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Quick Guide
VLT® 2800



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1 Introduction

1.1 Purpose of the Manual

The Quick Guide provides basic information for safe installation and commissioning of the frequency converter.

The Quick Guide is intended for use by qualified personnel.

Read and follow the Quick Guide to use the frequency converter safely and professionally, and pay particular attention to the safety instructions and general warnings. Keep the Quick Guide available with the frequency converter.

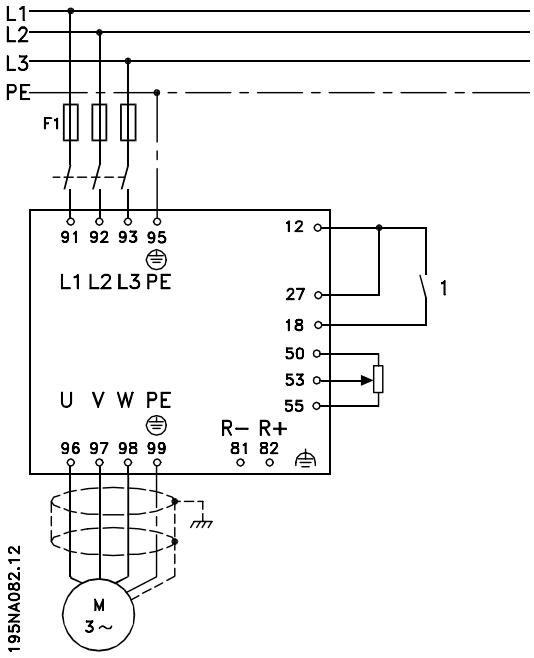


Illustration 1.1 Installation Example

For further examples of installation and detailed descriptions on functions, refer to the *VLT® 2800 Design Guide*.
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1.2 Additional Resources

The Quick Guide provides the basic information for installing and commissioning the frequency converter. Other resources are available to understand advanced frequency converter functions and programming:

- VLT 2800 Design Guide
- VLT 2800 Filter Instruction
- Brake Resistor Manual
- Profibus DP V1 Manual
- Profibus DP Manual
- VLT 2800 DeviceNet Manual
- Metasys N2 Manual
- Modbus RTU Manual
- Precise Stop
- Wobble Function
- VLT 2800 NEMA 1 Terminal Covering
- VLT 2800 LCP Remote-mounting Kit
- Protection against Electrical Hazards

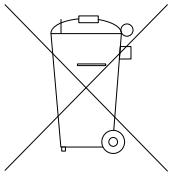
1.3 Document and Software Version

Edition	Remarks	Software version
MG28M2	Replaces MG28M1	3.2X

1.4 Approvals and Certifications

The frequency converter complies with UL508C thermal memory retention requirements. For more information, refer to the section *Motor Thermal Protection* in the *Design Guide*.

1.5 Disposal



Do not dispose of equipment containing electrical components together with domestic waste.
Collect it separately in accordance with local and currently valid legislation.

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2 Safety

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2.1 Safety Symbols

The following symbols are used in this document:

⚠WARNING

Indicates a potentially hazardous situation which could result in death or serious injury.

⚠CAUTION

Indicates a potentially hazardous situation which could result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTICE

Indicates important information, including situations that may result in damage to equipment or property.

2.2 Qualified Personnel

Correct and reliable transport, storage, installation, operation and maintenance are required for the trouble-free and safe operation of the frequency converter. Only qualified personnel is allowed to install or operate this equipment.

Qualified personnel is defined as trained staff, who are authorised to install, commission, and maintain equipment, systems and circuits in accordance with pertinent laws and regulations. Additionally, the personnel must be familiar with the instructions and safety measures described in this document.

2.3 Safety Precautions

⚠WARNING

HIGH VOLTAGE

Frequency converters contain high voltage when connected to AC mains input, DC power supply, or load sharing. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury.

- **Installation, start-up, and maintenance must be performed by qualified personnel only.**

⚠WARNING

UNINTENDED START

When the frequency converter is connected to AC mains, DC power supply, or load sharing, the motor may start at any time. Unintended start during programming, service or repair work can result in death, serious injury, or property damage. The motor can start by means of an external switch, a serial bus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 software, or after a cleared fault condition.

To prevent unintended motor start:

- **Disconnect the frequency converter from mains.**
- **Press [Off/Reset] on the LCP, before programming parameters.**
- **The frequency converter, motor, and any driven equipment must be fully wired and assembled when the frequency converter is connected to AC mains, DC power supply, or load sharing.**

2.3.1 Discharge Time

⚠WARNING

DISCHARGE TIME

The frequency converter contains DC-link capacitors, which can remain charged even when the frequency converter is not powered. Failure to wait the specified time after power has been removed before performing service or repair work, can result in death or serious injury.

- **Stop motor.**
- **Disconnect AC mains and remote DC-link power supplies, including battery back-ups, UPS, and DC-link connections to other frequency converters.**
- **Disconnect or lock PM motor.**
- **Wait at least 4 minutes for the capacitors to discharge fully, before performing any service or repair work.**

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⚠WARNING

LEAKAGE CURRENT HAZARD

Leakage currents exceed 3.5 mA. Failure to ground the frequency converter properly can result in death or serious injury.

- **Ensure correct grounding of the equipment by a certified electrical installer.**

⚠WARNING

EQUIPMENT HAZARD

Contact with rotating shafts and electrical equipment can result in death or serious injury.

- **Ensure that only trained and qualified personnel perform installation, start up, and maintenance.**
- **Ensure that electrical work conforms to national and local electrical codes.**
- **Follow the procedures in this manual.**

⚠CAUTION

INTERNAL FAILURE HAZARD

An internal failure in the frequency converter can result in serious injury, when the frequency converter is not properly closed.

- **Before applying power, ensure all safety covers are in place and securely fastened.**

NOTICE

HIGH ALTITUDES

For installation at altitudes above 2,000 m, contact Danfoss regarding PELV.

NOTICE

Use on Isolated Mains

For details about the use of the frequency converter on isolated mains, refer to section *RFI Switch* in the *Design Guide*.

Follow the recommendations regarding the installation on IT-mains. Use relevant monitoring devices for IT-mains to avoid damage.

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3 Mechanical Installation

3.1 Overview

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VLT 2800 frequency converters allow side-by-side installation on a wall in any position as the units do not require ventilation on the side. Because of the need for cooling, there must be 100 mm free air passage above and below the frequency converter.

All units with enclosure IP20 must be integrated in cabinets and panels. IP20 is not suitable for remote mounting. In some countries, for example in the USA, units with enclosure NEMA 1 are approved for remote mounting.

NOTICE

With the IP21 solution, all units require a minimum of 100 mm air on each side. This means that side-by-side mounting is NOT allowed.

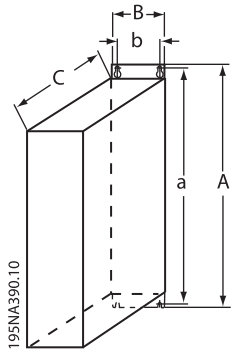


Illustration 3.1 Dimensions

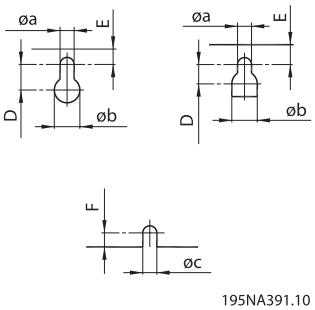


Illustration 3.2 Mounting Holes

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Size mm	A	a	B	b	C	D	E	øa	øb	F	øc
S2 - 200-240 V AC											
VLT 2803-2815	200	191	75	60	168	7	5	4.5	8	4	4.5
D2 - 200-240 V AC											
VLT 2803-2815	200	191	75	60	168	7	5	4.5	8	4	4.5
VLT 2822*	267.5	257	90	70	168	8	6	5.5	11	4.5	5.5
VLT 2840*	267.5	257	140	120	168	8	6	5.5	11	4.5	5.5
PD2 - 200-240 V AC											
VLT 2822	267.5	257	140	120	168	8	6	5.5	11	4.5	5.5
VLT 2840	505	490	200	120	244	7.75	7.25	6.5	13	8	6.5
T2 - 200-240 V AC											
VLT 2822	267.5	257	90	70	168	8	6	5.5	11	4.5	5.5
VLT 2840	267.5	257	140	120	168	8	6	5.5	11	4.5	5.5
T4 - 380-480 V AC											
VLT 2805-2815	200	191	75	60	168	7	5	4.5	8	4	4.5
VLT 2822-2840	267.5	257	90	70	168	8	6	5.5	11	4.5	5.5
VLT 2855-2875	267.5	257	140	120	168	8	6	5.5	11	4.5	5.5
VLT 2880-2882	505	490	200	120	244	7.75	7.25	6.5	13	8	6.5

Table 3.1 Dimensions

Installation Procedures

1. Drill holes in accordance with the measurements given in *Table 3.1*. Note the difference in unit voltages.
2. Retighten all 4 screws.
3. Fit the decoupling plate to the power cables and the ground screw (terminal 95).

3.2 Motor Coils (195N3110) and RFI 1B Filter (195N3103)

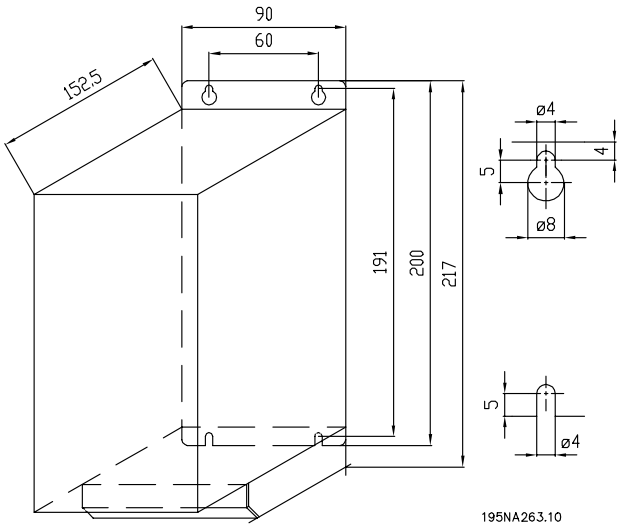


Illustration 3.3 Motor Coils (195N3110)

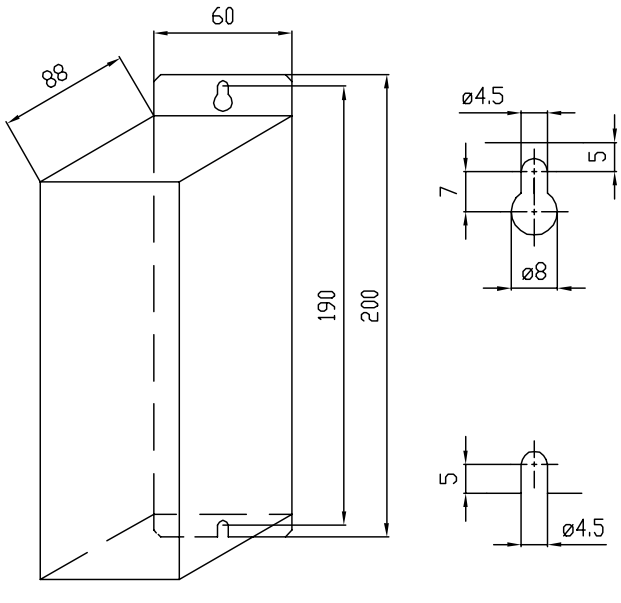


Illustration 3.4 RFI 1B Filter (195N3103)

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3.3 Terminal Cover

Illustration 3.5 shows the dimensions for NEMA 1 terminal covers for VLT 2803-2875.
Dimension 'a' depends on the unit type.

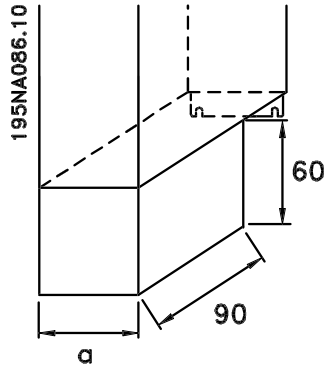


Illustration 3.5 Terminal Cover Dimensions

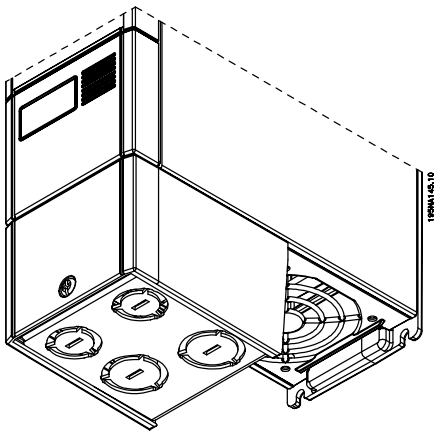


Illustration 3.6 NEMA 1 Terminal Cover

3.4 IP21 Solution

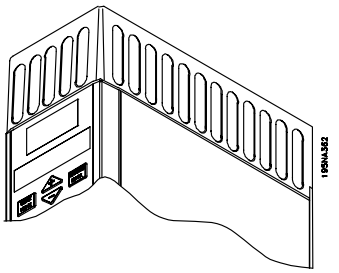


Illustration 3.7 IP21 Solution

Type	Code number	A	B	C
VLT 2803-2815, 200-240 V VLT 2805-2815, 380-480 V	195N2118	47	80	170
VLT 2822, 200-240 V VLT 2822-2840, 380-480 V	195N2119	47	95	170
VLT 2840, 200-240 V VLT 2822, PD2 VLT 2855-2875, 380-480 V	195N2120	47	145	170
VLT 2880-2882, 380-480 V VLT 2840, PD2	195N2126	47	205	245

Table 3.2 Dimensions

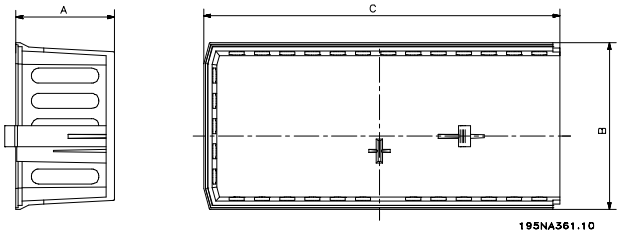


Illustration 3.8 Dimensions for IP 21

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3.5 EMC Filter for Long Motor Cables

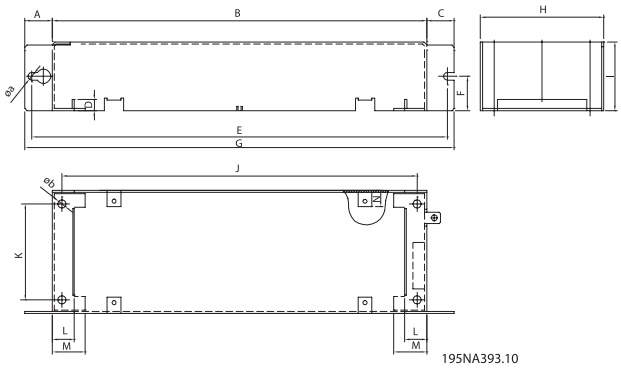


Illustration 3.9 Filter Dimensions

Filter	Dimensions							
192H4719	**A**	**B**	**C**	**øa**	**D**	**E**	**F**	**G**
	20	204	20	5.5	8	234	27.5	244
	H	**I**	**øb**	**J**	**K**	**L**	**M**	**N**
	75	45	6	190	60	16	24	12
192H4720	**A**	**B**	**C**	**øa**	**D**	**E**	**F**	**G**
	20	273	20	5.5	8	303	25	313
	H	**I**	**øb**	**J**	**K**	**L**	**M**	**N**
	90	50	6	257	70	16	24	12
192H4893	**A**	**B**	**C**	**øa**	**D**	**E**	**F**	**G**
	20	273	20	5.5	8	303	25	313
	H	**I**	**øb**	**J**	**K**	**L**	**M**	**N**
	140	50	6	257	120	16	24	12

Table 3.3 Filter Dimensions

4 Electrical Installation

4.1 Electrical Installation in General

NOTICE

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

4

Terminal tightening torques are described below:

VLT	Terminals	Torque (Nm)	Torque, Control Cables (Nm)
2803-2875	Power mains brake Ground	0.5-0.6 2-3	0.22-0.25
2880-2882, 2840 PD2	Power mains brake Ground	1.2-1.5 2-3	

4.2 Power Cables

NOTICE

The power terminals can be removed.

Connect mains to the mains terminals of the frequency converter, i.e. L1, L2 and L3 and the ground connection to terminal 95.

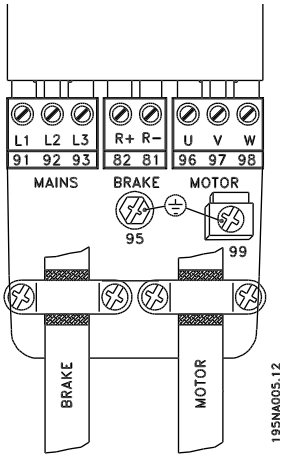


Illustration 4.1 Terminals

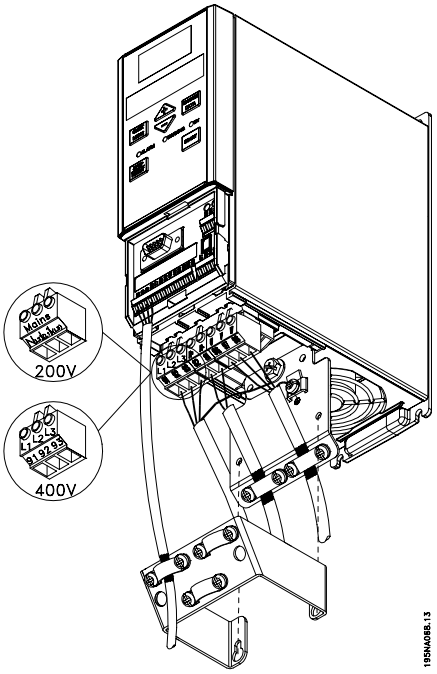


Illustration 4.2 VLT 2803-2815, 200-240 V
VLT 2805-2815, 380-480 V

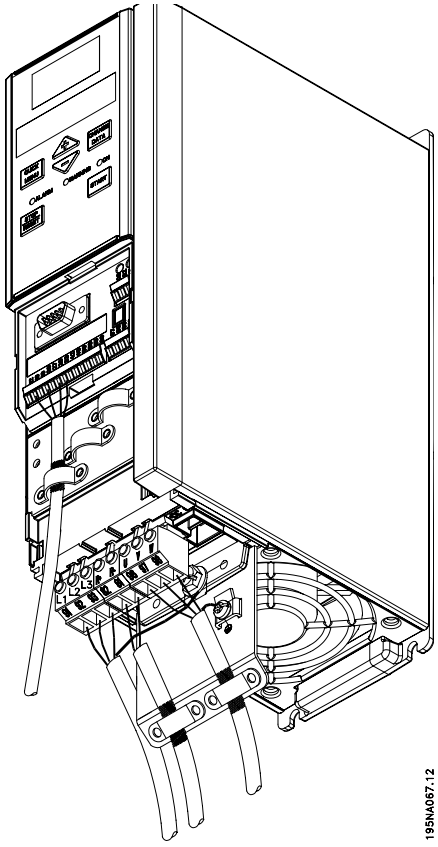


Illustration 4.3 VLT 2822, 200-240 V
VLT 2822-2840, 380-480 V

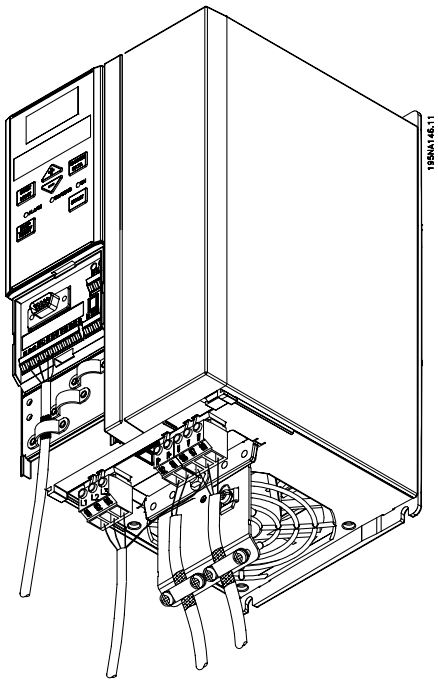


Illustration 4.4 VLT 2840, 200-240 V
VLT 2822, 200-240 V - PD2
VLT 2855-2875, 380-480 V

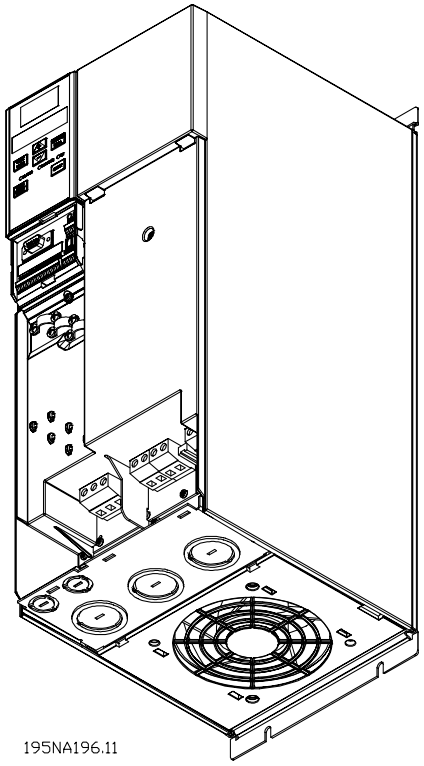


Illustration 4.5 VLT 2840, 200-240 V, PD2
VLT 2880-2882, 380-480 V

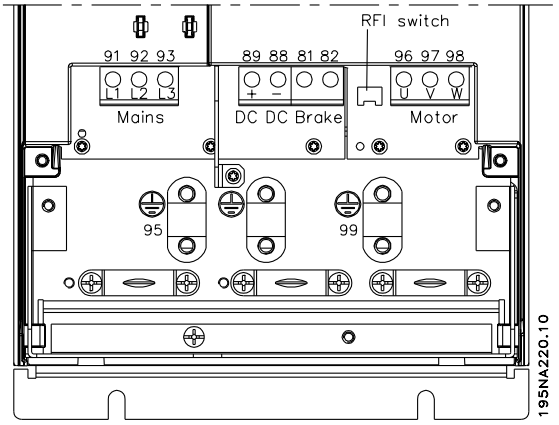


Illustration 4.6 Electrical Connections VLT 2880-2882 and 2840 PD2

Fit screened/armoured cable from the motor to the motor terminals of the frequency converter, i.e. U, V, W. The screen ends in a screen connector.

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4.3 Mains Connection

NOTICE

At 1 x 220-240 V, the neutral wire must be attached to terminal N (L2) and the phase wire must be connected to terminal L1 (L1).

No.	N(L2)	L1(L1)	(L3)	Mains voltage 1 x 220-240 V
	N	L1		
No.	95			Ground connection

Table 4.1 Mains Connection for 1 x 220-240 V

No.	N(L2)	L1(L1)	(L3)	Mains voltage 3 x 220-240 V
	L2	L1	L3	
No.	95			Ground connection

Table 4.2 Mains Connection for 3 x 220-240 V

No.	91	92	93	Mains voltage 3 x 380-480 V
	L1	L2	L3	
No.	95			Ground connection

Table 4.3 Mains Connection for 3 x 380-480 V

NOTICE

Check that the mains voltage fits the mains voltage of the frequency converter, which can be seen from the nameplate.

CAUTION

400-V units with RFI-filters may not be connected to mains supplies in which the voltage between phase and ground is more than 300 V. For the IT mains and the delta ground, the mains voltage can exceed 300 V between phase and ground. Units with type code R5 (IT mains) can be connected to mains supplies with up to 400 V between phase and ground.

See *chapter 7.2 General Specifications* for correct dimensioning of cable cross-section. See also the section *Galvanic isolation* in the *VLT® 2800 Design Guide* for further details.

4.4 Motor Connection

Connect the motor to terminals 96, 97, 98. Connect ground to terminal 99.

See *chapter 7.2 General Specifications* for correct dimensioning of cable cross-section.

All types of 3-phase asynchronous standard motors can be connected to a frequency converter. Normally, small motors are star-connected (230/400 V, Δ/Y).

NOTICE

In motors without phase insulation paper, an LC filter should be fitted on the output of the frequency converter.

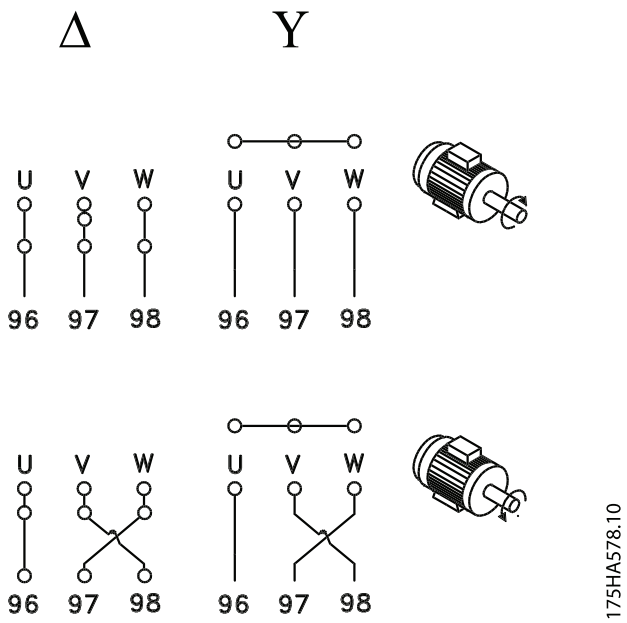


Illustration 4.7 Motor Connection

The factory setting is for clockwise rotation.
The direction of rotation can be changed by switching 2 phases on the motor terminals.

4.5 Parallel Connection of Motors

The frequency converter is able to control several motors connected in parallel.
Consult the *Design Guide* for further information.

NOTICE

Ensure that the total cable length is appropriate. See the *chapter 4.10.1 EMC Emission* to learn about the relationship between cable length and EMC emission.

NOTICE

Parameter *107 Automatic motor adaption, AMT* cannot be used when motors are connected in parallel. Parameter *101 Torque characteristic* must be set to *Special motor characteristics [8]* when motors are connected in parallel.

4.6 Motor Cables

See *chapter 7.2 General Specifications* for correct dimensioning of motor cable cross-section and length. See *chapter 4.10.1 EMC Emission* for relationship between length and EMC emission.
Always comply with national and local regulations on cable cross-section.

NOTICE

If an unscreened/unarmoured cable is used, some EMC requirements are not complied with. Refer to *chapter 4.10.1 EMC Emission* for more details.

To comply with the EMC specifications regarding emission, the motor cable must be screened/armoured, 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. Connect the motor cable screen to the metal cabinet of the frequency converter and to the metal cabinet of the motor. Make the screen connections with the biggest possible surface area (cable clamp). This is enabled by different installation devices in different frequency converters. Avoid mounting with twisted screen ends (pigtails), since these spoil the screening effect at high frequencies. If it is necessary to break the screen to install a motor isolator or motor relay, the screen must be continued at the lowest possible HF impedance.

4.7 Motor Thermal Protection

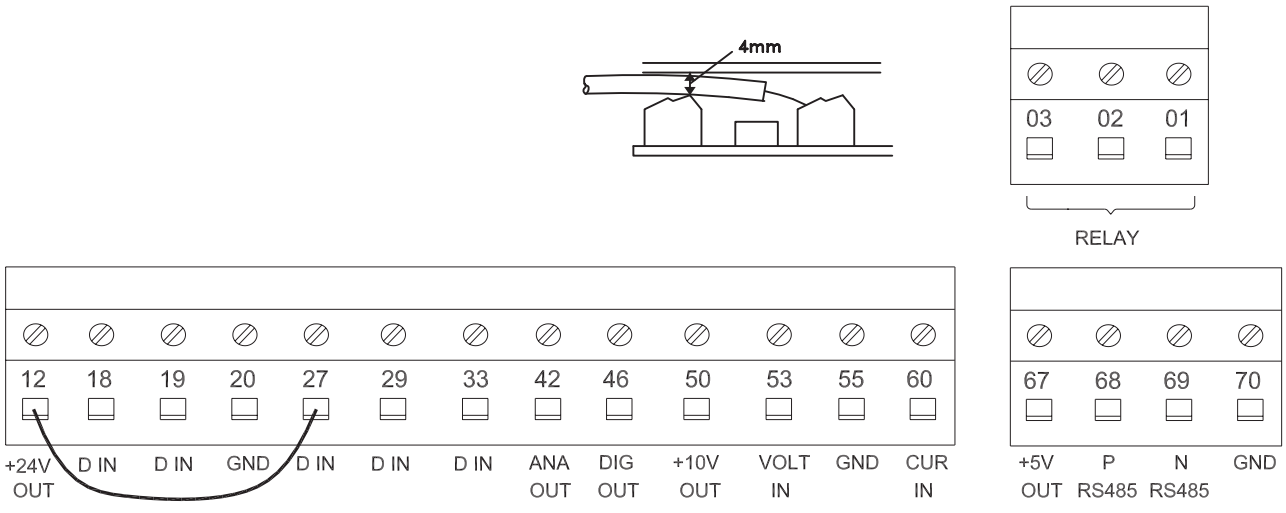
The electronic thermal relay in the frequency converter has received the UL-approval for single motor protection, when parameter *128 Motor thermal protection* has been set for *ETR Trip* and parameter *105 Motor current, $I_{M,N}$* has been programmed to the rated motor current (see motor nameplate).

4.8 Control Cables

Remove the front cover underneath the control panel. Place a jumper between terminals 12 and 27.

Control cables must be screened/armoured. The screen must be connected to the frequency converter chassis with a clamp. Normally, the screen must also be connected to the chassis of the controlling unit (use the instructions for the unit in question). In connection with very long control cables and analog signals, in rare cases depending on the installation, 50/60 Hz ground loops may occur because of noise transmitted from mains supply cables. In this connection, it may be necessary to break the screen and possibly insert a 100 nF capacitor between the screen and the chassis.

See section *Grounding of Screened/Armoured control cables* in the *Design Guide* for the correct termination of control cables.



195NA392.10

Illustration 4.8 Control Cable Connection

No.	Function
01-03	Relay outputs 01-03 can be used for indicating status and alarms/warnings.
12	24 V DC voltage supply.
18-33	Digital inputs.
20, 55	Common frame for input and output terminals.
42	Analog output for displaying frequency, reference, current or torque.
46[1)]	Digital output for displaying status, warnings or alarms, as well as frequency output.
50	+10 V DC supply voltage for potentiometer or thermistor.
53	Analogue voltage input 0-10 V DC.
60	Analogue current input 0/4-20 mA.
67[1)]	+ 5 V DC supply voltage to Profibus.
68, 69[1)]	RS-485, Serial communication.
70[1)]	Frame for terminals 67, 68 and 69. Normally, this terminal is not to be used.

Table 4.4 Control Signals

1) The terminals are not valid for DeviceNet. See the DeviceNet manual for further details.

See parameter *323 Relay output* for programming of relay output.

No.	01-02	1-2 make (NO - Normally Open)
	01-03	1-3 break (NC - Normally Closed)

Table 4.5 Relay Contacts

NOTICE

The cable jacket for the relay must cover the first row of control card terminals - otherwise the galvanic isolation (PELV) cannot be maintained. Max. cable diameter: 4 mm.

4.9 Grounding

Comply with the following at installation:

- Safety grouding: The frequency converter has a high leakage current and must be grounded properly for safety. Follow all local safety regulations.
- High frequency grounding: Keep grounding connections as short as possible.

Connect all grounding systems to ensure the lowest possible conductor impedance. The lowest possible conductor impedance is achieved by keeping the conductor as short as possible and by grounding with the greatest possible surface area. If multiple frequency converters are installed in a cabinet, use the metal cabinet backplate as a joint ground reference plate. Fit the frequency converters to the backplate at the lowest possible impedance.

To achieve low impedance, connect the frequency converter to the backplate with the frequency converter fastening bolts. The backplate must be free from paint.

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4.10 EMC Emission

The following system results are achieved on a system consisting of a VLT® 2800 frequency converter with screened/armoured control cable, control box with potentiometer, screened/armoured motor cable and screened/armoured brake cable as well as an LCP2 with cable.

VLT 2803-2875	Emission			
	Industrial environment		Residential, commercial and light industry	
	EN 55011 class 1A		EN 55011 class 1B	
Set-up	Cable-borne 150 kHz-30 MHz	Radiated 30 MHz-1 GHz	Cable-borne 150 kHz-30 MHz	Radiated 30 MHz-1 GHz
3 x 480 V version with 1A RFI filter	Yes 25 m screened/ armoured	Yes 25 m screened/armoured	No	No
3 x 480 V version with 1A RFI filter (R5: For IT mains)	Yes 5 m screened/armoured	Yes 5 m screened/armoured	No	No
1 x 200 V version with 1A RFI filter[1)]	Yes 40 m screened/ armoured	Yes 40 m screened/armoured	Yes 15 m screened/armoured	No
3 x 200 V version with 1A RFI filter (R4: For use with RCD)	Yes 20 m screened/ armoured	Yes 20 m screened/armoured	Yes 7 m screened/armoured	No
3 x 480 V version with 1A+1B RFI filter	Yes 50 m screened/ armoured	Yes 50 m screened/armoured	Yes 25 m screened/armoured	No
1 x 200 V version with 1A+1B RFI filter[1)]	Yes 100 m screened/ armoured	Yes 100 m screened/ armoured	Yes 40 m screened/armoured	No
VLT 2880-2882	**Emission**			
	Industrial environment		**Residential, commerce and light industry**	
	EN 55011 class 1A		**EN 55011 class 1B**	
Set-up	**Cable-borne 150 kHz-30 MHz**	**Radiated 30 MHz-1 GHz**	**Cable-borne 150 kHz-30 MHz**	**Radiated 30 MHz-1GHz**
3 x 480 V version with 1B RFI filter	Yes 50 m	Yes 50 m	Yes 50 m	No

Table 4.6 EMC Emission Compliance

1) For VLT 2822-2840 3 x 200-240 V, the same values apply as for the 480 V version with 1A RFI filter.

- **EN 55011: Emission**
  Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) high-frequency equipment.
  - **Class 1A:** Equipment used in an industrial environment.
  - **Class 1B:** Equipment used in areas with a public supply network (residential, commerce and light industry.

4.11 Extra Protection

RCD (Residual Current Device) relays, RCD relays, ELCBs (Earth Leakage Circuit Breaker), multiple protective grounding or grounding can be used as extra protection, provided that local safety regulations are complied with.

3-phase VLT frequency converters require an RCD type B. If an RFI filter is mounted in the frequency converter, and either the switch of the RCD or a manually operated switch is used to connect the frequency converter to the mains voltage, a time delay of minimum 40 ms is required (RCD type B).

If no RFI filter is mounted, or a CI contactor is used for mains connection, no time delay is required.

Single-phase VLT frequency converters require an RCD type A. There is no particular need for a time delay whether RFI filters are mounted or not.

See application note *Protection against Electrical Hazards* for further information on ELCBs.

4.12 EMC-Correct Electrical Installation

General points to observe to ensure EMC-correct electrical installation.

- Use only screened/armoured motor cables and screened/armoured control cables.
- Connect the screen to ground at both ends.
- Avoid installation with twisted screen ends (pigtails), since this ruins the screening effect at high frequencies. Use cable clamps instead.
- It is important to ensure good electrical contact from the installation plate through the installation screws to the metal cabinet of the frequency converter.
- Use starwashers and galvanically conductive installation plates.
- Do not use unscreened/unarmoured motor cables in the installation cabinets.

Illustration 4.9 shows EMC-correct electrical installation, in which the frequency converter has been fitted in an installation cabinet and connected to a PLC.

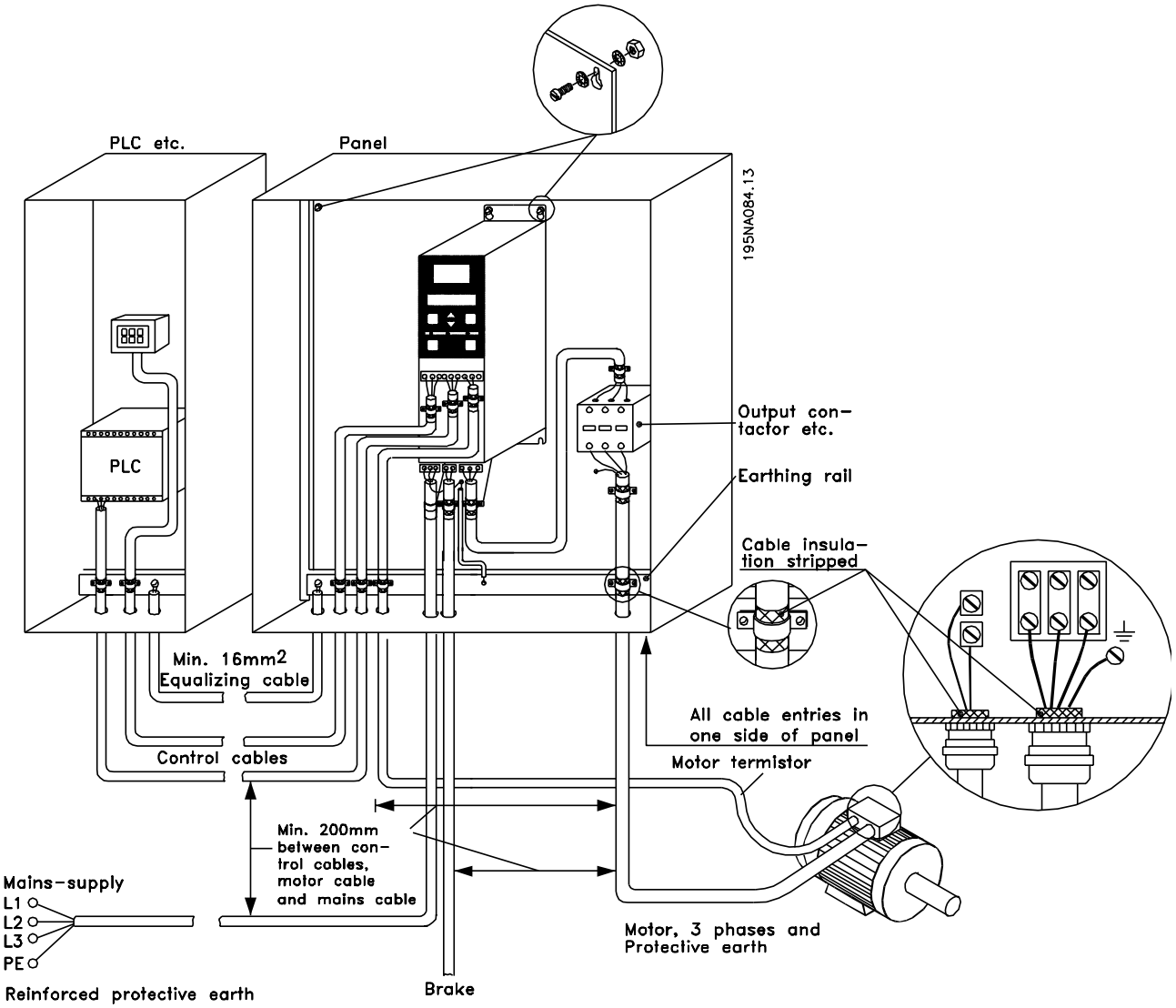


Illustration 4.9 Example of an EMC-correct Electrical Installation

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4.13 Fuses

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

Short circuit protection
Danfoss recommends using the fuses mentioned in *Table 4.7* to protect service personnel and equipment in case of an internal failure in the unit or short-circuit on DC-link. The frequency converter provides full short-circuit protection in case of a short circuit on the motor or brake output.

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

Non
If UL/cUL is not to be complied with, Danfoss recommends using the fuses mentioned in *Table 4.7*, which ensures compliance with EN50178/IEC61800-5-1.
In case of malfunction, not following the fuse recommendation may result in damage to the frequency converter.

4

Alternative fuses 380-500 V drives										
VLT 2800	**Bussmann E52273**	**Bussmann E4273**	**Bussmann E4273**	**Bussmann E4273**	**Bussmann E4273**	**Bussmann E4273**	**SIBA E180276**	**Little Fuse E81895**	**Ferraz-Shawmut E163267/ E2137**	**Ferraz-Shawmut E163267/ E2137**
	RK1/JDDZ	J/JDDZ	T/JDDZ	CC/JDDZ	CC/JDDZ	CC/JDDZ	RK1/JDDZ	RK1/JDDZ	CC/JDDZ	RK1/JDDZ
2805-2820	KTS-R20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20	5017906-020	KLS-R20	ATM-R25	A6K-20R
2855-2875	KTS-R25	JKS-25	JJS-25				5017906-025	KLS-R25	ATM-R20	A6K-25R
2880-2882	KTS-R50	JKS-50	JJS-50				5014006-050	KLS-R50	-	A6K-50R
Alternative Fuses 200-240 V drives										
2803-2822	KTN-R20	JKS-20	JJN-20				5017906-020	KLS-R20	ATM-R25	A6K-20R
2840	KTN-R25	JKS-25	JJN-25				5017906-025	KLS-R25	ATM-R20	A6K-25R

Table 4.7 Prefuses for UL/cUL

4.14 RFI Switch (VLT 2880-2882 Only)

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). For further reference, see IEC 364-3. If optimum EMC performance is needed, parallel motors are connected or the motor cable length is above 25 m, 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 ground capacity currents (according to IEC 61800-3).
Also refer to the application note *VLT on IT mains*. It is important to use isolation monitors that are capable for use together with power electronics (IEC 61557-8).

NOTICE

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. The RFI switch disconnects the capacitors galvanically from ground.

Remove the switch Mk9, placed next to terminal 96, to disconnect the RFI-filter.

5 Control Panel Operations

5.1 Programming

5.1.1 Control Unit

On the front of the frequency converter there is a control panel divided into 4 sections.

1. 6-digit LED display.
2. Keys for changing parameters and shifting display function.
3. Indicator lights.
4. Keys for local operation.

Warning	yellow
Alarm	red
Trip locked	yellow and red

Table 5.1 LED Indication

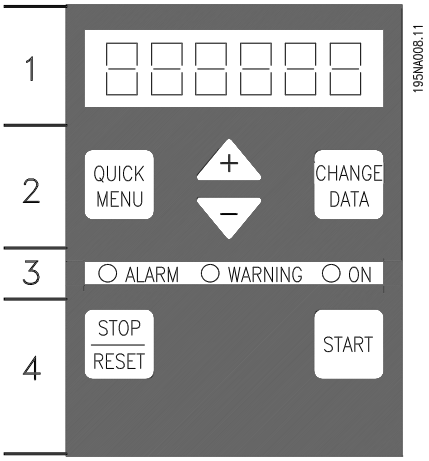


Illustration 5.1 Control Panel

All data is shown in a 6-digit LED display capable of showing one item of operating data continuously during normal operation. As a supplement to the display, there are 3 indicator lights for indication of mains connection (ON), warning (WARNING) and alarm (ALARM). Most of the frequency converter's parameter set-ups can be changed immediately via the control panel, unless this function has been programmed as *[1] Locked* via parameter *018 Lock for data changes*.

5.1.2 Control Keys

[QUICK MENU] allows access to the parameters used for the Quick menu.
The [QUICK MENU] key is also used if a change to a parameter value is not to be implemented.

[CHANGE DATA] is used for changing a setting.
If the display shows 3 dots at the right, the parameter value has more than 3 digits. To see the value, press [CHANGE DATA]
The [CHANGE DATA] key is also used for confirming a change of parameter settings.

[+]/[-]are used for selecting parameters and for changing parameter values.
These keys are also used in Display mode for selecting the display of an operating value.

The [QUICK MENU] and [+] keys must be pressed at the same time to give access to all parameters. See *Menu mode.*

[STOP/RESET] is used for stopping the connected motor or for resetting the frequency converter after a trip.
Can be selected as *[1] Active* or *[0] Not active* via parameter *014 Local stop/reset*. In Display mode, the display flashes if the stop function is activated.

NOTICE

If the [STOP/RESET] key is set to*[0] Not active* in parameter *014 Local stop/reset,* and there is no stop command via the digital inputs or serial communication, the motor can only be stopped by disconnecting the mains voltage to the frequency converter.

[START] is used for starting the frequency converter. It is always active, but the [START] key cannot override a stop command.

5.1.3 Manual Initialisation

Disconnect mains voltage. Press [QUICK MENU]/[+]/[CHANGE DATA] while simultaneously reconnecting the mains voltage. Release the keys; the frequency converter is now programmed for the factory setting.

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5.1.4 Display Readout States

In normal operation, one item of operating data can be displayed continuously at the operator's own choice. Press the [+/-] keys to select the following options in Display mode:

- Output frequency [Hz]
- Output current [A]
- Output voltage [V]
- Intermediate circuit voltage [V]
- Output power [kW]
- Scaled output frequency f_{out} x p008

5.1.5 Menu Mode

To enter the Menu mode, press [QUICK MENU] and [+] at the same time.
In Menu mode, most of the frequency converter parameters can be changed. Scroll through the parameters using the [+/-] keys. While scrolling in the Menu mode proceeds, the parameter number flashes.

5.1.6 Quick Menu

Press the [QUICK MENU] key to access the 12 most important parameters of the frequency converter. After programming, the frequency converter is in most cases ready for operation. When the [QUICK MENU] key is activated in Display mode, the Quick Menu starts. Scroll through the Quick Menu use the [+/-] keys to scroll through the Quick Menu. Change data values by first pressing [CHANGE DATA] and then changing the parameter value with the [+/-] keys.
The Quick Menu parameters are shown in *chapter 5.4 Parameter List*.

5.1.7 Hand Auto

During normal operation the frequency converter is in Auto mode, where the reference signal is given externally, analog or digital via the control terminals. However, in Hand mode, it is possible to give the reference signal locally via the control panel.

On the control terminals, the following control signals remain active when Hand mode is activated:

Hand Start (LCP2)	Quick Stop Inverse
Off Stop (LCP2)	Stop Inverse
Auto Start (LCP2)	Reversing
Reset	DC brake inverse
Coasting Stop Inverse	Setup Select LSB
Reset and Coast Stop Inverse	Setup Select MSB
Thermistor	Jog
Precise Stop Inverse	Stop Comm. Via Serial Comm.
Precise Stop/Start	

Switching between Auto- and Hand Mode
By pressing the [Change Data] in Display mode, the display indicates the mode of the frequency converter.
Scroll up/down to switch to Hand mode. Use [+]/[-] to change the reference.

NOTICE

Parameter *020 Hand operation* may block the choice of mode.

A change of parameter values is saved automatically after a mains failure.
If the display shows 3 dots at the right, the parameter value has more than 3 digits. Press [CHANGE DATA] to see the value.

Press [QUICK MENU]:

Set the motor parameters that are on the motor nameplate

- Motor power [kW] - Parameter 102
- Motor voltage [V] - Parameter 103
- Motor frequency [Hz] - Parameter 104
- Motor current [A] - Parameter 105
- Rated motor speed - Parameter 106

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Activate AMT

- Automatic motor tuning - Parameter 107

1. In parameter *107 Automatic motor tuning*, select data value *[2] Optimisation on (AMT start)*. "107" now flashes, and "2" does not flash.
2. Press Start to activate AMT. "107" now flashes and the dash moves from left to right in the data value field.
3. When "107" appears once more with the data value [0], AMT is complete. Press [STOP/RESET] to save the motor data.
4. "107" continues to flash with the data value [0]. You can now proceed.

NOTICE

VLT 2880-2882 do not have the AMT function.

Set reference range

- Min. reference, Ref_{MIN} - Parameter 204
- Max. reference, Ref_{MAX} - Parameter 205

Set ramp time

- Ramp-up time [s] - Parameter 207
- Ramp-down time [s] - Parameter 208

In parameter *002 Local/remote control*, the frequency converter mode can be selected as *[0] Remote operation*, i.e. via the control terminals, or *[1] Local*, i.e. via the control unit.

Set the control location to *[1] Local*

- Local/remote operation = *[1] Local*, Parameter *002 Local/Remote Operation*

Set the motor speed by adjusting the Parameter *003 Local Reference*

- Parameter *003 Local Reference*

5.2 Motor Start

Press [START] to start the motor. Set the motor speed by adjusting parameter *003 Local Reference*.

Check whether the direction of rotation of the motor shaft is clockwise. If not, exchange any 2 phases on the motor cable.
Press [STOP/RESET] to stop the motor.
Press [QUICK MENU] to return to Display mode.
[QUICK MENU] and [+] keys must be pressed simultaneously to give access to all parameters.

5.3 Connection Examples

More examples can be found in the *VLT® 2800 Design Guide*.

5.3.1 Start/Stop

Start/stop using terminal 18 and coasting stop using terminal 27.

- Parameter *302 Digital input = [7] Start*
- Parameter *304 Digital input = [2] Coasting stop inverted*

For Precise start/stop the following settings are made:

- Parameter *302 Digital input = [27] Precise start/stop*
- Parameter *304 Digital input = [2] Coasting stop inverted*

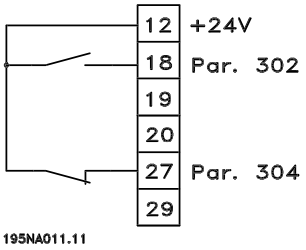


Illustration 5.2 Start/Stop Connection

5.4 Parameter List

All parameters are listed in the following. For information on conversion index, data type and further descriptions, see *VLT® 2800 Design Guide*.

For external communication, see *chapter 1.2 Additional Resources*.

NOTICE

Use MCT-10 and USB to RS-485 converter to change parameters.

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Parameter Overwiev			
0-XX Operation/Display	**008 Display Scaling of Output Frequency**	**013 Local Control**	[2] Speed control, closed loop
0-01 Language	0.01 - 100.00, *1.00	[0] Local not active	[3] Process control, closed loop
*[0] English	**009 Large Diplay Readout**	[1] Local control and open loop without slip compensation	**101 Torque Characteristic**
[1] German	[0] No readout	[2] Remote-operated control and open loop without slip compensation	*[1] Constant torque
[2] French	[1] Resulting reference [%]	[3] Local control as par. 100	[2] Variable torque low
[3] Danish	[2] Resulting reference [unit]	*[4] Remote-operated contorl as par. 100**014 Local stop**	[3] Variable torque medium
[4] Spanish	[3] Feedback [unit]	[0] Not active	[4] Variable torque high
[5] Italian**002 Local/Remote Operation**	*[4] Frequency [Hz]	*[1] Active	[5] Variable torque low with CT start
*[0] Remote operation	[5] Output frequency x scaling	**015 Local Jog**	[6] Variable torque medium with CT start
[1] Local operation	[6] Motor current [A]	*[0] Not active	[7] Variable torque high with CT start
003 Local Reference	[7] Torque [%]	[1] Active	[8] Special motor mode
If par. 013 = [1] or [2]: 0 - f_{MAX}, *50 Hz	[8] Power [kW]	**016 Local Reversing**	**102 Motor Power $P_{M,N}$**
If par. 013 = [3] or [4]: Ref_{MIN} - Ref_{MAX}, *0.0	[9] Power [HP]	*[0] Not active	0.25 - 22 kW, *Dep. on unit
004 Active Set-up	[11] Motor voltage [V]	[1] Active	**103 Motor Voltage $U_{M,N}$**
[0] Factory Set-up	[12] DC link voltage [V]	**017 Local reset of Trip**	For 200 V units: 50 - 999 V, *230 V
*[1] Set-up 1	[13] Thermal load motor [%]	[0] Not active	For 400 V units: 50 - 999 V, *400V
[2] Set-up 2	[14] Thermal load [%]	*[1] Active	**104 Motor Frequency $f_{M,N}$**
[3] Set-up 3	[15] Running hours [Hours]	**018 Lock for Data Changes**	24 - 1000 Hz, *50 Hz
[4] Set-up 4	[16] Digital input [Bin]	*[0] Not locked	**105 Motor Current $I_{M,N}$**
[5] Multi Set-up	[17] Analog input 53 [V]	[1] Locked	0.01 - I_{MAX}, Dep. on motor
005 Programming Set-up	[19] Analog input 60 [mA]	**019 Operating Mode at Power-up, Local Operation**	**106 Rated Motor Speed**
[0] Factory Set-up	[20] Pulse reference [Hz]	[0] Auto re-start, use saved reference	100 - $f_{M,N}$ x 60 (max. 60000 rpm), Dep. on par. 104
*[1] Set-up 1	[21] External reference [%]	*[1] Forced stop, use saved reference	**107 Automatic Motor Tuning, AMT**
[2] Set-up 2	[22] Status word [Hex]	[2] Forced stop, set ref. to 0	*[0] Optimisation off
[3] Set-up 3	[25] Heatsink temperature [°C]	**020 Hand Operation**	[1] Optimisation on
[4] Set-up 4	[26] Alarm word [Hex]	*[0] Not active	**108 Stator Resistance R_S**
*[5] Active Set-up	[27] Control word [Hex]	[1] Active	0.000 - x.xxx Ω, *Dep. on motor
0-06 Set-up Copying	[28] Warning word [Hex]	**024 Userdefined Quick Menu**	**109 Stator Resistance X_S**
*[0] No copying	[29] Extended status word [Hex]	*[0] Not active	0.00 - x.xx Ω, *Dep. on motor
[1] Copy to Set-up 1 from #	[30] Communication option card warning	[1] Active	**117 Resonance Damping**
[2] Copy to Set-up 2 from #	[31] Pulse count	**025 Quick Menu Set-up**	OFF - 100%
[3] Copy to Set-up 3 from #	**010 Small Display Line 1.1**	Value 0 - 999, *000	*OFF%
[4] Copy to Set-up 4 from #	See par. 009.	*Load and Motor*	**119 High Start Torque**
[5] Copy to all set-ups from #	*[17] Analog input 53	**100 Configuration**	0.0 - 0.5 s * 0.0 s
007 LCP Copy	**011 Small Display Readout 1.2**	*[0] Speed control, open loop	**120 Start Delay**
*[0] No copying	See par. 009.		0.0 - 10.0 s * 0.0 s
[1] Upload all parameters	*[6] Motor Current [A]		
[2] Download all parameters	**012 Small Display Readout 1.3**		
[3] Download size-independent parameters	*See par. 009.		
	*[3] Feedback [unit]		

121 Start Function
[0] DC hold during start delay time
[1] DC brake during start delay time
*[2] Coasting during start delay time
[3] Start frequency/voltage clockwise
[4] Start frequency/voltage in reference direction
122 Function at Stop
*[0] Coasting
[1] DC hold
123 Min. Frequency for Activation of Function at Stop
0.1 - 10 Hz, *0.1 Hz
126 DC Brake Time
0 - 60 s, *10 s
127 DC brake cut-in Frequency
0.0 (OFF) - Par. 202, *OFF
128 Thermal Motor Protection
*[0] No protection
[1] Thermistor warning
[2] Thermistor trip
[3] ETR warning 1
[4] ETR trip 1
[5] ETR warning 2
[6] ETR trip 2
[7] ETR warning 3
[8] ETR trip 3
[9] ETR warning 4
[10] ETR trip 4
130 Start Frequency
0.0 - 10.0 Hz, *0.0 Hz
131 Initial Voltage
0.0 - 200.0 V, *0.0 V
132 DC Brake Voltage
0 - 100% of max. DC brake voltage, *0%
133 Start Voltage
0.00 - 100.00 V, *Dep. on unit
134 Load Compensation
0.0 - 300.0%, 100,0%
135 U/f Ratio
0.00 - 20.00 at Hz, *Dep. on unit
136 Slip Compensation
0 - 150 % * 100 %-500 . +500% of rated slip compensation, *100%
137 DC Hold Voltage
0 - 100% if nax. DC hold voltage, *0%
138 Brake Cut Out Value
0.5 - 132.0/1000.0 Hz, *3.0 Hz

139 Brake Cut In Frequency
0.5 - 132.0/1000.0 Hz, *3.0 Hz
140 Current, Minimum Value
0% - 100% of inverter output current
142 Leakage Reactance X_L
0.000 - xxx.xxx Ω, *Dep- on motor
143 Internal Fan Control
*[0] Automatic
[1] Always switched on
[2] Always switched off
144 Gain AC Brake
1.00 - 1.50, *1.30
146 Reset Voltage Vector
*[0] Off
[1] Reset
***References and Limits*200 Output Frequency Range**
*[0] Only clockwise, 0 - 132 Hz
[1] Both directions, 0 - 132 Hz
[2] Counterclockwise only, 0 - 132 Hz
[4] Both directions, 0 - 1000 Hz
[5] Counterclokcwise only, 0 - 1000 Hz
201 Output Frequency Low Limit, f_{MIN}
0.0 - f_{MAX}, *0.0 Hz
202 Output Frequency High Limit, F_{MAX}
f_{MIN} - 132/1000 Hz (par. 200 *Output frequency range*, 132 Hz
203 Reference Range
[0] Min. reference - Max. reference
[1] Analog Input 53 -Max. reference - +Max. reference
204 Minimum Reference, Ref_{MIN}
Par. 100 [0]. -100,000.000 - par. 205 *Ref_{MAX}*, *0.000 Hz
Par. 100 [1]/[3], -par. 414 *Minimum feedback* - par. 205 *Ref_{MAX}*, *0.000 rpm/par. 416
205 maximum Reference, Ref_{MAX}
Par. 100 [0]. Par. 204 *Ref_{MIN} - 1000.000 Hz*, *50.000 Hz
Par. 100 [1]/[3]. Par. 204 *Ref_{MIN}* - Par. 415 *Max Feedback*, *50.000 rpm/par. 416
206 Ramp Type
*[0] Linear
[1] Sin shaped
[2] Sin^2

207 Ramp-up Time 1
0.02 - 3600.00 s, * 3.00 s (VLT 2803 - 2875), * 10.00 (2880 - 2882)
208 Ramp-down Time 1
0.02 - 3600.00 s, * 3.00 s (VLT 2803 - 2875), * 10.00 (2880 - 2882)
209 Ramp-up Time 2
0.02 - 3600.00 s, * 3.00 s (VLT 2803 - 2875), * 10.00 (2880 - 2882)
210 Ramp-down Time 2
0.02 - 3600.00 s, * 3.00 s (VLT 2803 - 2875), * 10.00 (2880 - 2882)
211 Jog Ramp Time
0.02 - 3600.00 s, * 3.00 s (VLT 2803 - 2875), * 10.00 (2880 - 2882)
212 Quick-stop Ramp-down Time
0.02 - 3600.00 s, * 3.00 s (VLT 2803 - 2875), * 10.00 (2880 - 2882)
213 Jog Frequency
0.0 - Par. 202 *Output Frequency High Limit, f_{MAX}*
214 Reference Function
*[0] Sum
[1] Relative
[2] External/preset
215-218 Preset reference 1-4
0.0 - 400.0 Hz * 0.0 Hz-100.00% - +100.00%, * 0.00%
219 Catch Up/Slow Down Reference
0.00 - 100% of the given reference, * 0.00%
221 Current Limit, I_{LIM}
0 - xxx.x% of par. 105, * 160%
223 Warning, Low Current, I_{LOW}
0.0 - par. 224 *Warning: High Current, I_{HIGH}, * 0.0 A*
224 Warning: High Current, I_{HIGH}
0 - I_{MAX}, * I_{MAX}
225 Warning: Low Frequency, f_{LOW}
0.0 - par. 226 *Warn.: High frequency, f*

HIGH, *0.0 Hz
226 Warning: High Frequency f_{HIGH}
If par. 200 = [0]/[1]. Par. 225 *f_{LOW}* - 132 Hz, * 132.0 Hz
If par. 200 [2]/[3]. Par 225 *f_{LOW}* - 1000 Hz, * 132.0 Hz

227 Warning: Low Feedback, FB_{LOW}
0.0 - 400.0 Hz * 0.0 Hz-100,000.000 - par. 228 *Warn.: FB_{HIGH}*, * -4000.000
228 Warning: High Feedback, FB_{HIGH}
Par. 227 *Warn.: FB_{LOW}* - 100,000.000, * 4000.000
229 Frequency Bypass, Bandwidth
0 (OFF) - 100 Hz, * 0 Hz
230 - 231 Frequency Bypass 1 - 2
0 - 100 Hz, *0.0 Hz ***Inputs and Outputs*302 Terminal 18 Digital Input**
[0] No function
[1] Reset
[2] Coasting stop inverse
[3] Reset and coasting inverse
[4] Quick-stop inverse
[5] DC braking inverse
[6] Stop inverse
*[7] Start
[8] Pulse start
[9] Reversing
[10] Reversing
[11] Start Clockwise
[12] Start counterclockwise
[13] Jog
[14] Freeze reference
[15] Freeze output frequency
[16] Speed up
[17] Speed down
[19] Catch up
[20] Slow down
[21] Ramp 2
[22] Preset ref, LSB
[23] Preset ref, MSB
[24] Preset reference on
[25] Thermistor
[26] Precise stop
[27] Precise Start Stop
[31] Selection of Set-up, LSB
[32] Selection of Set-up, MSB
[33] Reset and start
[34 Pulse counter start
303 Terminal 19 Digital Input
See par. 302 * [9] Reversing

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304 Terminal 27 Digital Input
[0] No function
[1] Reset
[2] Coasting stop inverse
*[3] Reset and coasting inverse
[4] Quick-stop inverse
[5] DC braking inverse
[6] Stop inverse
[7] Start
[8] Pulse start
[9] Reversing
[10] Reversing
[11] Start Clockwise
[12] Start counterclockwise
[13] Jog
[14] Freeze reference
[15] Freeze output frequency
[16] Speed up
[17] Speed down
[19] Catch up
[20] Slow down
[21] Ramp 2
[22] Preset ref, LSB
[23] Preset ref, MSB
[24] Preset reference on
[25] Thermistor
[26] Precise stop
[27] Precise Start Stop
[31] Selection of Set-up, LSB
[32] Selection of Set-up, MSB
[33] Reset and start
[34 Pulse counter start
305 Terminal 29 Digital Input
See par. 305 * [13] Jog
307Terminal 33 Digital Input
*[0] No function
[1] Reset
[2] Coasting stop inverse
[3] Reset and coasting inverse
[4] Quick-stop inverse
[5] DC braking inverse
[6] Stop inverse
[7] Start
[8] Pulse start
[9] Reversing
[10] Reversing
[11] Start Clockwise
[12] Start counterclockwise
[13] Jog
[14] Freeze reference
[15] Freeze output frequency
[16] Speed up
[17] Speed down
[19] Catch up
[20] Slow down
[21] Ramp 2
[22] Preset ref, LSB
[23] Preset ref, MSB
[24] Preset reference on
[28] Pulse reference
[29] Pulse feedback
[30] Pulse input
[31] Selection of Set-up, LSB
[32] Selection of Set-up, MSB
[33] Reset and start
308 Terminal 53, Analog Input Voltage
[0] No function
*[1] Reference
[2] Feedback
[3] Wobble **309 Terminal 53 Min. Scaling**
0.0 - 10.0 V, * 0.0 V
310 Terminal 53 Max. Scaling
0.0 - 10.0 V, * 10.0 V
314 Terminal 60 Analog Input Current
[0] No function
[1] Reference
*[2] Feedback
[10] Wobble
315 Terminal 60 Min. Scaling
0.0 - 20.0 mA, * 4.0 mA
316 Terminal 60 Max. Scaling
0.0 - 20.0 mA, * 20.0 mA
317 Time Out
1 - 99 s * 10 s
318
*[0] No operation
[1] Freeze output frequency
[2] Stop
[3] Jog
[4] Max speed
[5] Stop and trip
319 Analog output terminal 42
[0] No function
[1] External reference min. - max. 0 - 20 mA
[2] External reference min. - max. 4- 20 mA
[3] Feedback min. - max. 0-20 mA
[4] Feedback min. - max. 4- 20 mA
[5] Output frequency 0 - max 0-20 mA
[6] Output frequency 0 - max 4-20 mA
*[7] Output current 0 - I_{INV} 0-20 mA
[8] Output current 0 - I_{INV} 4-20 mA
[9] Output power 0-$P_{M,N}$ 0-20 mA
[10] Output power 0-$P_{M,N}$ 4-20 mA
[11] Inverter temperature 20-100 °C 0-20 mA
[12] Inverter temperature 20-100 °C 4-20 mA
323 Relay Output 1-3
[0] No function
*[1] Unit ready
[2] Enable/no warning
[3] Running
[4] Running in reference, no warning
[5] Running, no warning
[6] Running in reference range, no warnings
[7] Ready - mains voltage within range
[8] Alarm or warning
[9] Current higher than current limit
[10] Alarm
[11] Output frequency higher than f_{LOW}
[12] Output frequency lower than f_{HIGH}
[13] Output current higher than I_{LOW}
[14] Output current lower than I_{HIGH} par. 224
[15] Feedback higher than FB_{LOW}
[16] Feedback lower than FB_{HIGH} par. 228
[17] Relay 123
[18] Reversing
[19] Thermal warning
[20] Local operation
[22] Out of frequency range par. 225/226
[23] Out of current range
[24] Out of feedback range
[24] Mechanical brake control
[25] Control word bit 11
327 Pulse reference/feedback
150 - 67600 Hz, * 5000 Hz
328 Maximum Pulse 29
150 - 67600 Hz, * 5000 Hz
341 Digital/Pulse Output Terminal 46
[0] Unit ready
Par. [0] - [20], see par. 323
[21] Pulse reference
Par. [22] - [25], see par. 323
[26] Pulse feedback
[27] Output frequency
[28] Pulse current
[29] Pulse power
[30] Pulse temperature
342 Terminal 46, max. Pulse Scaling
150 - 10000 Hz, * 5000 Hz
343 Precise Stop Function
*[0] Precise ramp stop
[1] Counter stop with reset
[2] Counter stop without reset
[3] Speed-compensated counter stop
[4] Speed-compensated stop with reset
[5] Speed-compensated stop without reset
Counter Value
0 - 999999, * 100000 pulses
349 Speed Comp Delay
0 ms - 100 ms, * 10 ms
Special Functions
400 Brake Function
[0] OFF
[1] Resistor brake
[4] AC brake
[5] Load sharing

405 Reset Function
*[0] Manual reset
[1] Automatic reset x 1
[3] Automatic reset x 3
[10] Automatic reset x 10
[11] Reset at power-up
406 Automatic Restart Time
0 - 10 s, * 5 s
409 Trip Delay Overcurrent, I_{LIM}
0 - 60 s (61 = OFF), * OFF
411 Switching Frequency
3000 - 14000 Hz (VLT 2803 - 2875), * 4500 Hz
3000 - 10000 Hz (VLT 2880 - 2882), * 4500 Hz
412 Variable Switching Frequency
*[2] Without LC-filter
[3] LC-filter connected
413 Overmodulation Function
[0] OFF
*[1] ON
414 Minimum Feedback, FB_{MIN}
-100,000.000 - par. 415, *FB_{MAX}*, * 0.000
415 Maximum Feedback, FB_{MAX}
FB_{MIN} - 100,000.000, * 1500.000
416 Process Units
*[0] No unit
[1] %
[2] ppm
[3] rpm
[4] bar
[5] Cycles/min
[6] Pulses/s
[7] Units/s
[8] Units/min
[9] Units/h
[10] ° C
[11] Pa
[12] l/s
[13] m^3/s
[14] l/min
[15] m^3/min
[16] l/h
[17] m^3/h
[18] Kg/s
[19] Kg/min
[20] Kg/h
[21] T/min
[22] T/h
[23] Metres
[24] Nm
[25] m/s
[26] m/min
[27] ° F
[28] In wg
[29] Gal/s
[30] Ft^3/s
[31] Gal/min[32] Ft^3/min
[33] Gal/h
[34] Ft^3/h
[35] Lb/s
[36] Lb/min
[37] Lb/h
[38] Lb ft
[39] Ft/s
[40] Ft/min
417 Speed PID Proportional Gain
0.000 (OFF) - 1.000, * 0.010
418 Speed PID Integral Time
20.00 - 999.99 ms (1000 - OFF), * 100 ms
419 Speed PID Differential Time
0.00 (OFF) - 200.00 ms, * 20.00 ms
420 Speed PID D-Gain Limit
5.0 - 50.0, * 5.0
421 Speed PID Lowpass Filter Time
20 - 500 ms, * 100 ms
423 U1 Voltage0.0 - 999.0 V, * par. 103
424 F1 Frequency
0.0 - par. 426, *F2 frequency*, * Par. 104
425 U2 Voltage
0.0 - 999.0 V, * par. 103
426 F2 Frequency
Par. 424, *F1 frequency* - Par. 428, *F3 frequency*, * par. 104
427 U3 Voltage
0.0 - 999.0 V, * par. 103
428 F3 Frequency
Par. 426, *F2 frequency* - 1000 Hz, * par. 104
437 Process PID Normal/Inverse Control
*[0] Normal
[1] Inverse
438 Process PID Anti Windup
[0] Not active
[1] Active
Process PID Start Frequency
f_{MIN} - f_{MAX} (par. 201 - par. 202), * par. 201
440 Process PID Proportional Gain
0.0 - 10.00, * 0.01
441 Process PID Integration Time
0.00 (OFF) - 10.00 s, * OFF
442 Process PID Differentiation Time
0.00 (OFF) - 10.00 s, * 0.00 s
443 Process PID Diff. Gain Limit
5.0 - 50.0, * 5.0
444 Process PID Lowpass Filter Time
0.02 - 10.00, * 0.02
445 Flying Start
*[0] OFF
[1] OK - same direction
[2] OK - both directions
[2] DC brake and start
451 Speed PID Feedforward Factor
0 - 500 %, * 100 %
452 Controller Range
0 - 200 %, * 10 %
456 Brake Voltage Reduce
0 - 25 V if 200 V, * 0
0 - 50 V if 400 V, * 0
461 Feedback Conversion
*[0] Linear
[1] Square root
462 Enhanced Sleep Mode Timer
Value 0 - 9999 s, * 0 = OFF
463 Boost Setpoint
1 - 200%, * 100% of setpoint
464 Wakeup Pressure
Par. 204, *Ref_{MIN}* - par. 215-218 setpoint, * 0
465 Minimum Pump Frequency
Value par. 201, *f_{MIN}* - par. 202 f_{MAX} (Hz), * 20
466 Maximum Pump Frequency
Value par. 201, *f_{MIN}* - par. 202 f_{MAX} (Hz), * 50
467 Minimum Pump Power
0 - 500.000 W, * 0
468 Maximum Pump Power
0 - 500.000 W, * 0
469 No Flow Power Compensation
0.01 - 2, * 1.2
470 Dry Run Time Out
5 - 30 s, * 31 = OFF
471 Dry Run Interlock Timer
0.5 - 60 min., * 30 min.
484 Initial Ramp
OFF/000.1 s - 360.0 s, * OFF
485 Fill Rate
OFF/000000.001 - 999999.999 (units/s), * OFF
486 Filled Setpoint
Par. 414 - par. 205, * par. 414

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6 Troubleshooting

6.1 Warning and Alarm Messages

No.	Description	W	A	T	Cause of Problem
2	Live zero error (LIVE ZERO ERROR)	X	X	X	Voltage or current signal on terminals 53 or 60 is below 50% of preset value.
4	Mains phase loss (MAINS PHASE LOSS)	X	X	X	No phase on mains supply side.
5	Voltage warning high (DC LINK VOLTAGE HIGH)	X			The intermediate circuit voltage exceeds the limit set.
6	Voltage warning low (DC LINK VOLTAGE LOW)	X			The intermediate circuit voltage is lower the limit set.
7	Overvoltage (DC LINK OVERVOLT)	X	X	X	The intermediate voltage exceeds the limit set.
8	Undervoltage (DC LINK UNDERVOLT)	X	X	X	The intermediate voltage is lower than the limit set.
9	Inverter overload (INVERTER TIME)	X	X		The frequency converter is close to tripping due to overload.
10	Motor overloaded (MOTOR, TIME)	X	X		The motor is too hot due to overload.
11	Motor thermistor (MOTOR THERMISTOR)	X	X		Either the motor is too hot or the thermistor has been disconnected.
12	Current limit (CURRENT LIMIT)	X	X		Output current is higher than set in par. 221.
13	Overcurrent (OVERCURRENT)	X	X	X	The peak current limit has been exceeded.
14	Earth fault (EARTH FAULT)		X	X	Discharge from output phases to earth.
15	Switch mode fault (SWITCH MODE FAULT)		X	X	Fault in switch mode power supply.
16	Short-circuit (CURR. SHORT CIRCUIT)		X	X	Short-circuit on the motor terminals or in the motor.
17	Serial communication timeout (STD BUS TIMEOUT)	X	X		No serial communication to the frequency converter.
18	HPFB bus timeout (HPFB TIMEOUT)	X	X		No serial communication to the communication option card.
33	Out of frequency range (OUT FREQ RNG/ROT LIM)	X			Output frequency has reached the limit set in either par. 201 or par. 202.
34	HPFB communication fault (PROFIBUS OPT. FAULT)	X	X		Fault only occurs in fieldbus versions. Please see par. 953 in fieldbus literature.
35	Inrush fault (INRUSH FAULT)		X	X	Connected to mains too many times within 1 minute.
36	Overtemperature (OVERTEMPERATURE)	X	X		The upper temperature limit has been exceeded.
37-45	Internal fault (INTERNAL FAULT)		X	X	Contact Danfoss.
50	AMT not possible		X		Either R_S value is outside permitted limits, or motor current is too low on at least one phase, or the motor is too small for AMA.
51	AMT fault re. nameplate data (AMT TYPE.DATA FAULT)		X		Inconsistency between registered motor data.
54	AMT wrong motor (AMT WRONG MOTOR)		X		AMA has detected a missing motor phase.
55	AMT timeout (AMT TIMEOUT)		X		Calculations are taking too long, probably caused by noise on motor cables.
56	AMT warning during AMT (AMT WARN. DURING AMT)		X		Warning is given while AMA is performed.
99	Locked (LOCKED)	X			See parameter *018 Lock for data changes*.

Table 6.1 Warning and Alarm Messages

W: *Warning*

A: *Alarm*

T: *Trip locked*

A warning or an alarm appears in the display as a numerical code **Err. xx**. A warning shows in the display until the fault has been corrected, while an alarm continues to flash until the [STOP/RESET] key is pressed. *Table 6.1* shows the various warnings and alarms, and whether the fault locks the frequency converter. After a *Trip locked*, the mains supply is cut off and the fault is corrected. The mains supply is reconnected and the frequency converter is reset. The frequency converter is now ready. A *Trip* can be reset manually in 3 ways:

1. Via the operating key [STOP/RESET].
2. Via a digital input.
3. Via serial communication.

It is also possible to select an automatic reset in parameter *405 Reset function*. When a cross appears in both warning and alarm, this means either of the following:

- A warning occurs before an alarm
- A warning or an alarm can be programmed for a given fault.

For example, this is possible in parameter *128 Motor thermal protection*. After a trip, the motor coasts, and both alarm and warning flash on the frequency converter. If the fault disappears, only the alarm flashes. After a reset the frequency converter is ready to start operation again.

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7 Specifications

7.1 Mains Supply Data

7.1.1 Mains Supply 200-240 V

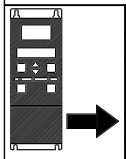
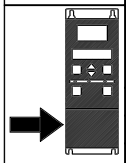
According to international standards		Type	2803	2805	2807	2811	2815	2822	2822 PD2	2840	2840 PD2
	Output current	$I_{INV.}$ [A]	2.2	3.2	4.2	6.0	6.8	9.6	9.6	16	16
	(3 x 200-240V)	I_{MAX} (60s) [A]	3.5	5.1	6.7	9.6	10.8	15.3	10.6	25.6	17.6
	Output power (230 V)	$S_{INV.}$ [KVA]	0.9	1.3	1.7	2.4	2.7	3.8	3.8	6.4	6.4
	Typical shaft output	$P_{M,N}$ [kW]	0.37	0.55	0.75	1.1	1.5	2.2	2.2	3.7	3.7
	Typical shaft output	$P_{M,N}$ [HP]	0.5	0.75	1.0	1.5	2.0	3.0	3.0	5.0	5.0
	Max. cable cross section, motor	[mm²/AWG]	4/10	4/10	4/10	4/10	4/10	4/10	4/10	4/10	16/6
	Input current	$I_{L,N}$ [A]	5.9	8.3	10.6	14.5	15.2	-	22.0	-	31.0
	(1 x 220-240 V)	$I_{L,MAX}$ (60s) [A]	9.4	13.3	16.7	23.2	24.3	-	24.3	-	34.5
	Input current	$I_{L,N}$ [A]	2.9	4.0	5.1	7.0	7.6	8.8	8.8	14.7	14.7
	(3 x 200-240 V)	$I_{L,MAX}$ (60s) [A]	4.6	6.4	8.2	11.2	12.2	14.1	9.7	23.5	16.2
	Max. cable cross section, power	[mm²/AWG]	4/10	4/10	4/10	4/10	4/10	4/10	4/10	4/10	16/6
	Max. pre-fuses	IEC/UL [A]	20/20	20/20	20/20	20/20	20/20	20/20	35/35	25/25	50/50
	Efficiency	[%]	95	95	95	95	95	95	95	95	95
	Power loss at 100% load	[W]	24	35	48	69	94	125	125	231	231
	Weight	[kg]	2.0	2.0	2.0	2.0	2.0	3,7	6.0	6.0	18,5
	Enclosure	type	IP 20	IP 20	IP 20	IP 20	IP 20	IP 20	IP 20	IP 20	IP 20/NEMA 1

Table 7.1 Mains Supply 200-240 V

7.1.2 Mains Supply 380-480 V

According to international standards		Type	2805	2807	2811	2815	2822	2830
	Output current	$I_{INV.}$ [A]	1.7	2.1	3.0	3.7	5.2	7.0
	(3 x 380-480V)	I_{MAX} (60s) [A]	2.7	3.3	4.8	5.9	8.3	11.2
	Output power (400 V)	$S_{INV.}$ [KVA]	1.1	1.7	2.0	2.6	3.6	4.8
	Typical shaft output	$P_{M,N}$ [kW]	0.55	0.75	1.1	1.5	2.2	3.0
	Typical shaft output	$P_{M,N}$ [HP]	0.75	1.0	1.5	2.0	3.0	4.0
	Max. cable cross section, motor	[mm²/AWG]	4/10	4/10	4/10	4/10	4/10	4/10
	Input current	$I_{L,N}$ [A]	1.6	1.9	2.6	3.2	4.7	6.1
	(3 x 380-480 V)	$I_{L,MAX}$(60s)[A]	2.6	3.0	4.2	5.1	7.5	9.8
	Max. cable cross section, power	[mm²/AWG]	4/10	4/10	4/10	4/10	4/10	4/10
	Max. pre-fuses	IEC/UL [A]	20/20	20/20	20/20	20/20	20/20	20/20
	Efficiency	[%]	96	96	96	96	96	96
	Power loss at 100% load	[W]	28	38	55	75	110	150
	Weight	[kg]	2.1	2.1	2.1	2.1	3.7	3.7
	Enclosure	type	IP 20	IP 20	IP 20	IP 20	IP 20	IP 20

Table 7.2 Mains Supply 380-480 V

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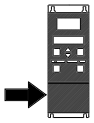
According to international standards		Type	2840	2855	2875	2880	2881	2882
	Output current	$I_{INV.}$ [A]	9.1	12	16	24	32.0	37.5
	(3 x 380-480V)	I_{MAX} (60s) [A]	14.5	19.2	25.6	38.4	51.2	60.0
	Output power (400 V)	$S_{INV.}$ [KVA]	6.3	8.3	11.1	16.6	22.2	26.0
	Typical shaft output	$P_{M,N}$ [kW]	4.0	5.5	7.5	11.0	15.0	18.5
	Typical shaft output	$P_{M,N}$ [HP]	5.0	7.5	10.0	15.0	20.0	25.0
	Max. cable cross section, motor	[mm^2/AWG]	4/10	4/10	4/10	16/6	16/6	16/6
	Input current	$I_{L,N}$ [A]	8.1	10.6	14.9	24.0	32.0	37.5
	(3 x 380-480 V)	$I_{L,MAX}$(60s)[A]	13.0	17.0	23.8	38.4	51.2	60
	Max. cable cross section, power	[mm^2/AWG]	4/10	4/10	4/10	16/6	16/6	16/6
	Max. pre-fuses	IEC/UL [A]	20/20	25/25	25/25	50/50	50/50	50/50
	Efficiency	[%]	96	96	96	97	97	97
	Power loss at 100% load	[W]	200	275	372	412	562	693
	Weight	[kg]	3.7	6.0	6.0	18.5	18.5	18.5
	Enclosure	type	IP20	IP20	IP20	IP20/ NEMA 1	IP20/ NEMA 1	IP20/ NEMA 1

Table 7.3 Mains Supply 380-480 V

7.2 General Specifications

Supply voltage VLT 2803-2840 220-240 V (N, L1)	1x220/230/240 V ±10%
Supply voltage VLT 2803-2840 200-240 V	3x200/208/220/230/240 V ±10%
Supply voltage VLT 2805-2882 380-480 V	3x380/400/415/440/480 V ±10%
Supply voltage VLT 2805-2840 (R5)	380/400 V + 10%
Supply frequency	50/60 Hz ± 3 Hz
Max. imbalance on supply voltage	± 2.0% of rated supply voltage
True Power Factor (λ)	0.90 nominal at rated load
Displacement Power Factor (cos φ)	near unity (> 0.98)
Number of connections at supply input L1, L2, L3	2 times/min.
Max. short-circuit value	100,000 A

See Special Conditions section in the Design Guide.

Output data (U, V, W)	
Output voltage	0-100% of supply voltage
Output frequency	0.2-132 Hz, 1-590 Hz
Rated motor voltage, 200-240 V units	200/208/220/230/240 V
Rated motor voltage, 380-480 V units	380/400/415/440/460/480 V
Rated motor frequency	50/60 Hz
Switching on output	Unlimited
Ramp times	0.02-3600 s

Torque characteristics	
Starting torque (parameter *101 Torque characteristic* = Constant torque)	160% in 1 min.[1)]
Starting torque (parameter *101 Torque characteristics* = Variable torque)	160% in 1 min.[1)]
Starting torque (parameter *119 High starting torque*)	180% for 0.5 s
Overload torque (parameter *101 Torque characteristic* = Constant torque)	160%[1)]
Overload torque (parameter *101 Torque characteristic* = Variable torque)	160%[1)]

Percentage relates to frequency converter's nominal current.

1) VLT 2822 PD2/2840 PD2 1x220 V only 110% in 1 min

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Control card, digital inputs	
Number of programmable digital inputs	5
Terminal number	18, 19, 27, 29, 33
Voltage level	0 - 24 V DC (PNP positive logic)
Voltage level, logic '0'	< 5 V DC
Voltage level, logic '1'	> 10 V DC
Maximum voltage on input	28 V DC
Input resistance, R_i (terminals 18, 19, 27, 29)	approx. 4 kΩ
Input resistance, R_i (terminal 33)	approx. 2 kΩ

All digital inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. See section Galvanic Isolation in the Design Guide.

Control card, analog inputs	
Number of analog voltage inputs	1 pcs.
Terminal number	53
Voltage level	0 - 10 V DC (scaleable)
Input resistance, R_i	approx. 10 kΩ
Max. voltage	20 V
Number of analog current inputs	1 pcs.
Terminal number	60
Current level	0/4 - 20 mA (scaleable)
Input resistance, R_i	approx. 300 Ω
Max. current	30 mA
Resolution for analog inputs	10 bit
Accuracy of analog inputs	Max. error 1% of full scale
Scan interval	13.3 m

The analog inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. See section Galvanic Isolation in the Design Guide.

Control card, pulse inputs	
Number of programmable pulse inputs	1
Terminal number	33
Max. frequency at terminal 33	67.6 kHz (Push-pull)
Max. frequency at terminal 33	5 kHz (open collector)
Min. frequency at terminal 33	4 Hz
Voltage level	0-24 V DC (PNP positive logic)
Voltage level, logic '0'	< 5 V DC
Voltage level, logic '1'	> 10 V DC
Maximum voltage on input	28 V DC
Input resistance, R_i	approx. 2 kΩ
Scan interval	13.3 ms
Resolution	10 bit
Accuracy (100 Hz-1 kHz) terminal 33	Max. error: 0.5% of full scale
Accuracy (1 kHz-67.6 kHz) terminal 33	Max. error: 0.1% of full scale

The pulse input (terminal 33) is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. See section Galvanic Isolation in the Design Guide.

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Control card, digital/frequency output	
Number of programmable digital/pulse outputs	1 pcs.
Terminal number	46
Voltage level at digital/frequency output	0-24 V DC (O.C PNP)
Max. output current at digital/frequency output	25 mA.
Max. load at digital/frequency output	1 kΩ
Max. capacity at frequency output	10 nF
Minimum output frequency at frequency output	16 Hz
Maximum output frequency at frequency output	10 kHz
Accuracy on frequency output	Max. error: 0.2% of full scale
Resolution on frequency output	10 bit

The digital output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. See section Galvanic Isolation in the Design Guide.

Control card, analog output	
Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	0/4-20 mA
Max. load to common at analog output	500 Ω
Accuracy on analog output	Max. error: 1.5% of full scale
Resolution on analog output	10 bit

The analog output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. See section Galvanic Isolation in the Design Guide.

Control card, 24 V DC output	
Terminal number	12
Max. load	130 mA

The 24 V DC supply is galvanically isolated from the supply voltage (PELV) , but has the same potential as the analogue and digital inputs and outputs. See section Galvanic Isolation in the Design Guide.

Control card, 10 V DC output	
Terminal number	50
Output voltage	10.5 V ±0.5 V
Max. load	15 mA

The 10 V DC supply is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. See section Galvanic Isolation in the Design Guide.

Control card, RS 485 serial communication	
Terminal number	68 (TX+, RX+), 69 (TX-, RX-)
Terminal number 67	+ 5 V
Terminal number 70	Common for terminals 67, 68 and 69

Full galvanic isolation. See section Galvanic Isolation in the Design Guide.
For DeviceNet units, see VLT 2800 DeviceNet manual.

Relay outputs[1)]	
Number of programmable relay outputs	1
Terminal number, control card (resisitvie and inductive load)	1-3 (break), 1-2 (make)
Max. terminal load (AC1) on 1-3, 1-2, control card	250 V AC, 2 A, 500 VA
Max. terminal load (DC1 (IEC 947)) on 1-3, 1-2, control card	25 V DC, 2 A/50 V DC, 1A, 50 W
Min. terminal load (AC/DC) on 1-3, 1-2, control card	24 V DC 10 mA, 24 V AC 100 mA

1) The relay contact is separated from the rest of the circuit by strengthened isolation.

NOTICE

Rated values resistive load - cosΦ >0.8 for up to 300,000 operations.
Inductive loads at cosΦ 0.25 approximately 50% load or 50% life time.

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Cable lengths and cross sections	
Max. motor cable length, screened/armoured cable	40 m
Max. motor cable length, unscreened/unarmoured cable	75 m
Max. motor cable length, screened/armoured cable and motor coil	100 m
Max. motor cable length, unscreened/unarmoured cable and motor coil	200 m
Max. motor cable length, screened/armoured cable and RFI/1B filter	200 V, 100 m
Max. motor cable length, screened/armoured cable and RFI/1B filter	400 V, 25 m
Max. motor cable length, screened/armoured cable and RFI 1B/LC filter	400 V, 25 m

Max. cross section to motor, see next section.

Max. cross section to control wires, rigid wire	1.5 mm^2/16 AWG (2x0.75 mm^2)
Max. cross section to control cables, flexible cable	1 mm^2/18 AWG
Max. cross section to control cables, cable with enclosed core	0.5 mm^2/20 AWG

When complying with EN 55011 1A and EN 55011 1B the motor cable must in certain instances be reduced. See EMC Emission for more details.

Control characteristics	
Frequency range	0.2-132 Hz, 1-590 Hz
Resolution of output frequency	0.013 Hz, 0.2-590 Hz
Repeat accuracy of *Precise start/stop*(terminals 18, 19)	± 0.5 ms
System response time (terminals 18, 19, 27, 29, 33)	26.6 ms
Speed control range (open loop)	1:10 of synchronous speed
Speed control range (closed loop)	1:120 of synchronous speed
Speed accuracy (open loop)	150-3600 RPM: Max. error of ±23 RPM
Speed accuracy (closed loop)	30-3600 RPM: Max. error of ±7.5 RPM

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

Surroundings	
Enclosure	IP20
Enclosure with options	NEMA 1 and IP21
Vibration test	0.7 g
Max. relative humidity	5%-93% during operation
Ambient temperature	Max. 45 °C (24-hour average max. 40 °C)

Derating for high ambient temperature, see Special Conditions in the Design Guide

Min. ambient temperature during full-scale 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 high air pressure, see Special Conditions in the Design Guide

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

See section Special Conditions in the Design Guide

Safeguards

- Electronic thermal motor protection against overload.
- Temperature monitoring of the power module ensures that the frequency converter cuts out if the temperature reaches 100 °C. An overload temperature cannot be reset until the temperature of the power module is below 70 °C.

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7.3 Special Conditions

7.3.1 Aggressive Environments

⚠CAUTION

Do not install the frequency converter in environments where liquids, particles or gases are in the air that would impact and damage the electronics. Unless the necessary measures are taken to protect the frequency converter, there is a risk of stoppages, which reduce the service life of the frequency converter.

Aggressive gases, such as sulphur, nitrogen and chlorine compounds, together with high humidity and temperature, facilitate possible chemical processes on the components of the frequency converter. These chemical processes quickly impact and damage the electronics. In these areas, cabinet fitting with fresh-air circulation in the cabinet is recommended, thereby ensuring that aggressive gases are kept away from the frequency converter.

7

NOTICE

Fitting of frequency converters in aggressive environments increases the risk of stoppages, in addition to considerably reducing the service life of the unit.

Before installing the frequency converter, check if there are liquids, particles or gases in the air. This can be done by looking at existing installations in the same environment. Typical indicators of harmful airborne liquids are water or oil on metal parts or corrosion of metal parts. Too many dust particles are typically observed on top of installation cabinets and on existing electrical installations. Indicators of aggressive gases in the air are black copper rails and cable ends on existing electrical installations.

7.3.2 Derating for Ambient Temperature

The ambient temperature measured over 24 hours should be at least 5 °C lower than the max. ambient temperature. If the frequency converter is operated above 45 °C, the continuous output current should be decreased.

7.3.3 Derating for Low Air Pressure

Above 1,000 m the ambient temperature or max. output current must be derated.
For altitudes above 2,000 m, contact Danfoss regarding PELV.

7.3.4 Derating for Running at Low Speeds

When a motor is connected to at frequency converter, check that the cooling of the motor is adequate.
A problem may occur at low speeds in constant torque applications. Running continuously at low speeds – below half the nominal motor speed – may require additional air cooling. Alternatively, select a larger motor (one size up).

7.3.5 Derating for Long Motor Cables

The frequency converter has been tested using a 75 m unscreened/unarmoured cable and a 25 m screened/armoured cable and has been designed to work using a motor cable with a rated cross-section. If a cable with a larger cross-section is required, it is recommended to reduce the output current by 5% for each step the cable cross-section is increased. (Increased cable cross-section leads to increased capacitance to ground, and thus to an increased earth leakage current).

7.3.6 Derating for High Switch Frequency

The frequency converter automatically derates the rated output current $I_{VLT,N,}$ when the switching frequency exceeds 4.5 kHz.
In both cases, the reduction is carried out linearly, down to 60% of $I_{VLT,N}$.

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