MAKING MODERN LIVING POSSIBLE

Operating Instructions
VLT® HVAC Drive FC 102

315-1400 kW

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THE REAL DRIVE

ENGINEERING TOMORROW

Danfoss

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EU DECLARATION OF CONFORMITY

Danfoss A/S

Danfoss Drives A/S

declares under our sole responsibility that the

Product category: Frequency Converter
Type designation(s): FC-102XYYYZZ**************************

Character X: N or P
Character YYY: K37, K75, 1K1, 1K5, 2K2, 3K0, 3K7, 4K0, 5K5, 7K5, 11K, 15K, 18K, 22K, 30K, 37K, 45K, 55K, 75K, 90K, 110, 132, 150, 160, 200, 250, 315, 355, 400, 450, 500, 560, 630, 710, 800, 900, 1M0, 1M2, 1M4
Character ZZ: T2, T4, T6, T7
* may be any number or letter indicating drive options which do not impact this DoC.
The meaning of the 39 characters in the type code string can be found in appendix 00729776.

Covered by this declaration is in conformity with the following directive(s), standard(s) or other normative document(s), provided that the product is used in accordance with our instructions.

Low Voltage Directive 2014/35/EU

EN61800-5-1:2007 + A1:2017	Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy.

EMC Directive 2014/30/EU

EN61800-3:2004 + A1:2012	Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods.

RoHS Directive 2011/65/EU including amendment 2015/863.

EN63000:2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Date: 2020.09.02 Place of issue: Graasten, DK	Issued by **Signature:** **Name: Gert Kjær** **Title: Senior Director, GDE**	Date: 2020.09.02 Place of issue: Graasten, DK	Approved by **Signature:** **Name: Michael Termansen** **Title: VP, PD Center Denmark**

Danfoss only vouches for the correctness of the English version of this declaration. In the event of the declaration being translated into any other language, the translator concerned shall be liable for the correctness of the translation

For products including available Safe Torque Off (STO) function according to unit typecode on the nameplate: **T or U at character 18 of the typecode.**

Machine Directive 2006/42/EC

EN/IEC 61800-5-2:2007 (Safe Stop function conforms with STO – Safe Torque Off, SIL 2 Capability)	Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional

Other standards considered:

EN ISO 13849-1:2015 (Safe Stop function, PL d (MTTFd=14000 years, DC=90%, Category 3)	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
EN/IEC 61508-1:2011, EN/IEC 61508-2:2011 (Safe Stop function, SIL 2 (PFH = 1E-10/h, 1E-8/h for specific variants, PFD = 1E-10, 1E-4 for specific variants, SFF>99%, HFT=0))	Functional safety of electrical/electronic/ programmable electronic safety-related systems Part 1: General requirements Part 2: Requirements for electrical/ electronic / programmable electronic safety-related systems
EN/IEC 62061:2005 + A1:2013 (Safe Stop function, SILCL 2)	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems
EN/IEC 60204-1:2006 + A1:2009 (Stop Category 0)	Safety of machinery - Electrical equipment of machines - Part 1: General requirements

For products including ATEX option, it requires STO function in the products. The products can have the VLT PTC Thermistor Card MCB112 installed from factory **(2 at character 32 in the typecode)**, or it can be separately installed as an additional part.

2014/34/EU - Equipment for explosive atmospheres (ATEX)

Based on EU harmonized standard: EN 50495: 2010	Safety devices required for safe functioning of equipment with respect to explosion risks.

Notified Body:
PTB Physikalisch-Technische Bundesanstalt, Bundesallee 100, 38116 Braunschweig,
has assessed the conformity of the "ATEX certified motor thermal protection systems" of Danfoss FC VLT Drives with Safe Torque Off function and has issued the certificate PTB 14 ATEX 3009.

Contents

1 Introduction

1.1 Purpose of the Manual

The frequency converter is designed to provide high shaft performance on electrical motors. Read these operating instructions carefully for proper use. Incorrect handling of the frequency converter may cause improper operation of the frequency converter or related equipment, shorten lifetime or cause other troubles.

These operating instructions provide information on:

- Start-up
- Installation
- Programming
- Troubleshooting
- *Chapter 1 Introduction* introduces the manual and informs about approvals, symbols, and abbreviations used in this manual.
- *Chapter 2 Safety* entails instructions on how to handle the frequency converter in a safe way.
- *Chapter 3 Mechanical Installation* guides through the mechanical installations.
- *Chapter 4 Electrical Installation* guides through the electrical installations.
- *Chapter 5 How to Operate the Frequency Converter* explains how to operate the frequency converter via the LCP.
- *Chapter 6 How to Programme* explains how to programme the frequency converter via the LCP.
- *Chapter 7 General Specifications* contains technical data about the frequency converter.
- *Chapter 8 Warnings and Alarms* assists in solving problems that may occur when using the frequency converter.

VLT® is a registered trademark.

1.2 Additional Resources

- *VLT® HVAC Drive FC 102Operating Instructions* provide the necessary information for getting the frequency converter up and running.
- *VLT® HVAC Drive FC 102 Design Guide* entails all technical information about the frequency converter and customer design and applications.
- *VLT® HVAC Drive FC 102 Programming Guide* provides information on how to programme and includes complete parameter descriptions.
- *Analog I/O Option MCB 109 Installation Instructions*.
- *Temperature Derating Guide Application Note*.
- *MCT 10 Set-up SoftwareOperating Instructions* enables the user to configure the frequency converter from a Windows™ based PC environment.
- *Danfoss VLT® Energy Box software* at *www.danfoss.com/BusinessAreas/DrivesSolutions*.
- *VLT® HVAC Drive Drive Applications*.
- *PROFIBUS Installation Guide*.
- *VLT® DeviceNet MCA 104 Operating Instructions*.
- *VLT® HVAC Drive FC 102 BACnet Operating Instructions*.
- *VLT® HVAC Drive FC 102 LonWorks Operating Instructions*.
- *VLT® HVAC Drive FC 102 Metasys N2 Operating Instructions*.
- *VLT® HVAC Drive FC 102 FLN Operating Instructions*.
- *Output Filter Design Guide*.
- *Brake Resistor MCE 101 Design Guide*.

Danfoss technical literature is available in print from your local Danfoss Sales Office or online at: *www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.htm*

1.3 Document and Software Version

This manual is regularly reviewed and updated. All suggestions for improvement are welcome. *Table 1.1* shows the document version and the corresponding software version.

Edition	Remarks	Software version
MG16B2xx	Replaces MG16B1xx	4.1x

Table 1.1 Document and Software Version

1.4 Approvals and Certifications

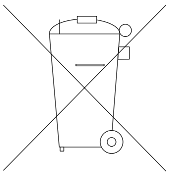
1.4.1 Approvals

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

NOTICE

Imposed limitations on the output frequency (due to export control regulations):
From software version 6.72 onwards, the output frequency of the frequency converter is limited to 590 Hz. Software versions 6x.xx also limit the maximum output frequency to 590 Hz, but these versions cannot be flashed, that is, neither downgraded nor upgraded.

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.

1.6 Abberviations and Conventions

60° AVM	60° Asynchronous vector modulation
A	Ampere/AMP
AC	Alternating current
AD	Air discharge
AEO	Automatic energy optimisation
AI	Analog input
AMA	Automatic motor adaptation
AWG	American wire gauge
°C	Degrees Celsius
CD	Contant discharge
CM	Common mode
CT	Constant torque
DC	Direct current
DI	Digital input
DM	Differential mode
D-TYPE	Drive dependent
EMC	Electro magnetic compatibility
ETR	Electronic thermal relay
f_{JOG}	Motor frequency when jog function is activated.
f_M	Motor frequency
f_{MAX}	The maximum output frequency the frequency converter applies on its output.
f_{MIN}	The minimum motor frequency from frequency converter
$f_{M,N}$	Nominal motor frequency
FC	Frequency converter
g	Gramme
Hiperface®	Hiperface® is a registered trademark by Stegmann
hp	Horsepower
HTL	HTL encoder (10-30 V) pulses - High-voltage transistor logic
Hz	Hertz
I_{INV}	Rated inverter output current
I_{LIM}	Current limit
$I_{M,N}$	Nominal motor current
$I_{VLT,MAX}$	The maximum output current
$I_{VLT,N}$	The rated output current supplied by the frequency converter
kHz	Kilohertz
LCP	Local control panel
lsb	Least significant bit
m	Meter
mA	Milliampere
MCM	Mille circular mil
MCT	Motion control tool
mH	Millihenry inductance
min	Minute
ms	Millisecond
msb	Most significant bit
η_{VLT}	Efficiency of the frequency converter defined as ratio between power output and power input.
nF	Nanofarad
NLCP	Numerical local control panel
Nm	Newton meters
n_s	Synchronous motor speed
On-line/Off-line Parameters	Changes to on-line parameters are activated immediately after the data value is changed.
$P_{br,cont.}$	Rated power of the brake resistor (average power during continuous braking).
PCB	Printed circuit board
PCD	Process data
PELV	Protective extra low voltage
P_m	Frequency converter nominal output power as HO.
$P_{M,N}$	Nominal motor power
PM motor	Permanent magnet motor
Process PID	The PID regulator maintains the desired speed, pressure, temperature, etc.
$R_{br,nom}$	The nominal resistor value that ensures a brake power on motor shaft of 150/160% for 1 minute
RCD	Residual current device
Regen	Regenerative terminals
R_{min}	Minimum permissible brake resistor value by frequency converter
RMS	Root mean square
RPM	Revolutions per minute
R_{rec}	Resistor value and resistance of the brake resistor
s	Second

SFAVM	Stator flux-oriented asynchronous vector modulation
STW	Status word
SMPS	Switch mode power supply
THD	Total harmonic distortion
T_{LIM}	Torque limit
TTL	TTL encoder (5 V) pulses - transistor transistor logic
$U_{M,N}$	Nominal motor voltage
V	Volts
VT	Variable torque
VVC^{+}	Voltage vector control

Table 1.2 Abbreviations

Conventions
Numbered lists indicate procedures.
Bullet lists indicate other information and description of illustrations.
Italicised text indicates

- Cross reference
- Link
- Footnote
- Parameter name, parameter group name, parameter option

All dimensions are in mm [inch].
* indicates a default setting of a parameter.

2 Safety

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 can also be used to alert against unsafe practices.

NOTICE

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

2.1 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 are allowed to install or operate this equipment.

Qualified personnel are 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 these operating instructions.

2.2 Safety Regulations

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 after a cleared fault condition.

To prevent unintended motor start:

- **Disconnect the frequency converter from the 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.**

2.2.1 Discharge Time

Voltage [V]	Minimum waiting time (minutes)	
	30	40
380-500 V		315-1000 kW
525-600 V	400-1400 kW	

Table 2.1 Discharge Time

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 the 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 these operating instructions.**

⚠WARNING

UNINTENDED MOTOR ROTATION
WINDMILLING

Unintended rotation of permanent magnet motors can result in serious injury or equipment damage.

- **Ensure that permanent magnet motors are blocked to prevent unintended rotation.**

⚠CAUTION

INTERNAL FAILURE HAZARD

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

- **Ensure that all safety covers are in place and securely fastened before applying power.**

2.2.2 Safe Torque Off (STO)

STO is an option. To run STO, additional wiring for the frequency converter is required. Refer to *VLT® Frequency Converters Safe Torque Off Operating Instructions* for further information.

3 Mechanical Installation

3.1 Pre-installation

3.1.1 Planning the Installation Site

NOTICE

Plan the installation of the frequency converter before commencing the installation. Neglecting this may result in extra work during and after installation.

Select the best possible operation site by considering the following (see details on the following pages, and the respective Design Guides):

- Ambient operating temperature
- Installation method
- How to cool the unit
- Position of the frequency converter
- Cable routing
- Ensure that the power source supplies the correct voltage and necessary current.
- Ensure that the motor current rating is within the maximum current from the frequency converter.
- If the frequency converter is without built-in fuses, ensure that the external fuses are rated correctly.

3.1.1.1 Inspection on Receipt

After receiving the delivery, immediately check whether the scope of delivery matches the shipping documents. Danfoss does not honour claims for faults registered at a later time. Register a complaint immediately:

- With the carrier in case of visible transport damage.
- With the responsible Danfoss representative in case of visible defects or incomplete delivery.

3.1.2 Receiving the Frequency Converter

When receiving the frequency converter, make sure that the packaging is intact, and be aware of any damage that might have occurred to the unit during transport. In case damage has occurred, immediately contact the shipping company to claim the damage.

3.1.3 Transportation and Unpacking

Locate the frequency converter as close as possible to the final installation site before unpacking.
Remove the box and handle the frequency converter on the pallet, as long as possible.

3.1.4 Lifting

Always lift the frequency converter via the dedicated lifting eyes.

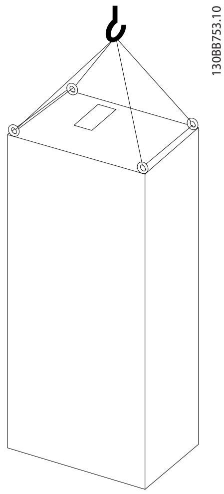


Illustration 3.1 Recommended Lifting Method, Enclosure Size F8.

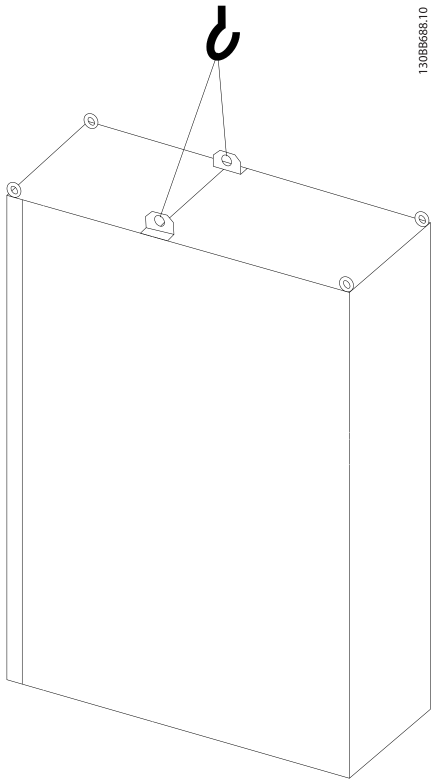


Illustration 3.2 Recommended Lifting Method, Enclosure Size F9/F10.

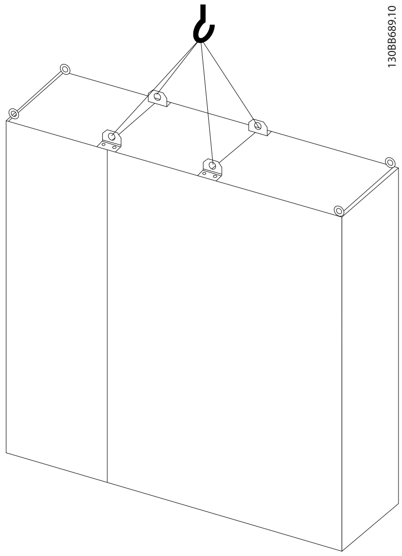
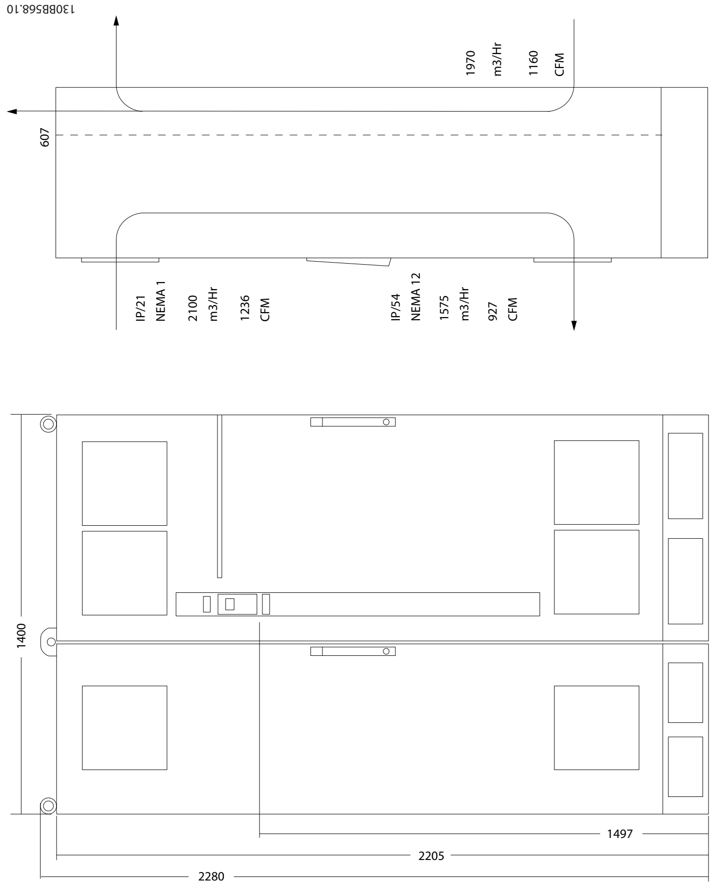
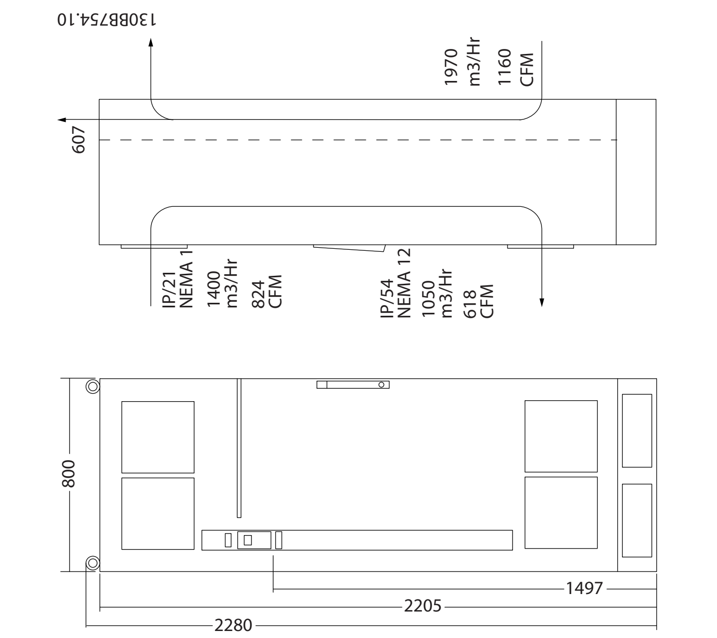


Illustration 3.3 Recommended Lifting Method, Enclosure Size F11/F12/F13/F14.

NOTICE

The plinth is provided in the same packaging as the frequency converter, but is not attached during shipment. The plinth is required to allow airflow cooling to the frequency converter. Position the frequency converter on top of the plinth in the final installation location. The angle from the top of the frequency converter to the lifting cable should be >60°.
In addition to *Illustration 3.1* to *Illustration 3.3*, a spreader bar can be used to lift the frequency converter.

3.1.5 Mechanical Dimensions

IP 21/54 - NEMA 1/12 F9	
IP 21/54 - NEMA 1/12 F8	

All dimensions in mm

Table 3.1

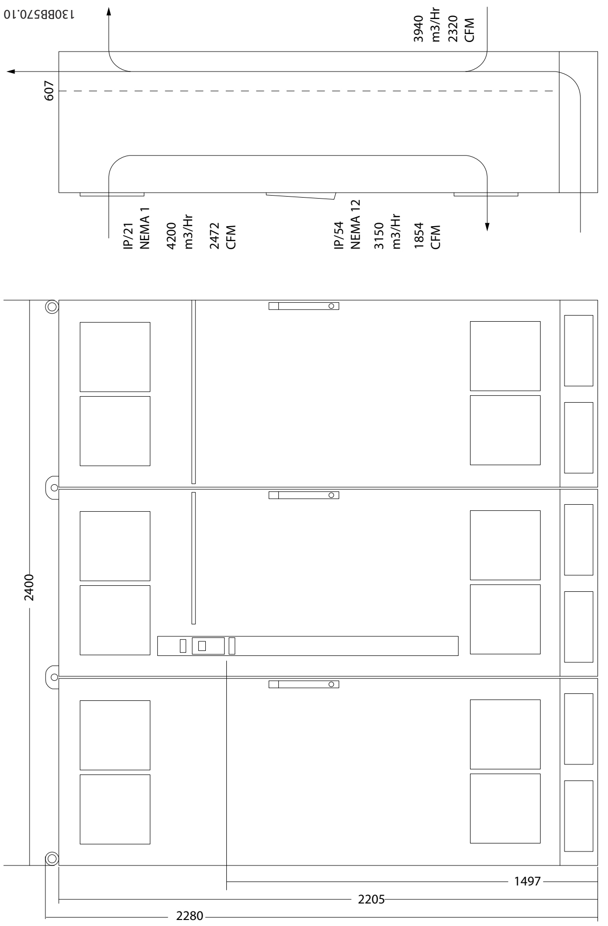
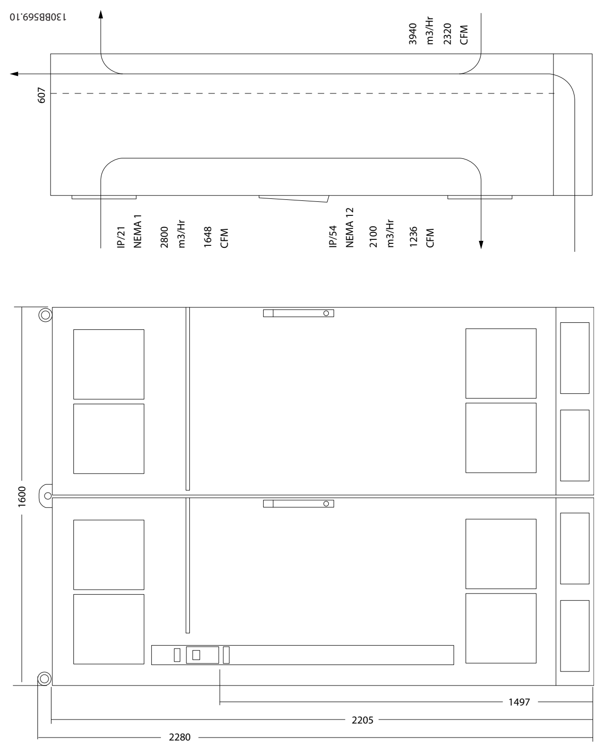
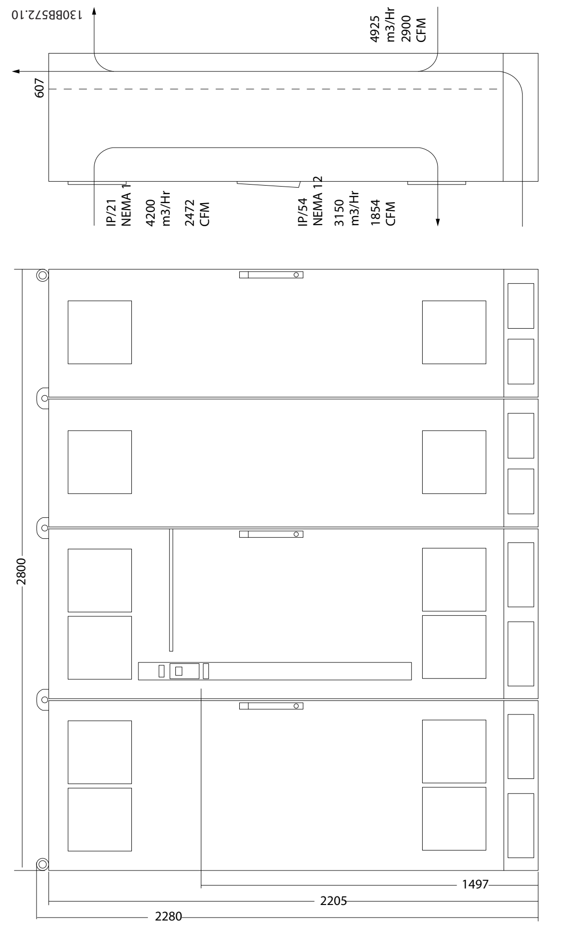
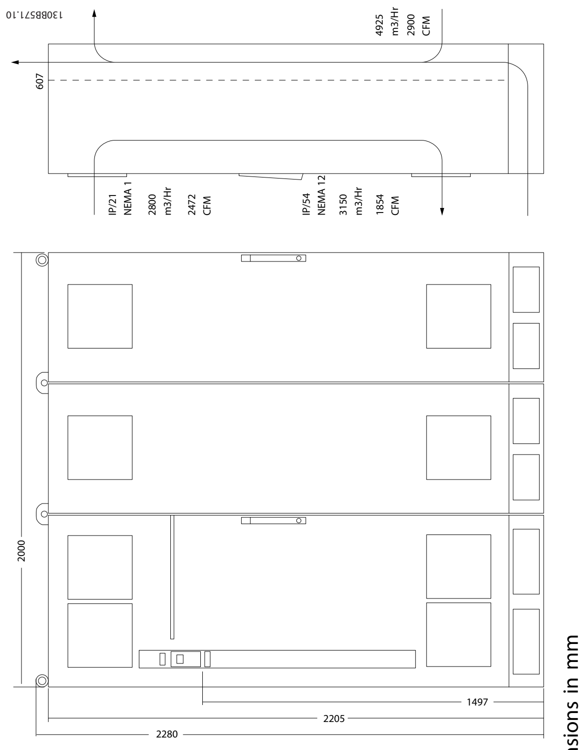
F11	IP 21/54 - NEMA 1/12
	
F10	IP 21/54 - NEMA 1/12
	
All dimensions in mm	

Table 3.2

F13	IP 21/54 - NEMA 1/12



F12	IP 21/54 - NEMA 1/12



All dimensions in mm

Table 3.3

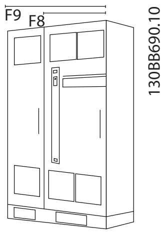
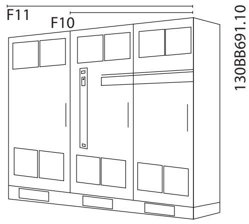
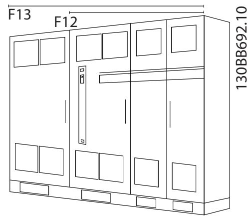
Enclosure size		F8	F9	F10	F11	F12	F13
							
High overload rated power - 160% overload torque		**315 - 450 kW (380 - 500 V) 400 - 630 kW (525-690 V)**		**500 - 710 kW (380 - 500 V) 710 - 900 kW (525-690 V)**		**800 - 1000 kW (380 - 500 V) 1000 - 1400 kW (525-690 V)**	
IP NEMA		21, 54 Type 12		21, 54 Type 12		21, 54 Type 12	
Shipping dimensions [mm]	Height	2324	2324	2324	2324	2324	2324
	Width	970	1568	1760	2559	2160	2960
	Depth	1130	1130	1130	1130	1130	1130
Drive dimensions	Height	2204	2204	2204	2204	2204	2204
	Width	800	1400	1600	2200	2000	2600
	Depth	606	606	606	606	606	606
	Max weight [kg]	440	656	880	1096	1022	1238

Table 3.4 Mechanical Dimensions, Enclosure Sizes E and F

NOTICE

The F frames are available in 6 different sizes, F8, F9, F10, F11, F12 and F13 The F8, F10 and F12 consist of an inverter cabinet on the right and rectifier cabinet on the left. The F9, F11 and F13 have an additional options cabinet left of the rectifier cabinet. The F9 is an F8 with an additional options cabinet. The F11 is an F10 with an additional options cabinet. The F13 is an F12 with an additional options cabinet.

3.2 Mechanical Installation

3.2.1 Preparation for Installation

Make the following preparations to ensure reliable and effective installation of the frequency converter:

- Provide a suitable mounting arrangement. The mounting arrangement depends on the design, weight, and torque of the frequency converter.
- Examine the mechanical drawings to ensure that the space requirements are met.
- Ensure that all wiring is done in accordance with national regulations.

3.2.2 Tools Required

- Drill with 10 or 12 mm bit.
- Tape measure.
- Wrench with relevant metric sockets (7-17 mm).
- Extensions to wrench.
- Sheet metal punch for conduits or cable glands in IP21/Nema 1 and IP54 units
- Lifting bar to lift the unit (rod or tube max. Ø 25 mm (1 inch), able to lift minimum 400 kg (880 lbs)).
- Crane or other lifting aid to place the frequency converter in position.

3.2.3 General Considerations

Space
Ensure sufficient space above and below the frequency converter to allow airflow and cable access. In addition, allow for enough space in front of the unit to open the panel door, see *Illustration 3.4* to *Illustration 3.10*.

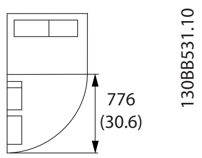


Illustration 3.4 Space in Front of Enclosure Size F8

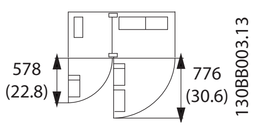


Illustration 3.5 Space in Front of Enclosure Size F9

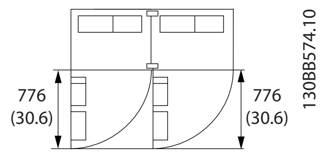


Illustration 3.6 Space in Front of Enclosure Size F10

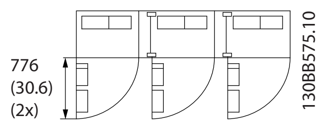


Illustration 3.7 Space in Front of Enclosure Size F11

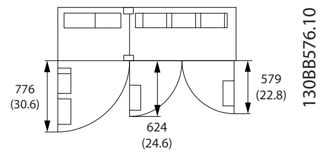


Illustration 3.8 Space in Front of Enclosure Size F12

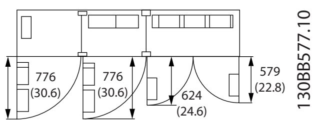


Illustration 3.9 Space in Front of Enclosure Size F13

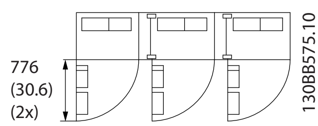


Illustration 3.10 Space in Front of Enclosure Size F14

Wire access
Ensure that proper wire access is present including the necessary bending allowance.

NOTICE

All cable lugs/shoes must mount within the width of the terminal bus bar.

3

3.2.4 Terminal Locations, F8-F14

The F enclosures are available in 7 different sizes, F8, F9, F10, F11, F12, F13, and F14. The F8, F10, F12, and F14 consist of an inverter cabinet on the right and rectifier cabinet on the left. The F9, F11 and F13 have an additional options cabinet left of the rectifier cabinet. The F9 is an F8 with an additional options cabinet. The F11 is an F10 with an additional options cabinet. The F13 is an F12 with an additional options cabinet.

3.2.4.1 Inverter and Rectifier, Enclosure Sizes F8 and F9

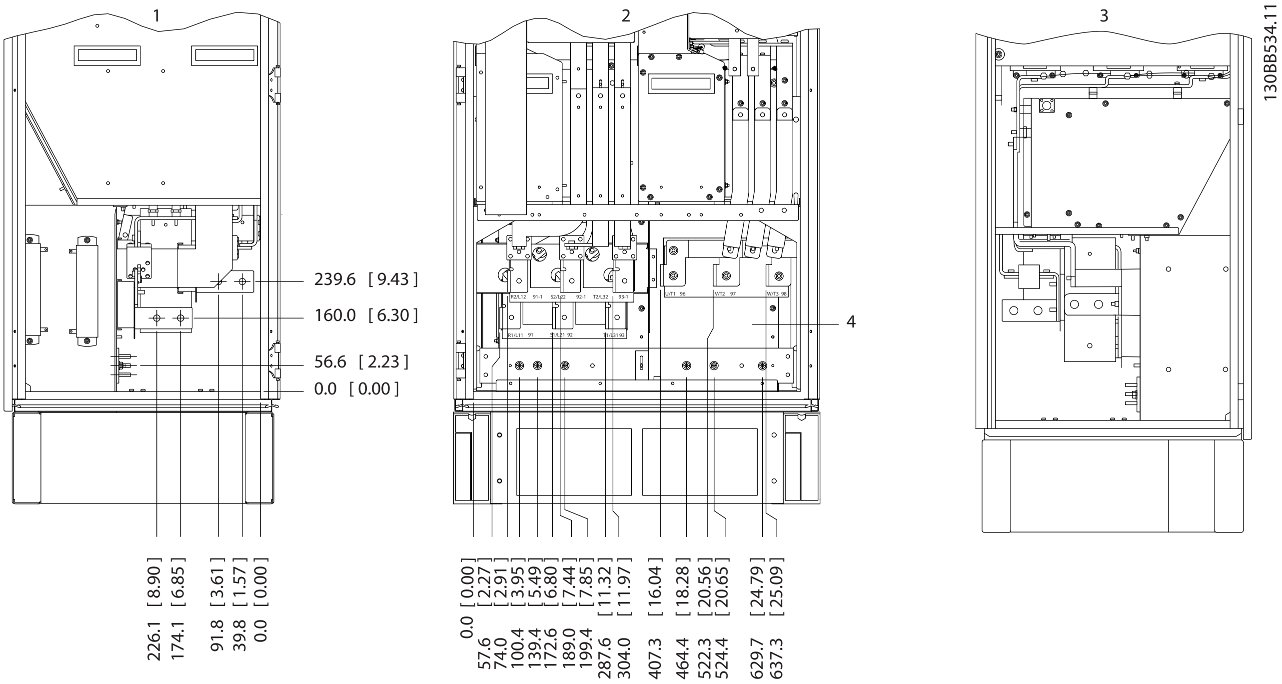


Illustration 3.11 Terminal Locations - Left, Front and Right Views. The gland plate is 42 mm below .0 level.

1) Ground bar

3.2.4.2 Inverter, Enclosure Sizes F10 and F11

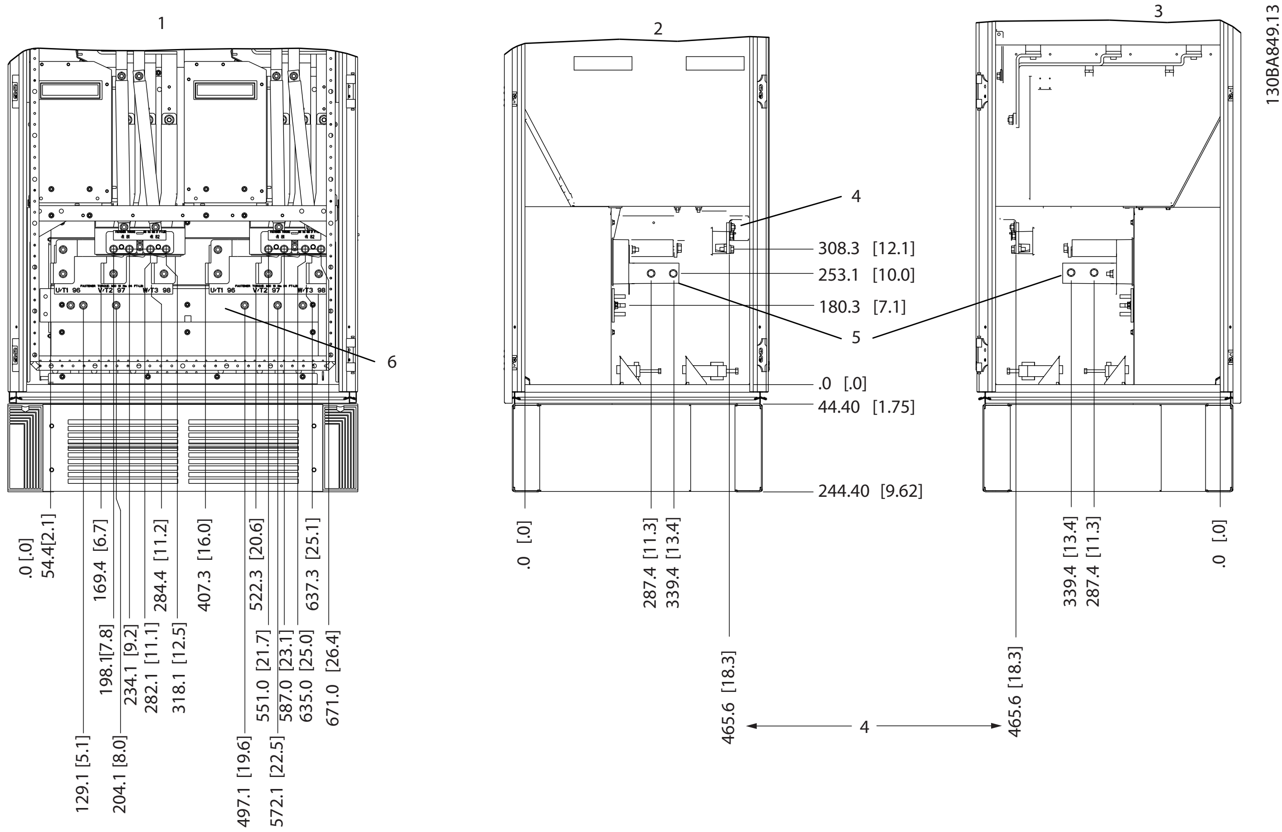


Illustration 3.12 Terminal Locations - Left, Front and Right Views. The gland plate is 42 mm below .0 level.

1) Ground bar

2) Motor terminals

3) Brake terminals

3.2.4.3 Inverter, Enclosure Sizes F12 and F13

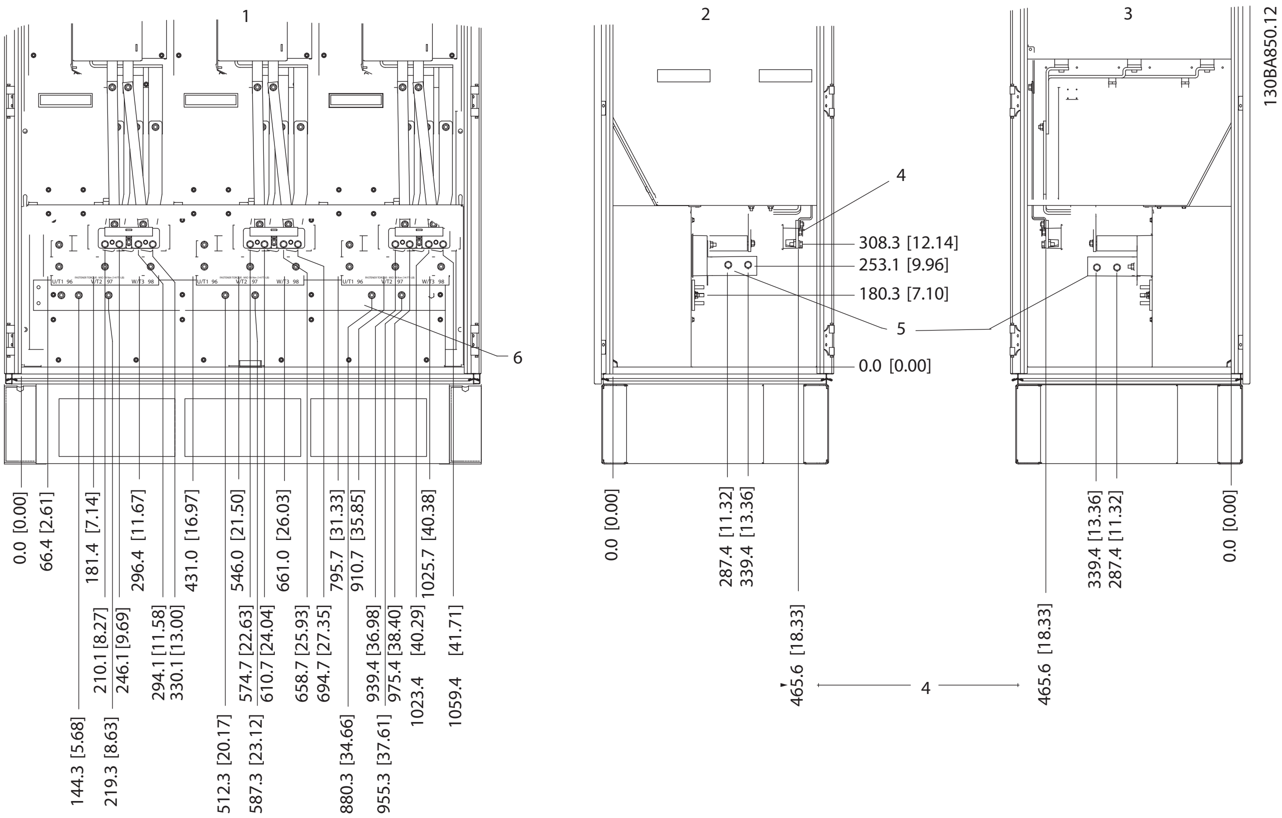


Illustration 3.13 Terminal Locations - Left, Front and Right Views. The gland plate is 42 mm below .0 level.

1) Ground bar

3.2.4.4 Inverter, Enclosure Size F14

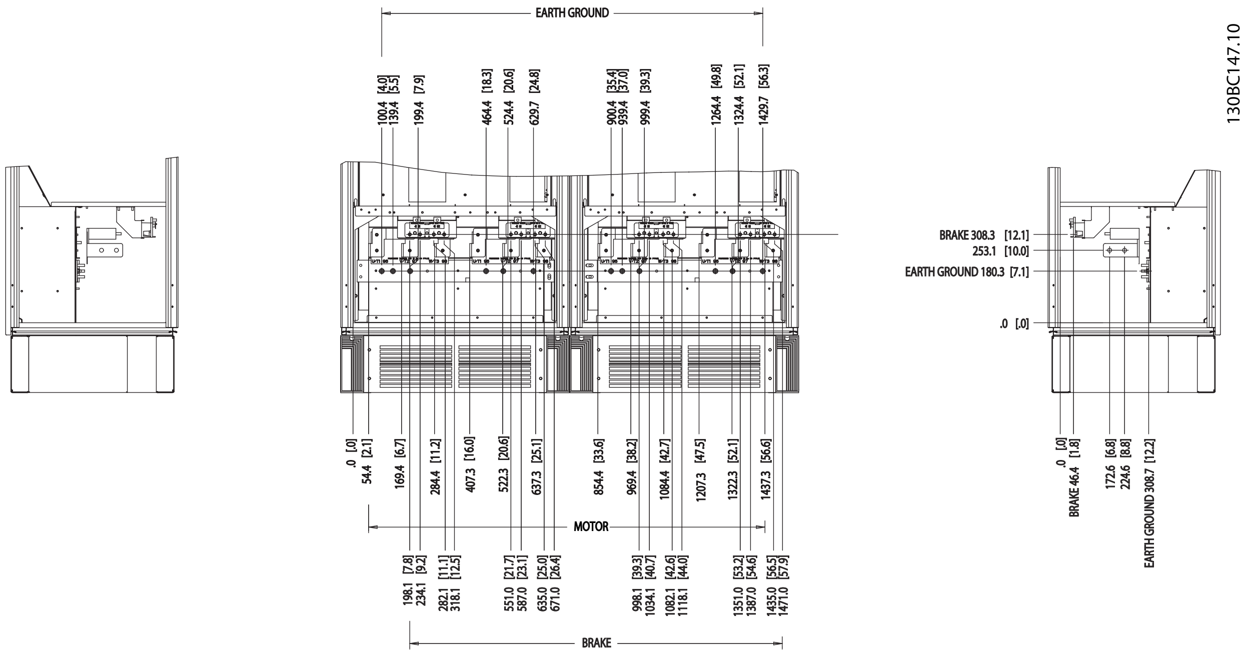


Illustration 3.14 Terminal Locations - Left, Front and Right Views. The gland plate is 42 mm below .0 level.

3.2.4.5 Rectifier, Enclosure Sizes F10, F11, F12 and F13

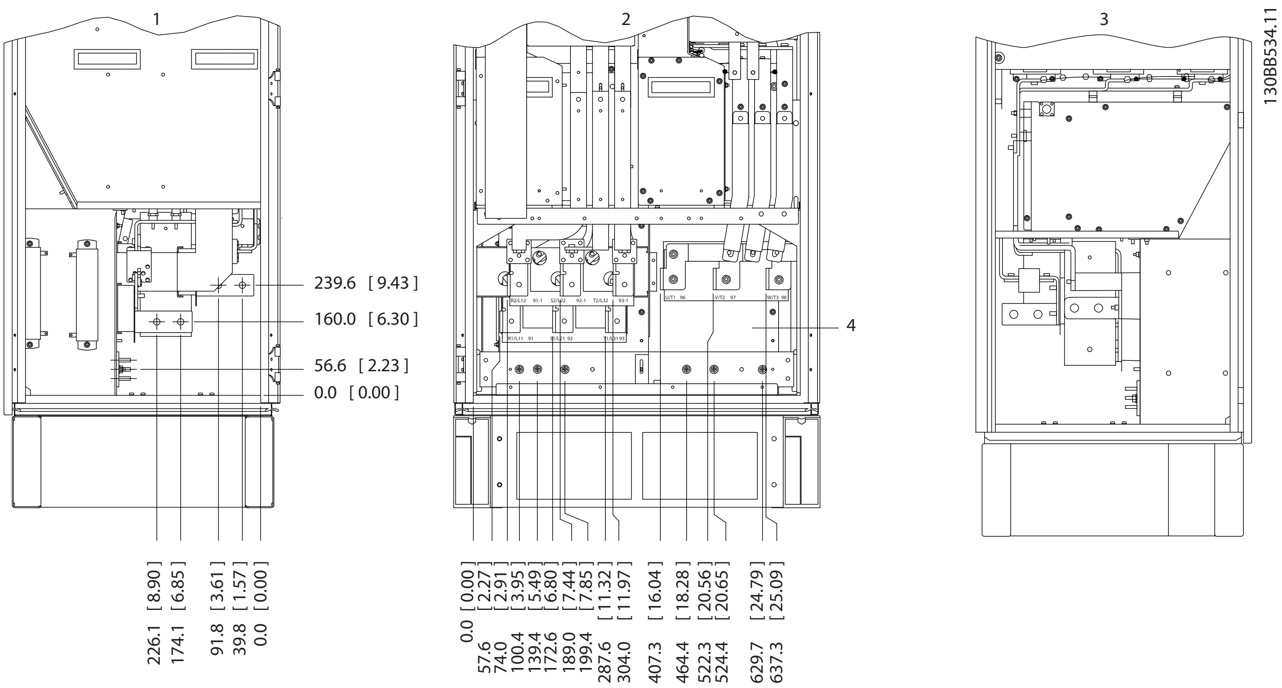


Illustration 3.15 Terminal Locations - Left, Front and Right Views. The gland plate is 42 mm below .0 level.

1) Loadshare Terminal (-)

2) Ground bar

3) Loadshare Terminal (+)

3.2.4.6 Rectifier, Enclosure Size F14

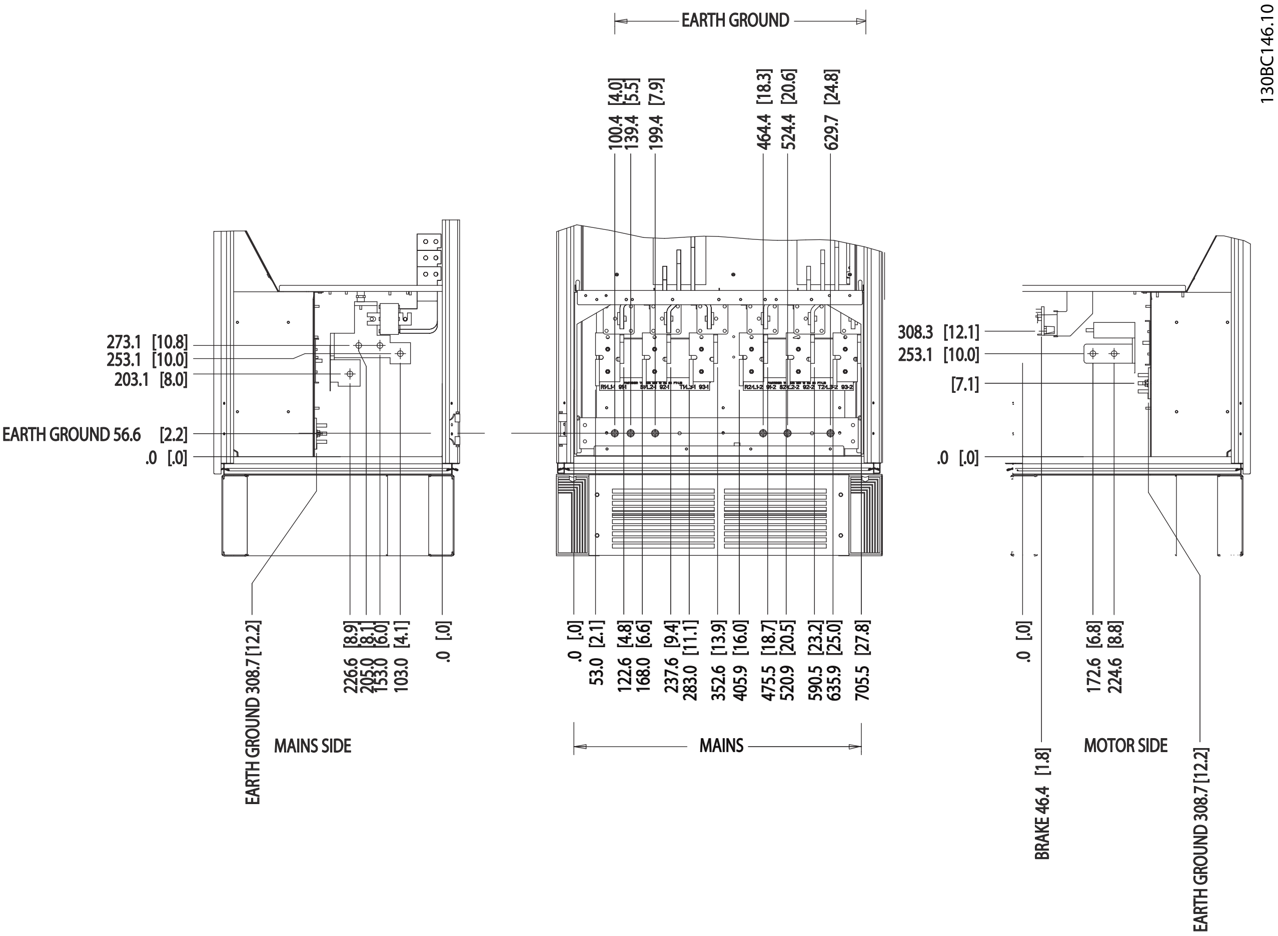


Illustration 3.16 Terminal Locations - Left, Front and Right Views. The gland plate is 42 mm below .0 level.

3.2.4.7 Options Cabinet, Enclosure Size F9

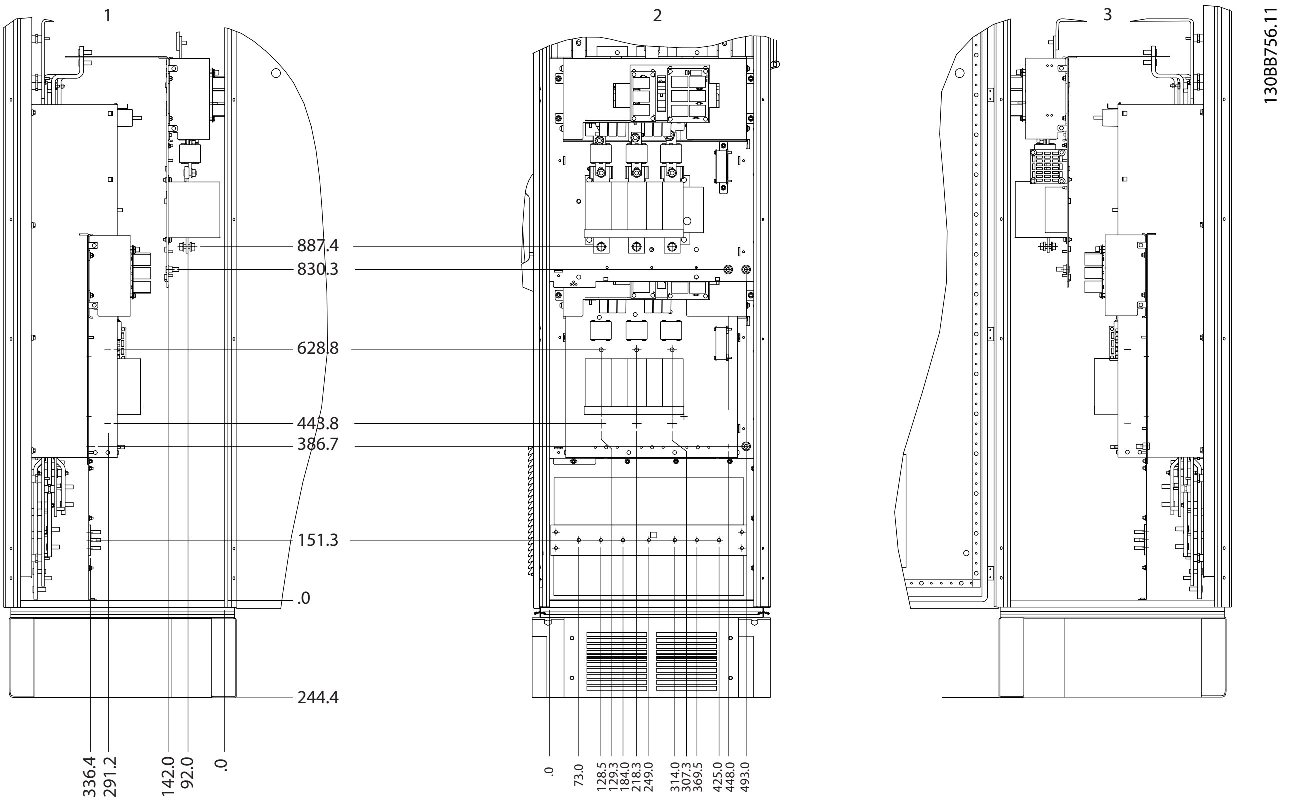


Illustration 3.17 Terminal Locations - Left, Front and Right Views

3.2.4.8 Options Cabinet, Enclosure Sizes F11/F13

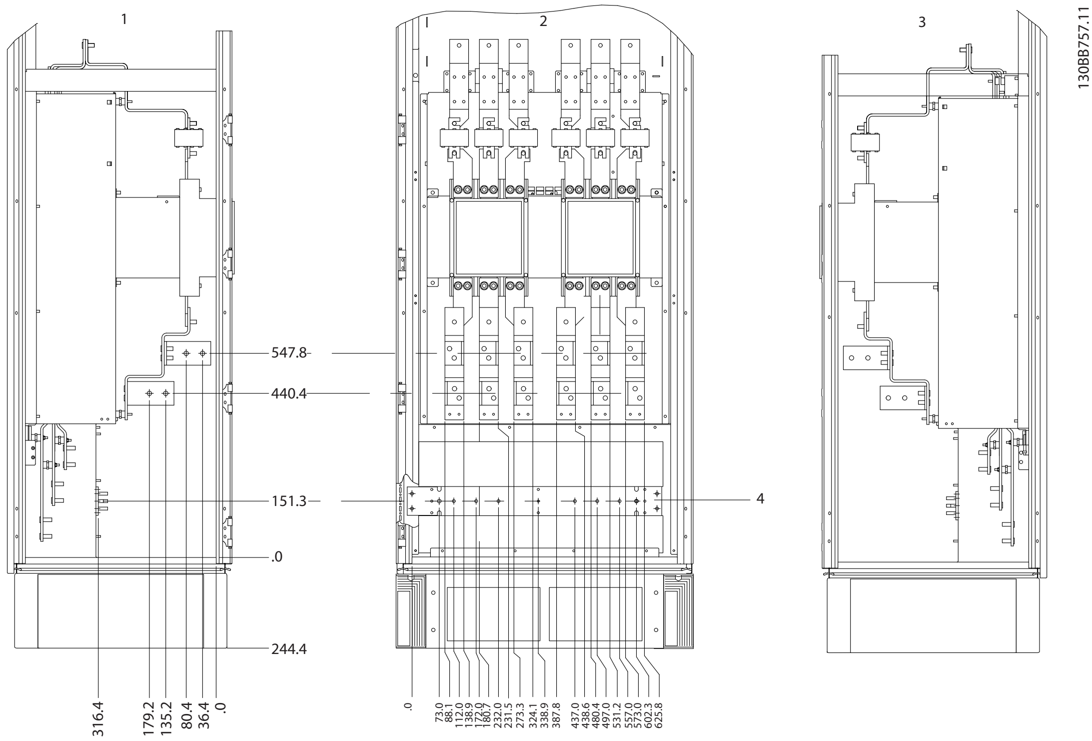


Illustration 3.18 Terminal Locations - Left, Front and Right Views

3.2.5 Cooling and Airflow

Cooling
Cooling can be achieved in different ways:

- By using the cooling ducts at the top and bottom of the unit.
- By taking air in and out the back of the unit.
- By combining the cooling methods.

Duct cooling
A dedicated option has been developed to optimise the installation of frequency converters in Rittal TS8 enclosures utilising the frequency converter fan for forced air cooling of the backchannel. The air out of the top of the enclosure could be ducted outside a facility so the heat losses from the backchannel are not dissipated within the control room. This ultimately reduces the air-conditioning requirements of the facility.

Back cooling
The backchannel air can also be ventilated in and out of the back of a Rittal TS8 enclosure. The backchannel takes cool air from outside the facility and returns warm air to outside the facility, thus reducing air-conditioning requirements.

Airflow
Ensure sufficient airflow over the heat sink. The flow rate is shown in *Table 3.5*.

Enclosure protection	Door fan(s)/Top fan airflow	Heat sink fan(s)
IP21/NEMA 1	700 m^3/h (412 cfm)*	985 m^3/h (580 cfm)*
IP54/NEMA 12	525 m^3/h (309 cfm)*	985 m^3/h (580 cfm)*

Table 3.5 Heat Sink Air Flow

** Airflow per fan. Enclosure sizes F contain multiple fans.*

NOTICE

The fan runs for the following reasons:

- **AMA**
- **DC Hold**
- **Pre-Mag**
- **DC Brake**
- **60% of nominal current is exceeded.**
- **Specific heat sink temperature exceeded (power size dependent).**

The fan runs for minimum 10 minutes.

External ducts
If additional duct work is added externally to the Rittal cabinet, calculate the pressure drop in the ducting. To derate the frequency converter according to the pressure drop, refer to *Illustration 3.19*.

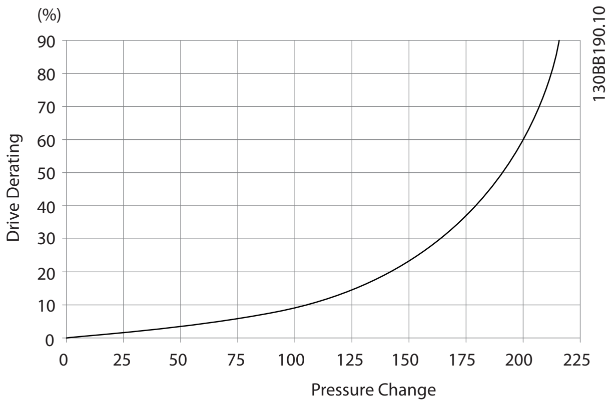


Illustration 3.19 Enclosure Size F, Derating vs. Pressure Change (Pa)

Drive air flow: 985 m³/h (580 cfm)

3.2.6 Gland/Conduit Entry - IP21 (NEMA 1) and IP54 (NEMA12)

Cables are connected through the gland plate from the bottom. Remove the plate and plan where to place the entry for the glands or conduits. Prepare holes in the marked area on the drawings in *Table 3.6* and *Table 3.7*.

NOTICE

Fit the gland plate to the frequency converter to ensure the specified protection degree, as well as ensuring proper cooling of the unit. If the gland plate is not mounted, the frequency converter may trip on Alarm 69, Pwr. Card Temp

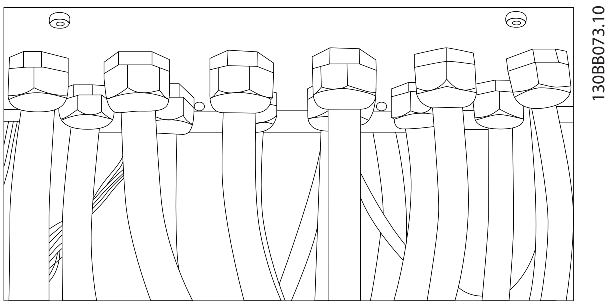


Illustration 3.20 Example of Proper Installation of the Gland Plate.

3

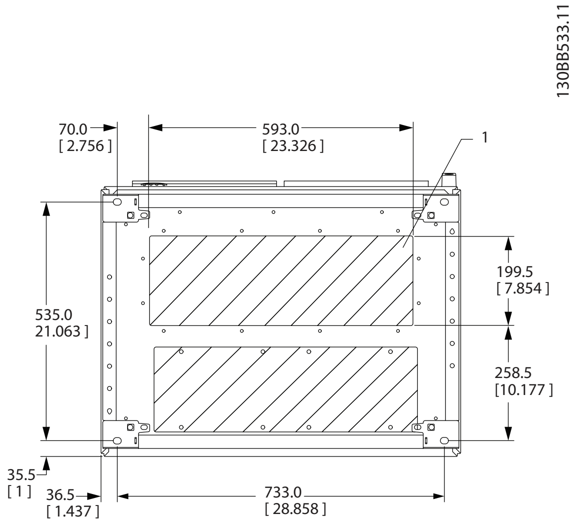
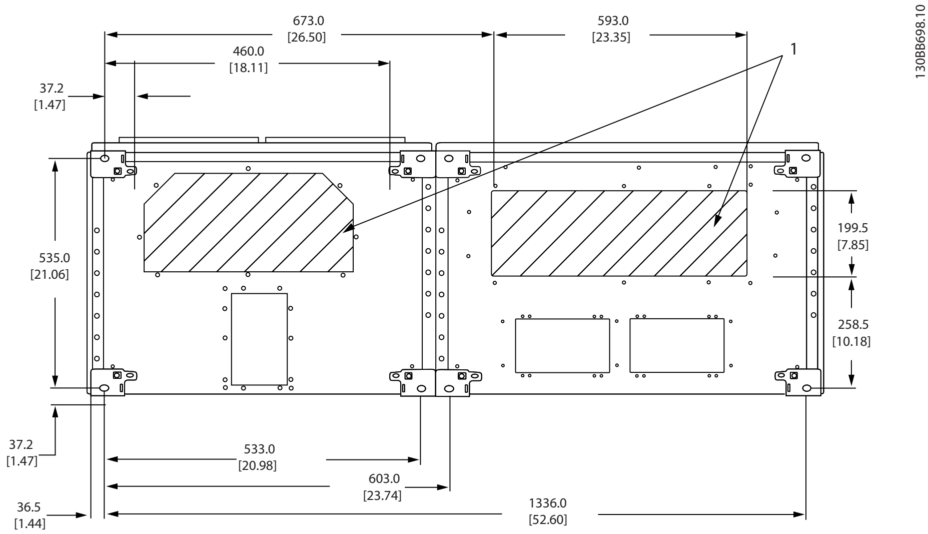
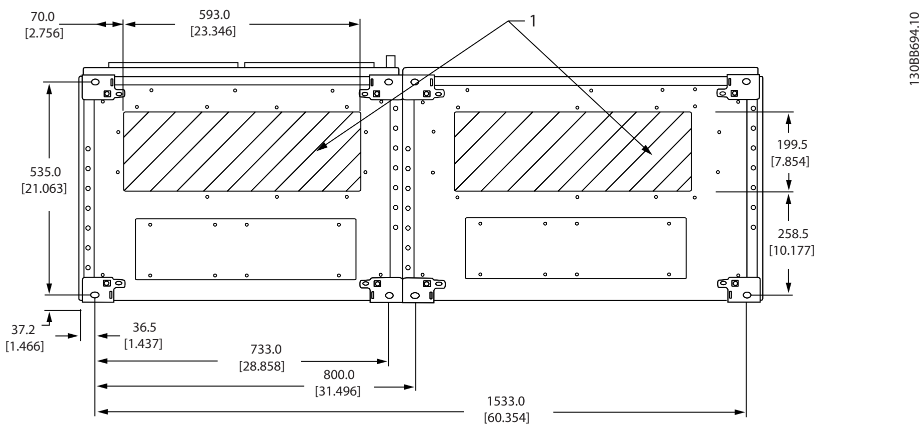
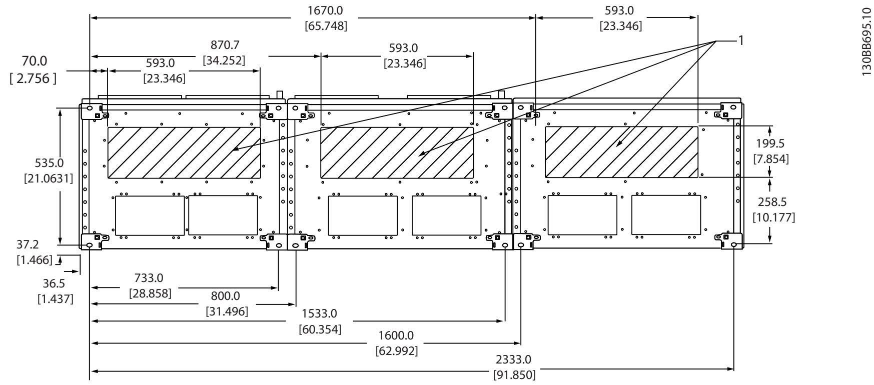
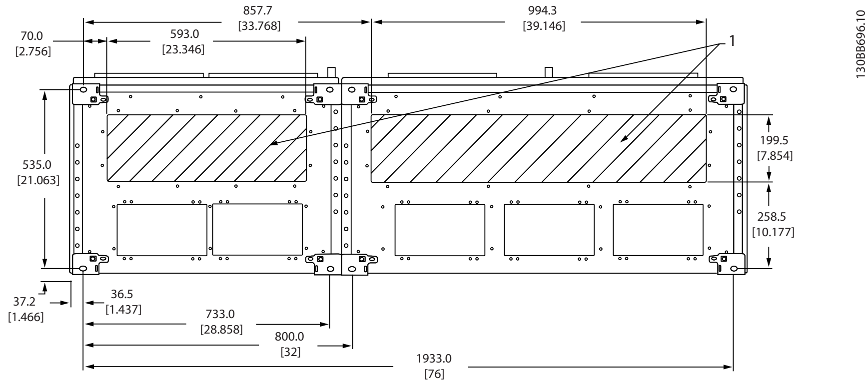
Enclosure Size F8

Enclosure Size F9

Enclosure Size F10

1 Place conduits in marked areas

Table 3.6 F8-F10: Cable Entries Viewed from the Bottom of the Frequency Converter

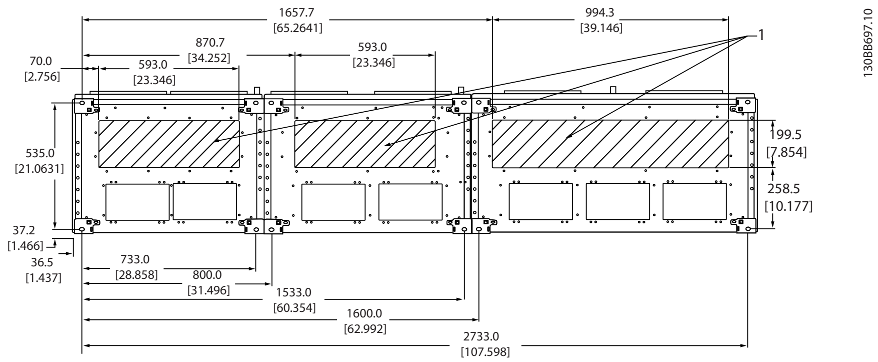
Enclosure Size F11



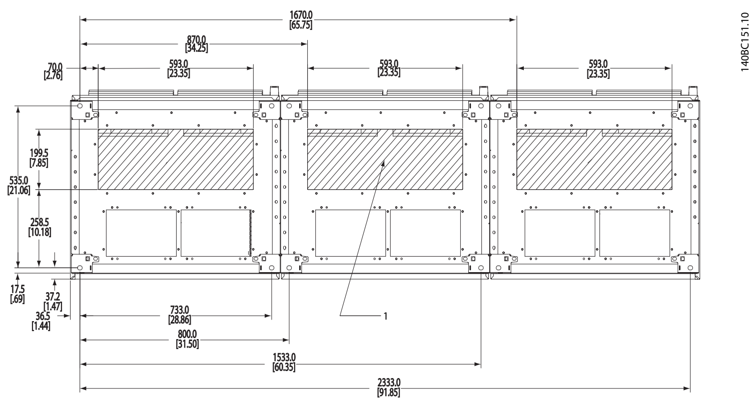
Enclosure Size F12



Enclosure Size F13



Enclosure Size F 14



1 Place conduits in marked areas

Table 3.7 F11-F14: Cable Entries Viewed from the Bottom of the Frequency Converter

3.3 Frame size F Panel Options

3.3.1 Panel Options

Space heaters and thermostat
Space heaters are mounted on the cabinet interior of enclosure size F10-F14 frequency converters. They are controlled via an automatic thermostat, and help control humidity inside the enclosure, thereby extending the lifetime of frequency converter components in damp environments. The thermostat default settings turn on the heaters at 10 °C (50 °F) and turn them off at 15.6 °C (60 °F).

Cabinet light with power outlet
A light mounted on the cabinet interior of enclosure size F10-F14 frequency converters increases visibility during servicing and maintenance. The housing light includes a power outlet for temporarily powering tools or other devices, available in 2 voltages:

- 230 V, 50 Hz, 2.5 A, CE/ENEC
- 120 V, 60 Hz, 5 A, UL/cUL

Transformer tap set-up
If the cabinet light and outlet, and/or the space heaters and thermostat are installed, transformer T1 requires the taps to be set to the proper input voltage. A 380-480/500 V unit is initially set to the 525 V tap and a 525-690 V unit is set to the 690 V tap. This ensures that no overvoltage of secondary equipment occurs if the tap is not changed before power is applied. See *Table 3.8* to set the proper tap at terminal T1, located in the rectifier cabinet. For location in the frequency converter, see the illustration of the rectifier in *Illustration 4.1*.

Input voltage range [V]	Tap to select [V]
380–440	400
441–490	460
491–550	525
551–625	575
626–660	660
661–690	690

Table 3.8 Transformer Tap Setting

NAMUR terminals
NAMUR is an international association of automation technology users in the process industries, primarily chemical and pharmaceutical industries in Germany. Selection of this option provides terminals organised and labeled to the specifications of the NAMUR standard for frequency converter input and output terminals. This requires an MCB 112 PTC Thermistor Card and an MCB 113 Extended Relay Card.

RCD (residual current device)
Uses the core balance method to monitor ground fault currents in grounded and high-resistance grounded systems (TN and TT systems in IEC terminology). There is a pre-warning (50% of main alarm setpoint) and a main alarm setpoint. Associated with each setpoint is an SPDT alarm relay for external use. Requires an external *window-type* current transformer (not supplied).

- Integrated into the frequency converter's safe-stop circuit.
- IEC 60755 Type B device monitors AC, pulsed DC, and pure DC ground fault currents.
- LED bar graph indicator of the ground fault current level from 10–100% of the setpoint.
- Fault memory
- TEST/RESET button

IRM (insulation resistance monitor)
Monitors the insulation resistance in ungrounded systems (IT systems in IEC terminology) between the system phase conductors and ground. There is an ohmic pre-warning and a main alarm setpoint for the insulation level. Associated with each setpoint is an SPDT alarm relay for external use.

NOTICE

Only one insulation resistance monitor can be connected to each ungrounded (IT) system.

- Integrated into the frequency converter's safe-stop circuit.
- LCD display of the ohmic value of the insulation resistance.
- Fault Memory
- [Info], [Test], and [Reset] keys

Manual motor starters
Provide 3-phase power for electric blowers often required for larger motors. Power for the starters is provided from the load side of any supplied contactor, circuit breaker, or disconnect switch. Power is fused before each motor starter and is off when the incoming power to the frequency converter is off. Up to 2 starters are allowed (only 1 if a 30 A, fuse-protected circuit is ordered). The manual motor starter is integrated into the frequency converter's STO and includes the following features:

- Operation switch (on/off)
- Short-circuit and overload protection with test function
- Manual reset function

30 Amp, fuse-protected terminals

- 3-phase power matching incoming mains voltage for powering auxiliary customer equipment.
- Not available if 2 manual motor starters are selected.
- Terminals are off when the incoming power to the frequency converter is off.
- Power for the fused protected terminals is provided from the load side of any supplied circuit breaker or disconnect switch.

24 V DC power supply

- 5 A, 120 W, 24 V DC
- Protected against output overcurrent, overload, short circuits, and overtemperature.
- For powering 3rd party accessory devices such as sensors, PLC I/O, contactors, temperature probes, indicator lights, and/or other electronic hardware.
- Diagnostics include a dry DC-ok contact, a green DC-ok LED, and a red overload LED.

External temperature monitoring
Designed for monitoring temperatures of external system components, such as the motor windings and/or bearings. Includes 8 universal input modules plus 2 dedicated thermistor input modules. All 10 modules are integrated into the frequency converter's STO circuit and can be monitored via a fieldbus network (requires a separate module/bus coupler).

Universal inputs (8) - signal types

- RTD inputs (including Pt100), 3-wire or 4-wire
- Thermocoupler
- Analog current or analog voltage

Additional features:

- 1 universal output, configurable for analog voltage or analog current.
- 2 output relays (N.O.)
- Dual-line LC display and LED diagnostics
- Sensor lead wire break, short-circuit, and incorrect polarity detection
- Interface set-up software

Dedicated thermistor inputs (2) - features

- Each module is capable of monitoring up to 6 thermistors in series.
- Fault diagnostics for wire breakage or short-circuits of sensor leads.
- ATEX/UL/CSA certification
- A 3rd thermistor input can be provided by the PTC Thermistor Option Card MCB 112, if necessary.

4 Electrical Installation

4.1 Electrical Installation

4.1.1 Power Connections

Cabling and Fusing

NOTICE

Cables General

All cabling must comply with national and local regulations on cable cross-sections and ambient temperature. UL applications require 75 °C copper conductors. 75 °C and 90 °C copper conductors are thermally acceptable for the frequency converter to use in non UL applications.

The power cable connections are located as in *Illustration 4.1*. Dimensioning of the cable cross-section must be done in accordance with the current ratings and local legislation. See *chapter 7.1 General Specifications* for details.

For protection of the frequency converter, use the recommended fuses, or ensure that the unit has built-in fuses. Recommended fuses are detailed in in *chapter 4.1.12 Fuses*. Always ensure that fusing conforms to local regulations.

The mains connection is fitted to the mains switch if this is included.

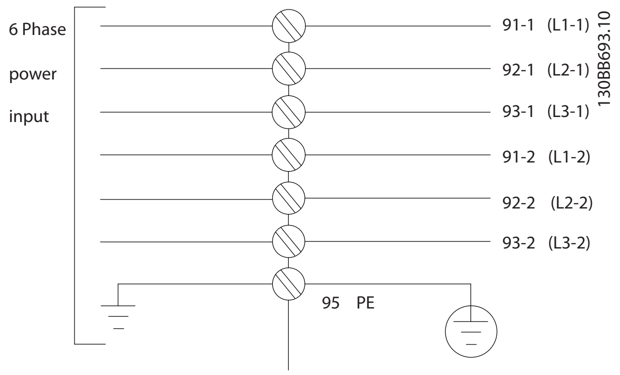


Illustration 4.1 Power Cable Connections

NOTICE

If an unscreened/unarmoured cable is used, some EMC requirements are not complied with. Use a screened/armoured motor cable to comply with EMC emission specifications. For more information, see *EMC Specifications* in the product relevant *design guide*.

See *chapter 7.1 General Specifications* for the correct dimensioning of the motor cable cross-section and length.

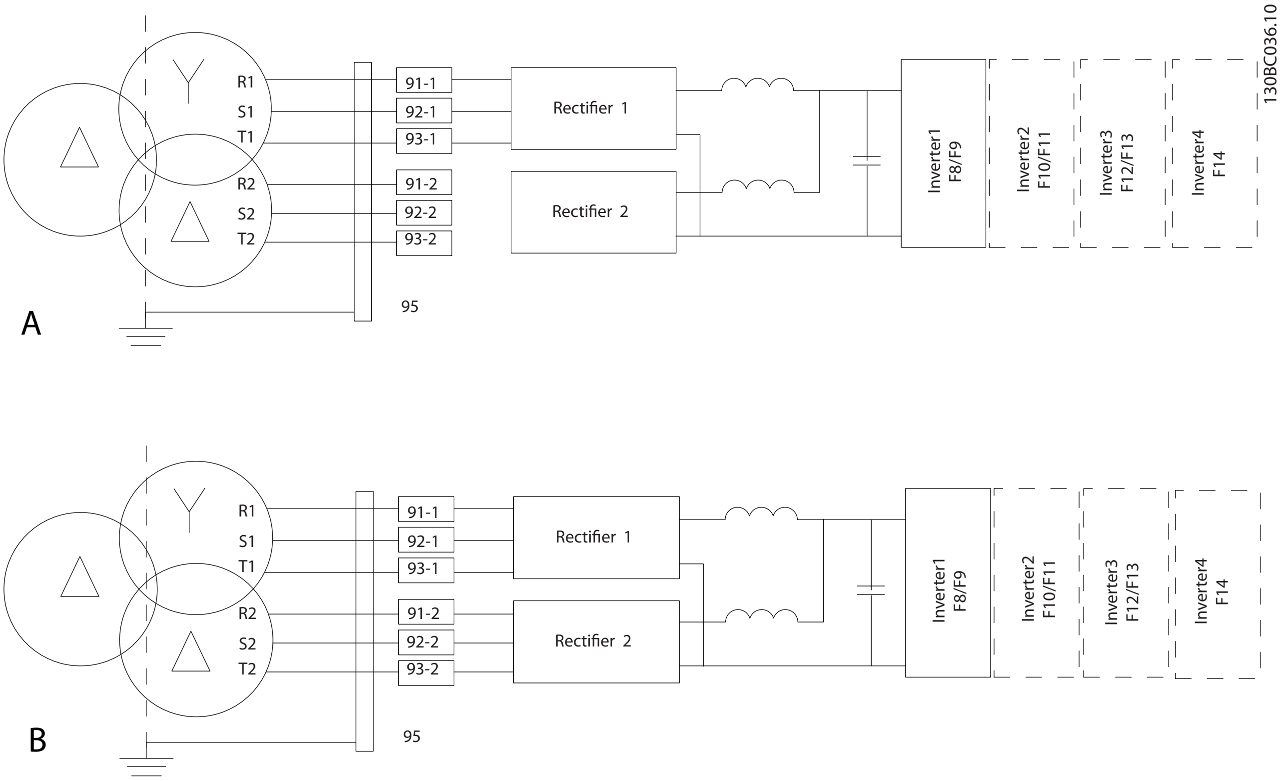


Illustration 4.2 A) Modified 6-Pulse Connection1), 2), 3)
B) 12-Pulse Connection2), 4)

Notes

1) 6-pulse connection eliminates the harmonics reduction benefits of the 12-pulse rectifier.
2) Suitable for IT and TN mains connection.
3) In the unlikely event that 1 of the 6-pulse modular rectifiers becomes inoperable, it is possible to operate the frequency converter at reduced load with a single 6-pulse rectifier. Contact Danfoss for reconnection details.
4) No paralleling of mains cabling is shown here.

Screening of cables

Avoid installation with twisted screen ends (pigtails). They 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.

Connect the motor cable screen to both the decoupling plate of the frequency converter and to the metal housing of the motor.

Make the screen connections with the largest possible surface area (cable clamp). This is done by using the supplied installation devices within the frequency converter.

Cable length and cross-section

The frequency converter has been EMC tested with a given cable length. Keep the motor cable as short as possible to reduce the noise level and leakage currents.

Switching frequency

When frequency converters are used with sine-wave filters to reduce the acoustic noise from a motor, set the switching frequency according to the instruction in *14-01 Switching Frequency*.

Term. no.				
96	**97**	**98**	**99**	
U	V	W	PE[1)]	Motor voltage 0-100% of mains voltage. 3 wires out of motor
U1	V1	W1	PE[1)]	Delta-connected
W2	U2	V2		6 wires out of motor
U1	V1	W1	PE[1)]	Star-connected U2, V2, W2 U2, V2 and W2 to be interconnected separately.

Table 4.1 Terminal Connections

1) Protective Earth Connection

NOTICE

In motors without phase insulation paper or other insulation reinforcement suitable for operation with voltage supply (such as a frequency converter), fit a sine-wave filter on the output of the frequency converter.

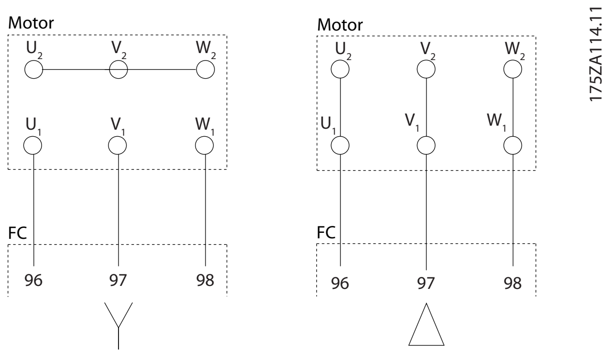
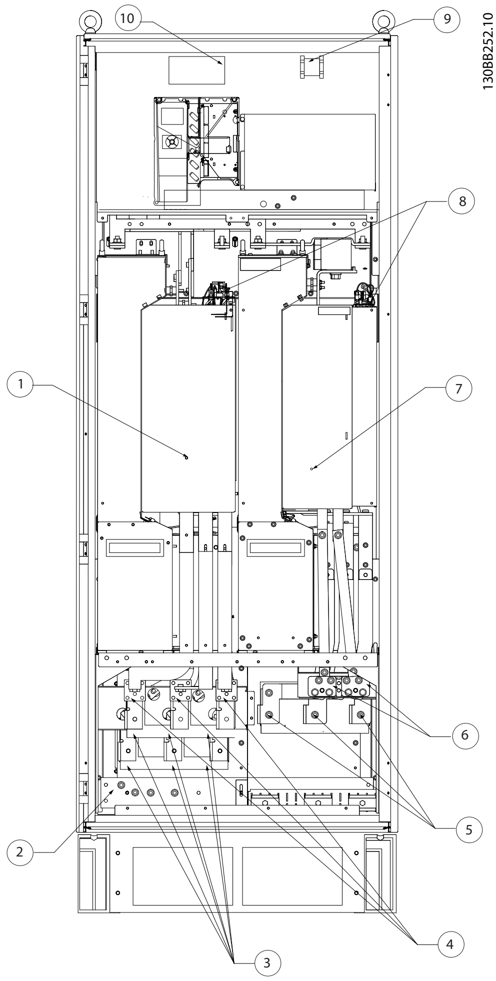
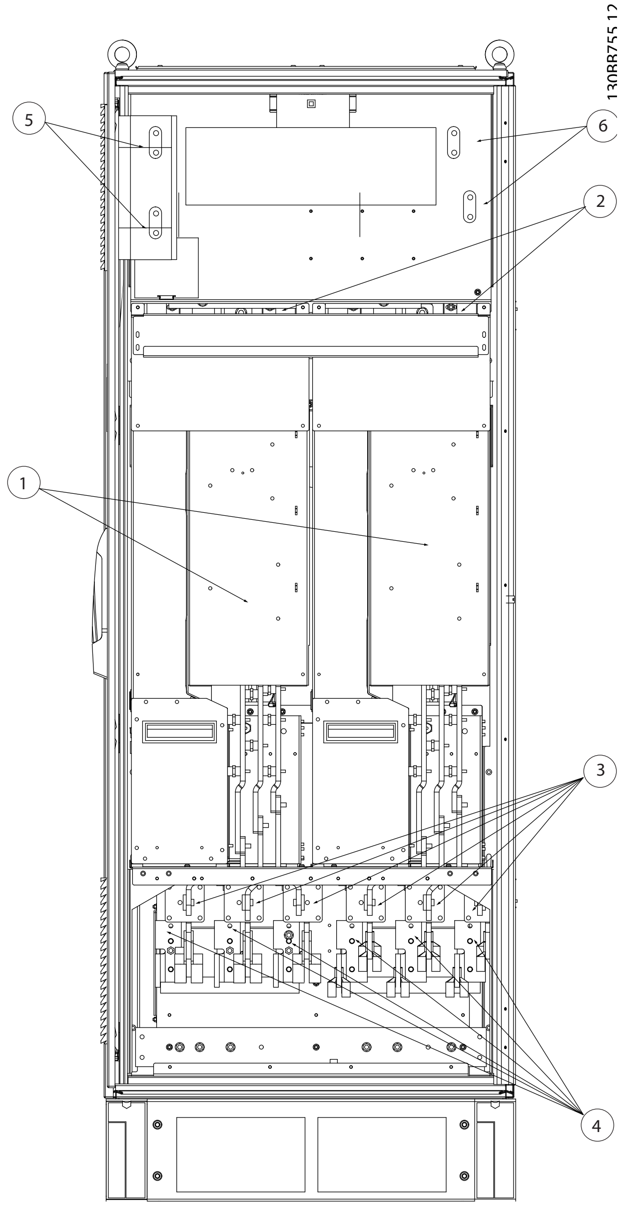


Illustration 4.3 Star and Delta Connections



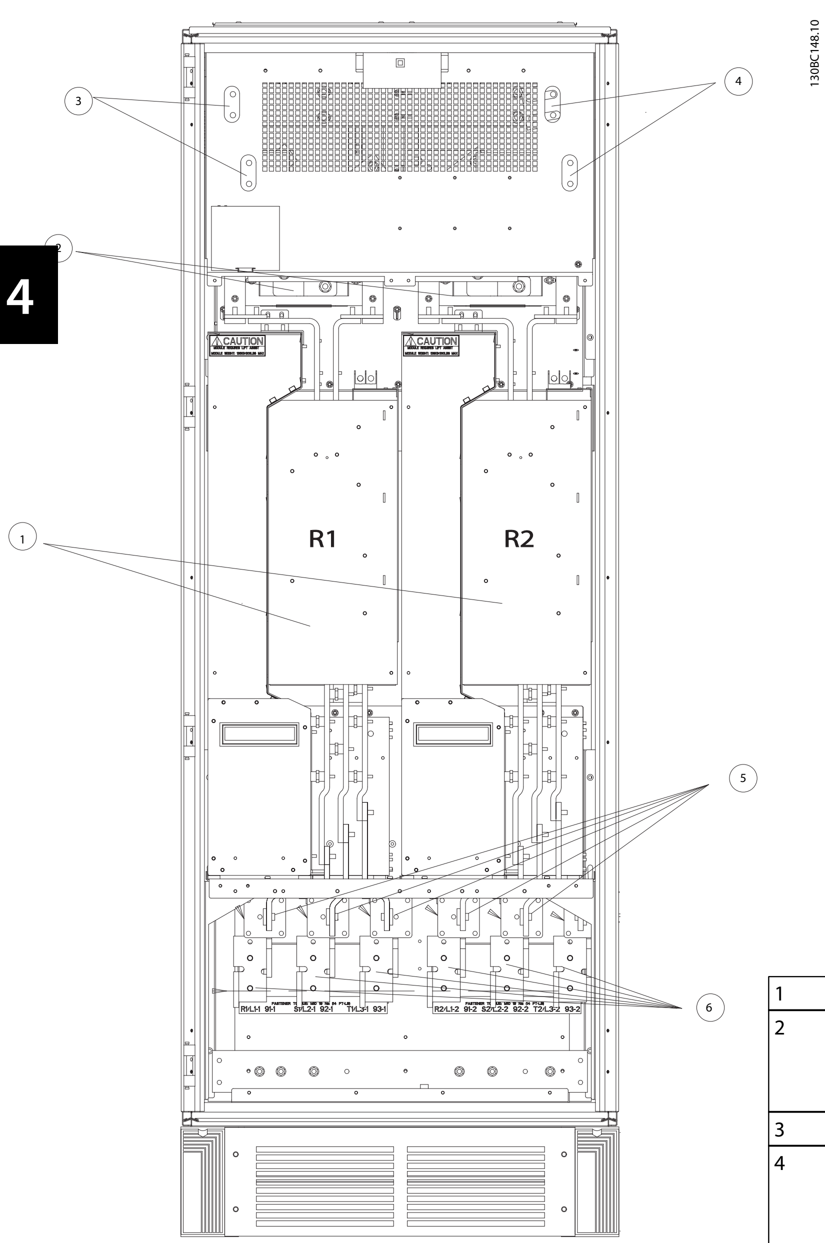
1	12-pulse rectifier module					
2	Ground/earth PE terminals					
3	Mains/fuses					
	R1	S1	T1			
	L1-1	L2-1	L3-1			
	91-1	92-1	93-1			
4	Mains/fuses					
	R2	S2	T2			
	L2-1	L2-2	L3-2			
	91-2	92-2	93-2			
5	Motor connection					
	U	V	W			
	T1	T2	T3			
	96	97	98			
6	Brake terminals					
	-R	+R				
	81	82				
7	Inverter module					
8	SCR enable/disable					
9	Relay 1			Relay 2		
	01	02	03	04	05	06
10	Auxillary fan					
	104	106				

Illustration 4.4 Rectifier and Inverter Cabinet, Enclosure Sizes F8 and F9



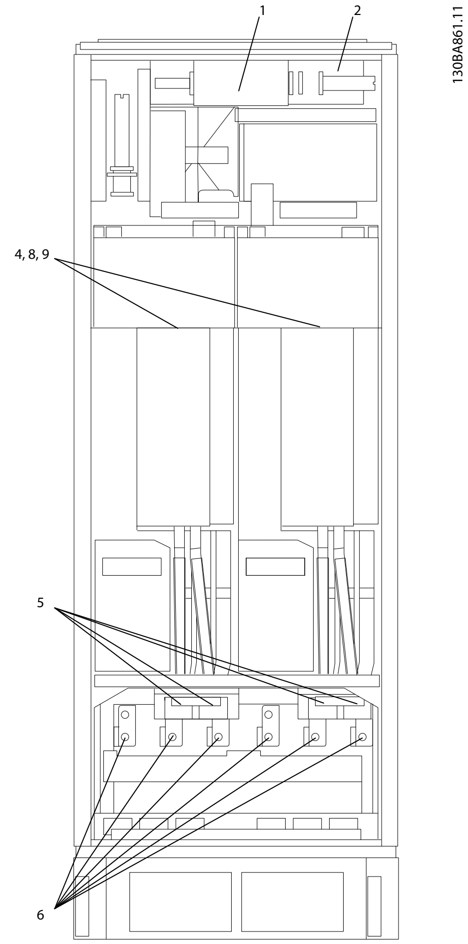
1	12-pulse rectifier module					
2	AUX fan					
	100	101	102	103		
	L1	L2	L1	L2		
3	Mains fuses F10/F12 (6 pieces)					
4	Mains					
	R1	S1	T1	R2	S2	T2
	L1-1	L2-1	L3-1	L1-2	L2-2	L3-2
5	DC bus connections for common DC bus					
	DC+	DC-				
6	DC bus connections for common DC bus					
	DC+	DC-				

Illustration 4.5 Rectifier Cabinet, Enclosure Sizes F10 and F12



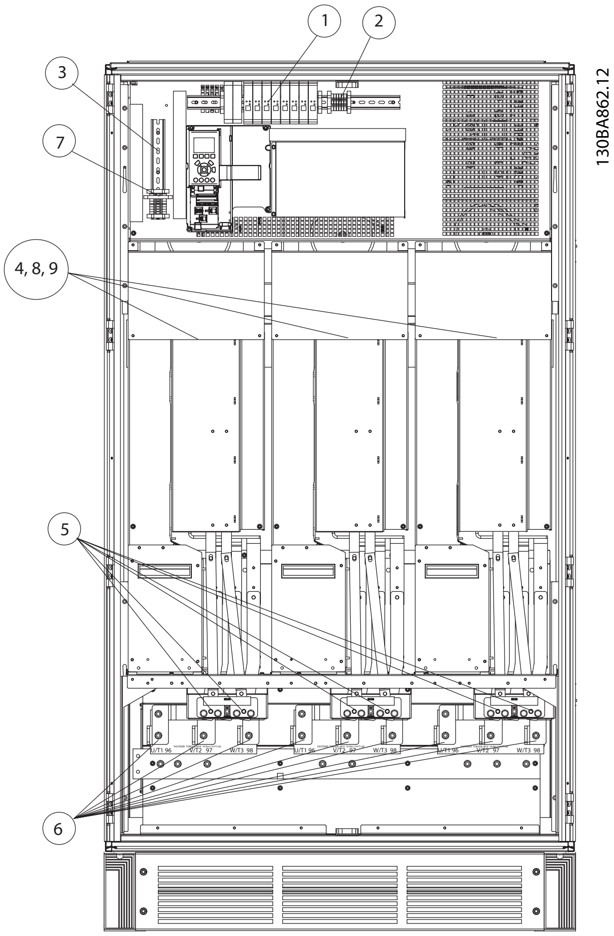
1	12-pulse rectifier modules					
2	N/A					
3	DC busbar access					
4	DC busbar access					
	100	101	102	103		
	L1	L2	L1	L2		
5	Mains fuses (6 pieces)					
	-R	+R				
	81	82				
6	Mains					
	R1	S1	T1	R2	S2	T2
	L1-1	L2-1	L3-1	L1-2	L2-2	L3-2

Illustration 4.6 Rectifier Cabinet, Enclosure Size F14



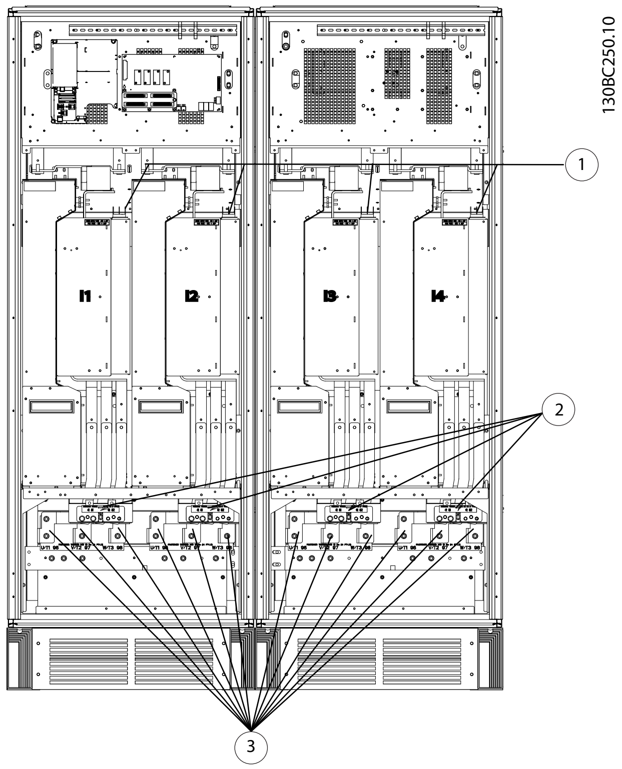
1	External temperature monitoring			
2	AUX relay			
	01	02	03	
	04	05	06	
3	NAMUR			
4	AUX fan			
	100	101	102	103
	L1	L2	L1	L2
5	Brake			
	-R	+R		
	81	82		
6	Motor			
	U	V	W	
	96	97	98	
	T1	T2	T3	
7	NAMUR fuse. See *Table 4.16* for part numbers.			
8	Fan fuses. See *Table 4.13* for part numbers.			
9	SMPS fuses. See *Table 4.12* for part numbers.			

Illustration 4.7 Inverter Cabinet, Enclosure Sizes F10 and F11



1	External temperature monitoring			
2	AUX relay			
	01	02	03	
	04	05	06	
3	NAMUR			
4	AUX fan			
	100	101	102	103
	L1	L2	L1	L2
5	Brake			
	-R	+R		
	81	82		
6	Motor			
	U	V	W	
	96	97	98	
	T1	T2	T3	
7	NAMUR fuse. See *Table 4.16* for part numbers.			
8	Fan fuses. See *Table 4.13* for part numbers.			
9	SMPS fuses. See *Table 4.12* for part numbers.			

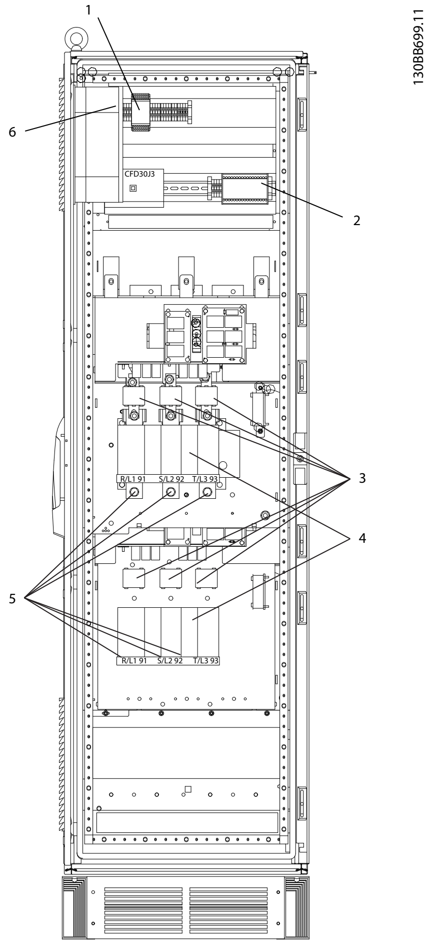
Illustration 4.8 Inverter Cabinet, Enclosure Sizes F12 and F13



4	AUX fan			
	100	101	102	103
	L1	L2	L1	L2
5	Brake			
	-R	+R		
	81	82		
6	Motor			
	U	V	W	
	96	97	98	
	T1	T2	T3	

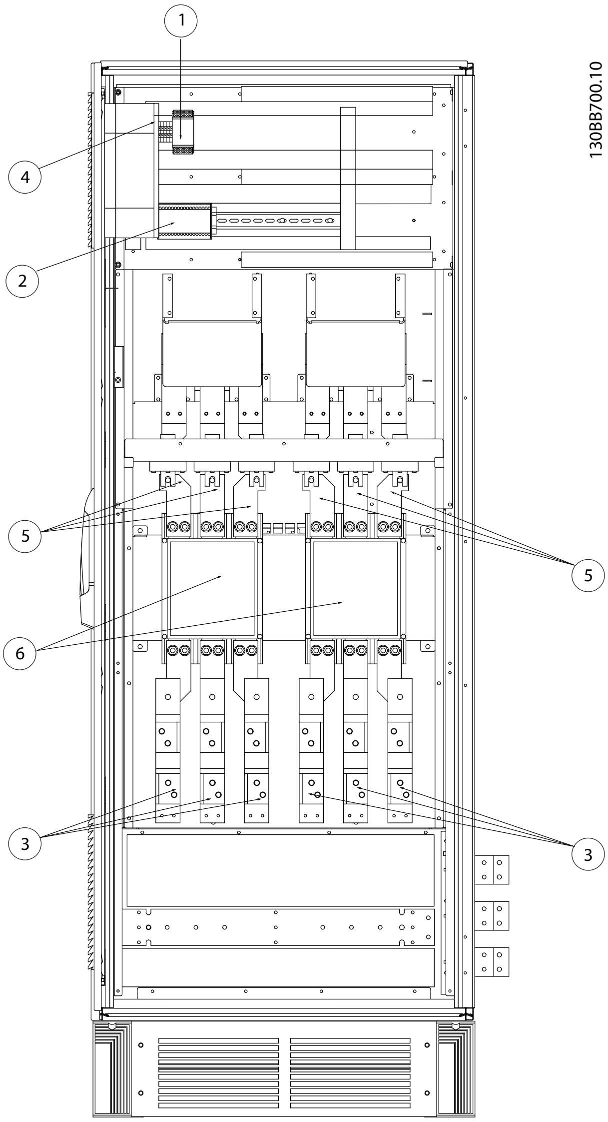
Illustration 4.9 Inverter Cabinet, Enclosure Size F14

4



1	Pilz relay terminal					
2	RCD or IRM terminal					
3	Mains/6-phase					
	R1	S1	T1	R2	S2	T2
	91-1	92-1	93-1	91-2	92-2	93-2
	L1-1	L2-1	L3-1	L1-2	L2-2	L3-2
4	Safety relay coil fuse with Pilz relay					
	See *chapter 4.1.13 Fuse Tables* for part numbers.					
5	Mains fuses, (6 pieces)					
	See *chapter 4.1.13 Fuse Tables* for part numbers.					
6	2x3-phase manual disconnect					

Illustration 4.10 Options Cabinet, Enclosure Size F9



1	Pilz relay terminal					
2	RCD or IRM terminal					
3	Mains/6-phase					
	R1	S1	T1	R2	S2	T2
	91-1	92-1	93-1	91-2	92-2	93-2
	L1-1	L2-1	L3-1	L1-2	L2-2	L3-2
4	Safety relay coil fuse with Pilz relay					
	See *chapter 4.1.13 Fuse Tables* for part numbers.					
5	Mains fuses, (6 pieces)					
	See *chapter 4.1.13 Fuse Tables* for part numbers.					
6	2x3-phase manual disconnect					

Illustration 4.11 Options Cabinet, Enclosure Sizes F11 and F13

4.1.2 Grounding

To obtain electromagnetic compatibility (EMC), consider the following basic issues when installing a frequency converter.

- Safety grounding: The frequency converter has a high leakage current (> 3.5 mA) and must be grounded appropriately for safety reasons. Apply local safety regulations.
- High-frequency grounding: Keep the ground wire connections as short as possible.

Connect the different ground systems at the lowest possible conductor impedance. This is obtained by keeping the conductor as short as possible and by using the greatest possible surface area.
The metal cabinets of the different devices are mounted on the cabinet rear plate using the lowest possible High-frequency impedance. This avoids having different High-frequency voltages for the individual devices and avoids the risk of radio interference currents running in any connection cables used between the devices. The radio interference has been reduced.
To obtain a low High-frequency impedance, use the fastening bolts of the devices as High-frequency connection to the rear plate. Remove any insulating paint or similar from the fastening points.

4.1.3 Extra Protection (RCD)

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

A ground fault may cause a DC component to develop in the fault current.

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

See also *Special Conditions* in the product relevant *design guide*.

4.1.4 RFI Switch

Mains supply isolated from ground
Turn off (OFF)[1] the RFI switch via *14-50 RFI Filter* on the frequency converter and *14-50 RFI Filter* on the filter if:

- The frequency converter is supplied from an isolated mains source (IT mains, floating delta and grounded delta).
- The frequency converter is supplied from TT/TN-S mains with grounded leg.

For further reference, see IEC 364-3.
Set *14-50 RFI Filter* to [ON] if:

- Optimum EMC performance is needed.
- Parallel motors are connected.
- The motor cable length is above 25 m.

[1] Not available for 525-600/690 V frequency converters.

In OFF, 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 which are compatible with power electronics (IEC 61557-8).

4.1.5 Torque

When tightening all electrical connections, it is important to tighten with the correct torque. Too low or too high torque results in a poor electrical connection. Use a torque wrench to ensure correct torque.

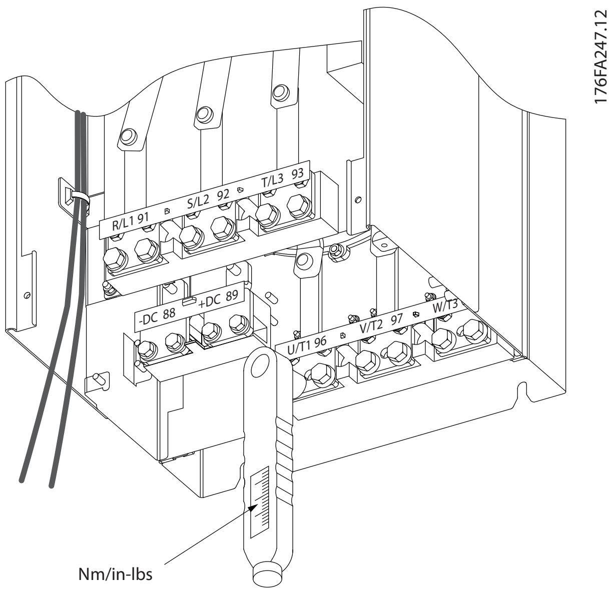


Illustration 4.12 Tightening Torques.

Enclosure size	Terminal	Torque	Bolt size
F8-F14	Mains Motor	19-40 Nm (168-354 in-lbs)	M10
	Brake Regen	8.5-20.5 Nm (75-181 in-lbs)	M8

Table 4.2 Tightening Torques

4.1.6 Screened Cables

⚠WARNING

Danfoss recommends using screened cables between the LCL filter and the frequency converter. Unshielded cables can be used between transformer and LCL filter input side.

It is important that screened and armoured cables are connected in a proper way to ensure high EMC immunity and low emissions.

The connection can be made using either cable glands or clamps.

- EMC cable glands: Available cable glands can be used to ensure an optimum EMC connection.
- EMC cable clamp: Clamps allowing easy connection are supplied with the frequency converter.

4.1.7 Motor Cable

Connect the motor to terminals U/T1/96, V/T2/97, W/T3/98. Ground to terminal 99. All types of 3-phase asynchronous standard motors can be used with a frequency converter. The factory setting is for clockwise rotation with the frequency converter output connected as follows:

Terminal Number	Function
96, 97, 98	Mains U/T1, V/T2, W/T3
99	Ground

Table 4.3 Motor Connection Terminals

- Terminal U/T1/96 connected to U-phase.
- Terminal V/T2/97 connected to V-phase.
- Terminal W/T3/98 connected to W-phase.

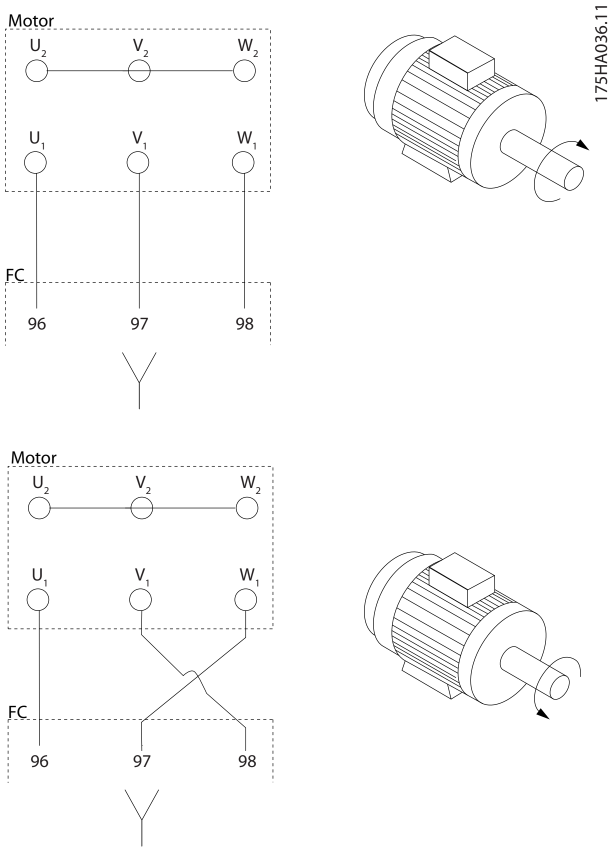


Illustration 4.13 Wiring for Clockwise and Counterclockwise Motor Rotation

The direction of rotation can be changed by switching 2 phases in the motor cable or by changing the setting of *4-10 Motor Speed Direction*.

A motor rotation check can be performed using *parameter 1-28 Motor Rotation Check* and following the steps shown on the display.

Requirements

F8/F9 requirements: The cables must be of equal length within 10% between the inverter module terminals and the first common point of a phase. The recommended common point is the motor terminals.

F10/F11 requirements: Motor phase cable quantities must be multiples of 2, resulting in 2, 4, 6, or 8 (1 cable is not allowed) to obtain equal amount of wires attached to both inverter module terminals. The cables must be equal length within 10% between the inverter module terminals and the first common point of a phase. The recommended common point is the motor terminals.

F12/F13 requirements: Motor phase cable quantities must be multiples of 3, resulting in 3, 6, 9, or 12 (1, 2, or 3 cables are not allowed) to obtain an equal amount of wires attached to each inverter module terminal. The wires must be of equal length within 10% between the inverter module terminals and the first common point of a phase. The recommended common point is the motor terminals.

F14 requirements: Motor phase cable quantities must be multiples of 4, resulting in 4, 8, 12, or 16 (1, 2, or 3 cables are not allowed) to obtain an equal amount of wires attached to each inverter module terminal. The wires must be of equal length within 10% between the inverter module terminals and the first common point of a phase. The recommended common point is the motor terminals.

Output junction box requirements: The length, minimum 2.5 m, and quantity of cables must be equal from each inverter module to the common terminal in the junction box.

NOTICE

If a retrofit application requires an unequal amount of wires per phase, consult Danfoss for requirements and documentation, or use the top/bottom entry side cabinet option.

4.1.8 Brake Cable for Frequency Converters with Factory-installed Brake Chopper Option

(Only standard with letter B in position 18 of product type code).

Use a screened connection cable to the brake resistor. The maximum length from the frequency converter to the DC bar is limited to 25 m (82 ft).

Terminal number	Function
81, 82	Brake resistor terminals

Table 4.4 Brake Resistor Terminals

The connection cable to the brake resistor must be screened. Connect the screen to the conductive back plate on the frequency converter and to the metal cabinet of the brake resistor with cable clamps.
Size the brake cable cross-section to match the brake torque. See also the Instructions *Brake Resistor* and *Brake Resistors for Horizontal Applications* for further information regarding safe installation.

NOTICE

Depending on the supply voltage, voltages up to 1099 V DC may occur on the terminals.

F enclosure requirements
Connect the brake resistor to the brake terminals in each inverter module.

4.1.9 Shielding against Electrical Noise

Before mounting the mains power cable, mount the EMC metal cover to ensure best EMC performance.

NOTICE

The EMC metal cover is only included in frequency converters with an RFI filter.

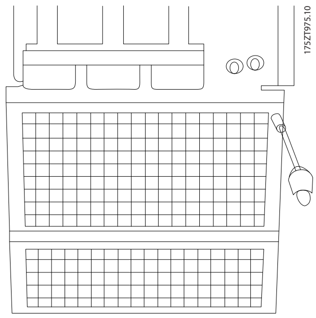


Illustration 4.14 Mounting of EMC shield.

4.1.10 Mains Connection

Mains and ground must be connected as detailed in *Table 4.5*.

Terminal number	Function
91-1, 92-1, 93-1	Mains R1/L1-1, S1/L2-1, T1/L3-1
91-2, 92-2, 93-2	Mains R2/L1-2, S2/L2-2, T2/L3-2
94	Ground

Table 4.5 Mains and Ground Connection Terminals

NOTICE

Check the nameplate to ensure that the mains voltage of the frequency converter matches the power supply of the plant.

Ensure that the power supply can supply the necessary current to the frequency converter.

If the frequency converter is without built-in fuses, ensure that the appropriate fuses have the correct current rating.

4

4.1.11 External Fan Supply

In case the frequency converter is supplied by DC, or if the fan must run independently of the power supply, an external power supply can be applied. The connection is made on the power card.

Terminal number	Function
100, 101	Auxiliary supply S, T
102, 103	Internal supply S, T

Table 4.6 External Fan Supply Terminals

The connector located on the power card provides the connection of line voltage for the cooling fans. The fans are connected from factory to be supplied from a common AC line (jumpers between 100-102 and 101-103). If an external supply is needed, remove the jumpers and connect the supply to terminals 100 and 101. Use a 5 A fuse for protection. In UL applications this should be LittleFuse KLK-5 or equivalent.

4.1.12 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
Protect the frequency converter against short-circuit to avoid electrical or fire hazard. Danfoss recommends using the fuses mentioned in to *Table 4.18* to protect service personnel and equipment in case of an internal failure in the frequency converter. The frequency converter provides full short-circuit protection in case of a short-circuit on the motor output.

Overcurrent protection
Provide overload protection to avoid fire hazard due to overheating of the cables in the installation. The frequency converter is equipped with an internal overcurrent protection, which can be used for upstream overload protection (UL-applications excluded). See *4-18 Current Limit*. Moreover, fuses or circuit breakers can be used to provide the overcurrent protection in the installation. Overcurrent protection must always be carried out according to national regulations.

UL compliance

The fuses in this section are suitable for use on a circuit capable of delivering 100000 A_{rms} (symmetrical), 240 V, or 480 V, or 500V, or 600 V depending on the frequency converter voltage rating. With the proper fusing the frequency converter Short Circuit Current Rating (SCCR) is 100000 A_{rms}.

Power size	Enclosure	Rating		Bussmann	Spare Bussmann	Estimated fuse power loss [W]	
	Size	Voltage (UL)	Amperes	P/N	P/N	400V	460V
P315T5	F8/F9	700	700	170M4017	176F9179	25	19
P355T5	F8/F9	700	700	170M4017	176F9179	30	22
P400T5	F8/F9	700	700	170M4017	176F9179	38	29
P450T5	F8/F9	700	700	170M4017	176F9179	3500	2800
P500T5	F10/F11	700	900	170M6013	176F9180	3940	4925
P560T5	F10/F11	700	900	170M6013	176F9180	2625	2100
P630T5	F10/F11	700	900	170M6013	176F9180	3940	4925
P710T5	F10/F11	700	1500	170M6018	176F9181	45	34
P800T5	F12/F13	700	1500	170M6018	176F9181	60	45
P1M0T5	F12/F13	700	1500	170M6018	176F9181	83	63

Table 4.7 Mains Fuses, 380-500 V

Power size	Enclosure	Rating		Bussmann	Spare Bussmann	Estimated fuse power loss [W]	
	Size	Voltage (UL)	Amperes	P/N	P/N	600V	690V
P450T7	F8/F9	700	630	170M4016	176F9179	13	10
P500T7	F8/F9	700	630	170M4016	176F9179	17	13
P560T7	F8/F9	700	630	170M4016	176F9179	22	16
P630T7	F8/F9	700	630	170M4016	176F9179	24	18
P710T7	F10/F11	700	900	170M6013	176F9180	26	20
P800T7	F10/F11	700	900	170M6013	176F9180	35	27
P900T7	F10/F11	700	900	170M6013	176F9180	44	33
P1M0T7	F12/F13	700	1500	170M6018	176F9181	26	20
P1M2T7	F12/F13	700	1500	170M6018	176F9181	37	28
P1M4T7	F12/F13	700	1500	170M6018	176F9181	47	36

Table 4.8 Mains Fuses, 525-690 V

Size/Type	Bussmann PN*	Rating	Siba
P500	170M8611	1100 A, 1000 V	20 781 32.1000
P560	170M8611	1100 A, 1000 V	20 781 32.1000
P630	170M6467	1400 A, 700 V	20 681 32.1400
P710	170M6467	1400 A, 700 V	20 681 32.1400
P800	170M8611	1100 A, 1000 V	20 781 32.1000
P1M0	170M6467	1400 A, 700 V	20 681 32.1400

Table 4.9 Inverter module DC Link Fuses, 380-500V

Size/Type	Bussmann PN*	Rating	Siba
P710	170M8611	1100 A, 1000 V	20 781 32. 1000
P800	170M8611	1100 A, 1000 V	20 781 32. 1000
P900	170M8611	1100 A, 1000 V	20 781 32. 1000
P1M0	170M8611	1100 A, 1000 V	20 781 32. 1000
P1M2	170M8611	1100 A, 1000 V	20 781 32. 1000
P1M4	170M8611	1100A, 1000V	20 781 32.1000

Table 4.10 Inverter module DC Link Fuses, 525-690V

**170M fuses from Bussmann shown use the -/80 visual indicator, -TN/80 Type T, -/110 or TN/110 Type T indicator fuses of the same size and amperage may be substituted for external use.*

4

Supplementary fuses

	Size/Type	Bussmann PN*	Rating	Alternative Fuses
2.5-4.0 A Fuse	P500-P1M0, 380-500 V	LPJ-6 SP or SPI	6 A, 600 V	Any listed Class J Dual Element, Time Delay, 6A
	P710-P1M4, 525-690 V	LPJ-10 SP or SPI	10 A, 600 V	Any listed Class J Dual Element, Time Delay, 10 A
4.0-6.3 A Fuse	P500-P1M0, 380-500 V	LPJ-10 SP or SPI	10 A, 600 V	Any listed Class J Dual Element, Time Delay, 10 A
	P710-P1M4, 525-690 V	LPJ-15 SP or SPI	15 A, 600 V	Any listed Class J Dual Element, Time Delay, 15 A
6.3 - 10 A Fuse	P500-P1M0, 380-500 V	LPJ-15 SP or SPI	15 A, 600 V	Any listed Class J Dual Element, Time Delay, 15 A
	P710-P1M4, 525-690 V	LPJ-20 SP or SPI	20 A, 600 V	Any listed Class J Dual Element, Time Delay, 20A
10 - 16 A Fuse	P500-P1M0, 380-500 V	LPJ-25 SP or SPI	25 A, 600 V	Any listed Class J Dual Element, Time Delay, 25 A
	P710-P1M4, 525-690 V	LPJ-20 SP or SPI	20 A, 600 V	Any listed Class J Dual Element, Time Delay, 20 A

Table 4.11 Manual Motor Controller Fuses

Enclosure size	Bussmann PN*	Rating
F8-F13	KTK-4	4 A, 600V

Table 4.12 SMPS Fuse

Size/Type	Bussmann PN*	LittelFuse	Rating
P355-P1M0, 380-500 V		KLK-15	15A, 600V
P450-P1M4, 525-690 V		KLK-15	15A, 600V

Table 4.13 Fan Fuses

Enclosure size	Bussmann PN*	Rating	Alternative fuses
F8-F13	LPJ-30 SP or SPI	30 A, 600 V	Any listed Class J Dual Element, Time Delay, 30 A

Table 4.14 30 A Fuse Protected Terminal Fuse

Enclosure size	Bussmann PN*	Rating	Alternative fuses
F8-F13	LPJ-6 SP or SPI	6 A, 600 V	Any listed Class J Dual Element, Time Delay, 6 A

Table 4.15 Control Transformer Fuse

Enclosure size	Bussmann PN*	Rating
F8-F13	GMC-800MA	800mA, 250V

Table 4.16 NAMUR Fuse

Frame size	Bussmann PN*	Rating	Alternative fuses
F8-F13	LP-CC-6	6A, 600V	Any listed Class CC, 6A

Table 4.17 Safety Relay Coil Fuse with PILS Relay

Enclosure size	Power	Type
380-500 V		
F9	P250	ABB OETL-NF600A
F9	P315	ABB OETL-NF600A
F9	P355	ABB OETL-NF600A
F9	P400	ABB OETL-NF600A
F11	P450	ABB OETL-NF800A
F11	P500	ABB OETL-NF800A
F11	P560	ABB OETL-NF800A
F11	P630	ABB OT800U21
F13	P710	Merlin Gerin NPJF36000S12AAYP
F13	P800	Merlin Gerin NPJF36000S12AAYP
525-690 V		
F9	P355	ABB OT400U12-121
F9	P400	ABB OT400U12-121
F9	P500	ABB OT400U12-121
F9	P560	ABB OT400U12-121
F11	P630	ABB OETL-NF600A
F11	P710	ABB OETL-NF600A
F11	P800	ABB OT800U21
F13	P900	ABB OT800U21
F13	P1M0	Merlin Gerin NPJF36000S12AAYP
F13	P1M2	Merlin Gerin NPJF36000S12AAYP

Table 4.18 Mains Disconnectors

4.1.13 Motor Insulation

For motor cable lengths ≤ the maximum cable length listed in , the motor insulation ratings in *Table 4.19* are recommended. Peak voltage can be up to twice the DC-link voltage, and 2.8 times the mains voltage, due to transmission line effects in the motor cable. If a motor has lower insulation rating, use a dU/dt or sine-wave filter.

Nominal mains voltage [V]	Motor insulation [V]
$U_N \leq 420$	Standard U_{LL}=1300
$420 < U_N \leq 500$	Reinforced U_{LL}=1600
$500 < U_N \leq 600$	Reinforced U_{LL}=1800
$600 < U_N \leq 690$	Reinforced U_{LL}=2000

Table 4.19 Motor Insulation Ratings

4.1.14 Motor Bearing Currents

All motors installed with VLT® HVAC Drive 315kW or higher power drives should have NDE (Non-Drive End) insulated bearings installed to eliminate circulating bearing currents. To minimize DE (Drive End) bearing and shaft currents proper grounding of the drive, motor, driven machine, and motor to the driven machine is required.

Standard Mitigation Strategies:

1. Use an insulated bearing
2. Apply rigorous installation procedures
    - Ensure the motor and load motor are aligned
    - Strictly follow the EMC Installation guideline
    - Reinforce the PE so the high frequency impedance is lower in the PE than the input power leads
    - Provide a good high frequency connection between the motor and the frequency converter for instance by screened cable which has a 360° connection in the motor and the frequency converter
    - Make sure that the impedance from frequency converter to building ground is lower that the grounding impedance of the machine. This can be difficult for pumps
    - Make a direct earth connection between the motor and load motor
3. Lower the IGBT switching frequency
4. Modify the inverter waveform, 60° AVM vs. SFAVM
5. Install a shaft grounding system or use an isolating coupling
6. Apply conductive lubrication
7. Use minimum speed settings if possible
8. Try to ensure the line voltage is balanced to ground. This can be difficult for IT, TT, TN-CS or Grounded leg systems
9. Use a dU/dt or sinus filter

4.1.15 Brake Resistor Temperature Switch

- Torque: 0.5-0.6 Nm (5 in-lbs)
- Screw size: M3

This input can be used to monitor the temperature of an externally connected brake resistor. If the input between 104 and 106 is established, the frequency converter trips on warning/alarm 27 *Brake IGBT*. If the connection is closed between 104 and 105, the frequency converter trips on warning/alarm 27 *Brake IGBT*.
Install a KLIXON switch that is normally closed. If this function is not used, short-circuit 106 and 104 together.

- Normally closed: 104-106 (factory installed jumper)
- Normally open: 104-105

Terminal number	Function
106, 104, 105	Brake resistor temperature switch.

Table 4.20 Brake Resistor Temperature Switch Terminals

⚠CAUTION

If the temperature of the brake resistor gets too high and the thermal switch drops out, the frequency converter stops braking and the motor starts coasting.

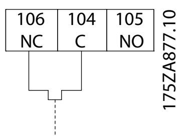


Illustration 4.15 Brake Resistor Temperature Switch

4.1.16 Control Cable Routing

Tie all control wires down to the designated control cable routing. Remember to connect the shields in a proper way to ensure optimum electrical immunity.

Fieldbus connection
Connections are made to the relevant options on the control card. For details, see the relevant fieldbus instruction. Place the cable in the provided path inside the

frequency converter and tie it down with other control wires.

Installation of 24 V external DC supply

- Torque: 0.5 - 0.6 Nm (5 in-lbs)
- Screw size: M3

Terminal number	Function
35 (-), 36 (+)	24 V external DC supply

Table 4.21 Terminals for 24 V External DC Supply

24 V DC external supply can be used as low-voltage supply to the control card and any option cards installed. This enables full operation of the LCP (including parameter setting) without connection to the mains. A warning of low voltage is given when 24 V DC has been connected; however, there is no tripping.

NOTICE

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

4.1.17 Access to Control Terminals

All terminals to the control cables are located beneath the LCP. They are accessed by opening the door of the IP21/IP54 unit, or by removing the covers of the IP00 unit.

4.1.18 Electrical Installation, Control Terminals

To connect the cable to the terminal:

1. Strip the insulation by about 9–10 mm

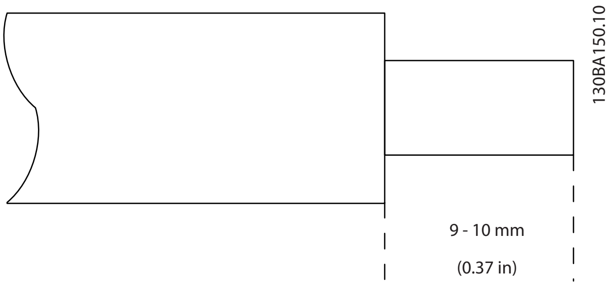


Illustration 4.16 Stripping of Insulation

2. Insert a screwdriver[1)] in the square hole.
3. Insert the cable in the adjacent circular hole.

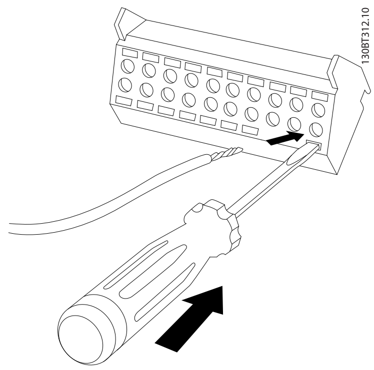


Illustration 4.17 Inserting Cable

4. Remove the screwdriver. The cable is now mounted in the terminal.

1) Maximum 0.4x2.5 mm

To remove the cable from the terminal:

1. Insert a screwdriver[1)] in the square hole.
2. Pull out the cable.

1) Max. 0.4x2.5 mm

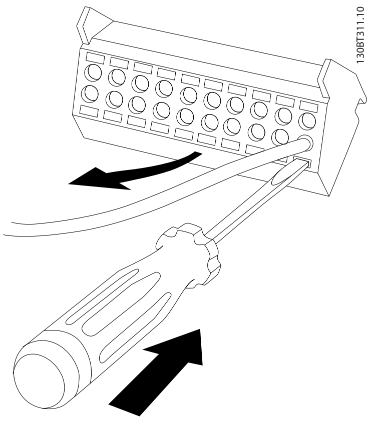


Illustration 4.18 Removing Cable

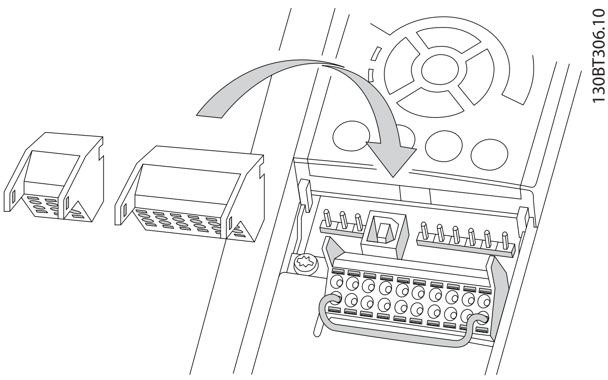


Illustration 4.19 Unplugging Control Terminals

4.2 Connection Examples

4.2.1 Start/Stop

Terminal 18 = *5-10 Terminal 18 Digital Input [8] Start*
Terminal 27 = *5-12 Terminal 27 Digital Input [0] No operation* (Default *coast inverse*)
Terminal 37 = Safe Torque Off

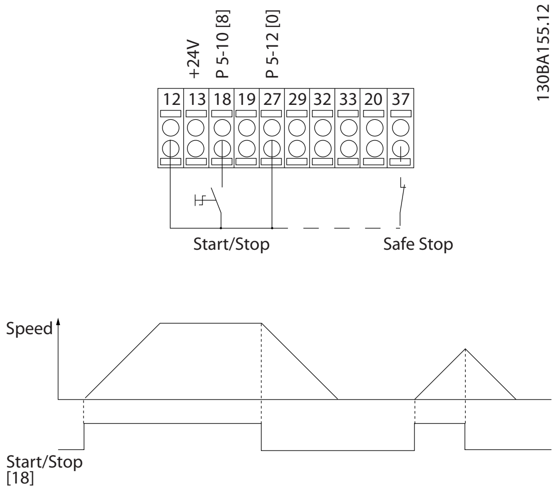


Illustration 4.20 Wiring Start/Stop

4.2.2 Pulse Start/Stop

Terminal 18 = *5-10 Terminal 18 Digital Input [9] Latched start*
Terminal 27= *5-12 Terminal 27 Digital Input [6] Stop inverse*
Terminal 37 = Safe Torque Off

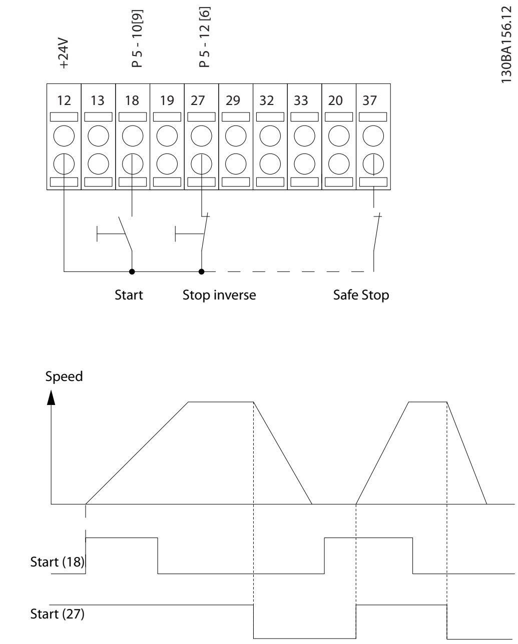


Illustration 4.21 Wiring Pulse Start/Stop

4.2.3 Speed Up/Down

Terminals 29/32 = Speed up/down

Terminal 18 = *5-10 Terminal 18 Digital Input [9] Start* (default)

Terminal 27 = *5-12 Terminal 27 Digital Input [19] Freeze reference*

Terminal 29 = *5-13 Terminal 29 Digital Input [21] Speed up*

Terminal 32 = *5-14 Terminal 32 Digital Input [22] Speed down*

NOTICE

Terminal 29 only in FC x02 (x=series type).

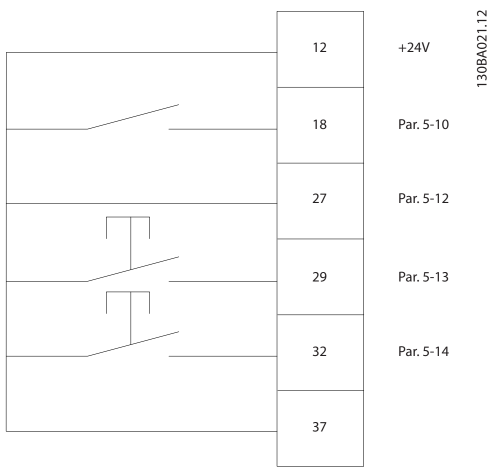


Illustration 4.22 Speed Up/Down

4.2.4 Potentiometer Reference

Voltage reference via a potentiometer

Reference Source 1 = *[1] Analog input 53* (default)

Terminal 53, Low Voltage = 0 V

Terminal 53, High Voltage = 10 V

Terminal 53, Low Ref./Feedback = 0 RPM

Terminal 53, High Ref./Feedback = 1500 RPM

Switch S201 = OFF (U)

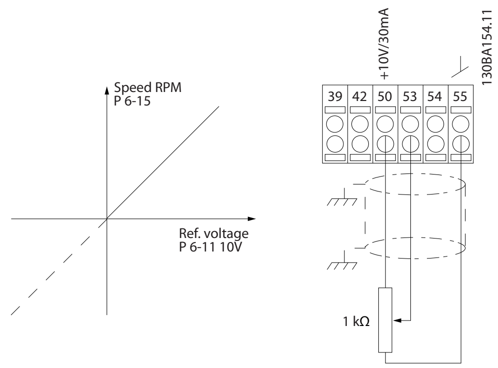


Illustration 4.23 Potentiometer Reference

4.3.1 Electrical Installation, Control Cables

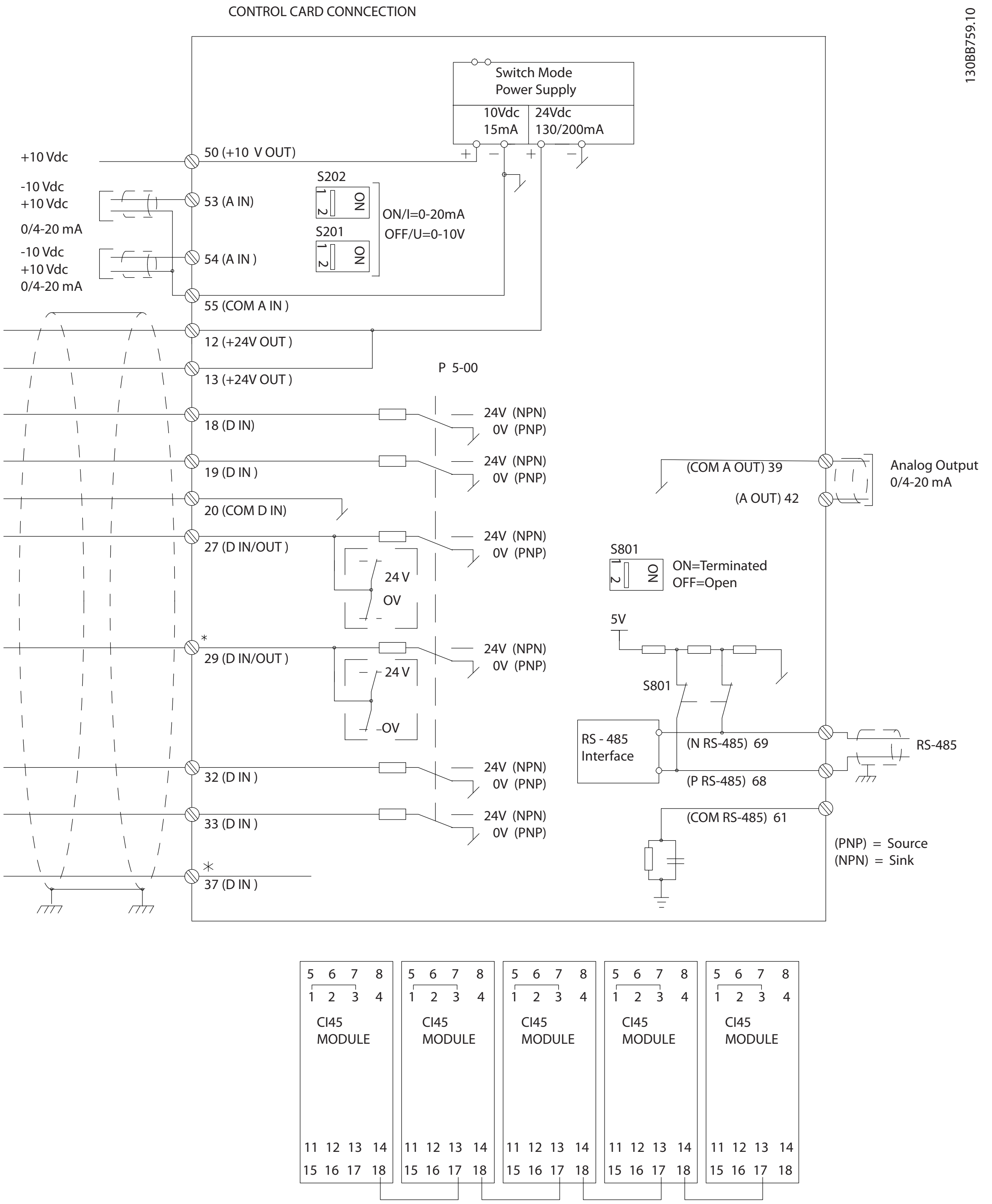


Illustration 4.24

A=Analog, D=Digital

*Terminal 37 (optional) is used for Safe Torque Off. For Safe Torque Off installation instructions, refer to the *Safe Torque Off Operating Instructions for Danfoss VLT® Frequency Converters*.

**Do not connect cable screen.

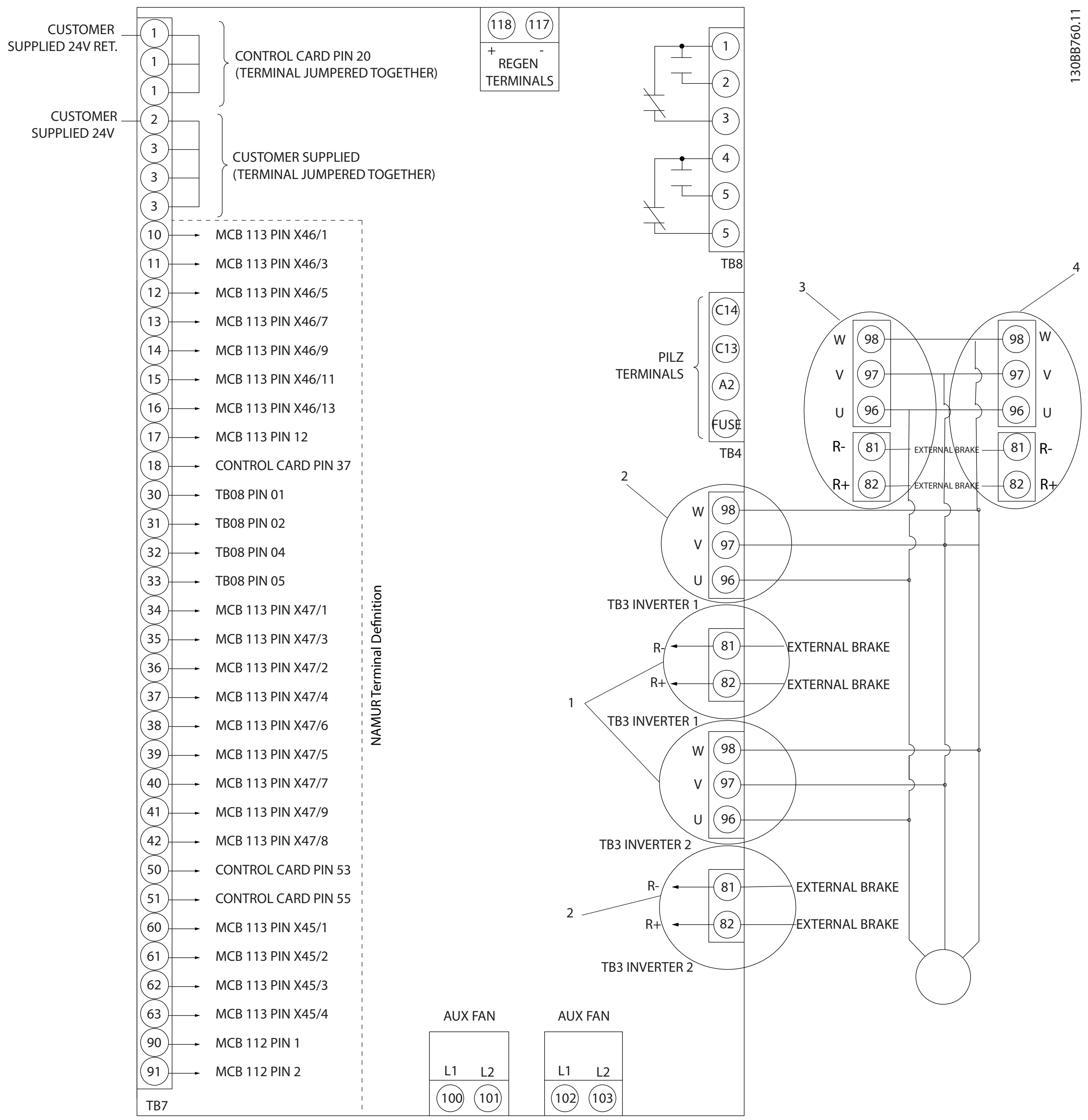


Illustration 4.25 Diagram Showing all Electrical Terminals with NAMUR Option

Very long control cables and analog signals may in rare cases and depending on installation result in 50/60 Hz ground loops due to noise from mains supply cables.

If this occurs, it may be necessary to break the screen or insert a 100 nF capacitor between screen and chassis.

Connect the digital and analog inputs and outputs separately to the frequency converter common inputs (terminal 20, 55, 39) to avoid ground currents from both groups to affect other groups. For example, switching on the digital input may disturb the analog input signal.

Input polarity of control terminals

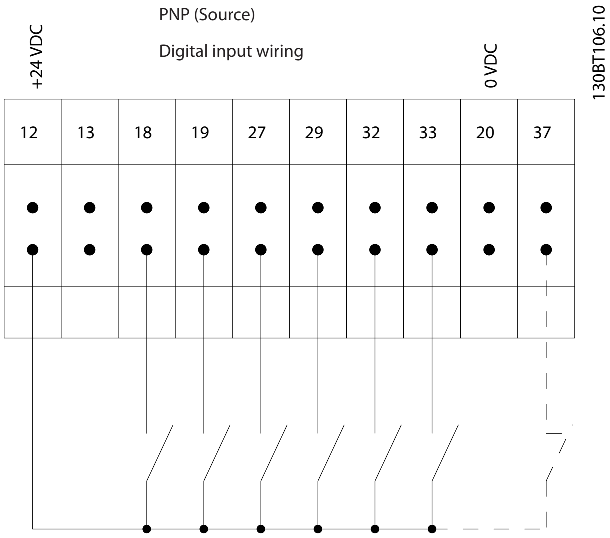


Illustration 4.26 PNP (Source)

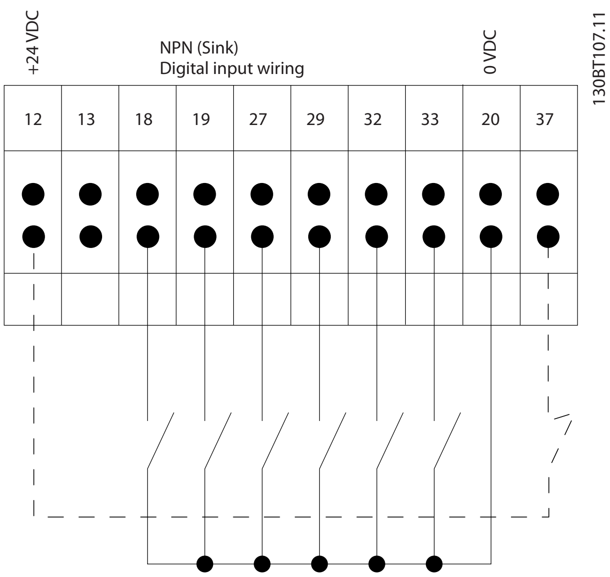


Illustration 4.27 NPN (Sink)

NOTICE

Control cables must be screened/armoured.

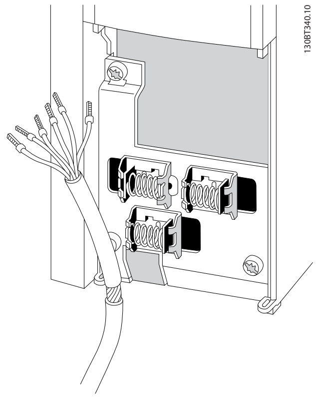


Illustration 4.28 Grounding of Screened/Armoured Control Cables

Connect the wires as described in the product related *Operating Instructions*. Remember to connect the shields in a proper way to ensure optimum electrical immunity.

4.3.2 Switches S201, S202 and S801

Use switches S201 (A53) and S202 (A54) to configure the analog input terminals 53 and 54 as a current (0–20 mA) or a voltage (-10 V to +10 V).

Enable termination on the RS-485 port (terminals 68 and 69) via the switch S801 (BUS TER.).

See *Illustration 4.24*.

Default setting:

S201 (A53) = OFF (voltage input)

S202 (A54) = OFF (voltage input)

S801 (Bus termination) = OFF

NOTICE

When changing the function of S201, S202, or S801 do not to use force during the switch over. Remove the LCP fixture (cradle) when operating the switches. Do not operate the switches when the frequency converter is powered.

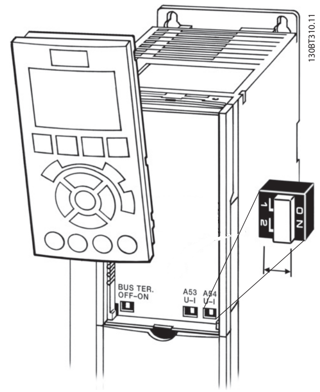


Illustration 4.29 Switch Location

4.4 Final Set-up and Test

To test the set-up and to ensure that the frequency converter is running, follow these steps.

Step 1. Locate the motor nameplate

NOTICE

The motor is either star (Y) or delta connected (Δ). This information is on the motor nameplate.

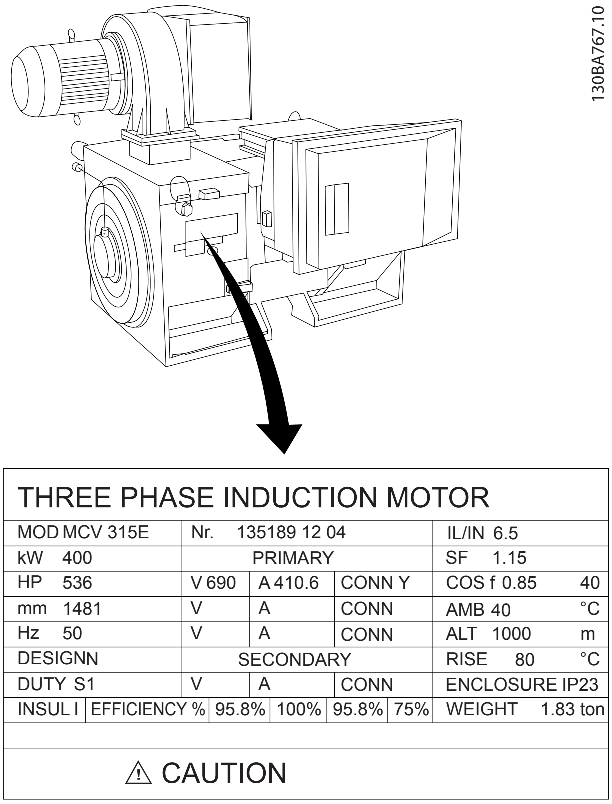


Illustration 4.30 Nameplate

Step 2. Enter the motor nameplate data in this parameter list.

To access this list, press [Quick Menu] then select *Q2 Quick Setup*.

1. *1-20 Motor Power [kW]*
   1-21 Motor Power [HP]
2. *1-22 Motor Voltage*
3. *1-23 Motor Frequency*
4. *1-24 Motor Current*
5. *1-25 Motor Nominal Speed*

Step 3. Activate the Automatic Motor Adaptation (AMA)

Performing an AMA ensures optimum performance. The AMA measures the values from the motor model equivalent diagram.

1. Connect terminal 37 to terminal 12 (if terminal 37 is available).
2. Connect terminal 27 to terminal 12 or set *5-12 Terminal 27 Digital Input* to *[0] No function*.
3. Activate the AMA *1-29 Automatic Motor Adaptation (AMA)*.
4. Select between complete or reduced AMA. If a sine-wave filter is mounted, run only the reduced AMA, or remove the sine-wave filter during the AMA procedure.

5. Press [OK]. The display shows *Press [Hand On] to start*.
6. Press [Hand On]. A progress bar indicates if the AMA is in progress.

Stop the AMA during operation

1. Press [Off] - the frequency converter enters into alarm mode and the display shows that the user terminated the AMA.

Successful AMA

1. The display shows *Press [OK] to finish AMA*.
2. Press [OK] to exit the AMA state.

Unsuccessful AMA

1. The frequency converter enters into alarm mode. A description of the alarm can be found in .
2. *Report Value* in the [Alarm Log] shows that the last measuring sequence carried out by the AMA, before the frequency converter entered alarm mode. This number along with the description of the alarm helps with troubleshooting. If contacting Danfoss for service, state the alarm number and description.

NOTICE

Incorrectly registered motor nameplate data or a too big difference between the motor power size and the frequency converter power size often causes unsuccessful AMA.

Step 4. Set the speed limit and ramp time

- *3-02 Minimum Reference*
- *3-03 Maximum Reference*

Step 5. Set up the desired limits for speed and ramp time.

- *4-11 Motor Speed Low Limit [RPM]* or *4-12 Motor Speed Low Limit [Hz]*
- *4-13 Motor Speed High Limit [RPM]* or *4-14 Motor Speed High Limit [Hz]*
- *3-41 Ramp 1 Ramp Up Time*
- *3-42 Ramp 1 Ramp Down Time*

4.5 Additional Connections

4.5.1 Mechanical Brake Control

In hoisting/lowering applications, it is necessary to be able to control an electro-mechanical brake:

- Control the brake using any relay output or digital output (terminal 27 or 29).
- Keep the output closed (voltage-free) as long as the frequency converter is unable to support the motor, for example due to the load being too heavy.
- Select *[32] Mechanical brake control* in parameter group *5-4* Relays* for applications with an electro-mechanical brake.
- The brake is released when the motor current exceeds the preset value in *2-20 Release Brake Current*.
- The brake is engaged when the output frequency is less than the frequency set in *2-21 Activate Brake Speed [RPM]* or *2-22 Activate Brake Speed [Hz]*, and only if the frequency converter carries out a stop command.

If the frequency converter is in alarm mode or in an over-voltage situation, the mechanical brake immediately cuts in.

4.5.2 Parallel Connection of Motors

The frequency converter can control several parallel-connected motors. The total current consumption of the motors must not exceed the rated output current $I_{M,N}$ for the frequency converter.

NOTICE

Installations with cables connected in a common joint as in *Illustration 4.31*, are only recommended for short cable lengths.

NOTICE

When motors are connected in parallel, *1-29 Automatic Motor Adaptation (AMA)* cannot be used.

NOTICE

The electronic thermal relay (ETR) of the frequency converter cannot be used as motor overload protection for the individual motor in systems with parallel-connected motors. Provide further motor overload protection, for example thermistors in each motor or individual thermal relays (circuit breakers are not suitable as protection).

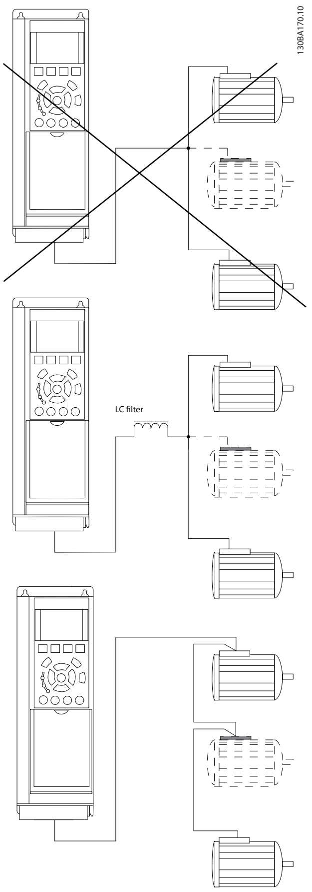


Illustration 4.31 Parallel Motor Connection

Problems may arise at start-up and at low RPM values if motor sizes are widely different because small motors' relatively high ohmic resistance in the stator calls for a higher voltage at start-up and at low RPM values.

4.5.3 Motor Thermal Protection

The electronic thermal relay in the frequency converter has received UL-approval for single motor overload protection, when *1-90 Motor Thermal Protection* is set for *[4] ETR Trip* and *1-24 Motor Current* are set to the rated motor current (see motor nameplate).
For thermal motor protection, it is also possible to use the MCB 112 PTC Thermistor Card option. This card provides ATEX certificate to protect motors in explosion hazardous areas, Zone 1/21 and Zone 2/22. When *1-90 Motor Thermal Protection* is set to *[20] ATEX ETR* and is combined with the use of MCB 112, it is possible to control an Ex-e motor in explosion hazardous areas. Consult the product relevant *Programming Guide* for details on how to set up the frequency converter for safe operation of Ex-e motors.

4.5.4 Mechanical Brake Control

In hoisting/lowering applications, it is necessary to be able to control an electro-mechanical brake:

- Control the brake using any relay output or digital output (terminal 27 or 29).
- Keep the output closed (voltage-free) as long as the frequency converter is unable to support the motor, for example due to the load being too heavy.
- Select *[32] Mechanical brake control* in parameter group *5-4* Relays* for applications with an electro-mechanical brake.
- The brake is released when the motor current exceeds the preset value in *2-20 Release Brake Current*.
- The brake is engaged when the output frequency is less than the frequency set in *2-21 Activate Brake Speed [RPM]* or *2-22 Activate Brake Speed [Hz]*, and only if the frequency converter carries out a stop command.

If the frequency converter is in alarm mode or in an over-voltage situation, the mechanical brake immediately cuts in.

5 How to Operate the Frequency Converter

5.1.1 3 Ways of Operating

The frequency converter can be operated in 3 ways:

1. Graphical Local Control Panel (GLCP)
2. Numeric Local Control Panel (NLCP)
3. RS-485 serial communication or USB, both for PC connection

If the frequency converter is fitted with fieldbus option, refer to relevant documentation.

5.1.2 How to Operate Graphical LCP (GLCP)

The following instructions are valid for the GLCP (LCP 102).

The GLCP is divided into 4 functional groups

1. Graphical display with status lines.
2. Menu keys and indicator lights (LEDs) - selecting mode, changing parameters and switching between display functions.
3. Navigation keys and indicator lights (LEDs).
4. Operation keys and indicator lights (LEDs).

Graphical display
The LCD-display is back-lit with a total of 6 alpha-numeric lines. All data is displayed on the LCP which can show up to 5 operating variables while in [Status] mode.

Display lines

a. **Status line:** Status messages displaying icons and graphics.

b. **Line 1–2:** Operator data lines displaying data and variables defined or selected by the user. By pressing the [Status] key, up to one extra line can be added.

c. **Status line:** Status messages displaying text.

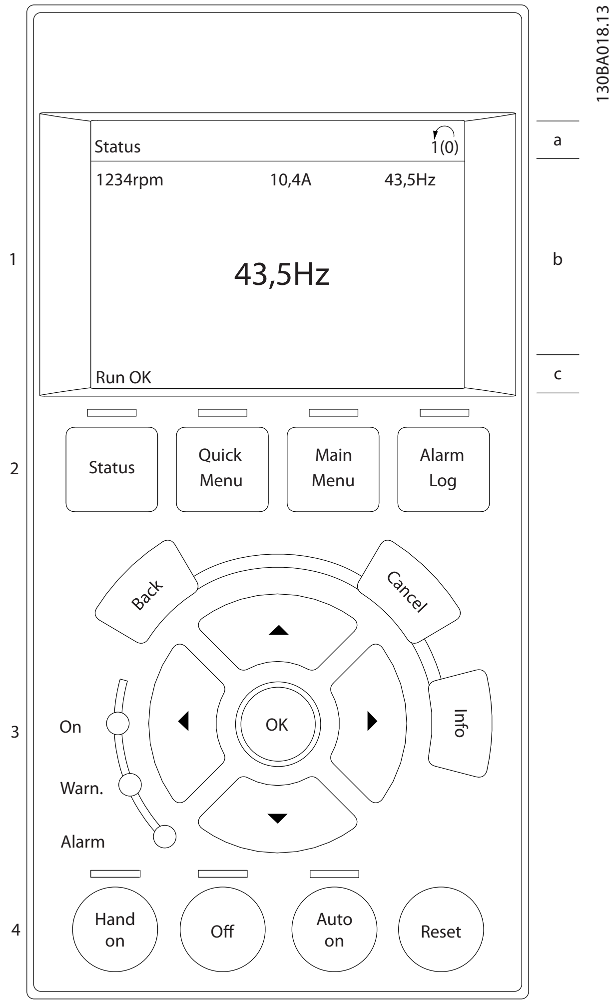


Illustration 5.1 LCP

The display is divided into 3 sections
Top section
(a) shows the status when in status mode or up to 2 variables when not in status mode and in the case of Alarm/Warning.

The number of the active set-up (selected as the active set-up in *0-10 Active Set-up*) is shown. When programming in another set-up than the active set-up, the number of the set-up being programmed appears to the right in brackets.

Middle section
(b) shows up to 5 variables with related unit, regardless of status. In case of alarm/warning, the warning is shown instead of the variables.

Bottom section
(c) always shows the state of the frequency converter in status mode.

It is possible to toggle between 3 status readout displays by pressing the [Status] key.
Operating variables with different formatting are shown in each status screen - see below.

Several values or measurements can be linked to each of the displayed operating variables. The values/measurements to be displayed can be defined via *0-20 Display Line 1.1 Small*, *0-21 Display Line 1.2 Small*, *0-22 Display Line 1.3 Small*, *0-23 Display Line 2 Large* and *0-24 Display Line 3 Large*, which can be accessed via [Quick Menu], *Q3 Function Set-ups*, *Q3-1 General Settings*, *Q3-13 Display Settings*.

Each value/measurement readout parameter selected in *0-20 Display Line 1.1 Small* to *0-24 Display Line 3 Large* has its own scale and number of digits after a possible decimal point. Larger numeric values are displayed with few digits after the decimal point.
Ex.: Current readout
5.25 A; 15.2 A 105 A.

Status display I
This readout state is standard after start-up or initialisation. Use [INFO] to obtain information about the value/measurement linked to the displayed operating variables (1.1, 1.2, 1.3, 2, and 3).
See the operating variables shown in the display in this illustration. 1.1, 1.2 and 1.3 are shown in small size. 2 and 3 are shown in medium size.

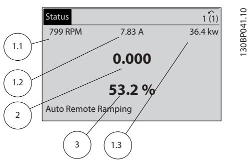


Illustration 5.2 Example of Status Display I

Status display II
See the operating variables (1.1, 1.2, 1.3, and 2) shown in the display in *Illustration 5.3*.
In the example, speed, motor current, motor power and frequency are selected as variables in the first and second lines.
1.1, 1.2 and 1.3 are shown in small size. 2 is shown in large size.

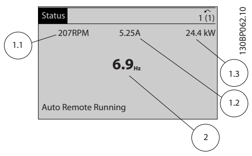


Illustration 5.3 Example of Status Display II

Status display III
This state displays the event and action of the Smart Logic Control.

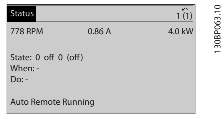


Illustration 5.4 Example of Status Display III

Display Contrast Adjustment
Press [status] and [▲] for darker display
Press [status] and [▼] for brighter display

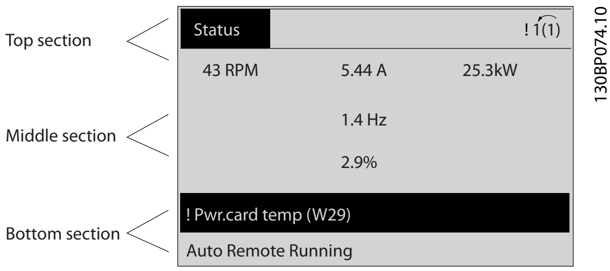


Illustration 5.5 Display Sections

Indicator lights (LEDs)
If certain threshold values are exceeded, the alarm and/or warning LED lights up. A status and alarm text appear in the display.
The On LED is activated when the frequency converter receives power from mains voltage, a DC bus terminal, or a 24 V external supply. At the same time, the backlight is on.

- Green LED/On: Control section is working.
- Yellow LED/Warn.: Indicates a warning.
- Flashing Red LED/Alarm: Indicates an alarm.

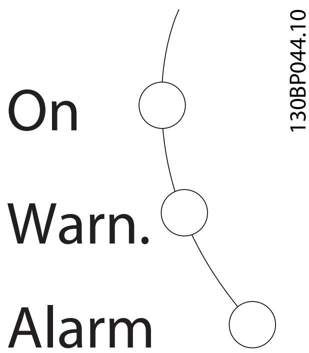


Illustration 5.6 Indicator Lights

GLCP keys
Menu keys
The menu keys are divided into functions. The keys below the display and indicator lights are used for parameter set-up, including selection of display indication during normal operation.

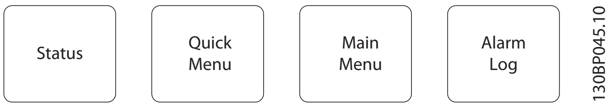


Illustration 5.7 Menu Keys

[Status]
indicates the status of the frequency converter and/or the motor. 3 different readouts can be selected by pressing the [Status] key:

- 5-line readouts
- 4-line readouts
- Smart Logic Control

Press [Status] to select the display mode or for changing back to Display mode from either Quick Menu mode, Main Menu mode or Alarm mode. Also press [Status] to toggle single or double readout mode.

[Quick Menu]
allows quick set-up of the frequency converter. The most common HVAC functions can be programmed here.

The [Quick Menu] consists of

- My Personal Menu
- Quick Set-up
- Function Set-up
- Changes Made
- Loggings

The Function Set-up provides quick and easy access to all parameters required for most HVAC applications including

- most VAV and CAV supply and return fans
- cooling tower fans
- primary, secondary and condenser water pumps
- other pump, fan and compressor applications

Among other features, it also includes parameters for selecting which variables to display in the LCP, digital preset speeds, scaling of analog references, closed loop single-zone and multi-zone applications and specific functions related to fans, pumps and compressors.

The Quick Menu parameters can be accessed immediately unless a password has been created via *0-60 Main Menu Password*, *0-61 Access to Main Menu w/o Password*, *0-65 Personal Menu Password* or *0-66 Access to Personal Menu w/o Password*.
It is possible to switch directly between Quick Menu mode and Main Menu mode.

[Main Menu]
is used for programming all parameters. The Main Menu parameters can be accessed immediately unless a password has been created via *0-60 Main Menu Password*, *0-61 Access to Main Menu w/o Password*, *0-65 Personal Menu Password* or *0-66 Access to Personal Menu w/o Password*. For most HVAC applications, it is not necessary to access the Main Menu parameters. Instead, the Quick Menu, Quick Set-up and Function Set-up provide the simplest and quickest access to the typical required parameters.
It is possible to switch directly between Main Menu mode and Quick Menu mode.
Parameter shortcut can be carried out by pressing down [Main Menu] for 3 s. The parameter shortcut allows direct access to any parameter.

[Alarm Log]
displays an alarm list of the 10 latest alarms (numbered A1-A10). To obtain more details about an alarm, press the navigation keys to manoeuvre to the alarm number and press [OK]. Information is displayed about the condition of the frequency converter before it enters the alarm mode.

The [Alarm Log] key on the LCP allows access to both alarm log and maintenance log.

[Back]
reverts to the previous step or layer in the navigation structure.

Illustration 5.8 Back Key

[Cancel]
Cancels the last change or command as long as the display has not been changed.

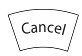


Illustration 5.9 Cancel Key

[Info]
displays information about a command, parameter, or function in any display window. [Info] provides detailed information when needed.
Exit Info mode by pressing either [Info], [Back], or [Cancel].

Illustration 5.10 Info Key

Navigation Keys
The 4 navigation keys are used to navigate between the different options available in [Quick Menu], [Main Menu] and [Alarm Log]. Press the keys to move the cursor.

[OK]
is used for selecting a parameter marked by the cursor and for enabling the change of a parameter.

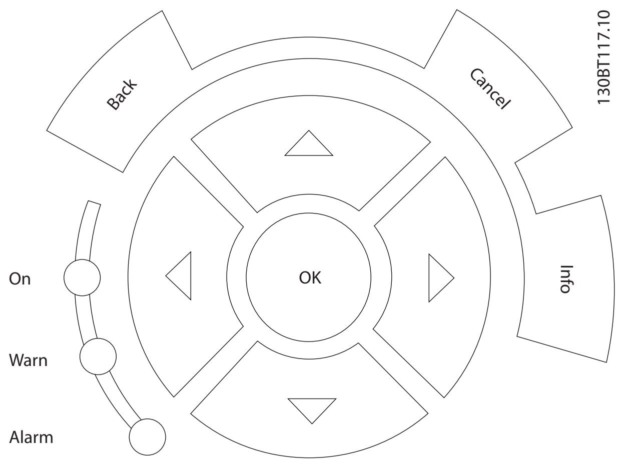


Illustration 5.11

Operation Keys
for local control are found at the bottom of the control panel.

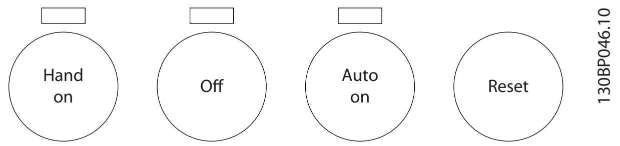


Illustration 5.12 Operation Keys

[Hand On]
enables control of the frequency converter via the GLCP. [Hand On] also starts the motor, and it is now possible to enter the motor speed data with the navigation keys. The key can be selected as *[1] Enable* or *[0] Disable* via *0-40 [Hand on] Key on LCP*.
The following control signals are still active when [Hand On] is activated:

- [Hand On] - [Off] - [Auto On]
- Reset
- Coasting stop inverse
- Reversing
- Set-up select lsb - Set-up select msb
- Stop command from serial communication
- Quick stop
- DC brake

NOTICE

External stop signals activated with control signals or a fieldbus overrides a start command via the LCP.

[Off]
stops the connected motor. The key can be selected as *[1] Enabled* or *[0] Disabled* via *0-41 [Off] Key on LCP*. If no external stop function is selected and the [Off] key is inactive, the motor can only be stopped by disconnecting the mains supply.

[Auto On]
enables the frequency converter to be controlled via the control terminals and/or serial communication. When a start signal is applied on the control terminals and/or the bus, the frequency converter starts. The key can be selected as *[1] Enabled* or *[0] Disabled* via *0-42 [Auto on] Key on LCP*.

NOTICE

An active HAND-OFF-AUTO signal via the digital inputs has higher priority than the control keys [Hand On] – [Auto On].

[Reset]
is used for resetting the frequency converter after an alarm (trip). It can be selected as *[1] Enable* or *[0] Disable* via *0-43 [Reset] Key on LCP*.

The parameter shortcut can be carried out by holding down the [Main Menu] key for 3 s. The parameter shortcut allows direct access to any parameter.

5.1.3 RS-485 Bus Connection

One or more frequency converters can be connected to a controller (or master) using the RS-485 standard interface. Terminal 68 is connected to the P signal (TX+, RX+), while terminal 69 is connected to the N signal (TX-, RX-).

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

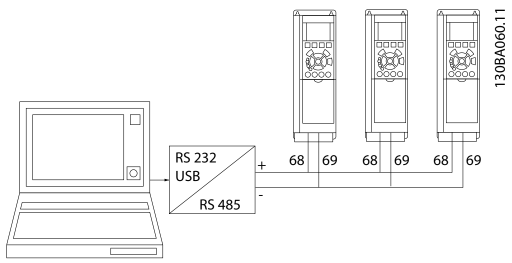


Illustration 5.13 Connection Example.

To avoid potential equalising currents in the screen, ground the cable screen via terminal 61, which is connected to the frame via an RC-link.

Bus termination
Terminate the RS-485 bus by a resistor network at both ends. If the frequency converter is the first or the last device in the RS-485 loop, set the switch S801 on the control card for ON.
For more information, see the paragraph *Switches S201, S202, and S801*.

5.1.4 How to Connect a PC to the Frequency Converter

To control or program the frequency converter from a PC, install the PC-based configuration tool MCT 10 Set-up Software.
The PC is connected via a standard (host/device) USB cable, or via the RS-485 interface as shown in *chapter 5.1.3 RS-485 Bus Connection*.

NOTICE

The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. The USB connection is connected to protective earth. Use only an isolated laptop as PC connection to the USB connector on the frequency converter.

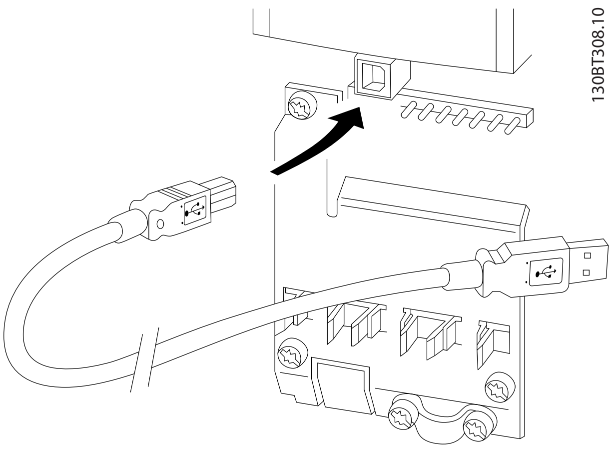


Illustration 5.14 USB Connection to Frequency Converter

5.1.5 PC Software Tools

PC-based MCT 10 Set-up Software
All frequency converters are equipped with a serial communication port. Danfoss provides a PC tool for communication between PC and frequency converter. Check the section on for detailed information on this tool.

MCT 10 Set-up Software
MCT 10 Set-up Software has been designed as an easy to use interactive tool for setting parameters in our frequency converters.
The MCT 10 Set-up Software is useful for:

- Planning a communication network off-line. MCT 10 Set-up Software contains a complete frequency converter database.
- Commissioning frequency converters on line.
- Saving settings for all frequency converters.
- Replacing a frequency converter in a network.
- Simple and accurate documentation of frequency converter settings after commissioning.
- Expanding an existing network.
- Future developed frequency converters are supported.

MCT 10 Set-up Software supports Profibus DP-V1 via a master class 2 connection. It enables online reading/ writing of parameters in a frequency converter via the Profibus network. This network eliminates the need for an extra communication network.

Save frequency converter settings:

1. Connect a PC to the unit via USB com port. (NOTE: Use a PC, which is isolated from the mains, with the USB port. Failure to do so may damage equipment.).
2. Open MCT 10 Set-up Software.
3. Select *Read from drive*.
4. Select *Save as*.

All parameters are now stored in the PC.

Load frequency converter settings:

1. Connect a PC to the frequency converter via USB com port.
2. Open MCT 10 Set-up Software.
3. Select *Open* – stored files are shown.
4. Open the appropriate file.
5. Select *Write to drive*.

All parameter settings are now transferred to the frequency converter.

A separate manual for MCT 10 Set-up Software is available from *www.Danfoss.com/BusinessAreas/DrivesSolutions/ Softwaredownload/DDPC+Software+Program.htm*.

The MCT 10 Set-up software modules
The following modules are included in the software package.

5

	MCT Set-up 10 Software Setting parameters Copy to and from frequency converters Documentation and print of parameter settings incl. diagrams
	Ext. user interface Preventive Maintenance Schedule Clock settings Timed Action Programming Smart Logic Controller Set-up

Table 5.1

Ordering number:
Order the CD containing MCT 10 Set-up Software using code number 130B1000.

The software can be downloaded from the Danfoss internet site *www.Danfoss.com/BusinessAreas/DrivesSolutions/Softwaredownload/DDPC+Software+Program.htm*

5.1.6 Tips and Tricks

- For most HVAC applications the Quick Menu, Quick Set-up and Function Set-up provides the simplest and quickest access to all the typical parameters required
- Whenever possible, performing an AMA, ensures best shaft performance
- Contrast of the display can be adjusted by pressing [Status] and [▲] for darker display or by pressing [Status] and [▼] for brighter display
- Under [Quick Menu] and [Changes Made] all parameters that have been changed from factory settings are displayed
- Press and hold [Main Menu] key for 3 s for access to any parameter
- For service purposes, copy all parameters to the LCP, see *0-50 LCP Copy* for further information

5.1.7 Quick Transfer of Parameter Settings when Using GLCP

Once the set-up of a frequency converter is complete, store (back up) the parameter settings in the GLCP or on a PC via MCT 10 Set-up Software.

⚠WARNING

Stop the motor before performing any of these operations.

Data storage in LCP

1. Go to *0-50 LCP Copy*.
2. Press [OK].
3. Select *[1] All to LCP*.
4. Press [OK].

All parameter settings are now stored in the GLCP indicated by the progress bar. When 100% is reached, press [OK].

The GLCP can now be connected to another frequency converter and the parameter settings copied to this frequency converter.

Data transfer from LCP to frequency converter

1. Go to *0-50 LCP Copy*.
2. Press [OK].
3. Select *[2] All from LCP*.
4. Press [OK]

The parameter settings stored in the GLCP are now transferred to the frequency converter indicated by the progress bar. When 100% is reached, press [OK].

5.1.8 Initialisation to Default Settings

There are 2 ways to initialise the frequency converter to default: Recommended initialisation and manual initialisation.
Be aware that they have different impact according to the following description.

Recommended initialisation (via *14-22 Operation Mode*)

1. Select *14-22 Operation Mode*.
2. Press [OK].
3. Select *[2] Initialisation* (for NLCP select "2").
4. Press [OK].
5. Remove power to unit and wait for display to turn off.
6. Reconnect power and the frequency converter is reset. Note that first start-up takes a few more seconds.
7. Press [Reset]

14-22 Operation Mode initialises all except:
14-50 RFI Filter
8-30 Protocol
8-31 Address
8-32 Baud Rate
8-35 Minimum Response Delay
8-36 Max Response Delay
8-37 Maximum Inter-Char Delay
15-00 Operating hours to *15-05 Over Volt's*

15-20 Historic Log: Event to *15-22 Historic Log: Time*
15-30 Alarm Log: Error Code to *15-32 Alarm Log: Time*

NOTICE

Parameters selected in *0-25 My Personal Menu* stay present with default factory setting.

Manual initialisation

NOTICE

When carrying out manual initialisation, serial communication, RFI filter settings and fault log settings are reset. Removes parameters selected in *0-25 My Personal Menu*.

1. Disconnect from mains and wait until the display turns off.
2. Press
   - 2a [Status] - [Main Menu] - [OK] at the same time while powering up for Graphical LCP (GLCP).
   - 2b [Menu] while powering up for LCP 101, Numerical Display.
3. Release the keys after 5 s.
4. The frequency converter is now programmed according to default settings.

This parameter initialises all except:
15-00 Operating hours
15-03 Power Up's
15-04 Over Temp's
15-05 Over Volt's

6 How to Programme

6.1.1 Parameter Set-Up

Group	Title	Function
0**	Operation and Display	Parameters used to program the fundamental functions of the frequency converter and the LCP including: • Selection of language • Selection of which variables are displayed at each position in the display. As an example, static duct pressure or condenser water return temperature can be displayed with the setpoint in small digits in the top row and feedback in large digits in the centre of the display) • Enabling/disabling of the LCP keys • Passwords for the LCP • Upload and download of commissioned parameters to/from the LCP • Setting the built-in clock
1**	Load/Motor	Parameters used to configure the frequency converter for the specific application and motor including: • Open or closed loop operation • Type of application such as compressor, fan or centrifugal pump • Motor nameplate data • Auto-tuning of the frequency converter to the motor for optimum performance • Flying start (typically used for fan applications) • Thermal motor protection
2**	Brakes	Parameters used to configure brake functions of the frequency converter which although not common in many HVAC applications, can be useful on special fan applications. Parameters including: • DC brake • Dymamic/resistor brake • Overvoltage control (which provides automatic adjustment of the deceleration rate (auto-ramping) to avoid tripping when decelerating large inertia fans)
3**	Reference/Ramps	Parameters used to program the • minimum and maximum reference limits of speed (RPM/Hz) in open loop or in actual units when operating in closed loop) • digital/preset references • jog speed • definition of the source of each reference (for example, which analog input the reference signal is connected to) • ramp-up and ramp-down times • digital potentiometer settings

Group	Title	Function
4**	Limits/Warnings	Parameters used to program limits and warnings of operation including: • Allowable motor direction • Minimum and maximum motor speeds. As an example, in pump applications the minimum speed is often set to approx 30–40%. This speed ensures that pump seals always are adequately lubricated, avoid cavitation and ensure that adequate head always is produced to create flow) • Torque and current limits to protect the pump, fan or compressor driven by the motor • Warnings for low/high current, speed, reference, and feedback • Missing motor phase protection • Speed bypass frequencies including semi-automatic set-up of these frequencies (for example, to avoid resonance conditions on cooling tower and other fans)
5**	Digital In/Out	Parameters used to program the functions of all • digital inputs • digital outputs • relay outputs • pulse inputs • pulse outputs for terminals on the control card and all option cards.
6**	Analog In/Out	Parameters used to program the functions associated with all analog inputs and analog outputs for the terminals on the control card and General Purpose I/O option (MCB 101) including: • Analog input live zero timeout function (which for example can be used to command a cooling tower fan to operate at full speed if the condenser water return sensor fails) • Scaling of the analog input signals (for example to match the analog input to the mA and pressure range of a static duct pressure sensor) • Filter time constant to filter out electrical noise on the analog signal which can sometimes occur when long cables are installed • Function and scaling of the analog outputs (for example to provide an analog output representing motor current or kW to an analog input of a DDC controller) • Configure the analog outputs to be controlled by the BMS via a high-level interface (HLI) (for example, to control a chilled water valve) including ability to define a default value of these outputs in the event of the HLI failing
8**	Communication and Options	Parameters used for configuring and monitoring functions associated with the serial communications/high level interface to the frequency converter
9**	Profibus	Parameters only applicable when a Profibus option is installed.
10**	CAN Fieldbus	Parameters only applicable when a DeviceNet option is installed.
11**	LonWorks	Parameters only applicable when a Lonworks option is installed.

Group	Title	Function
13**	Smart Logic Controller	Parameters used to configure the built-in Smart Logic Controller (SLC). The SLC can be used for • simple functions such as - comparators (for example, if running above x Hz, activate output relay) - timers (for example, when a start signal is applied, first activate output relay to open supply air damper and wait x seconds before ramping up) • complex sequence of user-defined actions executed by the SLC when the associated user-defined event is evaluated as TRUE by the SLC. For example, initiate an economiser mode in a simple AHU cooling application control scheme where there is no BMS. For such an application, the SLC can monitor the outside air relative humidity. If the relative humidity is below a defined value, the supply air temperature setpoint could be automatically increased. With the frequency converter monitoring the outside air relative humidity and supply air temperature via its analog inputs, and controlling the chilled water valve via one of the extended PI(D) loops and an analog output, it would then modulate that valve to maintain a higher supply air temperature). The SLC can often replace the need for other external control equipment.
14**	Special Functions	Parameters used to configure special functions of the frequency converter including: • Setting of the switching frequency to reduce audible noise from the motor (sometimes required for fan applications) • Kinetic back-up function (especially useful for critical applications in semi-conductor installations where performance under mains dip/mains loss is important) • Mains imbalance protection • Automatic reset (to avoid the need for a manual reset of Alarms) • Energy optimisation parameters. These parameters typically do not need changing but enable fine-tuning of this automatic function ensuring that the frequency converter and motor combination operate at their optimum efficiency. • Autoderating functions (which enable the frequency converter to continue operation at reduced performance under extreme operating conditions ensuring maximum up time)
15**	FC Information	Parameters providing operating data and other frequency converter information including: • Operating and running hour counters • kWh counter; resetting of the running and kWh counters • Alarm/fault log (where the past 10 alarms are logged along with any associated value and time) • Frequency converter and option card identification parameters such as code number and software version
16**	Data Readouts	Read-only parameters which display the status/value of many operating variables which can be displayed on the LCP or viewed in this parameter group. These parameters can be useful during commissioning when interfacing with a BMS via a high-level interface.
18**	Info & Readouts	Read-only parameters which display the last 10 preventive maintenance log items, actions and time and the value of analog inputs and outputs on the Analog I/O option card which can be useful during commissioning when interfacing with a BMS via a high-level interface.

Group	Title	Function
20**	FC Closed Loop	Parameters used to configure the closed loop PI(D) controller which controls the speed of the pump, fan or compressor in closed loop mode including: • Defining where each of the 3 possible feedback signals come from (for example, which analog input or the BMS HLI) • Conversion factor for each of the feedback signals. An example could be a pressure signal used for indication of flow in an AHU or converting from pressure to temperature in a compressor application) • Engineering unit for the reference and feedback (for example, Pa, kPa, m Wg, in Wg, bar, m3/s, m3/h, °C, °F etc) • The function (for example, sum, difference, average, minimum or maximum) used to calculate the resulting feedback for single zone applications or the control philosophy for multi-zone applications • Programming of the setpoints • Manual or auto-tuning of the PI(D) loop
21**	Extended Closed Loop	Parameters used to configure the 3 extended closed loop PI(D) controllers. The controllers can for example be used to control external actuators (for example, chilled water valve to maintain supply air temperature in a VAV system) including: • Engineering unit for the reference and feedback of each controller (for example, °C, °F etc) • Defining the range of the reference/setpoint for each controller • Defining where each of the references/setpoints and feedback signals come from (for example, which analog input or the BMS HLI) • Programming of the setpoint and manual or auto-tuning of each of the PI(D) controllers.
22**	Application Functions	Parameters used to monitor, protect and control pumps, fans and compressors including: • No-flow detection and protection of pumps (including auto-setup of this function) • Dry pump protection • End-of-curve detection and protection of pumps • Sleep mode (especially useful for cooling tower and booster pump sets) • Broken belt detection (typically used for fan applications to detect no air flow instead of using a Δp switch installed across the fan) • Short cycle protection of compressors and pump flow compensation of setpoint (especially useful for secondary chilled water pump applications where the Δp sensor has been installed close to the pump and not acoss the furthest most significant load(s) in the system • Using this function can compensate for the sensor installation and help to realise the maximum energy savings).
23**	Time Based Functions	Time-based parameters including: • Parameters used to initiate daily or weekly actions based on the built-in real time clock. The actions could be change of setpoint for night set back mode or start/stop of the pump/fan/ compressor start/stop of an external equipment) • Preventive maintenance functions which can be based on running or operating hour time intervals or on specific dates and times • Energy log (especially useful in retrofit applications or where information of the actual historical load (kW) on the pump/fan/compressor is of interest) • Trending (useful in retrofit or other applications where there is an interest to log operating power, current, frequency or speed of the pump/fan/compressor for analysis and a payback counter
24**	Application Functions 2	Parameters used to set up fire mode and/or to control a bypass contactor/starter if designed into the system.

Group	Title	Function
25**	Cascade Controller	Parameters used to configure and monitor the built-in pump cascade controller (typically used for pump booster sets).
26**	Analog I/O Option MCB 109	Parameters used to configure the Analog I/O option (MCB 109) including: • Definition of the analog input types (for example, voltage, Pt1000 or Ni1000) • Scaling and definition of the analog output functions and scaling.

Table 6.1 Parameter Groups

6

Parameter descriptions and selections are displayed on the graphic (GLCP) or numeric (NLCP) display. (See relevant section for details.) Access the parameters by pressing [Quick Menu] or [Main Menu] on the LCP. The Quick Menu is used primarily for commissioning the unit at start-up by providing the parameters necessary to start operation. The Main Menu provides access to all parameters for detailed application programming.

All digital input/output and analog input/output terminals are multifunctional. All terminals have factory default functions suitable for most HVAC applications but if other special functions are required, they must be programmed as explained in parameter group *5-** Digital In/out* or *6-** Analog In/out*.

6.1.2 Quick Menu Mode

Parameter data
The graphical display (GLCP) provides access to all parameters listed under the Quick Menus. The numeric display (NLCP) only provides access to the Quick Set-up parameters. To set parameters pressing [Quick Menu] - enter or change parameter data or settings in accordance with the following procedure

1. Press [Quick Menu].
2. Press [▲] and [▼] to find the parameter to change.
3. Press [OK].
4. Press [▲] and [▼] to select the correct parameter setting.
5. Press [OK].
6. To move to a different digit within a parameter setting, use the [◀] and [▶].
7. Highlighted area indicates digit selected for change.
8. Press [Cancel] to disregard change, or press [OK] to accept change and enter the new setting.

Example of changing parameter data
Assume *parameter 22-60 Broken Belt Function* is set to [Off]. To monitor the fan-belt condition, non-broken or broken, follow this procedure

1. Press [Quick Menu].
2. Select Function Set-ups with [▼].
3. Press [OK].
4. Press [▼] to select Application Settings .
5. Press [OK].
6. Press [OK] again for Fan Functions.
7. Select Broken Belt Function by pressing [OK].
8. Press [▼], to select *[2] Trip*.

If a broken fan-belt is detected, the frequency converter trips .

Select [My Personal Menu] to display personal parameters
For example, an AHU or pump OEM may have pre-programmed personal parameters to be in My Personal Menu during factory commissioning to make on-site commissioning/fine tuning simpler. These parameters are selected in *0-25 My Personal Menu*. Up to 20 different parameters can be programmed in this menu.

Select [Changes Made] to get information about

- The last 10 changes. Press [▲] and [▼] to scroll between the last 10 changed parameters.
- The changes made since default setting.

[Loggings]
shows information about the display line readouts. The information is shown as graphs.
Only display parameters selected in *0-20 Display Line 1.1 Small* and *0-24 Display Line 3 Large* can be viewed. It is possible to store up to 120 samples in the memory for later reference.

Quick Set-up

Efficient parameter set-up for HVAC applications
The parameters can easily be set up for most HVAC applications only by using the Quick Set-up option.
After pressing [Quick Menu], the different options in the Quick Menu are listed. See also *Illustration 6.1* and *Table 6.3* to *Table 6.6*.

Example of using the Quick Set-up option
To set the ramp down time to 100 s:

1. Select Quick Set-up. *Parameter 0-01 Language* in Quick Set-up appears.
2. Press [▼] repeatedly until *parameter 3-42 Ramp 1 Ramp Down Time* appears with the default setting of 20 s.
3. Press [OK].
4. Press [◄] to highlight the third digit before the comma.
5. Change '0' to '1' by pressing [▲].
6. Press [►] to highlight the digit '2'.
7. Change '2' to '0' by pressing [▼].
8. Press [OK].

The new ramp-down time is now set to 100 s.
Do the set-up in the order listed.

NOTICE

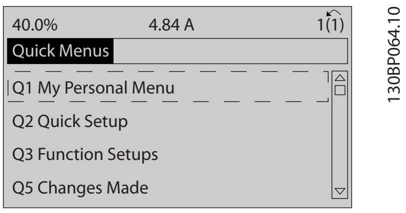


Illustration 6.1 Quick Menu View

The Quick Set-up menu gives access to the 18 most important set-up parameters of the frequency converter. After programming, the frequency converter is ready for operation. The 18 Quick Set-up parameters are shown in *Table 6.2*.

Parameter	[Units]
Parameter 0-01 Language	
Parameter 1-20 Motor Power [kW]	[kW]
Parameter 1-21 Motor Power [HP]	[Hp]
Parameter 1-22 Motor Voltage*	[V]
Parameter 1-23 Motor Frequency	[Hz]
Parameter 1-24 Motor Current	[A]
Parameter 1-25 Motor Nominal Speed	[RPM]
Parameter 1-28 Motor Rotation Check	[Hz]
Parameter 3-41 Ramp 1 Ramp Up Time	[s]
Parameter 3-42 Ramp 1 Ramp Down Time	[s]
Parameter 4-11 Motor Speed Low Limit [RPM]	[RPM]
Parameter 4-12 Motor Speed Low Limit [Hz]*	[Hz]
Parameter 4-13 Motor Speed High Limit [RPM]	[RPM]
Parameter 4-14 Motor Speed High Limit [Hz]*	[Hz]
3-19 Jog Speed [RPM]	[RPM]
Parameter 3-11 Jog Speed [Hz]*	[Hz]
5-12 Terminal 27 Digital Input	
Parameter 5-40 Function Relay**	

Table 6.2 Quick Set-up Parameters

**The display showing depends on the selections made in 0-02 Motor Speed Unit and 0-03 Regional Settings. The default settings of 0-02 Motor Speed Unit and 0-03 Regional Settings depend on which region of the world the frequency converter is supplied to but can be reprogrammed as required.*
*** Parameter 5-40 Function Relay is an array. Select between [0] Relay1 or [1] Relay2 . Standard setting is [0] Relay1 with the default option [9] Alarm.*

For a detailed information about settings and programming, see the *VLT® HVAC Drive Programming Guide*

NOTICE

If *[0] No Operation* is selected in *5-12 Terminal 27 Digital Input*, no connection to +24 V on terminal 27 is necessary to enable start.
If [2] Coast Inverse (factory default value) is selected in *5-12 Terminal 27 Digital Input*, a connection to +24 V is necessary to enable start.

6

0-01 Language		
Option:		**Function:**
		Defines the language to be used in the display. The frequency converter is delivered with 4 different language packages. English and German are included in all packages. English cannot be erased or manipulated.
[0] *	English	Part of Language packages 1–4
[1]	Deutsch	Part of Language packages 1–4
[2]	Francais	Part of Language package 1
[3]	Dansk	Part of Language package 1
[4]	Spanish	Part of Language package 1
[5]	Italiano	Part of Language package 1
[6]	Svenska	Part of Language package 1
[7]	Nederlands	Part of Language package 1
[10]	Chinese	Part of Language package 2
[20]	Suomi	Part of Language package 1
[22]	English US	Part of Language package 4
[27]	Greek	Part of Language package 4
[28]	Bras.port	Part of Language package 4
[36]	Slovenian	Part of Language package 3
[39]	Korean	Part of Language package 2
[40]	Japanese	Part of Language package 2
[41]	Turkish	Part of Language package 4
[42]	Trad.Chinese	Part of Language package 2
[43]	Bulgarian	Part of Language package 3
[44]	Srpski	Part of Language package 3
[45]	Romanian	Part of Language package 3
[46]	Magyar	Part of Language package 3
[47]	Czech	Part of Language package 3
[48]	Polski	Part of Language package 4
[49]	Russian	Part of Language package 3
[50]	Thai	Part of Language package 2
[51]	Bahasa Indonesia	Part of Language package 2
[52]	Hrvatski	Part of Language package 3

1-20 Motor Power [kW]		
Range:		**Function:**
Size related*	[0.09 - 3000.00 kW]	Enter the nominal motor power in kW according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit. Depending on the selections made in *0-03 Regional Settings*, either *parameter 1-20 Motor Power [kW]* or *parameter 1-21 Motor Power [HP]* is made invisible.

1-21 Motor Power [HP]		
Range:		**Function:**
Size related*	[0.09 - 3000.00 hp]	Enter the nominal motor power in hp according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit. Depending on the selections made in *0-03 Regional Settings*, either *parameter 1-20 Motor Power [kW]* or *parameter 1-21 Motor Power [HP]* is made invisible.

1-22 Motor Voltage		
Range:		**Function:**
Size related*	[10 - 1000 V]	Enter the nominal motor voltage according to the motor nameplate data. The default value corresponds to the nominal rated output of the frequency converter.

1-23 Motor Frequency		
Range:		**Function:**
Size related*	[20 - 1000 Hz]	Select the motor frequency value from the motor nameplate data. For 87 Hz operation with 230/400 V motors, set the nameplate data for 230 V/50 Hz. Adapt *parameter 4-13 Motor Speed High Limit [RPM]* and *3-03 Maximum Reference* to the 87 Hz application.

1-24 Motor Current		
Range:		**Function:**
Size related*	[0.10 - 10000.00 A]	Enter the nominal motor current value from the motor nameplate data. This data is used for calculating motor torque, thermal motor protection etc.

1-25 Motor Nominal Speed		
Range:		**Function:**
Size related*	[100 - 60000 RPM]	Enter the nominal motor speed value from the motor nameplate data. This data is used for calculating automatic motor compensations.

1-28 Motor Rotation Check		
Option:	**Function:**	
		Following installation and connection of the motor, this function allows the correct motor rotation direction to be verified. Enabling this function overrides any bus commands or digital inputs, except external interlock and Safe Torque Off (STO) (if included).
[0] *	Off	Motor rotation check is not active.
[1]	Enabled	Motor rotation check is enabled.

WARNING

Remove mains power before disconnecting motor phase cables.

NOTICE

Once the motor rotation check is enabled the display shows: *Note! Motor may run in wrong direction*. Pressing [OK], [Back] or [Cancel] dismisses the message and displays a new message: “Press [Hand On] to start the motor. Press [Cancel] to abort”. Pressing [Hand On] starts the motor at 5 Hz in forward direction and the display shows: “Motor is running. Check if motor rotation direction is correct. Press [Off] to stop the motor”. Pressing [Off] stops the motor and resets *parameter 1-28 Motor Rotation Check*. If motor rotation direction is incorrect, interchange 2 motor phase cables.

3-41 Ramp 1 Ramp Up Time		
Range:		**Function:**
Size related*	[1.00 - 3600 s]	Enter the ramp-up time, that is, the acceleration time from 0 RPM to *parameter 1-25 Motor Nominal Speed*. Select a ramp-up time such that the output current does not exceed the current limit in *4-18 Current Limit* during ramping. See ramp-down time in *parameter 3-42 Ramp 1 Ramp Down Time*.

$$par.3-41 = \frac{t_{acc} \times n_{nom}\,[par.1-25]}{ref\,[RPM]}[s]$$

3-42 Ramp 1 Ramp Down Time		
Range:		**Function:**
Size related*	[1.00 - 3600 s]	Enter the ramp-down time, that is, the deceleration time from *parameter 1-25 Motor Nominal Speed* to 0 RPM. Select a ramp-down time preventing overvoltage from arising in the inverter due to regenerative operation of the motor. The ramp-down time should also be long enough to prevent that the generated current exceeds the current limit set in *4-18 Current Limit*. See ramp-up time in *parameter 3-41 Ramp 1 Ramp Up Time.*

$$par.3-42 = \frac{t_{dec} \times n_{nom}\,[par.1-25]}{ref\,[RPM]}[s]$$

4-14 Motor Speed High Limit [Hz]		
Range:		**Function:**
Size related*	[par. 4-12 - par. 4-19 Hz]	Enter the max. limit for motor speed in Hz. *Parameter 4-14 Motor Speed High Limit [Hz]* can match the manufacturer's recommended maximum motor speed. The motor speed high limit must exceed the value in *parameter 4-12 Motor Speed Low Limit [Hz]*. The output frequency must not exceed 10% of the switching frequency.

NOTICE

Max. output frequency cannot exceed 10% of the inverter switching frequency (*parameter 14-01 Switching Frequency*).

4-12 Motor Speed Low Limit [Hz]		
Range:		**Function:**
Size related*	[0 - par. 4-14 Hz]	Enter the minimum limit for motor speed in Hz. The motor speed low limit can be set to correspond to the minimum output frequency of the motor shaft. The speed low limit must not exceed the setting in *parameter 4-14 Motor Speed High Limit [Hz]*.

4-13 Motor Speed High Limit [RPM]		
Range:		**Function:**
Size related*	[par. 4-11 - 60000 RPM]	Enter the maximum limit for motor speed in RPM. The motor speed high limit can be set to correspond to the manufacturer’s maximum rated motor. The motor speed high limit must exceed the setting in *parameter 4-11 Motor Speed Low Limit [RPM]*. The parameter name appears as either *parameter 4-11 Motor Speed Low Limit [RPM]* or *parameter 4-12 Motor Speed Low Limit [Hz]*, depending on • the settings of other parameters in the Main Menu, and • default settings based on geographical location.

6

NOTICE

Max. output frequency cannot exceed 10% of the inverter switching frequency (*parameter 14-01 Switching Frequency*).

NOTICE

Any changes in *parameter 4-13 Motor Speed High Limit [RPM]* reset the value in *parameter 4-53 Warning Speed High* to the same value as set in *parameter 4-13 Motor Speed High Limit [RPM]*.

4-11 Motor Speed Low Limit [RPM]		
Range:		**Function:**
Size related*	[0 - par. 4-13 RPM]	Enter the minimum limit for motor speed in RPM. The motor speed low limit can be set to correspond to the manufacturer's recommended minimum motor speed. The motor speed low limit must not exceed the setting in *parameter 4-13 Motor Speed High Limit [RPM]*.

3-11 Jog Speed [Hz]		
Range:		**Function:**
Size related*	[0 - par. 4-14 Hz]	The jog speed is a fixed output speed at which the frequency converter is running when the jog function is activated. See also *3-80 Jog Ramp Time*.

6.1.3 Function Setups

The Function Setup provides quick and easy access to all parameters required for most HVAC applications including

- most VAV and CAV supply and return fans
- cooling tower fans
- primary pumps
- secondary pumps
- condenser water pumps
- other pump, fan and compressor applications.

How to access Function Setup - example

1. Turn on the frequency converter (yellow LED lights).

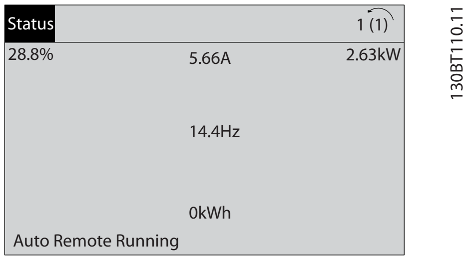


Illustration 6.2 Frequency Converter Turned on

2. Press [Quick Menus].

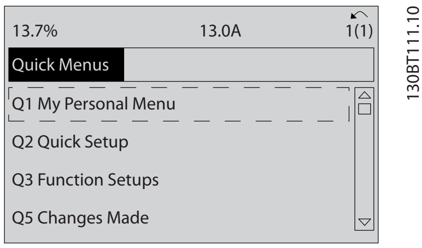


Illustration 6.3 Quick Menu Selected

3. Press [▲] and [▼] to scroll down to Function Setups. Press [OK].

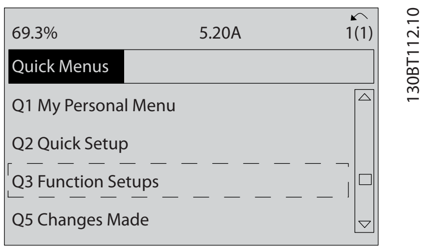


Illustration 6.4 Scrolling to Function Set-up

4. Function Setups options appear. Select Q3-1 *General Settings*. Press [OK].

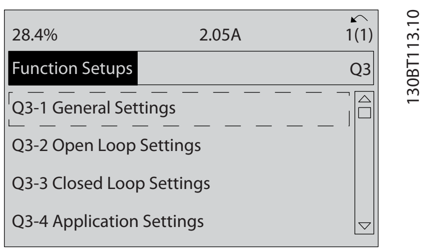


Illustration 6.5 Function Setups Options

5. Press [▲] and [▼] to scroll down to that is, Q3-11 *Analog Outputs*. Press [OK].

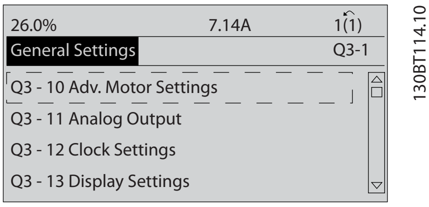


Illustration 6.6 General Settings Options

6. Select *parameter 6-50 Terminal 42 Output*. Press [OK].

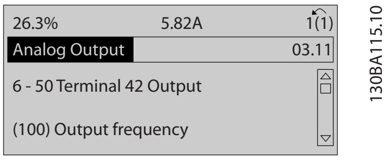


Illustration 6.7 Parameter parameter 6-50 Terminal 42 Output Selected

7. Press [▲] and [▼] to select between the different options. Press [OK].

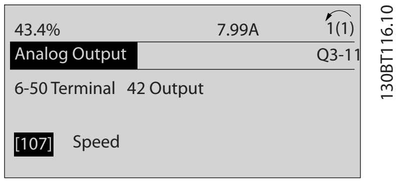


Illustration 6.8 Setting a Parameter

6

Function Set-ups parameters

The Function Set-ups parameters are grouped in the following way

Q3-10 Adv. Motor Settings	Q3-11 Analog Output	Q3-12 Clock Settings	Q3-13 Display Settings
Parameter 1-90 Motor Thermal Protection	Parameter 6-50 Terminal 42 Output	0-70 Date and Time	0-20 Display Line 1.1 Small
Parameter 1-93 Thermistor Source	Parameter 6-51 Terminal 42 Output Min Scale	0-71 Date Format	0-21 Display Line 1.2 Small
Parameter 1-29 Automatic Motor Adaptation (AMA)	Parameter 6-52 Terminal 42 Output Max Scale	0-72 Time Format	0-22 Display Line 1.3 Small
Parameter 14-01 Switching Frequency		0-74 DST/Summertime	0-23 Display Line 2 Large
Parameter 4-53 Warning Speed High		0-76 DST/Summertime Start	0-24 Display Line 3 Large
		0-77 DST/Summertime End	0-37 Display Text 1
			0-38 Display Text 2
			0-39 Display Text 3

Table 6.3 Q3-1 General Settings

Q3-20 Digital Reference	Q3-21 Analog Reference
Parameter 3-02 Minimum Reference	Parameter 3-02 Minimum Reference
3-03 Maximum Reference	3-03 Maximum Reference
Parameter 3-10 Preset Reference	Parameter 6-10 Terminal 53 Low Voltage
5-13 Terminal 29 Digital Input	Parameter 6-11 Terminal 53 High Voltage
5-14 Terminal 32 Digital Input	6-12 Terminal 53 Low Current
5-15 Terminal 33 Digital Input	6-13 Terminal 53 High Current
	Parameter 6-14 Terminal 53 Low Ref./Feedb. Value
	Parameter 6-15 Terminal 53 High Ref./Feedb. Value

Table 6.4 Q3-2 Open Loop Settings

Q3-30 Single Zone Int. Set Point	Q3-31 Single Zone Ext. Set Point	Q3-32 Multi Zone / Adv
Parameter 1-00 Configuration Mode	Parameter 1-00 Configuration Mode	Parameter 1-00 Configuration Mode
20-12 Reference/Feedback Unit	20-12 Reference/Feedback Unit	Parameter 3-15 Reference 1 Source
20-13 Minimum Reference/Feedb.	20-13 Minimum Reference/Feedb.	Parameter 3-16 Reference 2 Source
20-14 Maximum Reference/Feedb.	20-14 Maximum Reference/Feedb.	Parameter 20-00 Feedback 1 Source
6-22 Terminal 54 Low Current	Parameter 6-10 Terminal 53 Low Voltage	Parameter 20-01 Feedback 1 Conversion
Parameter 6-24 Terminal 54 Low Ref./Feedb. Value	Parameter 6-11 Terminal 53 High Voltage	20-02 Feedback 1 Source Unit
Parameter 6-25 Terminal 54 High Ref./ Feedb. Value	6-12 Terminal 53 Low Current	Parameter 20-03 Feedback 2 Source
Parameter 6-26 Terminal 54 Filter Time Constant	6-13 Terminal 53 High Current	Parameter 20-04 Feedback 2 Conversion
Parameter 6-27 Terminal 54 Live Zero	Parameter 6-14 Terminal 53 Low Ref./Feedb. Value	20-05 Feedback 2 Source Unit
Parameter 6-00 Live Zero Timeout Time	Parameter 6-15 Terminal 53 High Ref./ Feedb. Value	Parameter 20-06 Feedback 3 Source
Parameter 6-01 Live Zero Timeout Function	6-22 Terminal 54 Low Current	Parameter 20-07 Feedback 3 Conversion
Parameter 20-21 Setpoint 1	Parameter 6-24 Terminal 54 Low Ref./Feedb. Value	20-08 Feedback 3 Source Unit
Parameter 20-81 PID Normal/ Inverse Control	Parameter 6-25 Terminal 54 High Ref./ Feedb. Value	20-12 Reference/Feedback Unit
20-82 PID Start Speed [RPM]	Parameter 6-26 Terminal 54 Filter Time Constant	20-13 Minimum Reference/Feedb.
20-83 PID Start Speed [Hz]	Parameter 6-27 Terminal 54 Live Zero	20-14 Maximum Reference/Feedb.
Parameter 20-93 PID Proportional Gain	Parameter 6-00 Live Zero Timeout Time	Parameter 6-10 Terminal 53 Low Voltage
Parameter 20-94 PID Integral Time	Parameter 6-01 Live Zero Timeout Function	Parameter 6-11 Terminal 53 High Voltage
20-70 Closed Loop Type	Parameter 20-81 PID Normal/ Inverse Control	6-12 Terminal 53 Low Current
20-71 PID Performance	20-82 PID Start Speed [RPM]	6-13 Terminal 53 High Current
20-72 PID Output Change	20-83 PID Start Speed [Hz]	Parameter 6-14 Terminal 53 Low Ref./Feedb. Value
20-73 Minimum Feedback Level	Parameter 20-93 PID Proportional Gain	Parameter 6-15 Terminal 53 High Ref./Feedb. Value
20-74 Maximum Feedback Level	Parameter 20-94 PID Integral Time	Parameter 6-16 Terminal 53 Filter Time Constant
20-79 PID Autotuning	20-70 Closed Loop Type	Parameter 6-17 Terminal 53 Live Zero
	20-71 PID Performance	Parameter 6-20 Terminal 54 Low Voltage
	20-72 PID Output Change	Parameter 6-21 Terminal 54 High Voltage
	20-73 Minimum Feedback Level	6-22 Terminal 54 Low Current
	20-74 Maximum Feedback Level	6-23 Terminal 54 High Current
	20-79 PID Autotuning	Parameter 6-24 Terminal 54 Low Ref./Feedb. Value
		Parameter 6-25 Terminal 54 High Ref./Feedb. Value
		Parameter 6-26 Terminal 54 Filter Time Constant
		Parameter 6-27 Terminal 54 Live Zero
		Parameter 6-00 Live Zero Timeout Time
		Parameter 6-01 Live Zero Timeout Function
		Parameter 4-56 Warning Feedback Low
		Parameter 4-57 Warning Feedback High
		Parameter 20-20 Feedback Function
		Parameter 20-21 Setpoint 1
		Parameter 20-22 Setpoint 2

Q3-30 Single Zone Int. Set Point	Q3-31 Single Zone Ext. Set Point	Q3-32 Multi Zone / Adv
		Parameter 20-81 PID Normal/ Inverse Control
		20-82 PID Start Speed [RPM]
		20-83 PID Start Speed [Hz]
		Parameter 20-93 PID Proportional Gain
		Parameter 20-94 PID Integral Time
		20-70 Closed Loop Type
		20-71 PID Performance
		20-72 PID Output Change
		20-73 Minimum Feedback Level
		20-74 Maximum Feedback Level
		20-79 PID Autotuning

Table 6.5 Q3-3 Closed Loop Settings

Q3-40 Fan Functions	Q3-41 Pump Functions	Q3-42 Compressor Functions
Parameter 22-60 Broken Belt Function	22-20 Low Power Auto Set-up	Parameter 1-03 Torque Characteristics
Parameter 22-61 Broken Belt Torque	Parameter 22-21 Low Power Detection	Parameter 1-71 Start Delay
Parameter 22-62 Broken Belt Delay	Parameter 22-22 Low Speed Detection	Parameter 22-75 Short Cycle Protection
Parameter 4-64 Semi-Auto Bypass Set-up	Parameter 22-23 No-Flow Function	Parameter 22-76 Interval between Starts
Parameter 1-03 Torque Characteristics	Parameter 22-24 No-Flow Delay	Parameter 22-77 Minimum Run Time
Parameter 22-22 Low Speed Detection	Parameter 22-40 Minimum Run Time	Parameter 5-01 Terminal 27 Mode
Parameter 22-23 No-Flow Function	Parameter 22-41 Minimum Sleep Time	Parameter 5-02 Terminal 29 Mode
Parameter 22-24 No-Flow Delay	Parameter 22-42 Wake-up Speed [RPM]	5-12 Terminal 27 Digital Input
Parameter 22-40 Minimum Run Time	22-43 Wake-up Speed [Hz]	5-13 Terminal 29 Digital Input
Parameter 22-41 Minimum Sleep Time	22-44 Wake-up Ref./FB Difference	Parameter 5-40 Function Relay
Parameter 22-42 Wake-up Speed [RPM]	22-45 Setpoint Boost	Parameter 1-73 Flying Start
22-43 Wake-up Speed [Hz]	22-46 Maximum Boost Time	1-86 Trip Speed Low [RPM]
22-44 Wake-up Ref./FB Difference	Parameter 22-26 Dry Pump Function	1-87 Trip Speed Low [Hz]
22-45 Setpoint Boost	22-27 Dry Pump Delay	
22-46 Maximum Boost Time	22-80 Flow Compensation	
Parameter 2-10 Brake Function	22-81 Square-linear Curve Approximation	
2-16 AC brake Max. Current	22-82 Work Point Calculation	
Parameter 2-17 Over-voltage Control	22-83 Speed at No-Flow [RPM]	
Parameter 1-73 Flying Start	22-84 Speed at No-Flow [Hz]	
Parameter 1-71 Start Delay	22-85 Speed at Design Point [RPM]	
Parameter 1-80 Function at Stop	22-86 Speed at Design Point [Hz]	
Parameter 2-00 DC Hold/Preheat Current	22-87 Pressure at No-Flow Speed	
Parameter 4-10 Motor Speed Direction	22-88 Pressure at Rated Speed	
	22-89 Flow at Design Point	
	22-90 Flow at Rated Speed	
	Parameter 1-03 Torque Characteristics	
	Parameter 1-73 Flying Start	

Table 6.6 Q3-4 Application Settings

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1-00 Configuration Mode		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.**
[0]	Open Loop	Motor speed is determined by applying a speed reference or by setting desired speed when in Hand Mode. Open loop is also used if the frequency converter is of a closed loop control system based on an external PID controller providing a speed reference signal as output.
[3]	Closed Loop	Motor speed is determined by a reference from the built-in PID controller varying the motor speed as of a closed loop control process (e.g. constant pressure or flow). The PID controller must be configured in parameter group *20-** Feedback* or via the Function Set-ups accessed by pressing [Quick Menus].

NOTICE

When set for closed loop, the commands reversing and start reversing do not reverse the motor direction.

1-03 Torque Characteristics		
Option:		**Function:**
[0]	Compressor torque	For speed control of screw and scroll compressors. Provides a voltage which is optimised for a constant torque load characteristic of the motor in the entire range down to 10 Hz.
[1]	Variable torque	For speed control of centrifugal pumps and fans. Also to be used when controlling more than one motor from the same frequency converter (for example, multiple condenser fans or cooling tower fans). Provides a voltage which is optimised for a squared torque load characteristic of the motor.
[2]	Auto Energy Optim. CT	For optimum energy-efficient speed control of screw and scroll compressors. Provides a voltage which is optimised for a constant torque load characteristic of the motor in the entire range down to 15 Hz. In addition, the AEO feature adapts the voltage exactly to the current load situation, thereby reducing energy consumption and audible noise from the motor. To obtain optimum performance, set the motor power factor cos phi correctly. This value is set in *14-43 Motor Cosphi*. The parameter has a default value which is automatically adjusted when the motor data is programmed. These settings typically ensure optimum motor voltage, but if the motor power factor cos phi requires tuning, an AMA function can be carried out using *parameter 1-29 Automatic Motor Adaptation (AMA)*. It is rarely necessary to adjust the motor power factor parameter manually.
[3] *	Auto Energy Optim. VT	For optimum energy efficient speed control of centrifugal pumps and fans. Provides a voltage optimised for a squared torque load characteristic of the motor. In addition, the AEO feature adapts the voltage exactly to the current load situation, thereby reducing energy consumption and audible noise from the motor. To obtain optimum performance, set the motor power factor cos phi correctly. This value is set in *14-43 Motor Cosphi*. The parameter has a default value and is automatically adjusted when the motor data is programmed. These settings typically ensure optimum motor voltage, but if the motor power factor cos phi requires tuning, an AMA function can be carried out using *parameter 1-29 Automatic Motor Adaptation (AMA)*. It is rarely necessary to adjust the motor power factor parameter manually.

NOTICE

***Parameter 1-03 Torque Characteristics* have no effect when *1-10 Motor Construction = [1] PM, non-salient SPM*.**

NOTICE

For pumps or fan applications where the viscosity or density can vary significantly or where excessive flow, for example due to pipe breakage, can occur, select Auto Energy Optim. CT

1-29 Automatic Motor Adaptation (AMA)		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.**
[0] *	Off	No function
[1]	Enable Complete AMA	Performs AMA of the stator resistance R_S, the rotor resistance R_r, the stator leakage reactance X_1, the rotor leakage reactance X_2 and the main reactance X_h.
[2]	Enable Reduced AMA	Performs a reduced AMA of the stator resistance R_s in the system only. Select this option if an LC filter is used between the frequency converter and the motor.

NOTICE

***Parameter 1-29 Automatic Motor Adaptation (AMA)* have no effect when *1-10 Motor Construction = [1] PM, non-salient SPM*.**

Activate the AMA function by pressing [Hand On] after selecting [1] or [2]. See also the section *Automatic Motor Adaptation* in the *Design Guide*. After a normal sequence, the display reads: *Press [OK] to finish AMA*. After pressing [OK], the frequency converter is ready for operation.

NOTICE

- **For the best adaptation of the frequency converter, run AMA on a cold motor**
- **AMA cannot be performed while the motor is running**

NOTICE

Avoid generating external torque during AMA.

NOTICE

If one of the settings in parameter group *1-2* Motor Data* is changed, *1-30 Stator Resistance (Rs)* to *1-39 Motor Poles* return to default settings.

NOTICE

Full AMA should be run without filter only while reduced AMA should be run with filter.

See section: *Application Examples > Automatic Motor Adaptation* in the *Design Guide*.

1-71 Start Delay

Range:		Function:
00 s*	[0 - 120 s]	When the frequency converter receives the start command, it delays the motor start for the time specified in this parameter. The function selected in *parameter 1-80 Function at Stop* is active in the delay period.

1-73 Flying Start

Option:		Function:
		This function makes it possible to catch a motor which is spinning freely due to a mains drop-out. When *parameter 1-73 Flying Start* is enabled, *parameter 1-71 Start Delay* has no function. Search direction for flying start is linked to the setting in *parameter 4-10 Motor Speed Direction*. *[0] Clockwise*: Flying start search in clockwise direction. If not successful, a DC brake is carried out. *[2] Both Directions*: The flying start first makes a search in the direction determined by the last reference (direction). If not finding the speed, it makes a search in the other direction. If not successful, a DC brake is activated in the time set in *2-02 DC Braking Time*. Start then takes place from 0 Hz.
[0]	Disabled	Select *[0] Disable* if this function is not required
[1]	Enabled	Select *[1] Enable* to enable the frequency converter to catch and control a spinning motor. The parameter is always set to *[1] Enable* when *1-10 Motor Construction* = [1] PM non-salient. Important related parameters: • *1-58 Flystart Test Pulses Current* • *1-59 Flystart Test Pulses Frequency* • *1-70 PM Start Mode* • *2-06 Parking Current* • *2-07 Parking Time* • *2-03 DC Brake Cut In Speed [RPM]* • *2-04 DC Brake Cut In Speed [Hz]* • *2-06 Parking Current* • *2-07 Parking Time*

The flying-start function used for PM motors is based on an initial speed estimation. The speed is always estimated as the first thing after an active start signal is given. Based on the setting of *1-70 PM Start Mode* the following happens:
1-70 PM Start Mode = [0] Rotor Detection:
If the speed estimate comes out as greater than 0 Hz, the frequency converter catches the motor at that speed and resume normal operation. Otherwise, the frequency converter estimates the rotor position and start normal operation from there.

1-70 PM Start Mode = [1] Parking:
If the speed estimate comes out lower than the setting in *1-59 Flystart Test Pulses Frequency*, the parking function is engaged (see *2-06 Parking Current* and *2-07 Parking Time*). Otherwise, the frequency converter catches the motor at that speed and resume normal operation. Refer to description of *1-70 PM Start Mode* for recommended settings.

Current limitations of the flying-start principle used for PM motors:

- The speed range is up to 100% nominal speed or the field weakening speed (which ever is lowest).
- PMSM with high back EMF (>300 VLL(rms)) and high winding inductance (>10 mH) needed more

time for reducing short circuit current to zero and may be susceptible to error in estimation.

- Current testing limited to a speed range up to 300 Hz. For certain units, the limit is 250 Hz; all 200-240 V units up to and including 2.2 kW and all 380-480 V units up to and including 4 kW.
- Current testing limited to a machine power size up to 22 kW.
- Prepared for salient pole machine (IPMSM) but not yet verified on those types of machine.
- For high-inertia applications (that is, where the load inertia is more than 30 times larger than the motor inertia), use a brake resistor to avoid overvoltage trip during high-speed engagement of the flying-start function.

6

1-80 Function at Stop		
Option:		**Function:**
		Select the frequency converter function after a stop command or after the speed is ramped down to the settings in *1-81 Min Speed for Function at Stop [RPM]*. Available selections depend on *1-10 Motor Construction*: [0] Asynchron: [0] Coast [1] DC-hold [2] Motor check, warning [6] Motor check, alarm [1] PM non-salient: [0] coast
[0] *	Coast	Leaves motor in free mode.
[1]	DC Hold/ Motor Preheat	Energises motor with a DC hold current (see *parameter 2-00 DC Hold/Preheat Current*).
[2]	Motor check, warning	Issues a warning if the motor is not connected.
[6]	Motor check, alarm	Issues an alarm if the motor is not connected.

1-90 Motor Thermal Protection		
Option:		**Function:**
		The frequency converter determines the motor temperature for motor overload protection in 2 different ways: • Via a thermistor sensor connected to one of the analog or digital inputs (*parameter 1-93 Thermistor Source*). • Via calculation (ETR = Electronic Thermal Relay) of the thermal load, based on the actual load and time. The calculated thermal load is compared with the rated motor current $I_{M,N}$ and the rated motor frequency $f_{M,N}$. The calculations estimate the need for a lower load at lower speed due to less cooling from the fan incorporated in the motor.
[0]	No protection	If the motor is continuously overloaded, and no warning or trip of frequency converter is wanted.
[1]	Thermistor warning	Activates a warning when the connected thermistor in the motor reacts in the event of motor overtemperature.
[2]	Thermistor trip	Stops (trips) the frequency converter when the connected thermistor in the motor reacts in the event of motor overtemperature.
[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	

ETR (Electronic Thermal Relay) functions 1-4 calculate the load when the set-up where they were selected is active. For example ETR-3 starts calculating when set-up 3 is selected. For the North American market: The ETR functions provide class 20 motor overload protection in accordance with NEC.

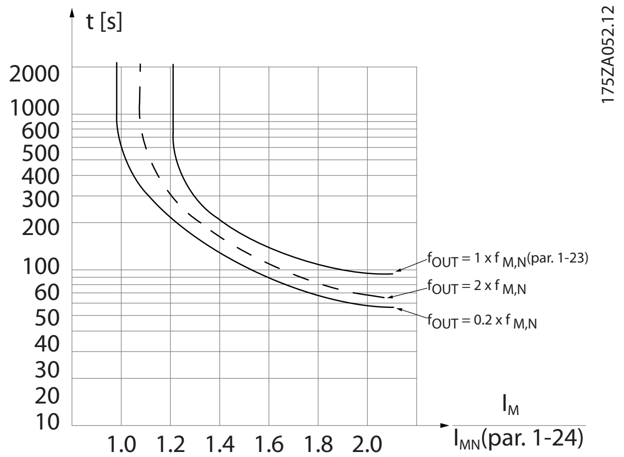

Illustration 6.9 Thermal motor protection

WARNING

To maintain PELV, all connections made to the control terminals must be PELV, for example, thermistor must be reinforced/double insulated

NOTICE

Danfoss recommends using 24 V DC as thermistor supply voltage.

NOTICE

The ETR timer function does not work when *1-10 Motor Construction = [1] PM, non-salient SPM*.

NOTICE

For correct operation of the ETR function, the setting in *parameter 1-03 Torque Characteristics* must fit the application (see description of *parameter 1-03 Torque Characteristics*).

1-93 Thermistor Source		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.** Select the input to which the thermistor (PTC sensor) should be connected. An analog input option *[1] Analog Input 53* or *[2] Analog Input 54* cannot be selected if the analog input is already in use as a reference source (selected in *parameter 3-15 Reference 1 Source, parameter 3-16 Reference 2 Source* or *3-17 Reference 3 Source*). When using MCB 112, *[0] None* must always be selected.
[0] *	None	
[1]	Analog Input 53	
[2]	Analog Input 54	
[3]	Digital input 18	
[4]	Digital input 19	
[5]	Digital input 32	
[6]	Digital input 33	

NOTICE

Digital input should be set to *[0] PNP - Active at 24 V* in *5-00 Digital I/O Mode*.

2-00 DC Hold/Preheat Current		
Range:		**Function:**
50 %*	[0 - 160 %]	Enter a value for holding current as a percentage of the rated motor current $I_{M,N}$ set in *parameter 1-24 Motor Current*. 100% DC hold current corresponds to $I_{M,N}$. This parameter holds the motor (holding torque) or pre-heats the motor. This parameter is active if *[1] DC hold/Motor Preheat* is selected in *parameter 1-80 Function at Stop*.

NOTICE

***Parameter 2-00 DC Hold/Preheat Current* have no effect when *1-10 Motor Construction = [1] PM, non-salient SPM*.**

NOTICE

The maximum value depends on the rated motor current.
Avoid 100% current for too long. It may damage the motor.

6

2-10 Brake Function		
Option:		**Function:**
		Available selections depend on *1-10 Motor Construction*: [0] Asynchron: *[0] Off* *[1] Resistor brake* *[2] AC brake* [1] PM non-salient: *[0] Off* *[1] Resistor brake*
[0]	Off	No brake resistor installed.
[1]	Resistor brake	Brake resistor incorporated in the system, for dissipation of surplus brake energy as heat. Connecting a brake resistor allows a higher DC-link voltage during braking (generating operation). The resistor brake function is only active in frequency converters with an integral dynamic brake.
[2]	AC brake	AC Brake only works in compressor torque mode in *parameter 1-03 Torque Characteristics*.

2-17 Over-voltage Control		
Option:		**Function:**
[0]	Disabled	No OVC required.
[2] *	Enabled	Activates OVC.

NOTICE

***Parameter 2-17 Over-voltage Control* has no effect when *1-10 Motor Construction = [1] PM, non-salient SPM*.**

NOTICE

The ramp time is automatically adjusted to avoid tripping of the frequency converter.

3-02 Minimum Reference		
Range:		**Function:**
Size related*	[-999999.999 - par. 3-03 ReferenceFeed-backUnit]	Enter the minimum reference. The minimum reference is the lowest value obtainable by summing all references. The minimum reference value and unit matches the configuration made in *parameter 1-00 Configuration Mode* and *20-12 Reference/Feedback Unit.* ***NOTICE*** **This parameter is used in open loop only.**

3-04 Reference Function		
Option:		**Function:**
[0]	Sum	Sums both external and preset reference sources.
[1]	External/ Preset	Use either the preset or the external reference source. Shift between external and preset via a command on a digital input.

3-10 Preset Reference		
Array [8]		
Range:		**Function:**
0 %*	[-100 - 100 %]	Enter up to 8 different preset references (0-7) in this parameter, using array programming. The preset reference is stated as a percentage of the value Ref_{MAX} (*3-03 Maximum Reference*, for closed loop see *20-14 Maximum Reference/ Feedb.*). When using preset references, select Preset ref. bit 0/1/2 [16], [17] or [18] for the corresponding digital inputs in parameter group *5-1* Digital Inputs*.

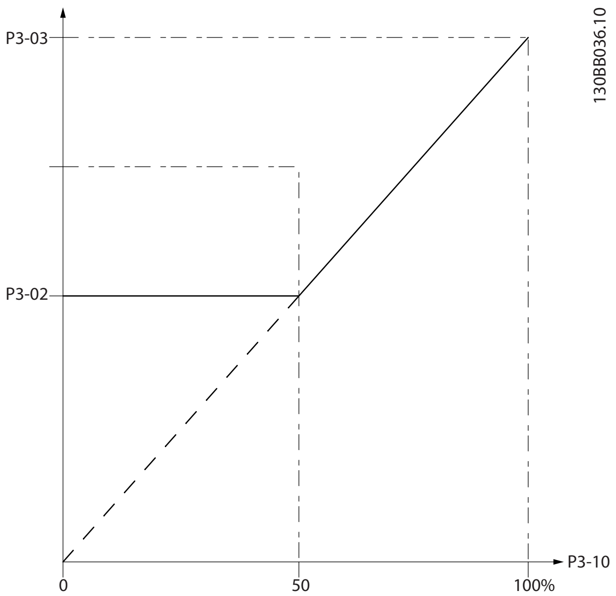

Illustration 6.10 Preset Reference

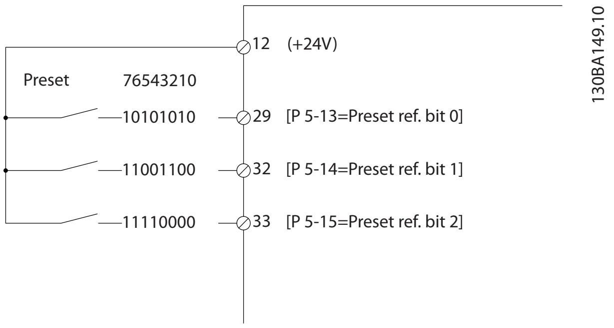

Illustration 6.11 Preset Reference Scheme

3-15 Reference 1 Source		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.** Select the reference input to be used for the first reference signal. *Parameter 3-15 Reference 1 Source*, *parameter 3-16 Reference 2 Source* and *3-17 Reference 3 Source* define up to 3 different reference signals. The sum of these reference signals defines the actual reference.
[0]	No function	
[1] *	Analog Input 53	
[2]	Analog Input 54	
[7]	Pulse input 29	
[8]	Pulse input 33	
[20]	Digital pot.meter	
[21]	Analog input X30/11	
[22]	Analog input X30/12	
[23]	Analog Input X42/1	
[24]	Analog Input X42/3	
[25]	Analog Input X42/5	
[29]	Analog Input X48/2	
[30]	Ext. Closed Loop 1	
[31]	Ext. Closed Loop 2	
[32]	Ext. Closed Loop 3	

3-16 Reference 2 Source		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.** Select the reference input to be used for the second reference signal. *Parameter 3-15 Reference 1 Source, parameter 3-16 Reference 2 Source* and *3-17 Reference 3 Source* define up to 3 different reference signals. The sum of these reference signals defines the actual reference.
[0]	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[7]	Pulse input 29	
[8]	Pulse input 33	
[20] *	Digital pot.meter	
[21]	Analog input X30/11	
[22]	Analog input X30/12	
[23]	Analog Input X42/1	
[24]	Analog Input X42/3	
[25]	Analog Input X42/5	
[29]	Analog Input X48/2	
[30]	Ext. Closed Loop 1	
[31]	Ext. Closed Loop 2	
[32]	Ext. Closed Loop 3	

4-10 Motor Speed Direction		
Option:		**Function:**
		Selects the motor speed direction required. Use this parameter to prevent unwanted reversing.
[0]	Clockwise	Only operation in clockwise direction is allowed.
[2] *	Both directions	Operation in both clockwise and counter-clockwise direction is allowed.

NOTICE

The setting in *parameter 4-10 Motor Speed Direction* has impact on the Flying Start in *parameter 1-73 Flying Start*.

4-53 Warning Speed High		
Range:		**Function:**
Size related*	[par. 4-52 - par. 4-13 RPM]	Enter the n_{HIGH} value. When the motor speed exceeds this limit (n_{HIGH}), the display reads SPEED HIGH. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02. Programme the upper signal limit of the motor speed, n_{HIGH}, within the normal working range of the frequency converter. Refer to .

6

NOTICE

Any changes in *parameter 4-13 Motor Speed High Limit [RPM]* reset the value in *parameter 4-53 Warning Speed High* to the same value as set in *parameter 4-13 Motor Speed High Limit [RPM]*.
If a different value is needed in *parameter 4-53 Warning Speed High*, it must be set after programming of *parameter 4-13 Motor Speed High Limit [RPM]*

4-56 Warning Feedback Low		
Range:		**Function:**
-999999.999 ProcessCtrlUnit*	[-999999.999 - par. 4-57 ProcessCtrlUnit]	Enter the lower feedback limit. When the feedback drops below this limit, the display reads $Feedb_{Low}$. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-57 Warning Feedback High		
Range:		**Function:**
999999.999 ProcessCtrlUnit*	[par. 4-56 - 999999.999 ProcessCtrlUnit]	Enter the upper feedback limit. When the feedback exceeds this limit, the display reads $Feedb_{High}$. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-64 Semi-Auto Bypass Set-up		
Option:		**Function:**
[0] *	Off	No function
[1]	Enabled	Starts the semi-automatic bypass set-up and continues with the procedure described above.

5-01 Terminal 27 Mode		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.**
[0] *	Input	Defines terminal 27 as a digital input.
[1]	Output	Defines terminal 27 as a digital output.

5-02 Terminal 29 Mode		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.**
[0] *	Input	Defines terminal 29 as a digital input.
[1]	Output	Defines terminal 29 as a digital output.

6.1.4 5-1* Digital Inputs

Parameters for configuring the input functions for the input terminals.
The digital inputs are used for selecting various functions in the frequency converter. All digital inputs can be set to the following functions

Digital input function	Select	Terminal
No operation	[0]	All *terminal 19, 32, 33
Reset	[1]	All
Coast inverse	[2]	27
Coast and reset inverse	[3]	All
DC-brake inverse	[5]	All
Stop inverse	[6]	All
External interlock	[7]	All
Start	[8]	All *terminal 18
Latched start	[9]	All
Reversing	[10]	All
Start reversing	[11]	All
Jog	[14]	All *terminal 29
Preset reference on	[15]	All
Preset ref bit 0	[16]	All
Preset ref bit 1	[17]	All
Preset ref bit 2	[18]	All
Freeze reference	[19]	All
Freeze output	[20]	All
Speed up	[21]	All
Speed down	[22]	All
Set-up select bit 0	[23]	All
Set-up select bit 1	[24]	All
Pulse input	[32]	terminal 29, 33
Ramp bit 0	[34]	All
Mains failure inverse	[36]	All
Fire mode	[37]	All
Run Permissive	[52]	All
Hand start	[53]	All
Auto start	[54]	All
DigiPot Increase	[55]	All
DigiPot Decrease	[56]	All
DigiPot Clear	[57]	All
Counter A (up)	[60]	29, 33
Counter A (down)	[61]	29, 33

Digital input function	Select	Terminal
Reset Counter A	[62]	All
Counter B (up)	[63]	29, 33
Counter B (down)	[64]	29, 33
Reset Counter B	[65]	All
Sleep Mode	[66]	All
Reset Maintenance Word	[78]	All
PTC Card 1	[80]	All
Lead Pump Start	[120]	All
Lead Pump Alternation	[121]	All
Pump 1 Interlock	[130]	All
Pump 2 Interlock	[131]	All
Pump 3 Interlock	[132]	All

5-12 Terminal 27 Digital Input

The parameter contains all options and functions listed in parameter group *5-1* Digital Inputs* except for option *[32] Pulse input*.

5-13 Terminal 29 Digital Input

The parameter contains all options and functions listed in parameter group *5-1* Digital Inputs*.

5-14 Terminal 32 Digital Input

The parameter contains all options and functions listed in parameter group *5-1* Digital Inputs* except for option *[32] Pulse input*.

5-15 Terminal 33 Digital Input

The parameter contains all options and functions listed in parameter group *5-1* Digital Inputs*.

5-40 Function Relay

Array [8]
(Relay 1 [0], Relay 2 [1]
Option MCB 105: Relay 7 [6], Relay 8 [7] and Relay 9 [8]).
Select options to define the function of the relays.
The selection of each mechanical relay is realised in an array parameter.

Option:		Function:
[0]	No operation	
[1]	Control Ready	
[2]	Drive ready	
[3]	Drive rdy/rem ctrl	
[4]	Standby / no warning	
[5]	Running	Default setting for relay 2.
[6]	Running / no warning	
[8]	Run on ref/no warn	
[9]	Alarm	Default setting for relay 1.
[10]	Alarm or warning	
[11]	At torque limit	
[12]	Out of current range	
[13]	Below current, low	

5-40 Function Relay

Array [8]
(Relay 1 [0], Relay 2 [1]
Option MCB 105: Relay 7 [6], Relay 8 [7] and Relay 9 [8]).
Select options to define the function of the relays.
The selection of each mechanical relay is realised in an array parameter.

Option:		Function:
[14]	Above current, high	
[15]	Out of speed range	
[16]	Below speed, low	
[17]	Above speed, high	
[18]	Out of feedb. range	
[19]	Below feedback, low	
[20]	Above feedback, high	
[21]	Thermal warning	
[25]	Reverse	
[26]	Bus OK	
[27]	Torque limit & stop	
[28]	Brake, no brake war	
[29]	Brake ready, no fault	
[30]	Brake fault (IGBT)	
[33]	Safe stop active	
[35]	External Interlock	
[36]	Control word bit 11	
[37]	Control word bit 12	
[40]	Out of ref range	
[41]	Below reference, low	
[42]	Above ref, high	
[45]	Bus ctrl.	
[46]	Bus ctrl, 1 if timeout	
[47]	Bus ctrl, 0 if timeout	
[60]	Comparator 0	
[61]	Comparator 1	
[62]	Comparator 2	
[63]	Comparator 3	
[64]	Comparator 4	
[65]	Comparator 5	
[70]	Logic rule 0	
[71]	Logic rule 1	
[72]	Logic rule 2	
[73]	Logic rule 3	
[74]	Logic rule 4	
[75]	Logic rule 5	
[80]	SL digital output A	
[81]	SL digital output B	
[82]	SL digital output C	
[83]	SL digital output D	
[84]	SL digital output E	
[85]	SL digital output F	
[160]	No alarm	
[161]	Running reverse	
[165]	Local ref active	
[166]	Remote ref active	

5-40 Function Relay

Array [8]
(Relay 1 [0], Relay 2 [1]
Option MCB 105: Relay 7 [6], Relay 8 [7] and Relay 9 [8]).
Select options to define the function of the relays.
The selection of each mechanical relay is realised in an array parameter.

Option:		Function:
[167]	Start command activ	
[168]	Hand / Off	
[169]	Auto mode	
[180]	Clock Fault	
[181]	Prev. Maintenance	
[188]	AHF Capacitor Connect	
[189]	External Fan Control	
[190]	No-Flow	
[191]	Dry Pump	
[192]	End Of Curve	
[193]	Sleep Mode	
[194]	Broken Belt	
[195]	Bypass Valve Control	
[196]	Fire Mode	
[197]	Fire Mode was Act.	
[198]	Drive Bypass	
[211]	Cascade Pump 1	
[212]	Cascade Pump 2	
[213]	Cascade Pump 3	

6-00 Live Zero Timeout Time

Range:		Function:
10 s*	[1 - 99 s]	Enter the live zero time-out time period. Live zero time-out time is active for analog inputs, that is, terminal 53 or terminal 54, used as reference or feedback sources. If the reference signal value associated with the selected current input drops below 50% of the value set in *parameter 6-10 Terminal 53 Low Voltage*, *6-12 Terminal 53 Low Current*, *parameter 6-20 Terminal 54 Low Voltage* or *6-22 Terminal 54 Low Current* for a time period longer than the time set in *parameter 6-00 Live Zero Timeout Time*, the function selected in *parameter 6-01 Live Zero Timeout Function* is activated.

6-01 Live Zero Timeout Function

Option:		Function:
		Select the time-out function. The function set in *parameter 6-01 Live Zero Timeout Function* is activated if the input signal on terminal 53 or 54 is below 50% of the value in *parameter 6-10 Terminal 53 Low Voltage*, *6-12 Terminal 53 Low Current*, *parameter 6-20 Terminal 54 Low Voltage* or *6-22 Terminal 54 Low Current* for a time period defined in *parameter 6-00 Live Zero Timeout Time*. If several time-outs occur simultaneously, the frequency converter prioritises the time-out functions as follows 1. *Parameter 6-01 Live Zero Timeout Function* 2. *8-04 Control Timeout Function* The output frequency of the frequency converter can be: • [1] frozen at the present value • [2] overruled to stop • [3] overruled to jog speed • [4] overruled to max. speed • [5] overruled to stop with subsequent trip
[0] *	Off	
[1]	Freeze output	
[2]	Stop	
[3]	Jogging	
[4]	Max. speed	
[5]	Stop and trip	

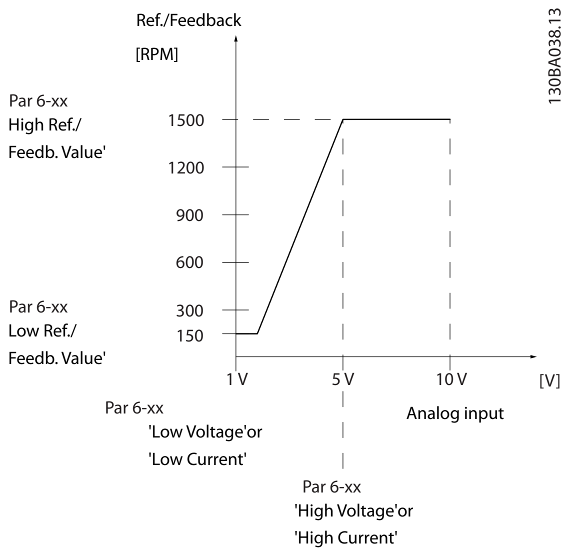

Illustration 6.12 Live Zero Conditions

6-10 Terminal 53 Low Voltage

Range:		Function:
0.07 V*	[0 - par. 6-11 V]	Enter the low-voltage value. This analog input scaling value should correspond to the low reference/feedback value set in *parameter 6-14 Terminal 53 Low Ref./Feedb. Value*.

6-11 Terminal 53 High Voltage

Range:		Function:
10 V*	[par. 6-10 - 10 V]	Enter the high-voltage value. This analog input scaling value should correspond to the high reference/feedback value set in *parameter 6-15 Terminal 53 High Ref./Feedb. Value*.

6-14 Terminal 53 Low Ref./Feedb. Value

Range:		Function:
0*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the low voltage/low current set in *parameter 6-10 Terminal 53 Low Voltage* and *6-12 Terminal 53 Low Current*.

6-15 Terminal 53 High Ref./Feedb. Value

Range:		Function:
Size related*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the high voltage/high current value set in *parameter 6-11 Terminal 53 High Voltage* and *6-13 Terminal 53 High Current*.

6-16 Terminal 53 Filter Time Constant

Range:		Function:
0.001 s*	[0.001 - 10 s]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal 53. A high time constant value improves dampening, but also increases the time delay through the filter.

6-17 Terminal 53 Live Zero

Option:		Function:
		This parameter makes it possible to disable the Live Zero monitoring. For example, to be used if the analog outputs are used as of a decentral I/O system (for example, when not as part of any frequency converter related control functions, but feeding a Building Management System with data).
[0]	Disabled	
[1] *	Enabled	

6-20 Terminal 54 Low Voltage

Range:		Function:
0.07 V*	[0 - par. 6-21 V]	Enter the low-voltage value. This analog input scaling value should correspond to the low reference/feedback value, set in *parameter 6-24 Terminal 54 Low Ref./Feedb. Value*.

6-21 Terminal 54 High Voltage

Range:		Function:
10 V*	[par. 6-20 - 10 V]	Enter the high-voltage value. This analog input scaling value should correspond to the high reference/feedback value set in *parameter 6-25 Terminal 54 High Ref./Feedb. Value*.

6-24 Terminal 54 Low Ref./Feedb. Value

Range:		Function:
0*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the low voltage/low current value set in *parameter 6-20 Terminal 54 Low Voltage* and *6-22 Terminal 54 Low Current*.

6-25 Terminal 54 High Ref./Feedb. Value

Range:		Function:
100*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the high voltage/ high current value set in *parameter 6-21 Terminal 54 High Voltage* and *6-23 Terminal 54 High Current*.

6-26 Terminal 54 Filter Time Constant

Range:		Function:
0.001 s*	[0.001 - 10 s]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal 54. A high time constant value improves dampening but also increases the time delay through the filter.

6-27 Terminal 54 Live Zero

Option:		Function:
		This parameter makes it possible to disable the Live Zero monitoring. For example, to be used if the analog outputs are used as of a decentral I/O system (for example, when not as of any frequency converter related control functions, but feeding a Building Management System with data).
[0]	Disabled	
[1] *	Enabled	

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6-50 Terminal 42 Output		
Option:		Function:
		Select the function of Terminal 42 as an analog current output. A motor current of 20 mA corresponds to I_{max}.
[0]	No operation	
[100]	Output freq. 0-100	0-100 Hz, (0-20 mA)
[101]	Reference Min-Max	Minimum reference - Maximum reference, (0-20 mA)
[102]	Feedback +-200%	-200% to +200% of *20-14 Maximum Reference/Feedb.*, (0-20 mA)
[103]	Motor cur. 0-Imax	0 - Inverter Max. Current (*16-37 Inv. Max. Current*), (0-20 mA)
[104]	Torque 0-Tlim	0 - Torque limit (*4-16 Torque Limit Motor Mode*), (0-20 mA)
[105]	Torque 0-Tnom	0 - Motor rated torque, (0-20 mA)
[106]	Power 0-Pnom	0 - Motor rated power, (0-20 mA)
[107]	Speed 0-HighLim	0 - Speed High Limit (*parameter 4-13 Motor Speed High Limit [RPM]* and *parameter 4-14 Motor Speed High Limit [Hz]*), (0-20 mA)
[113]	Ext. Closed Loop 1	0-100%, (0-20 mA)
[114]	Ext. Closed Loop 2	0-100%, (0-20 mA)
[115]	Ext. Closed Loop 3	0-100%, (0-20 mA)
[130]	Out frq 0-100 4-20mA	0-100 Hz
[131]	Reference 4-20mA	Minimum Reference - Maximum Reference
[132]	Feedback 4-20mA	-200% to +200% of *20-14 Maximum Reference/Feedb.*
[133]	Motor cur. 4-20mA	0 - Inverter Max. Current (*16-37 Inv. Max. Current*)
[134]	Torq.0-lim 4-20 mA	0 - Torque limit (*4-16 Torque Limit Motor Mode*)
[135]	Torq.0-nom 4-20mA	0 - Motor rated torque
[136]	Power 4-20mA	0 - Motor rated power
[137]	Speed 4-20mA	0 - Speed High Limit (4-13 and 4-14)
[139]	Bus ctrl.	0-100%, (0-20 mA)
[140]	Bus ctrl. 4-20 mA	0-100%
[141]	Bus ctrl t.o.	0-100%, (0-20 mA)
[142]	Bus ctrl t.o. 4-20mA	0-100%
[143]	Ext. CL 1 4-20mA	0-100%
[144]	Ext. CL 2 4-20mA	0-100%
[145]	Ext. CL 3 4-20mA	0-100%

NOTICE

Values for setting the minimum reference are found in open loop *parameter 3-02 Minimum Reference* and for closed loop *20-13 Minimum Reference/Feedb.* - values for maximum reference for open loop is found in *3-03 Maximum Reference* and for closed loop *20-14 Maximum Reference/Feedb.*

6-51 Terminal 42 Output Min Scale		
Range:		Function:
0 %*	[0 - 200 %]	Scale for the minimum output (0 mA or 4 mA) of the analog signal at terminal 42. Set the value to be the percentage of the full range of the variable selected in *parameter 6-50 Terminal 42 Output.*

6-52 Terminal 42 Output Max Scale		
Range:		Function:
100 %*	[0 - 200 %]	Scale for the maximum output (20 mA) of the analog signal at terminal 42. Set the value to be the percentage of the full range of the variable selected in *parameter 6-50 Terminal 42 Output.*

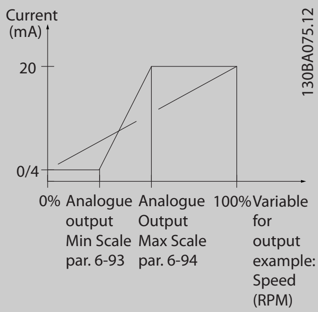

Illustration 6.13 Output Current vs Reference Variable

It is possible to get a value lower than 20 mA at full scale by programming values >100% by using a formula as follows:

$$20\ mA / desired\ maximum\ current \times 100\%$$

$$i.e.\ 10mA:\ \frac{20\ mA}{10\ mA} \times 100\% = 200\%$$

Example 1:

Variable value=OUTPUT FREQUENCY, range=0-100 Hz
Range needed for output=0-50 Hz
Output signal 0 mA or 4 mA is needed at 0 Hz (0% of range) - set *parameter 6-51 Terminal 42 Output Min Scale* to 0%
Output signal 20 mA is needed at 50 Hz (50% of range) - set *parameter 6-52 Terminal 42 Output Max Scale* to 50%

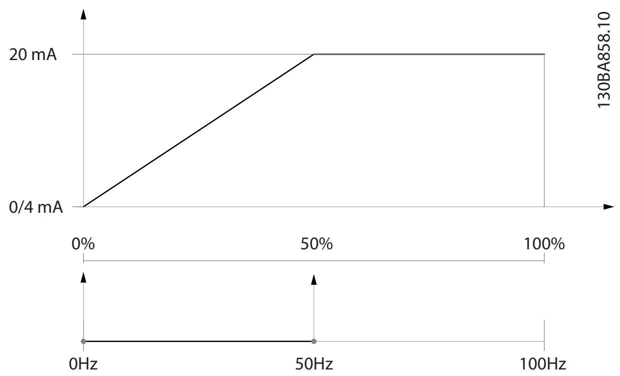

Illustration 6.14 Example 1

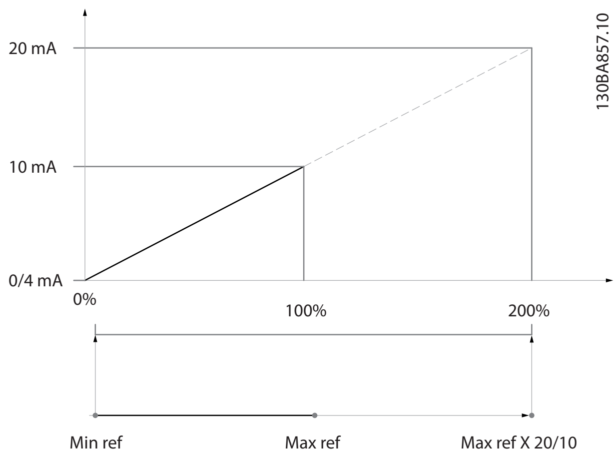

Illustration 6.16 Example 3

Example 2:
Variable=FEEDBACK, range=-200% to +200%
Range needed for output=0-100%
Output signal 0 mA or 4 mA is needed at 0% (50% of range) - set *parameter 6-51 Terminal 42 Output Min Scale* to 50%
Output signal 20 mA is needed at 100% (75% of range) - set *parameter 6-52 Terminal 42 Output Max Scale* to 75%

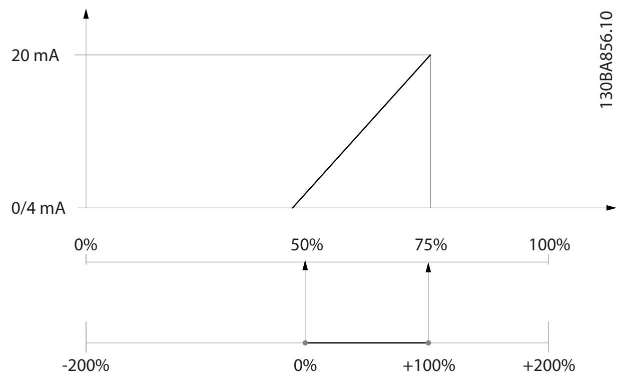

Illustration 6.15 Example 2

Example 3:
Variable value=REFERENCE, range=Minimum ref - maximum ref.
Range needed for output=Minimum ref (0%) - Maximum ref (100%), 0-10 mA
Output signal 0 mA or 4 mA is needed at minimum ref - set *parameter 6-51 Terminal 42 Output Min Scale* to 0%
Output signal 10 mA is needed at maximum ref (100% of range) - set *parameter 6-52 Terminal 42 Output Max Scale* to 200%
(20 mA/10 mA x 100%=200%).

14-01 Switching Frequency		
Option:		**Function:**
		Select the inverter switching frequency. Changing the switching frequency can help to reduce acoustic noise from the motor. **NOTICE** **The output frequency value of the frequency converter must never exceed 1/10 of the switching frequency. When the motor is running, adjust the switching frequency in *parameter 14-01 Switching Frequency* until the motor is as noiseless as possible. See also *14-00 Switching Pattern* and section *Derating* in the relevant *Design Guide*.**
[0]	1.0 kHz	
[1]	1.5 kHz	
[2]	2.0 kHz	
[3]	2.5 kHz	
[4]	3.0 kHz	
[5]	3.5 kHz	
[6]	4.0 kHz	
[7]	5.0 kHz	
[8]	6.0 kHz	
[9]	7.0 kHz	
[10]	8.0 kHz	
[11]	10.0 kHz	
[12]	12.0kHz	
[13]	14.0 kHz	
[14]	16.0kHz	

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20-00 Feedback 1 Source		
Option:		**Function:**
		Up to 3 different feedback signals can be used to provide the feedback signal for the frequency converter's PID controller. This parameter defines which input is used as the source of the first feedback signal. Analog input X30/11 and analog input X30/12 refer to inputs on the optional general purpose I/O board.
[0]	No function	
[1]	Analog Input 53	
[2] *	Analog Input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog Input X30/11	
[8]	Analog Input X30/12	
[9]	Analog Input X42/1	
[10]	Analog Input X42/3	
[11]	Analog Input X42/5	
[15]	Analog Input X48/2	
[100]	Bus Feedback 1	
[101]	Bus Feedback 2	
[102]	Bus feedback 3	
[104]	Sensorless Flow	Requires set-up by MCT 10 Set-up Software with sensorless specific plug-in.
[105]	Sensorless Pressure	Requires set-up by MCT 10 Set-up Software with sensorless specific plug-in.

NOTICE

If a feedback is not used, its source must be set to *[0] No Function*. *Parameter 20-20 Feedback Function* determines how the PID controller uses the 3 possible feedbacks.

20-01 Feedback 1 Conversion		
Option:		**Function:**
		This parameter allows a conversion function to be applied to Feedback 1.
[0] *	Linear	No effect on the feedback.
[1]	Square root	Commonly used when a pressure sensor is used to provide flow feedback ($(flow \propto \sqrt{pressure})$).
[2]	Pressure to temperature	Used in compressor applications to provide temperature feedback using a pressure sensor. The temperature of the refrigerant is calculated using the following formula: $Temperature = \frac{A2}{(ln(Pe+1)-A1)} - A3,$ where A1, A2 and A3 are refrigerant-specific constants. The refrigerant must be selected in *20-30 Refrigerant*. *Parameter 20-21 Setpoint 1* through *20-23 Setpoint 3* allow the values of A1, A2 and A3 to be entered for a refrigerant that is not listed in *20-30 Refrigerant*.
[3]	Pressure to flow	Used in applications where for controlling the air flow in a duct. A dynamic pressure measurement (pitot tube) represents the feedback signal. $Flow = Duct\ Area \times \sqrt{Dynamic\ Pressure} \times Air\ Density\ Factor$ See also *20-34 Duct 1 Area [m2]* through *20-38 Air Density Factor [%]* for setting of duct area and air density.
[4]	Velocity to flow	Used in applications where for controlling the air flow in a duct. An air velocity measurement represents the feedback signal. $Flow = Duct\ Area \times Air\ Velocity$ See also *20-34 Duct 1 Area [m2]* through *20-37 Duct 2 Area [in2]* for setting of duct area.

20-03 Feedback 2 Source		
Option:		**Function:**
		See *parameter 20-00 Feedback 1 Source* for details.
[0] *	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog Input X30/11	
[8]	Analog Input X30/12	
[9]	Analog Input X42/1	
[10]	Analog Input X42/3	
[11]	Analog Input X42/5	
[15]	Analog Input X48/2	
[100]	Bus Feedback 1	
[101]	Bus Feedback 2	
[102]	Bus feedback 3	
[104]	Sensorless Flow	
[105]	Sensorless Pressure	

20-04 Feedback 2 Conversion		
Option:		Function:
		See *parameter 20-01 Feedback 1 Conversion* for details.
[0] *	Linear	
[1]	Square root	
[2]	Pressure to temperature	
[3]	Pressure to flow	
[4]	Velocity to flow	

20-06 Feedback 3 Source		
Option:		Function:
		See *parameter 20-00 Feedback 1 Source* for details.
[0] *	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog Input X30/11	
[8]	Analog Input X30/12	
[9]	Analog Input X42/1	
[10]	Analog Input X42/3	
[11]	Analog Input X42/5	
[15]	Analog Input X48/2	
[100]	Bus Feedback 1	
[101]	Bus Feedback 2	
[102]	Bus feedback 3	
[104]	Sensorless Flow	
[105]	Sensorless Pressure	

20-07 Feedback 3 Conversion		
Option:		Function:
		See *parameter 20-01 Feedback 1 Conversion* for details.
[0] *	Linear	
[1]	Square root	
[2]	Pressure to temperature	
[3]	Pressure to flow	
[4]	Velocity to flow	

20-20 Feedback Function		
Option:		Function:
		This parameter determines how the 3 possible feedbacks are used to control the output frequency of the frequency converter.
[0]	Sum	Sets up the PID Controller to use the sum of Feedback 1, Feedback 2 and Feedback 3 as the feedback. **NOTICE** **Any unused feedbacks must be set to *No Function* in *parameter 20-00 Feedback 1 Source, parameter 20-03 Feedback 2 Source*, or *parameter 20-06 Feedback 3 Source*.** The sum of setpoint 1 and any other references that are enabled (see *parameter group 3-1* References*) are used as the PID Controller's setpoint reference.
[1]	Difference	Sets up the PID controller to use the difference between Feedback 1 and Feedback 2 as the feedback. Feedback 3 is not used with this selection. Only Setpoint 1 is used. The sum of Setpoint 1 and any other references that are enabled (see *parameter group 3-1* References*) are used as the PID controller's setpoint reference.
[2]	Average	Sets up the PID Controller to use the average of Feedback 1, Feedback 2 and Feedback 3 as the feedback. **NOTICE** **Any unused feedbacks must be set to *No Function* in *parameter 20-00 Feedback 1 Source, parameter 20-03 Feedback 2 Source*, or *parameter 20-06 Feedback 3 Source*. The sum of Setpoint 1 and any other references that are enabled (see *parameter group 3-1* References*) are used as the PID Controller's setpoint reference.**
[3] *	Minimum	Sets up the PID Controller to compare feedback 1, feedback 2 and feedback 3 and uses the lowest value as the feedback. **NOTICE** **Any unused feedbacks must be set to *No Function* in *parameter 20-00 Feedback 1 Source, parameter 20-03 Feedback 2 Source*, or *parameter 20-06 Feedback 3 Source*. Only setpoint 1 is used. The sum of setpoint 1 and any other references that are enabled (see *parameter group 3-1* References*) are used as the PID Controller's setpoint reference.**
[4]	Maximum	Sets up the PID Controller to compare feedback 1, feedback 2 and feedback 3 and use the highest value as the feedback.

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20-20 Feedback Function		
Option:		**Function:**
		NOTICE **Any unused feedbacks must be set to *No Function* in *parameter 20-00 Feedback 1 Source*, *parameter 20-03 Feedback 2 Source*, or *parameter 20-06 Feedback 3 Source*.** Only setpoint 1 is used. The sum of setpoint 1 and any other references that are enabled (see *parameter group 3-1* References*) are used as the PID Controller's setpoint reference.
[5]	Multi Setpoint Min	Sets up the PID Controller to calculate the difference between feedback 1 and setpoint 1, feedback 2 and setpoint 2, and feedback 3 and setpoint 3. It uses the feedback/setpoint pair in which the feedback is the farthest below its corresponding setpoint reference. If all feedback signals are above their corresponding setpoints, the PID Controller uses the feedback/setpoint pair with the least difference between the 2. **NOTICE** **If only 2 feedback signals are used, set the non-used feedback to *[0] No Function* in *parameter 20-00 Feedback 1 Source*, *parameter 20-03 Feedback 2 Source*, or *parameter 20-06 Feedback 3 Source*. Note that each setpoint reference is the sum of its respective parameter value (*parameter 20-21 Setpoint 1*, *parameter 20-22 Setpoint 2* and *20-23 Setpoint 3*) and any other references that are enabled (see *parameter group 3-1* References*).**
[6]	Multi Setpoint Max	Sets up the PID Controller to calculate the difference between feedback 1 and setpoint 1, feedback 2 and setpoint 2, and feedback 3 and setpoint 3. It uses the feedback/setpoint pair in which the feedback is farthest above its corresponding setpoint reference. If all feedback signals are below their corresponding setpoints, the PID Controller uses the feedback/setpoint pair with the least difference between the 2. **NOTICE** **If only 2 feedback signals are used, set the non-used feedback to *[0] No Function* in *parameter 20-00 Feedback 1 Source*, *parameter 20-03 Feedback 2 Source*, or *parameter 20-06 Feedback 3 Source*. Note that each setpoint reference is the sum of its respective parameter value (*parameter 20-21 Setpoint 1*, *parameter 20-22 Setpoint 2* and *20-23 Setpoint 3*) and any other references that are enabled (see *parameter group 3-1* References*).**

NOTICE

Any unused feedback must be set to *[0] No function* in its Feedback Source parameter:
***Parameter 20-00 Feedback 1 Source*,**
***parameter 20-03 Feedback 2 Source*, or**
***parameter 20-06 Feedback 3 Source*.**

The PID controller uses the feedback resulting from the function selected in *parameter 20-20 Feedback Function* to control the output frequency of the frequency converter. This feedback can also

- be shown on the frequency converter's display
- be used to control a frequency converter's analog output
- be transmitted over various serial communication protocols

The frequency converter can be configured to handle multi-zone applications. 2 different multi-zone applications are supported:

- Multi-zone, single setpoint
- Multi-zone, multi-setpoint

Examples 1 and 2 illustrate the difference between the 2:

Example 1 – Multi-zone, single setpoint

In an office building, a VAV (variable air volume) VLT® HVAC Drive system must ensure a minimum pressure at selected VAV boxes. Due to the varying pressure losses in each duct, the pressure at each VAV box cannot be assumed to be the same. The minimum pressure required is the same for all VAV boxes. This control method can be set up by setting *parameter 20-20 Feedback Function* to option [3], Minimum, and entering the desired pressure in *parameter 20-21 Setpoint 1*. If any feedback is below the setpoint, the PID Controller increases the fan speed. If all feedbacks are above the setpoint, the PID controller decreases the fan speed.

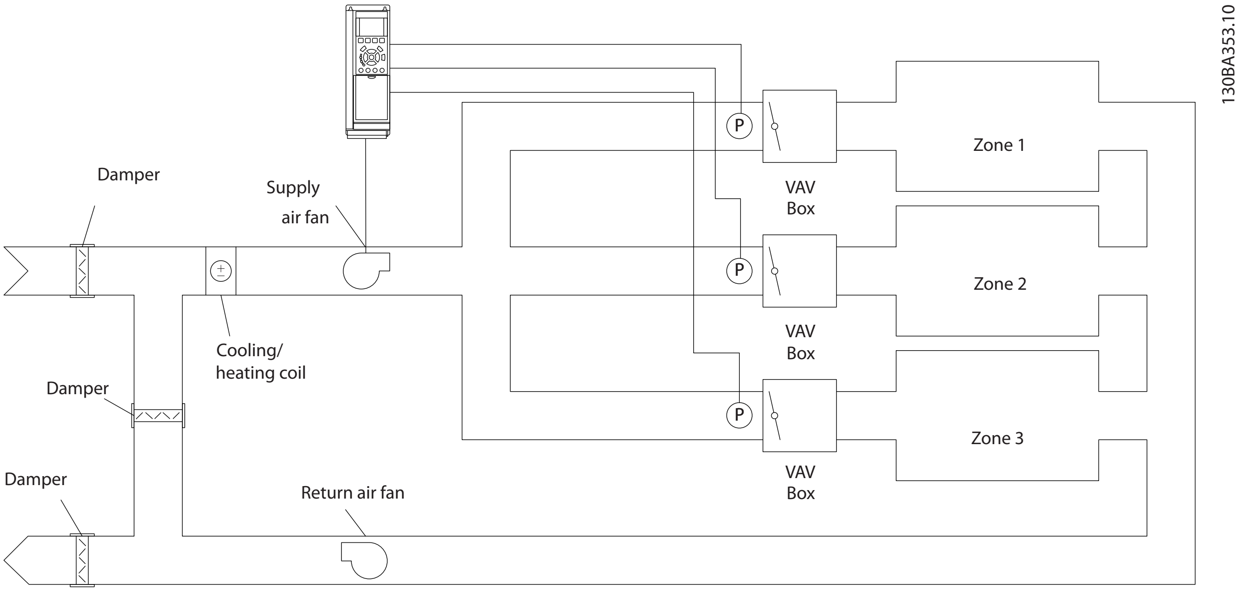

Illustration 6.17

Example 2 – Multi-zone, multi-setpoint

The previous example illustrates the use of multi-zone, multi-setpoint control. If the zones require different pressures for each VAV box, each setpoint may be specified in *parameter 20-21 Setpoint 1*, *parameter 20-22 Setpoint 2* and *20-23 Setpoint 3*. By selecting *[5] Multi-setpoint minimum* in *parameter 20-20 Feedback Function*, the PID Controller increases the fan speed if any one of the feedbacks is below its setpoint. If all feedbacks are above their individual setpoints, the PID controller decreases the fan speed.

20-21 Setpoint 1		
Range:		**Function:**
0 ProcessCtrlUnit*	[-999999.999 - 999999.999 ProcessCtrlUnit]	Setpoint 1 is used in closed loop mode to enter a setpoint reference that is used by the frequency converter's PID controller. See the description of *parameter 20-20 Feedback Function*. **NOTICE** **The setpoint reference entered here is added to any other references that are enabled (see parameter group *3-1* References*).**

20-22 Setpoint 2		
Range:		**Function:**
0 ProcessCtrlUnit*	[-999999.999 - 999999.999 ProcessCtrlUnit]	Setpoint 2 is used in closed loop mode to enter a setpoint reference that may be used by the frequency converter's PID controller. See the description of *Feedback Function*, *parameter 20-20 Feedback Function*. **NOTICE** **The setpoint reference entered here is added to any other references that are enabled (see *parameter group 3-1* References*).**

20-81 PID Normal/ Inverse Control		
Option:		**Function:**
[0] *	Normal	The frequency converter's output frequency decreases when the feedback is greater than the setpoint reference. This behaviour is common for pressure-controlled supply fan and pump applications.
[1]	Inverse	The frequency converter's output frequency increases when the feedback is greater than the setpoint reference. This behaviour is common for

20-81 PID Normal/ Inverse Control		
Option:		Function:
		temperature-controlled cooling applications, such as cooling towers.

20-93 PID Proportional Gain		
Range:		Function:
0.50*	[0 - 10]	The proportional gain indicates the number of times the error between the set point and the feedback signal is to be applied.

If (Error x Gain) jumps with a value equal to what is set in *20-14 Maximum Reference/Feedb.*, the PID controller tries to change the output speed equal to what is set in *parameter 4-13 Motor Speed High Limit [RPM]/ parameter 4-14 Motor Speed High Limit [Hz]*. However, the output speed is limited by this setting.
The proportional band (error causing output to change from 0-100%) can be calculated with the formula

$$\left(\frac{1}{\textit{Proportional Gain}}\right) \times (\textit{Max Reference})$$

NOTICE

Always set the desired value for *20-14 Maximum Reference/Feedb.* before setting the values for the PID controller in parameter group *20-9* PID Controller*.

20-94 PID Integral Time		
Range:		Function:
20 s*	[0.01 - 10000 s]	The integrator accumulates a contribution to the output from the PID controller as long as there is a deviation between the reference/ setpoint and feedback signals. The contribution is proportional to the size of the deviation. This ensures that the deviation (error) approaches zero. Quick response on any deviation is obtained when the integral time is set to a low value. Setting it too low, however, may cause the control to become unstable. The value set is the time needed for the integrator to add the same contribution as the proportional for a certain deviation. If the value is set to 10,000, the controller acts as a pure proportional controller with a P-band based on the value set in *parameter 20-93 PID Proportional Gain*. When no deviation is present, the output from the proportional controller is 0.

22-21 Low Power Detection		
Option:		Function:
[0] *	Disabled	
[1]	Enabled	The low-power detection commissioning must be carried out to set the parameters in parameter group *22-3* No-Flow Power Tuning* for proper operation.

22-22 Low Speed Detection		
Option:		Function:
[0] *	Disabled	
[1]	Enabled	Detects when the motor operates with a speed as set in *parameter 4-11 Motor Speed Low Limit [RPM]* or *parameter 4-12 Motor Speed Low Limit [Hz]*.

22-23 No-Flow Function		
Common actions for low-power detection and low-speed detection (Individual selections not possible).		
Option:		Function:
[0] *	Off	
[1]	Sleep Mode	The frequency converter enters sleep mode and stops when a no-flow condition is detected. See parameter group *22-4* Sleep Mode* for programming options for sleep mode.
[2]	Warning	The frequency converter continues to run, but activates a no-flow warning [W92]. A digital output or a serial communication bus can communicate a warning to other equipment.
[3]	Alarm	The frequency converter stops running and activates a no-flow alarm [A 92]. A frequency converter digital output or a serial communication bus can communicate an alarm to other equipment.

NOTICE

Do not set *14-20 Reset Mode*, to *[13] Infinite auto reset*, when *parameter 22-23 No-Flow Function* is set to *[3] Alarm*. Doing so, causes the frequency converter to continuously cycle between running and stopping when a no-flow condition is detected.

NOTICE

Disable the bypass's automatic bypass funcion

- **if the frequency converter is equipped with a constant speed bypass with an automatic bypass function starting the bypass if the frequency converter experiences a persistent alarm condition, and**
- **if *[3] Alarm* is selected as the no-flow function.**

22-24 No-Flow Delay

Range:		Function:
10 s*	[1 - 600 s]	Set the time that low power/low speed must stay detected to activate signal for actions. If detection disappears before the timer runs out, the timer is reset.

22-26 Dry Pump Function

Select desired action for dry pump operation.

Option:		Function:
[0] *	Off	
[1]	Warning	The frequency converter continues to run, but activates a dry pump warning [W93]. A frequency converter digital output or a serial communication bus can communicate a warning to other equipment.
[2]	Alarm	The frequency converter stops running and activates a dry pump alarm [A93]. A frequency converter digital output or a serial communication bus can communicate an alarm to other equipment.
[3]	Man. Reset Alarm	The frequency converter stops running and activates a dry pump alarm [A93]. A frequency converter digital output or a serial communication bus can communicate an alarm to other equipment.

NOTICE

Low Power Detection **must be enabled (*parameter 22-21 Low Power Detection*) and commissioned (using either parameter group *22-3* No-flow Power Tuning No Flow Power Tuning*, or *22-20 Low Power Auto Set-up*) to use dry-pump detection.**

NOTICE

Do not set *14-20 Reset Mode*, to *[13] Infinite auto reset*, when *parameter 22-26 Dry Pump Function* is set to *[2] Alarm*. Doing so causes the frequency converter to continuously cycle between running and stopping when a dry pump condition is detected.

NOTICE

If the frequency converter is equipped with a constant speed bypass with an automatic bypass function that starts the bypass if the frequency converter experiences a persistent alarm condition, be sure to disable the bypass's automatic bypass function, if *[2] Alarm* or *[3] Man. Reset Alarm* is selected as the dry-pump function.

22-40 Minimum Run Time

Range:		Function:
10 s*	[0 - 600 s]	Set the desired minimum running time for the motor after a start command (digital input or bus) before entering sleep mode.

22-41 Minimum Sleep Time

Range:		Function:
10 s*	[0 - 600 s]	Set the desired minimum time for staying in sleep mode. This setting overrides any wake-up conditions.

22-42 Wake-up Speed [RPM]

Range:		Function:
Size related*	[par. 4-11 - par. 4-13 RPM]	To be used if *0-02 Motor Speed Unit* has been set for RPM (parameter not visible if Hz selected). Only to be used if *parameter 1-00 Configuration Mode* is set for open loop and an external controller applies speed reference. Set the reference speed at which the sleep mode should be cancelled.

22-60 Broken Belt Function

Selects the action to be performed if the broken belt condition is detected

Option:		Function:
[0] *	Off	
[1]	Warning	The frequency converter continues to run, but activates a broken belt warning [W95]. A frequency converter digital output or a serial communication bus can communicate a warning to other equipment.
[2]	Trip	The frequency converter stops running and activates a broken belt alarm [A 95]. A frequency converter digital output or a serial communication bus can communicate an alarm to other equipment.

NOTICE

Do not set *14-20 Reset Mode*, to *[13] Infinite auto reset*, when *parameter 22-60 Broken Belt Function* is set to *[2] Trip*. Doing so causes the frequency converter to continuously cycle between running and stopping when a broken belt condition is detected.

NOTICE

If the frequency converter is equipped with a constant speed bypass with an automatic bypass function that starts the bypass if the frequency converter experiences a persistent alarm condition, be sure to disable the bypass's automatic bypass function, if *[2] Trip* is selected as the broken belt function.

22-61 Broken Belt Torque		
Range:		**Function:**
10 %*	[0 - 100 %]	Sets the broken belt torque as a percentage of the rated motor torque.

22-62 Broken Belt Delay		
Range:		**Function:**
10 s	[0 - 600 s]	Sets the time for which the broken belt conditions must be active before carrying out the action selected in *parameter 22-60 Broken Belt Function*.

22-75 Short Cycle Protection		
Option:		**Function:**
[0] *	Disabled	Timer set in *parameter 22-76 Interval between Starts* is disabled.
[1]	Enabled	Timer set in *parameter 22-76 Interval between Starts* is enabled.

22-76 Interval between Starts		
Range:		**Function:**
Size related*	[par. 22-77 - 3600 s]	Sets the time desired as minimum time between 2 starts. Any normal start command (Start/Jog/Freeze) is disregarded until the timer has expired.

22-77 Minimum Run Time		
Range:		**Function:**
0 s*	[0 - par. 22-76 s]	Sets the time desired as minimum run time after a normal start command (start/jog/freeze). Any normal stop command is disregarded until the set time has expired. The timer starts counting following a normal start command (start/jog/freeze). A coast (inverse) or an external interlock command overrides the timer.

NOTICE

Does not work in cascade mode.

6.1.5 Main Menu Mode

Both the GLCP and NLCP provide access to the main menu mode. Select the Main Menu mode by pressing [Main Menu]. *Illustration 6.18* shows the resulting readout, which appears on the display of the GLCP.
Lines 2 to 5 on the display show a list of parameter groups which can be selected by toggling [▲] and [▼].

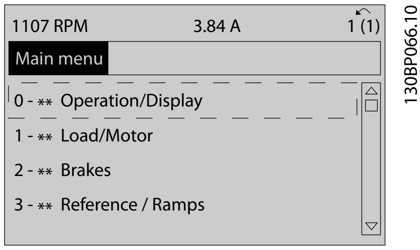

Illustration 6.18 Display Example

Each parameter has a name and number which remain the same regardless of the programming mode. In the Main Menu mode, the parameters are divided into groups. The first digit of the parameter number (from the left) indicates the parameter group number.

All parameters can be changed in the Main Menu. The configuration of the unit (*parameter 1-00 Configuration Mode*) determines other parameters available for programming. For example, selecting closed loop enables more parameters related to closed loop operation. Option cards added to the unit enable more parameters associated with the option device.

6.1.6 Parameter Selection

In the Main Menu mode, the parameters are divided into groups. Press the navigation keys to select a parameter group.
The following parameter groups are accessible:

Group no.	Parameter group
0-**	Operation/Display
1-**	Load/Motor
2-**	Brakes
3-**	References/Ramps
4-**	Limits/Warnings
5-**	Digital In/Out
6-**	Analog In/Out
8-**	Comm. and Options
9-**	Profibus
10-**	CAN Fieldbus
11-**	LonWorks
13-**	Smart Logic
14-**	Special Functions
15-**	FC Information
16-**	Data Readouts
18-**	Data Readouts 2
20-**	FC Closed Loop
21-**	Ext. Closed Loop
22-**	Application Functions
23-**	Time Actions
25-**	Cascade Controller
26-**	Analog I/O Option MCB 109

Group no.	Parameter group
27-**	Cascade CTL Option
29-**	Water Application Functions
31-**	Bypass Option

Table 6.7 Parameter Groups

After selecting a parameter group, select a parameter with the navigation keys.
The middle section on the GLCP display shows the parameter number and name as well as the selected parameter value.

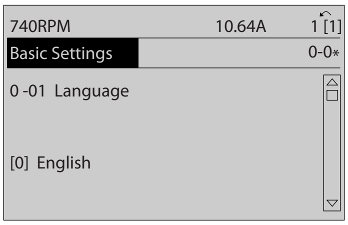

Illustration 6.19 Display Example

6.1.7 Changing Data

1. Press [Quick Menu] or [Main Menu] key.
2. Press [▲] and [▼] to find parameter group to edit.
3. Press [OK] key.
4. Press [▲] and [▼] to find parameter to edit.
5. Press [OK] key.
6. Press [▲] and [▼] to select correct parameter setting. Or, to move to digits within a number, press keys. Cursor indicates digit selected to change. [▲] increases the value, [▼] decreases the value.
7. Press [Cancel] to disregard change, or press [OK] to accept change and enter new setting.

6.1.8 Changing a Text Value

If the selected parameter is a text value, change the text value with the [▲]/[▼] keys.
[▲] increases the value, and [▼] decreases the value. Place the cursor on the value to be saved and press [OK].

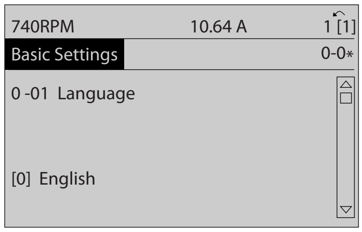

Illustration 6.20 Display Example

6.1.9 Changing a Group of Numeric Data Values

If the selected parameter represents a numeric data value, change the selected data value with the [◄] and [►] keys as well as the up/down [▲] [▼] keys. Press [◄] and [►] to move the cursor horizontally.

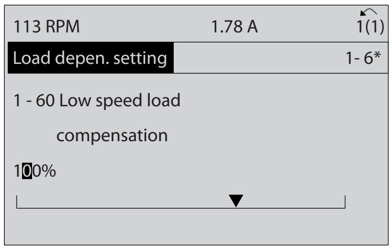

Illustration 6.21 Display Example

Press [▲] and [▼] to change the data value. [▲] increases the data value, and [▼] decreases the data value. Place the cursor on the value to be saved and press [OK].

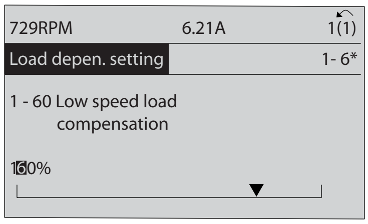

Illustration 6.22 Display Example

6.1.10 Changing of Data Value, Step-by-Step

Certain parameters can be changed step by step or infinitely variably. This applies to *parameter 1-20 Motor Power [kW]*, *parameter 1-22 Motor Voltage* and *parameter 1-23 Motor Frequency*.
The parameters are changed both as a group of numeric data values and as numeric data values infinitely variably.

6.1.11 Readout and Programming of Indexed Parameters

Parameters are indexed when placed in a rolling stack. *15-30 Alarm Log: Error Code* to *15-32 Alarm Log: Time* contain a fault log which can be read out. Select a parameter, press [OK], and use [▲] and [▼] to scroll through the value log.

Use *parameter 3-10 Preset Reference* as another example: Select the parameter, press [OK], and use [▲] and [▼] to scroll through the indexed values. To change the parameter value, select the indexed value and press [OK]. Change the value by [▲] and [▼]. Press [OK] to accept the new setting. Press [Cancel] to abort. Press [Back] to leave the parameter.

6.2 Parameter Menu Structure

0-**	**Operation / Display**
0-0*	**Basic Settings**
0-01	Language
0-02	Motor Speed Unit
0-03	Regional Settings
0-04	Operating State at Power-up
0-05	Local Mode Unit
0-1*	**Set-up Operations**
0-10	Active Set-up
0-11	Programming Set-up
0-12	This Set-up Linked to
0-13	Readout: Linked Set-ups
0-14	Readout: Prog. Set-ups / Channel
0-2*	**LCP Display**
0-20	Display Line 1.1 Small
0-21	Display Line 1.2 Small
0-22	Display Line 1.3 Small
0-23	Display Line 2 Large
0-24	Display Line 3 Large
0-25	My Personal Menu
0-3*	**LCP Custom Readout**
0-30	Custom Readout Unit
0-31	Custom Readout Min Value
0-32	Custom Readout Max Value
0-37	Display Text 1
0-38	Display Text 2
0-39	Display Text 3
0-4*	**LCP Keypad**
0-40	[Hand on] Key on LCP
0-41	[Off] Key on LCP
0-42	[Auto on] Key on LCP
0-43	[Reset] Key on LCP
0-44	[Off/Reset] Key on LCP
0-45	[Drive Bypass] Key on LCP
0-5*	**Copy/Save**
0-50	LCP Copy
0-51	Set-up Copy
0-6*	**Password**
0-60	Main Menu Password
0-61	Access to Main Menu w/o Password
0-65	Personal Menu Password
0-66	Access to Personal Menu w/o Password
0-67	Bus Access Password
0-7*	**Clock Settings**
0-70	Date and Time
0-71	Date Format
0-72	Time Format
0-74	DST/Summertime
0-76	DST/Summertime Start
0-77	DST/Summertime End
0-79	Clock Fault
0-81	Working Days
0-82	Additional Working Days
0-83	Additional Non-Working Days
0-89	Date and Time Readout
1-**	**Load and Motor**
1-0*	**General Settings**
1-00	Configuration Mode
1-03	Torque Characteristics
1-06	Clockwise Direction
1-1*	**Motor Selection**
1-10	Motor Construction
1-1*	**VVC+ PM**
1-14	Damping Gain
1-15	Low Speed Filter Time Const.
1-16	High Speed Filter Time Const.
1-17	Voltage filter time const.
1-2*	**Motor Data**
1-20	Motor Power [kW]
1-21	Motor Power [HP]
1-22	Motor Voltage
1-23	Motor Frequency
1-24	Motor Current
1-25	Motor Nominal Speed
1-26	Motor Cont. Rated Torque
1-28	Motor Rotation Check
1-29	Automatic Motor Adaptation (AMA)
1-3*	**Adv. Motor Data**
1-30	Stator Resistance (Rs)
1-31	Rotor Resistance (Rr)
1-35	Main Reactance (Xh)
1-36	Iron Loss Resistance (Rfe)
1-37	d-axis Inductance (Ld)
1-39	Motor Poles
1-40	Back EMF at 1000 RPM
1-46	Position Detection Gain
1-5*	**Load Indep. Setting**
1-50	Motor Magnetisation at Zero Speed
1-51	Min Speed Normal Magnetising [RPM]
1-52	Min Speed Normal Magnetising [Hz]
1-58	Flystart Test Pulses Current
1-59	Flystart Test Pulses Frequency
1-6*	**Load Depen. Setting**
1-60	Low Speed Load Compensation
1-61	High Speed Load Compensation
1-62	Slip Compensation
1-63	Slip Compensation Time Constant
1-64	Resonance Dampening
1-65	Resonance Dampening Time Constant
1-66	Min. Current at Low Speed
1-7*	**Start Adjustments**
1-70	PM Start Mode
1-71	Start Delay
1-72	Start Function
1-73	Flying Start
1-77	Compressor Start Max Speed [RPM]
1-78	Compressor Start Max Speed [Hz]
1-79	Compressor Start Max Time to Trip
1-8*	**Stop Adjustments**
1-80	Function at Stop
1-81	Min Speed for Function at Stop [RPM]
1-82	Min Speed for Function at Stop [Hz]
1-86	Trip Speed Low [RPM]
1-87	Trip Speed Low [Hz]
1-9*	**Motor Temperature**
1-90	Motor Thermal Protection
1-91	Motor External Fan
1-93	Thermistor Source
2-**	**Brakes**
2-0*	**DC-Brake**
2-00	DC Hold/Preheat Current
2-01	DC Brake Current
2-02	DC Braking Time
2-03	DC Brake Cut In Speed [RPM]
2-04	DC Brake Cut In Speed [Hz]
2-06	Parking Current
2-07	Parking Time
2-1*	**Brake Energy Funct.**
2-10	Brake Function
2-11	Brake Resistor (ohm)
2-12	Brake Power Limit (kW)
2-13	Brake Power Monitoring
2-15	Brake Check
2-16	AC brake Max. Current
2-17	Over-voltage Control
3-**	**Reference / Ramps**
3-0*	**Reference Limits**
3-02	Minimum Reference
3-03	Maximum Reference
3-04	Reference Function
3-1*	**References**
3-10	Preset Reference
3-11	Jog Speed [Hz]
3-13	Reference Site
3-14	Preset Relative Reference
3-15	Reference 1 Source
3-16	Reference 2 Source
3-17	Reference 3 Source
3-19	Jog Speed [RPM]
3-4*	**Ramp 1**
3-41	Ramp 1 Ramp Up Time
3-42	Ramp 1 Ramp Down Time
3-5*	**Ramp 2**
3-51	Ramp 2 Ramp Up Time
3-52	Ramp 2 Ramp Down Time
3-8*	**Other Ramps**
3-80	Jog Ramp Time
3-81	Quick Stop Ramp Time
3-82	Starting Ramp Up Time
3-9*	**Digital Pot.Meter**
3-90	Step Size
3-91	Ramp Time
3-92	Power Restore
3-93	Maximum Limit
3-94	Minimum Limit
3-95	Ramp Delay
4-**	**Limits / Warnings**
4-1*	**Motor Limits**
4-10	Motor Speed Direction
4-11	Motor Speed Low Limit [RPM]
4-12	Motor Speed Low Limit [Hz]
4-13	Motor Speed High Limit [RPM]
4-14	Motor Speed High Limit [Hz]
4-16	Torque Limit Motor Mode
4-17	Torque Limit Generator Mode
4-18	Current Limit
4-19	Max Output Frequency
4-5*	**Adj. Warnings**
4-50	Warning Current Low
4-51	Warning Current High
4-52	Warning Speed Low
4-53	Warning Speed High
4-54	Warning Reference Low
4-55	Warning Reference High
4-56	Warning Feedback Low
4-57	Warning Feedback High
4-58	Missing Motor Phase Function
4-6*	**Speed Bypass**
4-60	Bypass Speed From [RPM]
4-61	Bypass Speed From [Hz]
4-62	Bypass Speed To [RPM]
4-63	Bypass Speed To [Hz]
4-64	Semi-Auto Bypass Set-up
5-**	**Digital In/Out**
5-0*	**Digital I/O mode**
5-00	Digital I/O Mode
5-01	Terminal 27 Mode
5-02	Terminal 29 Mode
5-1*	**Digital Inputs**
5-10	Terminal 18 Digital Input
5-11	Terminal 19 Digital Input
5-12	Terminal 27 Digital Input
5-13	Terminal 29 Digital Input
5-14	Terminal 32 Digital Input
5-15	Terminal 33 Digital Input
5-16	Terminal X30/2 Digital Input
5-17	Terminal X30/3 Digital Input
5-18	Terminal X30/4 Digital Input
5-19	Terminal 37 Safe Stop
5-3*	**Digital Outputs**
5-30	Terminal 27 Digital Output
5-31	Terminal 29 Digital Output
5-32	Term X30/6 Digi Out (MCB 101)
5-33	Term X30/7 Digi Out (MCB 101)
5-4*	**Relays**
5-40	Function Relay
5-41	On Delay, Relay
5-42	Off Delay, Relay
5-5*	**Pulse Input**
5-50	Term. 29 Low Frequency
5-51	Term. 29 High Frequency
5-52	Term. 29 Low Ref./Feedb. Value
5-53	Term. 29 High Ref./Feedb. Value
5-54	Pulse Filter Time Constant #29
5-55	Term. 33 Low Frequency
5-56	Term. 33 High Frequency
5-57	Term. 33 Low Ref./Feedb. Value
5-58	Term. 33 High Ref./Feedb. Value
5-59	Pulse Filter Time Constant #33
5-6*	**Pulse Output**
5-60	Terminal 27 Pulse Output Variable
5-62	Pulse Output Max Freq #27
5-63	Terminal 29 Pulse Output Variable
5-65	Pulse Output Max Freq #29
5-66	Terminal X30/6 Pulse Output Variable
5-68	Pulse Output Max Freq #X30/6
5-8*	**I/O Options**
5-80	AHF Cap Reconnect Delay
5-9*	**Bus Controlled**
5-90	Digital & Relay Bus Control
5-93	Pulse Out #27 Bus Control
5-94	Pulse Out #27 Timeout Preset
5-95	Pulse Out #29 Bus Control
5-96	Pulse Out #29 Timeout Preset
5-97	Pulse Out #X30/6 Bus Control
5-98	Pulse Out #X30/6 Timeout Preset
6-**	**Analog In/Out**
6-0*	**Analog I/O Mode**
6-00	Live Zero Timeout Time
6-01	Live Zero Timeout Function
6-02	Fire Mode Live Zero Timeout Function
6-1*	**Analog Input 53**
6-10	Terminal 53 Low Voltage
6-11	Terminal 53 High Voltage
6-12	Terminal 53 Low Current
6-13	Terminal 53 High Current
6-14	Terminal 53 Low Ref./Feedb. Value
6-15	Terminal 53 High Ref./Feedb. Value
6-16	Terminal 53 Filter Time Constant
6-17	Terminal 53 Live Zero
6-2*	**Analog Input 54**
6-20	Terminal 54 Low Voltage
6-21	Terminal 54 High Voltage
6-22	Terminal 54 Low Current
6-23	Terminal 54 High Current
6-24	Terminal 54 Low Ref./Feedb. Value
6-25	Terminal 54 High Ref./Feedb. Value
6-26	Terminal 54 Filter Time Constant
6-27	Terminal 54 Live Zero
6-3*	**Analog Input X30/11**
6-30	Terminal X30/11 Low Voltage
6-31	Terminal X30/11 High Voltage
6-34	Term. X30/11 Low Ref./Feedb. Value
6-35	Term. X30/11 High Ref./Feedb. Value
6-36	Term. X30/11 Filter Time Constant
6-37	Term. X30/11 Live Zero
6-4*	**Analog Input X30/12**
6-40	Terminal X30/12 Low Voltage
6-41	Terminal X30/12 High Voltage
6-44	Term. X30/12 Low Ref./Feedb. Value
6-45	Term. X30/12 High Ref./Feedb. Value
6-46	Term. X30/12 Filter Time Constant
6-47	Term. X30/12 Live Zero
6-5*	**Analog Output 42**
6-50	Terminal 42 Output
6-51	Terminal 42 Output Min Scale
6-52	Terminal 42 Output Max Scale
6-53	Terminal 42 Output Bus Control
6-54	Terminal 42 Output Timeout Preset
6-55	Analog Output Filter
6-6*	**Analog Output X30/8**
6-60	Terminal X30/8 Output
6-61	Terminal X30/8 Min. Scale
6-62	Terminal X30/8 Max. Scale

6

6-63 Terminal X30/8 Output Bus Control
6-64 Terminal X30/8 Output Timeout Preset
8- Comm. and Options**
8-0* General Settings
8-01 Control Site
8-02 Control Source
8-03 Control Timeout Time
8-04 Control Timeout Function
8-05 End-of-Timeout Function
8-06 Reset Control Timeout
8-07 Diagnosis Trigger
8-08 Readout Filtering
8-09 Communication Charset
8-1* Control Settings
8-10 Control Profile
8-13 Configurable Status Word STW
8-3* FC Port Settings
8-30 Protocol
8-31 Address
8-32 Baud Rate
8-33 Parity / Stop Bits
8-34 Estimated cycle time
8-35 Minimum Response Delay
8-36 Maximum Response Delay
8-37 Maximum Inter-Char Delay
8-4* FC MC protocol set
8-40 Telegram Selection
8-42 PCD Write Configuration
8-43 PCD Read Configuration
8-5* Digital/Bus
8-50 Coasting Select
8-52 DC Brake Select
8-53 Start Select
8-54 Reversing Select
8-55 Set-up Select
8-56 Preset Reference Select
8-7* BACnet
8-70 BACnet Device Instance
8-72 MS/TP Max Masters
8-73 MS/TP Max Info Frames
8-74 "I-Am" Service
8-75 Initialisation Password
8-8* FC Port Diagnostics
8-80 Bus Message Count
8-81 Bus Error Count
8-82 Slave Messages Rcvd
8-83 Slave Error Count
8-84 Slave Messages Sent
8-85 Slave Timeout Errors
8-89 Diagnostics Count
8-9* Bus Jog / Feedback
8-90 Bus Jog 1 Speed
8-91 Bus Jog 2 Speed
8-94 Bus Feedback 1
8-95 Bus Feedback 2
8-96 Bus Feedback 3
9- Profibus**
9-00 Setpoint
9-07 Actual Value
9-15 PCD Write Configuration
9-16 PCD Read Configuration
9-18 Node Address
9-22 Telegram Selection
9-23 Parameters for Signals
9-27 Parameter Edit
9-28 Process Control
9-44 Fault Message Counter
9-45 Fault Code
9-47 Fault Number
9-52 Fault Situation Counter
9-53 Profibus Warning Word
9-63 Actual Baud Rate
9-64 Device Identification
9-65 Profile Number
9-67 Control Word 1
9-68 Status Word 1
9-71 Profibus Save Data Values
9-72 ProfibusDriveReset
9-75 DO Identification
9-80 Defined Parameters (1)
9-81 Defined Parameters (2)
9-82 Defined Parameters (3)
9-83 Defined Parameters (4)
9-84 Defined Parameters (5)
9-90 Changed Parameters (1)
9-91 Changed Parameters (2)
9-92 Changed Parameters (3)
9-93 Changed Parameters (4)
9-94 Changed Parameters (5)
9-99 Profibus Revision Counter
11- LonWorks**
11-0* LonWorks ID
11-00 Neuron ID
11-1* LON Functions
11-10 Drive Profile
11-15 LON Warning Word
11-17 XIF Revision
11-18 LonWorks Revision
11-2* LON Param. Access
11-21 Store Data Values
12- Ethernet**
12-0* IP Settings
12-00 IP Address Assignment
12-01 IP Address
12-02 Subnet Mask
12-03 Default Gateway
12-04 DHCP Server
12-05 Lease Expires
12-06 Name Servers
12-07 Domain Name
12-08 Host Name
12-09 Physical Address
12-1* Ethernet Link Parameters
12-10 Link Status
12-11 Link Duration
12-12 Auto Negotiation
12-13 Link Speed
12-14 Link Duplex
12-2* Process Data
12-20 Control Instance
12-21 Process Data Config Write
12-22 Process Data Config Read
12-27 Primary Master
12-28 Store Data Values
12-29 Store Always
12-3* EtherNet/IP
12-30 Warning Parameter
12-31 Net Reference
12-32 Net Control
12-33 CIP Revision
12-34 CIP Product Code
12-35 EDS Parameter
12-37 COS Inhibit Timer
12-38 COS Filter
12-4* Modbus TCP
12-40 Status Parameter
12-41 Slave Message Count
12-42 Slave Exception Message Count
12-8* Other Ethernet Services
12-80 FTP Server
12-81 HTTP Server
12-82 SMTP Service
12-89 Transparent Socket Channel Port
12-9* Advanced Ethernet Services
12-90 Cable Diagnostic
12-91 Auto Cross Over
12-92 IGMP Snooping
12-93 Cable Error Length
12-94 Broadcast Storm Protection
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26-1*	**Analog Input X42/1**
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26-11	Terminal X42/1 High Voltage
26-14	Term. X42/1 Low Ref./Feedb. Value
26-15	Term. X42/1 High Ref./Feedb. Value
26-16	Term. X42/1 Filter Time Constant
26-17	Term. X42/1 Live Zero
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26-20	Terminal X42/3 Low Voltage
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26-24	Term. X42/3 Low Ref./Feedb. Value
26-25	Term. X42/3 High Ref./Feedb. Value
26-26	Term. X42/3 Filter Time Constant
26-27	Term. X42/3 Live Zero
26-3*	**Analog Input X42/5**
26-30	Terminal X42/5 Low Voltage
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26-34	Term. X42/5 Low Ref./Feedb. Value
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26-36	Term. X42/5 Filter Time Constant
26-37	Term. X42/5 Live Zero
26-4*	**Analog Out X42/7**
26-40	Terminal X42/7 Output
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26-44	Terminal X42/7 Timeout Preset
26-5*	**Analog Out X42/9**
26-50	Terminal X42/9 Output
26-51	Terminal X42/9 Min. Scale
26-52	Terminal X42/9 Max. Scale
26-53	Terminal X42/9 Bus Control
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26-60	Terminal X42/11 Output
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30-23	Locked Rotor Detection Time [s]
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35-**	**Sensor Input Option**
35-0*	**Temp. Input Mode**
35-00	Term. X48/4 Temperature Unit
35-01	Term. X48/4 Input Type
35-02	Term. X48/7 Temperature Unit
35-03	Term. X48/7 Input Type
35-04	Term. X48/10 Temperature Unit
35-05	Term. X48/10 Input Type
35-06	Temperature Sensor Alarm Function
35-1*	**Temp. Input X48/4**
35-14	Term. X48/4 Filter Time Constant
35-15	Term. X48/4 Temp. Monitor
35-16	Term. X48/4 Low Temp. Limit
35-17	Term. X48/4 High Temp. Limit
35-2*	**Temp. Input X48/7**
35-24	Term. X48/7 Filter Time Constant
35-25	Term. X48/7 Temp. Monitor
35-26	Term. X48/7 Low Temp. Limit
35-27	Term. X48/7 High Temp. Limit
35-3*	**Temp. Input X48/10**
35-34	Term. X48/10 Filter Time Constant
35-35	Term. X48/10 Temp. Monitor
35-36	Term. X48/10 Low Temp. Limit
35-37	Term. X48/10 High Temp. Limit
35-4*	**Analog Input X48/2**
35-42	Term. X48/2 Low Current
35-43	Term. X48/2 High Current
35-44	Term. X48/2 Low Ref./Feedb. Value
35-45	Term. X48/2 High Ref./Feedb. Value
35-46	Term. X48/2 Filter Time Constant
35-47	Term. X48/2 Live Zero
99-*	**Devel support**
99-0*	**DSP Debug**
99-00	DAC 1 selection
99-01	DAC 2 selection
99-02	DAC 3 selection
99-03	DAC 4 selection
99-04	DAC 1 scale
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99-1*	**Hardware Control**
99-11	RFI 2
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99-1*	**Software Readouts**
99-13	Idle time
99-14	Paramdb requests in queue
99-15	Secondary Timer at Inverter Fault
99-16	No of Current Sensors
99-2*	**Heatsink Readouts**
99-20	HS Temp. (PC1)
99-21	HS Temp. (PC2)
99-22	HS Temp. (PC3)
99-23	HS Temp. (PC4)
99-24	HS Temp. (PC5)
99-25	HS Temp. (PC6)
99-26	HS Temp. (PC7)
99-27	HS Temp. (PC8)
99-2*	**Platform Readouts**
99-29	Platform Version
99-4*	**Software Control**
99-40	StartupWizardState
99-5*	**PC Debug**
99-50	PC Debug Selection
99-51	PC Debug 0
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99-53	PC Debug 2
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99-55	PC Debug 4
99-56	Fan 1 Feedback
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99-58	PC Auxiliary Temp
99-59	Power Card Temp.
99-9*	**Internal Values**
99-90	Options present
99-91	Motor Power Internal
99-92	Motor Voltage Internal
99-93	Motor Frequency Internal
99-94	Imbalance derate [%]
99-95	Temperature derate [%]
99-96	Overload derate [%]

7 General Specifications

Mains Supply (L1-1, L2-1, L3-1, L1-2, L2-2, L3-2)	
Supply voltage	380-500 V ±10%
Supply voltage	525-690 V ±10%

Mains voltage low/mains drop-out:
During low mains voltage or a mains drop-out, the frequency converter continues until the intermediate circuit voltage drops below the minimum stop level, which corresponds typically to 15% below the frequency converter's lowest rated supply voltage. Power-up and full torque cannot be expected at mains voltage lower than 10% below the frequency converter's lowest rated supply voltage.

Supply frequency	50/60 Hz ±5%
Max. imbalance temporary between mains phases	3.0 % of rated supply voltage
True Power Factor (λ)	≥ 0.9 nominal at rated load
Displacement Power Factor (cosφ) near unity	(> 0.98)
Switching on input supply L1, L2, L3 (power-ups)	maximum once/2 min.
Environment according to EN60664-1	overvoltage category III / pollution degree 2

The unit is suitable for use on a circuit capable of delivering not more than 100.000 RMS symmetrical Amperes, 480/690 V maximum.

Motor output (U, V, W)	
Output voltage	0-100% of supply voltage
Output frequency	0-800* Hz
Switching on output	Unlimited
Ramp times	1-3600 s

** Voltage and power dependent*

Torque characteristics	
Starting torque (constant torque)	maximum 110% for 1 min.*
Starting torque	maximum 135% up to 0.5 s*
Overload torque (constant torque)	maximum 110% for 1 min.*

**Percentage relates to the frequency converter's nominal torque.*

Cable lengths and cross-sections	
Max. motor cable length, screened/armoured	150 m
Max. motor cable length, unscreened/unarmoured	300 m
Max. cross section to motor, mains, load sharing and brake *	
Maximum cross section to control terminals, rigid wire	1.5 mm^2/16 AWG (2x0.75 mm^2)
Maximum cross section to control terminals, flexible cable	1 mm^2/18 AWG
Maximum cross section to control terminals, cable with enclosed core	0.5 mm^2/20 AWG
Minimum cross section to control terminals	0.25 mm^2

** See chapter 7.1.1 Mains Supply 3 x 380 - 500V AC - High Power and chapter 7.1.1 Electrical Data - 525 - 690 VAC for more information.*

Digital inputs	
Programmable digital inputs	4 (6)
Terminal number	18, 19, 27[1)], 29[1)], 32, 33,
Logic	PNP or NPN
Voltage level	0-24 V DC
Voltage level, logic'0' PNP	<5 V DC
Voltage level, logic'1' PNP	>10 V DC
Voltage level, logic '0' NPN	>19 V DC
Voltage level, logic '1' NPN	<14 V DC
Maximum voltage on input	28 V DC

Input resistance, R_i	approx. 4 kΩ

All digital inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.
1) Terminals 27 and 29 can also be programmed as output.

Analog inputs	
Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	Switches S201 and S202
Voltage mode	Switch S201/S202 = OFF (U)
Voltage level	0-10 V (scaleable)
Input resistance, R_i	approx. 10 kΩ
Maximum voltage	±20 V
Current mode	Switch S201/S202 = ON (I)
Current level	0/4-20 mA (scaleable)
Input resistance, R_i	approx. 200 Ω
Maximum current	30 mA
Resolution for analog inputs	10 bit (+ sign)
Accuracy of analog inputs	Maximum error 0.5% of full scale
Bandwidth	200 Hz

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

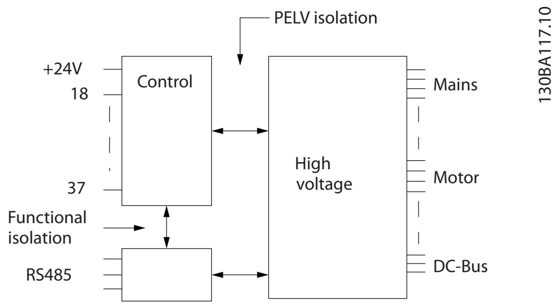

Illustration 7.1 PELV Isolation of Analog Inputs

Pulse inputs	
Programmable pulse inputs	2
Terminal number pulse	29, 33
Maximum frequency at terminal 29, 33	110 kHz (push-pull driven)
Maximum frequency at terminal 29, 33	5 kHz (open collector)
Minimum frequency at terminal 29, 33	4 Hz
Voltage level	see *Digital inputs*
Maximum voltage on input	28 V DC
Input resistance, R_i	approx. 4 kΩ
Pulse input accuracy (0.1-1 kHz)	Maximum error 0.1% of full scale

Analog output	
Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	0/4-20 mA
Maximum resistor load to common at analog output	500 Ω
Accuracy on analog output	Maximum error 0.8% of full scale

Resolution on analog output	8 bit

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

Control card, RS-485 serial communication	
Terminal number	68 (P,TX+, RX+), 69 (N,TX-, RX-)
Terminal number 61	Common for terminals 68 and 69

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

Digital output	
Programmable digital/pulse outputs	2
Terminal number	27, 29[1)]
Voltage level at digital/frequency output	0-24 V
Maximum output current (sink or source)	40 mA
Maximum load at frequency output	1 kΩ
Maximum capacitive load at frequency output	10 nF
Minimum output frequency at frequency output	0 Hz
Maximum output frequency at frequency output	32 kHz
Accuracy of frequency output	Maximum error 0.1% of full scale
Resolution of frequency outputs	12 bit

1) Terminal 27 and 29 can also be programmed as input.

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

Control card, 24 V DC output	
Terminal number	12, 13
Maximum load	200 mA

The 24 V DC supply is galvanically isolated from the supply voltage (PELV), but has the same potential as the analog and digital inputs and outputs.

Relay outputs	
Programmable relay outputs	2
Relay 01 Terminal number	1-3 (break), 1-2 (make)
Maximum terminal load (AC-1)[1)] on 1-3 (NC), 1-2 (NO) (Resistive load)	240 V AC, 2 A
Maximum terminal load (AC-15)[1)] (Inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Maximum terminal load (DC-1)[1)] on 1-2 (NO), 1-3 (NC) (Resistive load)	60 V DC, 1 A
Maximum terminal load (DC-13)[1)] (Inductive load)	24 V DC, 0.1 A
Relay 02 Terminal number	4-6 (break), 4-5 (make)
Maximum terminal load (AC-1)[1)] on 4-5 (NO) (Resistive load)[2)3)]	400 V AC, 2 A
Maximum terminal load (AC-15)[1)] on 4-5 (NO) (Inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Maximum terminal load (DC-1)[1)] on 4-5 (NO) (Resistive load)	80 V DC, 2 A
Maximum terminal load (DC-13)[1)] on 4-5 (NO) (Inductive load)	24 V DC, 0.1 A
Maximum terminal load (AC-1)[1)] on 4-6 (NC) (Resistive load)	240 V AC, 2 A
Maximum terminal load (AC-15)[1)] on 4-6 (NC) (Inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Maximum terminal load (DC-1)[1)] on 4-6 (NC) (Resistive load)	50 V DC, 2 A
Maximum terminal load (DC-13)[1)] on 4-6 (NC) (Inductive load)	24 V DC, 0.1 A
Minimum terminal load on 1-3 (NC), 1-2 (NO), 4-6 (NC), 4-5 (NO)	24 V DC, 10 mA, 24 V AC, 20 mA
Environment according to EN 60664-1	overvoltage category III/pollution degree 2

1) IEC 60947 parts 4 and 5

The relay contacts are galvanically isolated from the rest of the circuit by reinforced isolation (PELV).

2) Overvoltage Category II

3) UL applications 300 V AC 2 A

Control card, 10 V DC output	
Terminal number	50
Output voltage	10.5 V ±0.5 V
Maximum load	25 mA

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

Control characteristics	
Resolution of output frequency at 0-590 Hz	±0.003 Hz
System response time (terminals 18, 19, 27, 29, 32, 33)	≤2 ms
Speed control range (open loop)	1:100 of synchronous speed
Speed accuracy (open loop)	30-4000 RPM: Maximum error of ±8 RPM

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

Surroundings	
Enclosure, frame size E	IP00, IP21, IP54
Enclosure, frame size F	IP21, IP54
Vibration test	0.7 g
Relative humidity	5% - 95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43) H_2S test	class kD
Test method according to IEC 60068-2-43 H_2S (10 days)	
Ambient temperature (at 60 AVM switching mode)	
- with derating	max. 55 °C[1)]
- with full output power, typical EFF2 motors	max. 50 °C[1)]
- at full continuous FC output current	max. 45 °C[1)]

[1)] For more information on derating see the Design Guide, section on Special Conditions.

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

Derating for high altitude, see section on special conditions in the Design Guide

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

See section on special conditions in the Design Guide!

Control card performance	
Scan interval	5 ms

Control card, USB serial communication	
USB standard	1.1 (Full speed)
USB plug	USB type B “device” plug

⚠CAUTION

Connection to PC is carried out via a standard host/device USB cable.
The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.
The USB connection is NOT galvanically isolated from protective earth. Use only isolated laptop/PC as connection to the USB connector on the frequency converter or an isolated USB cable/converter.

Protection and features

- Electronic thermal motor protection against overload.
- Temperature monitoring of the heat sink ensures that the frequency converter trips if the temperature reaches a predefined level. An overload temperature cannot be reset until the temperature of the heat sink is below the

values stated in the tables on the following pages (Guideline - these temperatures may vary for different power sizes, frame sizes, enclosure ratings etc.).

- The frequency converter is protected against short circuits on motor terminals U, V, W.
- If a mains phase is missing, the frequency converter trips or issues a warning (depending on the load).
- Monitoring of the intermediate circuit voltage ensures that the frequency converter trips if the intermediate circuit voltage is too low or too high.
- The frequency converter is protected against ground faults on motor terminals U, V, W.

Mains Supply 6 x 380 - 500V AC				
	P315	P355	P400	P450
Typical Shaft output at 400 V [kW]	315	355	400	450
Typical Shaft output at 460 V [HP]	450	500	600	600
Typical Shaft output at 500 V [kW]	355	400	500	530
Enclosure IP21	F8/F9	F8/F9	F8/F9	F8/F9
Enclosure IP54	F8/F9	F8/F9	F8/F9	F8/F9
Output current				
Continuous (at 400 V) [A]	600	648	745	800
Intermittent (60 sec overload) (at 400 V) [A]	660	724	820	880
Continuous (at 460/ 500 V) [A]	540	590	678	730
Intermittent (60 sec overload) (at 460/ 500 V) [A]	594	649	746	803
Continuous KVA (at 400 V) [KVA]	416	456	516	554
Continuous KVA (at 460 V) [KVA]	430	470	540	582
Continuous KVA (at 500 V) [KVA]	468	511	587	632
Max. input current				
Continuous (at 400 V) [A]	590	647	733	787
Continuous (at 460/ 500 V) [A]	531	580	667	718
Max. cable size, mains [mm^2 (AWG[2)])]	4x90 (3/0)	4x90 (3/0)	4x240 (500 mcm)	4x240 (500 mcm)
Max. cable size, motor [mm^2 (AWG[2)])]	4x240 (4x500 mcm)	4x240 (4x500 mcm)	4x240 (4x500 mcm)	4x240 (4x500 mcm)
Max. cable size, brake [mm^2 (AWG[2)])	2 x 185 (2 x 350 mcm)	2 x 185 (2 x 350 mcm)	2 x 185 (2 x 350 mcm)	2 x 185 (2 x 350 mcm)
Max. external mains fuses [A] [1]	700			
Estimated power loss at 400 V [W] [4)]	6790	7701	8879	9670
Estimated power loss at 460 V [W]	6082	6953	8089	8803
Weight,enclosure IP21, IP 54 [kg]	440/656			
Efficiency[4)]	0.98			
Output frequency	0 - 600Hz			
Heatsink overtemp. trip	95 °C			
Power card ambient trip	68 °C			
* High overload = 160% torque during 60 sec, Normal overload = 110% torque during 60 sec.				

Table 7.1

Mains Supply 6 x 380 - 500V AC						
	P500	P560	P630	P710	P800	P1000
Typical Shaft output at 400 V [kW]	500	560	630	710	800	1000
Typical Shaft output at 460 V [HP]	650	750	900	1000	1200	1350
Typical Shaft output at 500 V [kW]	560	630	710	800	1000	1100
EnclosureIP21, 54 without/ with options cabinet	F10/F11	F10/F11	F10/F11	F10/F11	F12/F13	F12/F13
Output current						
Continuous (at 400 V) [A]	880	990	1120	1260	1460	1720
Intermittent (60 sec overload) (at 400 V) [A]	968	1089	1232	1386	1606	1892
Continuous (at 460/ 500 V) [A]	780	890	1050	1160	1380	1530
Intermittent (60 sec overload) (at 460/ 500 V) [A]	858	979	1155	1276	1518	1683
Continuous KVA (at 400 V) [KVA]	610	686	776	873	1012	1192
Continuous KVA (at 460 V) [KVA]	621	709	837	924	1100	1219
Continuous KVA (at 500 V) [KVA]	675	771	909	1005	1195	1325
Max. input current						
Continuous (at 400 V) [A]	857	964	1090	1227	1422	1675
Continuous (at 460/ 500 V) [A]	759	867	1022	1129	1344	1490
Max. cable size,motor [mm^2 (AWG[2)])]	8x150 (8x300 mcm)				12x150 (12x300 mcm)	
Max. cable size,mains [mm^2 (AWG[2)])]	6x120 (6x250 mcm)					
Max. cable size, brake [mm^2 (AWG[2)])	4x185 (4x350 mcm)				6x185 (6x350 mcm)	
Max. external mains fuses [A] [1)]	900			1500		
Estimated power loss at 400 V [W] [4)]	10647	12338	13201	15436	18084	20358
Estimated power loss at 460 V [W]	9414	11006	12353	14041	17137	17752
F9/F11/F13 max. added losses A1 RFI, CB or Disconnect, & contactor F9/F11/F13	963	1054	1093	1230	2280	2541
Max. panel options losses	400					
Weight, enclosure IP21, IP54 [kg]	1004/ 1299	1004/ 1299	1004/ 1299	1004/ 1299	1246/ 1541	1246/ 1541
Weight rectifier module [kg]	102	102	102	102	136	136
Weight inverter module [kg]	102	102	102	136	102	102
Efficiency[4)]	0.98					
Output frequency	0-600Hz					
Heatsink overtemp. trip	95 °C					
Power card ambient trip	68 °C					
* High overload = 160% torque during 60 sec., Normal overload = 110% torque during 60 sec.						

Table 7.2

Mains Supply 3 x 525- 690V AC				
	P450	P500	P560	P630
Typical Shaft output at 550 V [kW]	355	400	450	500
Typical Shaft output at 575 V [HP]	450	500	600	650
Typical Shaft output at 690 V [kW]	450	500	560	630
Enclosure IP21	F8/F9	F8/F9	F8/F9	F8/F9
Enclosure IP54	F8/F9	F8/F9	F8/F9	F8/F9
Output current				
Continuous (at 550 V) [A]	470	523	596	630
Intermittent (60 sec overload) (at 550 V) [A]	517	575	656	693
Continuous (at 575/ 690 V) [A]	450	500	570	630
Intermittent (60 sec overload) (at 575/ 690 V) [A]	495	550	627	693
Continuous KVA (at 550 V) [KVA]	448	498	568	600
Continuous KVA (at 575 V) [KVA]	448	498	568	627
Continuous KVA (at 690 V) [KVA]	538	598	681	753
Max. input current				
Continuous (at 550 V) [A]	453	504	574	607
Continuous (at 575 V) [A]	434	482	549	607
Continuous (at 690 V) [A]	434	482	549	607
Max. cable size, mains [mm^2 (AWG)]	4x85 (3/0)			
Max. cable size, motor [mm^2 (AWG)]	4 x 250 (500 mcm)			
Max. cable size, brake [mm^2 (AWG)]	2 x 185 (2 x 350 mcm)	2 x 185 (2 x 350 mcm)	2 x 185 (2 x 350 mcm)	2 x 185 (2 x 350 mcm)
Max. external mains fuses [A] [1]	630			
Estimated power loss at 600 V [W] [4)]	6132	6903	8343	9244
Estimated power loss at 690 V [W] [4)]	6449	7249	8727	9673
Weight, enclosure IP21, IP 54 [kg]	440/656			
Efficiency[4)]	0.98			
Output frequency	0 - 500 Hz			
Heatsink overtemp. trip	85 °C			
Power card ambient trip	68 °C			
* High overload = 160% torque during 60 sec, Normal overload = 110% torque during 60 sec.				

Table 7.3

Mains Supply 3 x 525- 690V AC			
	P710	P800	P900
Typical Shaft output at 550 V [kW]	560	670	750
Typical Shaft output at 575 V [HP]	750	950	1050
Typical Shaft output at 690 V [kW]	710	800	900
Enclosure IP21, 54 without/ with options cabinet	F10/F11	F10/F11	F10/F11
Output current			
Continuous (at 550 V) [A]	763	889	988
Intermittent (60 sec overload) (at 550 V) [A]	839	978	1087
Continuous (at 575/ 690 V) [A]	730	850	945
Intermittent (60 sec overload) (at 575/ 690 V) [A]	803	935	1040
Continuous KVA (at 550 V) [KVA]	727	847	941
Continuous KVA (at 690 V) [KVA]	872	1016	1129
Max. input current			
Continuous (at 550 V) [A]	743	866	962
Continuous (at 575 V) [A]	711	828	920
Continuous (at 690 V) [A]	711	828	920
Max. cable size, motor [mm^2 (AWG$^{2)}$)]	8x150 (8x300 mcm)		
Max. cable size,mains [mm^2 (AWG$^{2)}$)]	6x120 (6x250 mcm)		
Max. cable size, brake [mm^2 (AWG$^{2)}$)	4x185 (4x350 mcm)		
Max. external mains fuses [A] [1]	900		
Estimated power loss at 600 V [W] [4)]	10771	12272	13835
Estimated power loss at 690V [W] [4)]	11315	12903	14533
F3/F4 Max added losses CB or Disconnect & Contactor	427	532	615
Max panel options losses	400		
Weight, enclosure IP21, IP 54 [kg]	1004/ 1299	1004/ 1299	1004/ 1299
Weight, Rectifier Module [kg]	102	102	102
Weight, Inverter Module [kg]	102	102	136
Efficiency[4)]	0.98		
Output frequency	0-500 Hz		
Heatsink overtemp. trip	85 °C		
Power card ambient trip	68 °C		
* High overload = 160% torque during 60 sec., Normal overload = 110% torque during 60 sec.			

Table 7.4

Mains Supply 3 x 525- 690V AC			
	P1M0	P1M2	P1M4
Typical Shaft output at 550 V [kW]	850	1000	1100
Typical Shaft output at 575 V [HP]	1150	1350	1550
Typical Shaft output at 690 V [kW]	1000	1200	1400
Enclosure IP21, 54 without/ with options cabinet	F12/F13	F12/F13	F12/F13
Output current			
Continuous (at 550 V) [A]	1108	1317	1479
Intermittent (60 sec overload) (at 550 V) [A]	1219	1449	1627
Continuous (at 575/ 690 V) [A]	1060	1260	1415
Intermittent (60 sec overload) (at 575/ 690 V) [A]	1166	1386	1557
Continuous KVA (at 550 V) [KVA]	1056	1255	1409
Continuous KVA (at 690 V) [KVA]	1267	1506	1691
Max. input current			
Continuous (at 550 V) [A]	1079	1282	1440
Continuous (at 575 V) [A]	1032	1227	1378
Continuous (at 690 V) [A]	1032	1227	1378
Max. cable size, motor [mm^2 (AWG[2)])]	12x150 (12x300 mcm)		
Max. cable size,mains F12 [mm^2 (AWG[2)])]	8x240 (8x500 mcm)		
Max. cable size,mains F13 [mm^2 (AWG[2)])]	8x400 (8x900 mcm)		
Max. cable size, brake [mm^2 (AWG[2)])	6x185 (6x350 mcm)		
Max. external mains fuses [A] [1]	1600	2000	2500
Estimated power loss at 600 V [W] [4)]	15592	18281	20825
Estimated power loss at 690V [W] [4)]	16375	19207	21857
F3/F4 Max added losses CB or Disconnect & Contactor	665	863	1044
Max panel options losses	400		
Weight, enclosure IP21, IP 54 [kg]	1246/ 1541	1246/ 1541	1280/1575
Weight, Rectifier Module [kg]	136	136	136
Weight, Inverter Module [kg]	102	102	136
Efficiency[4)]	0.98		
Output frequency	0-500 Hz		
Heatsink overtemp. trip	85 °C		
Power card ambient trip	68 °C		
* High overload = 160% torque during 60 sec., Normal overload = 110% torque during 60 sec.			

Table 7.5

1) For type of fuse see section *Fuses.*

2) American Wire Gauge.

3) Measured using 5 m screened motor cables at rated load and rated frequency.

4) The typical power loss is at nominal load conditions and expected to be within +/-15% (tolerence relates to variety in voltage and cable conditions).
Values are based on a typical motor efficiency (eff2/eff3 border line). Motors with lower efficiency will also add to the power loss in the frequency converter and opposite.
If the switching frequency is increased compared to the default setting, the power losses may rise significantly.
LCP and typical control card power consumptions are included. Further options and customer load may add up to 30W to the losses. (Though typical only 4W extra for a fully loaded control card, or options for slot A or slot B, each).
Although measurements are made with state of the art equipment, some measurement inaccuracy must be allowed for (+/-5%).

8 Warnings and Alarms

A warning or an alarm is signalled by the relevant LED on the front of the frequency converter and indicated by a code on the display.

A warning remains active until its cause is no longer present. Under certain circumstances operation of the motor may still be continued. Warning messages may be critical, but are not necessarily so.

If an alarm occurs, the frequency converter trips. Alarms must be reset to restart operation once their cause has been rectified.

This may be done in 4 ways:

1. Pressing [Reset] on the LCP
2. Via a digital input with the “Reset” function
3. Via serial communication/optional fieldbus
4. By resetting automatically using the [Auto Reset] function (default)

NOTICE

After a manual reset pressing [Reset], the [Auto On] or [Hand On] must be pressed to restart the motor.

If an alarm cannot be reset, the reason may be that its cause has not been rectified, or the alarm is trip-locked (see also *Table 8.1*).

CAUTION

Alarms that are trip-locked offer additional protection, means that the mains supply must be switched off before the alarm can be reset. After being switched back on, the frequency converter is no longer blocked and may be reset as described above once the cause has been rectified.
Alarms that are not trip-locked can also be reset using the automatic reset function in *14-20 Reset Mode* (Warning: automatic wake-up is possible!)
If a warning and alarm is marked against a code in the table on the following page, this means that either a warning occurs before an alarm, or it can be specified whether it is a warning or an alarm that is to be displayed for a given fault.
This is possible, for instance, in *parameter 1-90 Motor Thermal Protection*. After an alarm or trip, the motor carries on coasting, and the alarm and warning flash on the frequency converter. Once the problem has been rectified, only the alarm continues flashing.

No.	Description	Warning	Alarm/ Trip	Alarm/Trip Lock	Parameter Reference
1	10 Volts low	X			
2	Live zero error	(X)	(X)		6-01
3	No motor	(X)			1-80
4	Mains phase loss	(X)	(X)	(X)	14-12
5	DC link voltage high	X			
6	DC link voltage low	X			
7	DC over voltage	X	X		
8	DC under voltage	X	X		
9	Inverter overloaded	X	X		
10	Motor ETR over temperature	(X)	(X)		1-90
11	Motor thermistor over temperature	(X)	(X)		1-90
12	Torque limit	X	X		
13	Over Current	X	X	X	
14	Earth fault	X	X	X	
15	Hardware mismatch		X	X	
16	Short Circuit		X	X	
17	Control word timeout	(X)	(X)		8-04
23	Internal Fan Fault	X			
24	External Fan Fault	X			14-53
25	Brake resistor short-circuited	X			

No.	Description	Warning	Alarm/ Trip	Alarm/Trip Lock	Parameter Reference
26	Brake resistor power limit	(X)	(X)		2-13
27	Brake chopper short-circuited	X	X		
28	Brake check	(X)	(X)		2-15
29	Drive over temperature	X	X	X	
30	Motor phase U missing	(X)	(X)	(X)	4-58
31	Motor phase V missing	(X)	(X)	(X)	4-58
32	Motor phase W missing	(X)	(X)	(X)	4-58
33	Inrush fault		X	X	
34	Fieldbus communication fault	X	X		
35	Out of frequency range	X	X		
36	Mains failure	X	X		
37	Phase Imbalance	X	X		
38	Internal fault		X	X	
39	Heat sink sensor		X	X	
40	Overload of Digital Output Terminal 27	(X)			5-00, 5-01
41	Overload of Digital Output Terminal 29	(X)			5-00, 5-02
42	Overload of Digital Output On X30/6	(X)			5-32
42	Overload of Digital Output On X30/7	(X)			5-33
46	Pwr. card supply		X	X	
47	24 V supply low	X	X	X	
48	1.8 V supply low		X	X	
49	Speed limit	X	(X)		1-86
50	AMA calibration failed		X		
51	AMA check U_{nom} and I_{nom}		X		
52	AMA low I_{nom}		X		
53	AMA motor too big		X		
54	AMA motor too small		X		
55	AMA Parameter out of range		X		
56	AMA interrupted by user		X		
57	AMA timeout		X		
58	AMA internal fault	X	X		
59	Current limit	X			
60	External Interlock	X			
62	Output Frequency at Maximum Limit	X			
64	Voltage Limit	X			
65	Control Board Over-temperature	X	X	X	
66	Heat sink Temperature Low	X			
67	Option Configuration has Changed		X		
69	Pwr. Card Temp		X	X	
70	Illegal FC configuration			X	
71	PTC 1 Safe Stop	X	X[1)]		
72	Dangerous Failure			X[1)]	
73	Safe Stop Auto Restart				
76	Power Unit Setup	X			
79	Illegal PS config		X	X	
80	Drive Initialized to Default Value		X		
91	Analog input 54 wrong settings			X	
92	NoFlow	X	X		22-2*
93	Dry Pump	X	X		22-2*
94	End of Curve	X	X		22-5*
95	Broken Belt	X	X		22-6*
96	Start Delayed	X			22-7*

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No.	Description	Warning	Alarm/ Trip	Alarm/Trip Lock	Parameter Reference
97	Stop Delayed	X			22-7*
98	Clock Fault	X			0-7*
201	Fire M was Active				
202	Fire M Limits Exceeded				
203	Missing Motor				
204	Locked Rotor				
243	Brake IGBT	X	X		
244	Heat sink temp	X	X	X	
245	Heat sink sensor		X	X	
246	Pwr.card supply		X	X	
247	Pwr.card temp		X	X	
248	Illegal PS config		X	X	
250	New spare parts			X	
251	New Type Code		X	X	

Table 8.1 Alarm/Warning Code List

(X) Dependent on parameter

1) Can not be Auto reset via 14-20 Reset Mode

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A trip is the action when an alarm has appeared. The trip will coast the motor and can be reset by pressing [Reset] or make a reset by a digital input (parameter group *5-1* Digital Inputs* [1]). The original event that caused an alarm cannot damage the frequency converter or cause dangerous conditions. A trip lock is an action when an alarm occurs, which may cause damage to frequency converter or connected parts. A Trip Lock situation can only be reset by a power cycling.

Warning	yellow
Alarm	flashing red
Trip locked	yellow and red

Table 8.2 LED Indication

Alarm Word and Extended Status Word					
Bit	**Hex**	**Dec**	**Alarm Word**	**Warning Word**	**Extended Status Word**
0	00000001	1	Brake Check	Brake Check	Ramping
1	00000002	2	Pwr. Card Temp	Pwr. Card Temp	AMA Running
2	00000004	4	Earth Fault	Earth Fault	Start CW/CCW
3	00000008	8	Ctrl.Card Temp	Ctrl.Card Temp	Slow Down
4	00000010	16	Ctrl. Word TO	Ctrl. Word TO	Catch Up
5	00000020	32	Over Current	Over Current	Feedback High
6	00000040	64	Torque Limit	Torque Limit	Feedback Low
7	00000080	128	Motor Th Over	Motor Th Over	Output Current High
8	00000100	256	Motor ETR Over	Motor ETR Over	Output Current Low
9	00000200	512	Inverter Overld.	Inverter Overld.	Output Freq High
10	00000400	1024	DC under Volt	DC under Volt	Output Freq Low
11	00000800	2048	DC over Volt	DC over Volt	Brake Check OK
12	00001000	4096	Short Circuit	DC Voltage Low	Braking Max
13	00002000	8192	Inrush Fault	DC Voltage High	Braking
14	00004000	16384	Mains ph. Loss	Mains ph. Loss	Out of Speed Range
15	00008000	32768	AMA Not OK	No Motor	OVC Active
16	00010000	65536	Live Zero Error	Live Zero Error	
17	00020000	131072	Internal Fault	10V Low	
18	00040000	262144	Brake Overload	Brake Overload	
19	00080000	524288	U phase Loss	Brake Resistor	
20	00100000	1048576	V phase Loss	Brake IGBT	
21	00200000	2097152	W phase Loss	Speed Limit	
22	00400000	4194304	Fieldbus Fault	Fieldbus Fault	
23	00800000	8388608	24V Supply Low	24V Supply Low	
24	01000000	16777216	Mains Failure	Mains Failure	
25	02000000	33554432	1.8V Supply Low	Current Limit	
26	04000000	67108864	Brake Resistor	Low Temp	
27	08000000	134217728	Brake IGBT	Voltage Limit	
28	10000000	268435456	Option Change	Unused	
29	20000000	536870912	Drive Initialized	Unused	
30	40000000	1073741824	Safe Stop	Unused	

Table 8.3 Description of Alarm Word, Warning Word and Extended Status Word

The alarm words, warning words and extended status words can be read out via serial bus or optional fieldbus for diagnosis. See also *16-90 Alarm Word*, *16-92 Warning Word* and *16-94 Ext. Status Word*.

WARNING 1, 10 Volts low
The control card voltage is <10 V from terminal 50.
Remove some of the load from terminal 50, as the 10 V supply is overloaded. Maximum 15 mA or minimum 590 Ω.

A short-circuit in a connected potentiometer or improper wiring of the potentiometer can cause this condition.

Troubleshooting

- Remove the wiring from terminal 50. If the warning clears, the problem is with the wiring. If the warning does not clear, replace the control card.

WARNING/ALARM 2, Live zero error
This warning or alarm only appears if programmed in *parameter 6-01 Live Zero Timeout Function*. The signal on one of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or a faulty device sending the signal can cause this condition.

Troubleshooting

- Check the connections on all the analog input terminals.
    - Control card terminals 53 and 54 for signals, terminal 55 common.
    - MCB 101 terminals 11 and 12 for signals, terminal 10 common.
    - MCB 109 terminals 1, 3, 5 for signals, terminals 2, 4, 6 common.
- Check that the frequency converter programming and switch settings match the analog signal type.
- Perform an input terminal signal test.

WARNING/ALARM 3, No motor
No motor has been connected to the output of the frequency converter.

WARNING/ALARM 4, Mains phase loss
A phase is missing on the supply side, or the mains voltage imbalance is too high. This message also appears for a fault in the input rectifier on the frequency converter. Options are programmed in *14-12 Function at Mains Imbalance*.

Troubleshooting

- Check the supply voltage and supply currents to the frequency converter.

WARNING 5, DC link voltage high
The intermediate circuit voltage (DC) is higher than the high-voltage warning limit. The limit is dependent on the frequency converter voltage rating. The unit is still active.

WARNING 6, DC link voltage low
The intermediate circuit voltage (DC) is lower than the low-voltage warning limit. The limit is dependent on the frequency converter voltage rating. The unit is still active.

WARNING/ALARM 7, DC overvoltage
If the intermediate circuit voltage exceeds the limit, the frequency converter trips after a time.

Troubleshooting

- Connect a brake resistor
- Extend the ramp time.
- Change the ramp type.
- Activate the functions in *parameter 2-10 Brake Function*.
- Increase *14-26 Trip Delay at Inverter Fault*
- If the alarm/warning occurs during a power sag, use kinetic back-up (*14-10 Mains Failure*).

WARNING/ALARM 8, DC under voltage
If the DC-link voltage drops below the undervoltage limit, the frequency converter checks if a 24 V DC backup supply is connected. If no 24 V DC backup supply is connected, the frequency converter trips after a fixed time delay. The time delay varies with unit size.

Troubleshooting

- Check that the supply voltage matches the frequency converter voltage.
- Perform an input voltage test.
- Perform a soft charge circuit test.

WARNING/ALARM 9, Inverter overload
The frequency converter is about to cut out because of an overload. The counter for electronic, thermal inverter protection issues a warning at 98% and trips at 100%, while giving an alarm. The frequency converter cannot be reset until the counter is below 90%.
The fault is that the frequency converter has run with more than 100% overload for too long.

Troubleshooting

- Compare the output current shown on the LCP with the frequency converter rated current.
- Compare the output current shown on the LCP with the measured motor current.
- Display the thermal drive load on the LCP and monitor the value. When running above the frequency converter continuous current rating, the counter increases. When running below the frequency converter continuous current rating, the counter decreases.

WARNING/ALARM 10, Motor overload temperature
According to the electronic thermal protection (ETR), the motor is too hot. Select whether the frequency converter issues a warning or an alarm when the counter reaches 100% in *parameter 1-90 Motor Thermal Protection*. The fault occurs when the motor runs with more than 100% overload for too long.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- Check that the motor current set in *1-24 Motor Current* is correct.

- Ensure that the motor data in *parameters 1-20* to *1-25* are set correctly.
- If an external fan is in use, check that it is selected in *1-91 Motor External Fan*.
- Running AMA in *parameter 1-29 Automatic Motor Adaptation (AMA)* tunes the frequency converter to the motor more accurately and reduces thermal loading.

WARNING/ALARM 11, Motor thermistor overtemp
The thermistor may be disconnected. Select whether the frequency converter issues a warning or an alarm in *parameter 1-90 Motor Thermal Protection*.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- Check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply). Also check that the terminal switch for 53 or 54 is set for voltage. Check that *1-93 Thermistor Resource* is set to terminal 53 or 54.
- When using digital inputs 18 or 19, check that the thermistor is connected correctly between either terminal 18 or 19 (digital input PNP only) and terminal 50.
- If a KTY sensor is used, check for correct connection between terminals 54 and 55
- If using a thermal switch or thermistor, check that the programming of *1-93 Thermistor Resource* matches sensor wiring.
- If using a KTY Sensor, check the programming of *1-95 KTY Sensor Type*, *1-96 KTY Thermistor Resource* and *1-97 KTY Threshold level* match sensor wiring.

WARNING/ALARM 12, Torque limit
The torque has exceeded the value in *4-16 Torque Limit Motor Mode* or the value in *4-17 Torque Limit Generator Mode*. *14-25 Trip Delay at Torque Limit* can change this warning from a warning-only condition to a warning followed by an alarm.

Troubleshooting

- If the motor torque limit is exceeded during ramp up, extend the ramp-up time.
- If the generator torque limit is exceeded during ramp-down, extend the ramp down time.
- If torque limit occurs while running, increase the torque limit. Make sure that the system can operate safely at a higher torque.
- Check the application for excessive current draw on the motor.

WARNING/ALARM 13, Over current
The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts approximately 1.5 s, then the frequency converter trips and issues an alarm. Shock loading or quick acceleration with high inertia loads can cause this fault. If the acceleration during ramp-up is quick, the fault can also appear after kinetic back-up.
If extended mechanical brake control is selected, a trip can be reset externally.

Troubleshooting

- Remove the power and check if the motor shaft can be turned.
- Check that the motor size matches the frequency converter.
- Check that the motor data is correct in *parameters 1-20* to *1-25*.

ALARM 14, Earth (ground) fault
There is current from the output phases to ground, either in the cable between the frequency converter and the motor, or in the motor itself.

Troubleshooting

- Remove the power to the frequency converter and repair the ground fault.
- Check for ground faults in the motor by measuring the resistance to the ground of the motor cables and the motor with a megohmmeter.
- Perform a current sensor test.

ALARM 15, Hardware mismatch
A fitted option is not operational with the present control board hardware or software.

Record the value of the following parameters and contact Danfoss:

- *15-40 FC Type*
- *15-41 Power Section*
- *15-42 Voltage*
- *15-43 Software Version*
- *15-45 Actual Typecode String*
- *15-49 SW ID Control Card*
- *15-50 SW ID Power Card*
- *15-60 Option Mounted*
- *15-61 Option SW Version* (for each option slot)

ALARM 16, Short circuit
There is short-circuiting in the motor or motor wiring.

Troubleshooting

- Remove the power to the frequency converter and repair the short-circuit.

WARNING/ALARM 17, Control word timeout
There is no communication with the frequency converter.

8

The warning is only active when *8-04 Control Word Timeout Function* is not set to *[0] Off*.
If *8-04 Control Word Timeout Function* is set to *[2] Stop* and *[26] Trip*, a warning appears and the frequency converter ramps down until it trips and then displays an alarm.

Troubleshooting:

- Check the connections on the serial communication cable.
- Increase *8-03 Control Word Timeout Time*
- Check the operation of the communication equipment.
- Verify a proper installation based on EMC requirements.

ALARM 18, Start failed
The speed has not exceeded *1-77 Compressor Start Max Speed [RPM]* during start within the allowed time. (set in *1-79 Compressor Start Max Time to Trip*). This may be caused by a blocked motor.

WARNING 23, Internal fan fault
The fan warning function is an extra protective function that checks if the fan is running/mounted. The fan warning can be disabled in *14-53 Fan Monitor ([0] Disabled)*.

Troubleshooting

- Check the fan resistance.
- Check the soft charge fuses.

WARNING 24, External fan fault
The fan warning function is an extra protective function that checks if the fan is running/mounted. The fan warning can be disabled in *14-53 Fan Monitor ([0] Disabled)*.

Troubleshooting

- Check the fan resistance.
- Check the soft charge fuses.

WARNING 25, Brake resistor short circuit
The brake resistor is monitored during operation. If a short-circuit occurs, the brake function is disabled and the warning appears. The frequency converter is still operational, but without the brake function.

Troubleshooting

- Remove the power to the frequency converter and replace the brake resistor (see *2-15 Brake Check*).

WARNING/ALARM 26, Brake resistor power limit
The power transmitted to the brake resistor is calculated as a mean value over the last 120 s of run time. The calculation is based on the intermediate circuit voltage and the brake resistance value set in *2-16 AC brake Max. Current*. The warning is active when the dissipated braking is >90% of the brake resistance power. If *[2] Trip* is selected in *2-13 Brake Power Monitoring*, the frequency converter trips when the dissipated braking power reaches 100%.

⚠WARNING

If the brake transistor is short-circuited, there is a risk of substantial power being transmitted to the brake resistor.

WARNING/ALARM 27, Brake chopper fault
The brake transistor is monitored during operation. If a short-circuit occurs, the brake function is disabled and a warning is issued. The frequency converter is still operational, but since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.
Remove the power to the frequency converter and remove the brake resistor.

This alarm/warning could also occur if the brake resistor overheats. Terminals 104 and 106 are available as brake resistors Klixon inputs.

WARNING/ALARM 28, Brake check failed
The brake resistor is not connected or not working.
Check *2-15 Brake Check*.

ALARM 29, Heat Sink temp
The maximum temperature of the heat sink has been exceeded. The temperature fault resets when the temperature falls below a defined heat sink temperature. The trip and reset points vary based on the frequency converter power size.

Troubleshooting
Check for the following conditions.

- Ambient temperature too high.
- Motor cables too long.
- Incorrect airflow clearance above and below the frequency converter.
- Blocked airflow around the frequency converter.
- Damaged heat sink fan.
- Dirty heat sink.

For D, E, and F enclosures, this alarm is based on the temperature measured by the heat sink sensor mounted inside the IGBT modules. For the F enclosures, the thermal sensor in the rectifier module can also cause this alarm.

Troubleshooting

- Check the fan resistance.
- Check the soft charge fuses.
- Check the IGBT thermal sensor.

ALARM 30, Motor phase U missing
Motor phase U between the frequency converter and the motor is missing.

Troubleshooting

- Remove the power from the frequency converter and check motor phase U.

ALARM 31, Motor phase V missing
Motor phase V between the frequency converter and the motor is missing.

Troubleshooting

- Remove the power from the frequency converter and check motor phase V.

ALARM 32, Motor phase W missing
Motor phase W between the frequency converter and the motor is missing.

Troubleshooting

- Remove the power from the frequency converter and check motor phase W.

ALARM 33, Inrush fault
Too many power-ups have occurred within a short time period.

Troubleshooting

- Let the unit cool to operating temperature.

WARNING/ALARM 34, Fieldbus communication fault
The fieldbus on the communication option card is not working.

WARNING/ALARM 35, Option fault
This warning is active if the output frequency has reached the high limit (set in *4-53 Warning Speed High*) or low limit (set in *4-52 Warning Speed Low*). In *Process Control, Closed Loop* (*1-00 Configuration Mode*) this warning is displayed.

WARNING/ALARM 36, Mains failure
This warning/alarm is only active if the supply voltage to the frequency converter is lost and *14-10 Mains Failure* is not set to *[0] No Function*. Check the fuses to the frequency converter and mains supply to the unit.

ALARM 38, Internal fault
When an internal fault occurs, a code number defined in *Table 8.4* is displayed.

Troubleshooting

- Cycle the power.
- Check that the option is properly installed.
- Check for loose or missing wiring.

It may be necessary to contact Danfoss Service or the supplier. Note the code number for further trouble-shooting directions.

Number	Text
0	The serial port cannot be initialised. Contact your Danfoss supplier or Danfoss Service.
256–258	The power EEPROM data is defective or too old.
512	The control board EEPROM data is defective or too old.
513	Communication time-out reading EEPROM data
514	Communication time-out reading EEPROM data
515	Application-oriented control cannot recognise the EEPROM data.
516	Cannot write to the EEPROM because a write command is in progress.
517	The write command is under time-out.
518	Failure in the EEPROM.
519	Missing or invalid barcode data in EEPROM.
783	Parameter value outside of minimum/maximum limits.
1024–1279	A CAN telegram could not be sent.
1281	Digital signal processor flash time-out.
1282	Power micro software version mismatch.
1283	Power EEPROM data version mismatch.
1284	Cannot read digital signal processor software version.
1299	The option software in slot A is too old.
1300	The option software in slot B is too old.
1301	The option software in slot C0 is too old.
1302	The option software in slot C1 is too old.
1315	The option software in slot A is not supported (not allowed).
1316	The option software in slot B is not supported (not allowed).
1317	The option software in slot C0 is not supported (not allowed).
1318	The option software in slot C1 is not supported (not allowed).
1379	Option A did not respond when calculating the platform version
1380	Option B did not respond when calculating the platform version.
1381	Option C0 did not respond when calculating the platform version.
1382	Option C1 did not respond when calculating the platform version.
1536	An exception in the application-oriented control is registered. The debug information is written on the LCP.
1792	DSP Watch Dog is active. Debugging of power part data, motor-oriented control data not transferred correctly.
2049	Power data restarted.
2064–2072	H081x: Option in slot x has restarted.
2080–2088	H082x: Option in slot x has issued a power-up wait.
2096–2104	H983x: Option in slot x has issued a legal power-up wait.
2304	Could not read any data from the power EEPROM.
2305	Missing software version from the power unit.
2314	Missing power unit data from the power unit.
2315	Missing software version from the power unit.
2316	Missing lo_statepage from the power unit.
2324	The power card configuration is determined to be incorrect at power-up.
2325	A power card has stopped communicating while mains power is applied.

Number	Text
2326	The power card configuration is determined to be incorrect after the delay for power cards to register.
2327	Too many power card locations have been registered as present.
2330	The power size information between the power cards does not match.
2561	No communication from DSP to ATACD.
2562	No communication from ATACD to DSP (state running).
2816	Stack overflow control board module
2817	Scheduler slow tasks
2818	Fast tasks
2819	Parameter thread
2820	LCP stack overflow
2821	Serial port overflow
2822	USB port overflow
2836	cfListMempool is too small.
3072–5122	The parameter value is outside its limits.
5123	Option in slot A: Hardware incompatible with the control board hardware.
5124	Option in slot B: Hardware incompatible with the control board hardware.
5125	Option in slot C0: Hardware incompatible with the control board hardware.
5126	Option in slot C1: Hardware incompatible with the control board hardware.
5376–6231	Out of memory

Table 8.4 Internal Fault, Code Numbers

ALARM 39, Heat sink sensor
No feedback from the heat sink temperature sensor.

The signal from the IGBT thermal sensor is not available on the power card. The problem could be on the power card, on the gate drive card, or the ribbon cable between the power card and gate drive card.

WARNING 40, Overload of digital output terminal 27
Check the load connected to terminal 27 or remove the short-circuit connection. Check *5-00 Digital I/O Mode* and *5-01 Terminal 27 Mode*.

WARNING 41, Overload of digital output terminal 29
Check the load connected to terminal 29 or remove the short-circuit connection. Check *5-00 Digital I/O Mode* and *parameter 5-02 Terminal 29 Mode*.

WARNING 42, Overload of digital output on X30/6 or overload of digital output on X30/7
For X30/6, check the load connected to X30/6 or remove the short-circuit connection. Check *5-32 Term X30/6 Digi Out (MCB 101)*.

For X30/7, check the load connected to X30/7 or remove the short-circuit connection. Check *5-33 Term X30/7 Digi Out (MCB 101)*.

ALARM 46, Power card supply
The supply on the power card is out of range.

There are 3 power supplies generated by the switch mode power supply (SMPS) on the power card: 24 V, 5 V, and±18 V. When powered with 24 V DC with the MCB 107 option, only the 24 V and 5 V supplies are monitored. When powered with 3-phase mains voltage, all 3 supplies are monitored.

WARNING 47, 24 V supply low
The 24 V DC is measured on the control card. This alarm arises when the detected voltage of terminal 12 is <18 V.

Troubleshooting

- Check for a defective control card.

WARNING 48, 1.8 V supply low
The 1.8 V DC supply used on the control card is outside of the allowable limits. The power supply is measured on the control card. Check for a defective control card. If an option card is present, check for overvoltage.

WARNING 49, Speed limit
When the speed is outside of the specified range in *parameter 4-11 Motor Speed Low Limit [RPM]* and *parameter 4-13 Motor Speed High Limit [RPM]*, the frequency converter shows a warning. When the speed is below the specified limit in *1-86 Trip Speed Low [RPM]* (except when starting or stopping), the frequency converter trips.

ALARM 50, AMA calibration failed
Contact the Danfoss supplier or Danfoss Service.

ALARM 51, AMA check U_{nom} and I_{nom}
The settings for motor voltage, motor current and motor power are wrong. Check the settings in *parameters 1-20* to *1-25*.

ALARM 52, AMA low I_{nom}
The motor current is too low. Check the settings.

ALARM 53, AMA motor too big
The motor is too big for the AMA to operate.

ALARM 54, AMA motor too small
The motor is too small for the AMA to operate.

ALARM 55, AMA parameter out of range
The parameter values of the motor are outside of the acceptable range. AMA cannot run.

ALARM 56, AMA interrupted by user
The user has interrupted the AMA.

ALARM 57, AMA internal fault
Continue to restart the AMA, until the AMA is carried out.

NOTICE

Repeated runs may heat the motor to a level where the resistance R_s and R_r are increased. In most cases, however, this behaviour is not critical.

ALARM 58, AMA Internal fault
Contact your Danfoss supplier.

WARNING 59, Current limit
The current is higher than the value in *4-18 Current Limit*. Ensure that motor data in *parameters 1–20* to *1–25* are set correctly. Increase the current limit if necessary. Ensure that the system can operate safely at a higher limit.

WARNING 60, External interlock
External interlock has been activated. To resume normal operation, apply 24 V DC to the terminal programmed for external interlock and reset the frequency converter (via serial communication, digital I/O, or by pressing [Reset]).

WARNING 62, Output frequency at maximum limit
The output frequency is higher than the value set in *4-19 Max Output Frequency*.

ALARM 64, Voltage Limit
The load and speed combination demands a motor voltage higher than the actual DC-link voltage.

WARNING/ALARM 65, Control card over temperature
The cut-out temperature of the control card is 80 °C.

Troubleshooting

- Check that the ambient operating temperature is within the limits.
- Check for clogged filters.
- Check the fan operation.
- Check the control card.

WARNING 66, Heat sink temperature low
The frequency converter is too cold to operate. This warning is based on the temperature sensor in the IGBT module.
Increase the ambient temperature of the unit. Also, a trickle amount of current can be supplied to the frequency converter whenever the motor is stopped by setting *parameter 2-00 DC Hold/Preheat Current* at 5% and *parameter 1-80 Function at Stop*.

Troubleshooting
The heat sink temperature measured as 0 °C could indicate that the temperature sensor is defective, causing the fan speed to increase to the maximum. This warning results if the sensor wire between the IGBT and the gate drive card is disconnected. Also, check the IGBT thermal sensor.

ALARM 67, Option module configuration has changed
One or more options have either been added or removed since the last power-down. Check that the configuration change is intentional and reset the unit.

ALARM 68, Safe Stop activated
STO has been activated. To resume normal operation, apply 24 V DC to terminal 37, then send a reset signal (via bus, digital I/O, or by pressing [Reset].

ALARM 69, Power card temperature
The temperature sensor on the power card is either too hot or too cold.

Troubleshooting

- Check the operation of the door fans.
- Check that the filters for the door fans are not blocked.
- Check that the gland plate is properly installed on IP21/IP54 (NEMA 1/12) frequency converters.

ALARM 70, Illegal FC configuration
The control card and power card are incompatible. To check compatibility, contact your Danfoss supplier with the type code of the unit from the nameplate and the part numbers of the cards.

ALARM 72, Dangerous failure
STO with trip lock. Unexpected signal levels on safe stop and digital input from the VLT® PTC Thermistor Card MCB 112.

WARNING 73, Safe Stop auto restart
Safe stopped. With automatic restart enabled, the motor could start when the fault is cleared.

WARNING 76, Power unit setup
The required number of power units does not match the detected number of active power units.

WARNING 77, Reduced power mode
The frequency converter is operating in reduced power mode (less than the allowed number of inverter sections). This warning is generated on power cycle when the frequency converter is set to run with fewer inverters and remains on.

ALARM 79, Illegal power section configuration
The scaling card has an incorrect part number or is not installed. The MK102 connector on the power card could not be installed.

ALARM 80, Drive initialised to default value
Parameter settings are initialised to default settings after a manual reset. To clear the alarm, reset the unit.

ALARM 91, Analog input 54 wrong settings
Switch S202 has to be set in position OFF (voltage input) when a KTY sensor is connected to analog input terminal 54.

ALARM 92, No flow
A no-flow condition has been detected in the system. *parameter 22-23 No-Flow Function* is set for alarm.

Troubleshooting

- Troubleshoot the system and reset the frequency converter after the fault has been cleared.

ALARM 93, Dry pump
A no-flow condition in the system with the frequency converter operating at high speed may indicate a dry pump. *parameter 22-26 Dry Pump Function* is set for alarm. Troubleshoot the system and reset the frequency converter after the fault has been cleared.

ALARM 94, End of curve
Feedback is lower than the set point. This may indicate leakage in the system. *22-50 End of Curve Function* is set for alarm.

Troubleshooting

- Troubleshoot the system and reset the frequency converter after the fault has been cleared.

ALARM 95, Broken belt
Torque is below the torque level set for no load, indicating a broken belt. *Parameter 22-60 Broken Belt Function* is set for alarm.

Troubleshooting

- Troubleshoot the system and reset the frequency converter after the fault has been cleared.

ALARM 96, Start delayed
Motor start has been delayed due to short-cycle protection. *Parameter 22-76 Interval between Starts* is enabled.

Troubleshooting

- Troubleshoot the system and reset the frequency converter after the fault has been cleared.

WARNING 97, Stop delayed
Stopping the motor has been delayed due to short -cycle protection. *Parameter 22-76 Interval between Starts* is enabled.

Troubleshooting

- Troubleshoot the system and reset the frequency converter after the fault has been cleared.

WARNING 98, Clock fault
Time is not set or the RTC clock has failed.

Troubleshooting

- Reset the clock in *0-70 Date and Time*.

WARNING 201, Fire mode was active
This indicates the frequency converter had entered fire mode. Cycle power to the unit to remove the warning. See the fire mode data in the alarm log.

WARNING 202, Fire mode limits exceeded
While operating in fire mode one or more alarm conditions have been ignored which would normally trip the unit. Operating in this condition voids unit warranty. Cycle power to the unit to remove the warning. See the fire mode data in the alarm log.

WARNING 203, Missing motor
With a frequency converter operating multi-motors, an under-load condition was detected. This could indicate a missing motor. Inspect the system for proper operation.

WARNING 204, Locked rotor
With a frequency converter operating multi-motors, an overload condition was detected. This could indicate a locked rotor. Inspect the motor for proper operation.

ALARM 243, Brake IGBT
This alarm is only for enclosure size F frequency converters. It is equivalent to Alarm 27. The report value in the alarm log indicates which power module generated the alarm:

1 = Left most inverter module.

2 = Middle inverter module in enclosure sizes F12 or F3.

2 = Right inverter module in enclosure sizes F10 or F11.

2 = Second frequency converter from the left inverter module in enclosure size F14.

3 = Right inverter module in enclosure sizes F12 or F13.

3 = Third from the left intverter module in enclosure size F14.

4 = Far right inverter module in enclosure size F14.

5 = Rectifier module.

6 = Right rectifier module in enclosure size F14.

ALARM 244, Heat Sink temperature
This alarm is only for enclosure type F frequency converters. It is equivalent to Alarm 29. The report value in the alarm log indicates which power module generated the alarm:

1 = Left most inverter module.

2 = Middle inverter module in enclosure size F12 or F3.

2 = Right inverter module in enclosure size F10 or F11.

2 = Second frequency converter from the left inverter module in enclosure size F14.

3 = Rght inverter module in enclosure sizes F12 or F13.

3 = Tird from the left intverter module in enclosure size F14.

4 = Far right inverter module in enclosure sizes F14.

5 = Rectifier module.

6 = Right rectifier module in enclosure sizes F14.

ALARM 245, Heat Sink sensor
This alarm is only for enclosure size F frequency converters. It is equivalent to Alarm 39. The report value in the alarm log indicates which power module generated the alarm:

1 = Left most inverter module.

2 = Middle inverter module in enclosure sizes F12 or F13.

2 = Right inverter module in enclosure sizes F10 or F11.

2 = Second frequency converter from the left inverter module in enclosure size F14.

3 = Right inverter module in enclosure sizes F12 or F13.

3 = Third from the left inverter module in enclosure size F14.

4 = Far right inverter module in enclosure size F14.

5 = Rectifier module.

6 = Right rectifier module in enclosure size F14.

ALARM 246, Power card supply
This alarm is only for enclosure size F frequency converters. It is equivalent to Alarm 46. The report value in the alarm log indicates which power module generated the alarm:

1 = Left most inverter module.

2 = Middle inverter module in enclosure sizes F12 or F13.

2 = Right inverter module in enclosure sizes F10 or F11.

2 = Second frequency converter from the left inverter module in enclosure size F14.

3 = Right inverter module in enclosure sizes F12 or F13.

3 = Third from the left inverter module in enclosure size F14.

4 = Far right inverter module in enclosure size F14.

5 = Rectifier module.

6 = Right rectifier module in enclosure size F14.

ALARM 247, Power card temperature
This alarm is only for enclosure size F frequency converters. It is equivalent to Alarm 69. The report value in the alarm log indicates which power module generated the alarm:

1 = Left most inverter module.

2 = Middle inverter module in enclosure sizes F12 or F13.

2 = Right inverter module in enclosure sizes F10 or F11.

2 = Second frequency converter from the left inverter module in enclosure size F14.

3 = Right inverter module in enclosure sizes F12 or F13.

3 = Third from the left inverter module in enclosure size F14.

4 = Far right inverter module in enclosure size F14.

5 = Rectifier module.

6 = Right rectifier module in enclosure size F14.

ALARM 248, Illegal power section configuration
This alarm is only for enclosure size F frequency converters. It is equivalent to Alarm 79. The report value in the alarm log indicates which power module generated the alarm:

1 = Left most inverter module.

2 = Middle inverter module in enclosure sizes F12 or F13.

2 = Right inverter module in enclosure sizes F10 or F11.

2 = Second frequency converter from the left inverter module in enclosure size F14.

3 = Right inverter module in enclosure sizes F12 or F13.

3 = Third from the left inverter module in enclosure sizes F14.

4 =Ffar right inverter module in enclosure sizes F14.

5 = Rectifier module.

6 = Right rectifier module in enclosure size F14.

WARNING 250, New spare part
A component in the frequency converter has been replaced.

Troubleshooting

- Reset the frequency converter for normal operation.

WARNING 251, New typecode
The power card or other components have been replaced and the typecode changed.

Troubleshooting

- Reset to remove the warning and resume normal operation.

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