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Operating Instructions

VLT® AutomationDrive FC 302

250-1400 kW

www.danfoss.com/drives

VLT® THE REAL DRIVE

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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 Instructions* entails instructions on how to handle the frequency converter in a safe way.
- *Chapter 3 How to Install* guides through the mechanical and electrical installations.
- *Chapter 4 How to Programme* explains how to operate and programme the frequency converter via the LCP.
- *Chapter 5 General Specifications* contains technical data about the frequency converter.
- *Chapter 6 Warnings and Alarms* assists in solving problems that may occur when using the frequency converter.

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1.2 Additional Resources

- The *VLT AutomationDrive® 90–1200 kW Operating Instructions* provide the necessary information for getting the frequency converter up and running.
- The *VLT AutomationDrive® FC 301/302 Design Guide* details all technical information about the frequency converter and customer design and applications.
- The *VLT AutomationDrive® Programming Guide* provides information on how to programme and includes complete parameter descriptions.
- The *VLT AutomationDrive® PROFIBUS Operating Instructions* provide the information required for controlling, monitoring, and programming the frequency converter via a PROFIBUS fieldbus.
- The *VLT AutomationDrive® DeviceNet Operating Instructions* provide the information required for controlling, monitoring, and programming the frequency converter via a DeviceNet fieldbus.

Danfoss technical literature is also available online at *www.danfoss.com/drives*.

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
MG34Q3xx	Replaces MG34Q2xx	7.1x

Table 1.1 Document and Software Version

1.4 Approvals and Certifications

1.4.1 Approvals

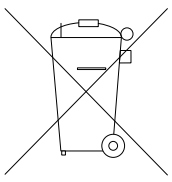
The frequency converter complies with UL508C thermal memory retention requirements. For more information, refer to the section *Motor Thermal Protection* in the product specific *design guide*.

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.

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1.6 Abbreviations 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

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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.

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2 Safety Instructions

2.1 Safety Symbols

The following symbols are used in this document:

⚠WARNING

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

⚠CAUTION

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

NOTICE

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

2.2 Qualified Personnel

Correct and reliable transport, storage, installation, operation, and maintenance are required for the trouble-free and safe operation of the frequency converter. Only qualified personnel 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.

2.3 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.**

⚠WARNING

DISCHARGE TIME

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

1. **Stop the motor.**
2. **Disconnect the AC mains, permanent magnet type motors, and remote DC-link power supplies, including battery back-ups, UPS, and DC-link connections to other frequency converters.**
3. **Wait for the capacitors to discharge fully before performing any service or repair work. The duration of waiting time is specified in *Table 2.1*.**

Voltage [V]	Minimum waiting time (minutes)	
	40	30
380-500	250–800 kW	–
525-690	–	355–1400 kW
High voltage may be present even when the warning LED indicator lights are off.		

Table 2.1 Discharge Time

2

⚠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.**

2.3.1 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.

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3 How to Install

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 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.

3.1.3 Improper Unit Lift!

Always lift the frequency converter via the dedicated lifting eyes.

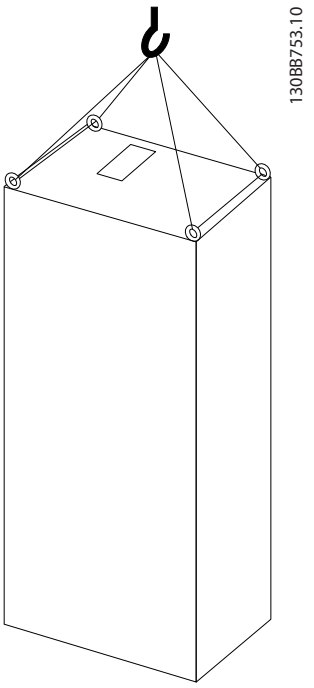

Illustration 3.1 Recommended Lifting Method, Enclosure Size F8.

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3

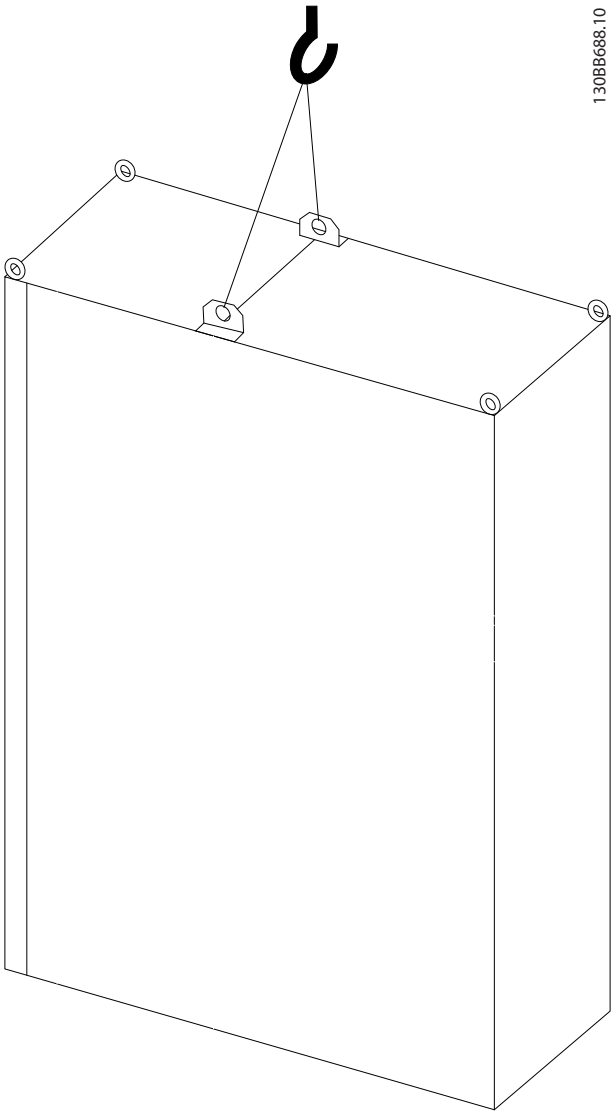

Illustration 3.2 Recommended Lifting Method, Enclosure Size F9/F10.

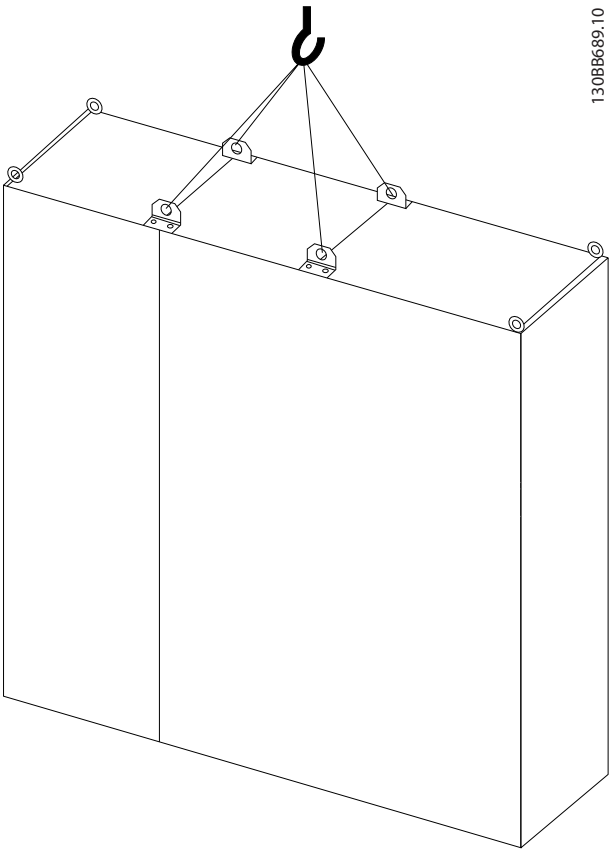

Illustration 3.3 Recommended Lifting Method, Enclosure Size F11/F12/F13/F14.

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.

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3.1.4 Mechanical Dimensions

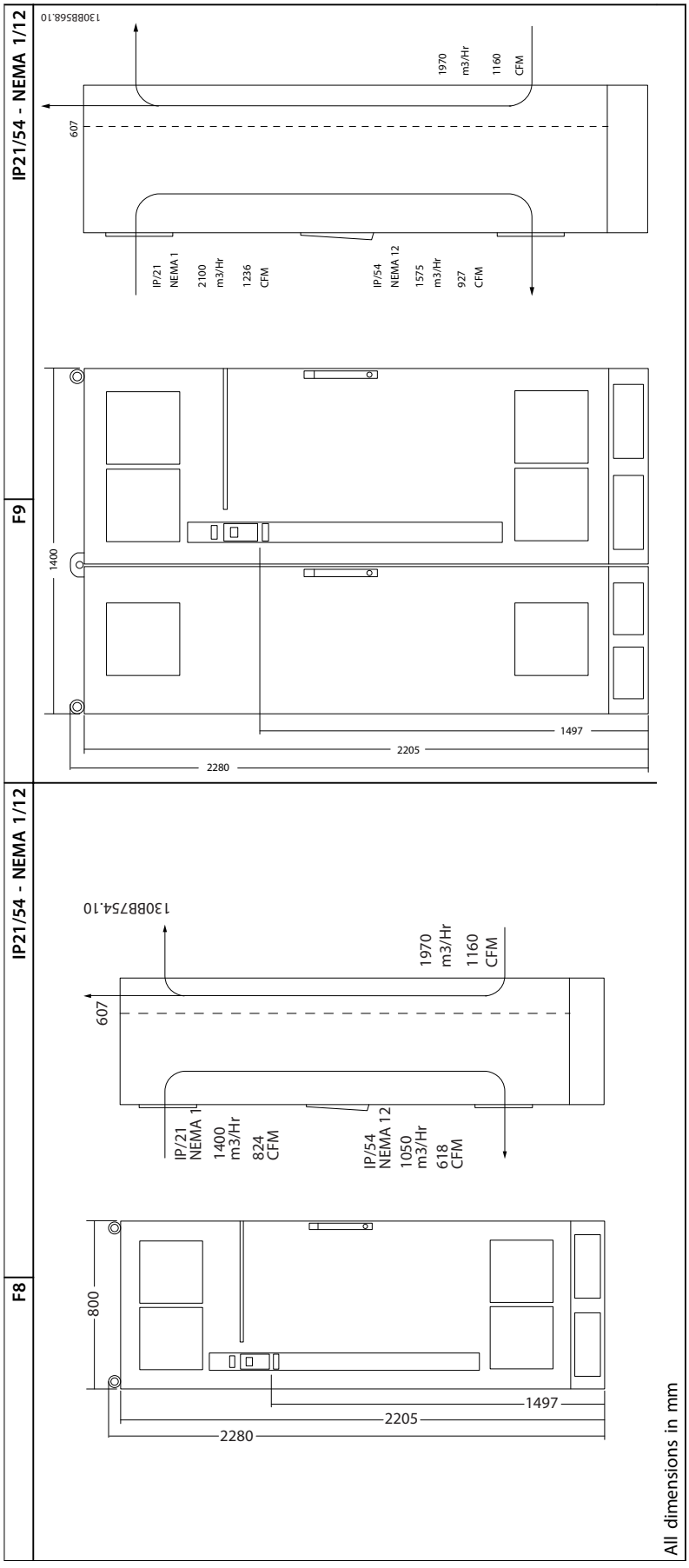

Table 3.1 Mechanical Dimensions, Enclosure Sizes F8 and F9

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3

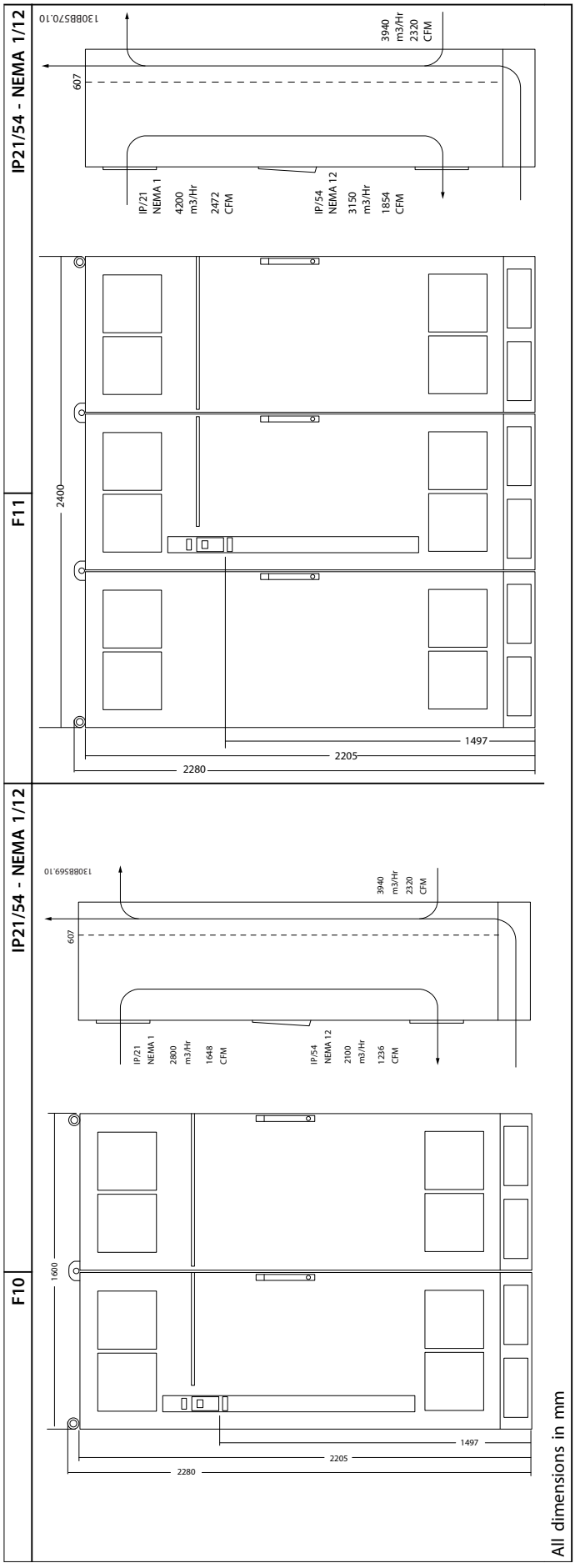

Table 3.2 Mechanical Dimensions, Enclosure Sizes F10 and F 11

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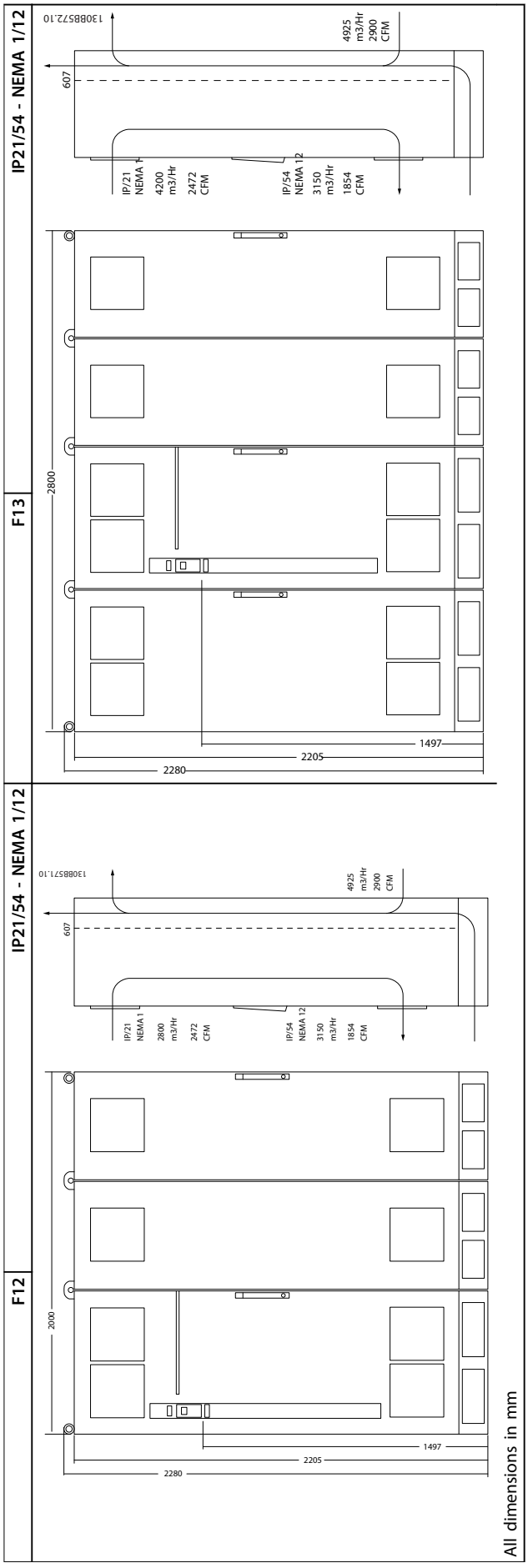

Table 3.3 Mechanical Dimensions, Enclosure Sizes F12 and F13

3

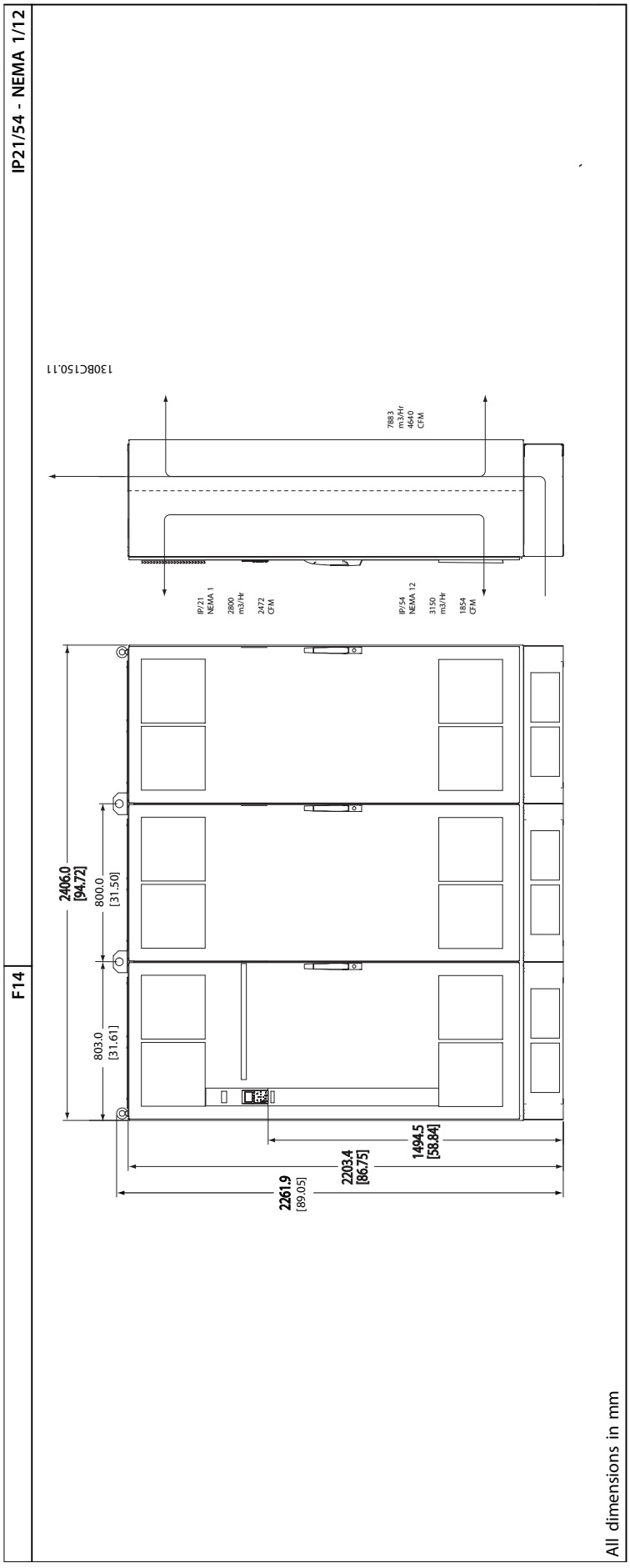

Table 3.4 Mechanical Dimensions, Enclosure Size F14

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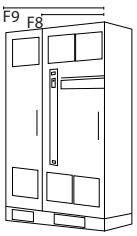
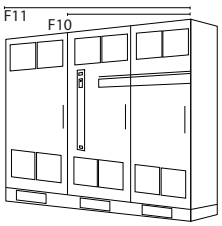
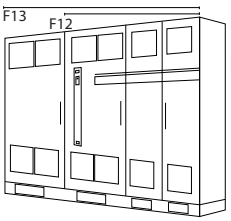
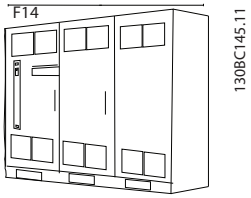
Enclosure size	F8	F9	F10	F11	F12	F13	F14
							
High overload rated power - 160% overload torque	**250-400 kW (380-500 V) 355-560 kW (525-690 V)**	**250-400 kW (380-500 V) 355-56 kW (525-690 V)**	**450-630 kW (380-500 V) 630-800 kW (525-690 V)**	**710-800 kW (380-500 V) 900-1200 kW (525-690 V)**	**450-630 kW (380-500 V) 630-800 kW (525-690 V)**	**710-800 kW (380-500 V) 900-1200 kW (525-690 V)**	**1400 kW (525-690 V)**
IP	21, 54	21, 54	21, 54	21, 54	21, 54	21, 54	21, 54
NEMA	12	12	12	12	12	12	Type 12
Shipping dimensions [mm]							
Height	2324	2324	2324	2324	2324	2324	2362
Width	970	1568	1760	2559	2160	2960	2578
Depth	1130	1130	1130	1130	1130	1130	1130
Frequency converter dimensions [mm]							
Height	2204	2204	2204	2204	2204	2204	2262
Width	800	1400	1600	2400	2000	2800	2400
Depth	606	606	606	606	606	606	608
Max weight [kg]	440	656	880	1096	1022	1238	1410

Table 3.5 Mechanical Dimensions, Enclosure Sizes F8-F14

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*.

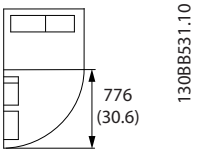


Illustration 3.4 Space in Front of Enclosure Size F8

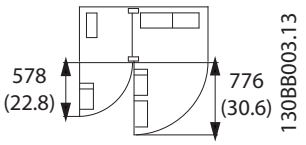


Illustration 3.5 Space in Front of Enclosure Size F9

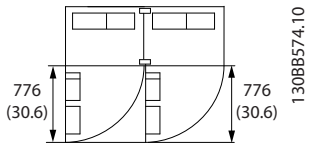


Illustration 3.6 Space in Front of Enclosure Size F10

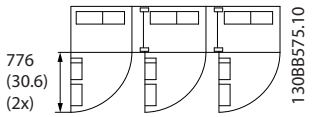


Illustration 3.7 Space in Front of Enclosure Size F11

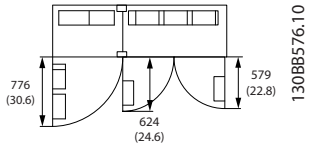


Illustration 3.8 Space in Front of Enclosure Size F12

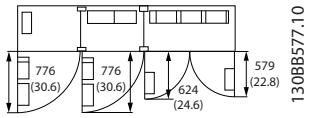


Illustration 3.9 Space in Front of Enclosure Size F13

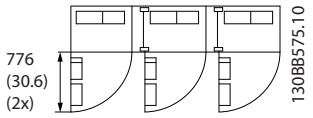


Illustration 3.10 Space in Front of Enclosure Size F14

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.

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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

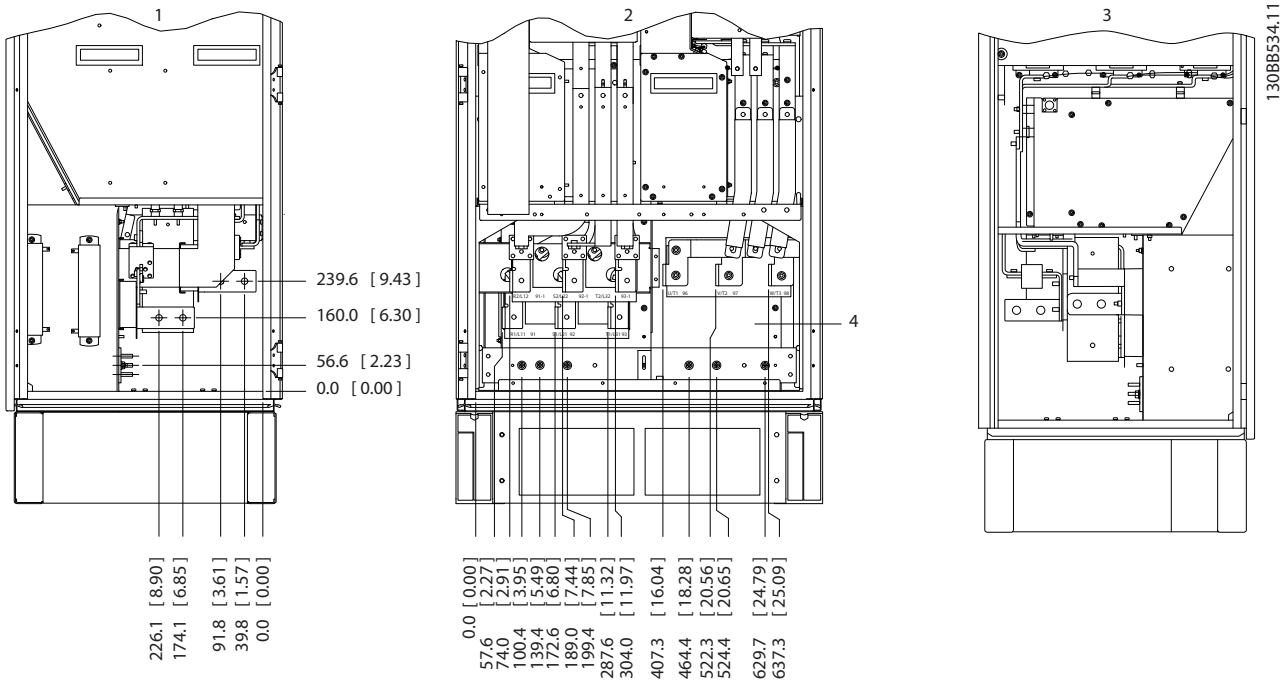

Illustration 3.11 Terminal Locations - Left, Front and Right Views. The gland plate is 42 mm below .0 level.
1) Ground bar

3

3.2.4.2 Inverter, Enclosure Sizes F10 and F11

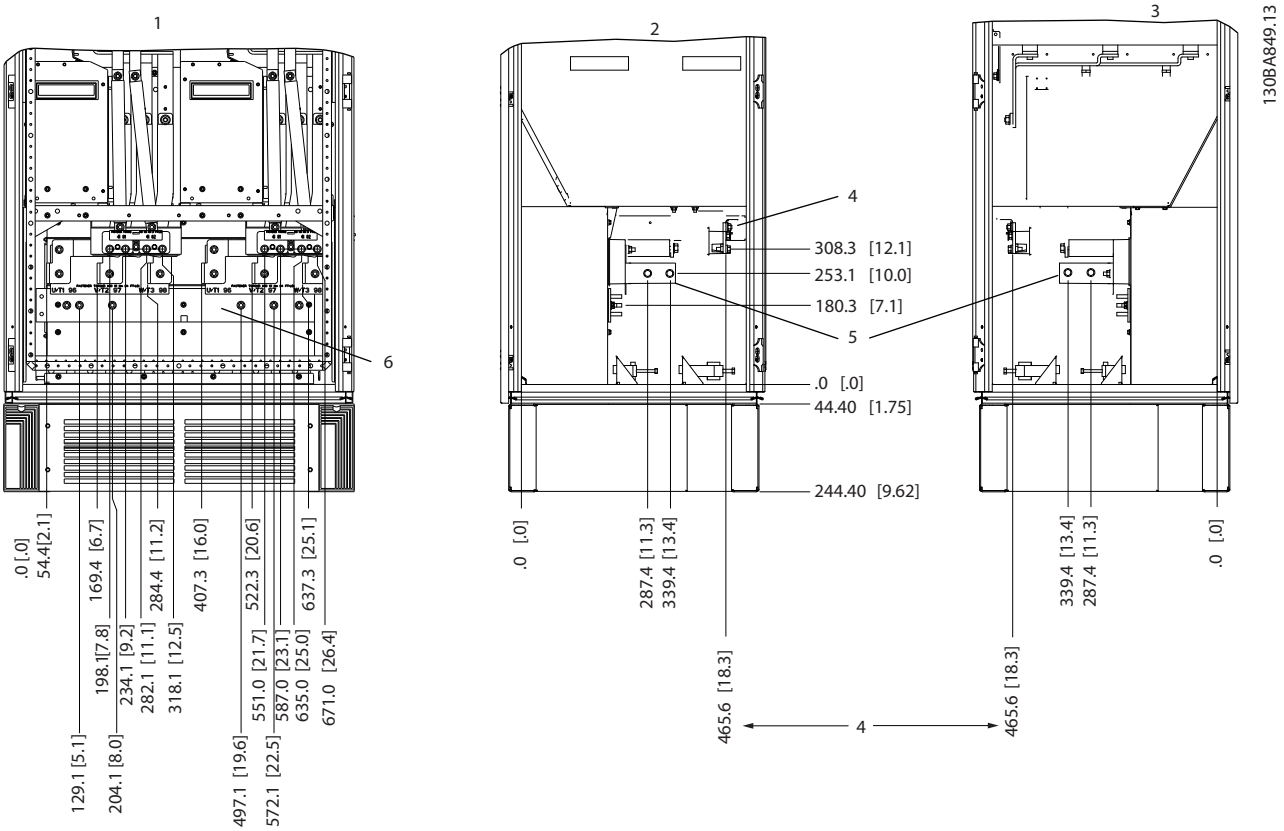

Illustration 3.12 Terminal Locations - Left, Front and Right Views. The gland plate is 42 mm below .0 level.

1) Ground bar

2) Motor terminals

3) Brake terminals

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3.2.4.3 Inverter, Enclosure Sizes F12 and F13

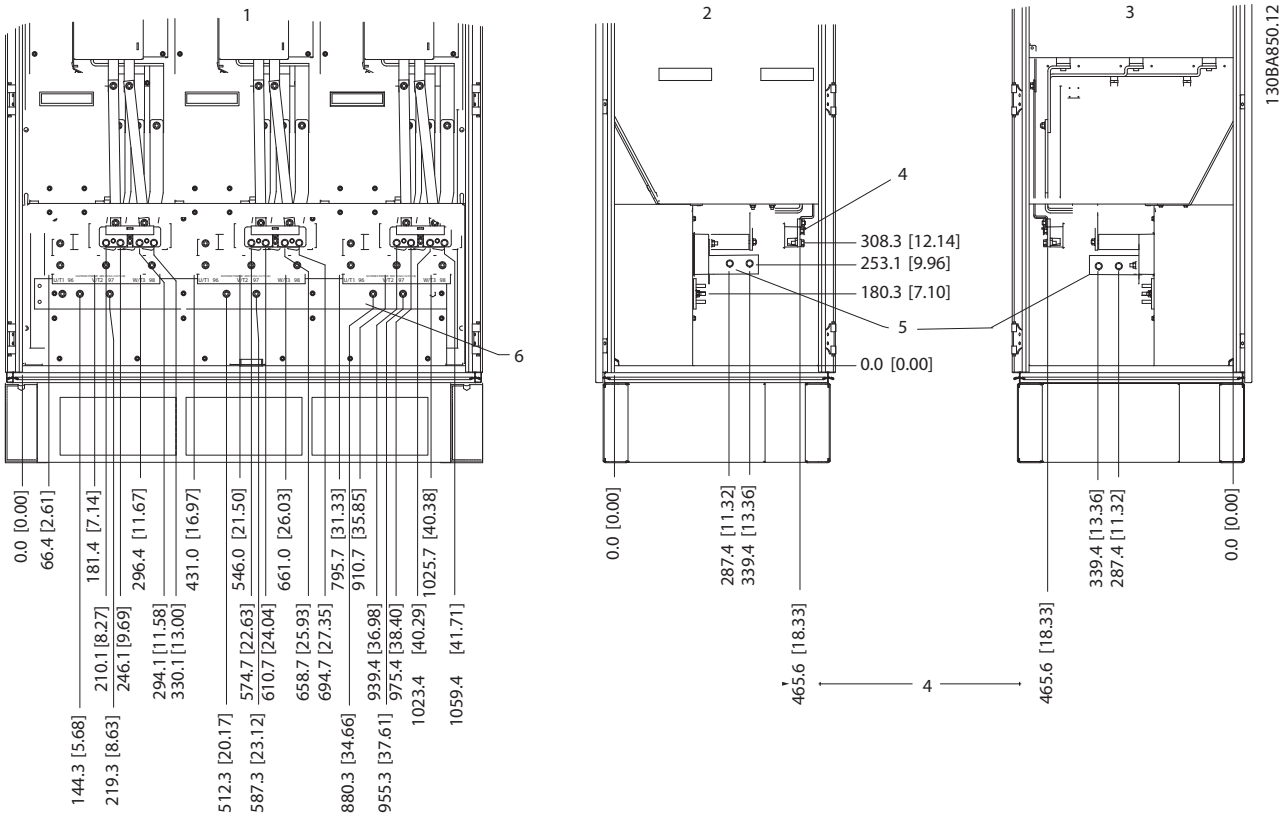

Illustration 3.13 Terminal Locations - Left, Front and Right Views. The gland plate is 42 mm below .0 level.

1) Ground bar

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3.2.4.4 Inverter, Enclosure Size F14

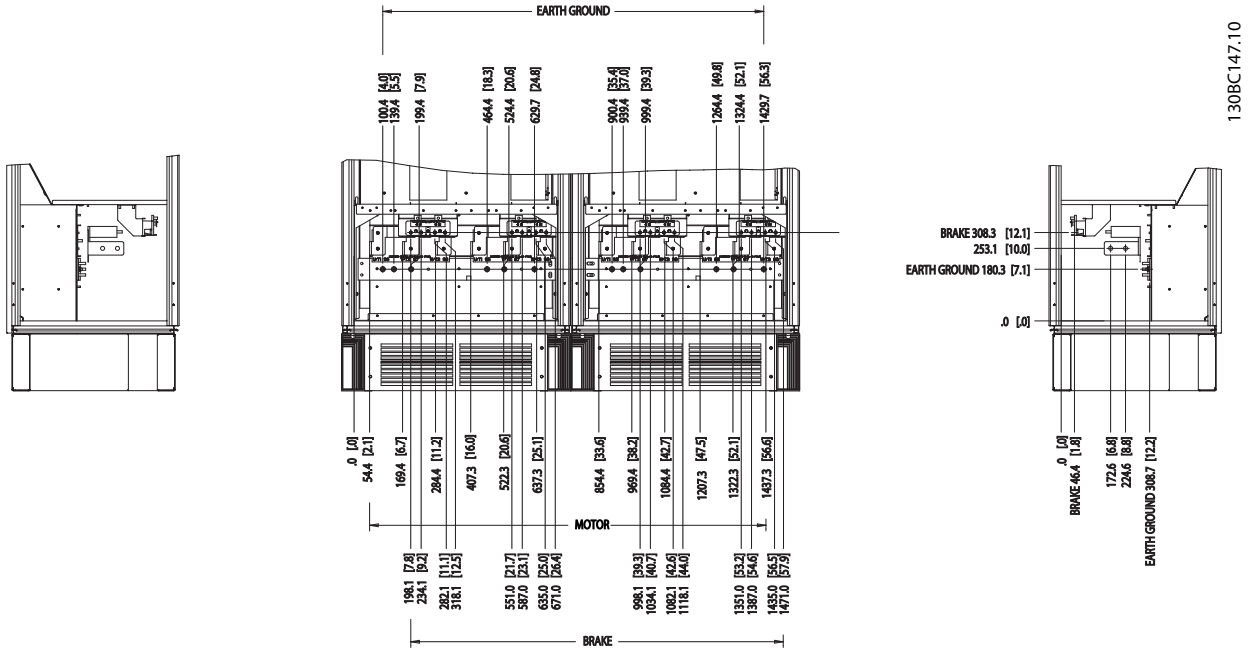

Illustration 3.14 Terminal Locations - Left, Front and Right Views. The gland plate is 42 mm below .0 level.

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

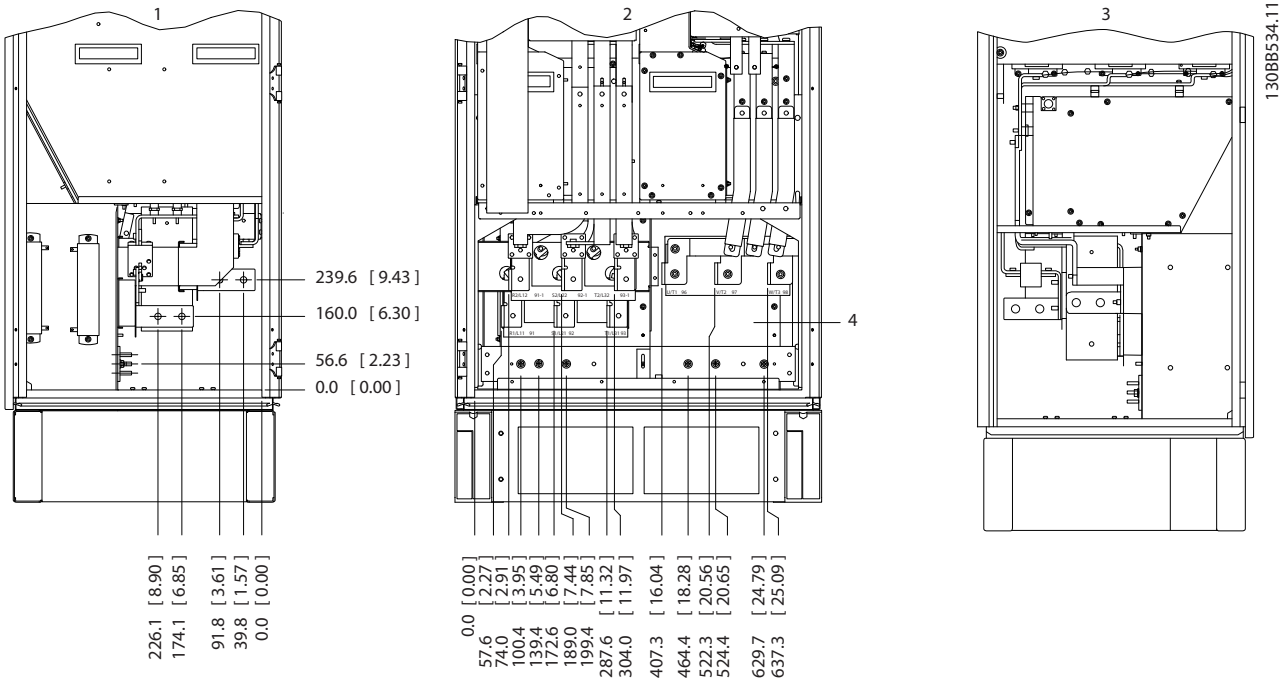

Illustration 3.15 Terminal Locations - Left, Front and Right Views. The gland plate is 42 mm below .0 level.

1) Loadshare Terminal (-)

2) Ground bar

3) Loadshare Terminal (+)

3.2.4.6 Rectifier, Enclosure Size F14

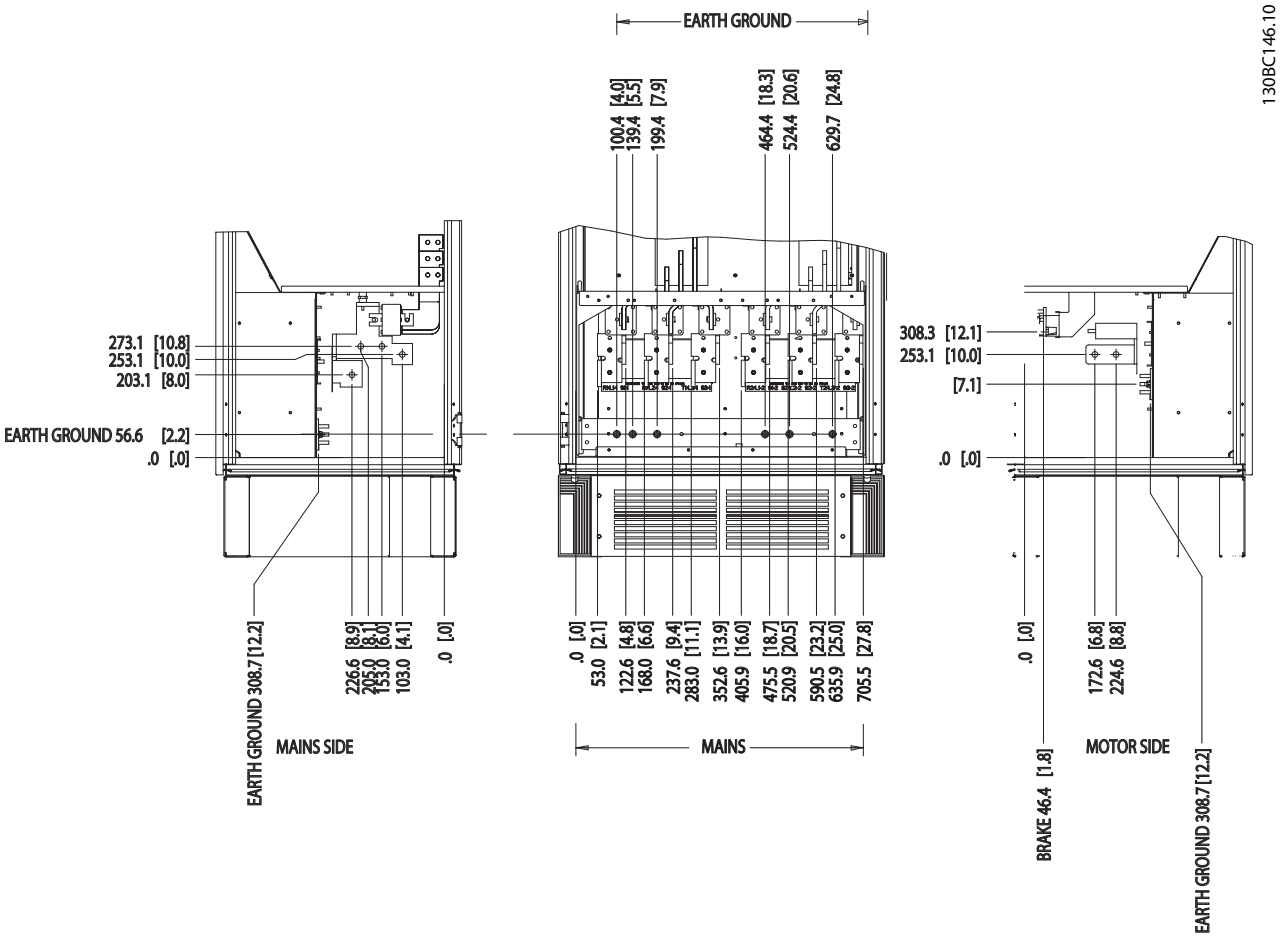

Illustration 3.16 Terminal Locations - Left, Front and Right Views. The gland plate is 42 mm below .0 level.

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3.2.4.7 Options Cabinet, Enclosure Size F9

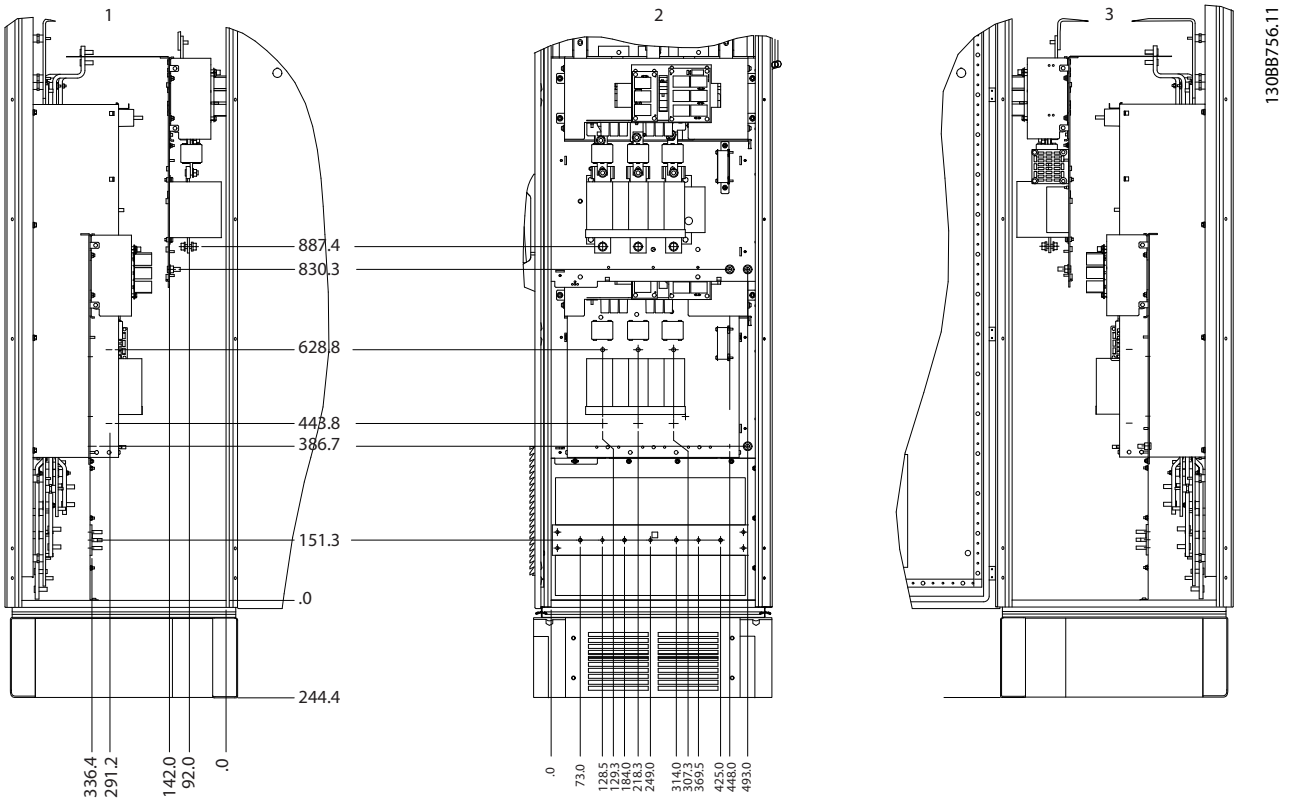

Illustration 3.17 Terminal Locations - Left, Front and Right Views

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3.2.4.8 Options Cabinet, Enclosure Sizes F11/F13

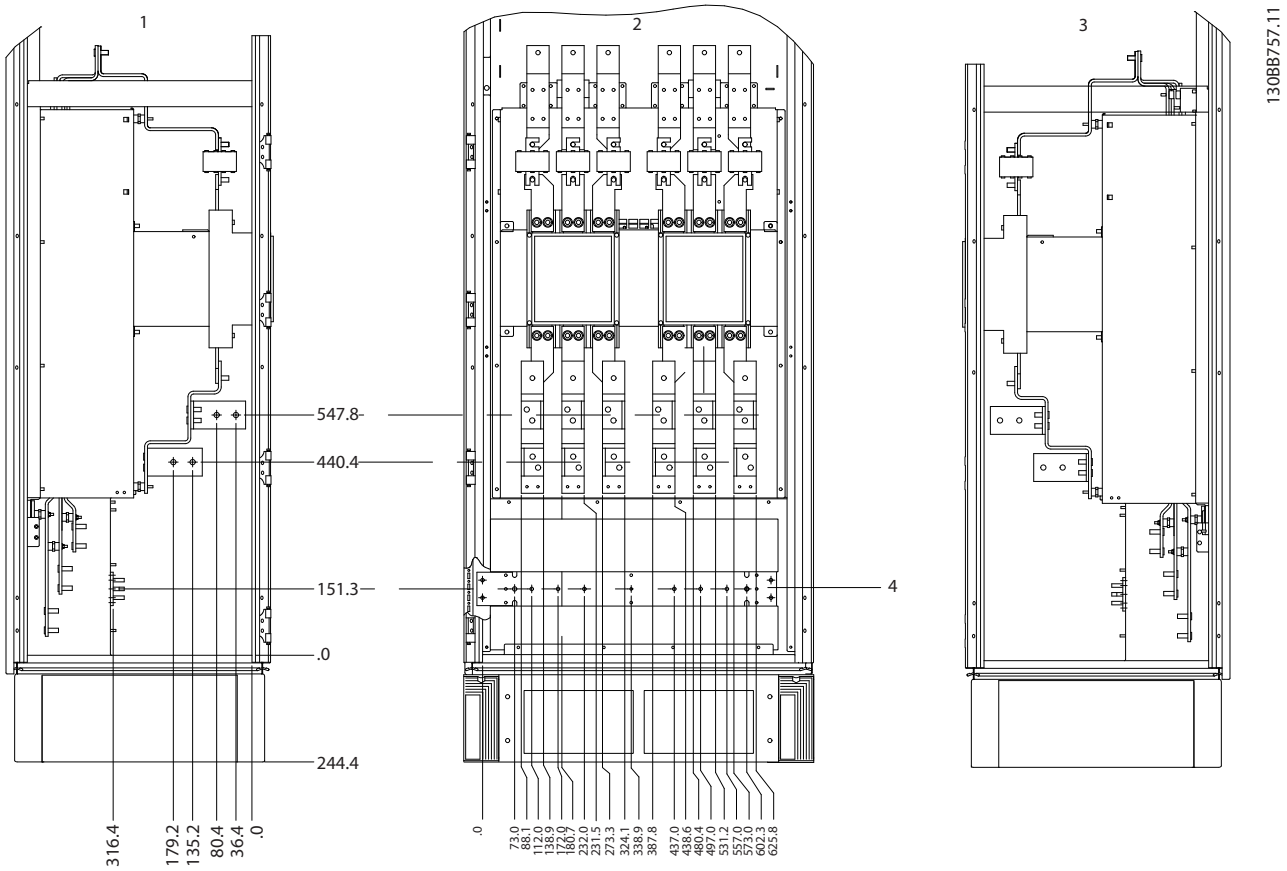

Illustration 3.18 Terminal Locations - Left, Front and Right Views

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 3.6*.

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 3.6 Heat Sink Air Flow

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

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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*.

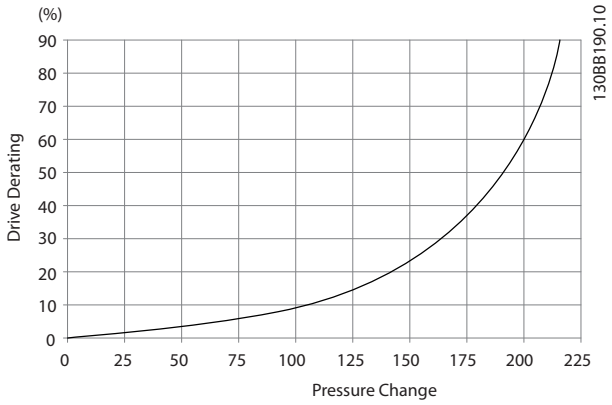

Illustration 3.19 Enclosure Size F, Derating vs. Pressure Change (Pa)
Drive air flow: 985 m^3/h (580 cfm)

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 3.7* and *Table 3.8*.

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

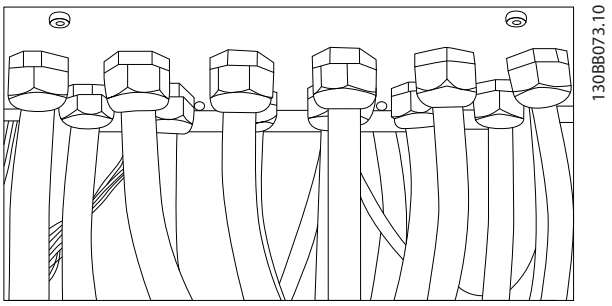

Illustration 3.20 Example of Proper Installation of the Gland Plate.

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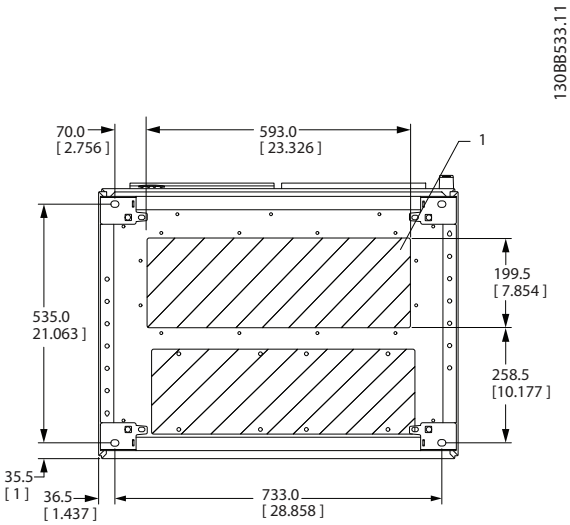
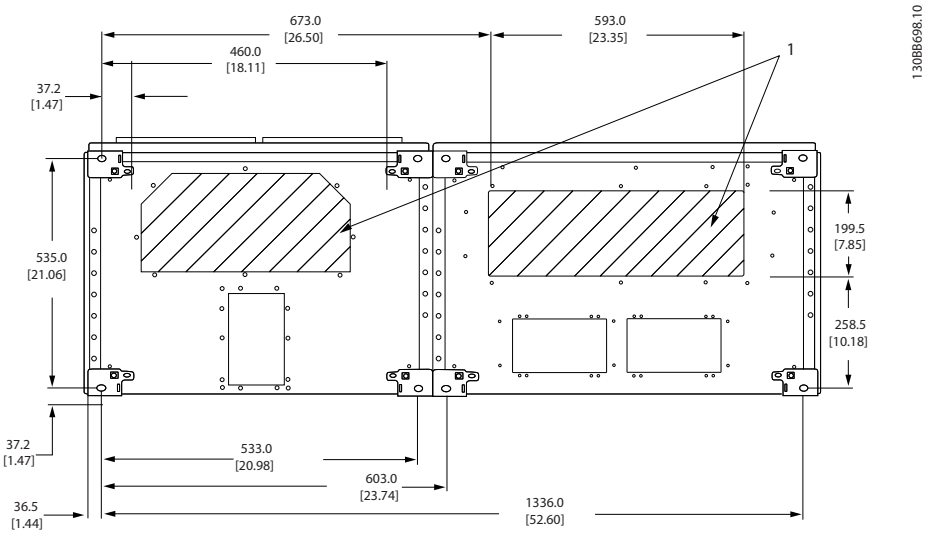
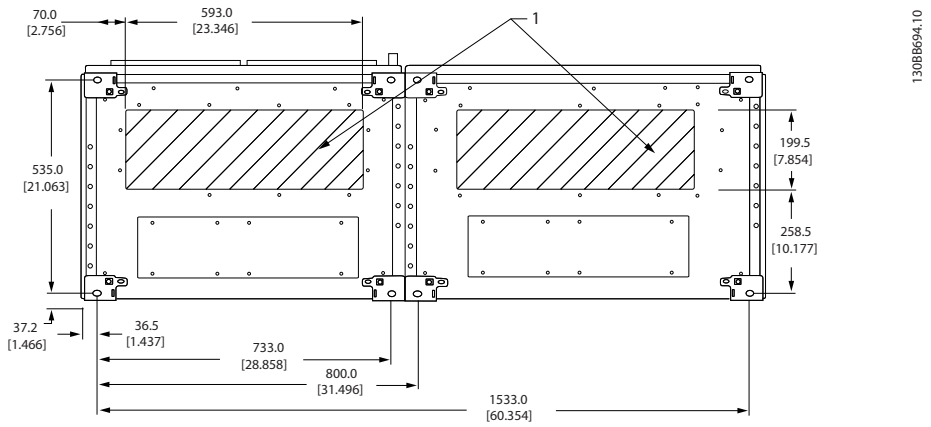
Enclosure Size F8



Enclosure Size F9



Enclosure Size F10



1 Place conduits in marked areas

Table 3.7 F8-F10: Cable Entries Viewed from the Bottom of the Frequency Converter

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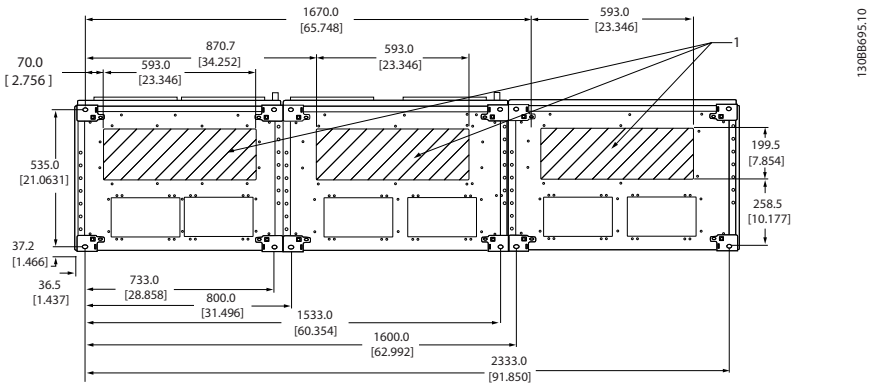
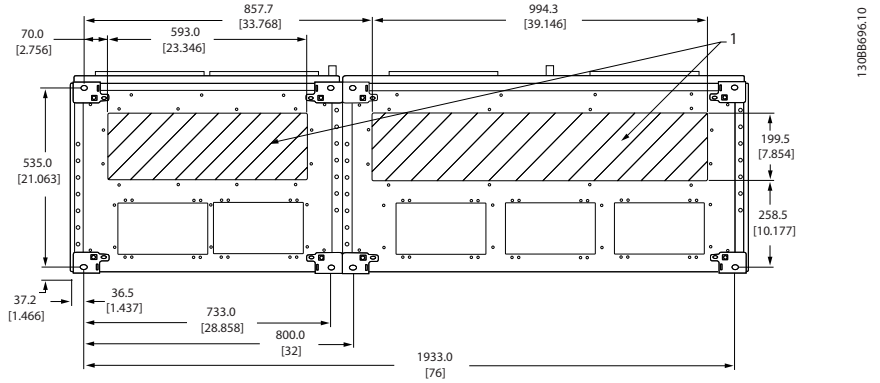
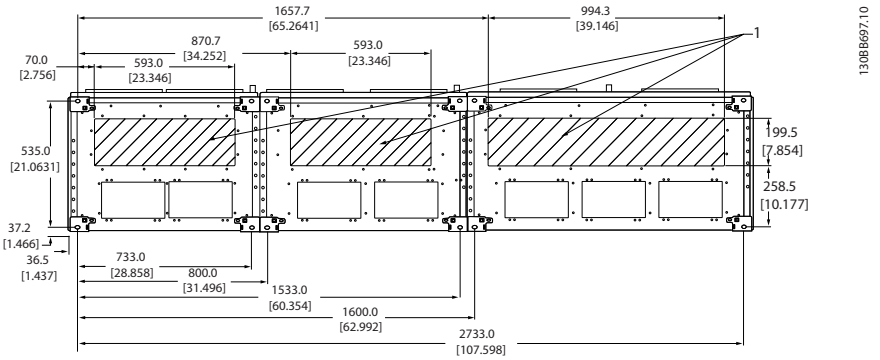
Enclosure Size F11



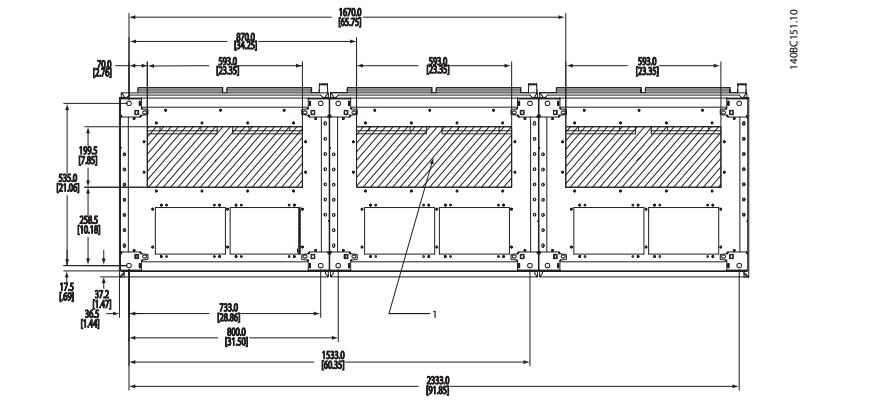
Enclosure Size F12



Enclosure Size F13



Enclosure Size F 14



1 Place conduits in marked areas

Table 3.8 F11-F14: Cable Entries Viewed from the Bottom of the Frequency Converter

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3.3 Installing the 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 3.9* 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 3.21*.

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 3.9 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

3

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.

3.4 Electrical Installation

3.4.1 Transformer Selection

Use the frequency converter with a 12-pulse isolation transformer.

3.4.2 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 3.21*. Dimensioning of the cable cross-section must be done in accordance with the current ratings and local legislation. See *chapter 5.1 Mains Supply* 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 3.4.13 Fuses*. Always ensure that fusing conforms to local regulations.

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

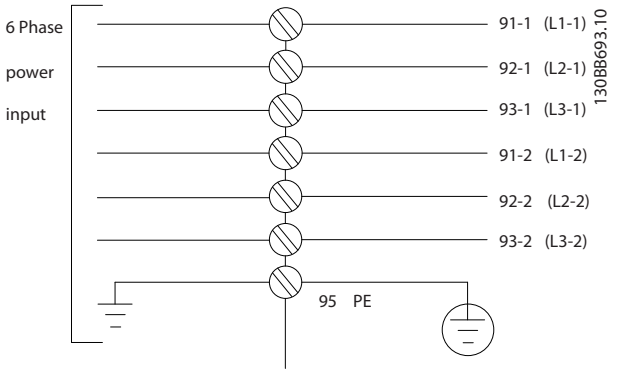

Illustration 3.21 Power Cable Connections

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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 5.1 Mains Supply* for the correct dimensioning of the motor cable cross-section and length.

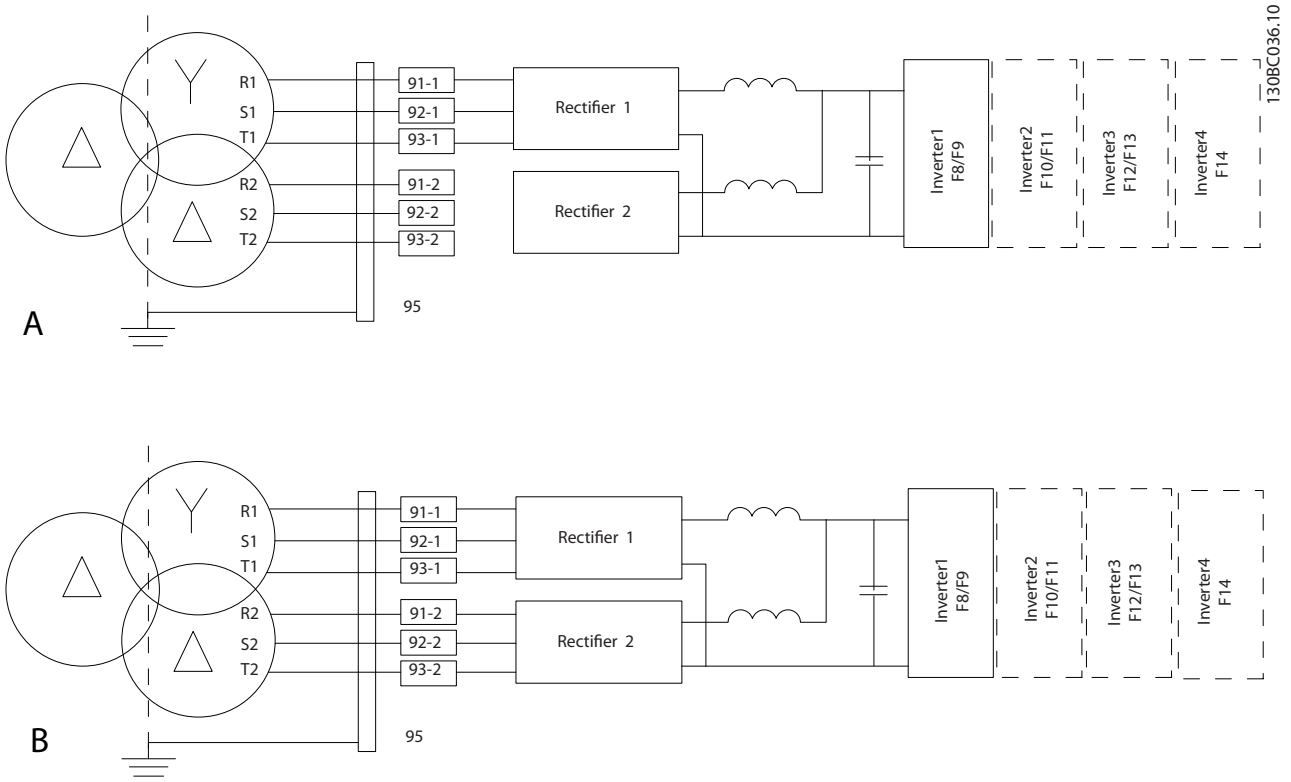

Illustration 3.22 A) Modified 6-Pulse Connection[1), 2), 3)]
B) 12-Pulse Connection[2), 4)]

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.

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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*.

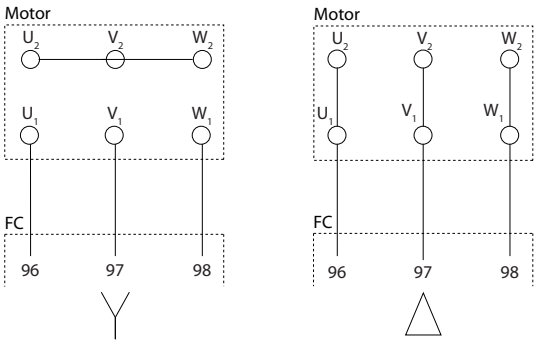
Term. no.				
96	**97**	**98**	**99**	
U	V	W	PE[1)]	Motor voltage 0-100% of mains voltage. 3 wires out of motor
U1	V1	W1	PE[1)]	Delta-connected
W2	U2	V2		6 wires out of motor
U1	V1	W1	PE[1)]	Star-connected U2, V2, W2 U2, V2 and W2 to be interconnected separately.

Table 3.10 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.



175ZA114.11

Illustration 3.23 Star and Delta Connections

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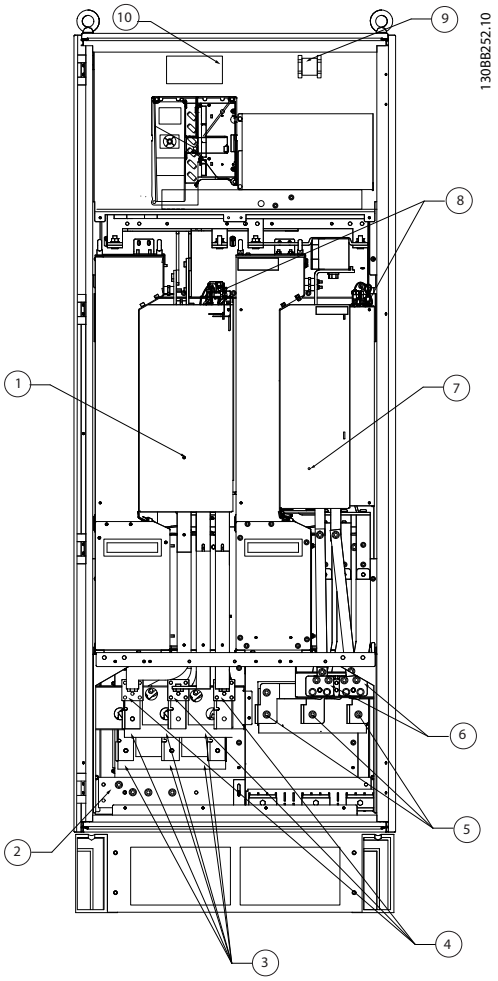
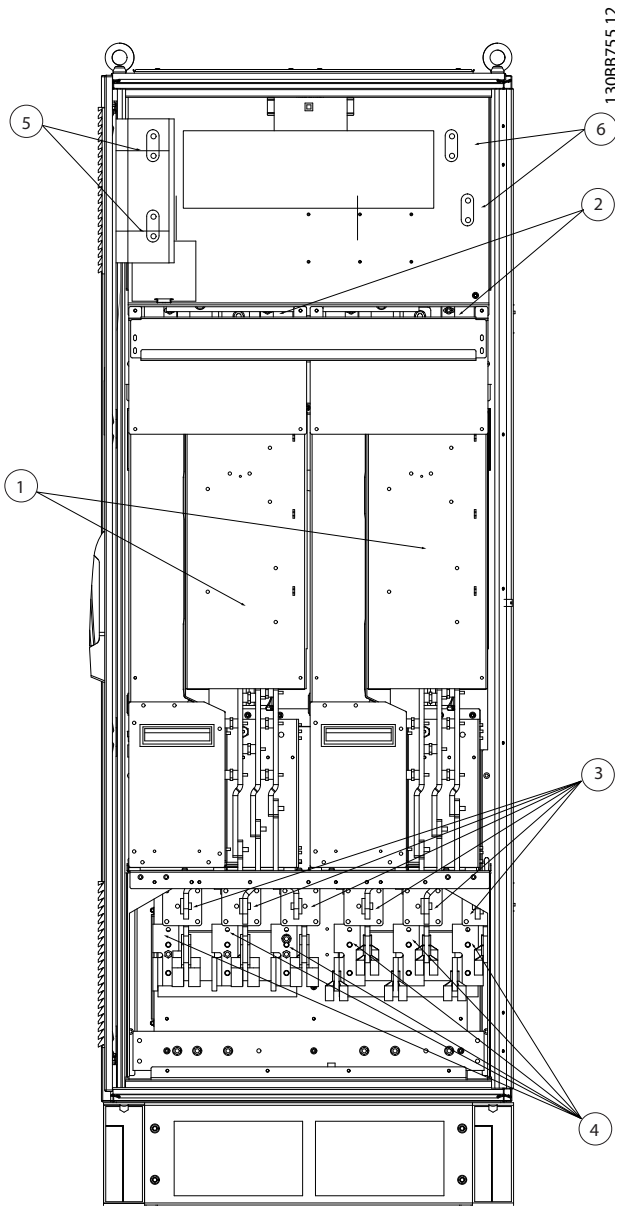


1	12-pulse rectifier module					
2	Ground/earth PE terminals					
3	Mains/fuses					
	R1	S1	T1			
	L1-1	L2-1	L3-1			
	91-1	92-1	93-1			
4	Mains/fuses					
	R2	S2	T2			
	L2-1	L2-2	L3-2			
	91-2	92-2	93-2			
5	Motor connection					
	U	V	W			
	T1	T2	T3			
	96	97	98			
6	Brake terminals					
	-R	+R				
	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 3.24 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 3.25 Rectifier Cabinet, Enclosure Sizes F10 and F12

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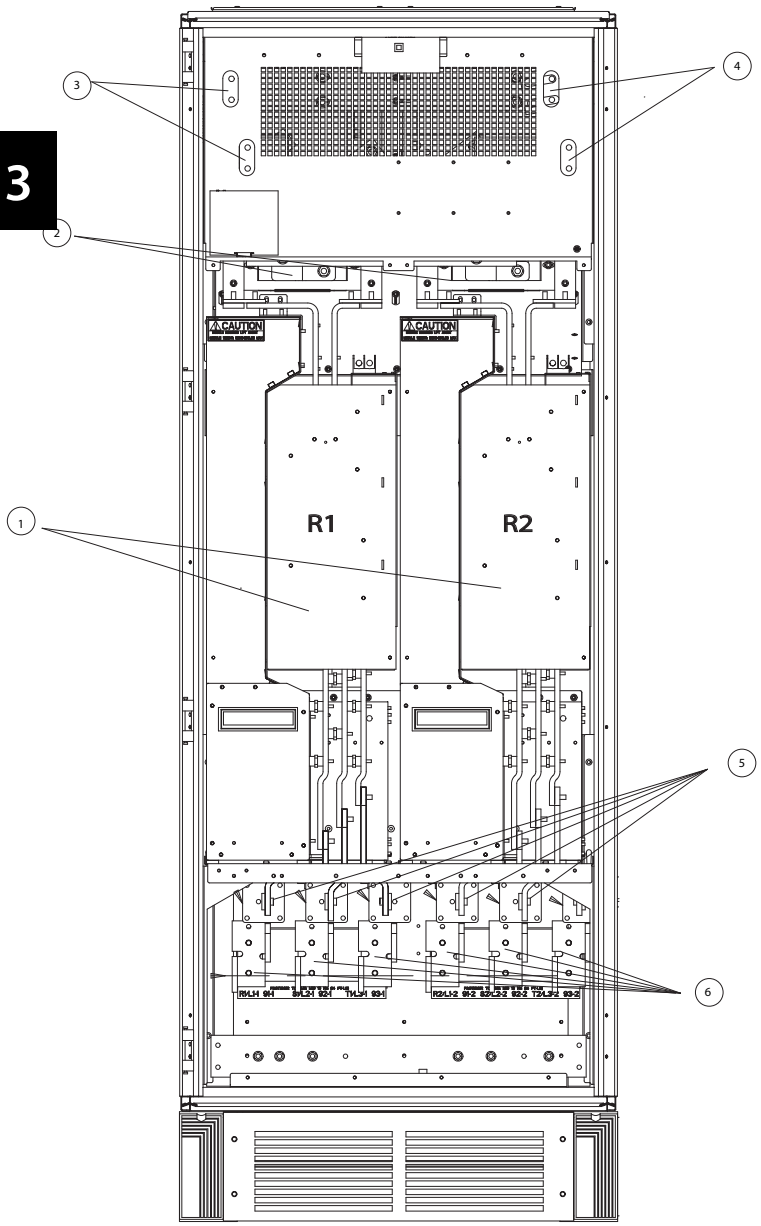
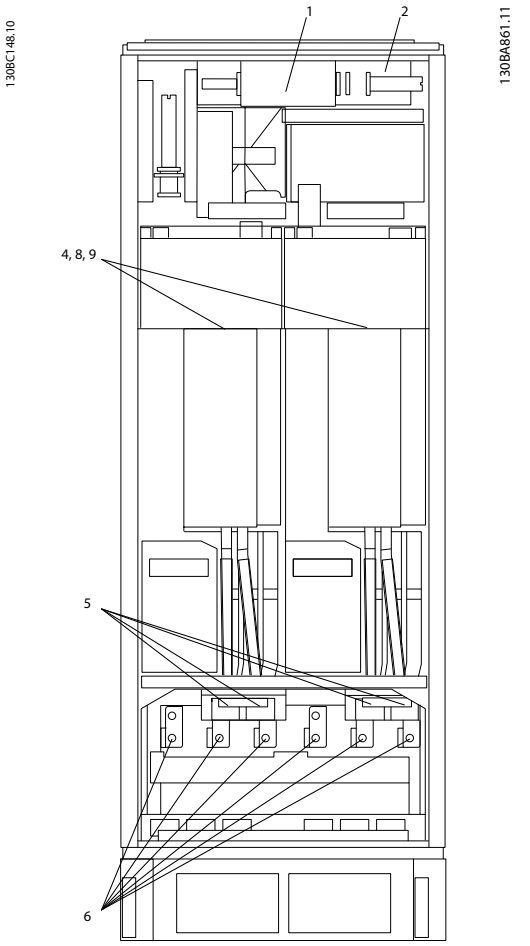


1	12-pulse rectifier modules
2	N/A
3	DC busbar access
4	DC busbar access
	100 101 102 103
	L1 L2 L1 L2
5	Mains fuses (6 pieces)
	-R +R
	81 82
6	Mains
	R1 S1 T1 R2 S2 T2
	L1-1 L2-1 L3-1 L1-2 L2-2 L3-2

Illustration 3.26 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 3.25* for part numbers.
8	Fan fuses. See *Table 3.22* for part numbers.
9	SMPS fuses. See *Table 3.21* for part numbers.

Illustration 3.27 Inverter Cabinet, Enclosure Sizes F10 and F11

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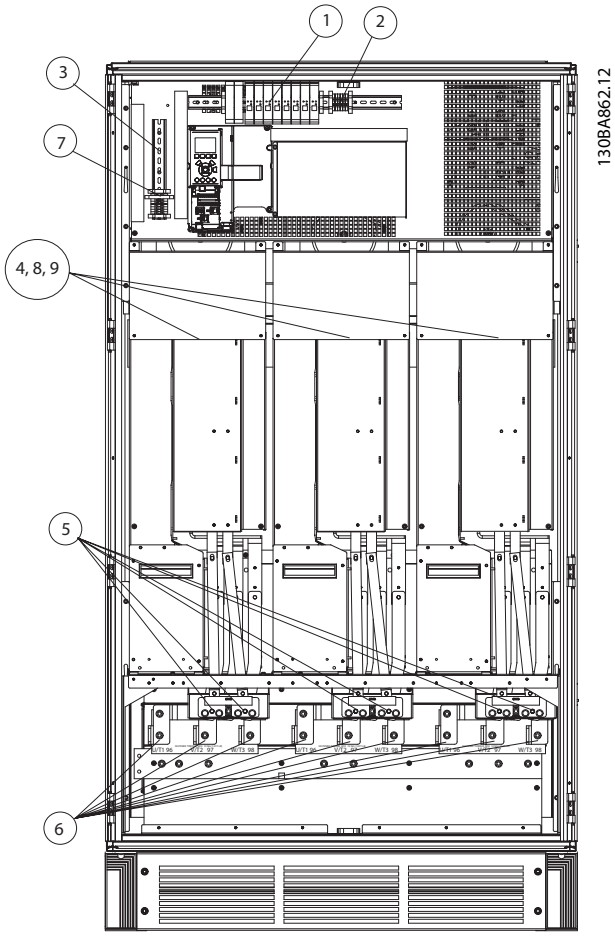
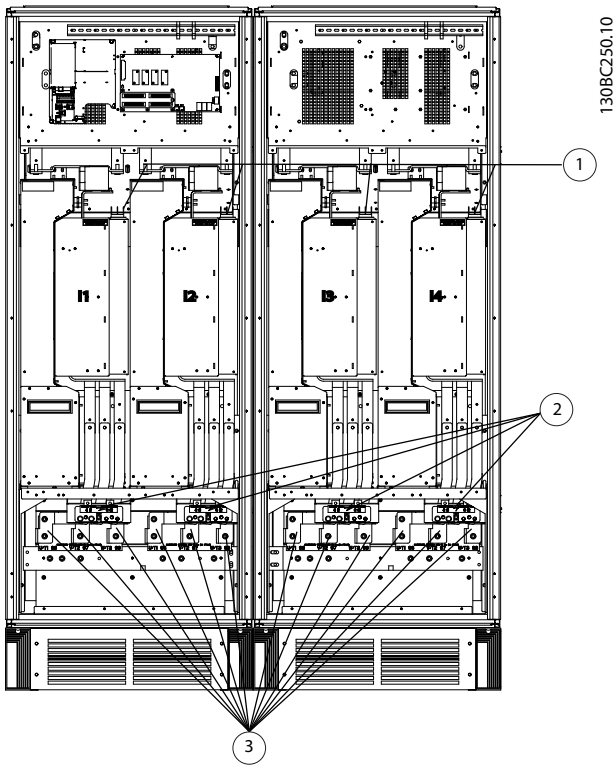


1	External temperature monitoring			
2	AUX relay			
	01	02	03	
	04	05	06	
3	NAMUR			
4	AUX fan			
	100	101	102	103
	L1	L2	L1	L2
5	Brake			
	-R	+R		
	81	82		
6	Motor			
	U	V	W	
	96	97	98	
	T1	T2	T3	
7	NAMUR fuse. See *Table 3.25* for part numbers.			
8	Fan fuses. See *Table 3.22* for part numbers.			
9	SMPS fuses. See *Table 3.21* for part numbers.			

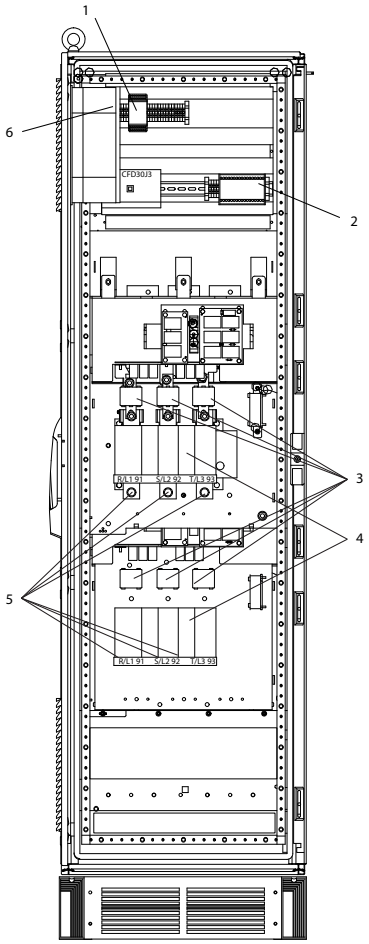
Illustration 3.28 Inverter Cabinet, Enclosure Sizes F12 and F13



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	

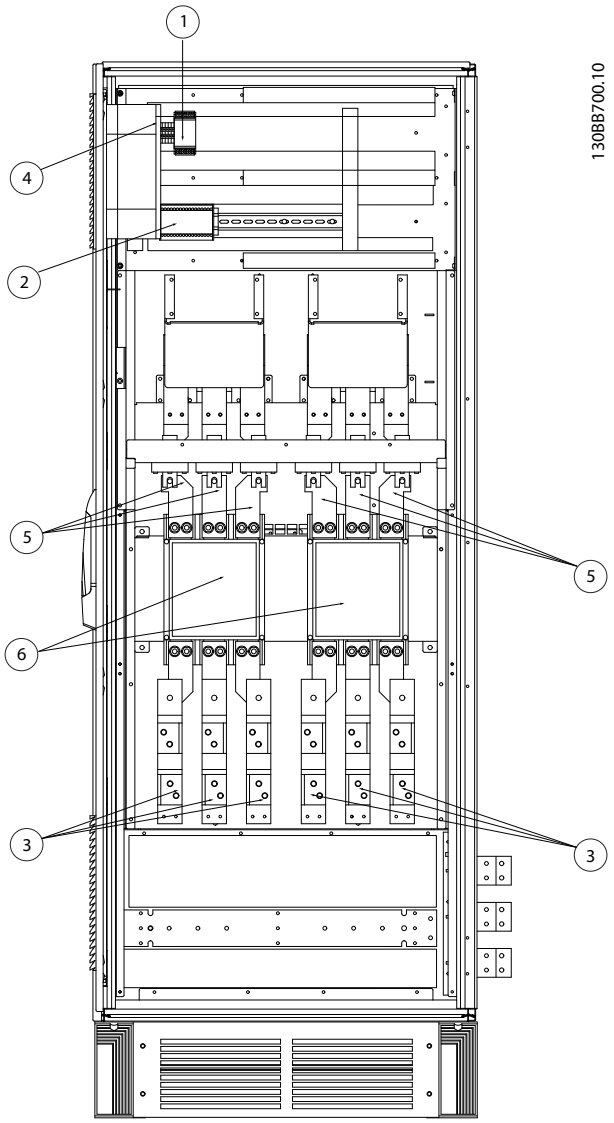
Illustration 3.29 Inverter Cabinet, Enclosure Size F14

3



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 3.4.14 Fuse Tables* for part numbers.					
5	Mains fuses, (6 pieces)					
	See *chapter 3.4.14 Fuse Tables* for part numbers.					
6	2x3-phase manual disconnect					

Illustration 3.30 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 3.4.14 Fuse Tables* for part numbers.					
5	Mains fuses, (6 pieces)					
	See *chapter 3.4.14 Fuse Tables* for part numbers.					
6	2x3-phase manual disconnect					

Illustration 3.31 Options Cabinet, Enclosure Sizes F11 and F13

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3.4.3 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.

3.4.4 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*.

3.4.5 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).

3.4.6 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.

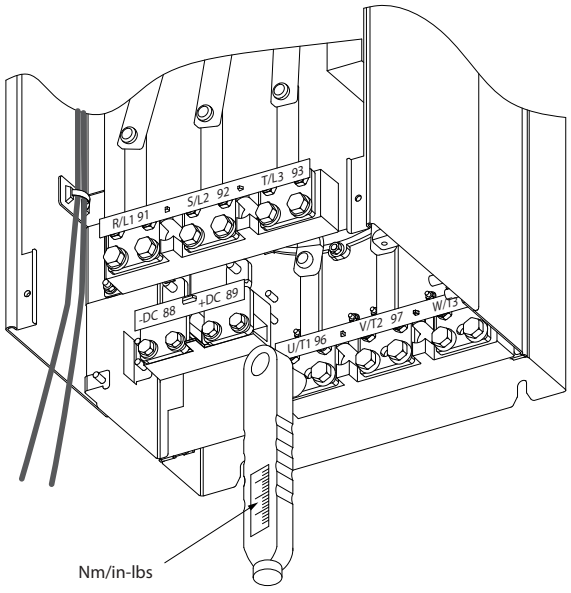

Illustration 3.32 Tightening Torques.

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 3.11 Tightening Torques

3

3.4.7 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.

3.4.8 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 3.12 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.

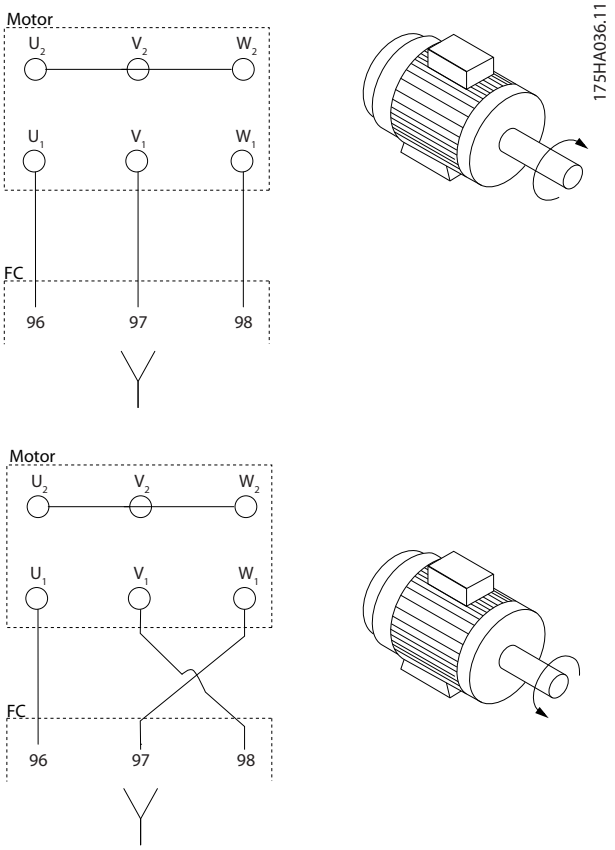

Illustration 3.33 Wiring for Clockwise and Counterclockwise Motor Rotation

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 *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

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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.

3.4.9 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 3.13 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.

3.4.10 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.

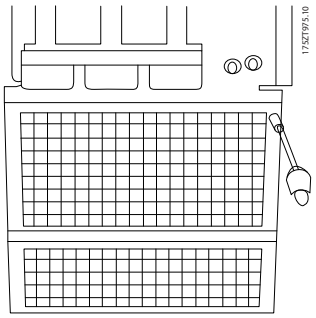

Illustration 3.34 Mounting of EMC shield

3.4.11 Mains Connection

Mains and ground must be connected as detailed in *Table 3.14*.

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 3.14 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.

3

3.4.12 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 3.15 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.

3.4.13 Fuses

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

Short-circuit protection
Protect the frequency converter against short-circuit to avoid electrical or fire hazard. Danfoss recommends using the fuses mentioned in *Table 3.16* to *Table 3.27* 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 listed in *Table 3.16* to *Table 3.27* are suitable for use on a circuit capable of delivering 100000 A_{rms} (symmetrical), 240 V, 480 V, 500 V, 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]	
FC 302	Type	Voltage (UL)	Amperes	P/N	P/N	400 V	460 V
P250T5	F8/F9	700	700	170M4017	176F8591	25	19
P315T5	F8/F9	700	700	170M4017	176F8591	30	22
P355T5	F8/F9	700	700	170M4017	176F8591	38	29
P400T5	F8/F9	700	700	170M4017	176F8591	3500	2800
P450T5	F10/F11	700	900	170M6013	176F8592	3940	4925
P500T5	F10/F11	700	900	170M6013	176F8592	2625	2100
P560T5	F10/F11	700	900	170M6013	176F8592	3940	4925
P630T5	F10/F11	700	1500	170M6018	176F8592	45	34
P710T5	F12/F13	700	1500	170M6018	176F9181	60	45
P800T5	F12/F13	700	1500	170M6018	176F9181	83	63

Table 3.16 Mains Fuses, 380-500 V

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Power size	Enclosure	Rating		Bussmann	Spare Bussmann	Estimated fuse power loss [W]	
FC 302	Type	Voltage (UL)	Amperes	P/N	P/N	600 V	690 V
P355T7	F8/F9	700	630	170M4016	176F8335	13	10
P400T7	F8/F9	700	630	170M4016	176F8335	17	13
P500T7	F8/F9	700	630	170M4016	176F8335	22	16
P560T7	F8/F9	700	630	170M4016	176F8335	24	18
P630T7	F10/F11	700	900	170M6013	176F8592	26	20
P710T7	F10/F11	700	900	170M6013	176F8592	35	27
P800T7	F10/F11	700	900	170M6013	176F8592	44	33
P900T7	F12/F13	700	1500	170M6018	176F9181	26	20
P1M0T7	F12/F13	700	1500	170M6018	176F9181	37	28
P1M2T7	F12/F13	700	1500	170M6018	176F9181	47	36
P1M4T7	F14	700	1500	170M6018	176F9181	47	36

Table 3.17 Mains Fuses, 525-690 V

Size/Type	Bussmann PN[1)]	Rating	Siba
P450	170M8611	1100 A, 1000 V	20 781 32.1000
P500	170M8611	1100 A, 1000 V	20 781 32.1000
P560	170M6467	1400 A, 700 V	20 681 32.1400
P630	170M6467	1400 A, 700 V	20 681 32.1400
P710	170M8611	1100 A, 1000 V	20 781 32.1000
P800	170M6467	1400 A, 700 V	20 681 32.1400

Table 3.18 Inverter module DC-Link Fuses, 380-500 V

Size/Type	Bussmann PN[1)]	Rating	Siba
P630	170M8611	1100 A, 1000 V	20 781 32. 1000
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	1100 A, 1000 V	20 781 32.1000

Table 3.19 Inverter module DC-Link Fuses, 525-690 V

1) The Bussmann 170M fuses 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.

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3

3.4.14 Supplementary Fuses

	Size/type	Bussmann PN	Rating	Alternative fuses
2.5-4.0 A fuse	P450-P800, 380-500 V	LPJ-6 SP or SPI	6 A, 600 V	Any listed Class J Dual Element, Time Delay, 6 A
	P630-P1M2, 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	P450-P800, 380-500 V	LPJ-10 SP or SPI	10 A, 600 V	Any listed Class J Dual Element, Time Delay, 10 A
	P630-P1M2, 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	P450-P800, 380-500 V	LPJ-15 SP or SPI	15 A, 600 V	Any listed Class J Dual Element, Time Delay, 15 A
	P630-P1M2, 525-690 V	LPJ-20 SP or SPI	20 A, 600 V	Any listed Class J Dual Element, Time Delay, 20 A
10-16 A fuse	P450-P800, 380-500 V	LPJ-25 SP or SPI	25 A, 600 V	Any listed Class J Dual Element, Time Delay, 25 A
	P630-P1M2, 525-690 V	LPJ-20 SP or SPI	20 A, 600 V	Any listed Class J Dual Element, Time Delay, 20 A
	P630-P1M4, 525-690 V	LPJ-20 SP or SPI	20 A, 600 V	Any listed Class J Dual Element, Time Delay, 20 A

Table 3.20 Manual Motor Controller Fuses

Enclosure size	Bussmann PN	Rating
F8-F14	KTK-4	4 A, 600 V

Table 3.21 SMPS Fuse

Size/type	Bussmann PN	LittelFuse	Rating
P315-P800, 380-500 V	–	KLK-15	15 A, 600 V
P500-P1M2, 525-690 V	–	KLK-15	15 A, 600 V
P500-P1M4, 525-690 V	–	KLK-15	15 A, 600 V

Table 3.22 Fan Fuses

Enclosure size	Bussmann PN	Rating	Alternative fuses
F8-F14	LPJ-30 SP or SPI	30 A, 600 V	Any listed Class J Dual Element, Time Delay, 30 A

Table 3.23 30 A Fuse Protected Terminal Fuse

Enclosure size	Bussmann PN	Rating	Alternative fuses
F8-F14	LPJ-6 SP or SPI	6 A, 600 V	Any listed Class J Dual Element, Time Delay, 6 A

Table 3.24 Control Transformer Fuse

Enclosure size	Bussmann PN	Rating
F8-F14	GMC-800MA	800 mA, 250 V

Table 3.25 NAMUR Fuse

Enclosure size	Bussmann PN	Rating	Alternative fuses
F8-F14	LP-CC-6	6 A, 600 V	Any listed Class CC, 6 A

Table 3.26 Safety Relay Coil Fuse with Pilz Relay

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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 3.27 Mains Disconnectors

3.4.15 Motor Insulation

For motor cable lengths ≤ the maximum cable length listed in *chapter 5.4 Cable Specifications*, the motor insulation ratings in *Table 3.28* 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 3.28 Motor Insulation Ratings

3.4.16 Motor Bearing Currents

All motors installed with FC 302 250 kW or higher power frequency converters should have NDE (Non-Drive End) insulated bearings installed to eliminate circulating bearing currents. To minimise DE (Drive End) bearing and shaft currents, ensure that the frequency converter, motor, driven machine, and motor to the driven machine are grounded properly.

Standard mitigation strategies:

1. Use an insulated bearing.
2. Apply rigorous installation procedures.
   - 2a Ensure that the motor and load motor are aligned.
   - 2b Strictly follow the EMC installation guideline.
   - 2c Reinforce the PE so the high frequency impedance is lower in the PE than the input power leads.
   - 2d Provide a good high frequency connection between the motor and the frequency converter, for example by using screened cable which has a 360° connection in the motor and the frequency converter.
   - 2e Make sure that the impedance from the frequency converter to the building ground is lower than the grounding impedance of the machine.
   - 2f Make a direct ground 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 where possible.
8. Ensure that the mains voltage is balanced to ground.
9. Use a dU/dt or sine-wave filter.

3.4.17 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 3.29 Brake Resistor Temperature Switch Terminals

3

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.

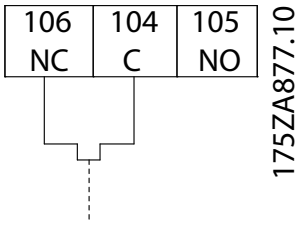

Illustration 3.35 Brake Resistor Temperature Switch

3.4.18 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 3.30 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.

3.4.19 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.

3.4.20 Electrical Installation, Control Terminals

To connect the cable to the terminal:

1. Strip the insulation by about 9–10 mm

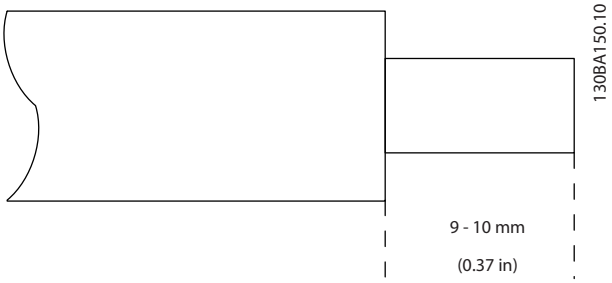

Illustration 3.36 Stripping of Insulation

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

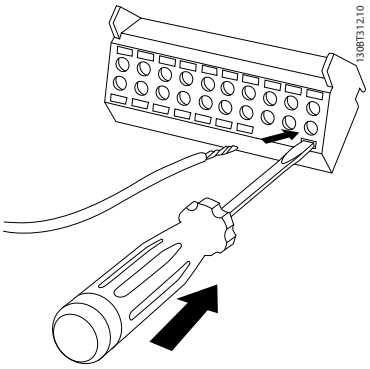

Illustration 3.37 Inserting Cable

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

1) Maximum 0.4x2.5 mm

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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

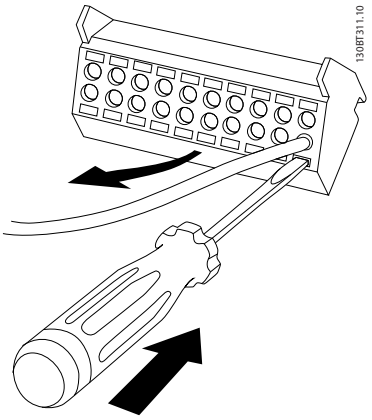

Illustration 3.38 Removing Cable

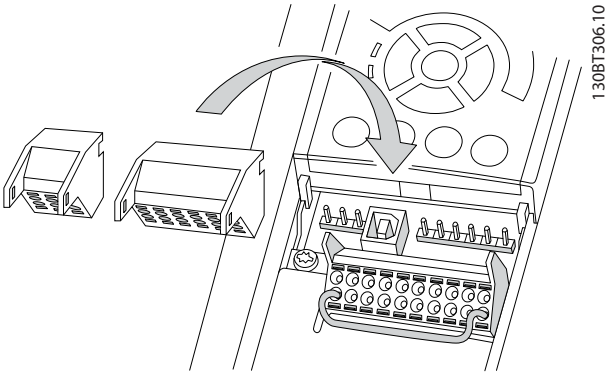

Illustration 3.39 Unplugging Control Terminals

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3.4.21 Electrical Installation, Control Cables

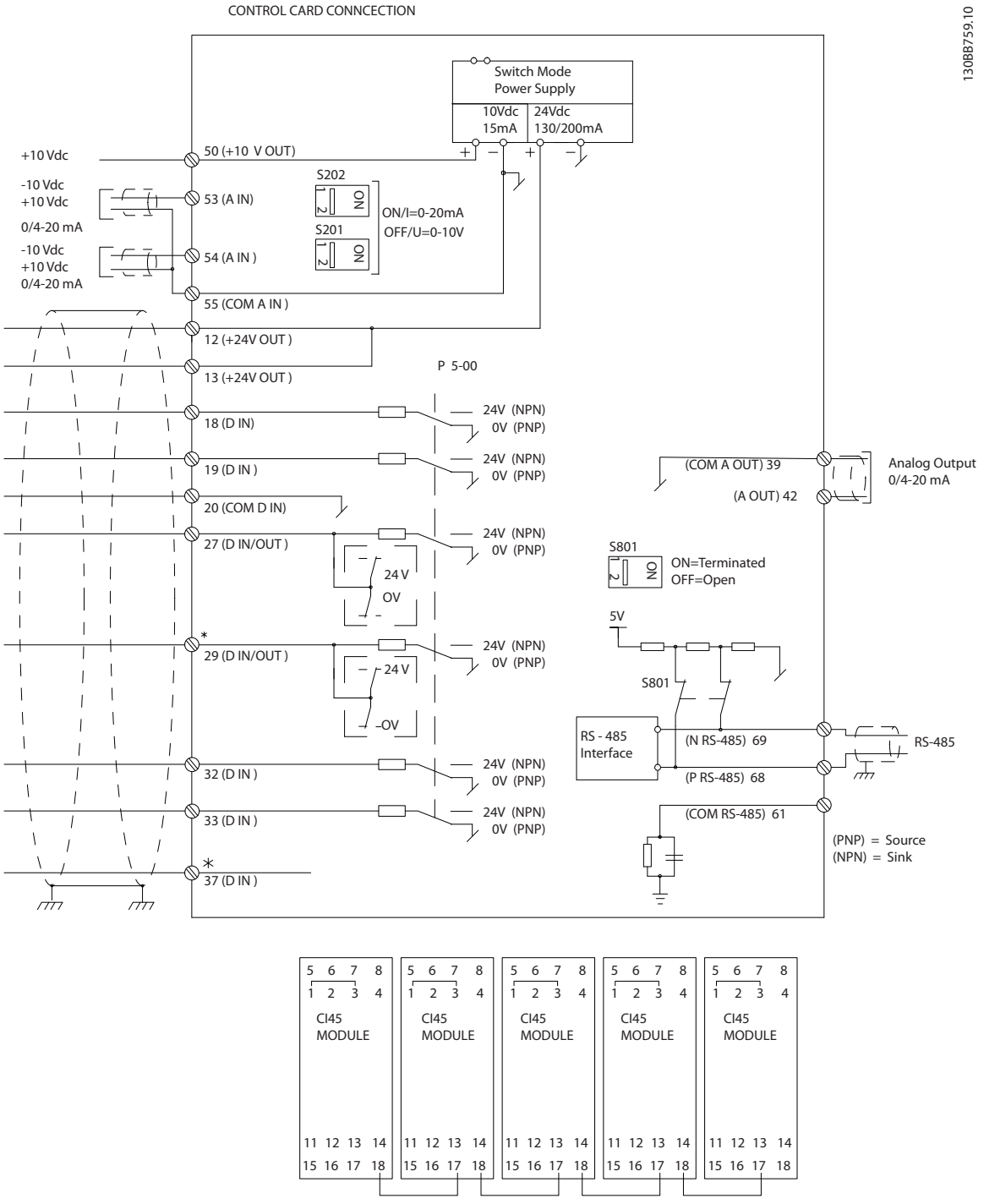

Illustration 3.40 Wiring Diagram

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.

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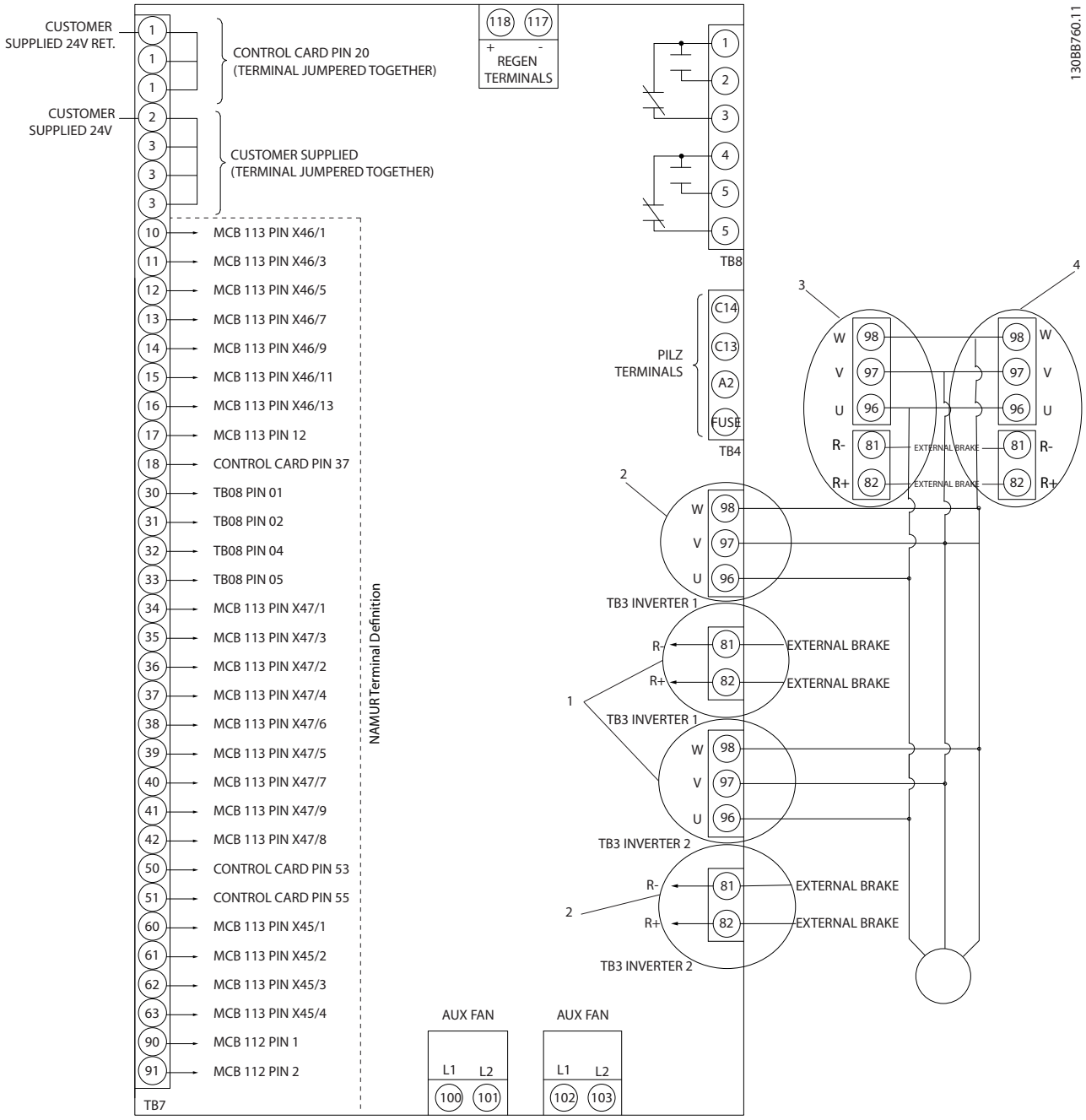

Illustration 3.41 Diagram Showing all Electrical Terminals with NAMUR Option

3

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

If ground loops occur, it may be necessary to break the screen or insert a 100 nF capacitor between the screen and the 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 affecting other groups. For example, switching on the digital input may disturb the analog input signal.

Input polarity of control terminals

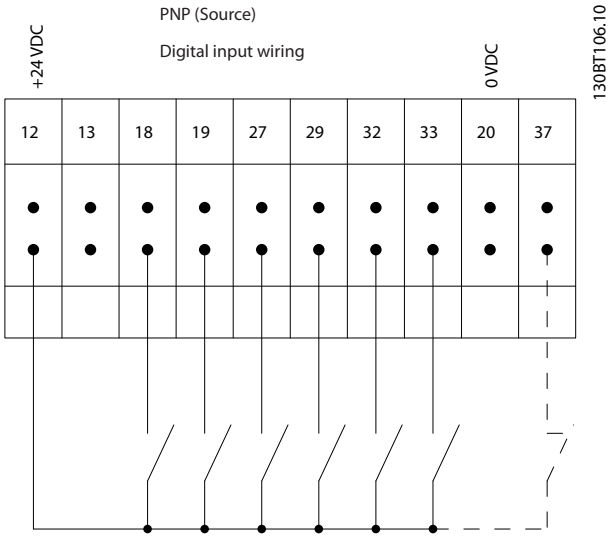

Illustration 3.42 PNP (Source)

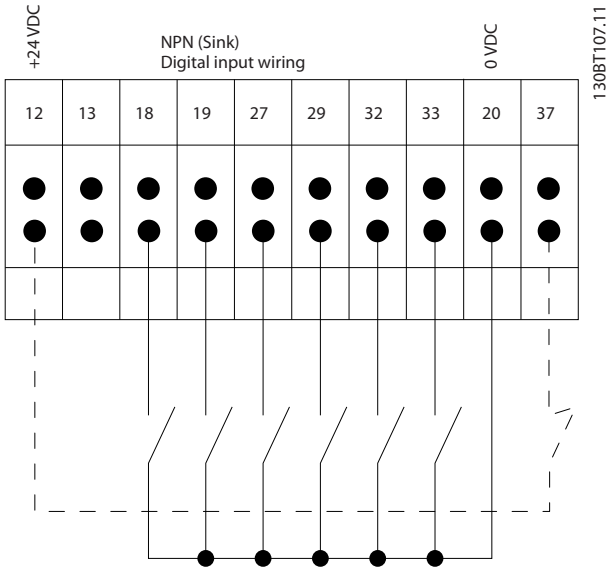

Illustration 3.43 NPN (Sink)

NOTICE

Control cables must be screened/armoured.

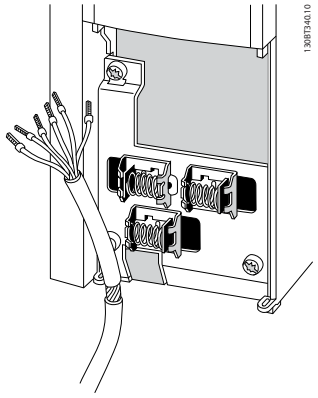

Illustration 3.44 Grounding of Screened/Armoured Control Cables

Remember to connect the shields in a proper way to ensure optimum electrical immunity.

3.4.22 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 3.40*.

Default setting:

S201 (A53) = OFF (voltage input)

S202 (A54) = OFF (voltage input)

S801 (Bus termination) = OFF

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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.

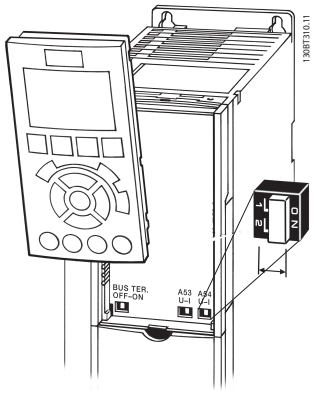

Illustration 3.45 Switch Location

3.5 Connection Examples

3.5.1 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

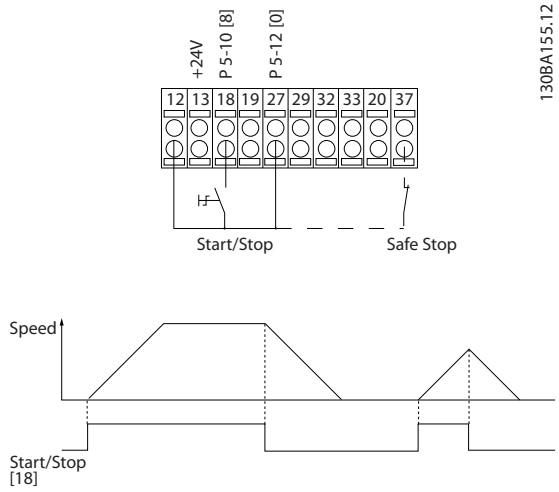

Illustration 3.46 Wiring Start/Stop

3.5.2 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

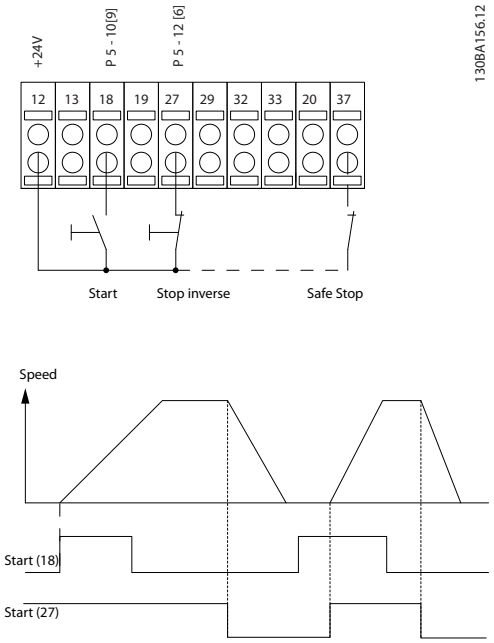

Illustration 3.47 Wiring Pulse Start/Stop

3.5.3 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).

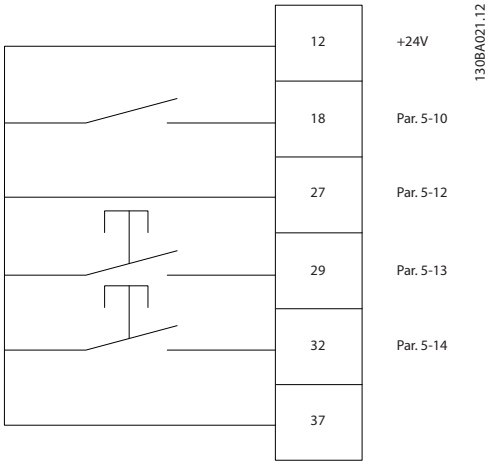

Illustration 3.48 Speed Up/Down

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3.5.4 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)

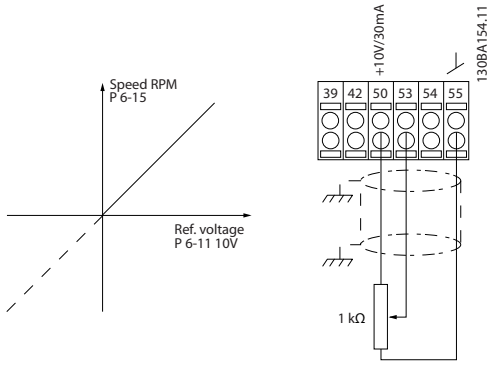
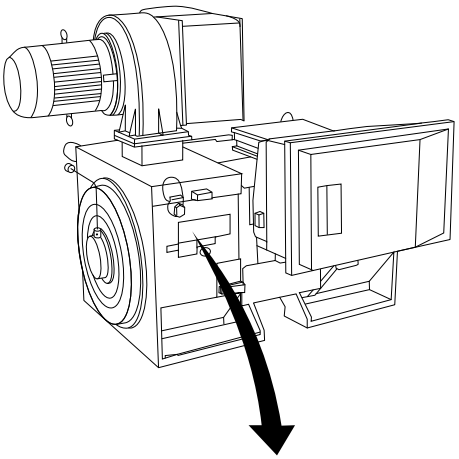


Illustration 3.49 Potentiometer Reference



THREE PHASE INDUCTION MOTOR									
MOD MCV 315E	Nr. 135189 12 04						IL/IN 6.5		
kW 400	PRIMARY						SF 1.15		
HP 536	V 690	A 410.6	CONN Y				COS f 0.85	40	
mm 1481	V	A	CONN				AMB 40	°C	
Hz 50	V	A	CONN				ALT 1000	m	
DESIGNN	SECONDARY						RISE 80	°C	
DUTY S1	V	A	CONN				ENCLOSURE IP23		
INSUL I	EFFICIENCY %	95.8%	100%	95.8%	75%		WEIGHT 1.83 ton		
⚠ CAUTION									

Illustration 3.50 Nameplate

3.6 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.

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

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

1. *Parameter 1-20 Motor Power [kW]*
   1-21 Motor Power [HP]
2. *1-22 Motor Voltage*
3. *Parameter 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.

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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 *chapter 6 Warnings and Alarms*.
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

- *Parameter 3-02 Minimum Reference*
- *Parameter 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]*
- *Parameter 3-41 Ramp 1 Ramp Up Time*
- *Parameter 3-42 Ramp 1 Ramp Down Time*

3.7 Additional Connections

3.7.1 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.

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3.7.2 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 3.51*, 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).

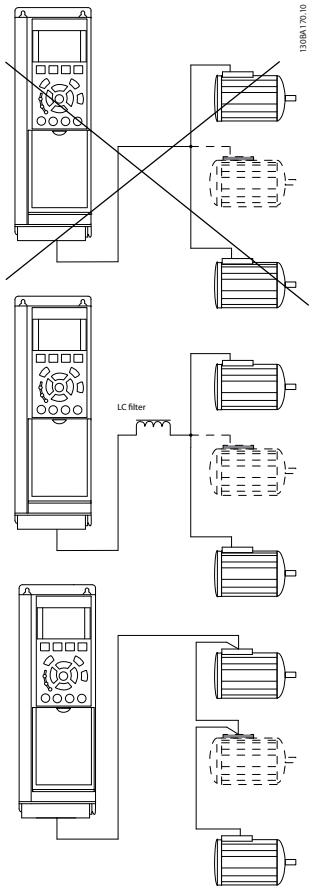

Illustration 3.51 Parallel Motor Connection

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.

3.7.3 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.

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4 How to Programme

4.1 The Graphical LCP

The LCP is divided into 4 functional groups:

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

The LCP display can show up to 5 items of operating data while displaying *Status*.

Display lines:

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

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

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

NOTICE

If start-up is delayed, the LCP displays the INITIALISING message until it is ready. Adding or removing options may delay the start-up.

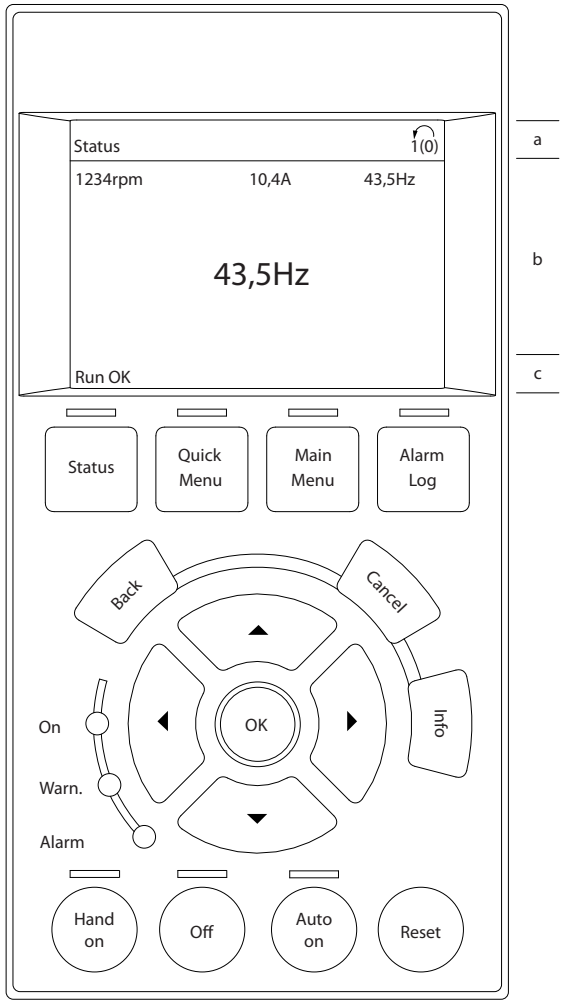

Illustration 4.1 LCP

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4

4.1.1 Initial Commissioning

The easiest way of carrying out the initial commissioning is by pressing [Quick Menu] and following the quick set-up procedure using LCP 102 (read *Table 4.1* from left to right). The example applies to open loop applications.

Press				
Quick Menu	↓	Q2 Quick Menu	OK	↓
Parameter 0-01 Language	OK	Set language	↓	
Parameter 1-20 Motor Power [kW]	OK	Set motor nameplate power	↓	
1-22 Motor Voltage	OK	Set nameplate voltage	↓	
Parameter 1-23 Motor Frequency	OK	Set nameplate frequency	↓	
1-24 Motor Current	OK	Set nameplate current	↓	
1-25 Motor Nominal Speed	OK	Set nameplate speed in RPM	↓	
5-12 Terminal 27 Digital Input	OK	If terminal default is *Coast inverse*, it is possible to change this setting to *No function*. No connection to terminal 27 is then needed for running AMA	↓	
1-29 Automatic Motor Adaptation (AMA)	OK	Set desired AMA function. Enable complete AMA is recommended	↓	
Parameter 3-02 Minimum Reference	OK	Set the minimum speed of the motor shaft	↓	
Parameter 3-03 Maximum Reference	OK	Set the maximum speed of the motor shaft	↓	
Parameter 3-41 Ramp 1 Ramp Up Time	OK	Set the ramping up time with reference to synchronous motor speed, n_s	↓ ↓	
Parameter 3-42 Ramp 1 Ramp Down Time	OK	Set the ramping down time with reference to synchronous motor speed, n_s	↓	
3-13 Reference Site	OK	Set the site from where the reference must work	↓	

Table 4.1 Quick Set-up Procedure

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Another easy way of commissioning the frequency converter is by using the Smart Application Setup (SAS), which can also be found by pressing [Quick Menu]. Follow the indications on the successive screens to set up the applications listed.

The [Info] key can be used throughout the SAS to see help information for various selections, settings and messages. The following 3 applications are included:

- Mechanical Brake
- Conveyor
- Pump/Fan

The following 4 field-busses can be selected:

- Profibus
- Profinet
- DeviceNet
- EthernetIP

NOTICE

The start conditions are ignored while in the wizard.

NOTICE

The *Smart Set-up* runs automatically on the first power-up of the frequency converter or after a reset to factory settings. If no action is taken, the SAS screen automatically disappears after 10 minutes.

4.2 Quick Set-up

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

0-01 Language		
Option:		**Function:**
[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]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the nominal motor power in kW according to the motor nameplate data. The default value corresponds to the nominal rated output of the frequency converter. This parameter is visible in the LCP if *0-03 Regional Settings* is set to *[0] International*. ***NOTICE*** **4 sizes down, 1 size up from nominal unit rating.**

4

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]	Minimum to maximum motor frequency: 20-1000 Hz. Select the motor frequency value from the motor nameplate data. If a value other than 50 Hz or 60 Hz is selected, adapt the load independent settings in *1-50 Motor Magnetisation at Zero Speed* to *1-53 Model Shift Frequency*. For 87 Hz operation with 230/400 V motors, set the nameplate data for 230 V/50 Hz. To run at 87 Hz, adapt *4-13 Motor Speed High Limit [RPM]* and *parameter 3-03 Maximum Reference*.

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.

5-12 Terminal 27 Digital Input

Option: Function:

Select the function from the available digital input range.

No operation	[0]
Reset	[1]
Coast inverse	[2]
Coast and reset inverse	[3]
Quick stop inverse	[4]
DC-brake inverse	[5]
Stop inverse	[6]
Start	[8]
Latched start	[9]
Reversing	[10]
Start reversing	[11]
Enable start forward	[12]
Enable start reverse	[13]
Jog	[14]
Preset ref bit 0	[16]
Preset ref bit 1	[17]
Preset ref bit 2	[18]
Freeze reference	[19]
Freeze output	[20]
Speed up	[21]
Speed down	[22]
Set-up select bit 0	[23]
Set-up select bit 1	[24]
Catch up	[28]
Slow down	[29]
Pulse input	[32]
Ramp bit 0	[34]
Ramp bit 1	[35]
Mains failure inverse	[36]
DigiPot Increase	[55]
DigiPot Decrease	[56]
DigiPot Clear	[57]
Reset Counter A	[62]
Reset Counter B	[65]

5-12 Terminal 27 Digital Input

Option: Function:

1-29 Automatic Motor Adaptation (AMA)

Option: Function:

NOTICE

This parameter cannot be adjusted while the motor is running.

The AMA function optimises dynamic motor performance by automatically optimising the advanced motor parameters (*1-30 Stator Resistance (Rs)* to *1-35 Main Reactance (Xh)*) at motor standstill.
Activate the AMA function by pressing [Hand on] after selecting *[1] Enable complete AMA* or *[2] Enable reduced AMA*. See also *chapter 3.6.1 Final Set-Up and Test*. After a normal sequence, the display reads: "Press [OK] to finish AMA". After pressing [OK], the frequency converter is ready for operation.

[0] *	OFF	
[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

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1-29 Automatic Motor Adaptation (AMA)		
Option:		**Function:**
		option if an LC filter is used between the frequency converter and the motor.

NOTICE

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

NOTICE

It is important to set parameter group *1-2* Motor Data* correctly, since these form part of the AMA algorithm. An AMA must be performed to achieve optimum dynamic motor performance. It may take up to 10 minutes, depending on the power rating of the motor.

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 their default setting.

3-02 Minimum Reference		
Range:		**Function:**
Size related*	[-999999.999 - par. 3-03 ReferenceFeedbackUnit]	Enter the minimum reference. The minimum reference is the lowest value obtainable by summing all references. Minimum reference is active only when *3-00 Reference Range* is set to *[0] Min.- Max.* The minimum reference unit matches: • The configuration of *1-00 Configuration Mode*: for *[1] Speed closed loop*, RPM; for *[2] Torque*, Nm. • The unit selected in *3-01 Reference/Feedback Unit.*

3-03 Maximum Reference		
Range:		**Function:**
Size related*	[par. 3-02 - 999999.999 ReferenceFeedbackUnit]	Enter the maximum reference. The maximum reference is the highest value obtainable by summing all references. **The maximum reference unit matches:** • The choice of configuration in *1-00 Configuration Mode*: for *[1] Speed closed loop*, RPM; for *[2] Torque*, Nm. • The unit selected in *3-00 Reference Range.*

3-41 Ramp 1 Ramp Up Time		
Range:		**Function:**
Size related*	[0.01 - 3600 s]	Enter the ramp-up time, i.e. the acceleration time from 0 RPM to the synchronous motor speed n_S. Select a ramp-up time which prevents the output current from exceeding the current limit in *4-18 Current Limit* during ramping. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-down time in *parameter 3-42 Ramp 1 Ramp Down Time.* $Par.\ 3-41 = \frac{tacc\,[s]\ x\ ns\,[RPM]}{ref\,[RPM]}$

3-42 Ramp 1 Ramp Down Time		
Range:		**Function:**
Size related*	[0.01 - 3600 s]	Enter the ramp-down time, that is, the deceleration time from the synchronous motor speed n_s to 0 RPM. Select a ramp-down time such that no overvoltage arises in the inverter due to regenerative operation of the motor, and such that the generated current does not exceed the current limit set in *4-18 Current Limit*. The value 0.00 corresponds to 0.01 s in speed mode. See ramp-up time in *parameter 3-41 Ramp 1 Ramp Up Time.* $Par.\ 3-42 = \frac{tdec\,[s]\ x\ ns\,[RPM]}{ref\,[RPM]}$

4.3 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 (Hand)
    - 0-09 Performance Monitor
  - **0-1* Set-up Operations**
    - 0-10 Active Set-up
    - 0-11 Edit Set-up
    - 0-12 This Set-up Linked to
    - 0-13 Readout: Linked Set-ups
    - 0-14 Readout: Edit Set-ups / Channel
    - 0-15 Readout: actual setup
  - **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 Unit for User-defined Readout
    - 0-31 Min Value of User-defined Readout
    - 0-32 Max Value of User-defined Readout
    - 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 Quick Menu Password
    - 0-66 Access to Quick Menu w/o Password
    - 0-67 Bus Password Access
    - 0-68 Safety Parameters Password
    - 0-69 Password Protection of Safety Parameters
- **1-** Load and Motor**
  - **1-0* General Settings**
    - 1-00 Configuration Mode
    - 1-01 Motor Control Principle
    - 1-02 Flux Motor Feedback Source
    - 1-03 Torque Characteristics
    - 1-04 Overload Mode
    - 1-05 Local Mode Configuration
    - 1-06 Clockwise Direction
    - 1-07 Motor Angle Offset Adjust
  - **1-1* Special Settings**
    - 1-10 Motor Construction
    - 1-11 Motor Model
    - 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
    - 1-29 Automatic Motor Adaptation (AMA)
  - **1-3* Adv. Motor Data**
    - 1-30 Stator Resistance (Rs)
    - 1-31 Rotor Resistance (Rr)
    - 1-33 Stator Leakage Reactance (X1)
    - 1-34 Rotor Leakage Reactance (X2)
    - 1-35 Main Reactance (Xh)
    - 1-36 Iron Loss Resistance (Rfe)
    - 1-37 d-axis Inductance (Ld)
    - 1-38 q-axis Inductance (Lq)
    - 1-39 Motor Poles
    - 1-40 Back EMF at 1000 RPM
    - 1-41 Motor Angle Offset
    - 1-44 d-axis Inductance Sat. (LdSat)
    - 1-45 q-axis Inductance Sat. (LqSat)
    - 1-46 Position Detection Gain
    - 1-47 Low Speed Torque Calibration
    - 1-48 Inductance Sat. Point
  - **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]
    - 1-53 Model Shift Frequency
    - 1-54 Voltage reduction in fieldweakening
    - 1-55 U/f Characteristic - U
    - 1-56 U/f Characteristic - F
    - 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
    - 1-67 Load Type
    - 1-68 Minimum Inertia
    - 1-69 Maximum Inertia
  - **1-7* Start Adjustments**
    - 1-70 PM Start Mode
    - 1-71 Start Delay
    - 1-72 Start Function
    - 1-73 Flying Start
    - 1-74 Start Speed [RPM]
    - 1-75 Start Speed [Hz]
    - 1-76 Start Current
  - **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]
    - 1-83 Precise Stop Function
    - 1-84 Precise Stop Counter Value
    - 1-85 Precise Stop Speed Compensation Delay
  - **1-9* Motor Temperature**
    - 1-90 Motor Thermal Protection
    - 1-91 Motor External Fan
    - 1-93 Thermistor Resource
    - 1-94 ATEX ETR cur.lim. speed reduction
    - 1-95 KTY Sensor Type
    - 1-96 KTY Thermistor Resource
    - 1-97 KTY Threshold level
    - 1-98 ATEX ETR interpol. points freq.
    - 1-99 ATEX ETR interpol points current
- **2-** Brakes**
  - **2-0* DC-Brake**
    - 2-00 DC Hold 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]
    - 2-05 Maximum Reference
    - 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
    - 2-18 Brake Check Condition
    - 2-19 Over-voltage Gain
  - **2-2* Mechanical Brake**
    - 2-20 Release Brake Current
    - 2-21 Activate Brake Speed [RPM]
    - 2-22 Activate Brake Speed [Hz]
    - 2-23 Activate Brake Delay
    - 2-24 Stop Delay
    - 2-25 Brake Release Time
    - 2-26 Torque Ref
    - 2-27 Torque Ramp Time
    - 2-28 Gain Boost Factor
    - 2-29 Torque Ramp Down Time
    - 2-30 Position P Start Proportional Gain
    - 2-31 Speed PID Start Proportional Gain
    - 2-32 Speed PID Start Integral Time
    - 2-33 Speed PID Start Lowpass Filter Time
- **3-** Reference / Ramps**
  - **3-0* Reference Limits**
    - 3-00 Reference Range
    - 3-01 Reference/Feedback Unit
    - 3-02 Minimum Reference
    - 3-03 Maximum Reference
    - 3-04 Reference Function
  - **3-1* References**
    - 3-10 Preset Reference
    - 3-11 Jog Speed [Hz]
    - 3-12 Catch up/slow Down Value
    - 3-13 Reference Site
    - 3-14 Preset Relative Reference
    - 3-15 Reference Resource 1
    - 3-16 Reference Resource 2
    - 3-17 Reference Resource 3
    - 3-18 Relative Scaling Reference Resource
    - 3-19 Jog Speed [RPM]
  - **3-4* Ramp 1**
    - 3-40 Ramp 1 Type
    - 3-41 Ramp 1 Ramp Up Time
    - 3-42 Ramp 1 Ramp Down Time
    - 3-45 Ramp 1 S-ramp Ratio at Accel. Start
    - 3-46 Ramp 1 S-ramp Ratio at Accel. End
    - 3-47 Ramp 1 S-ramp Ratio at Decel. Start
    - 3-48 Ramp 1 S-ramp Ratio at Decel. End
  - **3-5* Ramp 2**
    - 3-50 Ramp 2 Type
    - 3-51 Ramp 2 Ramp Up Time
    - 3-52 Ramp 2 Ramp Down Time
    - 3-55 Ramp 2 S-ramp Ratio at Accel. Start
    - 3-56 Ramp 2 S-ramp Ratio at Accel. End
    - 3-57 Ramp 2 S-ramp Ratio at Decel. Start
    - 3-58 Ramp 2 S-ramp Ratio at Decel. End
  - **3-6* Ramp 3**
    - 3-60 Ramp 3 Type
    - 3-61 Ramp 3 Ramp up Time
    - 3-62 Ramp 3 Ramp down Time
    - 3-65 Ramp 3 S-ramp Ratio at Accel. Start
    - 3-66 Ramp 3 S-ramp Ratio at Accel. End
    - 3-67 Ramp 3 S-ramp Ratio at Decel. Start
    - 3-68 Ramp 3 S-ramp Ratio at Decel. End
  - **3-7* Ramp 4**
    - 3-70 Ramp 4 Type
    - 3-71 Ramp 4 Ramp up Time
    - 3-72 Ramp 4 Ramp Down Time
    - 3-75 Ramp 4 S-ramp Ratio at Accel. Start
    - 3-76 Ramp 4 S-ramp Ratio at Accel. End
    - 3-77 Ramp 4 S-ramp Ratio at Decel. Start
    - 3-78 Ramp 4 S-ramp Ratio at Decel. End
  - **3-8* Other Ramps**
    - 3-80 Jog Ramp Time
    - 3-81 Quick Stop Ramp Time
    - 3-82 Quick Stop Ramp Type
    - 3-83 Quick Stop S-ramp Ratio at Decel. Start
    - 3-84 Quick Stop S-ramp Ratio at Decel. End
  - **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
  - **4-2* Limit Factors**
    - 4-20 Torque Limit Factor Source
    - 4-21 Speed Limit Factor Source
  - **4-3* Motor Speed Mon.**
    - 4-30 Motor Feedback Loss Function
    - 4-31 Motor Feedback Speed Error
    - 4-32 Motor Feedback Loss Timeout
    - 4-34 Tracking Error Function
    - 4-35 Tracking Error
    - 4-36 Tracking Error Timeout
    - 4-37 Tracking Error Ramping
    - 4-38 Tracking Error Ramping Timeout
    - 4-39 Tracking Error After Ramping Timeout
  - **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]
- **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
    - 5-20 Terminal X46/1 Digital Input
    - 5-21 Terminal X46/3 Digital Input
    - 5-22 Terminal X46/5 Digital Input
    - 5-23 Terminal X46/7 Digital Input
    - 5-24 Terminal X46/9 Digital Input

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5-25	Terminal X46/11 Digital Input
5-26	Terminal X46/13 Digital Input
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
5-7*	**24V Encoder Input**
5-70	Term 32/33 Pulses Per Revolution
5-71	Term 32/33 Encoder Direction
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
6-1*	**Analog Input 1**
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
6-2*	**Analog Input 2**
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
6-3*	**Analog Input 3**
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
6-4*	**Analog Input 4**
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
6-5*	**Analog Output 1**
6-50	Terminal 42 Output
6-51	Terminal 42 Output Min Scale
6-52	Terminal 42 Output Max Scale
6-53	Term 42 Output Bus Ctrl
6-54	Terminal 42 Output Timeout Preset
6-55	Analog Output Filter
6-6*	**Analog Output 2**
6-60	Terminal X30/8 Output
6-61	Terminal X30/8 Min. Scale
6-62	Terminal X30/8 Max. Scale
6-63	Terminal X30/8 Bus Control
6-64	Terminal X30/8 Output Timeout Preset
6-7*	**Analog Output 3**
6-70	Terminal X45/1 Output
6-71	Terminal X45/1 Min. Scale
6-72	Terminal X45/1 Max. Scale
6-73	Terminal X45/1 Bus Control
6-74	Terminal X45/1 Output Timeout Preset
6-8*	**Analog Output 4**
6-80	Terminal X45/3 Output
6-81	Terminal X45/3 Min. Scale
6-82	Terminal X45/3 Max. Scale
6-83	Terminal X45/3 Bus Control
6-84	Terminal X45/3 Output Timeout Preset
7-**	**Controllers**
7-0*	**Speed PID Ctrl.**
7-00	Speed PID Feedback Source
7-02	Speed PID Proportional Gain
7-03	Speed PID Integral Time
7-04	Speed PID Differentiation Time
7-05	Speed PID Diff. Gain Limit
7-06	Speed PID Lowpass Filter Time
7-07	Speed PID Feedback Gear Ratio
7-08	Speed PID Feed Forward Factor
7-09	Speed PID Error Correction w/ Ramp
7-1*	**Torque PI Ctrl.**
7-12	Torque PI Proportional Gain
7-13	Torque PI Integration Time
7-2*	**Process Ctrl. Feedb**
7-20	Process CL Feedback 1 Resource
7-22	Process CL Feedback 2 Resource
7-3*	**Process PID Ctrl.**
7-30	Process PID Normal/ Inverse Control
7-31	Process PID Anti Windup
7-32	Process PID Start Speed
7-33	Process PID Proportional Gain
7-34	Process PID Integral Time
7-35	Process PID Differentiation Time
7-36	Process PID Diff. Gain Limit
7-38	Process PID Feed Forward Factor
7-39	On Reference Bandwidth
7-4*	**Adv. Process PID I**
7-40	Process PID I-part Reset
7-41	Process PID Output Neg. Clamp
7-42	Process PID Output Pos. Clamp
7-43	Process PID Gain Scale at Min. Ref.
7-44	Process PID Gain Scale at Max. Ref.
7-45	Process PID Feed Fwd Resource
7-46	Process PID Feed Fwd Normal/ Inv. Ctrl.
7-48	PCD Feed Forward
7-49	Process PID Output Normal/ Inv. Ctrl.
7-5*	**Adv. Process PID II**
7-50	Process PID Extended PID
7-51	Process PID Feed Fwd Gain
7-52	Process PID Feed Fwd Ramp up
7-53	Process PID Feed Fwd Ramp down
7-56	Process PID Ref. Filter Time
7-57	Process PID Fb. Filter Time
8-**	**Comm. and Options**
8-0*	**General Settings**
8-01	Control Site
8-02	Control Word Source
8-03	Control Word Timeout Time
8-04	Control Word Timeout Function
8-05	End-of-Timeout Function
8-06	Reset Control Word Timeout
8-07	Diagnosis Trigger
8-08	Readout Filtering
8-1*	**Ctrl. Word Settings**
8-10	Control Word Profile
8-13	Configurable Status Word STW
8-14	Configurable Control Word CTW
8-17	Configurable Alarm and Warning Word
8-19	Product Code
8-3*	**FC Port Settings**
8-30	Protocol
8-31	Address
8-32	FC Port Baud Rate
8-33	Parity / Stop Bits
8-34	Estimated cycle time
8-35	Minimum Response Delay
8-36	Max Response Delay
8-37	Max Inter-Char Delay
8-4*	**FC MC protocol set**
8-40	Telegram Selection
8-41	Parameters for Signals
8-42	PCD Write Configuration
8-43	PCD Read Configuration
8-5*	**Digital/Bus**
8-50	Coasting Select
8-51	Quick Stop Select
8-52	DC Brake Select
8-53	Start Select
8-54	Reversing Select
8-55	Set-up Select
8-56	Preset Reference Select
8-57	Profidrive OFF2 Select
8-58	Profidrive OFF3 Select
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
8-9*	**Bus Jog**
8-90	Bus Jog 1 Speed
8-91	Bus Jog 2 Speed
9-**	**PROFIdrive**
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
10-**	**CAN Fieldbus**
10-0*	**Common Settings**
10-00	CAN Protocol
10-01	Baud Rate Select
10-02	MAC ID
10-05	Readout Transmit Error Counter
10-06	Readout Receive Error Counter
10-07	Readout Bus Off Counter
10-1*	**DeviceNet**
10-10	Process Data Type Selection
10-11	Process Data Config Write
10-12	Process Data Config Read
10-13	Warning Parameter
10-14	Net Reference
10-15	Net Control
10-2*	**COS Filters**
10-20	COS Filter 1
10-21	COS Filter 2
10-22	COS Filter 3
10-23	COS Filter 4
10-3*	**Parameter Access**
10-30	Array Index
10-31	Store Data Values
10-32	Devicenet Revision
10-33	Store Always
10-34	DeviceNet Product Code
10-39	Devicenet F Parameters
10-5*	**CANopen**
10-50	Process Data Config Write.
10-51	Process Data Config Read.
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
12-23	Process Data Config Write Size
12-24	Process Data Config Read Size
12-27	Master Address
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

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12-42 Slave Exception Message Count
12-5* EtherCAT
12-50 Configured Station Alias
12-51 Configured Station Address
12-59 EtherCAT Status
12-6* Ethernet PowerLink
12-60 Node ID
12-62 SDO Timeout
12-63 Basic Ethernet Timeout
12-66 Threshold
12-67 Threshold Counters
12-68 Cumulative Counters
12-69 Ethernet PowerLink Status
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
12-95 Broadcast Storm Filter
12-96 Port Config
12-98 Interface Counters
12-99 Media Counters
13- Smart Logic**
13-0* SLC Settings
13-00 SL Controller Mode
13-01 Start Event
13-02 Stop Event
13-03 Reset SLC
13-1* Comparators
13-10 Comparator Operand
13-11 Comparator Operator
13-12 Comparator Value
13-1* RS Flip Flops
13-15 RS-FF Operand S
13-16 RS-FF Operand R
13-2* Timers
13-20 SL Controller Timer
13-4* Logic Rules
13-40 Logic Rule Boolean 1
13-41 Logic Rule Operator 1
13-42 Logic Rule Boolean 2
13-43 Logic Rule Operator 2
13-44 Logic Rule Boolean 3
13-5* States
13-51 SL Controller Event
13-52 SL Controller Action
14- Special Functions**
14-0* Inverter Switching
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5 General Specifications

5.1 Mains Supply

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 lowest rated supply voltage. Power-up and full torque cannot be expected at mains voltage lower than 10% below the lowest rated supply voltage.

Supply frequency	50/60 Hz ±5%
Maximum imbalance temporary between mains phases	3.0% of rated supply voltage
True power factor (λ)	≥0.9 nominal at rated load
Displacement power factor (cos ϕ) near unity	(>0.98)
Switching on input supply L1-1, L2-1, L3-1, L1-2, L2-2, L3-2 (power-ups)	maximum 1 time/2 minutes
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 100000 RMS symmetrical Amperes, 500/600/690V maximum.

5.2 Motor Output and Motor Data

Motor output (U, V, W)	
Output voltage	0-100% of supply voltage
Output frequency	0-800* Hz
Switching on output	Unlimited
Ramp times	0.001-3600 s

** Voltage and power dependent*

Torque characteristics	
Starting torque (constant torque)	maximum 160% for 60 s[1)] once in 10 minutes
Starting/overload torque (variable torque)	maximum 110% up to 0.5 s[1)] once in 10 minutes
Torque rise time in FLUX (for 5 kHz fsw)	1 ms
Torque rise time in VVC$^+$ (independent of fsw)	10 ms

1) Percentage relates to the nominal torque.
2) The torque response time depends on application and load but as a general rule, the torque step from 0 to reference is 4-5 x torque rise time.

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5.3 Ambient Conditions

Surroundings	
Enclosure	IP21/Type 1, IP54/Type 12
Vibration test	0.7 g
Maximum relative humidity	5-95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43	class H_25
Ambient temperature (with SFAVM switching mode)	
- with derating	Maximum 55 °C[1)]
- at full continuous drive output current	Maximum 45 °C[1)]

1) For more information on derating, see special conditions in the VLT AutomationDrive® Design Guide

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

Derating for high altitude, see special conditions in the VLT AutomationDrive® Design Guide

EMC standards, Emission	EN 61800-3, EN 61000-6-3/4, EN 55011
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 VLT AutomationDrive® FC 302 Design Guide.

5.4 Cable Specifications

Cable lengths and cross-sections	
Maximum motor cable length, screened/armoured	150 m
Maximum motor cable length, unscreened/unarmoured	300 m
Maximum cross-section to control terminals, flexible/rigid wire without cable end sleeves	1.5 mm^2/16 AWG
Maximum cross-section to control terminals, flexible wire with cable end sleeves	1 mm^2/18 AWG
Maximum cross-section to control terminals, flexible wire with cable end sleeves with collar	0.5 mm^2/20 AWG
Minimum cross-section to control terminals	0.25 mm^2/24 AWG

5.5 Control Input/output and Control Data

Digital inputs	
Programmable digital inputs	4 (6)
Terminal number	18, 19, 27[1)], 29, 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[2)]	>19 V DC
Voltage level, logic '1' NPN[2)]	<14 V DC
Maximum voltage on input	28 V DC
Pulse frequency range	0-110 kHz
(Duty cycle) Minimum pulse width	4.5 ms
Input resistance, R_i	approx. 4 kΩ

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Safe stop Terminal 37[3] (Terminal 37 is fixed PNP logic)	
Voltage level	0-24 V DC
Voltage level, logic'0' PNP	<4 V DC
Voltage level, logic'1' PNP	>20 V DC
Nominal input current at 24 V	50 mA rms
Nominal input current at 20 V	60 mA rms
Input capacitance	400 nF

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.

2) Except safe stop input Terminal 37.

3) See chapter 2.3.1 Safe Torque Off (STO) for further information about terminal 37 and Safe Stop.

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Analog inputs	
Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	Switch S201 and switch S202
Voltage mode	Switch S201/switch S202 = OFF (U)
Voltage level	-10 to +10 V (scaleable)
Input resistance, R_i	approx. 10 kΩ
Maximum voltage	±20 V
Current mode	Switch S201/switch S202 = ON (I)
Current level	0/4 to 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	100 Hz

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

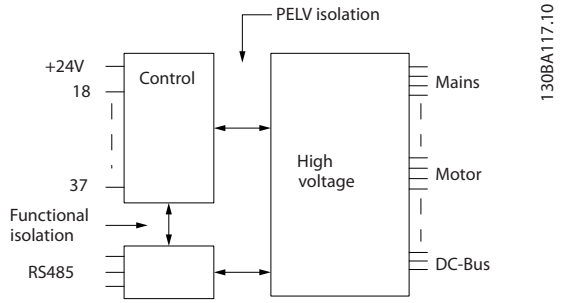

Illustration 5.1 PELV Isolation

Pulse/encoder inputs	
Programmable pulse/encoder inputs	2/1
Terminal number pulse/encoder	29[1], 33[2]/32[3], 33[3]
Maximum frequency at terminal 29, 32, 33	110 kHz (Push-pull driven)
Maximum frequency at terminal 29, 32, 33	5 kHz (open collector)
Minimum frequency at terminal 29, 32, 33	4 Hz
Voltage level	see section on Digital input
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
Encoder input accuracy (1-11 kHz)	Maximum error: 0.05% of full scale

The pulse and encoder inputs (terminals 29, 32, 33) are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.
1) FC 302 only
2) Pulse inputs are 29 and 33
3) Encoder inputs: 32 = A, and 33 = B

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.

Analog output	
Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	0/4 to 20 mA
Maximum load GND - analog output less than	500 Ω
Accuracy on analog output	Maximum error: 0.5% of full scale
Resolution on analog output	12 bit

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

Control card, 24 V DC output	
Terminal number	12, 13
Output voltage	24 V +1, -3V
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.

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

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

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

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

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

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 ground connection is not galvanically isolated from protection earth. Use only an isolated laptop as PC connection to the USB connector on the frequency converter.

5

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 @ cosφ0.4)	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 (FC 302 only) terminal number	4-6 (break), 4-5 (make)
Maximum terminal load (AC-1)[1)] on 4-5 (NO) (Resistive load)	400 V AC, 2 A
Maximum terminal load (AC-15)[1)] on 4-5 (NO) (Inductive load @ cosφ0.4)	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 @ cosφ0.4)	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 part 4 and 5
The relay contacts are galvanically isolated from the rest of the circuit by reinforced isolation (PELV).

Control card performance	
Scan interval	1 ms

Control characteristics	
Resolution of output frequency at 0-590 Hz	±0.003 Hz
Repeat accuracy of precise start/stop (terminals 18, 19)	≤±0.1 ms
System response time (terminals 18, 19, 27, 29, 32, 33)	≤2 ms
Speed control range (open loop)	1:100 of synchronous speed
Speed control range (closed loop)	1:1000 of synchronous speed
Speed accuracy (open loop)	30-4000 RPM: error ±8 RPM
Speed accuracy (closed loop), depending on resolution of feedback device	0-6000 RPM: error ±0.15 RPM
Torque control accuracy (speed feedback)	maximum error ±5% of rated torque

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

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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, enclosure 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 constantly checks for critical levels of internal temperature, load current, high voltage on the intermediate circuit, and low motor speeds. As a response to a critical level, the frequency converter can adjust the switching frequency and/or change the switching pattern to ensure the performance of the frequency converter.

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5.6 Electrical Data

Mains Supply 6x380-500 V AC								
FC 302	**P250**		**P315**		**P355**		**P400**	
High/Normal Load[A)] HO/NO	HO	NO	HO	NO	HO	NO	HO	NO
Typical Shaft output at 400 V [kW]	250	315	315	355	355	400	400	450
Typical Shaft output at 460 V [HP]	350	450	450	500	500	600	550	600
Typical Shaft output at 500 V [kW]	315	355	355	400	400	500	500	530
Enclosure protection rating IP21	F8/F9		F8/F9		F8/F9		F8/F9	
Enclosure protection rating IP54	F8/F9		F8/F9		F8/F9		F8/F9	
Output current								
Continuous (at 400 V) [A]	480	600	600	658	658	745	695	800
Intermittent (60 s overload) (at 400 V) [A]	720	660	900	724	987	820	1043	880
Continuous (at 460/500 V) [A]	443	540	540	590	590	678	678	730
Intermittent (60 s overload) (at 460/500 V) [A]	665	594	810	649	885	746	1017	803
Continuous KVA (at 400 V) [KVA]	333	416	416	456	456	516	482	554
Continuous KVA (at 460 V) [KVA]	353	430	430	470	470	540	540	582
Continuous KVA (at 500 V) [KVA]	384	468	468	511	511	587	587	632
Maximum input current								
Continuous (at 400 V) [A]	472	590	590	647	647	733	684	787
Continuous (at 460/500 V) [A]	436	531	531	580	580	667	667	718
Maximum cable size, mains [mm^2 (AWG[2)])]	4x90 (3/0)		4x90 (3/0)		4x240 (500 mcm)		4x240 (500 mcm)	
Maximum cable size, motor [mm^2 (AWG[2)])]	4x240 (4x500 MCM)		4x240 (4x500 MCM)		4x240 (4x500 MCM)		4x240 (4x500 MCM)	
Maximum cable size, brake [mm^2 (AWG[2)])	2x185 (2x350 MCM)		2x185 (2x350 MCM)		2x185 (2x350 MCM)		2x185 (2x350 MCM)	
Maximum external mains fuses [A][1)]	700							
Estimated power loss at 400 V [W][4)]	5164	6790	6960	7701	7691	8879	8178	9670
Estimated power loss at 460 V [W]	4822	6082	6345	6953	6944	8089	8085	8803
Weight,enclosure protection rating IP21, IP54 [kg]	440/656							
Efficiency[4)]	0.98							
Output frequency	0-600 Hz							
Heat sink overtemperature trip	95 °C							
Power card ambient trip	75 °C							
A) High overload = 160% torque during 60 s, Normal overload = 110% torque during 60 s								

Table 5.1 Mains Supply 6x380-500 V AC

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Mains Supply 6x380-500 V AC												
FC 302	**P450**		**P500**		**P560**		**P630**		**P710**		**P800**	
High/Normal Load[A)] HO/NO	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO
Typical Shaft output at 400 V [kW]	450	500	500	560	560	630	630	710	710	800	800	1000
Typical Shaft output at 460 V [HP]	600	650	650	750	750	900	900	1000	1000	1200	1200	1350
Typical Shaft output at 500 V [kW]	530	560	560	630	630	710	710	800	800	1000	1000	1100
Enclosure protection rating IP21, 54 without/with options cabinet	F10/F11		F10/F11		F10/F11		F10/F11		F12/F13		F12/F13	
Output current												
Continuous (at 400 V) [A]	800	880	880	990	990	1120	1120	1260	1260	1460	1460	1720
Intermittent (60 s overload) (at 400 V) [A]	1200	968	1320	1089	1485	1232	1680	1386	1890	1606	2190	1892
Continuous (at 460/500 V) [A]	730	780	780	890	890	1050	1050	1160	1160	1380	1380	1530
Intermittent (60 s overload) (at 460/500 V) [A]	1095	858	1170	979	1335	1155	1575	1276	1740	1518	2070	1683
Continuous KVA (at 400 V) [KVA]	554	610	610	686	686	776	776	873	873	1012	1012	1192
Continuous KVA (at 460 V) [KVA]	582	621	621	709	709	837	837	924	924	1100	1100	1219
Continuous KVA (at 500 V) [KVA]	632	675	675	771	771	909	909	1005	1005	1195	1195	1325
Maximum input current												
Continuous (at 400 V) [A]	779	857	857	964	964	1090	1090	1227	1227	1422	1422	1675
Continuous (at 460/500 V) [A]	711	759	759	867	867	1022	1022	1129	1129	1344	1344	1490
Maximum cable size,motor [mm^2 (AWG[2)])]	8x150 (8x300 MCM)								12x150 (12x300 MCM)			
Maximum cable size,mains [mm^2 (AWG[2)])]	6x120 (6x250 MCM)											
Maximum cable size, brake [mm^2 (AWG[2)])	4x185 (4x350 MCM)								6x185 (6x350 MCM)			
Maximum external mains fuses [A][1)]	900						1500					
Estimated power loss at 400 V [W][4)]	9492	10647	10631	12338	11263	13201	13172	15436	14967	18084	16392	20358
Estimated power loss at 460 V [W]	8730	9414	9398	11006	10063	12353	12332	14041	13819	17137	15577	17752
F9/F11/F13 maximum added losses A1 RFI, CB or Disconnect, & contactor F9/F11/F13	893	963	951	1054	978	1093	1092	1230	2067	2280	2236	2541
Maximum panel options losses	400											
Weight,enclosure protection rating 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	0-600 Hz											
Heat sink overtemperature trip	95 °C											
Power card ambient trip	75 °C											
A) High overload = 160% torque during 60 s, Normal overload = 110% torque during 60 s												

Table 5.2 Mains Supply 6x380-500 V AC

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Mains Supply 6x525-690 V AC								
FC 302	**P355**		**P400**		**P500**		**P560**	
High/Normal Load[A)] HO/NO	HO	NO	HO	NO	HO	NO	HO	NO
Typical Shaft output at 550 V [kW]	315	355	315	400	400	450	450	500
Typical Shaft output at 575 V [HP]	400	450	400	500	500	600	600	650
Typical Shaft output at 690 V [kW]	355	450	400	500	500	560	560	630
Enclosure protection rating IP21	F8/F9		F8/F9		F8/F9		F8/F9	
Enclosure protection rating IP54	F8/F9		F8/F9		F8/F9		F8/F9	
Output current								
Continuous (at 550 V) [A]	395	470	429	523	523	596	596	630
Intermittent (60 s overload) (at 550 V) [A]	593	517	644	575	785	656	894	693
Continuous (at 575/690 V) [A]	380	450	410	500	500	570	570	630
Intermittent (60 s overload) (at 575/690 V) [A]	570	495	615	550	750	627	855	693
Continuous KVA (at 550 V) [KVA]	376	448	409	498	498	568	568	600
Continuous KVA (at 575 V) [KVA]	378	448	408	498	498	568	568	627
Continuous KVA (at 690 V) [KVA]	454	538	490	598	598	681	681	753
Maximum input current								
Continuous (at 550 V) [A]	381	453	413	504	504	574	574	607
Continuous (at 575 V) [A]	366	434	395	482	482	549	549	607
Continuous (at 690 V) [A]	366	434	395	482	482	549	549	607
Maximum cable size, mains [mm^2 (AWG)]	4x85 (3/0)							
Maximum cable size, motor [mm^2 (AWG)]	4x250 (500 MCM)							
Maximum cable size, brake [mm^2 (AWG)]	2x185 (2x350 MCM)		2x185 (2x350 MCM)		2x185 (2x350 MCM)		2x185 (2x350 MCM)	
Maximum external mains fuses [A][1)]	630							
Estimated power loss at 600 V [W][4)]	5107	6132	5538	6903	7336	8343	8331	9244
Estimated power loss at 690 V [W][4)]	5383	6449	5818	7249	7671	8727	8715	9673
Weight, enclosure protection rating IP21, IP54 [kg]	440/656							
Efficiency[4)]	0.98							
Output frequency	0-500 Hz							
Heat sink overtemperature trip	85 °C							
Power card ambient trip	75 °C							
A) High overload = 160% torque during 60 s, Normal overload = 110% torque during 60 s								

Table 5.3 Mains Supply 6x525-690 V AC

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Mains Supply 6x525-690 V AC						
FC 302	**P630**		**P710**		**P800**	
High/Normal Load[A)] HO/NO	HO	NO	HO	NO	HO	NO
Typical Shaft output at 550 V [kW]	500	560	560	670	670	750
Typical Shaft output at 575 V [HP]	650	750	750	950	950	1050
Typical Shaft output at 690 V [kW]	630	710	710	800	800	900
Enclosure protection rating IP21, IP54 without/with options cabinet	F10/F11		F10/F11		F10/F11	
Output current						
Continuous (at 550 V) [A]	659	763	763	889	889	988
Intermittent (60 s overload) (at 550 V) [A]	989	839	1145	978	1334	1087
Continuous (at 575/690 V) [A]	630	730	730	850	850	945
Intermittent (60 s overload) (at 575/690 V) [A]	945	803	1095	935	1275	1040
Continuous KVA (at 550 V) [KVA]	628	727	727	847	847	941
Continuous KVA (at 575 V) [KVA]	627	727	727	847	847	941
Continuous KVA (at 690 V) [KVA]	753	872	872	1016	1016	1129
Maximum input current						
Continuous (at 550 V) [A]	642	743	743	866	866	962
Continuous (at 575 V) [A]	613	711	711	828	828	920
Continuous (at 690 V) [A]	613	711	711	828	828	920
Maximum cable size, motor [mm^2 (AWG[2)])]	8x150 (8x300 MCM)					
Maximum cable size,mains [mm^2 (AWG[2)])]	6x120 (6x250 MCM)					
Maximum cable size, brake [mm^2 (AWG[2)])	4x185 (4x350 MCM)					
Maximum external mains fuses [A][1)]	900					
Estimated power loss at 600 V [W][4)]	9201	10771	10416	12272	12260	13835
Estimated power loss at 690 V [W][4)]	9674	11315	10965	12903	12890	14533
F3/F4 Maximum added losses CB or Disconnect & Contactor	342	427	419	532	519	615
Maximum panel options losses	400					
Weight, enclosure protection rating IP21, IP54 [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					
Heat sink overtemperature trip	85 °C					
Power card ambient trip	75 °C					
[A)] High overload = 160% torque during 60 s, Normal overload = 110% torque during 60 s						

Table 5.4 Mains Supply 6x525-690 V AC

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Mains Supply 6x525-690 V AC								
FC 302	**P900**		**P1M0**		**P1M2**		**P1M4**	
High/Normal Load[A)] HO/NO	HO	NO	HO	NO	HO	NO	HO	NO
Typical Shaft output at 550 V [kW]	750	850	850	1000	1000	1100	1100	1250
Typical Shaft output at 575 V [HP]	1050	1150	1150	1350	1350	1550	1550	1700
Typical Shaft output at 690 V [kW]	900	1000	1000	1200	1200	1400	1400	1600
Enclosure protection rating IP21, IP54 without/with options cabinet	F12/F13		F12/F13		F12/F13		F14	
Output current								
Continuous (at 550 V) [A]	988	1108	1108	1317	1317	1479	1479	1652
Intermittent (60 s overload) (at 550 V) [A]	1482	1219	1662	1449	1976	1627	2218.5	1817.2
Continuous (at 575/690 V) [A]	945	1060	1060	1260	1260	1415	1415	1580
Intermittent (60 s overload) (at 575/690 V) [A]	1418	1166	1590	1386	1890	1557	2122	1738
Continuous KVA (at 550 V) [KVA]	941	1056	1056	1255	1255	1409	1409	1574
Continuous KVA (at 575 V) [KVA]	941	1056	1056	1255	1255	1409	1409	1574
Continuous KVA (at 690 V) [KVA]	1129	1267	1267	1506	1506	1691	1348	1505
Maximum input current								
Continuous (at 550 V) [A]	962	1079	1079	1282	1282	1440	1440	1608
Continuous (at 575 V) [A]	920	1032	1032	1227	1227	1378	1378	1538
Continuous (at 690 V) [A]	920	1032	1032	1227	1227	1378	1378	1538
Maximum cable size, motor [mm² (AWG[2)])]	12x150 (12x300 MCM)							
Maximum cable size,mains F12 [mm² (AWG[2)])]	8x240 (8x500 MCM)							
Maximum cable size,mains F13 [mm² (AWG[2)])]	8x400 (8x900 MCM)							
Maximum cable size, brake [mm² (AWG[2)])	6x185 (6x350 MCM)							
Maximum external mains fuses [A][1)]	1600		2000		2500			
Estimated power loss at 600 V [W][4)]	13755	15592	15107	18281	18181	20825	18843	21464
Estimated power loss at 690 V [W][4)]	14457	16375	15899	19207	19105	21857	19191	21831
F3/F4 Maximum added losses CB or Disconnect & Contactor	556	665	634	863	861	1044	1016	1267
Maximum panel options losses	400							
Weight,enclosure protection rating IP21, IP54 [kg]	1246/1541		1246/1541		1280/1575		3077/3372	
Weight, Rectifier Module [kg]	136							
Weight, Inverter Module [kg]	102				136			
Efficiency[4)]	0.98							
Output frequency	0-500 Hz							
Heat sink overtemperature trip	85 °C							
Power card ambient trip	75 °C							
A) High overload = 160% torque during 60 s, Normal overload = 110% torque during 60 s								

Table 5.5 Mains Supply 6x525-690 V AC

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1) For type of fuse see chapter 3.4.13 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. Motors with lower efficiency also add to the power loss in the frequency converter and vice-versa.
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 additional losses of up to 30 W may be incurred due to additional options and customer load. However, the typical additional losses are only 4 W extra each for a fully loaded control card, or options for slot A or slot B.
Although measurements are made with state of the art equipment, some measurement inaccuracy must be allowed for (±5%).

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6 Warnings and Alarms

6.1 Warning and Alarm Definitions

The following warning/alarm information defines each warning/alarm condition, provides the probable cause for the condition, and details a remedy or troubleshooting procedure.

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 *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 *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

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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 *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 *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 *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*

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- *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. 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.

WARNING/ALARM 22, Hoist mechanical brake
Report value shows what kind it is.
0 = The torque reference was not reached before time out (*2-27 Torque Ramp Up Time*).
1 = Expected brake feedback not received before time out (*2-23 Activate Brake Delay*, *2-25 Brake Release Time*).

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.

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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 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 6.1* 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.

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Number	Text
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.
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 6.1 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 *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 45, Earth fault 2
Ground fault.

Troubleshooting

- Check for proper grounding and loose connections.
- Check for proper wire size.
- Check the motor cables for short-circuits or leakage currents.

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 *4-11 Motor Speed Low Limit [RPM]* and *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.

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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/ALARM 61, Tracking error
An error has occurred between the calculated motor speed and the speed measurement from the feedback device. The function warning/alarm/disable is set in *4-30 Motor Feedback Loss Function*. Accepted error setting in *4-31 Motor Feedback Speed Error* and the allowed time the error occur setting in *4-32 Motor Feedback Loss Timeout*. During a commissioning procedure, the function could be effective.

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

ALARM 63, Mechanical brake low
The actual motor current has not exceeded the release brake current within the start delay time window.

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 *2-00 DC Hold/Preheat Current* at 5% and *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 71, PTC 1 Safe Torque Off
STO has been activated from the VLT® PTC Thermistor Card MCB 112 (motor too warm). Normal operation can resume when the VLT® PTC Thermistor Card MCB 112 applies 24 V DC to terminal 37 (when the motor temperature is acceptable) and when the digital input from the VLT® PTC Thermistor Card MCB 112 is deactivated. When that happens, a reset signal is be sent (via Bus, Digital I/O, or by pressing [Reset]).

NOTICE

If automatic restart is enabled, the motor could start when the fault is cleared.

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 81, CSIV corrupt
CSIV file has syntax errors.

ALARM 82, CSIV parameter error
CSIV failed to initialise a parameter.

ALARM 85, Dang fail PB
PROFIBUS/PROFIsafe error.

WARNING/ALARM 104, Mixing fan fault
The fan is not operating. The fan monitor checks that the fan is spinning at power-up or whenever the mixing fan is turned on. The mixing-fan fault can be configured as a warning or an alarm trip in *14-53 Fan Monitor*.

Troubleshooting

- Cycle power to the frequency converter to determine if the warning/alarm returns.

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.

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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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