-Setup | Conver-sion index | Data type |
|---|---|---|---|---|---|---|---|
| 500 | Address | 1 | 0 - 126 | Yes | No | 0 | 6 |
| 501 | Baudrate | 9600 Baud | | Yes | No | 0 | 5 |
| 502 | Coasting | Logic or | | Yes | Yes | 0 | 5 |
| 503 | Quick-stop | Logic or | | Yes | Yes | 0 | 5 |
| 504 | DC-brake | Logic or | | Yes | Yes | 0 | 5 |
| 505 | Start | Logic or | | Yes | Yes | 0 | 5 |
| 506 | Reversing | Logic or | | Yes | Yes | 0 | 5 |
| 507 | Selection of setup | Logic or | | Yes | Yes | 0 | 5 |
| 508 | Selection of speed | Logic or | | Yes | Yes | 0 | 5 |
| 509 | Bus jog 1 | 10.0 Hz | 0.0 - parameter 202 | Yes | Yes | -1 | 6 |
| 510 | Bus jog 2 | 10.0 Hz | 0.0 - parameter 202 | Yes | Yes | -1 | 6 |
| 511 | | | | | | | |
| 512 | Telegram profile | FC Drive | | No | Yes | 0 | 5 |
| 513 | Bus time interval | 1 sec. | 1 - 99 s | Yes | Yes | 0 | 5 |
| 514 | Bus time interval function | Off | | Yes | Yes | 0 | 5 |
| 515 | Data read-out: Reference % | | | No | No | -1 | 3 |
| 516 | Data read-out: Reference unit | | | No | No | -3 | 4 |
| 517 | Data read-out: Feedback | | | No | No | -3 | 4 |
| 518 | Data read-out: Frequency | | | No | No | -1 | 6 |
| 519 | Data read-out: Frequency x Scaling | | | No | No | -2 | 7 |
| 520 | Data read-out: Current | | | No | No | -2 | 7 |
| 521 | Data read-out: Torque | | | No | No | -1 | 3 |
| 522 | Data read-out: Power, kW | | | No | No | 1 | 7 |
| 523 | Data read-out: Power, HP | | | No | No | -2 | 7 |
| 524 | Data read-out: Motor voltage | | | No | No | -1 | 6 |
| 525 | Data read-out: DC link voltage | | | No | No | 0 | 6 |
| 526 | Data read-out: Motor temp. | | | No | No | 0 | 5 |
| 527 | Data read-out: VLT temp. | | | No | No | 0 | 5 |
| 528 | Data read-out: Digital input | | | No | No | 0 | 5 |
| 529 | Data read-out: Terminal 53, analogue input | | | No | No | -2 | 3 |
| 530 | Data read-out: Terminal 54, analogue input | | | No | No | -2 | 3 |
| 531 | Data read-out: Terminal 60, analogue input | | | No | No | -5 | 3 |
| 532 | Data read-out: Pulse reference | | | No | No | -1 | 7 |
| 533 | Data read-out: External reference % | | | No | No | -1 | 3 |
| 534 | Data read-out: Status word, binary | | | No | No | 0 | 6 |
| 535 | Data read-out: Brake power/2 min. | | | No | No | 2 | 6 |
| 536 | Data read-out: Brake power/sec. | | | No | No | 2 | 6 |
| 537 | Data read-out: Heat sink temperature | | | No | No | 0 | 5 |
| 538 | Data read-out: Alarm word, binary | | | No | No | 0 | 7 |
| 539 | Data read-out: VLT Control word, binary | | | No | No | 0 | 6 |
| 540 | Data read-out: Warning word, 1 | | | No | No | 0 | 7 |
| 541 | Data read-out: Extended Status word | | | No | No | 0 | 7 |
| 553 | Display text 1 | | | No | No | 0 | 9 |
| 554 | Display text 2 | | | No | No | 0 | 9 |
| 557 | Data read-out: Motor RPM | | | No | No | 0 | 4 |
| 558 | Data read-out: Motor RPM x scaling | | | No | No | -2 | 4 |
| 580 | Defined parameter | | | No | No | 0 | 6 |
| 581 | Defined parameter | | | No | No | 0 | 6 |
| 582 | Defined parameter | | | No | No | 0 | 6 |

| PNU # | Parameter description | Factory setting | Range | Changes during opera-tion | 4-Setup | Conver-sion index | Data Type |
|---|---|---|---|---|---|---|---|
| 600 | Operating data: Operating hours | | | No | No | 74 | 7 |
| 601 | Operating data: Hours run | | | No | No | 74 | 7 |
| 602 | Operating data: kWh counter | | | No | No | 1 | 7 |
| 603 | Operating data: Number of power-up's | | | No | No | 0 | 6 |
| 604 | Operating data: Number of overtemperatures | | | No | No | 0 | 6 |
| 605 | Operating data: Number of overvoltages | | | No | No | 0 | 6 |
| 606 | Data log: Digital input | | | No | No | 0 | 5 |
| 607 | Data log: Bus commands | | | No | No | 0 | 6 |
| 608 | Data log: Bus Status word | | | No | No | 0 | 6 |
| 609 | Data log: Reference | | | No | No | -1 | 3 |
| 610 | Data log: Feedback | | | No | No | -3 | 4 |
| 611 | Data log: Motor frequency | | | No | No | -1 | 3 |
| 612 | Data log: Motor voltage | | | No | No | -1 | 6 |
| 613 | Data log: Motor current | | | No | No | -2 | 3 |
| 614 | Data log: DC link voltage | | | No | No | 0 | 6 |
| 615 | Fault log: Error code | | | No | No | 0 | 5 |
| 616 | Fault log: Time | | | No | No | -1 | 7 |
| 617 | Fault log: Value | | | No | No | 0 | 3 |
| 618 | Reset of kWh counter | No reset | | Yes | No | 0 | 5 |
| 619 | Reset of hours-run counter | No reset | | Yes | No | 0 | 5 |
| 620 | Operating mode Normal function | Normal function | | No | No | 0 | 5 |
| 621 | Nameplate: VLT type | | | No | No | 0 | 9 |
| 622 | Nameplate: Power section | | | No | No | 0 | 9 |
| 623 | Nameplate: VLT ordering number | | | No | No | 0 | 9 |
| 624 | Nameplate: Software version no. | | | No | No | 0 | 9 |
| 625 | Nameplate: LCP identification no. | | | No | No | 0 | 9 |
| 626 | Nameplate: Database identification no. | | | No | No | -2 | 9 |
| 627 | Nameplate: Power section identification no. | | | No | No | 0 | 9 |
| 628 | Nameplate: Application option type | | | No | No | 0 | 9 |
| 629 | Nameplate: Application option ordering no. | | | No | No | 0 | 9 |
| 630 | Nameplate: Communication option type | | | No | No | 0 | 9 |
| 631 | Nameplate: Communication option ordering no. | | | No | No | 0 | 9 |

| PNU # | Parameter description | Factory setting | Range | Changes during operation | 4-Setup | Conversion index | Data type |
|---|---|---|---|---|---|---|---|
| 700 | Relay 6, function | Ready signal | | Yes | Yes | 0 | 5 |
| 701 | Relay 6, ON delay | 0 sec. | 0.00-600 sec. | Yes | Yes | -2 | 6 |
| 702 | Relay 6, OFF delay | 0 sec. | 0.00-600 sec. | Yes | Yes | -2 | 6 |
| 703 | Relay 7, function | Motor running | | Yes | Yes | 0 | 5 |
| 704 | Relay 7, ON delay | 0 sec. | 0.00-600 sec. | Yes | Yes | -2 | 6 |
| 705 | Relay 7, OFF delay | 0 sec. | 0.00-600 sec. | Yes | Yes | -2 | 6 |
| 706 | Relay 8, function | Mains ON | | Yes | Yes | 0 | 5 |
| 707 | Relay 8, ON delay | 0 sec. | 0.00-600 sec. | Yes | Yes | -2 | 6 |
| 708 | Relay 8, OFF delay | 0 sec. | 0.00-600 sec. | Yes | Yes | -2 | 6 |
| 709 | Relay 9, function | Fault | | Yes | Yes | 0 | 5 |
| 710 | Relay 9, ON delay | 0 sec. | 0.00-600 sec. | Yes | Yes | -2 | 6 |
| 711 | Relay 9, OFF delay | 0 sec. | 0.00-600 sec. | Yes | Yes | -2 | 6 |

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