MAKING MODERN LIVING POSSIBLE

Operating Instructions 12-Pulse High Power

VLT® HVAC Drive FC 100

VLT®
THE REAL DRIVE

Contents

1 How to Read the Instruction Manual

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1.1.2 Symbols

Symbols used in this manual

NOTE!

Indicates something to be noted by the reader.

⚠CAUTION

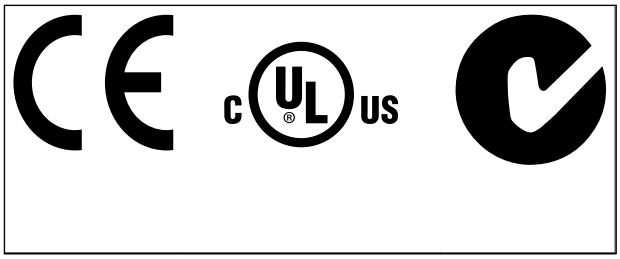
Indicates a general warning.

⚠WARNING

Indicates a high-voltage warning.

★ Indicates default setting

1.1.3 Approvals



1.1.4 Available Literature for VLT HVAC Drive

- Instruction Manual MG.16.Bx.yy provides the necessary information for getting the Adjustable frequency drive up and running.
- Design Guide MG.11.Bx.yy provides all technical information about the Adjustable frequency drive and customer design and applications.
- Programming Guide MG.11.Cx.yy provides information on how to program and includes complete parameter descriptions.
- Mounting Instruction, Analog I/O Option MCB 109, MI.38.Bx.yy
- Application Note, Temperature Derating Guide, MN.11.Ax.yy
- PC-based Configuration Tool MCT 10, MG.10.Ax.yy enables the user to configure the Adjustable frequency drive from a Windows™-based PC environment.
- Danfoss VLT® Energy Box software at *www.danfoss.com/BusinessAreas/DrivesSolutions* then choose PC Software Download
- VLT HVAC Drive Drive Applications, MG.11.Tx.yy
- Instruction Manual VLT HVAC Drive Profibus, MG.33.Cx.yy
- Instruction Manual VLT HVAC Drive Device Net, MG.33.Dx.yy
- Instruction Manual VLT HVAC Drive BACnet, MG.11.Dx.yy

- Instruction Manual VLT HVAC Drive LonWorks, MG.11.Ex.yy
- Instruction Manual VLT HVAC Drive Metasys, MG.11.Gx.yy
- Instruction Manual VLT HVAC Drive FLN, MG.11.Zx.yy
- Output Filter Design Guide, MG.90.Nx.yy
- Brake Resistor Design Guide, MG.90.Ox.yy

x = Revision number
yy = Language code

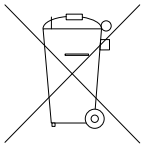
Danfoss technical literature is available in print from your local Danfoss Sales Office or online at: *www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.htm*

1.1.5 Abbreviations and Standards

Abbreviations:	Terms:	SI units:	I-P units:
a	Acceleration	m/s^2	ft/s^2
AWG	American wire gauge		
Auto Tune	Automatic Motor Tuning		
°C	Celsius		
I	Current	A	Amp
I_{LIM}	Current limit		
IT line power	Line power supply with star point in transformer floating to ground.		
Joule	Energy	J = N·m	ft-lb, Btu
°F	Fahrenheit		
FC	Adjustable Frequency Drive		
f	Frequency	Hz	Hz
kHz	Kilohertz	kHz	kHz
LCP	Local Control Panel		
mA	Milliampere		
ms	Millisecond		
min	Minute		
MCT	Motion Control Tool		
M-TYPE	Motor Type Dependent		
Nm	Newton meters		in-lbs
$I_{M,N}$	Nominal motor current		
$f_{M,N}$	Nominal motor frequency		
$P_{M,N}$	Nominal motor power		
$U_{M,N}$	Nominal motor voltage		
par.	Parameter		
PELV	Protective Extra Low Voltage		
Watt	Power	W	Btu/hr, hp
Pascal	Pressure	$Pa = N/m^2$	psi, psf, ft of water
I_{INV}	Rated Inverter Output Current		
RPM	Revolutions Per Minute		
SR	Size Related		
T	Temperature	C	F
t	Time	s	s, hr
T_{LIM}	Torque limit		
U	Voltage	V	V

Table 1.1 Abbreviation and standards table

1.1.6 Disposal Instructions



Equipment containing electrical components may not be disposed of together with domestic waste.
It must be separately collected with electrical and electronic waste according to local and currently valid legislation.

2 Safety

Caution

The adjustable frequency drive DC link capacitors remain charged after power has been disconnected. To avoid the electrical shock hazard, disconnect the adjustable frequency drive from line power before carrying out maintenance. Before servicing the adjustable frequency drive, wait the minimum amount of time indicated below:

380–500 V	425–1350 hp [315–1000 kW]	40 minutes
525–690 V	535–1875 hp [400–1400 kW]	30 minutes

VLT HVAC Drive
Instruction Manual
Software version: 3.5x

This instruction manual can be used for all VLT HVAC Drive adjustable frequency drives with software version 3.5x.
The software version number can be seen from *15-43 Software Version*.

2.1.1 High Voltage

WARNING

The voltage of the adjustable frequency drive is dangerous whenever the adjustable frequency drive is connected to line power. Incorrect installation or operation of the motor or adjustable frequency drive may cause damage to the equipment, serious personal injury or death. The instructions in this manual must therefore be observed, in addition to applicable local and national rules and safety regulations.

WARNING

Installation at high altitudes
380–500V: At altitudes above 9,843 feet [3 km], please contact Danfoss regarding PELV.
525–690V: At altitudes above 6561 ft [2 km], please contact Danfoss regarding PELV.

2.1.2 Safety Instructions

- Make sure the adjustable frequency drive is properly grounded.
- Protect users against supply voltage.
- Protect the motor against overloading according to national and local regulations.
- Motor overload protection is not included in the default settings. To add this function, set *1-90 Motor Thermal Protection* to value *ETR trip* or *ETR warning*. For the North American market: ETR functions provide class 20 motor overload protection in accordance with NEC.
- The ground leakage current exceeds 3.5mA.
- The [OFF] key is not a safety switch. It does not disconnect the adjustable frequency drive from line power.

2.1.3 General Warning

WARNING

Warning:
Touching the electrical parts may be fatal - even after the equipment has been disconnected from line power.
Make sure that other voltage inputs have been disconnected, such as load sharing (linkage of DC intermediate circuit), as well as the motor connection for kinetic backup.
When using the adjustable frequency drive: wait at least 40 minutes.
Shorter time is allowed only if indicated on the nameplate for the specific unit.

CAUTION

Leakage Current
The ground leakage current from the adjustable frequency drive exceeds 3.5 mA. To ensure that the ground cable has a good mechanical connection to the ground connection (terminal 95), the cable cross-section must be at least 0.016 in^2 [10 mm^2] or 2 rated ground wires terminated separately. For proper grounding for EMC, see section *Grounding* in the *How to Install* chapter.
Residual Current Device
This product can cause DC current in the protective conductor. Where a residual current device (RCD) is used for extra protection, only an RCD of Type B (time delayed) shall be used on the supply side of this product. See also RCD Application Note MN.90.Gx.02 (x=version number).
Protective grounding of the adjustable frequency drive and the use of RCDs must always follow national and local regulations.

2

2.1.4 Before Commencing Repair Work

1. Disconnect the adjustable frequency drive from line power.
2. Disconnect DC bus terminals 88 and 89 from load share applications
3. Wait for the discharge of the DC link. See period of time on the warning label.
4. Remove motor cable

2.1.5 Avoid Unintended Start

While the adjustable frequency drive is connected to line power, the motor can be started/stopped using digital commands, bus commands, references or via the Local Control Panel (LCP):

- Disconnect the adjustable frequency drive from line power whenever personal safety considerations make it necessary to avoid an unintended start.
- To avoid unintended start, always activate the [OFF] key before changing parameters.
- An electronic fault, temporary overload, a fault in the line power supply, or lost motor connection may cause a stopped motor to start. The adjustable frequency drive with safe stop provides protection against unintended start, if Safe Stop Terminal 37 is deactivated or disconnected.

2.1.6 Safe Stop

The Adjustable frequency drive can perform the safety function *Safe Torque Off* (As defined by draft CD IEC 61800-5-2) or *Stop Category 0* (as defined in EN 60204-1).

It is designed and approved suitable for the requirements of Safety Category 3 in EN 954-1. This functionality is called Safe Stop. Prior to integration and use of Safe Stop in an installation, a thorough risk analysis on the installation must be carried out in order to determine whether the Safe Stop functionality and safety category are appropriate and sufficient. In order to install and use the Safe Stop function in accordance with the requirements of Safety Category 3 in EN 954-1, the related information and instructions of the Design Guide must be followed! The information and instructions of the Instruction Manual are not sufficient for a correct and safe use of the safe stop functionality!

2.1.7 Safe Stop Installation

To carry out an installation of a Category 0 Stop (EN60204) in conformity with Safety Category 3 (EN954-1), follow these instructions:

1. The bridge (jumper) between Terminal 37 and 24V DC must be removed. Cutting or breaking the jumper is not sufficient. Remove it entirely to avoid short-circuiting. See jumper on *Figure 2.1*.
2. Connect terminal 37 to 24 V DC by a short circuit-protected cable. The 24 V DC voltage supply must be interruptible by an EN954-1 category 3 circuit interrupt device. If the interrupt device and the Adjustable frequency drive are placed in the same installation panel, you can use an non-shielded cable instead of a shielded one.

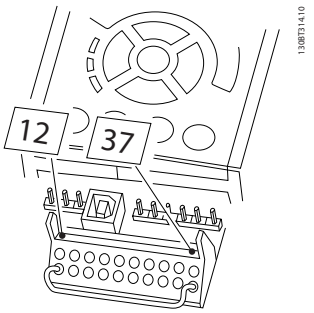


Figure 2.1 Bridge jumper between terminal 37 and 24 VDC

Figure 2.2 shows a Stopping Category 0 (EN 60204-1) with safety Category 3 (EN 954-1). The circuit interrupt is caused by an opening door contact. The illustration also shows how to connect a non-safety related hardware coast.

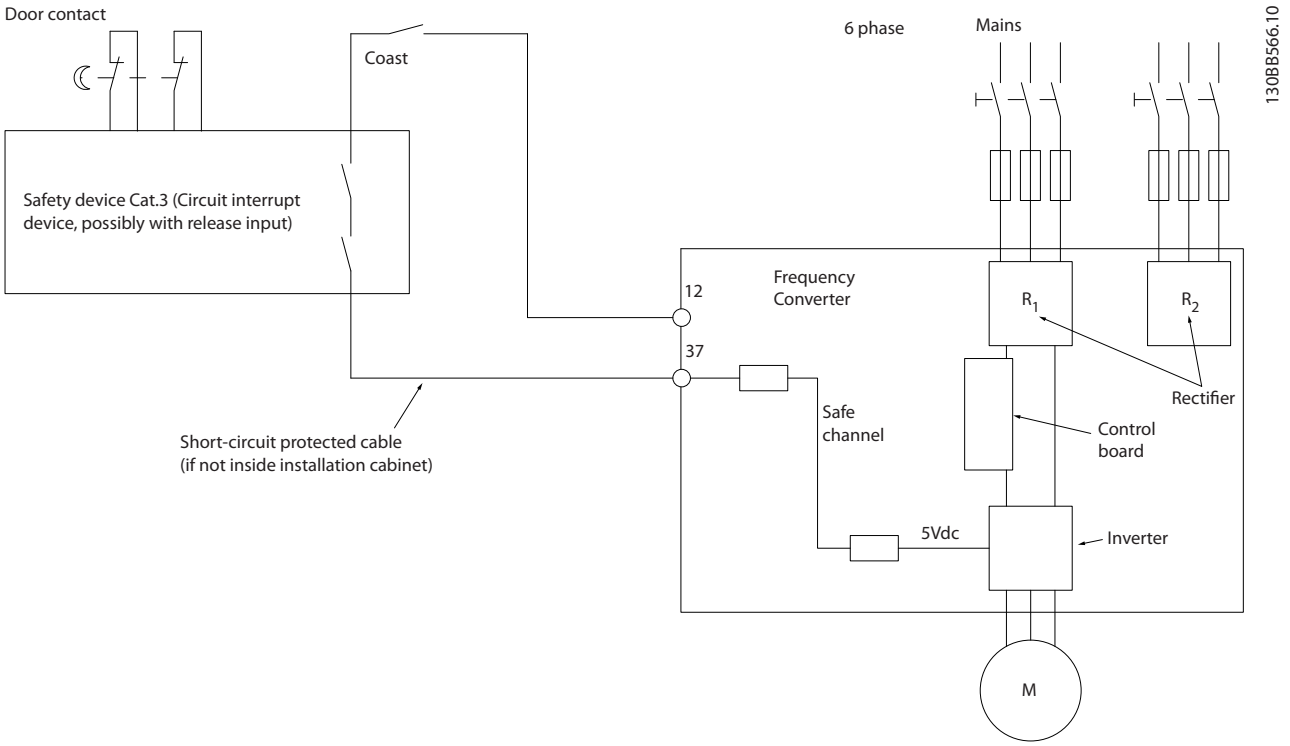


Figure 2.2 Essential aspects of an installation to achieve a Stopping Category 0 (EN 60204-1) with safety Category 3 (EN 954-1).

2.1.8 IT Line Power

14-50 RFI 1 can be used to disconnect the internal RFI capacitors from the RFI filter to ground in the 380–500V adjustable frequency drives. If this is done, it will reduce the RFI performance to A2 level. For the 525–690V adjustable frequency drives, *14-50 RFI 1* has no function. The RFI switch cannot be opened.

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3 Mechanical Installation

3.1 Pre-installation

3.1.1 Planning the Installation Site

NOTE!

Before performing the installation, it is important to plan the installation of the adjustable frequency drive. 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 in the respective Design Guides):

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

3.1.2 Receiving the Adjustable Frequency Drive

When receiving the adjustable frequency drive, make sure that the packaging is intact, and look for any damage that might have occurred to the unit during transport. If damage has occurred, immediately contact the shipping company to make a damage claim.

3.1.3 Transportation and Unpacking

Before unpacking the adjustable frequency drive, it is recommended to unload it as close as possible to the final installation site.
Remove the box and handle the adjustable frequency drive on the pallet, as long as possible.

3.1.4 Lifting

Always lift the adjustable frequency drive using the dedicated lifting holes. For all D and E2 (IP00) enclosures, use a bar to avoid bending the lifting holes of the adjustable frequency drive.

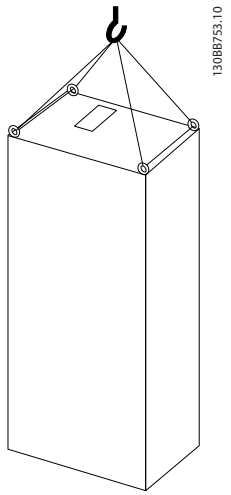

Figure 3.1 Recommended lifting method, frame size F8.

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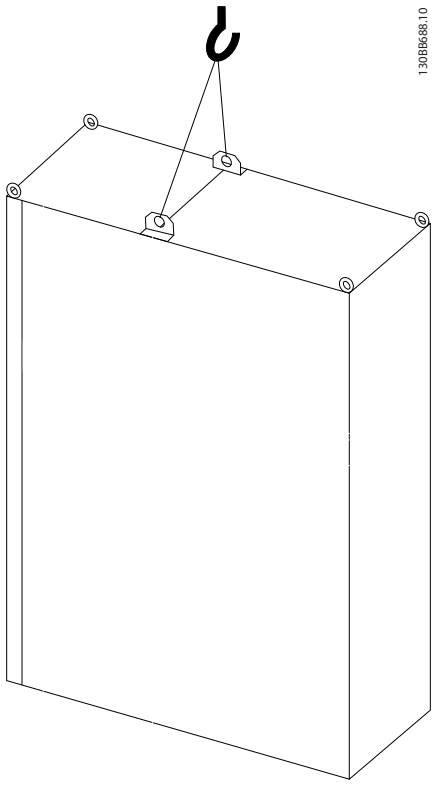


Figure 3.2 Recommended lifting method, frame size F9/F10.

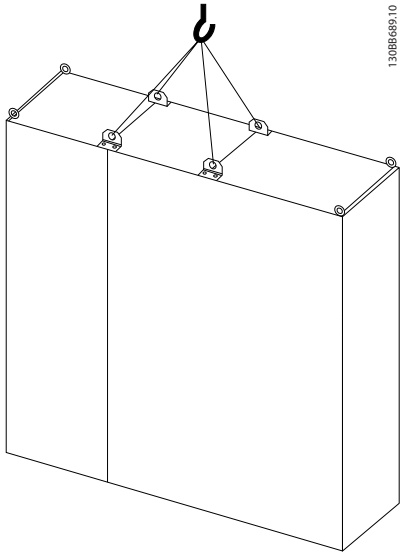


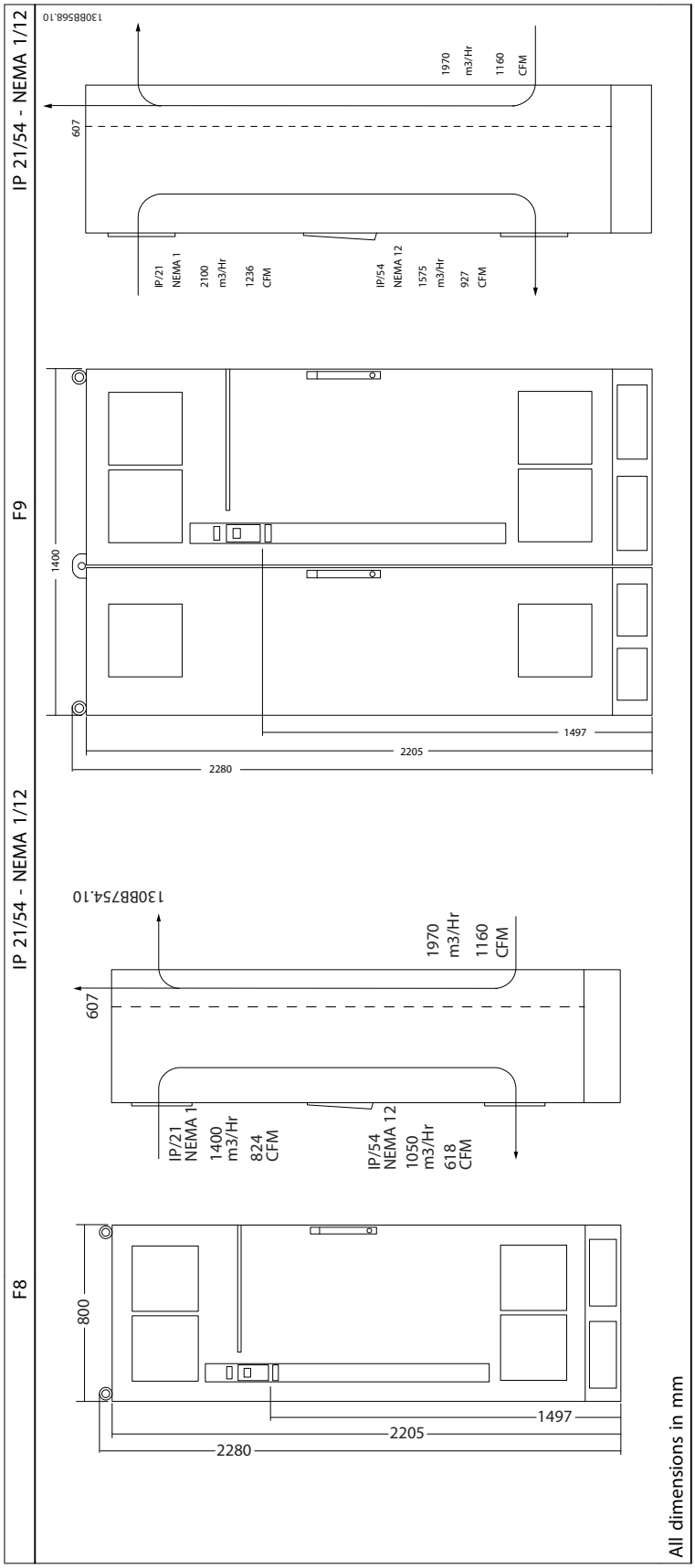
Figure 3.3 Recommended lifting method, frame size F11/F12/ F13.

NOTE!

Note the plinth is provided in the same packaging as the adjustable frequency drive but is not attached during shipment. The plinth is required to allow airflow to the drive to provide proper cooling. The F frames should be positioned on top of the plinth in the final installation location. The angle from the top of the drive to the lifting cable should be 140°F [60°C] or greater.
In addition to the drawings above a spreader bar is an acceptable way to lift the F Frame.

3

3.1.5 Mechanical Dimensions



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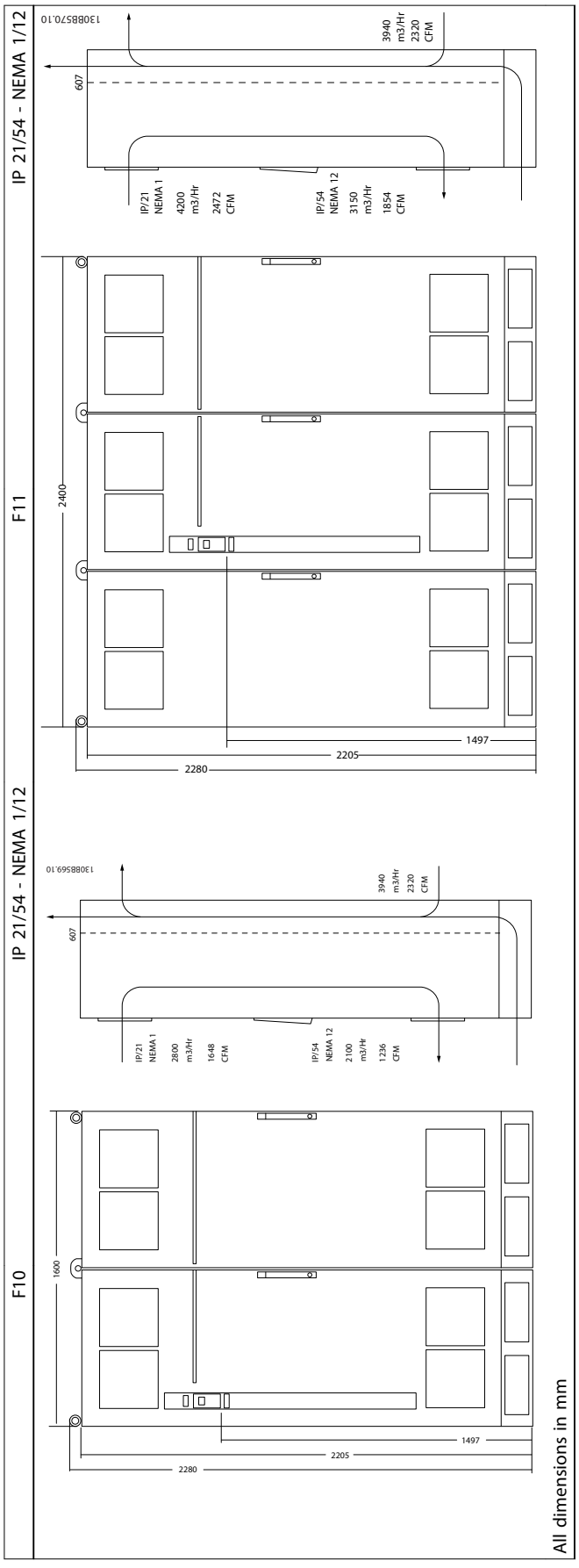
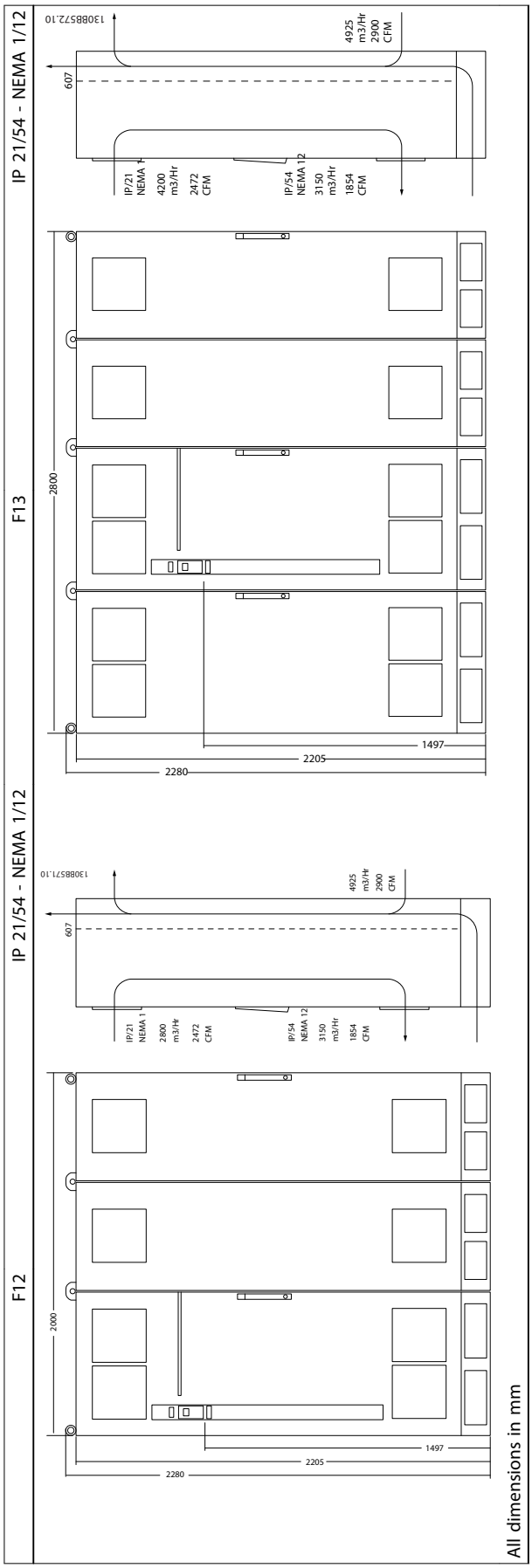
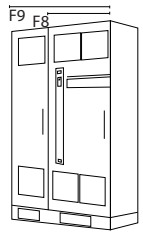
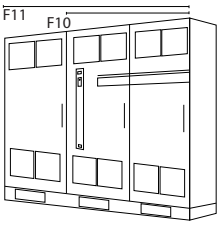
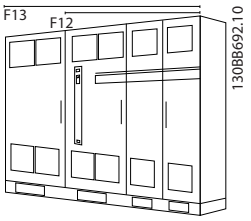

IP 21/54 - NEMA 1/12
F11
130BB570.10
3940 m3/Hr 2320 CFM
607
IP/21 NEMA 1
4200 m3/Hr
2472 CFM
IP/54 NEMA 12
3150 m3/Hr
1854 CFM
2400
1497
2205
2280
IP 21/54 - NEMA 1/12
130BB569.10
3940 m3/Hr
2320 CFM
607
IP/21 NEMA 1
2800 m3/Hr
1648 CFM
IP/54 NEMA 12
2100 m3/Hr
1236 CFM
F10
1600
1497
2205
2280
All dimensions in mm


IP 21/54 - NEMA 1/12
F13
130BB572.10
4925 m3/Hr 2900 CFM
607
IP/21 NEMA 1
4200 m3/Hr
2472 CFM
IP/54 NEMA 12
3150 m3/Hr
1854 CFM
2800
1497
2205
2280
IP 21/54 - NEMA 1/12
F12
130BB571.10
4925 m3/Hr 2900 CFM
607
IP/21 NEMA 1
2800 m3/Hr
2472 CFM
IP/54 NEMA 12
3150 m3/Hr
1854 CFM
2000
1497
2205
2280
All dimensions in mm

3

Mechanical dimensions, frame sizes E and F							
Frame size		**F8**	**F9**	**F10**	**F11**	**F12**	**F13**
							
High overload rated power - 160% overload torque		**425–600 hp [315–450 kW] (380–500 V) 535–850 hp [400–630 kW] (525–690 V)**		**675–950 hp [500–710 kW] (380–500 V) 950–1200 hp [710–900 kW] (525–690 V)**		**1075–1350 hp [800–1000 kW] (380–500 V) 1350–1875 hp [1000–1400 kW] (525–690 V)**	
IP NEMA		21, 54 Type 12		21, 54 Type 12		21, 54 Type 12	
Shipping dimensions	Height	91.5 in [2324 mm]	91.5 in [2324 mm]	91.5 in [2324 mm]	91.5 in [2324 mm]	91.5 in [2324 mm]	91.5 in [2324 mm]
	Width	38.2 in [970 mm]	61.7 in [1568 mm]	69.3 in [1760 mm]	100.75 in [2559 mm]	85 in [2160 mm]	116.5 in [2960 mm]
	Depth	44.49 in [1130 mm]	44.49 in [1130 mm]	44.49 in [1130 mm]	44.49 in [1130 mm]	44.49 in [1130 mm]	44.49 in [1130 mm]
Drive dimensions	Height	86.8 in [2204 mm]	86.8 in [2204 mm]	86.8 in [2204 mm]	86.8 in [2204 mm]	86.8 in [2204 mm]	86.8 in [2204 mm]
	Width	31.50 in [800 mm]	55.1 in [1400 mm]	63 in [1600 mm]	86.6 in [2200 mm]	78.74 in [2000 mm]	102.4 in [2600 mm]
	Depth	28.86 in [606 mm]	28.86 in [606 mm]	28.86 in [606 mm]	28.86 in [606 mm]	28.86 in [606 mm]	28.86 in [606 mm]
	Max weight	970 lbs [440 kg]	1446 lbs [656 kg]	1940 lbs [880 kg]	2416 lbs [1096 kg]	2253 lbs [1022 kg]	2729 lbs [1238 kg]

NOTE!

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

3.2 Mechanical Installation

Preparation of the mechanical installation of the adjustable frequency drive must be done carefully to ensure proper results and to avoid additional work during installation. Start by taking a close look at the mechanical drawings at the end of this instruction manual to become familiar with the space demands.

3.2.1 Tools Needed

To perform the mechanical installation, the following tools are needed:

- Drill with 0.39 or 0.47 in [10 or 12 mm] drill.
- Tape measure
- Wrench with relevant metric sockets (7–17mm)
- Extensions to wrench
- Sheet metal punch for conduits or cable connectors in IP 21/Nema 1 and IP 54 units
- Lifting bar to lift the unit (rod or tube max. Ø 25mm (1 inch), able to lift minimum 400kg (880lbs)).
- Crane or other lifting aid to place the adjustable frequency drive in position
- A Torx T50 tool is needed to install the E1 in IP21 and IP54 enclosure types.

3.2.2 General Considerations

Space

Ensure proper space above and below the adjustable frequency drive to allow airflow and cable access. In addition, space in front of the unit must be considered to allow the panel door to be opened.

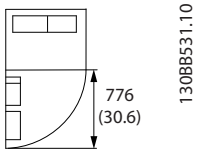


Figure 3.4 Space in front of IP21/IP54 enclosure type, frame size F8

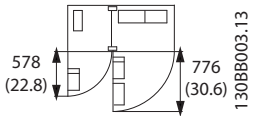


Figure 3.5 Space in front of IP21/IP54 enclosure type, frame size F9

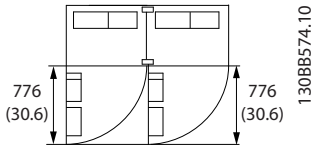


Figure 3.6 Space in front of IP21/IP54 enclosure type, frame size F10

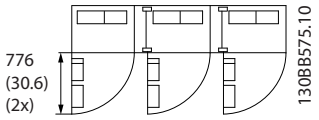


Figure 3.7 Space in front of IP21/IP54 enclosure type, frame size F11

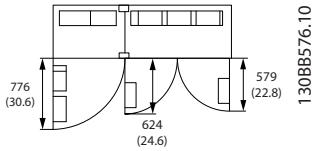


Figure 3.8 Space in front of IP21/IP54 enclosure type, frame size F12

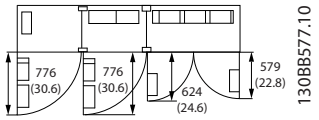


Figure 3.9 Space in front of IP21/IP54 enclosure type, frame size F13

Wire access

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

NOTE!

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

3.2.3 Terminal Locations, F8-F13

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

Terminal locations - Inverter and Rectifier Frame size F8 and F9

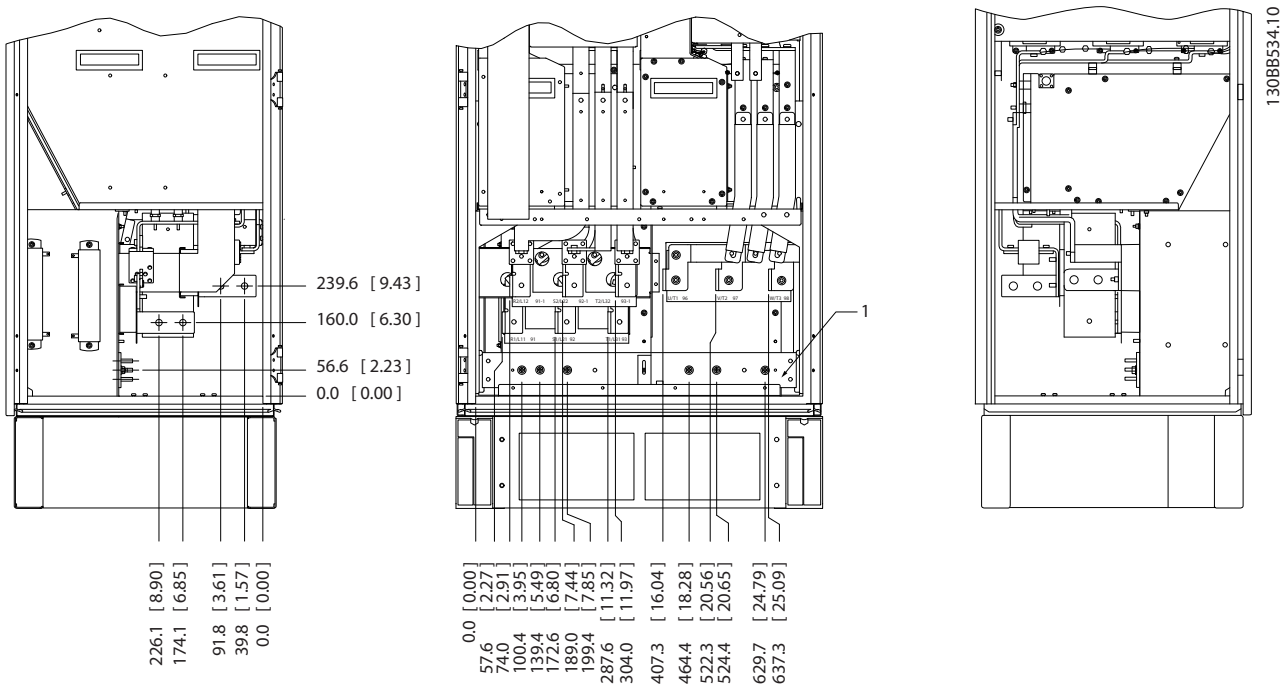


Figure 3.10 Terminal locations - Inverter and Rectifier Cabinet - F8 and F9 (front, left and right side view). The connector plate is 1.65 in [42 mm] below .0 level.

1) Ground bar

Terminal locations - Inverter Frame size F10 and F11

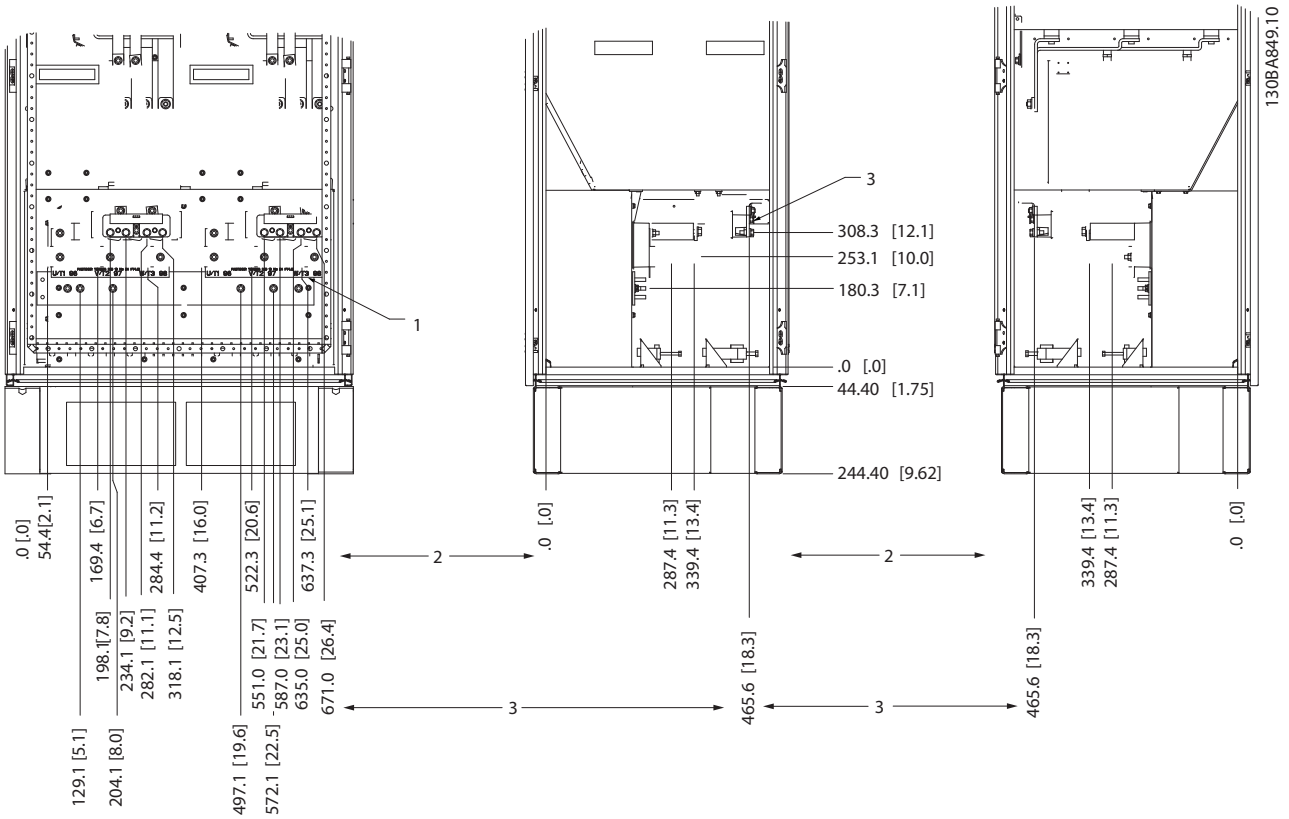


Figure 3.11 Terminal locations - Inverter Cabinet (front, left and right side view). The connector plate is 1.65 in [42 mm] below .0 level.

1) Ground bar

2) Motor terminals

3) Brake terminals

3

Terminal locations - Inverter Frame size F12 and F13

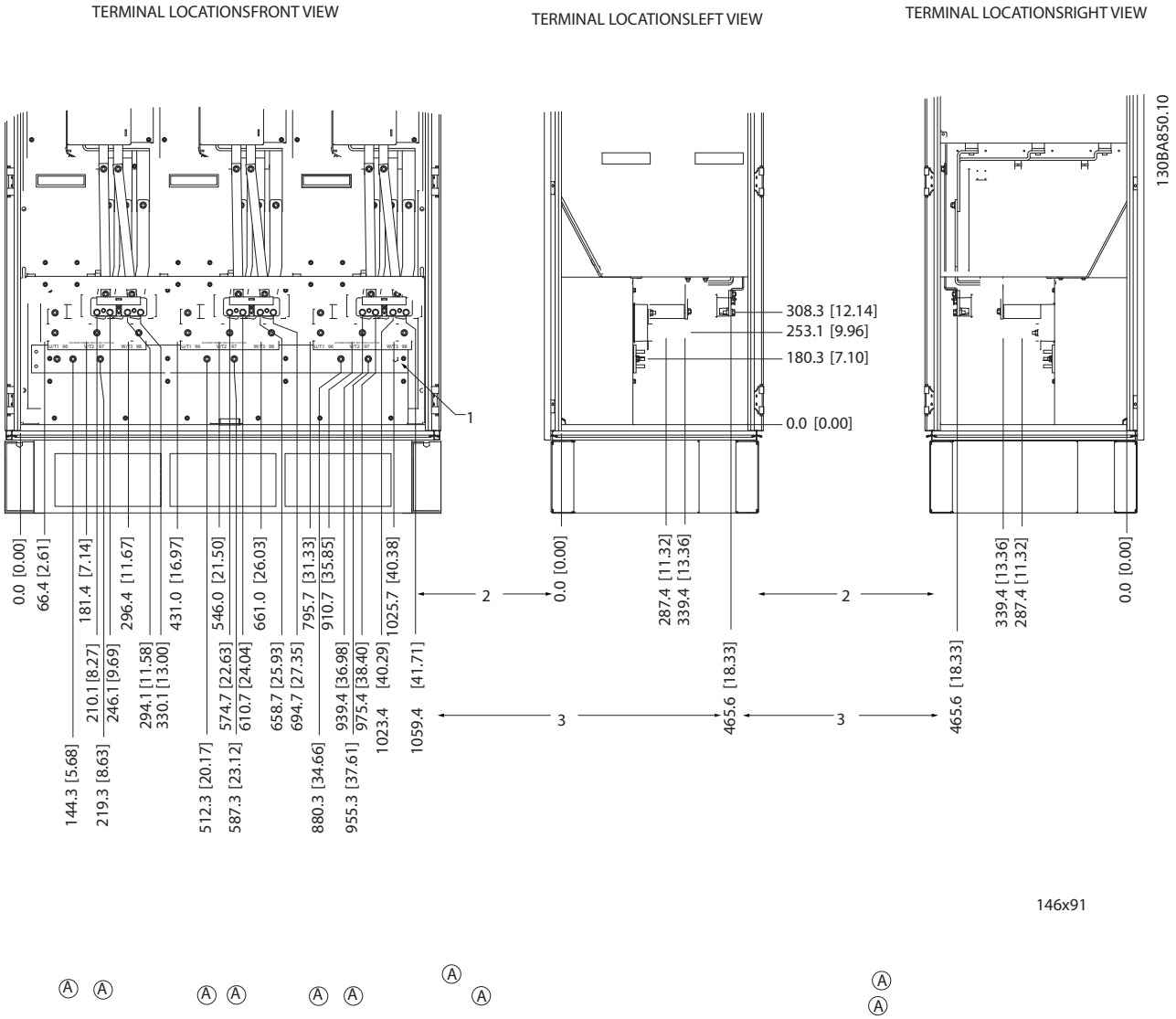


Figure 3.12 Terminal locations - Inverter Cabinet (front, left and right side view). The connector plate is 1.65 in [42 mm] below .0 level.
1) Ground bar

Terminal locations - Rectifier (F10, F11, F12 and F13)

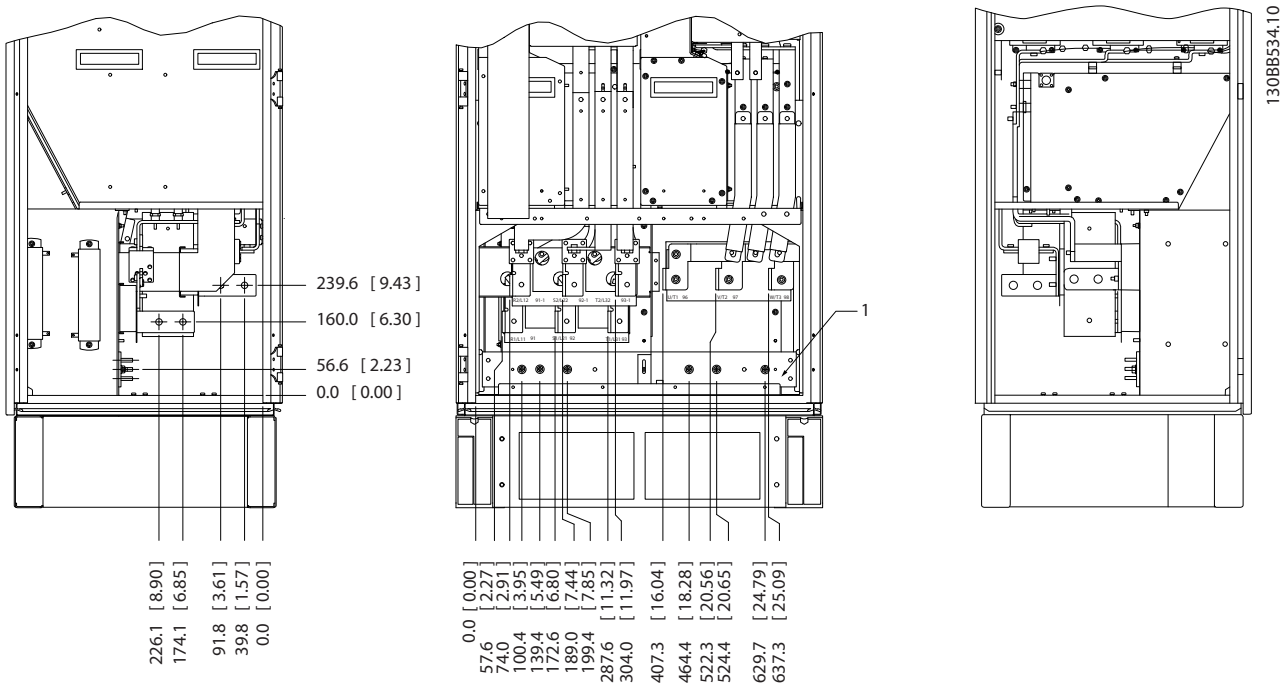


Figure 3.13 Terminal locations - Rectifier (left side, front and right side view). The connector plate is 1.65 in [42 mm] below .0 level.

1) Load share Terminal (-)

2) Ground bar

3) Load share Terminal (+)

3

Terminal locations - Options Cabinet Frame Size F9

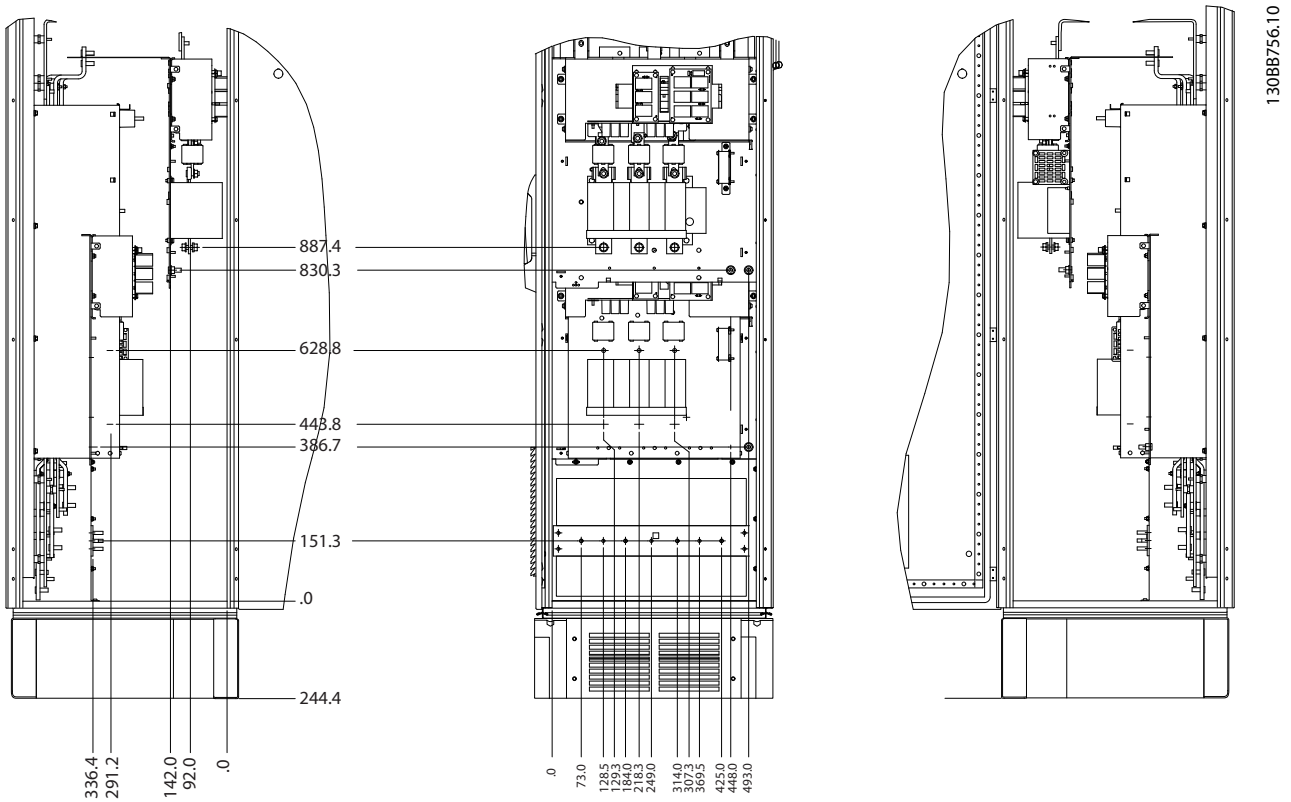


Figure 3.14 Terminal locations - Options cabinet (left side, front and right side view).

Terminal locations - Options Cabinet Frame Size F11/F13

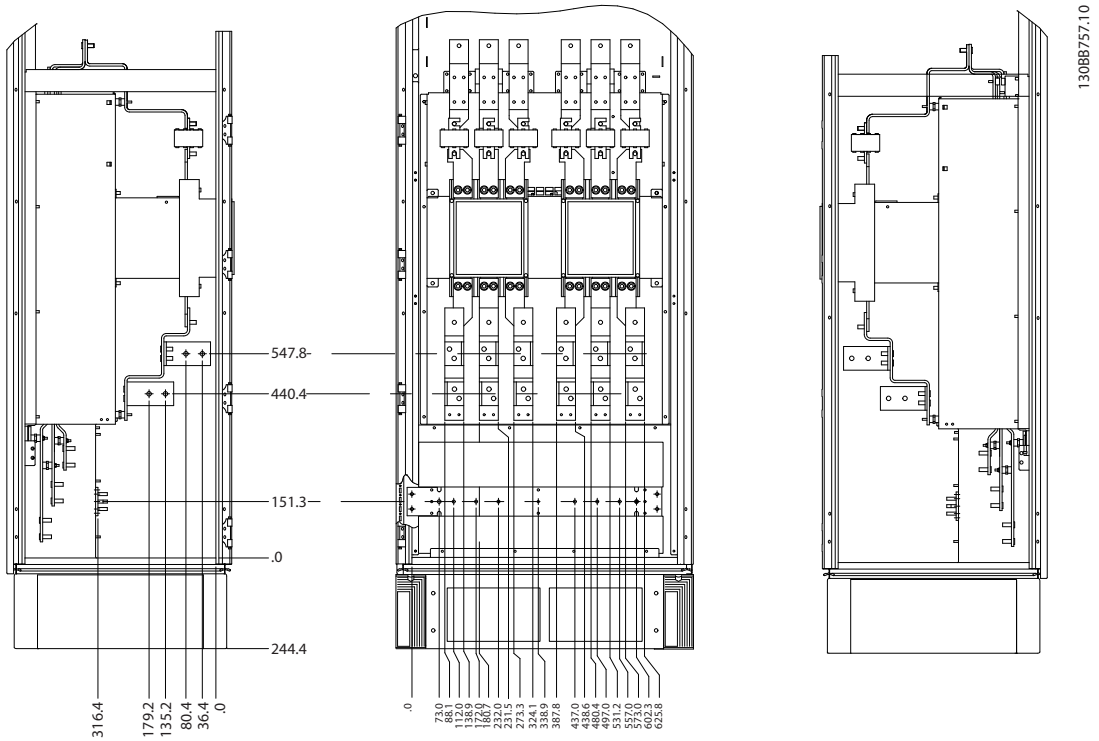


Figure 3.15 Terminal locations - Options cabinet (left side, front and right side view).

3

3.2.4 Cooling and Airflow

Cooling

Cooling can be obtained in different ways, by using the cooling ducts in the bottom and the top of the unit, by taking air in and out the back of the unit or by combining the cooling possibilities.

Duct cooling

A dedicated option has been developed to optimize installation of frequency converters in Rittal TS8 enclosures utilizing the fan of the adjustable frequency drive for forced air cooling of the backchannel. The air out the top of the enclosure could but ducted outside a facility so the heat loses from the backchannel are not dissipated within the control room reducing air-conditioning requirements of the facility.

Back cooling

The backchannel air can also be ventilated in and out the back of a Rittal TS8 enclosure. This offers a solution where the backchannel could take air from outside the facility and return the heat losses outside the facility thus reducing air-conditioning requirements.

Airflow

The necessary airflow over the heatsink must be ensured. The flow rate is shown below.

Enclosure protection	Door fan(s) / Top fan airflow	Heatsink 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 3.1 Heatsink Air Flow

** Airflow per fan. Frame size F contain multiple fans.*

NOTE!

The fan runs for the following reasons:

1. **AMA**
2. **DC Hold**
3. **Pre-Mag**
4. **DC Brake**
5. **60% of nominal current is exceeded**
6. **Specific heatsink temperature exceeded (power-size dependent).**

Once the fan is started, it will run for a minimum of 10 minutes.

External ducts

If additional duct work is added externally to the Rittal cabinet, the pressure drop in the ducting must be calculated. Use the charts below to derate the adjustable frequency drive according to the pressure drop.

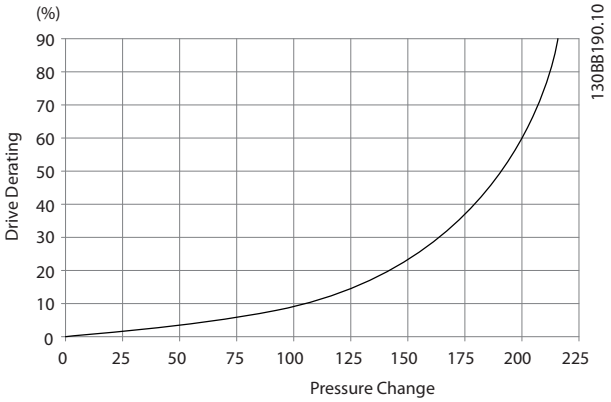


Figure 3.16 F frame Derating vs. Pressure Change
Drive air flow: 985 m^3/h (580 cfm)

3.2.5 Connector/Conduit Entry - IP21 (NEMA 1) and IP54 (NEMA12)

Cables are connected through the connector plate from the bottom. Remove the plate and plan where to place the entry for the connectors or conduits. Prepare holes in the marked area on the drawing.

NOTE!

The connector plate must be fitted to the adjustable frequency drive to ensure the specified protection degree, as well as ensuring proper cooling of the unit. If the connector plate is not mounted, the adjustable frequency drive may trip on Alarm 69, Pwr. Card Temp

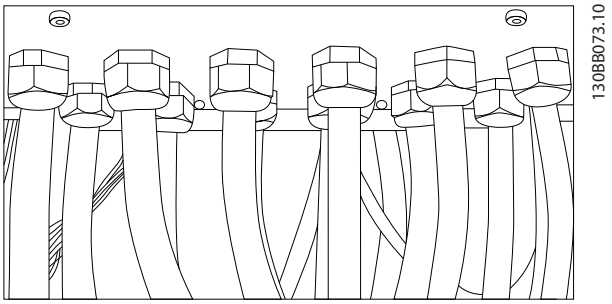
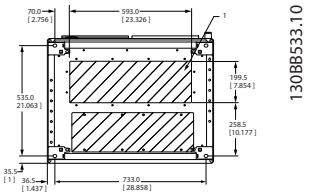
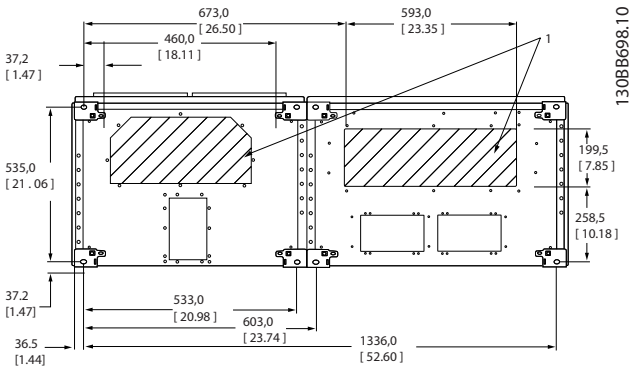


Figure 3.17 Example of proper installation of the connector plate.

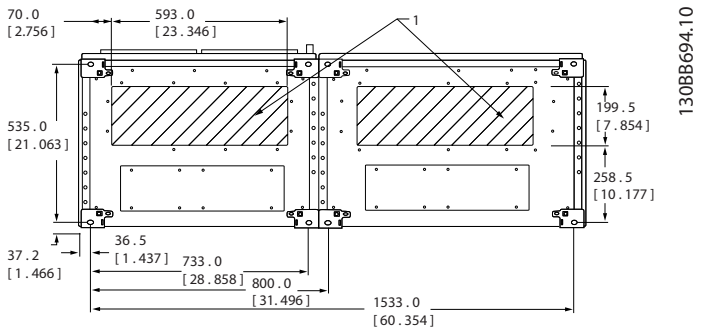
Frame size F8



Frame size F9

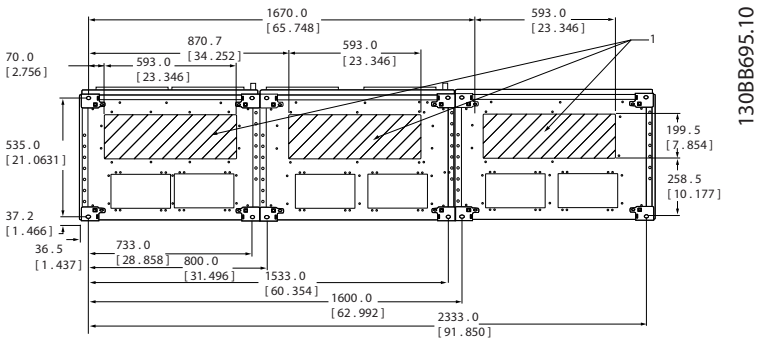


Frame size F10

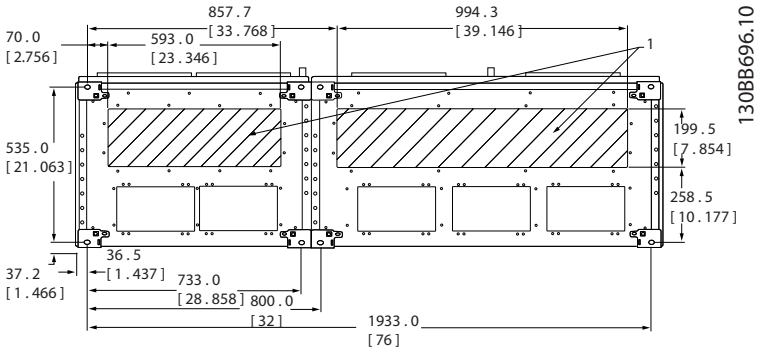


3

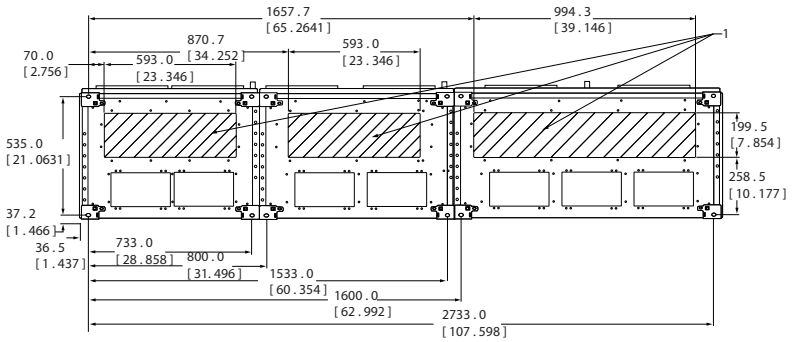
Frame size F11



Frame size F12



Frame size F13



F8-F13: Cable entries viewed from the bottom of the adjustable frequency drive - 1) Place conduits in marked areas.

3.3 Frame size F Panel Options

Space Heaters and Thermostat
Mounted on the cabinet interior of frame size F10-F13 adjustable frequency drives, space heaters controlled via automatic thermostat help control humidity inside the enclosure, extending the lifetime of drive 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 frame size F10-F13 adjustable frequency drives increase visibility during servicing and maintenance. The housing light includes a power outlet for temporarily powering tools or other devices, available in two 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 will initially be set to the 525 V tap and a 525–690V unit will be set to the 690V tap to insure no overvoltage of secondary equipment occurs if the tap is not changed prior to power being applied. See *Table 3.2* to set the proper tap at terminal T1 located in the rectifier cabinet. For location in the adjustable frequency drive, see figure of rectifier in *4.1.1 Power Connections*.

Input Voltage Range	Tap to Select
380–440 V	400V
441–490 V	460V
491–550 V	525V
551–625 V	575V
626–660 V	660V
661–690 V	690V

NAMUR Terminals
NAMUR is an international association of automation technology users in process industries, primarily in the chemical and pharmaceutical industries, in Germany. Selection of this option provides terminals organized and labeled to the specifications of the NAMUR standard for drive input and output terminals. This requires MCB 112 PTC Thermistor Card and 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 (supplied and installed by customer).

- Integrated into the drive'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

Insulation Resistance Monitor (IRM)
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. Note: only one insulation resistance monitor can be connected to each ungrounded (IT) system.

- Integrated into the drive's safe-stop circuit
- LCD display of the ohmic value of the insulation resistance
- Fault Memory
- INFO, TEST, and RESET buttons

IEC Emergency Stop with Pilz Safety Relay
Includes a redundant 4-wire emergency stop pushbutton mounted on the front of the enclosure and a Pilz relay that monitors it in conjunction with the drive's safe stop circuit and the line power contactor located in the options cabinet.

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 drive is off. Up to two starters are allowed (one if a 30 A, fuse-protected circuit is ordered). Integrated into the drive's safe-stop circuit.
Unit features include:

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

30 Ampere, Fuse-protected Terminals

- 3-phase power matching incoming AC line voltage for powering auxiliary customer equipment
- Not available if two manual motor starters are selected

- Terminals are off when the incoming power to the drive is off
- Power for the fused protected terminals will be provided from the load side of any supplied contactor, circuit breaker, or disconnect switch.

24V DC Power Supply

- 5A, 120W, 24V DC
- Protected against output overcurrent, overload, short circuits, and overtemperature
- For powering customer-supplied accessory devices such as sensors, PLC I/O, contactors, temperature probes, LEDs, 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 eight universal input modules plus two dedicated thermistor input modules. All ten modules are integrated into the drive's safe stop circuit and can be monitored via a serial communication bus network (requires the purchase of a separate module/bus coupler).

Universal inputs (8)

Signal types:

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

Additional features:

- One universal output, configurable for analog voltage or analog current
- Two 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 six thermistors in a series
- Fault diagnostics for wire breakage or short-circuits of sensor leads
- ATEX/UL/CSA certification
- A third thermistor input can be provided by the PTC thermistor option card MCB 112, if necessary.

4 Electrical Installation

4.1 Electrical Installation

4.1.1 Power Connections

Cabling and Fusing

NOTE!

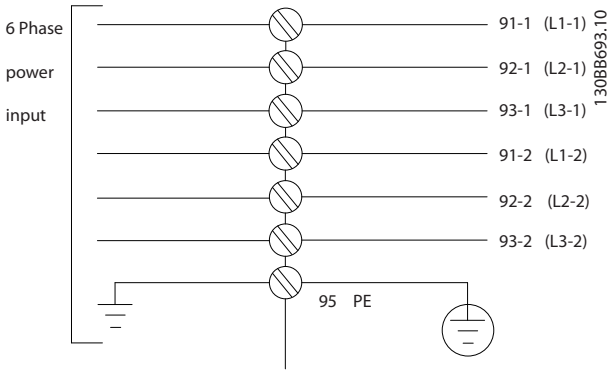
Cables General

All cabling must comply with national and local regulations on cable cross-sections and ambient temperature. UL applications require 167°F [75°C] copper conductors. 167°F [75°C] and 194°F [90°C] copper conductors are thermally acceptable for the adjustable frequency drive to use in non-UL applications.

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

For protection of the adjustable frequency drive, the recommended fuses must be used or the unit must be with built-in fuses. Recommended fuses can be seen in the tables of the fuse section. Always ensure that proper fusing is done according to local regulations.

The AC line input connection is fitted to the line power switch if this is included.



NOTE!

The motor cable must be shielded/armored. If an unshielded/unarmored cable is used, some EMC requirements are not complied with. Use a shielded/armored motor cable to comply with EMC emission specifications. For more information, see *EMC specifications* in the *Design Guide*.

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

4

4

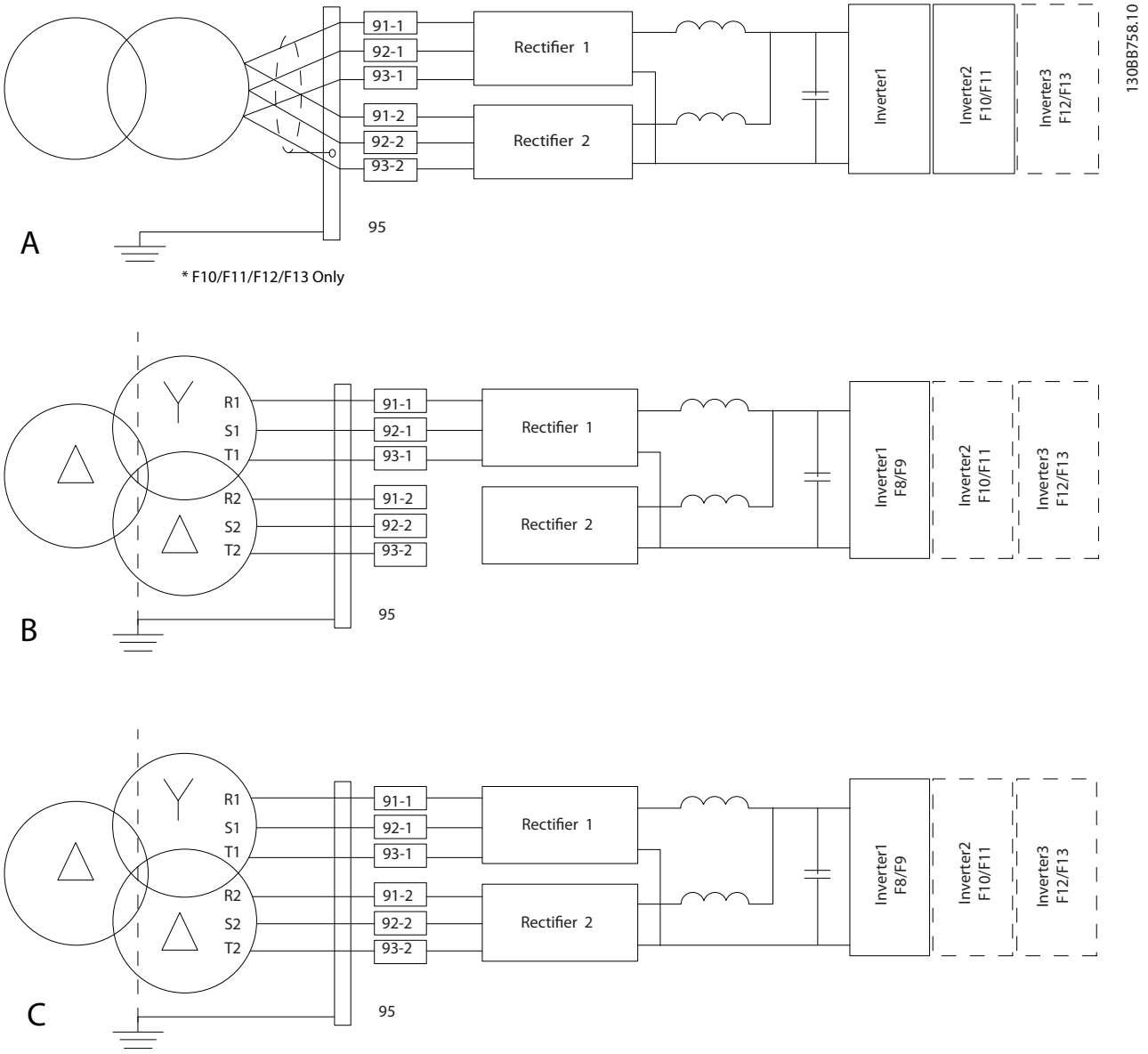


Figure 4.1

A) 6-Pulse Connection[1), 2), 3)]

B) Modified 6-Pulse Connection[2), 3), 4)]

C) 12-Pulse Connection[3), 5)]

Notes:

1) Parallel connection shown. A single 3-phase cable may be used with sufficient carrying capability. Shorting busbars must be installed.

2) 6-pulse connection eliminates the harmonics reduction benefits of the 12-pulse rectifier.

3) Suitable for IT and TN AC line input connections.

4) In the unlikely event that one of the 6-pulse modular rectifiers becomes inoperable, it is possible to operate the drive at reduced load with a single 6-pulse rectifier. Contact factory for reconnection details.

5) No paralleling of line power cabling is shown here.

Shielding of cables:
Avoid installation with twisted shield ends (pigtails). They spoil the shielding effect at higher frequencies. If it is necessary to break the shield to install a motor isolator or motor contactor, the shield must be continued at the lowest possible HF impedance.

Connect the motor cable shield to both the de-coupling plate of the adjustable frequency drive and to the metal housing of the motor.

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

Cable-length and cross-section:
The adjustable frequency drive has been EMC tested with a given length of cable. Keep the motor cable as short as possible to reduce the noise level and leakage currents.

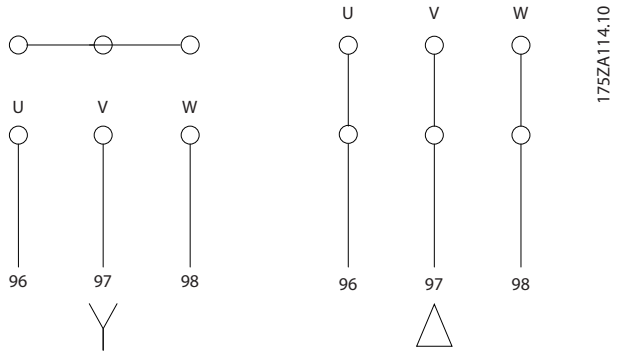
Switching frequency:
When adjustable frequency drives are used together with sine-wave filters to reduce the acoustic noise from a motor, the switching frequency must be set according to the instructions in *14-01 Switching Frequency*.

4

Term. no.	96	97	98	99	
	U	V	W	PE[1)]	Motor voltage 0–100% of AC line 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.

[1)]Protected Ground Connection

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



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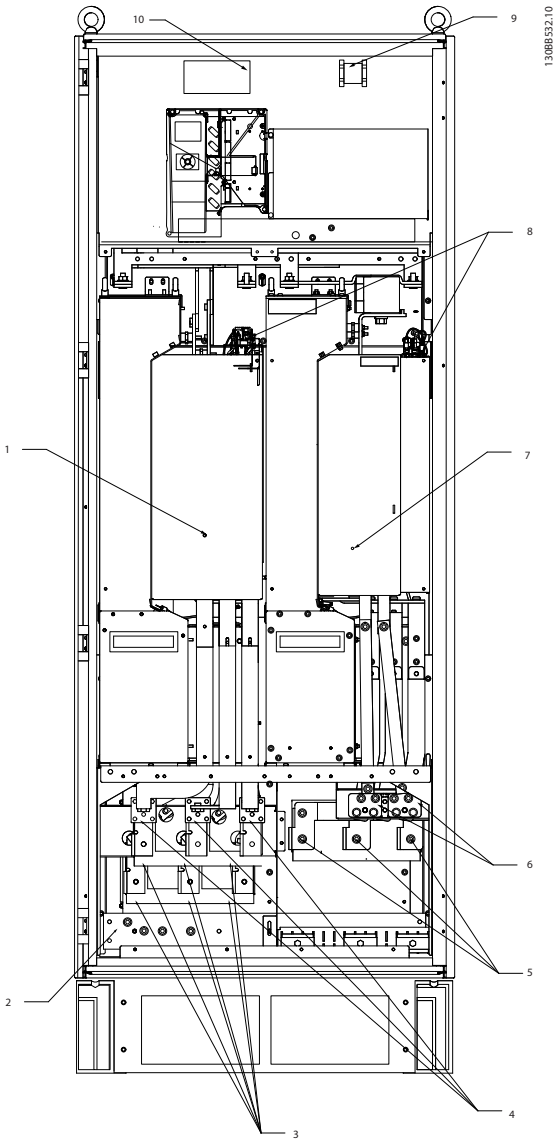


Figure 4.2 Rectifier and Inverter Cabinet, frame size F8 and F9

1)	12-pulse rectifier module			5)	Motor connection			
2)	Ground PE Terminals				U	V	W	
3)	Line / Fuses				T1	T2	T3	
	R1	S1	T1		96	97	98	
	L1-1	L2-1	L3-1	6)	Brake Terminals			
	91-1	92-1	93-1		-R	+R		
4)	Line / Fuses				81	82		
	R2	S2	T2	7)	Inverter Module			
	L2-1	L2-2	L3-2	8)	SCR Enable / Disable			
	91-2	92-2	93-2	9)	Relay 1		Relay 2	
					01	02	03	04	05	06
				10)	Auxillary Fan			
					104	106		

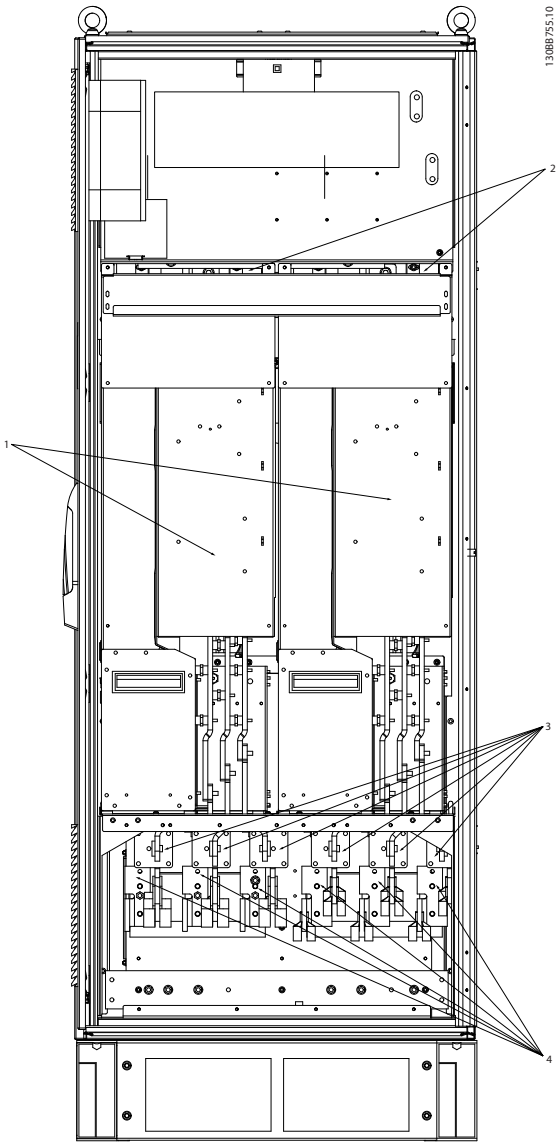


Figure 4.3 Rectifier Cabinet, frame size F10 and F12

1)	12-pulse rectifier module				4)	Line			
2)	AUX Fan					R1	S1	T1	R2	S2	T2
	100	101	102	103		L1-1	L2-1	L3-1	L1-2	L2-2	L3-2
	L1	L2	L1	L2	5)	DC Bus Connections for Common DC Bus					
3)	Line Fuses F10/F12 (6 pieces)					DC+	DC-				
					6)	DC Bus Connections for Common DC Bus					
						DC+	DC-				

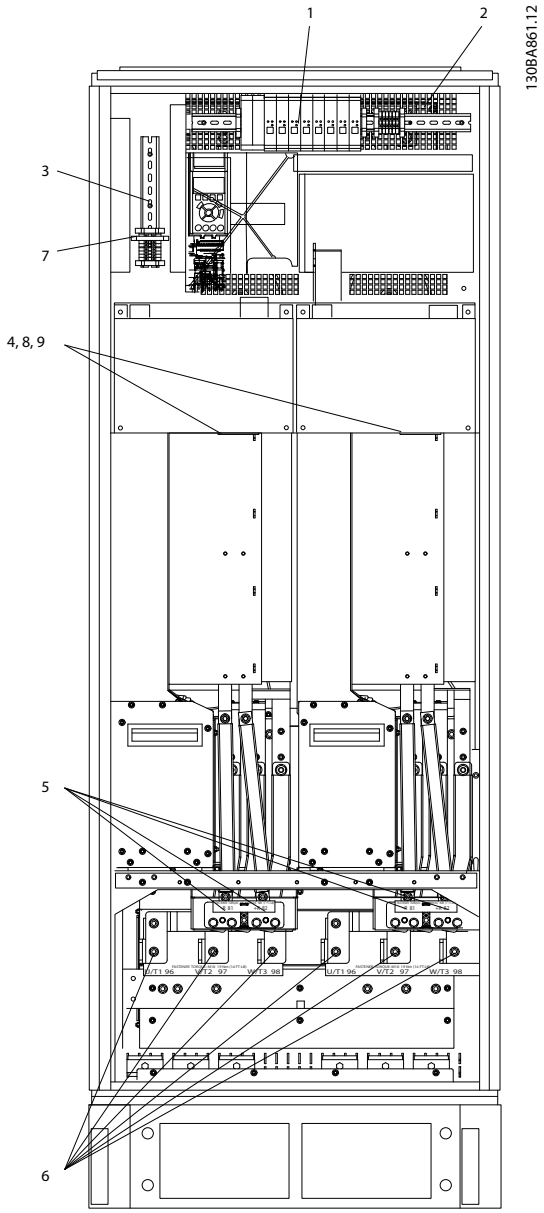


Figure 4.4 Inverter Cabinet, frame size F10 and F11

1)	External Temperature Monitoring			
2)	AUX Relay			
	01	02	03	
	04	05	06	
3)	NAMUR			
4)	AUX Fan			
	100	101	102	103
	L1	L2	L1	L2
5)	Brake			
	-R	+R		
	81	82		

6)	Motor		
	U	V	W
	96	97	98
	T1	T2	T3
7)	NAMUR Fuse. See fuse tables for part numbers		
8)	Fan Fuses. See fuse tables for part numbers		
9)	SMPS Fuses. See fuse tables for part numbers		

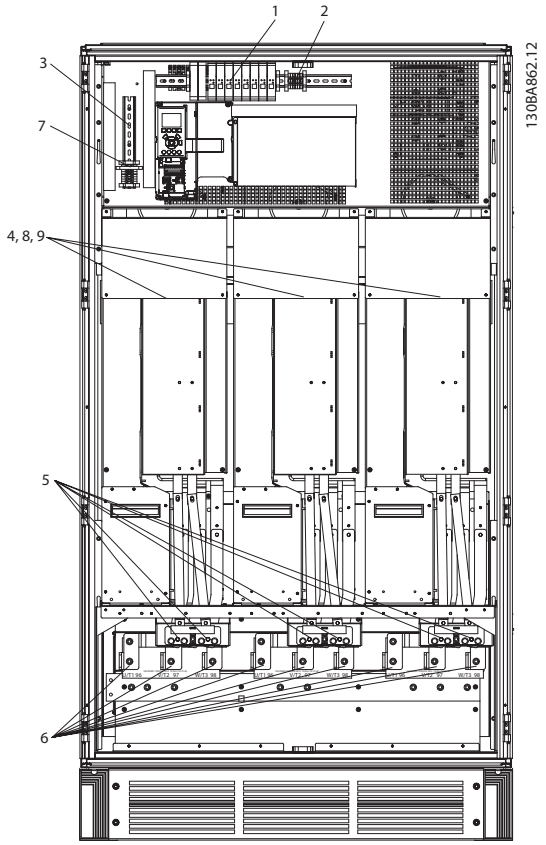


Figure 4.5 Inverter Cabinet, frame size F12 and F13

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 fuse tables for part numbers			
8)	Fan Fuses. See fuse tables for part numbers			
9)	SMPS Fuses. See fuse tables for part numbers			

4

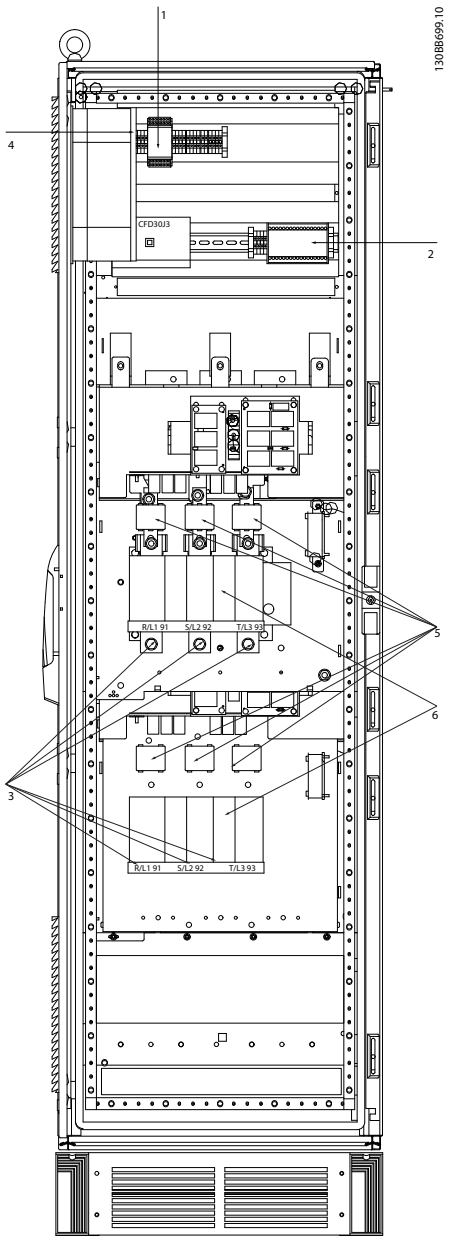


Figure 4.6 Options Cabinet, frame size F9

1)	Pilz Relay Terminal						
2)	RCD or IRM Terminal						
3)	Line power/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 PILS Relay						
	See fuse tables for part numbers						
5)	Line Fuses, (6 pieces)						
	See fuse tables for part numbers						
6)	2 x 3-phase manual disconnect						

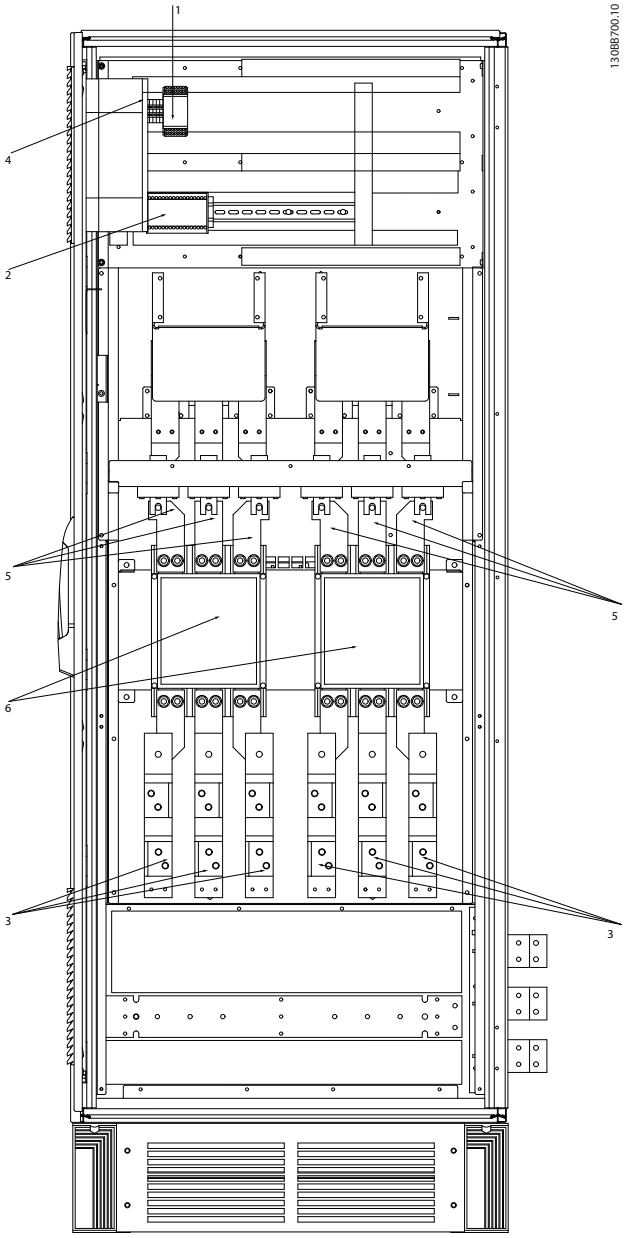


Figure 4.7 Options Cabinet, frame size F11 and F13

1)	Pilz Relay Terminal					
2)	RCD or IRM Terminal					
3)	Line power/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 PILS Relay					
	See fuse tables for part numbers					
5)	Line Fuses, (6 pieces)					
	See fuse tables for part numbers					
6)	2 x 3-phase manual disconnect					

4

4.1.2 Grounding

The following basic issues need to be considered when installing an adjustable frequency drive, so as to obtain electromagnetic compatibility (EMC).

- Safety grounding: Please note that the adjustable frequency drive has a high leakage current and must be grounded appropriately for safety reasons. Always follow 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. The lowest possible conductor impedance 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 HF impedance. This prevents having different HF voltages for the individual devices and prevents the risk of radio interference currents running in connection cables that may be used between the devices, as radio interference is reduced.
In order to obtain a low HF impedance, use the fastening bolts of the devices as HF connections to the rear plate. It is necessary to remove insulating paint and the like from the fastening points.

4.1.3 Extra Protection (RCD)

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

In the case of a ground fault, a DC component may develop in the fault current.

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

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

4.1.4 RFI Switch

Line power supply isolated from ground
If the adjustable frequency drive is supplied from an isolated line power source (IT line power, floating delta and grounded delta) or TT/TN-S line power with grounded leg, the RFI switch is recommended to be turned off (OFF) [1] via *14-50 RFI 1* on the drive and *14-50 RFI 1* on the filter.

For further reference, see IEC 364-3. In case optimum EMC performance is needed, parallel motors are connected or the motor cable length is above 82 ft [25 m], it is recommended to set *14-50 RFI 1* to [ON].
[1] Not available for 525–600/690V adjustable frequency drives.
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).
Please also refer to the application note VLT on IT line power, MN.90.CX.02. It is important to use isolation monitors that are capable for use together with power electronics (IEC 61557-8).

4.1.5 Torque

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

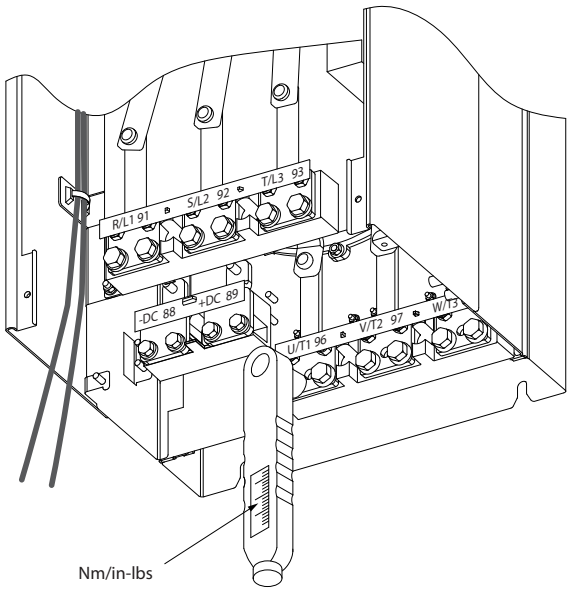


Figure 4.8 Always use a torque wrench to tighten the bolts.

Frame size	Terminal	Torque	Bolt size
F8-F13	Line power Motor	19–40Nm (168–354in-lbs)	M10
	Brake Regen	8.5–20.5Nm (75–181in-lbs) 8.5–20.5Nm (75–181in-lbs)	M8 M8

Table 4.1 Tightening torques

4.1.6 Shielded Cables

NOTE!

Danfoss recommends to use shielded cables between the LCL filter and the AFE unit. Unshielded cables can be used between transformer and LCL filter input side.

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

The connection can be made using either cable connectors or clamps:

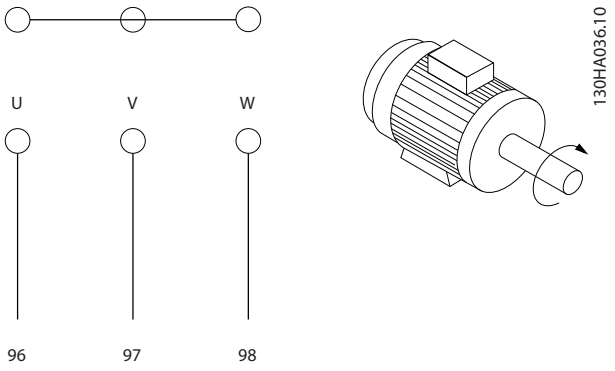
- EMC cable connectors: generally available cable connectors can be used to ensure an optimum EMC connection.
- EMC cable clamp: Clamps allowing for easy connection are supplied with the adjustable frequency drive.

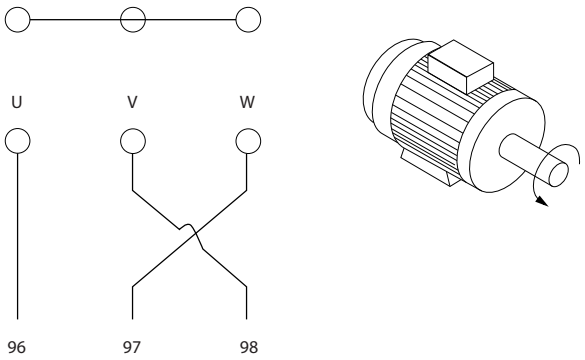
4.1.7 Motor Cable

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

Terminal No.	Function
96, 97, 98, 99	Line power U/T1, V/T2, W/T3 Ground

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





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

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

F frame Requirements

F8/F9 requirements: The cables are required to 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.

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 are required to 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 or 2 cables are not allowed) to obtain equal amount of wires attached to each inverter module terminal. The wires are required to 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.

Output junction box requirements: The length, a minimum of 8 ft [2.5 m], and quantity of cables must be equal from each inverter module to the common terminal in the junction box.

4

NOTE!

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

4.1.8 Brake Cable Drives with Factory Installed Brake Chopper Option

(Only standard with letter B in position 18 of typecode).

The connection cable to the brake resistor must be shielded and the max. length from adjustable frequency drive to the DC bar is limited to 82 feet [25 m].

Terminal No.	Function
81, 82	Brake resistor terminals

The connection cable to the brake resistor must be shielded. Connect the shield by means of cable clamps to the conductive backplate at the adjustable frequency drive and to the metal cabinet of the brake resistor.
Size the brake cable cross-section to match the brake torque. See also *Brake Instructions, MI.90.Fx.yy* and *MI. 50.Sx.yy* for further information regarding safe installation.

⚠WARNING

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

F Frame Requirements
The brake resistor(s) must be connected to the brake terminals in each inverter module.

4.1.9 Shielding against Electrical Noise

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

NOTE!

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

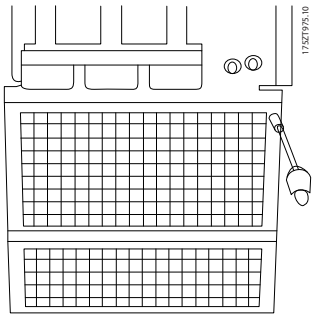


Figure 4.9 Mount the EMC shield.

4.1.10 AC line input connections

Line power must be connected to terminals 91-1, 92-1, 93-1, 91-2, 92-2 and 93-2 (see *Table 4.2*). Ground is connected to the terminal to the right of terminal 93.

Terminal No.	Function
91-1, 92-1, 93-1	Line power R1/L1-1, S1/L2-1, T1/ L3-1
91-2, 92-2, 93-2	Line power R2/L1-2, S2/L2-2, T2/ L3-2
94	Ground

NOTE!

Check the nameplate to ensure that the AC line voltage of the adjustable frequency drive matches the power supply of your plant.

Ensure that the power supply can supply the necessary current to the adjustable frequency drive.

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

4.1.11 External Fan Supply

If the adjustable frequency drive 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 No.	Function
100, 101	Auxiliary supply S, T
102, 103	Internal supply S, T

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

4.1.12 Fuses

Branch circuit protection:
In order 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:
The adjustable frequency drive must be protected against short-circuit to avoid electrical or fire hazard. Danfoss recommends using the fuses mentioned below to protect service personnel and equipment in case of an internal failure in the drive. The adjustable frequency drive 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 adjustable frequency drive is equipped with internal overcurrent protection that 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 below are suitable for use on a circuit capable of delivering 100,000 Arms (symmetrical), 240 V, or 480 V, or 500 V, or 600 V depending on the drive voltage rating. With the proper fusing, the drive Short Circuit Current Rating (SCCR) is 100,000 Arms.

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

Table 4.2 Line Fuses, 380–500V

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

Table 4.3 Line Fuses, 525–690V

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

Table 4.4 Inverter Module DC Link Fuses, 380–500V

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

Table 4.5 Inverter Module DC Link Fuses, 525–690V

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

Supplementary fuses

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

Table 4.6 Manual Motor Controller Fuses

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

Table 4.7 SMPS Fuse

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

Table 4.8 Fan Fuses

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

Table 4.9 30 A Fuse Protected Terminal Fuse

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

Table 4.10 Control Transformer Fuse

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

Table 4.11 NAMUR Fuse

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

Table 4.12 Safety Relay Coil Fuse with PILS Relay

4.1.13 Line Power Disconnectors

Frame size	Power & Voltage
F9	P250 380–500 V & P355-P560 525–690 V
	P315-P400 380–500 V
F11	P450 380–500 V & P630-P710 525–690 V
	P500-P630 380–500 V & P800 525–690 V
F13	P710-P800 380–500 V & P900-P1M2 525–690 V

4.1.14 Motor Insulation

For motor cable lengths ≤ than the maximum cable length listed in the General Specifications tables, the following motor insulation ratings are recommended because the peak voltage can be up to twice the DC link voltage, 2.8 times the AC line voltage due to transmission line effects in the motor cable. If a motor has lower insulation rating, it is recommended to use a du/dt or sine-wave filter.

Nominal AC Line Voltage	Motor Insulation
$U_N \leq 420$ V	Standard U_{LL} = 1300V
420V < $U_N \leq 500$ V	Reinforced U_{LL} = 1600V
500V < $U_N \leq 600$ V	Reinforced U_{LL} = 1800V
600V < $U_N \leq 690$ V	Reinforced U_{LL} = 2000V

4.1.15 Motor Bearing Currents

All motors installed with VLT HVAC Drive 425 hp [315kW] or higher power drives should have NDE (Non-Drive End) insulated bearings installed to eliminate circulating bearing currents. To minimize DE (Drive End) bearing and shaft currents proper grounding of the drive, motor, driven machine, and motor to the driven machine is required.

Standard Mitigation Strategies:

1. Use an insulated bearing
2. Apply rigorous installation procedures
   - Ensure the motor and load motor are aligned
   - Strictly follow the EMC Installation guideline
   - Reinforce the PE so the high frequency impedance is lower in the PE than the input power leads.
   - Provide a good high frequency connection between the motor and the adjustable frequency drive for instance by shielded cable which has a 360° connection in the motor and the adjustable frequency drive
   - Make sure that the impedance from adjustable frequency drive to building ground is lower that the grounding impedance of the machine. This can be difficult for pumps.
   - 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, if possible.
8. Try to ensure the line voltage is balanced to ground. This can be difficult for IT, TT, TN-CS or Grounded leg systems
9. Use a dU/dt or sinus filter

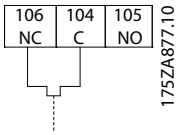
4.1.16 Brake Resistor Temperature Switch

Torque: 0.5–0.6Nm (5in-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 adjustable frequency drive will trip on warning / alarm 27, “Brake IGBT”. If the connection is closed between 104 and 105, the adjustable frequency drive will trip on warning/alarm 27, “Brake IGBT”. A KLIXON switch must be installed that is 'normally closed'. If this function is not used, 106 and 104 must be short-circuited together.
Normally closed: 104-106 (factory installed jumper)
Normally open: 104-105

Terminal No.	Function
106, 104, 105	Brake resistor temperature switch.

If the temperature of the brake resistor gets too high and the thermal switch drops out, the adjustable frequency drive will stop braking. The motor will start coasting.



4.1.17 Control Cable Routing

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

Serial communication bus connection
Connections are made to the relevant options on the control card. For details, see the relevant serial communication bus instruction. The cable must be placed in the provided path inside the adjustable frequency drive and tied down together with other control wires.

Installation of 24V external DC supply
Torque: 0.5–0.6Nm (5in-lbs)
Screw size: M3

No.	Function
35 (-), 36 (+)	24V 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 line power. Please note that a warning of low voltage will be given when 24 V DC has been connected; however, there will be no tripping.

⚠WARNING

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

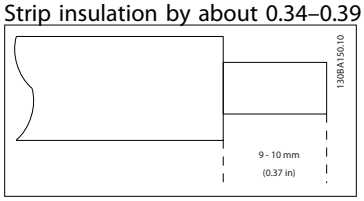
4.1.18 Access to Control Terminals

All terminals to the control cables are located beneath the LCP. They are accessed by opening the door of the IP21/ 54 version or removing the covers of the IP00 version.

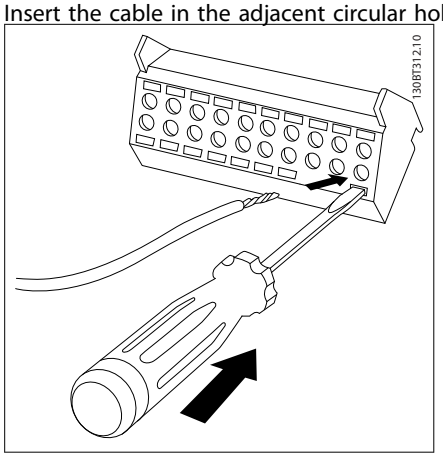
4.1.19 Electrical Installation, Control Terminals

To connect the cable to the terminal:

1. Strip insulation by about 0.34–0.39 in [9–10 mm].



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



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

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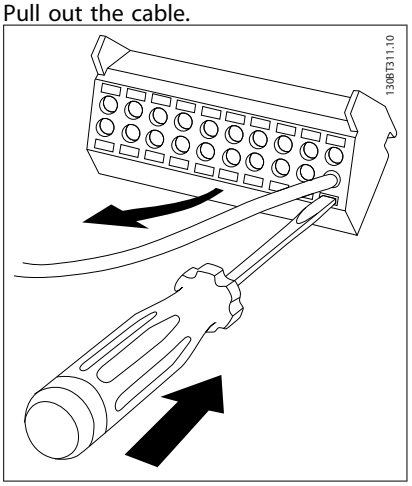
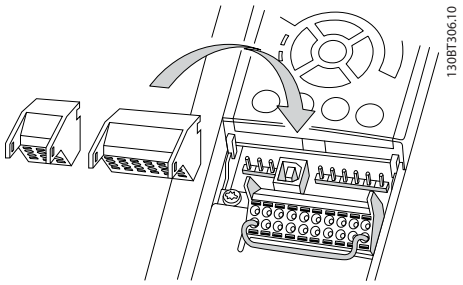
To remove the cable from the terminal:

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



[1)] Max. 0.015 x 0.1 in [0.4 x 2.5 mm]

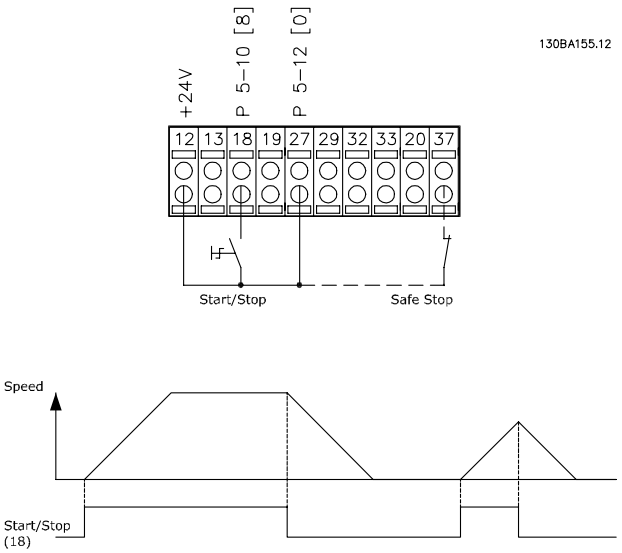


4.2 Connection Examples

4.2.1 Start/Stop

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

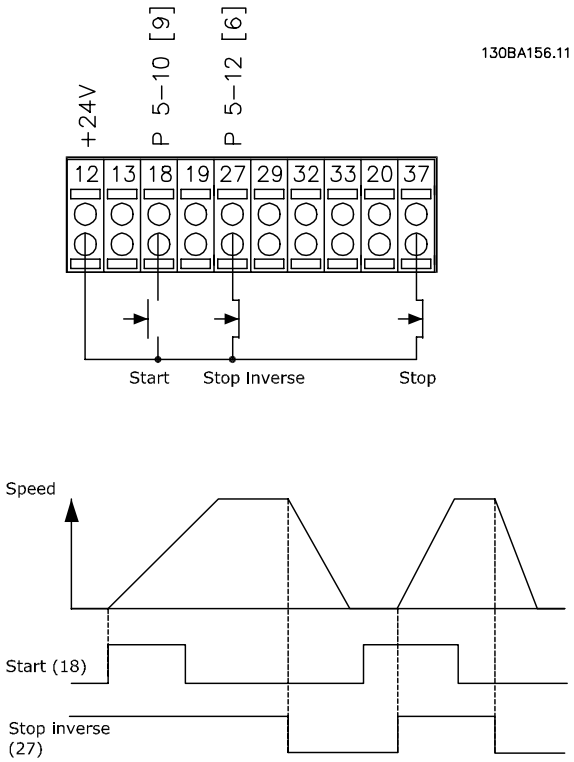
Terminal 37 = Safe stop



4.2.2 Pulse Start/Stop

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

Terminal 37 = Safe stop



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4.2.3 Speed Up/Down

Terminals 29/32 = Speed up/down

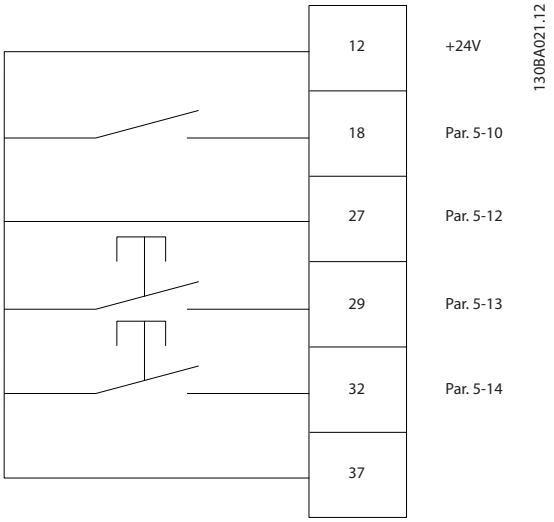
Terminal 18 = *5-10 Terminal 18 Digital Input* Start [9] (default)

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

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

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

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



4.2.4 Potentiometer Reference

Voltage reference via a potentiometer

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

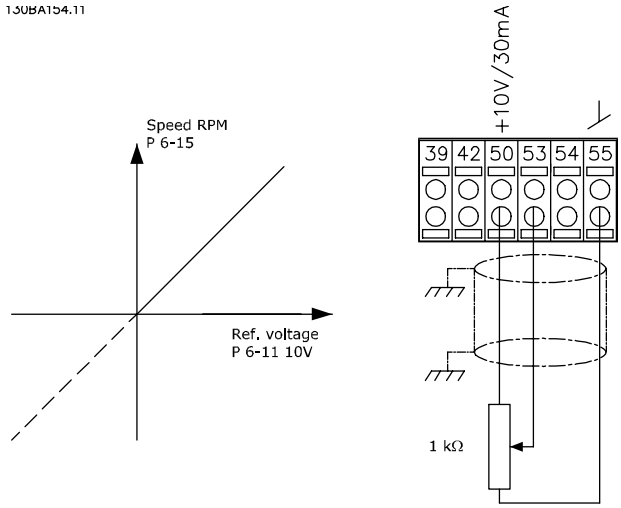
Terminal 53, Low Voltage = 0V

Terminal 53, High Voltage = 10V

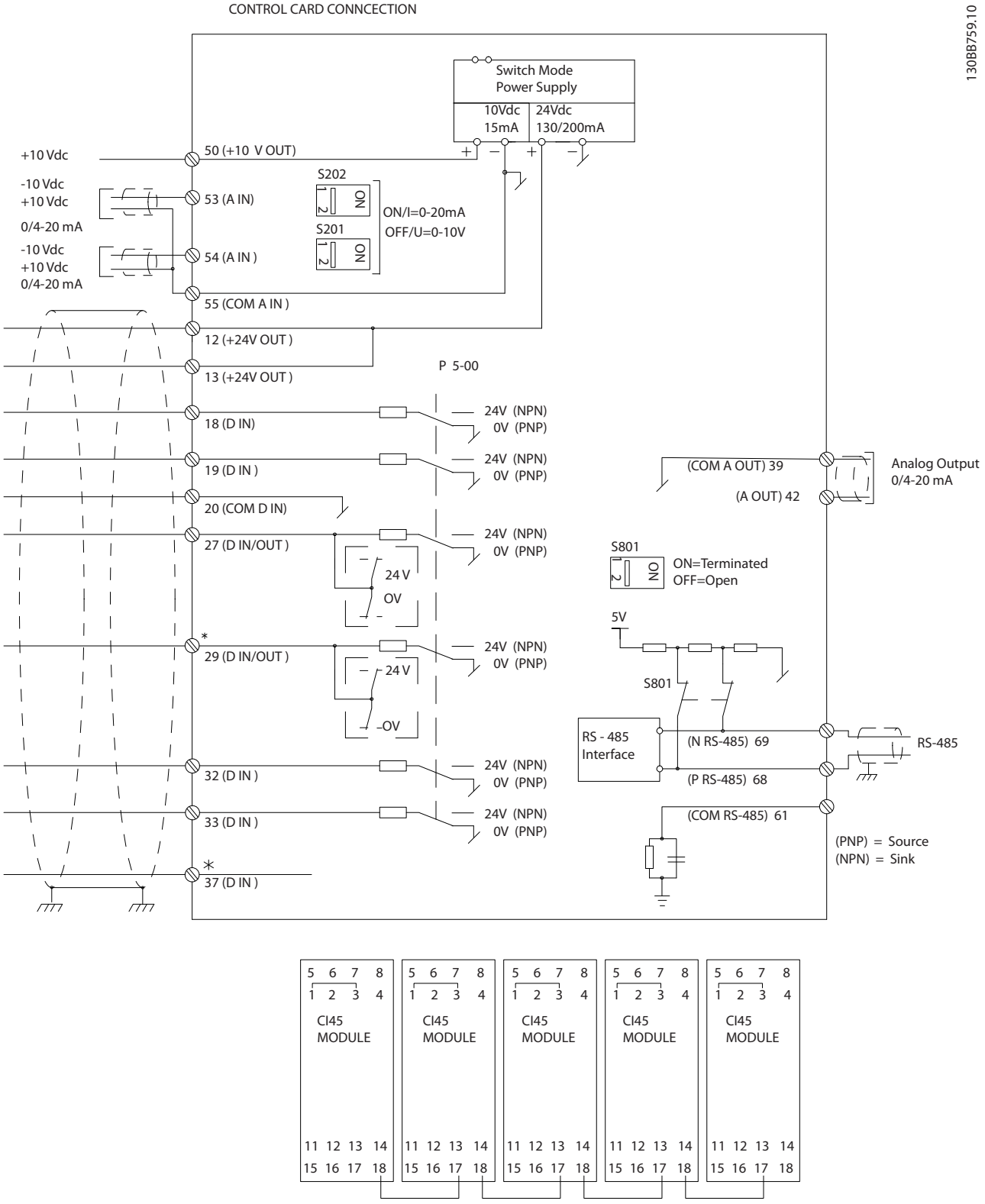
Terminal 53, Low Ref./Feedback = 0 RPM

Terminal 53, High Ref./Feedback = 1500 RPM

Switch S201 = OFF (U)



4.3.1 Electrical Installation, Control Cables



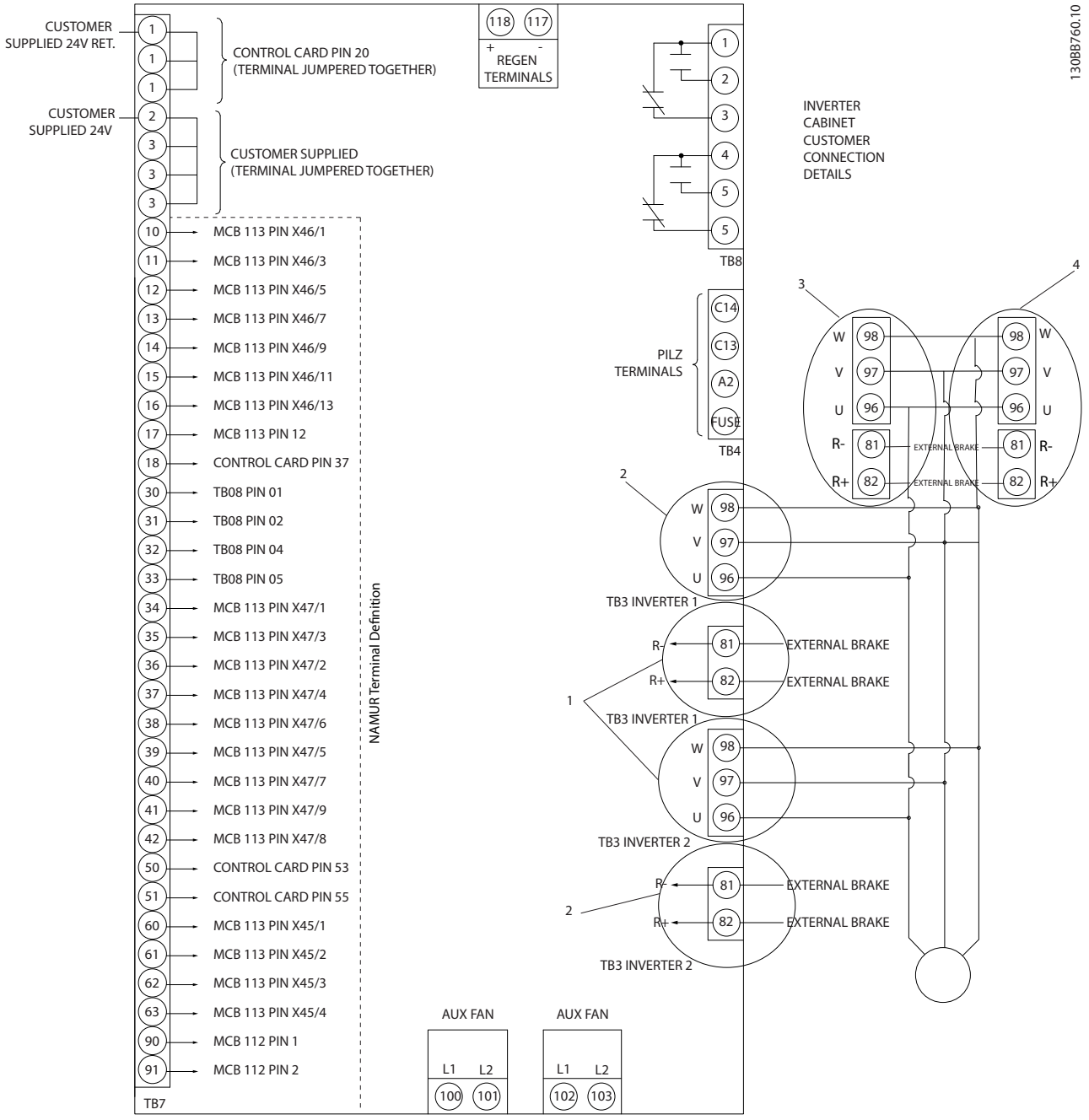


Figure 4.10 Diagram showing all electrical terminals without options

Terminal 37 is the input to be used for Safe Stop. For instructions on safe stop installation, refer to the section *Safe Stop Installation* in the adjustable frequency drive Design Guide. See also sections Safe Stop and Safe Stop Installation.

1) F8/F9 = (1) set of terminals.

2) F10/F11 = (2) sets of terminals.

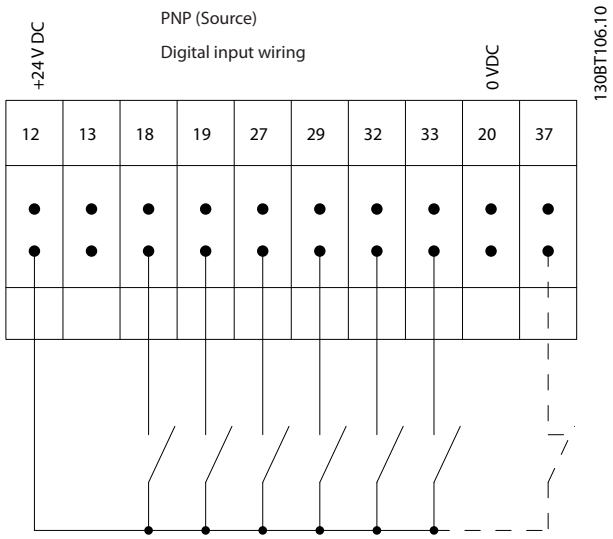
3) F12/F13 = (3) sets of terminals.

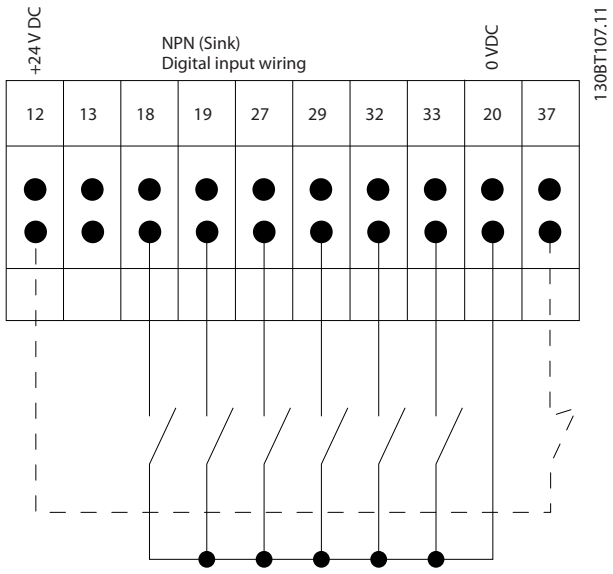
In rare cases, very long control cables and analog signals may, depending on installation, result in 50/60 Hz ground loops due to noise from line power supply cables.

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

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

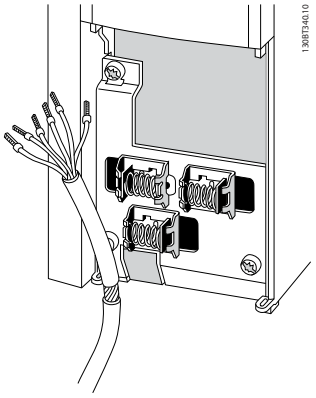
Input polarity of control terminals





NOTE!

Control cables must be shielded/armored.



Connect the wires as described in the Instruction Manual for the adjustable frequency drive. Remember to connect the shields in a proper way to ensure optimum electrical immunity.

4

4

4.3.2 Switches S201, S202, and S801

Switches S201 (A53) and S202 (A54) are used to select a current (0-20mA) or a voltage (-10 to 10V) configuration of the analog input terminals 53 and 54 respectively.

Switch S801 (BUS TER.) can be used to enable termination on the RS-485 port (terminals 68 and 69).

See drawing *Diagram showing all electrical terminals* in section *Electrical Installation.*

Default setting:

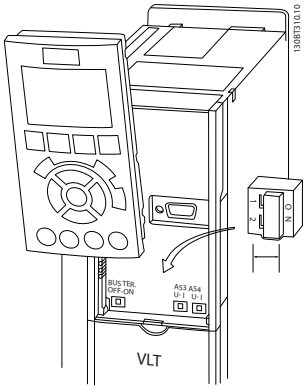
S201 (A53) = OFF (voltage input)

S202 (A54) = OFF (voltage input)

S801 (Bus termination) = OFF

NOTE!

When changing the function of S201, S202 or S801, be careful not to force the switch over. It is recommended to remove the LCP fixture (cradle) when operating the switches. The switches must not be operated while the adjustable frequency drive is powered.



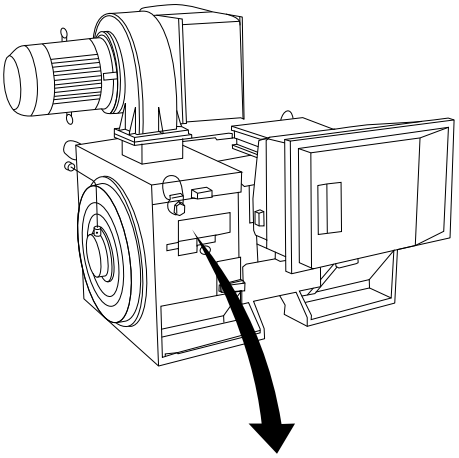
4.4 Final Set-up and Test

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

Step 1. Locate the motor nameplate

NOTE!

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



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						

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

To access this list, first press the [QUICK MENU] key, then select "Q2 Quick Set-up".

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

Step 3. Activate the Automatic Motor Adaptation (AMA)

Performing an AMA will ensure 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 'No function' (*5-12 Terminal 27 Digital Input* [0])
3. Activate the AMA *1-29 Automatic Motor Adaptation (AMA)*.
4. Choose between complete or reduced AMA. If a sine-wave filter is mounted, run only the reduced AMA, or remove the sine-wave filter during the AMA procedure.
5. Press the [OK] key. The display shows “Press [Hand on] to start”.
6. Press the [Hand on] key. A progress bar indicates if the AMA is in progress.

Stop the AMA during operation

1. Press the [OFF] key - the adjustable frequency drive enters into alarm mode and the display shows that the AMA was terminated by the user.

Successful AMA

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

Unsuccessful AMA

1. The adjustable frequency drive enters into alarm mode. A description of the alarm can be found in the *Warnings and Alarms* chapter.
2. "Report Value" in the [Alarm Log] shows the last measuring sequence carried out by the AMA before the adjustable frequency drive entered alarm mode. This number along with the description of the alarm will assist you in trouble-shooting. If you contact Danfoss for service, make sure to mention the number and alarm description.

NOTE!

Unsuccessful AMA is often caused by incorrectly registered motor nameplate data or a too big difference between the motor power size and the adjustable frequency drive power size.

Step 4. Set speed limit and ramp time

3-02 Minimum Reference
3-03 Maximum Reference

Table 4.13 Set up the desired limits for speed and ramp time.

4-11 Motor Speed Low Limit [RPM] or *4-12 Motor Speed Low Limit [Hz]*
4-13 Motor Speed High Limit [RPM] or *4-14 Motor Speed High Limit [Hz]*

3-41 Ramp 1 Ramp-up Time
3-42 Ramp 1 Ramp-down Time

4

4.5 Additional Connections

4.5.1 Mechanical Brake Control

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

- Control the brake using any relay output or digital output (terminal 27 or 29).
- Keep the output closed (voltage-free) as long as the adjustable frequency drive is unable to ‘support’ the motor, such as when the load is too heavy, for example.
- Select *Mechanical brake control* [32] in parameter group 5-4* 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 adjustable frequency drive carries out a stop command.

If the adjustable frequency drive is in alarm mode or in an overvoltage situation, the mechanical brake immediately cuts in.

4.5.2 Parallel Connection of Motors

The adjustable frequency drive 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 adjustable frequency drive.

NOTE!

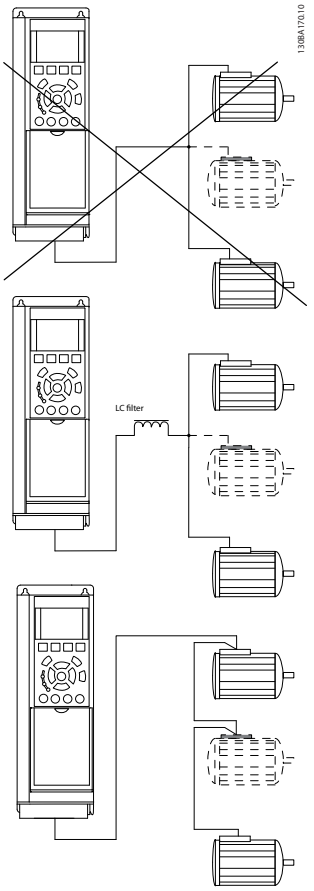
Installation with cables connected in a common joint, as in the figure below, is only recommended for short cable lengths.

NOTE!

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

NOTE!

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



Problems may arise at start 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 and at low RPM values.

4.5.3 Motor Thermal Protection

The electronic thermal relay in the adjustable frequency drive has received UL-approval for single motor protection, when *1-90 Motor Thermal Protection*is set for *ETR Trip* and *1-24 Motor Current* is 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 an ATEX certificate to protect motors in explosion hazard areas, Zone 1/21 and Zone 2/22. Please refer to the *Design Guide* for further information.

5 How to Operate the Adjustable Frequency Drive

5.1.1 Three Ways of Operating

The adjustable frequency drive can be operated in three ways:

1. Graphical Local Control Panel (GLCP), see 5.1.2
2. Numeric Local Control Panel (NLCP), see 5.1.3
3. RS-485 serial communication or USB, both for PC connection, see 5.1.4

If the adjustable frequency drive is fitted with a serial communication bus option, please refer to relevant documentation.

5.1.2 How to Operate the GraphicalLCP (GLCP)

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

The GLCP is divided into four functional groups:

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

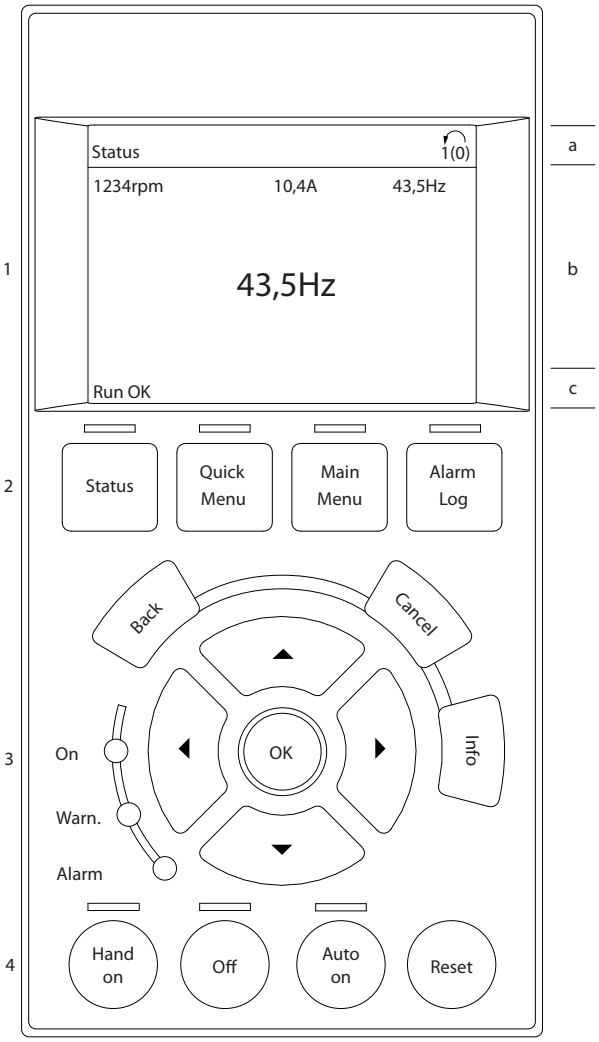
Graphical display:
The LCD display is back lit with a total of 6 alpha-numeric lines. All data is displayed on the LCP which can show up to five operating variables while in [Status] mode.

Display lines:

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

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

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



The display is divided into three sections:

The **top section** (a) shows the status when in status mode or up to two variables when not in status mode and in case of an alarm/warning.

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

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

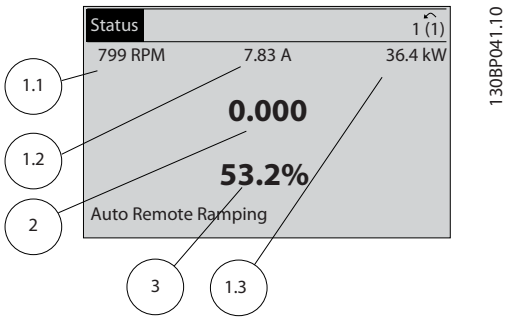
The **bottom section** (c) always shows the state of the adjustable frequency drive in status mode.

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

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

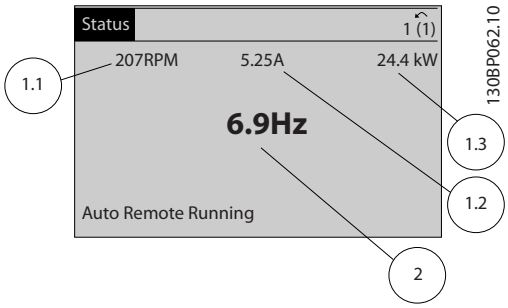
Each value/measurement readout parameter selected in *0-20 Display Line 1.1 Small* to *0-24 Display Line 3 Large* has its own scale and number of digits after a possible decimal point. Larger numeric values are displayed with few digits after the decimal point.
Ex.: Current readout
5.25 A; 15.2 A 105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

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

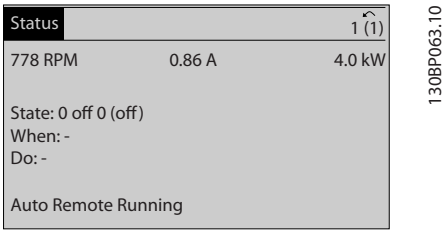


Status display II:
See the operating variables (1.1, 1.2, 1.3, and 2) shown in the display in this figure.
In the example, Speed, Motor current, Motor power and Frequency are selected as variables in the first and second lines.

1.1, 1.2 and 1.3 are shown in small size. 2 is shown in large size.

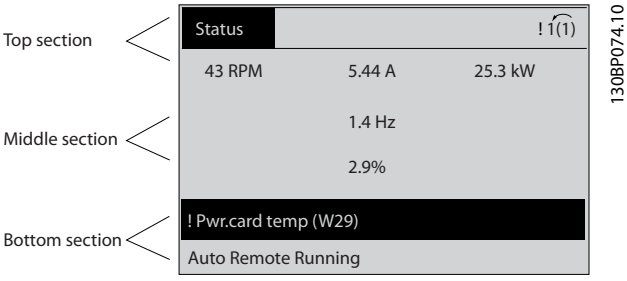


Status display III:
This state displays the event and action of the Smart Logic Control. For further information, see section *Smart Logic Control*.



Display Contrast Adjustment

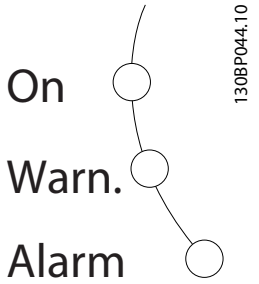
Press [status] and [▲] for darker display
Press [status] and [▼] for brighter display



LEDs:

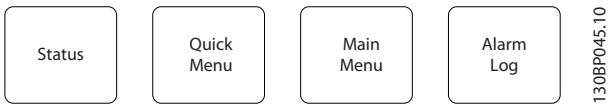
If certain threshold values are exceeded, the alarm and/or warning LED lights up. A status and alarm text appear on the control panel.
The On LED is activated when the adjustable frequency drive receives power from AC line voltage, a DC bus terminal, or an external 24 V supply. At the same time, the back light is on.

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



GLCP keys

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



[**Status**]
indicates the status of the adjustable frequency drive and/or the motor. Three different readouts can be chosen by pressing the [Status] key:
5 line readouts, 4 line readouts or Smart Logic Control.
Use **[Status]** for selecting the mode of display or for changing back to display mode from either the quick menu mode, the main menu mode or alarm mode. Also use the [Status] key to toggle single or double readout mode.

[**Quick Menu**]
allows quick set-up of the adjustable frequency drive. **The most common VLT HVAC Drive functions can be programmed here.**

The [Quick Menu] consists of:

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

The Function Set-up provides quick and easy access to all parameters required for the majority of VLT HVAC Drive applications including most VAV and CAV supply and return fans, cooling tower fans, primary, secondary and condenser water pumps and other pump, fan and compressor applications. Among other features, it also includes parameters for selecting which variables to display on the LCP, digital preset speeds, scaling of analog references, closed-loop single zone and multi-zone applications and specific functions related to fans, pumps and compressors.

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

[Main Menu]
is used for programming all parameters.The Main Menu parameters can be accessed immediately unless a password has been created via *0-60 Main Menu Password*, *0-61 Access to Main Menu w/o Password*, *0-65 Personal Menu Password* or *0-66 Access to Personal Menu w/o Password*. For the majority of VLT HVAC Drive applications, it is not necessary to access the Main Menu parameters but instead the Quick Menu, Quick Set-up and Function Set-up provide the simplest and quickest access to parameters that are typically required.
It is possible to switch directly between Main Menu mode and Quick Menu mode.
A parameter shortcut can be carried out by pressing the **[Main Menu]** key down for three seconds. The parameter shortcut allows direct access to any parameter.

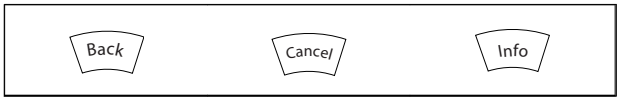
[Alarm Log]
displays an Alarm list of the five latest alarms (numbered A1-A5). To obtain additional details about an alarm, use the arrow keys to maneuver to the alarm number and press [OK]. Information is displayed about the condition of the adjustable frequency drive before it enters alarm mode.

The alarm log button on the LCP allows access to both alarm log and maintenance log.

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

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

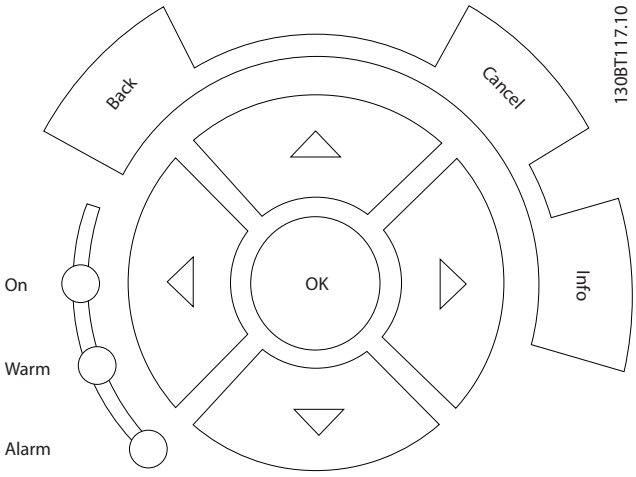
[Info]
displays information about a command, parameter, or function in any display window. [Info] provides detailed information when needed.
Exit Info mode by pressing either [Info], [Back], or [Cancel].



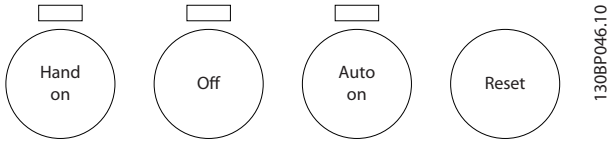
5

Navigation Keys
The four navigation arrows are used to navigate between the different choices available in **[Quick Menu]**, **[Main Menu]** and **[Alarm Log]**. Use the keys to move the cursor.

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



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



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

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

NOTE!

External stop signals activated by means of control signals or a serial bus will override a "start" command via the LCP.

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

[Auto on]
enables the adjustable frequency drive to be controlled via the control terminals and/or serial communication. When a start signal is applied on the control terminals and/or the bus, the adjustable frequency drive will start. The key can be selected as Enable [1] or Disable [0] via *0-42 [Auto on] Key on LCP*.

NOTE!

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

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

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

5.1.3 RS-485 Bus Connection

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

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

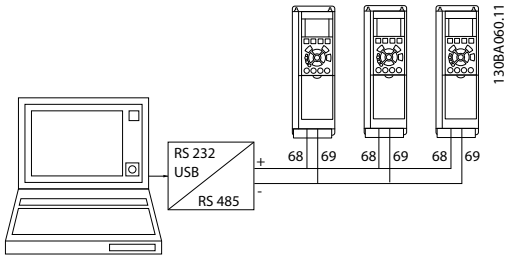


Figure 5.1 Connection example.

In order to avoid potential equalizing currents in the shield, ground the cable shield via terminal 61, which is connected to the frame via an RC link.

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

5.1.4 How to Connect a PC to the Adjustable Frequency Drive

To control or program the Adjustable frequency drive from a PC, install the PC-based Configuration Tool MCT 10 Set-up Software.
The PC is connected via a standard (host/device) USB cable, or via the RS-485 interface as shown in the VLT HVAC Drive *Design Guide, chapter How to Install > Installation of misc. connections*.

NOTE!

The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. The USB connection is connected to protection ground on the Adjustable frequency drive. Use only an isolated laptop for the PC connection to the USB connector on the Adjustable frequency drive.

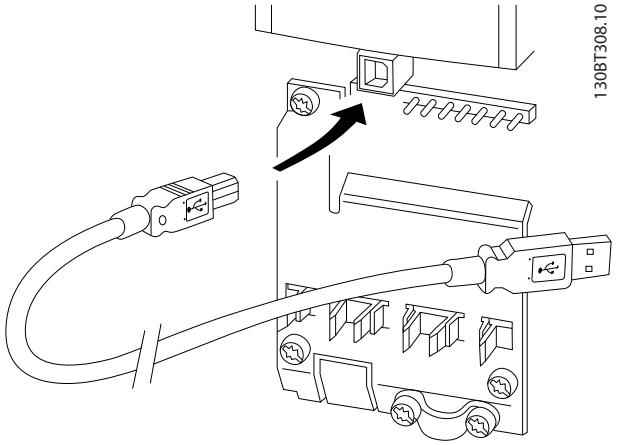


Figure 5.2 For control cable connections, see section on *Control Terminals*.

5.1.5 PC Software Tools

PC-based Configuration Tool MCT 10
All adjustable frequency drives are equipped with a serial communication port. Danfoss provides a PC tool for communication between PC and adjustable frequency drive, PC-based Configuration Tool MCT 10. Please check the section on *Available Literature* for detailed information on this tool.

MCT 10 set-up software
MCT 10 has been designed as an easy to use interactive tool for setting parameters in our adjustable frequency drives. The software can be downloaded from the Danfoss internet site *http://www.*Danfoss*.com/BusinessAreas/Drives-Solutions/Softwaredownload/DDPC+Software+Program.htm*. The MCT 10 set-up software will be useful for:

- Planning a communication network off-line. MCT 10 contains a complete adjustable frequency drive database
- Commissioning adjustable frequency drives online.
- Saving settings for all adjustable frequency drives.
- Replacing an adjustable frequency drive in a network.
- Simple and accurate documentation of adjustable frequency drive settings after commissioning.
- Expanding an existing network
- Adjustable frequency drives developed in the future will be fully supported.

MCT 10 set-up software supports Profibus DP-V1 via a master class 2 connection. This makes it possible to access

read/write parameters online in an adjustable frequency drive via the Profibus network. This will eliminate the need for an extra communication network.

Save adjustable frequency drive settings:

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

All parameters are now stored on the PC.

Load adjustable frequency drive settings:

1. Connect a PC to the adjustable frequency drive via the USB com port
2. Open MCT 10 Set-up software
3. Choose "Open" – stored files will be shown
4. Open the appropriate file
5. Choose "Write to drive"

All parameter settings are now transferred to the adjustable frequency drive.

A separate manual for MCT 10 Set-up Software is available: *MG.10.Rx.yy*.

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

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

Ext. user interface
Preventive Maintenance Schedule
Clock settings
Timed Action Programming
Smart Logic Controller Set-up

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

MCT 10 can also be downloaded from the Danfoss website: *WWW.DANFOSS.COM, Business Area: Motion Controls*.

5.1.6 Tips and Tricks

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

5.1.7 Quick Transfer of Parameter Settings When Using GLCP

Once the set-up of an adjustable frequency drive is complete, it is recommended to store (backup) the parameter settings in the GLCP or on a PC via MCT 10 Set-up Software Tool.

⚠WARNING

Stop the motor before performing any of these operations.

Data storage in LCP:

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

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

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

Data transfer from LCP to adjustable frequency drive:

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

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

5.1.8 Initialization to Default Settings

There are two ways to initialize the adjustable frequency drive to default: Recommended initialization and manual initialization.
Please be aware that they have different impacts according to the below description.

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

1. Select *14-22 Operation Mode*
2. Press [OK]
3. Select "Initialization" (for NLCP select "2")
4. Press [OK]
5. Disconnect the power from the unit and wait for the display to turn off.
6. Reconnecting the power resets the adjustable frequency drive. Note that first start-up takes a few more seconds
7. Press [Reset]

14-22 Operation Mode initializes all except:
14-50 RFI 1
8-30 Protocol
8-31 Address
8-32 Baud Rate
8-35 Minimum Response Delay
8-36 Max Response Delay
8-37 Max Inter-Char Delay
15-00 Operating Hours to *15-05 Over Volts*
15-20 Historic Log: Event to *15-22 Historic Log: Time*
15-30 Alarm Log: Error Code to *15-32 Alarm Log: Time*

NOTE!

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

Manual initialization

NOTE!

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

1. Disconnect from the line power and wait until the display turns off.

2a. Press [Status] - [Main Menu] - [OK] at the same time while powering up the Graphical LCP (GLCP)

2b. Press [Menu] while powering up for LCP 101, Numerical Display

3. Release the keys after 5 sec.

4. The adjustable frequency drive is now programmed according to default settings

This parameter initializes all except:
15-00 Operating Hours
15-03 Power-ups
15-04 Over Temps
15-05 Over Volts

5

6 How to Program

6.1.1 Parameter Set-up

Group	Title	Function
0**	Operation and Display	Parameters used to program the fundamental functions of the adjustable frequency drive and the LCP including: selection of language; selection of which variables are displayed at each position in the display (e.g., static duct pressure or condenser water return temperature can be displayed with the setpoint in small digits in the top row and feedback in large digits in the center of the display); enabling/disabling of the LCP keys/buttons; passwords for the LCP; upload and download of commissioned parameters to/from the LCP and setting the built-in clock.
1**	Load / Motor	Parameters used to configure the adjustable frequency drive for the specific application and motor including: open-loop or closed-loop operation; type of application such as compressor, fan or centrifugal pump; motor nameplate data; auto-tuning of the drive to the motor for optimum performance; flying start (typically used for fan applications) and motor thermal protection.
2**	Brakes	Parameters used to configure braking functions of the adjustable frequency drive which although not common in many HVAC applications, can be useful on special fan applications. Parameters including: DC braking; dynamic/resistor braking and overvoltage control (which provides automatic adjustment of the deceleration rate (auto-ramping) to avoid tripping when decelerating large inertia fans)
3**	Reference / Ramps	Parameters used to program the minimum and maximum reference limits of speed (RPM/Hz) in open-loop or in actual units when operating in closed-loop); digital/preset references; jog speed; definition of the source of each reference (e.g., which analog input the reference signal is connected to); ramp-up and ramp-down times and digital potentiometer settings.
4**	Limits / Warnings	Parameters used to program limits and warnings of operation including: allowable motor direction; minimum and maximum motor speeds (e.g., in pump applications it is typical to program a minimum speed to approx 30–40% to ensure pump seals are adequately lubricated at all times, avoid cavitation and ensure adequate head is produced at all times to create flow); torque and current limits to protect the pump, fan or compressor driven by the motor; warnings for low/high current, speed, reference, and feedback; missing motor phase protection; speed bypass frequencies including semi-automatic set-up of these frequencies (e.g., to avoid resonance conditions on cooling towers and other fans).
5**	Digital In / Out	Parameters used to program the functions of all digital inputs, digital outputs, relay outputs, pulse inputs and pulse outputs for terminals on the control card and all option cards.
6**	Analog In / Out	Parameters used to program the functions associated with all analog inputs and analog outputs for the terminals on the control card and General Purpose I/O option (MCB 101) (note: NOT Analog I/O option MCB 109, see parameter group 26-00) including: analog input live zero timeout function (which for example can be used to command a cooling tower fan to operate at full speed if the condenser water return sensor fails); scaling of the analog input signals (for example, to match the analog input to the mA and pressure range of a static duct pressure sensor); filter time constant to filter out electrical noise on the analog signal which can sometimes occur when long cables are installed; function and scaling of the analog outputs (for example, to provide an analog output representing motor current or kW to an analog input of a DDC controller) and to configure the analog outputs to be controlled by the BMS via a high level interface (HLI) (e.g., to control a chilled water valve) including ability to define a default value of these outputs in the event of the HLI failing.
8**	Communication and Options	Parameters used for configuring and monitoring functions associated with the serial communications / high level interface to the adjustable frequency drive
9**	Profibus	Parameters only applicable when a Profibus option is installed.
10**	CAN Fieldbus	Parameters only applicable when a DeviceNet option is installed.
11**	LonWorks	Parameters only applicable when a Lonworks option is installed.

Group	Title	Function
13**	Smart Logic Controller	Parameters used to configure the built-in Smart Logic Controller (SLC), which can be used for simple functions such as comparators (e.g., if running above xHz, activate output relay), timers (e.g., when a start signal is applied, first activate output relay to open supply air damper and wait x seconds before ramping up) or a more complex sequence of user defined actions executed by the SLC when the associated user defined event is evaluated as TRUE by the SLC. (For example, initiate an economizer mode in a simple AHU cooling application control scheme where there is no BMS. For such an application, the SLC can monitor the relative humidity of the outside air, and if it is below a defined value, the supply air temperature setpoint could be automatically increased. With the adjustable frequency drive monitoring the relative humidity of the outside air and supply air temperature via its analog inputs and controlling the chilled water valve via one of the extended PI(D) loops and an analog output, it would then modulate that valve to maintain a higher supply air temperature). The SLC can often replace the need for other external control equipment.
14**	Special Functions	Parameters used to configure special functions of the adjustable frequency drive including: setting of the switching frequency to reduce audible noise from the motor (sometimes required for fan applications); kinetic backup function (especially useful for critical applications in semi-conductor installations where performance under line power dip/line power loss is important); Line imbalance protection; automatic reset (to avoid the need for a manual reset of alarms); energy optimization parameters (which typically do not need changing but enable fine tuning of this automatic function (if necessary) ensuring the adjustable frequency drive and motor combination operate at their optimum efficiency at full and partial load conditions) and auto-derating functions (which enable the adjustable frequency drive to continue operation at reduced performance under extreme operating conditions ensuring maximum up time).
15**	FC Information	Parameters providing operating data and other drive information including: operating and running hour counters; kWh counter; resetting of the running and kWh counters; alarm/fault log (where the past 10 alarms are logged along with any associated value and time) and drive and option card identification parameters such as code number and software version.
16**	Data Readouts	Read only parameters which display the status/value of many operating variables which can be displayed on the LCP or viewed in this parameter group. These parameters can be particularly useful during commissioning when interfacing with a BMS via a high level interface.
18**	Info & Readouts	Read-only parameters which display the last 10 preventative maintenance log items, actions and time and the value of analog inputs and outputs on the Analog I/O option card which can be particularly useful during commissioning when interfacing with a BMS via a high level interface.
20**	FC Closed-loop	Parameters used to configure the closed-loop PI(D) controller which controls the speed of the pump, fan or compressor in closed-loop mode including: defining where each of the three possible feedback signals come from (e.g., which analog input or the BMS HLI); conversion factor for each of the feedback signals (e.g., where a pressure signal is used for indication of flow in an AHU or converting from pressure to temperature in a compressor application); engineering unit for the reference and feedback (e.g., Pa, kPa, m Wg, in Wg, bar, m^3/s, m3/h, °C, °F, etc.); the function (e.g., sum, difference, average, minimum or maximum) used to calculate the resulting feedback for single zone applications or the control philosophy for multi-zone applications; programming of the setpoint(s) and manual or auto-tuning of the PI(D) loop.
21**	Extended Closed-loop	Parameters used to configure the three extended closed-loop PI(D) controllers which, for example, can be used to control external servos (e.g., chilled water valve to maintain supply air temperature in a VAV system) including: engineering unit for the reference and feedback of each controller (e.g., °C, °F, etc.); defining the range of the reference/setpoint for each controller; defining where each of the references/setpoints and feedback signals come from (e.g., which analog input or the BMS HLI); programming of the setpoint and manual or auto-tuning of the each of the PI(D) controllers.

Group	Title	Function
22**	Application Functions	Parameters used to monitor, protect and control pumps, fans and compressors including: no-flow detection and protection of pumps (including auto-setup of this function); dry pump protection; end of curve detection and protection of pumps; sleep mode (especially useful for cooling tower and booster pump sets); broken belt detection (typically used for fan applications to detect no air flow instead of using a Δp switch installed across the fan); short cycle protection of compressors and pump flow compensation of setpoint (especially useful for secondary chilled water pump applications where the Δp sensor has been installed close to the pump and not across the furthest most significant load(s) in the system; using this function can compensate for the sensor installation and help to realize maximum energy savings).
23**	Time Based Functions	Time based parameters including: those used to initiate daily or weekly actions based on the built in real time clock (e.g. change of setpoint for night set back mode or start/stop of the pump/fan/compressor start/stop of a external equipment); preventative maintenance functions which can be based on running or operating hour time intervals or on specific dates and times; energy log (especially useful in retrofit applications or where information of the actual historical load (kW) on the pump/fan/compressor is of interest); trending (especially useful in retrofit or other applications where there is an interest to log operating power, current, frequency or speed of the pump/fan/compressor for analysis and a payback counter).
24**	Application Functions 2	Parameters used to set up fire mode and/or to control a bypass contactor/starter if designed into the system.
25**	Cascade Controller	Parameters used to configure and monitor the built-in pump cascade controller (typically used for pump booster sets).
26**	Analog I/O Option MCB 109	Parameters used to configure the Analog I/O option (MCB 109) including: definition of the analog input types (e.g., voltage, Pt1000 or Ni1000) and scaling and definition of the analog output functions and scaling.

Table 6.1 Parameter Groups

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

All digital input/output and analog input/output terminals are multifunctional. All terminals have factory default functions suitable for the majority of HVAC applications but if other special functions are required, they must be programmed as explained in parameter group 5 or 6.

6.1.2 Quick Menu Mode

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

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

Example of changing parameter data
Assume parameter 22-60 is set to [Off]. However, you want to monitor the fan belt condition - non-broken or broken - according to the following procedure:

1. Press Quick Menu key
2. Choose Function Set-ups with the [▼] button
3. Press [OK]
4. Choose Application Settings with the [▼] button
5. Press [OK]
6. Press [OK] again for Fan Functions
7. Choose Broken Belt Function by pressing [OK]
8. With [▼] button, choose [2] Trip

The adjustable frequency drive will now trip if a broken fan belt is detected.

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

Select [Changes Made] to get information about:

- The last 10 changes. Use the up/down navigation keys to scroll between the last 10 changed parameters.
- The changes made since default setting.

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

Quick Setup

Efficient Parameter Set-up for VLT HVAC Drive Applications:
The parameters can easily be set up for the vast majority of the VLT HVAC Drive applications only by using the **[Quick Set-up]** option.
After pressing [Quick Menu], the different choices in the quick menu are listed. See also figure 6.1 below and tables Q3-1 to Q3-4 in the following *Function Set-ups* section.

Example of using the Quick Set-up option:
Assume you want to set the ramp-down time to 100 seconds:

1. Select [Quick Setup]. The first *0-01 Language* in Quick Set-up appears
2. Press [▼] repeatedly until *3-42 Ramp 1 Ramp-down Time* appears with the default setting of 20 seconds
3. Press [OK]
4. Use the [◄] button to highlight the third digit before the comma
5. Change '0' to '1' by using the [▲] button
6. Use the [►] button to highlight the digit '2'
7. Change '2' to '0' with the [▼] button
8. Press [OK]

The new ramp-down time is now set to 100 seconds.
It is recommended to do the set-up in the order listed.

NOTE!

A complete description of the function is found in the parameter sections of this manual.

Figure 6.1 Quick Menu view.

The Quick Set-up menu gives access to the 18 most important set-up parameters of the adjustable frequency drive. After programming, the adjustable frequency drive will, in most cases, be ready for operation. The 18 Quick Set-up parameters are shown in the table below. A complete description of the function is given in the parameter description sections of this manual.

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

Table 6.2 Quick Set-up parameters

**The display showing depends on choices made in 0-02 Motor Speed Unit and 0-03 Regional Settings. The default settings of 0-02 Motor Speed Unit and 0-03 Regional Settings depend on which region of the world the adjustable frequency drive is supplied to but can be re-programmed as required.*

*** 5-40 Function Relay, is an array, where one may choose between Relay1 [0] or Relay2 [1]. Standard setting is Relay1 [0] with the default choice Alarm [9].*
See the parameter description in the section Commonly Used Parameters.

For detailed information about settings and programming, please see the *VLT HVAC Drive Programming Guide, MG. 11.CX.YY*

x=version number
y=language

NOTE!

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

0-01 Language		
Option:		**Function:**
		Defines the language to be used in the display. The adjustable frequency drive can be 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
	Svenska	Part of Language package 1
[7]	Nederlands	Part of Language package 1
[10]	Chinese	Part of Language package 2
	Suomi	Part of Language package 1
[22]	English US	Part of Language package 4
	Greek	Part of Language package 4
	Bras.port	Part of Language package 4
	Slovenian	Part of Language package 3
	Korean	Part of Language package 2

0-01 Language		
Option:		**Function:**
	Japanese	Part of Language package 2
	Turkish	Part of Language package 4
	Trad.Chinese	Part of Language package 2
	Bulgarian	Part of Language package 3
	Srpski	Part of Language package 3
	Romanian	Part of Language package 3
	Magyar	Part of Language package 3
	Czech	Part of Language package 3
	Polski	Part of Language package 4
	Russian	Part of Language package 3
	Thai	Part of Language package 2
	Bahasa Indonesia	Part of Language package 2

1-20 Motor Power [kW]		
Range:		**Function:**
4.00 kW*	[0.09 - 3000.00 kW]	

1-21 Motor Power [HP]		
Range:		**Function:**
4.00 hp*	[0.09 - 3000.00 hp]	Enter the nominal motor power in HP according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit. This parameter cannot be adjusted while the motor is running. Depending on the choices made in *0-03 Regional Settings*, either *1-20 Motor Power [kW]* or *1-21 Motor Power [HP]* is made invisible.

1-22 Motor Voltage		
Range:		**Function:**
400. V*	[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 unit. This parameter cannot be adjusted while the motor is running.

1-23 Motor Frequency		
Range:		**Function:**
50. Hz*	[20 - 1000 Hz]	Select the motor frequency value from the motor nameplate data.For 87 Hz operation with 230/400 V motors, set the nameplate data for 230 V/50 Hz. Adapt *4-13 Motor*

1-23 Motor Frequency		
Range:		**Function:**
		Speed High Limit [RPM] and *3-03 Maximum Reference* to the 87 Hz application.

NOTE!

This parameter cannot be adjusted while the motor is running.

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

NOTE!

This parameter cannot be adjusted while the motor is running.

1-25 Motor Nominal Speed		
Range:		**Function:**
1420. RPM*	[100 - 60000 RPM]	

NOTE!

This parameter cannot be adjusted while the motor is running.

1-28 Motor Rotation Check		
Option:		**Function:**
		Following installation and connection of the motor, this function allows the correct motor rotation direction to be verified. Enabling this function overrides any bus commands or digital inputs, except External Interlock and Safe Stop (if included).
[0] *	OFF	Motor Rotation Check is not active.
[1]	Enabled	Motor Rotation Check is enabled. Once enabled, display shows: "Please Note! Motor may run in wrong direction".

Pressing [OK], [Back] or [Cancel] will dismiss the message and display a new message: “Press [Hand on] to start the motor. Press [Cancel] to abort”. Pressing [Hand on] starts the motor at 5 Hz in forward direction and the display shows: “Motor is running. Check if motor rotation direction is correct. Press [Off] to stop the motor”. Pressing [Off] stops the motor and resets *1-28 Motor Rotation Check*. If motor rotation direction is incorrect, two motor phase cables should be interchanged. IMPORTANT:

⚠WARNING

Line power must be removed before disconnecting motor phase cables.

3-41 Ramp 1 Ramp-up Time		
Range:		**Function:**
10.00 s*	[1.00 - 3600.00 s]	Enter the ramp-up time, i.e., the acceleration time from 0 RPM to *1-25 Motor Nominal Speed*. Choose a ramp-up time such that the output current does not exceed the current limit in *4-18 Current Limit* during ramping. See ramp-down time in *3-42 Ramp 1 Ramp-down Time*.

$$par.3-41 = \frac{tacc \times nnorm\,[par.1-25]}{ref\,[rpm]}[s]$$

3-42 Ramp 1 Ramp-down Time		
Range:		**Function:**
20.00 s*	[1.00 - 3600.00 s]	Enter the ramp-down time, i.e., the deceleration time from *1-25 Motor Nominal Speed* to 0 RPM. Choose 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*. See ramp-up time in *3-41 Ramp 1 Ramp-up Time*.

$$par.3-42 = \frac{tdec \times nnorm\,[par.1-25]}{ref\,[rpm]}[s]$$

4-14 Motor Speed High Limit [Hz]		
Range:		**Function:**
50/60.0 Hz*	[par. 4-12 - par. 4-19 Hz]	Enter the maximum limit for motor speed. The Motor Speed High Limit can be set to correspond to the manufacturer's recommended maximum of the motor shaft. The Motor Speed High Limit must exceed the in *4-12 Motor Speed Low Limit [Hz]*. Only *4-11 Motor Speed Low Limit [RPM]* or *4-12 Motor Speed Low Limit [Hz]* will be displayed, depending on other parameters in the main menu, and depending on default settings dependant on global location.

NOTE!

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

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

4-13 Motor Speed High Limit [RPM]		
Range:		**Function:**
1500. RPM*	[par. 4-11 - 60000. RPM]	Enter the maximum limit for motor speed. The Motor Speed High Limit can be set to correspond to the manufacturer's maximum rated motor. The Motor Speed High Limit must exceed the setting in *4-11 Motor Speed Low Limit [RPM]*. Only *4-11 Motor Speed Low Limit [RPM]* or *4-12 Motor Speed Low Limit [Hz]* will be displayed, depending on other parameters in the main menu, and depending on default settings dependant on global location.

NOTE!

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

NOTE!

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

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

3-11 Jog Speed [Hz]		
Range:		**Function:**
10.0 Hz*	[0.0 - par. 4-14 Hz]	The jog speed is a fixed output speed at which the adjustable frequency drive is running when the jog function is activated. See also *3-80 Jog Ramp Time*.

6

6.1.3 Function Set-ups

The Function set-up provides quick and easy access to all parameters required for the majority of VLT HVAC Drive applications including most VAV and CAV supply and return fans, cooling tower fans, primary, secondary and condenser water pumps and other pump, fan and compressor applications.

How to access Function set-up - example

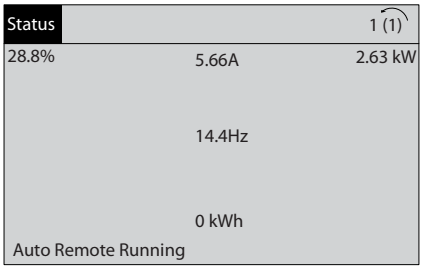


Figure 6.2 Step 1: Turn on the adjustable frequency drive (yellow LED lights)

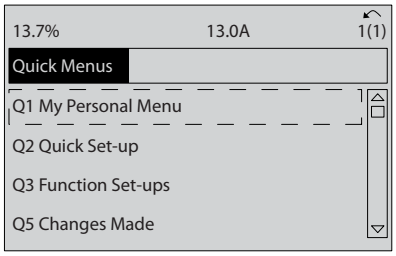


Figure 6.3 Step 2: Press the [Quick Menus] button (Quick Menus choices appear).

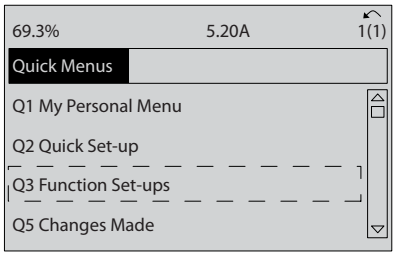


Figure 6.4 Step 3: Use the up/down navigation keys to scroll down to Function set-ups. Press [OK].

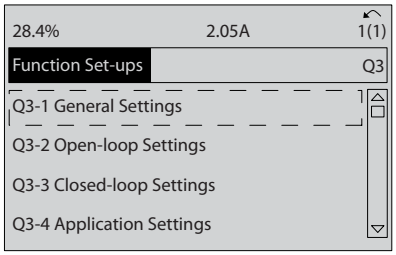


Figure 6.5 Step 4: Function set-ups choices appear. Choose Q3-1 *General Settings*. Press [OK].

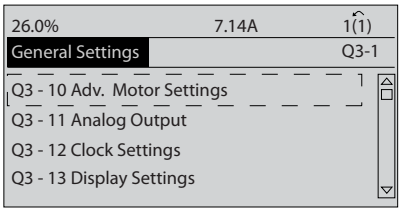


Figure 6.6 Step 5: Use the up/down navigation keys to scroll down to i.e., Q3-11 *Analog Outputs*. Press [OK].

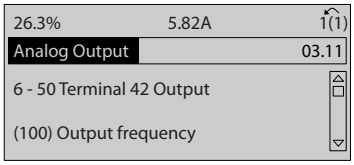


Figure 6.7 Step 6: Choose par. 6-50. Press [OK].

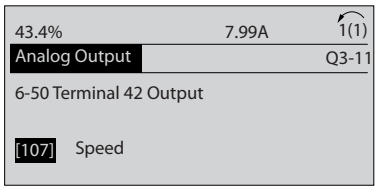


Figure 6.8 Step 7: Use the up/down navigation keys to select between the different choices. Press [OK].

Function Set-ups parameters

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

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

Q3-2 Open-loop Settings	
Q3-20 Digital Reference	**Q3-21 Analog Reference**
3-02 Minimum Reference	*3-02 Minimum Reference*
3-03 Maximum Reference	*3-03 Maximum Reference*
3-10 Preset Reference	*6-10 Terminal 53 Low Voltage*
5-13 Terminal 29 Digital Input	*6-11 Terminal 53 High Voltage*
5-14 Terminal 32 Digital Input	*6-12 Terminal 53 Low Current*
5-15 Terminal 33 Digital Input	*6-13 Terminal 53 High Current*
	6-14 Terminal 53 Low Ref./Feedb. Value
	6-15 Terminal 53 High Ref./Feedb. Value

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

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

6

1-00 Configuration Mode		
Option:		**Function:**
[0] *	Open-loop	Motor speed is determined by applying a speed reference or by setting desired speed when in hand mode. Open-loop is also used if the adjustable frequency drive is part of a closed-loop control system based on an external PID controller providing a speed reference signal as output.
[3]	Closed-loop	Motor speed will be determined by a reference from the built-in PID controller varying the motor speed as part of a closed-loop control process (e.g., constant pressure or flow). The PID controller must be configured in parameter group 20-** or via the Function Setups accessed by pressing the [Quick Menus] button.

NOTE!

This parameter cannot be changed when the motor is running.

NOTE!

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

1-03 Torque Characteristics		
Option:		**Function:**
[0] *	Compressor torque	*Compressor* [0]: For speed control of screw and scroll compressors. Provides a voltage which is optimized for a constant torque load characteristic of the motor in the entire range down to 10 Hz.
[1]	Variable torque	*Variable Torque* [1]: For speed control of centrifugal pumps and fans. Also to be used when controlling more than one motor from the same adjustable frequency drive (e.g., multiple condenser fans or cooling tower fans). Provides a voltage which is optimized for a squared torque load characteristic of the motor.

1-03 Torque Characteristics		
Option:		**Function:**
[2]	Auto Energy Optim. CT	*Auto Energy Optimization Compressor* [2]: For optimum energy efficient speed control of screw and scroll compressors. Provides a voltage which is optimized for a constant torque load characteristic of the motor in the entire range down to 15Hz but in addition the AEO feature will adapt the voltage exactly to the current load situation, thereby reducing energy consumption and audible noise from the motor. To obtain optimal performance, the motor power factor cos phi must be set correctly. This value is set in *14-43 Motor Cos-Phi*. The parameter has a default value which is automatically adjusted when the motor data is programmed. These settings will typically ensure optimum motor voltage but if the motor power factor cos phi requires tuning, an AMA function can be carried out using *1-29 Automatic Motor Adaptation (AMA)*. It is very rarely necessary to adjust the motor power factor parameter manually.
[3] *	Auto Energy Optim. VT	*Auto Energy Optimization VT* [3]: For optimum energy efficient speed control of centrifugal pumps and fans. Provides a voltage which is optimized for a squared torque load characteristic of the motor, but in addition, the AEO feature will adapt the voltage exactly to the current load situation, thereby reducing energy consumption and audible noise from the motor. To obtain optimal performance, the motor power factor cos phi must be set correctly. This value is set in *14-43 Motor Cos-Phi*. The parameter has a default value and is automatically adjusted when the motor data is programmed. These settings will typically ensure optimum motor voltage but if the motor power factor cos phi requires tuning, an AMA function can be carried out using *1-29 Automatic Motor Adaptation (AMA)*. It is very rarely necessary to adjust the motor power factor parameter manually.

1-29 Automatic Motor Adaptation (AMA)		
Option:		**Function:**
		The AMA function optimizes dynamic motor performance by automatically optimizing the advanced motor *1-30 Stator Resistance (Rs)* to *1-35 Main Reactance (Xh)*) while the motor is stationary.

1-29 Automatic Motor Adaptation (AMA)		
Option:		**Function:**
[0] *	Off	No function
[1]	Enable complete AMA	performs AMA of the stator resistance R_S, the rotor resistance R_r, the stator leakage reactance X_1, the rotor leakage reactance X_2 and the main reactance X_h.
[2]	Enable reduced AMA	Performs a reduced AMA of the stator resistance R_s in the system only. Select this option if an LC filter is used between the adjustable frequency drive and the motor.

Activate the AMA function by pressing [Hand on] after selecting [1] or [2]. See also the item *Automatic Motor Adaptation* in the Design Guide. After a normal sequence, the display will read: "Press [OK] to finish AMA". After pressing the [OK] key, the adjustable frequency drive is ready for operation.

NOTE!

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

NOTE!

Avoid generating external torque during AMA.

NOTE!

If one of the settings in parameter group 1-2* Motor Data is changed, *1-30 Stator Resistance (Rs)* to *1-39 Motor Poles*, the advanced motor parameters will return to default setting.
This parameter cannot be adjusted while the motor is running.

NOTE!

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

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

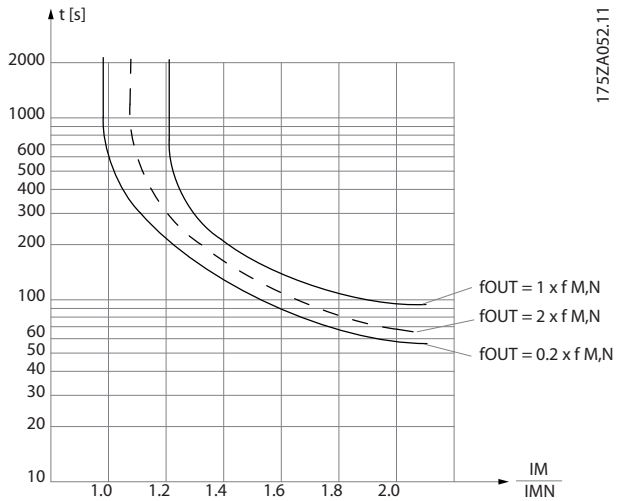
1-71 Start Delay		
Range:		**Function:**
0.0 s*	[0.0 - 120.0 s]	The function selected in *1-80 Function at Stop* is active in the delay period. Enter the time delay required before commencing acceleration.

1-73 Flying Start		
Option:		**Function:**
		This function makes it possible to catch a motor that is spinning freely due to a line drop-out. When *1-73 Flying Start* is enabled, *1-71 Start Delay* has no function. Search direction for flying start is linked to the setting in *4-10 Motor Speed Direction*. *Clockwise* [0]: Flying start search in clockwise direction. If not successful, a DC brake is carried out. *Both Directions* [2]: The flying start will first make a search in the direction determined by the last reference (direction). If unable to find the speed, it will search in the other direction. If not successful, a DC brake will be activated in the time set in *2-02 DC Braking Time*. Start will then take place from 0 Hz.
[0] *	Disabled	Select *Disable* [0] if this function is not required
[1]	Enabled	Select *Enable* [1] to enable the adjustable frequency drive to "catch" and control a spinning motor.

1-80 Function at Stop		
Option:		**Function:**
		Select the adjustable frequency drive function after a stop command or after the speed is ramped down to the settings in *1-81 Min Speed for Function at Stop [RPM]*.
[0] *	Coast	Leaves motor in free mode.
[1]	DC Hold/ Motor Preheat	Energizes motor with a DC holding current (see *2-00 DC Hold/Preheat Current*).

1-90 Motor Thermal Protection		
Option:		**Function:**
		The adjustable frequency drive determines the motor temperature for motor protection in two different ways: • Via a thermistor sensor connected to one of the analog or digital inputs (*1-93 Thermistor Source*). • Via calculation (ETR = Electronic Thermal Relay) of the thermal load, based on the actual load and time. The calculated thermal load is compared with the rated motor current $I_{M,N}$ and the rated motor frequency $f_{M,N}$. The calculations estimate the need for a lower load at lower speed due to less cooling from the fan incorporated in the motor.
[0] *	No protection	If the motor is continuously overloaded and no warning or trip of adjustable frequency drive is wanted.
[1]	Thermistor warning	Activates a warning when the connected thermistor in the motor reacts in the event of motor overtemperature.
[2]	Thermistor trip	Stops (trips) the adjustable frequency drive when the connected thermistor in the motor reacts in the event of motor overtemperature.
[3]	ETR warning 1	
[4] *	ETR trip 1	
[5]	ETR warning 2	
[6]	ETR trip 2	
[7]	ETR warning 3	
[8]	ETR trip 3	
[9]	ETR warning 4	
[10]	ETR trip 4	

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



⚠WARNING

In order to maintain PELV, all connections made to the control terminals must be PELV, e.g., thermistor must be reinforced/ double-insulated.

NOTE!

Danfoss recommends using 24 VDC as thermistor supply voltage.

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

NOTE!

This parameter cannot be adjusted while the motor is running.

NOTE!

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

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

NOTE!

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

2-10 Brake Function		
Option:		Function:
[0] *	Off	No brake resistor installed.
[1]	Resistor brake	Brake resistor incorporated in the system, for dissipation of surplus braking energy as heat. Connecting a brake resistor allows a higher DC link voltage during braking (generating operation). The resistor brake function is only active in adjustable frequency drives with an integral dynamic brake.
[2]	AC brake	AC Brake will only work in Compressor Torque mode in *1-03 Torque Characteristics*.

2-17 Over-voltage Control		
Option:		Function:
		Over-voltage control (OVC) reduces the risk of the adjustable frequency drive tripping due to overvoltage on the DC link caused by generative power from the load.
[0]	Disabled	No OVC required.
[2] *	Enabled	Activates OVC.

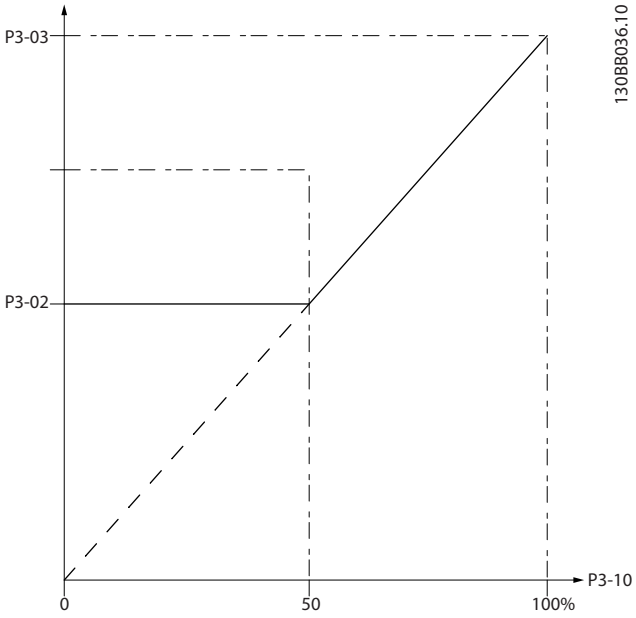
NOTE!

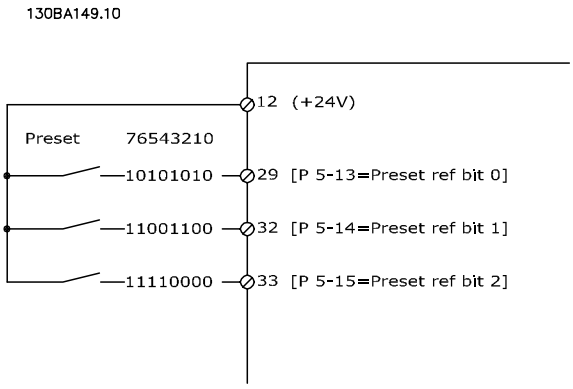
The ramp time is automatically adjusted to avoid tripping of the adjustable frequency drive.

3-02 Minimum Reference		
Range:		**Function:**
0.000 ReferenceFeed-backUnit*	[-999999.999 - par. 3-03 ReferenceFeedbackUnit]	

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

3-10 Preset Reference		
Array [8]		
Range:		**Function:**
0.00 %*	[-100.00 - 100.00 %]	





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

3-16 Reference 2 Source		
Option:		**Function:**
		Select the reference input to be used for the second reference signal. *3-15 Reference 1 Source*, *3-16 Reference 2 Source* and *3-17 Reference 3 Source* define up to three different reference signals. The sum of these reference signals defines the actual reference.

3-16 Reference 2 Source		
Option:		**Function:**
		This parameter cannot be adjusted while the motor is running.
[0]	No function	
[1]	Analog input 53	
[2]	Analog input 54	
[7]	Pulse input 29	
[8]	Pulse input 33	
[20] *	Digital pot.meter	
[21]	Analog input X30/11	
[22]	Analog input X30/12	
[23]	Analog Input X42/1	
[24]	Analog Input X42/3	
[25]	Analog Input X42/5	
[30]	Ext. Closed-loop 1	
[31]	Ext. Closed-loop 2	
[32]	Ext. Closed-loop 3	

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

NOTE!

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

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

NOTE!

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

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

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

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

5-01 Terminal 27 Mode		
Option:		**Function:**
[0] *	Input	Defines terminal 27 as a digital input.
[1]	Output	Defines terminal 27 as a digital output.

5-02 Terminal 29 Mode		
Option:		**Function:**
[0] *	Input	Defines terminal 29 as a digital input.
[1]	Output	Defines terminal 29 as a digital output.

This parameter cannot be adjusted while the motor is running.

6.1.4 5-1* Digital Inputs

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

Digital input function	Select	Terminal
No operation	[0]	All *terminal 19, 32, 33
Reset	[1]	All
Coast inverse	[2]	27
Coast and reset inverse	[3]	All
DC brake inverse	[5]	All
Stop inverse	[6]	All
External interlock	[7]	All
Start	[8]	All *terminal 18
Latched start	[9]	All
Reversing	[10]	All
Start reversing	[11]	All
Jog	[14]	All *terminal 29
Preset reference on	[15]	All
Preset ref bit 0	[16]	All
Preset ref bit 1	[17]	All
Preset ref bit 2	[18]	All
Freeze reference	[19]	All
Freeze output	[20]	All
Speed up	[21]	All
Speed down	[22]	All
Set-up select bit 0	[23]	All
Set-up select bit 1	[24]	All
Pulse input	[32]	terminal 29, 33
Ramp bit 0	[34]	All
Mains failure inverse	[36]	All
Fire mode	[37]	All
Run Permissive	[52]	All
Hand start	[53]	All
Auto start	[54]	All
DigiPot Increase	[55]	All
DigiPot Decrease	[56]	All
DigiPot Clear	[57]	All
Counter A (up)	[60]	29, 33
Counter A (down)	[61]	29, 33
Reset Counter A	[62]	All
Counter B (up)	[63]	29, 33
Counter B (down)	[64]	29, 33
Reset Counter B	[65]	All
Sleep Mode	[66]	All
Reset Maintenance Word	[78]	All
Lead Pump Start	[120]	All
Lead Pump Alternation	[121]	All
Pump 1 Interlock	[130]	All
Pump 2 Interlock	[131]	All
Pump 3 Interlock	[132]	All

6

5-12 Terminal 27 Digital Input

Same options and functions as par. 5-1*, except for *Pulse input*.

Option:		Function:
[0] *	No operation	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and Reset Inv	
[5]	DC brake inverse	
[6]	Stop inverse	
[7]	External interlock	
[8]	Start	
[9]	Latched start	
[10]	Reverse	
[11]	Start reverse	
[14]	Jog	
[15]	Preset reference on	
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	
[19]	Freeze reference	
[20]	Freeze output	
[21]	Speed up	
[22]	Slow	
[23]	Set-up select bit 0	
[24]	Set-up select bit 1	
[34]	Ramp bit 0	
[36]	Mains failure inverse	
[37]	Fire Mode	
[52]	Run permissive	
[53]	Hand start	
[54]	Auto-start	
[55]	DigiPot increase	
[56]	DigiPot decrease	
[57]	DigiPot clear	
[62]	Reset Counter A	
[65]	Reset Counter B	
[66]	Sleep Mode	
[78]	Reset Preventive Maintenance Word	
[120]	Lead Pump Start	
[121]	Lead Pump Alternation	
[130]	Pump 1 Interlock	
[131]	Pump 2 Interlock	
[132]	Pump 3 Interlock	

5-13 Terminal 29 Digital Input

Same options and functions as par. 5-1*.

Option:		Function:
[0]	No operation	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and Reset Inv	
[5]	DC brake inverse	
[6]	Stop inverse	
[7]	External interlock	
[8]	Start	
[9]	Latched start	
[10]	Reverse	
[11]	Start reverse	
[14] *	Jog	
[15]	Preset reference on	
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	
[19]	Freeze reference	
[20]	Freeze output	
[21]	Speed up	
[22]	Slow	
[23]	Set-up select bit 0	
[24]	Set-up select bit 1	
[30]	Counter input	
[32]	Pulse input	
[34]	Ramp bit 0	
[36]	Mains failure inverse	
[37]	Fire Mode	
[52]	Run permissive	
[53]	Hand start	
[54]	Auto-start	
[55]	DigiPot increase	
[56]	DigiPot decrease	
[57]	DigiPot clear	
[60]	Counter A (up)	
[61]	Counter A (down)	
[62]	Reset Counter A	
[63]	Counter B (up)	
[64]	Counter B (down)	
[65]	Reset Counter B	
[66]	Sleep Mode	
[78]	Reset Preventive Maintenance Word	
[120]	Lead Pump Start	
[121]	Lead Pump Alternation	
[130]	Pump 1 Interlock	
[131]	Pump 2 Interlock	
[132]	Pump 3 Interlock	

5-14 Terminal 32 Digital Input

Option:		Function:
[0] *	No Operation	Same options and functions as parameter group 5-1* *Digital Inputs*, except for *Pulse input*.

5-15 Terminal 33 Digital Input

Option:		Function:
[0] *	No Operation	Same options and functions as parameter group 5-1* *Digital Inputs*.

5-40 Function Relay

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

Option:		Function:
[0] *	No operation	
[1]	Control ready	
[2]	Drive ready	
[3]	Drive rdy/rem ctrl	
[4]	Stand-by / no warning	
[5] *	Running	Default setting for relay 2.
[6]	Running / no warning	
[8]	Run on ref/no warn	
[9] *	Alarm	Default setting for relay 1.
[10]	Alarm or warning	
[11]	At torque limit	
[12]	Out of current range	
[13]	Below current, low	
[14]	Above current, high	
[15]	Out of speed range	
[16]	Below speed, low	
[17]	Above speed, high	
[18]	Out of feedb. range	
[19]	Below feedback, low	
[20]	Above feedback, high	
[21]	Thermal warning	
[25]	Reverse	
[26]	Bus OK	
[27]	Torque limit stop	
[28]	Brake: No Brake War	
[29]	Brake ready, no fault	
[30]	Brake fault (IGBT)	
[35]	External Interlock	
[36]	Control word bit 11	
[37]	Control word bit 12	
[40]	Out of ref range	

5-40 Function Relay

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

Option:		Function:
[41]	Below reference, low	
[42]	Above ref, high	
[45]	Bus ctrl.	
[46]	Bus ctrl, 1 if timeout	
[47]	Bus ctrl, 0 if timeout	
[60]	Comparator 0	
[61]	Comparator 1	
[62]	Comparator 2	
[63]	Comparator 3	
[64]	Comparator 4	
[65]	Comparator 5	
[70]	Logic rule 0	
[71]	Logic rule 1	
[72]	Logic rule 2	
[73]	Logic rule 3	
[74]	Logic rule 4	
[75]	Logic rule 5	
[80]	SL digital output A	
[81]	SL digital output B	
[82]	SL digital output C	
[83]	SL digital output D	
[84]	SL digital output E	
[85]	SL digital output F	
[160]	No alarm	
[161]	Running reverse	
[165]	Local ref active	
[166]	Remote ref active	
[167]	Start cmd. active	
[168]	Hand mode	
[169]	Auto mode	
[180]	Clock Fault	
[181]	Prev. Maintenance	
[190]	No-Flow	
[191]	Dry Pump	
[192]	End Of Curve	
[193]	Sleep Mode	
[194]	Broken Belt	
[195]	Bypass Valve Control	
[196]	Fire Mode Active	
[197]	Fire Mode Was Active	
[198]	Bypass Mode Active	
[211]	Cascade Pump 1	
[212]	Cascade Pump 2	
[213]	Cascade Pump 3	

6

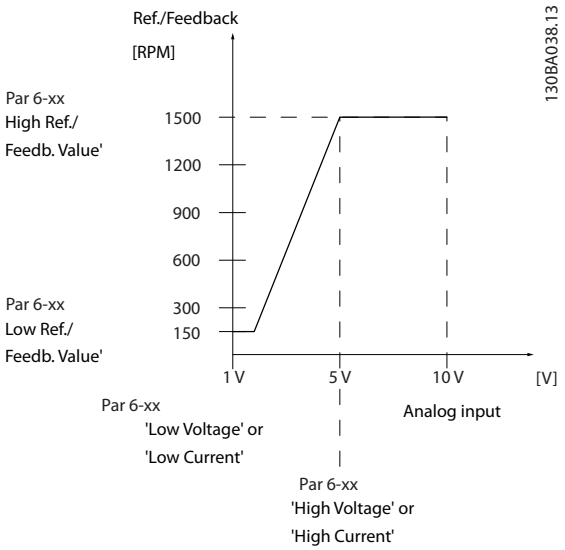
6

6-00 Live Zero Timeout Time

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

6-01 Live Zero Timeout Function

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



6-10 Terminal 53 Low Voltage

Range:		Function:
0.07 V*	[0.00 - par. 6-11 V]	Enter the low voltage value. This analog input scaling value should correspond to the low reference/feedback value set in *6-14 Terminal 53 Low Ref./Feedb. Value*.

6-11 Terminal 53 High Voltage

Range:		Function:
10.00 V*	[par. 6-10 - 10.00 V]	Enter the high voltage value. This analog input scaling value should correspond to the high reference/ feedback value set in *6-15 Terminal 53 High Ref./Feedb. Value*.

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

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

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

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

6-16 Terminal 53 Filter Time Constant

Range:		Function:
0.001 s*	[0.001 - 10.000 s]	Enter the time constant. This is a first-order digital low pass filter time constant for suppressing electrical noise in terminal 53. A high time constant value improves dampening but also increases the time delay through the filter. This parameter cannot be adjusted while the motor is running.

6-17 Terminal 53 Live Zero

Option:		Function:
		This parameter makes it possible to disable the Live Zero monitoring. For example, this is to be used if the analog outputs are used as part of a de-central I/O system (e.g., when not used as part of any adjustable frequency drive related control functions, but for feeding a building management system with data).
[0]	Disabled	
[1] *	Enabled	

6-20 Terminal 54 Low Voltage

Range:		Function:
0.07 V*	[0.00 - par. 6-21 V]	Enter the low voltage value. This analog input scaling value should correspond to the low reference/feedback value, set in *6-24 Terminal 54 Low Ref./Feedb. Value*.

6-21 Terminal 54 High Voltage

Range:		Function:
10.00 V*	[par. 6-20 - 10.00 V]	Enter the high voltage value. This analog input scaling value should correspond to the high reference/ feedback value set in *6-25 Terminal 54 High Ref./Feedb. Value*.

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

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

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

Range:		Function:
100.000 N/A*	[-999999.999 - 999999.999 N/A]	Enter the analog input scaling value that corresponds to the high voltage/high current

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

Range:		Function:
		value set in *6-21 Terminal 54 High Voltage* and *6-23 Terminal 54 High Current*.

6-26 Terminal 54 Filter Time Constant

Range:		Function:
0.001 s*	[0.001 - 10.000 s]	Enter the time constant. This is a first-order digital low pass filter time constant for suppressing electrical noise in terminal 54. A high time constant value improves dampening but also increases the time delay through the filter. This parameter cannot be adjusted while the motor is running.

6-27 Terminal 54 Live Zero

Option:		Function:
		This parameter makes it possible to disable the Live Zero monitoring. For example, this to be used if the analog outputs are used as part of a de-central I/O system (e.g., when used not as part of any adjustable frequency drive related control functions, but for feeding a building management system with data).
[0]	Disabled	
[1] *	Enabled	

6-50 Terminal 42 Output

Option:		Function:
		Select the function of Terminal 42 as an analog current output. A motor current of 20 mA corresponds to I_{max}.
[0] *	No operation	
[100]	Output frequency	0–100 Hz, (0–20 mA)
[101]	Reference	Minimum reference - Maximum reference, (0–20 mA)
[102]	Feedback	-200% to +200% of *20-14 Maximum Reference/Feedb.*, (0–20 mA)
[103]	Motor current	0 - Inverter Max. Current (*16-37 Inv. Max. Current*), (0–20 mA)
[104]	Torque rel to limit	0 - Torque limit (*4-16 Torque Limit Motor Mode*), (0–20 mA)
[105]	Torq relate to rated	0 - Motor rated torque, (0–20 mA)
[106]	Power	0 - Motor rated power, (0–20 mA)
[107] *	Speed	0 - Speed High Limit (*4-13 Motor Speed High Limit [RPM]* and

6-50 Terminal 42 Output		
Option:		**Function:**
		4-14 Motor Speed High Limit [Hz]), (0–20 mA)
[113]	Ext. Closed-loop 1	0–100%, (0–20 mA)
[114]	Ext. Closed-loop 2	0–100%, (0–20 mA)
[115]	Ext. Closed-loop 3	0–100%, (0–20 mA)
[130]	Output freq. 4-20mA	0–100 Hz
[131]	Reference 4-20mA	Minimum Reference - Maximum Reference
[132]	Feedback 4-20mA	-200% to +200% of *20-14 Maximum Reference/Feedb.*
[133]	Motor cur. 4-20mA	0 - Inverter Max. Current (*16-37 Inv. Max. Current*)
[134]	Torq.% lim 4-20 mA	0 - Torque limit (*4-16 Torque Limit Motor Mode*)
[135]	Torq.% nom 4-20 mA	0 - Motor rated torque
[136]	Power 4-20mA	0 - Motor rated power
[137]	Speed 4-20mA	0 - Speed High Limit (4-13 and 4-14)
[139]	Bus ctrl.	0–100%, (0–20 mA)
[140]	Bus ctrl. 4-20 mA	0 - 100%
[141]	Bus ctrl t.o.	0–100%, (0–20 mA)
[142]	Bus ctrl 4-20mA t.o.	0 - 100%
[143]	Ext. Closed-loop 1 4-20 mA	0 - 100%
[144]	Ext. Closed-loop 2 4-20 mA	0 - 100%
[145]	Ext. Closed-loop 3 4-20 mA	0 - 100%

NOTE!

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

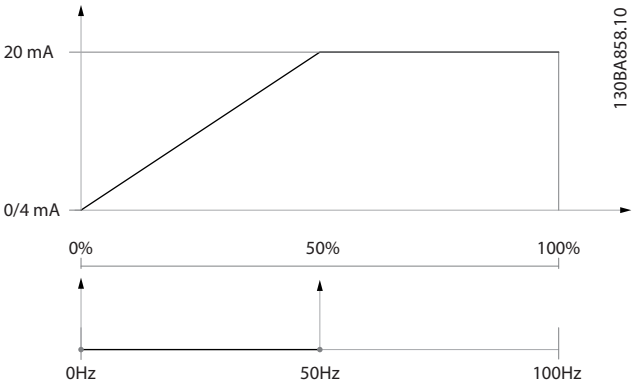
6-51 Terminal 42 Output Min Scale		
Range:		**Function:**
0.00 %*	[0.00 - 200.00 %]	

6-52 Terminal 42 Output Max Scale		
Range:		**Function:**
100.00 %*	[0.00 - 200.00 %]	

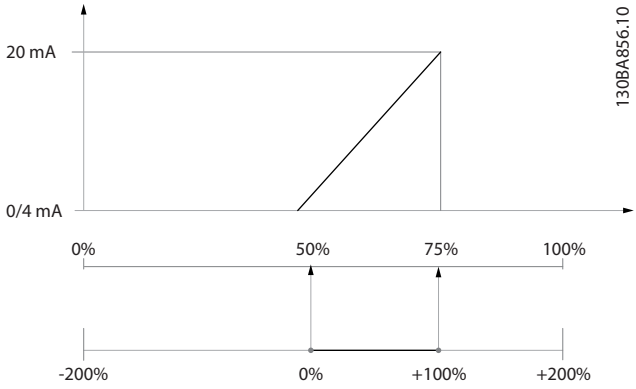
$$20\ mA\ /\ desired\ maximum\ current \times 100\ \%$$

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

EXAMPLE 1:
Variable value= OUTPUT FREQUENCY, range = 0–100 Hz
Range needed for output = 0–50 Hz
Output signal 0 or 4 mA is needed at 0 Hz (0% of range) - set *6-51 Terminal 42 Output Min Scale* to 0%
Output signal 20 mA is needed at 50 Hz (50% of range) - set *6-52 Terminal 42 Output Max Scale* to 50%

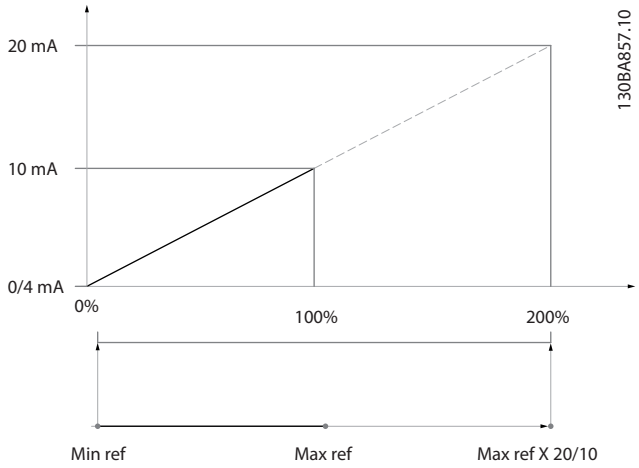


EXAMPLE 2:
Variable= FEEDBACK, range= -200% to +200%
Range needed for output= 0–100%
Output signal 0 or 4 mA is needed at 0% (50% of range) - set *6-51 Terminal 42 Output Min Scale* to 50%
Output signal 20 mA is needed at 100% (75% of range) - set *6-52 Terminal 42 Output Max Scale* to 75%



EXAMPLE 3:
Variable value= REFERENCE, range= Min ref - Max ref
Range needed for output= Min ref (0%) - Max ref (100%), 0–10 mA
Output signal 0 or 4 mA is needed at Min ref - set *6-51 Terminal 42 Output Min Scale* to 0%

Output signal 10 mA is needed at Max ref (100% of range) - set *6-52 Terminal 42 Output Max Scale* to 200% (20 mA / 10 mA x 100%=200%).



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

20-00 Feedback 1 Source		
Option:		**Function:**
		Up to three different feedback signals can be used to provide the feedback signal for the adjustable frequency drive's PID controller. This parameter defines which input will be used as the source of the first feedback signal. Analog input X30/11 and Analog input X30/12 refer to inputs on the optional general purpose I/O board.
[0]	No function	
[1]	Analog input 53	
[2] *	Analog input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog Input X42/1	
[10]	Analog Input X42/3	
[11]	Analog Input X42/5	
[100]	Bus feedback 1	
[101]	Bus feedback 2	
[102]	Bus feedback 3	

NOTE!

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

20-01 Feedback 1 Conversion		
Option:		**Function:**
		This parameter allows a conversion function to be applied to Feedback 1.
[0] *	Linear	*Linear* [0] has no effect on the feedback.
[1]	Square root	*Square root* [1] is commonly used when a pressure sensor is used to provide flow feedback ($flow \propto \sqrt{pressure}$).
[2]	Pressure to temperature	*Pressure to temperature* [2] is used in compressor applications to provide temperature feedback using a pressure sensor. The temperature of the refrigerant is calculated using the following formula: $Temperature = \frac{A2}{(ln(Pe+1) - A1)} - A3$, where A1, A2 and A3 are refrigerant-specific constants. The refrigerant must be selected in *20-30 Refrigerant*. *20-21 Setpoint 1* through

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20-01 Feedback 1 Conversion

Option:	Function:
	20-23 Setpoint 3 allow the values of A1, A2 and A3 to be entered for a refrigerant that is not listed in *20-30 Refrigerant*.

20-03 Feedback 2 Source

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

20-04 Feedback 2 Conversion

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

20-06 Feedback 3 Source

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

20-07 Feedback 3 Conversion

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

20-20 Feedback Function

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

20-20 Feedback Function		
Option:		Function:
		NOTE! **Any unused feedbacks must be set to *No Function* in *20-00 Feedback 1 Source*, *20-03 Feedback 2 Source*, or *20-06 Feedback 3 Source*. Only setpoint 1 will be used. The sum of Setpoint 1 and any other references that are enabled (see par. group 3-1*) will be used as the PID controller's setpoint reference.**
[4]	Maximum	*Maximum* [4] sets up the PID controller to compare Feedback 1, Feedback 2 and Feedback 3 and use the highest value as the feedback. **NOTE!** **Any unused feedbacks must be set to *No Function* in *20-00 Feedback 1 Source*, *20-03 Feedback 2 Source*, or *20-06 Feedback 3 Source*.** Only Setpoint 1 will be used. The sum of Setpoint 1 and any other references that are enabled (see par. group 3-1*) will be used as the PID controller's setpoint reference.
[5]	Multi Setpoint Min	*Multi-setpoint minimum* [5] sets up the PID Controller to calculate the difference between Feedback 1 and Setpoint 1, Feedback 2 and Setpoint 2, and Feedback 3 and Setpoint 3. It will use the feedback/setpoint pair in which the feedback is the farthest below its corresponding setpoint reference. If all feedback signals are above their corresponding setpoints, the PID Controller will use the feedback/setpoint pair in which the difference between the feedback and setpoint is the least.

20-20 Feedback Function		
Option:		Function:
		NOTE! **If only two feedback signals are used, the feedback that is not to be used must be set to *No Function* in *20-00 Feedback 1 Source*, *20-03 Feedback 2 Source* or *20-06 Feedback 3 Source*. Note that each setpoint reference will be the sum of its respective parameter value (*20-21 Setpoint 1*, *20-22 Setpoint 2* and *20-23 Setpoint 3*) and any other references that are enabled (see par. group 3-1*).**
[6]	Multi Setpoint Max	*Multi-setpoint maximum* [6] sets up the PID Controller to calculate the difference between Feedback 1 and Setpoint 1, Feedback 2 and Setpoint 2, and Feedback 3 and Setpoint 3. It will use the feedback/setpoint pair in which the feedback is farthest above its corresponding setpoint reference. If all feedback signals are below their corresponding setpoints, the PID Controller will use the feedback/setpoint pair in which the difference between the feedback and the setpoint reference is the least. **NOTE!** **If only two feedback signals are used, the feedback that is not to be used must be set to *No Function* in *20-00 Feedback 1 Source*, *20-03 Feedback 2 Source* or *20-06 Feedback 3 Source*. Note that each setpoint reference will be the sum of its respective parameter value (*20-21 Setpoint 1*, *20-22 Setpoint 2* and *20-23 Setpoint 3*) and any other references that are enabled (see par. group 3-1*).**

NOTE!

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

The feedback resulting from the function selected in *20-20 Feedback Function* will be used by the PID controller to control the output frequency of the adjustable frequency drive. This feedback can also be shown on the adjustable frequency drive's display, be used to control an adjustable frequency drive's analog output, and be transmitted over various serial communication protocols.

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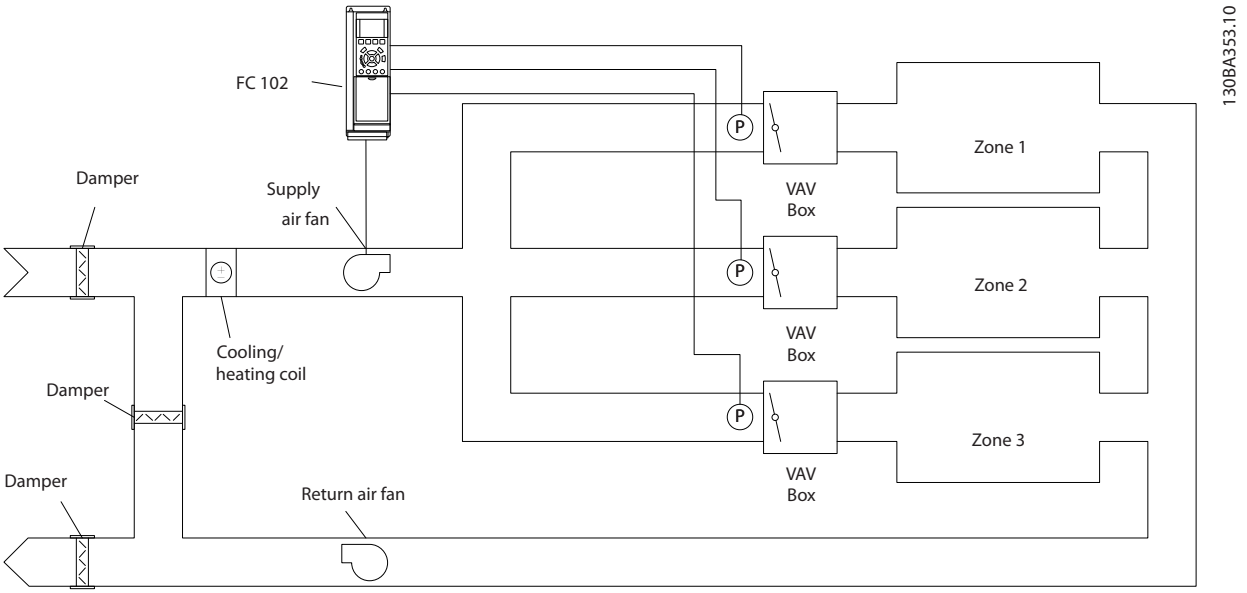
The adjustable frequency drive can be configured to handle multi-zone applications. Two different multi-zone applications are supported:

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

The difference between the two is illustrated by the following examples:

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



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

20-21 Setpoint 1		
Range:		**Function:**
0.000 ProcessCtrlUnit*	[-999999.999 - 999999.999 ProcessCtrlUnit]	Setpoint 1 is used in closed-loop mode to enter a setpoint reference that is used by the adjustable frequency drive's PID controller. See the description of *20-20 Feedback Function*.

20-21 Setpoint 1		
Range:		**Function:**
		NOTE! **Setpoint reference entered here is added to any other references that are enabled (see par. group 3-1*).**

20-22 Setpoint 2		
Range:		**Function:**
0.000 ProcessCtrlUnit*	[-999999.999 - 999999.999 ProcessCtrlUnit]	Setpoint 2 is used in closed-loop mode to enter a setpoint reference that may be used by the adjustable frequency drive's PID controller. See the description of *Feedback Function*, *20-20 Feedback Function*.

NOTE!

The setpoint reference entered here is added to any other references that are enabled (see par. group 3-1*).

20-81 PID Normal/ Inverse Control		
Option:		**Function:**
[0] *	Normal	*Normal* [0] causes the adjustable frequency drive's output frequency to decrease when the feedback is greater than the setpoint reference. This is common for pressure-controlled supply fan and pump applications.
[1]	Inverse	*Inverse* [1] causes the adjustable frequency drive's output frequency to increase when the feedback is greater than the setpoint reference. This is common for temperature-controlled cooling applications, such as cooling towers.

20-93 PID Proportional Gain		
Range:		**Function:**
0.50 N/A*	[0.00 - 10.00 N/A]	

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

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

NOTE!

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

20-94 PID Integral Time		
Range:		**Function:**
20.00 s*	[0.01 - 10000.00 s]	Over time, the integrator accumulates a contribution to the output from the PID controller as long as there is a deviation between the reference/setpoint and feedback signals. The contribution is proportional to the size of the deviation. This ensures that the deviation (error) approaches zero. Quick response on any deviation is obtained when the integral time is set to a low value. Setting it too low, however, may cause the control to become unstable. The value set is the time needed for the integrator to add the same contribution as the proportional part for a certain deviation. If the value is set to 10,000, the controller will act as a pure proportional controller with a P-band based on the value set in *20-93 PID Proportional Gain*. When no deviation is present, the output from the proportional controller will be 0.

22-21 Low Power Detection		
Option:		**Function:**
[0] *	Disabled	
[1]	Enabled	If selecting Enabled, the low power detection commissioning must be carried out in order to set the parameters in group 22-3* for proper operation!

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

22-23 No-Flow Function		
Common actions for Low Power Detection and Low Speed Detection (Individual selections not possible).		
Option:	**Function:**	
[0] *	OFF	
[1]	Sleep Mode	The drive will enter sleep mode and stop when a No Flow condition is detected. See parameter group 22-4* for programming options for sleep mode.
[2]	Warning	The drive will continue to run, but activate a No-Flow Warning [W92]. A drive digital output or a serial communication bus can communicate a warning to other equipment.
[3]	Alarm	The drive will stop running and activate a No-Flow Alarm [A 92]. A drive digital output or a serial communication bus can communicate an alarm to other equipment.

NOTE!

Do not set *14-20 Reset Mode* to [13] Infinite auto reset when *22-23 No-Flow Function*is set to [3] Alarm. Doing so will cause the drive to continuously cycle between running and stopping when a No Flow condition is detected.

NOTE!

If the drive is equipped with a constant speed bypass with an automatic bypass function that starts the bypass if the drive experiences a persistent alarm condition, be sure to disable the bypass' automatic bypass function, if [3] Alarm is selected as the No-Flow Function.

22-24 No-Flow Delay		
Range:		**Function:**
10 s*	[1 - 600 s]	Set the time. Low Power/Low Speed must remain detected to activate signal for actions. If detection disappears before the timer runs out, the timer will be reset.

22-26 Dry Pump Function		
Select desired action for dry pump operation.		
Option:	**Function:**	
[0] *	OFF	

22-26 Dry Pump Function		
Select desired action for dry pump operation.		
Option:	**Function:**	
[1]	Warning	The drive will continue to run, but activate a dry pump warning [W93]. A drive digital output or a serial communication bus can communicate a warning to other equipment.
[2]	Alarm	The drive will stop running and activate a dry pump alarm [A93]. A drive digital output or a serial communication bus can communicate an alarm to other equipment.

NOTE!

Low Power Detection must be Enabled (_22-21 Low Power Detection_) and commissioned (using either parameter group 22-3*, _No Flow Power Tuning_, or _22-20 Low Power Auto Set-up_) in order to use Dry Pump Detection.

NOTE!

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

NOTE!

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

22-40 Minimum Run Time		
Range:		**Function:**
10 s*	[0 - 600 s]	

22-41 Minimum Sleep Time		
Range:		**Function:**
10 s*	[0 - 600 s]	Set the desired minimum time for staying in sleep mode. This will override any wake-up conditions.

22-42 Wake-up Speed [RPM]		
Range:		**Function:**
0 RPM*	[par. 4-11 - par. 4-13 RPM]	To be used if *0-02 Motor Speed Unit* has been set for RPM (parameter not visible if Hz selected). Only to be used if *1-00 Configuration Mode* is set for open-loop and speed reference is applied by an external controller. Set the reference speed at which sleep mode should be canceled.

22-60 Broken Belt Function		
Selects the action to be performed if the broken belt condition is detected.		
Option:		**Function:**
[0] *	OFF	
[1]	Warning	The drive will continue to run, but activate a Broken Belt Warning [W95]. A drive digital output or a serial communication bus can communicate a warning to other equipment.
[2]	Trip	The drive will stop running and activate a Broken Belt alarm [A 95]. A drive digital output or a serial communication bus can communicate an alarm to other equipment.

NOTE!

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

NOTE!

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

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

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

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

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

22-77 Minimum Run Time		
Range:		**Function:**
0 s*	[0 - par. 22-76 s]	Sets the time desired as minimum run time after a normal start command (Start/Jog/Freeze). Any normal stop command will be disregarded until the set time has expired. The timer will start counting following a normal start command (Start/Jog/Freeze). The timer will be overridden by a Coast (Inverse) or an External Interlock command.

NOTE!

Does not work in cascade mode.

6

6.1.5 Main Menu Mode

Both the GLCP and NLCP provide access to the main menu mode. Select main menu mode by pressing the [Main Menu] key. Figure 6.2 shows the resulting readout, which appears on the display of the GLCP.
Lines 2 through 5 on the display show a list of parameter groups which can be chosen by toggling the up and down buttons.

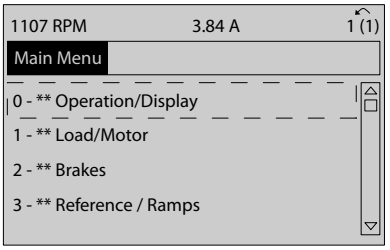


Figure 6.9 Display example.

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

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

6.1.6 Parameter Selection

In main menu mode, the parameters are divided into groups. Select a parameter group using the navigation keys.
The following parameter groups are accessible:

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

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

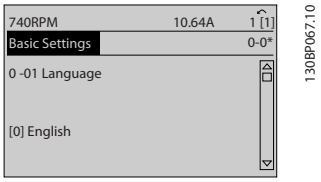


Figure 6.10 Display example.

6.1.7 Changing Data

1. Press the [Quick Menu] or [Main Menu] key.
2. Use [▲] and [▼] keys to find parameter group to edit.
3. Press [OK] key.
4. Use [▲] and [▼] keys to find parameter to edit.

5. Press [OK] key.
6. Use [▲] and [▼] keys to select correct parameter setting. Or, to move to digits within a number, use the keys. Cursor indicates digit selected to change. [▲] key increases the value, [▼] key decreases the value.
7. Press the [Cancel] key to disregard the change, or press the [OK] key to accept the change and enter the new setting.

6.1.8 Changing a Text Value

If the selected parameter is a text value, it can be changed by using the up/down navigation keys.
The up key increases the value, and the down key decreases the value. Place the cursor on the value to be saved and press [OK].

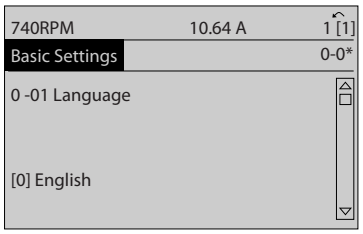


Figure 6.11 Display example.

6.1.9 Changing a Group of Numeric Data Values

If the chosen parameter represents a numeric data value, change the chosen data value by means of the [◄] and [►] navigation keys as well as the up/down [▲] [▼] navigation keys. Use the ◄] and [►] navigation keys to move the cursor horizontally.

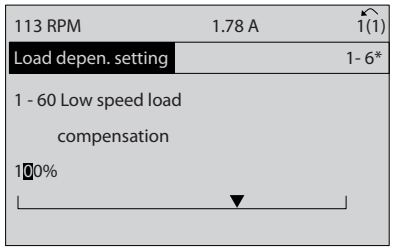


Figure 6.12 Display example.

Use the up/down navigation keys to change the data value. The up key increases the data value, while the down key reduces it. Place the cursor on the value to be saved and press [OK].

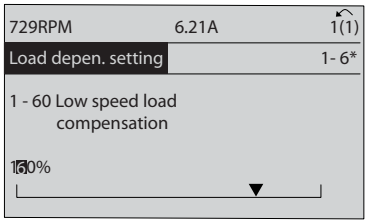


Figure 6.13 Display example.

6.1.10 Changing Data Values, Step-by-Step

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

6.1.11 Readout and Programming of Indexed Parameters

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

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

6

6.2 Parameter lists

6.2.1 Main Menu Structure

Parameters for the adjustable frequency drive are grouped into various parameter groups for easy selection of the correct parameters for optimized operation of the adjustable frequency drive.
The vast majority of VLT HVAC Drive applications can be programmed using the Quick Menu button and selecting the parameters under Quick Set-up and Function Set-ups. Descriptions and default settings of parameters may be found under the section Parameter Lists at the back of this manual.

0-** Operation/Display
1-** Load/Motor
2-** Brakes
3-** Reference/Ramps
4-** Limits / Warnings
5-** Digital In/Out
6-** Analog In/Out
8-** Comm. and Options
9-** Profibus
10-** CAN Fieldbus
11-** LonWorks
13-** Smart Logic Controller
14-** Special Functions
15-** FC Information
16-** Data Readouts
18-** Info & Readouts
20-** FC Closed-loop
21-** Ext. Closed-loop
22-** Application Functions
23-** Time-based Functions
24-** Application Functions 2
25-** Cascade Controller
26-** Analog I/O Option MCB 109

6.2.2 0-** Operation and Display

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
0-0* Basic Settings						
0-01	Language	[0] English	1 set-up	TRUE	-	Uint8
0-02	Motor Speed Unit	[1] Hz	2 set-ups	FALSE	-	Uint8
0-03	Regional Settings	[0] International	2 set-ups	FALSE	-	Uint8
0-04	Operating State at Power-up	[0] Resume	All set-ups	TRUE	-	Uint8
0-05	Local Mode Unit	[0] As Motor Speed Unit	2 set-ups	FALSE	-	Uint8
0-1* Set-up Operations						
0-10	Active Set-up	[1] Set-up 1	1 set-up	TRUE	-	Uint8
0-11	Programming Set-up	[9] Active Set-up	All set-ups	TRUE	-	Uint8
0-12	This Set-up Linked to	[0] Not linked	All set-ups	FALSE	-	Uint8
0-13	Readout: Linked Set-ups	0 N/A	All set-ups	FALSE	0	Uint16
0-14	Readout: Prog. Set-ups / Channel	0 N/A	All set-ups	TRUE	0	Int32
0-2* LCP Display						
0-20	Display Line 1.1 Small	1602	All set-ups	TRUE	-	Uint16
0-21	Display Line 1.2 Small	1614	All set-ups	TRUE	-	Uint16
0-22	Display Line 1.3 Small	1610	All set-ups	TRUE	-	Uint16
0-23	Display Line 2 Large	1613	All set-ups	TRUE	-	Uint16
0-24	Display Line 3 Large	1502	All set-ups	TRUE	-	Uint16
0-25	My Personal Menu	SR	1 set-up	TRUE	0	Uint16
0-3* LCP Cust. Readout						
0-30	Custom Readout Unit	[1] %	All set-ups	TRUE	-	Uint8
0-31	Custom Readout Min Value	SR	All set-ups	TRUE	-2	Int32
0-32	Custom Readout Max Value	100.00 CustomReadoutUnit	All set-ups	TRUE	-2	Int32
0-37	Display Text 1	0 N/A	1 set-up	TRUE	0	VisStr[25]
0-38	Display Text 2	0 N/A	1 set-up	TRUE	0	VisStr[25]
0-39	Display Text 3	0 N/A	1 set-up	TRUE	0	VisStr[25]
0-4* LCP Keypad						
0-40	[Hand on] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-41	[Off] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-42	[Auto on] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-43	[Reset] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-44	[Off/Reset] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-45	[Drive Bypass] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-5* Copy/Save						
0-50	LCP Copy	[0] No copy	All set-ups	FALSE	-	Uint8
0-51	Set-up Copy	[0] No copy	All set-ups	FALSE	-	Uint8
0-6* Password						
0-60	Main Menu Password	100 N/A	1 set-up	TRUE	0	Int16
0-61	Access to Main Menu w/o Password	[0] Full access	1 set-up	TRUE	-	Uint8
0-65	Personal Menu Password	200 N/A	1 set-up	TRUE	0	Int16
0-66	Access to Personal Menu w/o Password	[0] Full access	1 set-up	TRUE	-	Uint8
0-7* Clock Settings						
0-70	Set Date and Time	SR	All set-ups	TRUE	0	TimeOfDay
0-71	Date Format	null	1 set-up	TRUE	-	Uint8

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
0-72	Time Format	null	1 set-up	TRUE	-	Uint8
0-74	DST/Summertime	[0] Off	1 set-up	TRUE	-	Uint8
0-76	DST/Summertime Start	SR	1 set-up	TRUE	0	TimeOfDay
0-77	DST/Summertime End	SR	1 set-up	TRUE	0	TimeOfDay
0-79	Clock Fault	null	1 set-up	TRUE	-	Uint8
0-81	Working Days	null	1 set-up	TRUE	-	Uint8
0-82	Additional Working Days	SR	1 set-up	TRUE	0	TimeOfDay
0-83	Additional Non-Working Days	SR	1 set-up	TRUE	0	TimeOfDay
0-89	Date and Time Readout	0 N/A	All set-ups	TRUE	0	VisStr[25]

6.2.3 1-** Load / Motor

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	Change during operation	Conversion index	Type
1-0* General Settings						
1-00	Configuration Mode	null	All set-ups	TRUE	-	Uint8
1-03	Torque Characteristics	[3] Auto Energy Optim. VT	All set-ups	TRUE	-	Uint8
1-2* Motor Data						
1-20	Motor Power [kW]	SR	All set-ups	FALSE	1	Uint32
1-21	Motor Power [HP]	SR	All set-ups	FALSE	-2	Uint32
1-22	Motor Voltage	SR	All set-ups	FALSE	0	Uint16
1-23	Motor Frequency	SR	All set-ups	FALSE	0	Uint16
1-24	Motor Current	SR	All set-ups	FALSE	-2	Uint32
1-25	Motor Nominal Speed	SR	All set-ups	FALSE	67	Uint16
1-28	Motor Rotation Check	[0] Off	All set-ups	FALSE	-	Uint8
1-29	Automatic Motor Adaptation (AMA)	[0] Off	All set-ups	FALSE	-	Uint8
1-3* Addl. Motor Data						
1-30	Stator Resistance (Rs)	SR	All set-ups	FALSE	-4	Uint32
1-31	Rotor Resistance (Rr)	SR	All set-ups	FALSE	-4	Uint32
1-35	Main Reactance (Xh)	SR	All set-ups	FALSE	-4	Uint32
1-36	Iron Loss Resistance (Rfe)	SR	All set-ups	FALSE	-3	Uint32
1-39	Motor Poles	SR	All set-ups	FALSE	0	Uint8
1-5* Load Indep. Setting						
1-50	Motor Magnetization at Zero Speed	100 %	All set-ups	TRUE	0	Uint16
1-51	Min Speed Normal Magnetizing [RPM]	SR	All set-ups	TRUE	67	Uint16
1-52	Min Speed Normal Magnetizing [Hz]	SR	All set-ups	TRUE	-1	Uint16
1-6* Load Depen. Setting						
1-60	Low Speed Load Compensation	100 %	All set-ups	TRUE	0	Int16
1-61	High Speed Load Compensation	100 %	All set-ups	TRUE	0	Int16
1-62	Slip Compensation	0 %	All set-ups	TRUE	0	Int16
1-63	Slip Compensation Time Constant	SR	All set-ups	TRUE	-2	Uint16
1-64	Resonance Dampening	100 %	All set-ups	TRUE	0	Uint16
1-65	Resonance Dampening Time Constant	5 ms	All set-ups	TRUE	-3	Uint8
1-7* Start Adjustments						
1-71	Start Delay	0.0 s	All set-ups	TRUE	-1	Uint16
1-73	Flying Start	[0] Disabled	All set-ups	FALSE	-	Uint8
1-8* Stop Adjustments						
1-80	Function at Stop	[0] Coast	All set-ups	TRUE	-	Uint8
1-81	Min Speed for Function at Stop [RPM]	SR	All set-ups	TRUE	67	Uint16
1-82	Min. Speed for Function at Stop [Hz]	SR	All set-ups	TRUE	-1	Uint16
1-86	Trip Speed Low [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
1-87	Trip Speed Low [Hz]	0.0 Hz	All set-ups	TRUE	-1	Uint16
1-9* Motor Temperature						
1-90	Motor Thermal Protection	[4] ETR trip 1	All set-ups	TRUE	-	Uint8
1-91	Motor External Fan	[0] No	All set-ups	TRUE	-	Uint16
1-93	Thermistor Source	[0] None	All set-ups	TRUE	-	Uint8

6.2.4 2-** Brakes

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	Change during operation	Conversion index	Type
2-0* DC Brake						
2-00	DC Hold/Preheat Current	50 %	All set-ups	TRUE	0	Uint8
2-01	DC Brake Current	50 %	All set-ups	TRUE	0	Uint16
2-02	DC Braking Time	10.0 s	All set-ups	TRUE	-1	Uint16
2-03	DC Brake Cut-in Speed [RPM]	SR	All set-ups	TRUE	67	Uint16
2-04	DC Brake Cut-in Speed [Hz]	SR	All set-ups	TRUE	-1	Uint16
2-1* Brake Energy Funct.						
2-10	Brake Function	[0] Off	All set-ups	TRUE	-	Uint8
2-11	Brake Resistor (ohm)	SR	All set-ups	TRUE	0	Uint16
2-12	Braking Energy Limit (kW)	SR	All set-ups	TRUE	0	Uint32
2-13	Braking Energy Monitoring	[0] Off	All set-ups	TRUE	-	Uint8
2-15	Brake Check	[0] Off	All set-ups	TRUE	-	Uint8
2-16	AC Brake Max. Current	100.0%	All set-ups	TRUE	-1	Uint32
2-17	Overvoltage Control	[2] Enabled	All set-ups	TRUE	-	Uint8

6.2.5 3-** Reference / Ramps

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	Change during operation	Conversion index	Type
3-0* Reference Limits						
3-02	Minimum Reference	SR	All set-ups	TRUE	-3	Int32
3-03	Maximum Reference	SR	All set-ups	TRUE	-3	Int32
3-04	Reference Function	null	All set-ups	TRUE	-	Uint8
3-1* References						
3-10	Preset Reference	0.00%	All set-ups	TRUE	-2	Int16
3-11	Jog Speed [Hz]	SR	All set-ups	TRUE	-1	Uint16
3-13	Reference Site	[0] Linked to Hand / Auto	All set-ups	TRUE	-	Uint8
3-14	Preset Relative Reference	0.00%	All set-ups	TRUE	-2	Int32
3-15	Reference 1 Source	[1] Analog input 53	All set-ups	TRUE	-	Uint8
3-16	Reference 2 Source	[20] Digital pot.meter	All set-ups	TRUE	-	Uint8
3-17	Reference 3 Source	[0] No function	All set-ups	TRUE	-	Uint8
3-19	Jog Speed [RPM]	SR	All set-ups	TRUE	67	Uint16
3-4* Ramp 1						
3-41	Ramp 1 Ramp-up Time	SR	All set-ups	TRUE	-2	Uint32
3-42	Ramp 1 Ramp-down Time	SR	All set-ups	TRUE	-2	Uint32
3-5* Ramp 2						
3-51	Ramp 2 Ramp-up Time	SR	All set-ups	TRUE	-2	Uint32
3-52	Ramp 2 Ramp-down Time	SR	All set-ups	TRUE	-2	Uint32
3-8* Other Ramps						
3-80	Jog Ramp Time	SR	All set-ups	TRUE	-2	Uint32
3-81	Quick Stop Ramp Time	SR	2 set-ups	TRUE	-2	Uint32
3-9 * Digital Potentiometer						
3-90	Step Size	0.10%	All set-ups	TRUE	-2	Uint16
3-91	Ramp Time	1.00 s	All set-ups	TRUE	-2	Uint32
3-92	Power Restore	[0] Off	All set-ups	TRUE	-	Uint8
3-93	Maximum Limit	100 %	All set-ups	TRUE	0	Int16
3-94	Minimum Limit	0 %	All set-ups	TRUE	0	Int16
3-95	Ramp Delay	1.000 N/A	All set-ups	TRUE	-3	TimD

6.2.6 4-** Limits / Warnings

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	Change during operation	Conver-sion index	Type
4-1* Motor Limits						
4-10	Motor Speed Direction	[2] Both directions	All set-ups	FALSE	-	Uint8
4-11	Motor Speed Low Limit [RPM]	SR	All set-ups	TRUE	67	Uint16
4-12	Motor Speed Low Limit [Hz]	SR	All set-ups	TRUE	-1	Uint16
4-13	Motor Speed High Limit [RPM]	SR	All set-ups	TRUE	67	Uint16
4-14	Motor Speed High Limit [Hz]	SR	All set-ups	TRUE	-1	Uint16
4-16	Torque Limit Motor Mode	110.0%	All set-ups	TRUE	-1	Uint16
4-17	Torque Limit Generator Mode	100.0%	All set-ups	TRUE	-1	Uint16
4-18	Current Limit	SR	All set-ups	TRUE	-1	Uint32
4-19	Max. Output Frequency	SR	All set-ups	FALSE	-1	Uint16
4-5* Adj. Warnings						
4-50	Warning Current Low	0.00 A	All set-ups	TRUE	-2	Uint32
4-51	Warning Current High	ImaxVLT (P1637)	All set-ups	TRUE	-2	Uint32
4-52	Warning Speed Low	0 RPM	All set-ups	TRUE	67	Uint16
4-53	Warning Speed High	outputSpeedHighLimit (P413)	All set-ups	TRUE	67	Uint16
4-54	Warning Reference Low	-999999.999 N/A	All set-ups	TRUE	-3	Int32
4-55	Warning Reference High	999999.999 N/A	All set-ups	TRUE	-3	Int32
4-56	Warning Feedback Low	-999999.999 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
4-57	Warning Feedback High	999999.999 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
4-58	Missing Motor Phase Function	[1] On	All set-ups	TRUE	-	Uint8
4-6* Speed Bypass						
4-60	Bypass Speed From [RPM]	SR	All set-ups	TRUE	67	Uint16
4-61	Bypass Speed From [Hz]	SR	All set-ups	TRUE	-1	Uint16
4-62	Bypass Speed To [RPM]	SR	All set-ups	TRUE	67	Uint16
4-63	Bypass Speed To [Hz]	SR	All set-ups	TRUE	-1	Uint16
4-64	Semi-Auto Bypass Set-up	[0] Off	All set-ups	FALSE	-	Uint8

6.2.7 5-** Digital In / Out

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conversion index	Type
5-0* Digital I/O mode						
5-00	Digital I/O Mode	[0] PNP - Active at 24 V	All set-ups	FALSE	-	Uint8
5-01	Terminal 27 Mode	[0] Input	All set-ups	TRUE	-	Uint8
5-02	Terminal 29 Mode	[0] Input	All set-ups	TRUE	-	Uint8
5-1* Digital Inputs						
5-10	Terminal 18 Digital Input	[8] Start	All set-ups	TRUE	-	Uint8
5-11	Terminal 19 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-12	Terminal 27 Digital Input	null	All set-ups	TRUE	-	Uint8
5-13	Terminal 29 Digital Input	[14] Jog	All set-ups	TRUE	-	Uint8
5-14	Terminal 32 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-15	Terminal 33 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-16	Terminal X30/2 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-17	Terminal X30/3 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-18	Terminal X30/4 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-3* Digital Outputs						
5-30	Terminal 27 Digital Output	[0] No operation	All set-ups	TRUE	-	Uint8
5-31	Terminal 29 Digital Output	[0] No operation	All set-ups	TRUE	-	Uint8
5-32	Term X30/6 Digi Out (MCB 101)	[0] No operation	All set-ups	TRUE	-	Uint8
5-33	Term X30/7 Digi Out (MCB 101)	[0] No operation	All set-ups	TRUE	-	Uint8
5-4* Relays						
5-40	Function Relay	null	All set-ups	TRUE	-	Uint8
5-41	On Delay, Relay	0.01 s	All set-ups	TRUE	-2	Uint16
5-42	Off Delay, Relay	0.01 s	All set-ups	TRUE	-2	Uint16
5-5* Pulse Input						
5-50	Term. 29 Low Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-51	Term. 29 High Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-52	Term. 29 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
5-53	Term. 29 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
5-54	Pulse Filter Time Constant #29	100 ms	All set-ups	FALSE	-3	Uint16
5-55	Term. 33 Low Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-56	Term. 33 High Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-57	Term. 33 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
5-58	Term. 33 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
5-59	Pulse Filter Time Constant #33	100 ms	All set-ups	FALSE	-3	Uint16

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion index	Type
5-6* Pulse Output						
5-60	Terminal 27 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
5-62	Pulse Output Max Freq #27	5000 Hz	All set-ups	TRUE	0	Uint32
5-63	Terminal 29 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
5-65	Pulse Output Max Freq #29	5000 Hz	All set-ups	TRUE	0	Uint32
5-66	Terminal X30/6 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
5-68	Pulse Output Max Freq #X30/6	5000 Hz	All set-ups	TRUE	0	Uint32
5-9* Bus Controlled						
5-90	Digital & Relay Bus Control	0 N/A	All set-ups	TRUE	0	Uint32
5-93	Pulse Out #27 Bus Control	0.00%	All set-ups	TRUE	-2	N2
5-94	Pulse Out #27 Timeout Preset	0.00%	1 set-up	TRUE	-2	Uint16
5-95	Pulse Out #29 Bus Control	0.00%	All set-ups	TRUE	-2	N2
5-96	Pulse Out #29 Timeout Preset	0.00%	1 set-up	TRUE	-2	Uint16
5-97	Pulse Out #X30/6 Bus Control	0.00%	All set-ups	TRUE	-2	N2
5-98	Pulse Out #X30/6 Timeout Preset	0.00%	1 set-up	TRUE	-2	Uint16

6.2.8 6-** Analog In / Out

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	Change during operation	Conversion index	Type
6-0* Analog I/O Mode						
6-00	Live Zero Timeout Time	10 s	All set-ups	TRUE	0	Uint8
6-01	Live Zero Timeout Function	[0] Off	All set-ups	TRUE	-	Uint8
6-02	Fire Mode Live Zero Timeout Function	[0] Off	All set-ups	TRUE	-	Uint8
6-1* Analog Input 53						
6-10	Terminal 53 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
6-11	Terminal 53 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
6-12	Terminal 53 Low Current	4.00 mA	All set-ups	TRUE	-5	Int16
6-13	Terminal 53 High Current	20.00 mA	All set-ups	TRUE	-5	Int16
6-14	Terminal 53 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
6-15	Terminal 53 High Ref./Feedb. Value	SR	All set-ups	TRUE	-3	Int32
6-16	Terminal 53 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
6-17	Terminal 53 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
6-2* Analog Input 54						
6-20	Terminal 54 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
6-21	Terminal 54 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
6-22	Terminal 54 Low Current	4.00 mA	All set-ups	TRUE	-5	Int16
6-23	Terminal 54 High Current	20.00 mA	All set-ups	TRUE	-5	Int16
6-24	Terminal 54 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
6-25	Terminal 54 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
6-26	Terminal 54 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
6-27	Terminal 54 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
6-3* Analog Input X30/11						
6-30	Terminal X30/11 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
6-31	Terminal X30/11 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
6-34	Term. X30/11 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
6-35	Term. X30/11 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
6-36	Term. X30/11 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
6-37	Term. X30/11 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
6-4* Analog Input X30/12						
6-40	Terminal X30/12 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
6-41	Terminal X30/12 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
6-44	Term. X30/12 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
6-45	Term. X30/12 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
6-46	Term. X30/12 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
6-47	Term. X30/12 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion index	Type
6-5* Analog Output 42						
6-50	Terminal 42 Output	null	All set-ups	TRUE	-	Uint8
6-51	Terminal 42 Output Min Scale	0.00%	All set-ups	TRUE	-2	Int16
6-52	Terminal 42 Output Max Scale	100.00%	All set-ups	TRUE	-2	Int16
6-53	Terminal 42 Output Bus Control	0.00%	All set-ups	TRUE	-2	N2
6-54	Terminal 42 Output Timeout Preset	0.00%	1 set-up	TRUE	-2	Uint16
6-6* Analog Output X30/8						
6-60	Terminal X30/8 Output	[0] No operation	All set-ups	TRUE	-	Uint8
6-61	Terminal X30/8 Min. Scale	0.00%	All set-ups	TRUE	-2	Int16
6-62	Terminal X30/8 Max. Scale	100.00%	All set-ups	TRUE	-2	Int16
6-63	Terminal X30/8 Output Bus Control	0.00%	All set-ups	TRUE	-2	N2
6-64	Terminal X30/8 Output Timeout Preset	0.00%	1 set-up	TRUE	-2	Uint16

6.2.9 8-** Communication and Options

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	Change during operation	Conversion index	Type
8-0* General Settings						
8-01	Control Site	null	All set-ups	TRUE	-	Uint8
8-02	Control Source	null	All set-ups	TRUE	-	Uint8
8-03	Control Timeout Time	SR	1 set-up	TRUE	-1	Uint32
8-04	Control Timeout Function	[0] Off	1 set-up	TRUE	-	Uint8
8-05	End-of-Timeout Function	[1] Resume set-up	1 set-up	TRUE	-	Uint8
8-06	Reset Control Timeout	[0] Do not reset	All set-ups	TRUE	-	Uint8
8-07	Diagnosis Trigger	[0] Disable	2 set-ups	TRUE	-	Uint8
8-1* Control Settings						
8-10	Control Profile	[0] FC profile	All set-ups	TRUE	-	Uint8
8-13	Configurable Status Word STW	[1] Profile Default	All set-ups	TRUE	-	Uint8
8-3* FC Port Settings						
8-30	Protocol	null	1 set-up	TRUE	-	Uint8
8-31	Address	SR	1 set-up	TRUE	0	Uint8
8-32	Baud Rate	null	1 set-up	TRUE	-	Uint8
8-33	Parity / Stop Bits	null	1 set-up	TRUE	-	Uint8
8-35	Minimum Response Delay	SR	1 set-up	TRUE	-3	Uint16
8-36	Maximum Response Delay	SR	1 set-up	TRUE	-3	Uint16
8-37	Maximum Inter-Char Delay	SR	1 set-up	TRUE	-5	Uint16
8-4* FC MC protocol set						
8-40	Message Selection	[1] Standard message 1	2 set-ups	TRUE	-	Uint8
8-5* Digital/Bus						
8-50	Coasting Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-52	DC Brake Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-53	Start Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-54	Reversing Select	null	All set-ups	TRUE	-	Uint8
8-55	Set-up Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-56	Preset Reference Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-7* BACnet						
8-70	BACnet Device Instance	1 N/A	1 set-up	TRUE	0	Uint32
8-72	MS/TP Max Masters	127 N/A	1 set-up	TRUE	0	Uint8
8-73	MS/TP Max Info Frames	1 N/A	1 set-up	TRUE	0	Uint16
8-74	"I-Am" Service	[0] Send at power-up	1 set-up	TRUE	-	Uint8
8-75	Initialization Password	SR	1 set-up	TRUE	0	VisStr[20]
8-8* FC Port Diagnostics						
8-80	Bus Message Count	0 N/A	All set-ups	TRUE	0	Uint32
8-81	Bus Error Count	0 N/A	All set-ups	TRUE	0	Uint32
8-82	Slave Messages Rcvd	0 N/A	All set-ups	TRUE	0	Uint32
8-83	Slave Error Count	0 N/A	All set-ups	TRUE	0	Uint32
8-89	Diagnostics Count	0 N/A	1 set-up	TRUE	0	Uint32

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	Change during operation	Conver-sion index	Type
8-9* Bus Jog/Feedback						
8-90	Bus Jog 1 Speed	100 RPM	All set-ups	TRUE	67	Uint16
8-91	Bus Jog 2 Speed	200 RPM	All set-ups	TRUE	67	Uint16
8-94	Bus Feedback 1	0 N/A	1 set-up	TRUE	0	N2
8-95	Bus Feedback 2	0 N/A	1 set-up	TRUE	0	N2
8-96	Bus Feedback 3	0 N/A	1 set-up	TRUE	0	N2

6.2.10 9-** Profibus

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	Change during operation	Conversion index	Type
9-00	Setpoint	0 N/A	All set-ups	TRUE	0	Uint16
9-07	Actual Value	0 N/A	All set-ups	FALSE	0	Uint16
9-15	PCD Write Configuration	SR	2 set-ups	TRUE	-	Uint16
9-16	PCD Read Configuration	SR	2 set-ups	TRUE	-	Uint16
9-18	Node Address	126 N/A	1 set-up	TRUE	0	Uint8
9-22	Message Selection	[108] PPO 8	1 set-up	TRUE	-	Uint8
9-23	Parameters for Signals	0	All set-ups	TRUE	-	Uint16
9-27	Parameter Edit	[1] Enabled	2 set-ups	FALSE	-	Uint16
9-28	Process Control	[1] Enable cyclic master	2 set-ups	FALSE	-	Uint8
9-44	Fault Message Counter	0 N/A	All set-ups	TRUE	0	Uint16
9-45	Fault Code	0 N/A	All set-ups	TRUE	0	Uint16
9-47	Fault Number	0 N/A	All set-ups	TRUE	0	Uint16
9-52	Fault Situation Counter	0 N/A	All set-ups	TRUE	0	Uint16
9-53	Profibus Warning Word	0 N/A	All set-ups	TRUE	0	V2
9-63	Actual Baud Rate	[255] No baud rate found	All set-ups	TRUE	-	Uint8
9-64	Device Identification	0 N/A	All set-ups	TRUE	0	Uint16
9-65	Profile Number	0 N/A	All set-ups	TRUE	0	OctStr[2]
9-67	Control Word 1	0 N/A	All set-ups	TRUE	0	V2
9-68	Status Word 1	0 N/A	All set-ups	TRUE	0	V2
9-71	Profibus Save Data Values	[0] Off	All set-ups	TRUE	-	Uint8
9-72	ProfibusDriveReset	[0] No action	1 set-up	FALSE	-	Uint8
9-80	Defined Parameters (1)	0 N/A	All set-ups	FALSE	0	Uint16
9-81	Defined Parameters (2)	0 N/A	All set-ups	FALSE	0	Uint16
9-82	Defined Parameters (3)	0 N/A	All set-ups	FALSE	0	Uint16
9-83	Defined Parameters (4)	0 N/A	All set-ups	FALSE	0	Uint16
9-84	Defined Parameters (5)	0 N/A	All set-ups	FALSE	0	Uint16
9-90	Changed Parameters (1)	0 N/A	All set-ups	FALSE	0	Uint16
9-91	Changed Parameters (2)	0 N/A	All set-ups	FALSE	0	Uint16
9-92	Changed Parameters (3)	0 N/A	All set-ups	FALSE	0	Uint16
9-93	Changed Parameters (4)	0 N/A	All set-ups	FALSE	0	Uint16
9-94	Changed Parameters (5)	0 N/A	All set-ups	FALSE	0	Uint16

6.2.11 10-** CAN Fieldbus

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	Change during operation	Conversion index	Type
10-0* Common Settings						
10-00	CAN Protocol	null	2 set-ups	FALSE	-	Uint8
10-01	Baud Rate Select	null	2 set-ups	TRUE	-	Uint8
10-02	MAC ID	SR	2 set-ups	TRUE	0	Uint8
10-05	Readout Transmit Error Counter	0 N/A	All set-ups	TRUE	0	Uint8
10-06	Readout Receive Error Counter	0 N/A	All set-ups	TRUE	0	Uint8
10-07	Readout Bus-off Counter	0 N/A	All set-ups	TRUE	0	Uint8
10-1* DeviceNet						
10-10	Process Data Type Selection	null	All set-ups	TRUE	-	Uint8
10-11	Process Data Config Write	SR	2 set-ups	TRUE	-	Uint16
10-12	Process Data Config Read	SR	2 set-ups	TRUE	-	Uint16
10-13	Warning Parameter	0 N/A	All set-ups	TRUE	0	Uint16
10-14	Net Reference	[0] Off	2 set-ups	TRUE	-	Uint8
10-15	Net Control	[0] Off	2 set-ups	TRUE	-	Uint8
10-2* COS Filters						
10-20	COS Filter 1	0 N/A	All set-ups	FALSE	0	Uint16
10-21	COS Filter 2	0 N/A	All set-ups	FALSE	0	Uint16
10-22	COS Filter 3	0 N/A	All set-ups	FALSE	0	Uint16
10-23	COS Filter 4	0 N/A	All set-ups	FALSE	0	Uint16
10-3* Parameter Access						
10-30	Array Index	0 N/A	2 set-ups	TRUE	0	Uint8
10-31	Store Data Values	[0] Off	All set-ups	TRUE	-	Uint8
10-32	DeviceNet Revision	SR	All set-ups	TRUE	0	Uint16
10-33	Store Always	[0] Off	1 set-up	TRUE	-	Uint8
10-34	DeviceNet Product Code	120 N/A	1 set-up	TRUE	0	Uint16
10-39	DeviceNet F Parameters	0 N/A	All set-ups	TRUE	0	Uint32

6.2.12 11-** LonWorks

Par. No. #	Parameter description	Default value	4 set-up	FC 302 only	Change during operation	Conversion index	Type
11-0* LonWorks ID							
11-00	Neuron ID	0 N/A	All set-ups		TRUE	0	OctStr[6]
11-1* LON Functions							
11-10	Drive Profile	[0] VSD profile	All set-ups		TRUE	-	Uint8
11-15	LON Warning Word	0 N/A	All set-ups		TRUE	0	Uint16
11-17	XIF Revision	0 N/A	All set-ups		TRUE	0	VisStr[5]
11-18	LonWorks Revision	0 N/A	All set-ups		TRUE	0	VisStr[5]
11-2* LON Param. Access							
11-21	Store Data Values	[0] Off	All set-ups		TRUE	-	Uint8

6.2.13 13-** Smart Logic Controller

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	FC 302 only	Change during operation	Conversion index	Type
13-0* SLC Settings							
13-00	SL Controller Mode	null	2 set-ups		TRUE	-	Uint8
13-01	Start Event	null	2 set-ups		TRUE	-	Uint8
13-02	Stop Event	null	2 set-ups		TRUE	-	Uint8
13-03	Reset SLC	[0] Do not reset SLC	All set-ups		TRUE	-	Uint8
13-1* Comparators							
13-10	Comparator Operand	null	2 set-ups		TRUE	-	Uint8
13-11	Comparator Operator	null	2 set-ups		TRUE	-	Uint8
13-12	Comparator Value	SR	2 set-ups		TRUE	-3	Int32
13-2* Timers							
13-20	SL Controller Timer	SR	1 set-up		TRUE	-3	TimD
13-4* Logic Rules							
13-40	Logic Rule Boolean 1	null	2 set-ups		TRUE	-	Uint8
13-41	Logic Rule Operator 1	null	2 set-ups		TRUE	-	Uint8
13-42	Logic Rule Boolean 2	null	2 set-ups		TRUE	-	Uint8
13-43	Logic Rule Operator 2	null	2 set-ups		TRUE	-	Uint8
13-44	Logic Rule Boolean 3	null	2 set-ups		TRUE	-	Uint8
13-5* States							
13-51	SL Controller Event	null	2 set-ups		TRUE	-	Uint8
13-52	SL Controller Action	null	2 set-ups		TRUE	-	Uint8

6.2.14 14-** Special Functions

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	Change during operation	Conversion index	Type
14-0* Inverter Switching						
14-00	Switching Pattern	[0] 60 AVM	All set-ups	TRUE	-	Uint8
14-01	Switching Frequency	null	All set-ups	TRUE	-	Uint8
14-03	Overmodulation	[1] On	All set-ups	FALSE	-	Uint8
14-04	PWM Random	[0] Off	All set-ups	TRUE	-	Uint8
14-1* Mains On/Off						
14-10	Line Failure	[0] No function	All set-ups	FALSE	-	Uint8
14-11	AC line Voltage at Line Fault	SR	All set-ups	TRUE	0	Uint16
14-12	Function at Line Imbalance	[0] Trip	All set-ups	TRUE	-	Uint8
14-2* Reset Functions						
14-20	Reset Mode	null	All set-ups	TRUE	-	Uint8
14-21	Automatic Restart Time	10 s	All set-ups	TRUE	0	Uint16
14-22	Operation Mode	[0] Normal operation	All set-ups	TRUE	-	Uint8
14-23	Typecode Setting	null	2 set-ups	FALSE	-	Uint8
14-25	Trip Delay at Torque Limit	60 s	All set-ups	TRUE	0	Uint8
14-26	Trip Delay at Inverter Fault	SR	All set-ups	TRUE	0	Uint8
14-28	Production Settings	[0] No action	All set-ups	TRUE	-	Uint8
14-29	Service Code	0 N/A	All set-ups	TRUE	0	Int32
14-3* Current Limit Ctrl.						
14-30	Current Lim Ctrl, Proportional Gain	100 %	All set-ups	FALSE	0	Uint16
14-31	Current Lim Ctrl, Integration Time	0.020 s	All set-ups	FALSE	-3	Uint16
14-4* Energy Optimizing						
14-40	VT Level	66 %	All set-ups	FALSE	0	Uint8
14-41	AEO Minimum Magnetization	SR	All set-ups	TRUE	0	Uint8
14-42	Minimum AEO Frequency	10 Hz	All set-ups	TRUE	0	Uint8
14-43	Motor Cos-Phi	SR	All set-ups	TRUE	-2	Uint16
14-5* Environment						
14-50	RFI Filter	[1] On	1 set-up	FALSE	-	Uint8
14-52	Fan Control	[0] Auto	All set-ups	TRUE	-	Uint8
14-53	Fan Monitor	[1] Warning	All set-ups	TRUE	-	Uint8
14-6* Auto Derate						
14-60	Function at Overtemperature	[0] Trip	All set-ups	TRUE	-	Uint8
14-61	Function at Inverter Overload	[0] Trip	All set-ups	TRUE	-	Uint8
14-62	Inv. Overload Derate Current	95 %	All set-ups	TRUE	0	Uint16

6.2.15 15-** FC Information

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	Change during operation	Conver-sion index	Type
15-0* Operating Data						
15-00	Operating Hours	0 h	All set-ups	FALSE	74	Uint32
15-01	Running Hours	0 h	All set-ups	FALSE	74	Uint32
15-02	kWh Counter	0 kWh	All set-ups	FALSE	75	Uint32
15-03	Power-ups	0 N/A	All set-ups	FALSE	0	Uint32
15-04	Overtemps	0 N/A	All set-ups	FALSE	0	Uint16
15-05	Overvolts	0 N/A	All set-ups	FALSE	0	Uint16
15-06	Reset kWh Counter	[0] Do not reset	All set-ups	TRUE	-	Uint8
15-07	Reset Running Hours Counter	[0] Do not reset	All set-ups	TRUE	-	Uint8
15-08	Number of Starts	0 N/A	All set-ups	FALSE	0	Uint32
15-1* Data Log Settings						
15-10	Logging Source	0	2 set-ups	TRUE	-	Uint16
15-11	Logging Interval	SR	2 set-ups	TRUE	-3	TimD
15-12	Trigger Event	[0] False	1 set-up	TRUE	-	Uint8
15-13	Logging Mode	[0] Log always	2 set-ups	TRUE	-	Uint8
15-14	Samples Before Trigger	50 N/A	2 set-ups	TRUE	0	Uint8
15-2* Historic Log						
15-20	Historic Log: Event	0 N/A	All set-ups	FALSE	0	Uint8
15-21	Historic Log: Value	0 N/A	All set-ups	FALSE	0	Uint32
15-22	Historic Log: Time	0 ms	All set-ups	FALSE	-3	Uint32
15-23	Historic Log: Date and Time	SR	All set-ups	FALSE	0	TimeOfDay
15-3* Alarm Log						
15-30	Alarm Log: Error Code	0 N/A	All set-ups	FALSE	0	Uint8
15-31	Alarm Log: Value	0 N/A	All set-ups	FALSE	0	Int16
15-32	Alarm Log: Time	0 s	All set-ups	FALSE	0	Uint32
15-33	Alarm Log: Date and Time	SR	All set-ups	FALSE	0	TimeOfDay
15-4* Drive Identification						
15-40	FC Type	0 N/A	All set-ups	FALSE	0	VisStr[6]
15-41	Power Section	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-42	Voltage	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-43	Software Version	0 N/A	All set-ups	FALSE	0	VisStr[5]
15-44	Ordered Typecode String	0 N/A	All set-ups	FALSE	0	VisStr[40]
15-45	Actual Typecode String	0 N/A	All set-ups	FALSE	0	VisStr[40]
15-46	Adjustable Frequency Drive Ordering No.	0 N/A	All set-ups	FALSE	0	VisStr[8]
15-47	Power Card Ordering No.	0 N/A	All set-ups	FALSE	0	VisStr[8]
15-48	LCP ID No	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-49	SW ID Control Card	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-50	SW ID Power Card	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-51	Adjustable Frequency Drive Serial Number	0 N/A	All set-ups	FALSE	0	VisStr[10]
15-53	Power Card Serial Number	0 N/A	All set-ups	FALSE	0	VisStr[19]

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion index	Type
15-6* Option Ident						
15-60	Option Mounted	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-61	Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-62	Option Ordering No	0 N/A	All set-ups	FALSE	0	VisStr[8]
15-63	Option Serial No	0 N/A	All set-ups	FALSE	0	VisStr[18]
15-70	Option in Slot A	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-71	Slot A Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-72	Option in Slot B	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-73	Slot B Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-74	Option in Slot C0	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-75	Slot C0 Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-76	Option in Slot C1	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-77	Slot C1 Option SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-9* Parameter Info						
15-92	Defined Parameters	0 N/A	All set-ups	FALSE	0	Uint16
15-93	Modified Parameters	0 N/A	All set-ups	FALSE	0	Uint16
15-98	Drive Identification	0 N/A	All set-ups	FALSE	0	VisStr[40]
15-99	Parameter Metadata	0 N/A	All set-ups	FALSE	0	Uint16

6.2.16 16-** Data Readouts

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	FC 302 only	Change during operation	Conversion index	Type
16-0* General Status							
16-00	Control Word	0 N/A	All set-ups		FALSE	0	V2
16-01	Reference [Unit]	0.000 ReferenceFeedbackUnit	All set-ups		FALSE	-3	Int32
16-02	Reference [%]	0.0%	All set-ups		FALSE	-1	Int16
16-03	Status Word	0 N/A	All set-ups		FALSE	0	V2
16-05	Main Actual Value [%]	0.00%	All set-ups		FALSE	-2	N2
16-09	Custom Readout	0.00 CustomReadoutUnit	All set-ups		FALSE	-2	Int32
16-1* Motor Status							
16-10	Power [kW]	0.00 kW	All set-ups		FALSE	1	Int32
16-11	Power [hp]	0.00 hp	All set-ups		FALSE	-2	Int32
16-12	Motor Voltage	0.0 V	All set-ups		FALSE	-1	Uint16
16-13	Frequency	0.0 Hz	All set-ups		FALSE	-1	Uint16
16-14	Motor Current	0.00 A	All set-ups		FALSE	-2	Int32
16-15	Frequency [%]	0.00%	All set-ups		FALSE	-2	N2
16-16	Torque [Nm]	0.0 Nm	All set-ups		FALSE	-1	Int32
16-17	Speed [RPM]	0 RPM	All set-ups		FALSE	67	Int32
16-18	Motor Thermal	0 %	All set-ups		FALSE	0	Uint8
16-22	Torque [%]	0 %	All set-ups		FALSE	0	Int16
16-3* Drive Status							
16-30	DC Link Voltage	0 V	All set-ups		FALSE	0	Uint16
16-32	Brake Energy /s	0.000 kW	All set-ups		FALSE	0	Uint32
16-33	Brake Energy/2 min	0.000 kW	All set-ups		FALSE	0	Uint32
16-34	Heatsink Temp.	32°F [0°C]	All set-ups		FALSE	100	Uint8
16-35	Inverter Thermal	0 %	All set-ups		FALSE	0	Uint8
16-36	Inv. Nom. Current	SR	All set-ups		FALSE	-2	Uint32
16-37	Inv. Max. Current	SR	All set-ups		FALSE	-2	Uint32
16-38	SL Controller State	0 N/A	All set-ups		FALSE	0	Uint8
16-39	Control Card Temp.	32°F [0°C]	All set-ups		FALSE	100	Uint8
16-40	Logging Buffer Full	[0] No	All set-ups		TRUE	-	Uint8
16-5* Ref. & Feedb.							
16-50	External Reference	0.0 N/A	All set-ups		FALSE	-1	Int16
16-52	Feedback [Unit]	0.000 ProcessCtrlUnit	All set-ups		FALSE	-3	Int32
16-53	Digi Pot Reference	0.00 N/A	All set-ups		FALSE	-2	Int16
16-54	Feedback 1 [Unit]	0.000 ProcessCtrlUnit	All set-ups		FALSE	-3	Int32
16-55	Feedback 2 [Unit]	0.000 ProcessCtrlUnit	All set-ups		FALSE	-3	Int32
16-56	Feedback 3 [Unit]	0.000 ProcessCtrlUnit	All set-ups		FALSE	-3	Int32
16-58	PID Output [%]	0.0%	All set-ups		TRUE	-1	Int16

Par. No. #	Parameter description	Default value	4 set-up	FC 302 only	Change during operation	Conversion index	Type
16-6* Inputs & Outputs							
16-60	Digital Input	0 N/A	All set-ups		FALSE	0	Uint16
16-61	Terminal 53 Switch Setting	[0] Current	All set-ups		FALSE	-	Uint8
16-62	Analog Input 53	0.000 N/A	All set-ups		FALSE	-3	Int32
16-63	Terminal 54 Switch Setting	[0] Current	All set-ups		FALSE	-	Uint8
16-64	Analog Input 54	0.000 N/A	All set-ups		FALSE	-3	Int32
16-65	Analog Output 42 [mA]	0.000 N/A	All set-ups		FALSE	-3	Int16
16-66	Digital Output [bin]	0 N/A	All set-ups		FALSE	0	Int16
16-67	Pulse Input #29 [Hz]	0 N/A	All set-ups		FALSE	0	Int32
16-68	Pulse Input #33 [Hz]	0 N/A	All set-ups		FALSE	0	Int32
16-69	Pulse Output #27 [Hz]	0 N/A	All set-ups		FALSE	0	Int32
16-70	Pulse Output #29 [Hz]	0 N/A	All set-ups		FALSE	0	Int32
16-71	Relay Output [bin]	0 N/A	All set-ups		FALSE	0	Int16
16-72	Counter A	0 N/A	All set-ups		TRUE	0	Int32
16-73	Counter B	0 N/A	All set-ups		TRUE	0	Int32
16-75	Analog In X30/11	0.000 N/A	All set-ups		FALSE	-3	Int32
16-76	Analog In X30/12	0.000 N/A	All set-ups		FALSE	-3	Int32
16-77	Analog Out X30/8 [mA]	0.000 N/A	All set-ups		FALSE	-3	Int16
16-8* Fieldbus & FC Port							
16-80	Fieldbus CTW 1	0 N/A	All set-ups		FALSE	0	V2
16-82	Fieldbus REF 1	0 N/A	All set-ups		FALSE	0	N2
16-84	Comm. Option STW	0 N/A	All set-ups		FALSE	0	V2
16-85	FC Port CTW 1	0 N/A	All set-ups		FALSE	0	V2
16-86	FC Port REF 1	0 N/A	All set-ups		FALSE	0	N2
16-9* Diagnosis Readouts							
16-90	Alarm Word	0 N/A	All set-ups		FALSE	0	Uint32
16-91	Alarm Word 2	0 N/A	All set-ups		FALSE	0	Uint32
16-92	Warning Word	0 N/A	All set-ups		FALSE	0	Uint32
16-93	Warning Word 2	0 N/A	All set-ups		FALSE	0	Uint32
16-94	Ext. Status Word	0 N/A	All set-ups		FALSE	0	Uint32
16-95	Ext. Status Word 2	0 N/A	All set-ups		FALSE	0	Uint32
16-96	Maintenance Word	0 N/A	All set-ups		FALSE	0	Uint32

6.2.17 18-** Info & Readouts

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	FC 302 only	Change during operation	Conver-sion index	Type
18-0* Maintenance Log							
18-00	Maintenance Log: Item	0 N/A	All set-ups		FALSE	0	Uint8
18-01	Maintenance Log: Action	0 N/A	All set-ups		FALSE	0	Uint8
18-02	Maintenance Log: Time	0 s	All set-ups		FALSE	0	Uint32
18-03	Maintenance Log: Date and Time	SR	All set-ups		FALSE	0	TimeOfDay
18-1* Fire Mode Log							
18-10	Fire Mode Log: Event	0 N/A	All set-ups		FALSE	0	Uint8
18-11	Fire Mode Log: Time	0 s	All set-ups		FALSE	0	Uint32
18-12	Fire Mode Log: Date and Time	SR	All set-ups		FALSE	0	TimeOfDay
18-3* Inputs & Outputs							
18-30	Analog Input X42/1	0.000 N/A	All set-ups		FALSE	-3	Int32
18-31	Analog Input X42/3	0.000 N/A	All set-ups		FALSE	-3	Int32
18-32	Analog Input X42/5	0.000 N/A	All set-ups		FALSE	-3	Int32
18-33	Analog Out X42/7 [V]	0.000 N/A	All set-ups		FALSE	-3	Int16
18-34	Analog Out X42/9 [V]	0.000 N/A	All set-ups		FALSE	-3	Int16
18-35	Analog Out X42/11 [V]	0.000 N/A	All set-ups		FALSE	-3	Int16

6.2.18 20-** FC Closed-loop

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	FC 302 only	Change during operation	Conversion index	Type
20-0* Feedback							
20-00	Feedback 1 Source	[2] Analog input 54	All set-ups		TRUE	-	Uint8
20-01	Feedback 1 Conversion	[0] Linear	All set-ups		FALSE	-	Uint8
20-02	Feedback 1 Source Unit	null	All set-ups		TRUE	-	Uint8
20-03	Feedback 2 Source	[0] No function	All set-ups		TRUE	-	Uint8
20-04	Feedback 2 Conversion	[0] Linear	All set-ups		FALSE	-	Uint8
20-05	Feedback 2 Source Unit	null	All set-ups		TRUE	-	Uint8
20-06	Feedback 3 Source	[0] No function	All set-ups		TRUE	-	Uint8
20-07	Feedback 3 Conversion	[0] Linear	All set-ups		FALSE	-	Uint8
20-08	Feedback 3 Source Unit	null	All set-ups		TRUE	-	Uint8
20-12	Reference/Feedback Unit	null	All set-ups		TRUE	-	Uint8
20-13	Minimum Reference/Feedb.	0.000 ProcessCtrlUnit	All set-ups		TRUE	-3	Int32
20-14	Maximum Reference/Feedb.	100.000 ProcessCtrlUnit	All set-ups		TRUE	-3	Int32
20-2* Feedback/Setpoint							
20-20	Feedback Function	[3] Minimum	All set-ups		TRUE	-	Uint8
20-21	Setpoint 1	0.000 ProcessCtrlUnit	All set-ups		TRUE	-3	Int32
20-22	Setpoint 2	0.000 ProcessCtrlUnit	All set-ups		TRUE	-3	Int32
20-23	Setpoint 3	0.000 ProcessCtrlUnit	All set-ups		TRUE	-3	Int32
20-3* Feedback Adv. Conv							
20-30	Refrigerant	[0] R22	All set-ups		TRUE	-	Uint8
20-31	User-defined Refrigerant A1	10.0000 N/A	All set-ups		TRUE	-4	Uint32
20-32	User-defined Refrigerant A2	-2250.00 N/A	All set-ups		TRUE	-2	Int32
20-33	User-defined Refrigerant A3	250.000 N/A	All set-ups		TRUE	-3	Uint32
20-7* PID Auto tuning							
20-70	Closed-loop Type	[0] Auto	2 set-ups		TRUE	-	Uint8
20-71	PID Performance	[0] Normal	2 set-ups		TRUE	-	Uint8
20-72	PID Output Change	0.10 N/A	2 set-ups		TRUE	-2	Uint16
20-73	Minimum Feedback Level	-999999.000 ProcessCtrlUnit	2 set-ups		TRUE	-3	Int32
20-74	Maximum Feedback Level	999999.000 ProcessCtrlUnit	2 set-ups		TRUE	-3	Int32
20-79	PID Auto-tuning	[0] Disabled	All set-ups		TRUE	-	Uint8
20-8* PID Basic Settings							
20-81	PID Normal/ Inverse Control	[0] Normal	All set-ups		TRUE	-	Uint8
20-82	PID Start Speed [RPM]	SR	All set-ups		TRUE	67	Uint16
20-83	PID Start Speed [Hz]	SR	All set-ups		TRUE	-1	Uint16
20-84	On Reference Bandwidth	5 %	All set-ups		TRUE	0	Uint8
20-9* PID Controller							
20-91	PID Anti Windup	[1] On	All set-ups		TRUE	-	Uint8
20-93	PID Proportional Gain	0.50 N/A	All set-ups		TRUE	-2	Uint16
20-94	PID Integral Time	20.00 s	All set-ups		TRUE	-2	Uint32
20-95	PID Differentiation Time	0.00 s	All set-ups		TRUE	-2	Uint16
20-96	PID Diff. Gain Limit	5.0 N/A	All set-ups		TRUE	-1	Uint16

6.2.19 21-** Ext. Closed-loop

Par. No. #	Parameter description	Default value	4 set-up	FC 302 only	Change during operation	Conversion index	Type
21-0* Ext. CL Auto-tuning							
21-00	Closed-loop Type	[0] Auto	2 set-ups		TRUE	-	Uint8
21-01	PID Performance	[0] Normal	2 set-ups		TRUE	-	Uint8
21-02	PID Output Change	0.10 N/A	2 set-ups		TRUE	-2	Uint16
21-03	Minimum Feedback Level	-999999.000 N/A	2 set-ups		TRUE	-3	Int32
21-04	Maximum Feedback Level	999999.000 N/A	2 set-ups		TRUE	-3	Int32
21-09	PID Auto-tuning	[0] Disabled	All set-ups		TRUE	-	Uint8
21-1* Ext. CL 1 Ref./Fb.							
21-10	Ext. 1 Ref./Feedback Unit	[1] %	All set-ups		TRUE	-	Uint8
21-11	Ext. 1 Minimum Reference	0.000 ExtPID1Unit	All set-ups		TRUE	-3	Int32
21-12	Ext. 1 Maximum Reference	100.000 ExtPID1Unit	All set-ups		TRUE	-3	Int32
21-13	Ext. 1 Reference Source	[0] No function	All set-ups		TRUE	-	Uint8
21-14	Ext. 1 Feedback Source	[0] No function	All set-ups		TRUE	-	Uint8
21-15	Ext. 1 Setpoint	0.000 ExtPID1Unit	All set-ups		TRUE	-3	Int32
21-17	Ext. 1 Reference [Unit]	0.000 ExtPID1Unit	All set-ups		TRUE	-3	Int32
21-18	Ext. 1 Feedback [Unit]	0.000 ExtPID1Unit	All set-ups		TRUE	-3	Int32
21-19	Ext. 1 Output [%]	0 %	All set-ups		TRUE	0	Int32
21-2* Ext. CL 1 PID							
21-20	Ext. 1 Normal/Inverse Control	[0] Normal	All set-ups		TRUE	-	Uint8
21-21	Ext. 1 Proportional Gain	0.01 N/A	All set-ups		TRUE	-2	Uint16
21-22	Ext. 1 Integral Time	10000.00 s	All set-ups		TRUE	-2	Uint32
21-23	Ext. 1 Differentiation Time	0.00 s	All set-ups		TRUE	-2	Uint16
21-24	Ext. 1 Dif. Gain Limit	5.0 N/A	All set-ups		TRUE	-1	Uint16
21-3* Ext. CL 2 Ref./Fb.							
21-30	Ext. 2 Ref./Feedback Unit	[1] %	All set-ups		TRUE	-	Uint8
21-31	Ext. 2 Minimum Reference	0.000 ExtPID2Unit	All set-ups		TRUE	-3	Int32
21-32	Ext. 2 Maximum Reference	100.000 ExtPID2Unit	All set-ups		TRUE	-3	Int32
21-33	Ext. 2 Reference Source	[0] No function	All set-ups		TRUE	-	Uint8
21-34	Ext. 2 Feedback Source	[0] No function	All set-ups		TRUE	-	Uint8
21-35	Ext. 2 Setpoint	0.000 ExtPID2Unit	All set-ups		TRUE	-3	Int32
21-37	Ext. 2 Reference [Unit]	0.000 ExtPID2Unit	All set-ups		TRUE	-3	Int32
21-38	Ext. 2 Feedback [Unit]	0.000 ExtPID2Unit	All set-ups		TRUE	-3	Int32
21-39	Ext. 2 Output [%]	0 %	All set-ups		TRUE	0	Int32
21-4* Ext. CL 2 PID							
21-40	Ext. 2 Normal/Inverse Control	[0] Normal	All set-ups		TRUE	-	Uint8
21-41	Ext. 2 Proportional Gain	0.01 N/A	All set-ups		TRUE	-2	Uint16
21-42	Ext. 2 Integral Time	10000.00 s	All set-ups		TRUE	-2	Uint32
21-43	Ext. 2 Differentiation Time	0.00 s	All set-ups		TRUE	-2	Uint16
21-44	Ext. 2 Dif. Gain Limit	5.0 N/A	All set-ups		TRUE	-1	Uint16

Par. No. #	Parameter description	Default value	4 set-up	FC 302 only	Change during operation	Conversion index	Type
21-5* Ext. CL 3 Ref./Fb.							
21-50	Ext. 3 Ref./Feedback Unit	[1] %	All set-ups		TRUE	-	Uint8
21-51	Ext. 3 Minimum Reference	0.000 ExtPID3Unit	All set-ups		TRUE	-3	Int32
21-52	Ext. 3 Maximum Reference	100.000 ExtPID3Unit	All set-ups		TRUE	-3	Int32
21-53	Ext. 3 Reference Source	[0] No function	All set-ups		TRUE	-	Uint8
21-54	Ext. 3 Feedback Source	[0] No function	All set-ups		TRUE	-	Uint8
21-55	Ext. 3 Setpoint	0.000 ExtPID3Unit	All set-ups		TRUE	-3	Int32
21-57	Ext. 3 Reference [Unit]	0.000 ExtPID3Unit	All set-ups		TRUE	-3	Int32
21-58	Ext. 3 Feedback [Unit]	0.000 ExtPID3Unit	All set-ups		TRUE	-3	Int32
21-59	Ext. 3 Output [%]	0 %	All set-ups		TRUE	0	Int32
21-6* Ext. CL 3 PID							
21-60	Ext. 3 Normal/Inverse Control	[0] Normal	All set-ups		TRUE	-	Uint8
21-61	Ext. 3 Proportional Gain	0.01 N/A	All set-ups		TRUE	-2	Uint16
21-62	Ext. 3 Integral Time	10000.00 s	All set-ups		TRUE	-2	Uint32
21-63	Ext. 3 Differentiation Time	0.00 s	All set-ups		TRUE	-2	Uint16
21-64	Ext. 3 Dif. Gain Limit	5.0 N/A	All set-ups		TRUE	-1	Uint16

6.2.20 22-** Application Functions

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	FC 302 only	Change during operation	Conversion index	Type
22-0* Miscellaneous							
22-00	External Interlock Delay	0 s	All set-ups		TRUE	0	Uint16
22-2* No-Flow Detection							
22-20	Low Power Auto Set-up	[0] Off	All set-ups		FALSE	-	Uint8
22-21	Low Power Detection	[0] Disabled	All set-ups		TRUE	-	Uint8
22-22	Low Speed Detection	[0] Disabled	All set-ups		TRUE	-	Uint8
22-23	No-Flow Function	[0] Off	All set-ups		TRUE	-	Uint8
22-24	No-Flow Delay	10 s	All set-ups		TRUE	0	Uint16
22-26	Dry Pump Function	[0] Off	All set-ups		TRUE	-	Uint8
22-27	Dry Pump Delay	10 s	All set-ups		TRUE	0	Uint16
22-3* No-Flow Power Tuning							
22-30	No-Flow Power	0.00 kW	All set-ups		TRUE	1	Uint32
22-31	Power Correction Factor	100 %	All set-ups		TRUE	0	Uint16
22-32	Low Speed [RPM]	SR	All set-ups		TRUE	67	Uint16
22-33	Low Speed [Hz]	SR	All set-ups		TRUE	-1	Uint16
22-34	Low Speed Power [kW]	SR	All set-ups		TRUE	1	Uint32
22-35	Low Speed Power [HP]	SR	All set-ups		TRUE	-2	Uint32
22-36	High Speed [RPM]	SR	All set-ups		TRUE	67	Uint16
22-37	High Speed [Hz]	SR	All set-ups		TRUE	-1	Uint16
22-38	High Speed Power [kW]	SR	All set-ups		TRUE	1	Uint32
22-39	High Speed Power [HP]	SR	All set-ups		TRUE	-2	Uint32
22-4* Sleep Mode							
22-40	Minimum Run Time	10 s	All set-ups		TRUE	0	Uint16
22-41	Minimum Sleep Time	10 s	All set-ups		TRUE	0	Uint16
22-42	Wake-up Speed [RPM]	SR	All set-ups		TRUE	67	Uint16
22-43	Wake-up Speed [Hz]	SR	All set-ups		TRUE	-1	Uint16
22-44	Wake-up Ref./FB Difference	10 %	All set-ups		TRUE	0	Int8
22-45	Setpoint Boost	0 %	All set-ups		TRUE	0	Int8
22-46	Maximum Boost Time	60 s	All set-ups		TRUE	0	Uint16
22-5* End of Curve							
22-50	End of Curve Function	[0] Off	All set-ups		TRUE	-	Uint8
22-51	End of Curve Delay	10 s	All set-ups		TRUE	0	Uint16
22-6* Broken Belt Detection							
22-60	Broken Belt Function	[0] Off	All set-ups		TRUE	-	Uint8
22-61	Broken Belt Torque	10 %	All set-ups		TRUE	0	Uint8
22-62	Broken Belt Delay	10 s	All set-ups		TRUE	0	Uint16
22-7* Short Cycle Protection							
22-75	Short Cycle Protection	[0] Disabled	All set-ups		TRUE	-	Uint8
22-76	Interval between Starts	start_to_start_min_on_time (P2277)	All set-ups		TRUE	0	Uint16
22-77	Minimum Run Time	0 s	All set-ups		TRUE	0	Uint16

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	FC 302 only	Change during operation	Conversion index	Type
22-8* Flow Compensation							
22-80	Flow Compensation	[0] Disabled	All set-ups		TRUE	-	Uint8
22-81	Square-linear Curve Approximation	100 %	All set-ups		TRUE	0	Uint8
22-82	Work Point Calculation	[0] Disabled	All set-ups		TRUE	-	Uint8
22-83	Speed at No-Flow [RPM]	SR	All set-ups		TRUE	67	Uint16
22-84	Speed at No-Flow [Hz]	SR	All set-ups		TRUE	-1	Uint16
22-85	Speed at Design Point [RPM]	SR	All set-ups		TRUE	67	Uint16
22-86	Speed at Design Point [Hz]	SR	All set-ups		TRUE	-1	Uint16
22-87	Pressure at No-Flow Speed	0.000 N/A	All set-ups		TRUE	-3	Int32
22-88	Pressure at Rated Speed	999999.999 N/A	All set-ups		TRUE	-3	Int32
22-89	Flow at Design Point	0.000 N/A	All set-ups		TRUE	-3	Int32
22-90	Flow at Rated Speed	0.000 N/A	All set-ups		TRUE	-3	Int32

6.2.21 23-** Time-based Funtions

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	FC 302 only	Change during operation	Conversion index	Type
23-0* Timed Actions							
23-00	ON Time	SR	2 set-ups		TRUE	0	TimeOfDayWoDate
23-01	ON Action	[0] Disabled	2 set-ups		TRUE	-	Uint8
23-02	OFF Time	SR	2 set-ups		TRUE	0	TimeOfDayWoDate
23-03	OFF Action	[0] Disabled	2 set-ups		TRUE	-	Uint8
23-04	Occurrence	[0] All days	2 set-ups		TRUE	-	Uint8
23-1* Maintenance							
23-10	Maintenance Item	[1] Motor bearings	1 set-up		TRUE	-	Uint8
23-11	Maintenance Action	[1] Lubricate	1 set-up		TRUE	-	Uint8
23-12	Maintenance Time Base	[0] Disabled	1 set-up		TRUE	-	Uint8
23-13	Maintenance Time Interval	1 h	1 set-up		TRUE	74	Uint32
23-14	Maintenance Date and Time	SR	1 set-up		TRUE	0	TimeOfDay
23-1* Maintenance Reset							
23-15	Reset Maintenance Word	[0] Do not reset	All set-ups		TRUE	-	Uint8
23-16	Maintenance Text	0 N/A	1 set-up		TRUE	0	VisStr[20]
23-5* Energy Log							
23-50	Energy Log Resolution	[5] Last 24 Hours	2 set-ups		TRUE	-	Uint8
23-51	Period Start	SR	2 set-ups		TRUE	0	TimeOfDay
23-53	Energy Log	0 N/A	All set-ups		TRUE	0	Uint32
23-54	Reset Energy Log	[0] Do not reset	All set-ups		TRUE	-	Uint8
23-6* Trending							
23-60	Trend Variable	[0] Power [kW]	2 set-ups		TRUE	-	Uint8
23-61	Continuous Bin Data	0 N/A	All set-ups		TRUE	0	Uint32
23-62	Timed Bin Data	0 N/A	All set-ups		TRUE	0	Uint32
23-63	Timed Period Start	SR	2 set-ups		TRUE	0	TimeOfDay
23-64	Timed Period Stop	SR	2 set-ups		TRUE	0	TimeOfDay
23-65	Minimum Bin Value	SR	2 set-ups		TRUE	0	Uint8
23-66	Reset Continuous Bin Data	[0] Do not reset	All set-ups		TRUE	-	Uint8
23-67	Reset Timed Bin Data	[0] Do not reset	All set-ups		TRUE	-	Uint8
23-8* Payback Counter							
23-80	Power Reference Factor	100 %	2 set-ups		TRUE	0	Uint8
23-81	Energy Cost	1.00 N/A	2 set-ups		TRUE	-2	Uint32
23-82	Investment	0 N/A	2 set-ups		TRUE	0	Uint32
23-83	Energy Savings	0 kWh	All set-ups		TRUE	75	Int32
23-84	Cost Savings	0 N/A	All set-ups		TRUE	0	Int32

6.2.22 24-** Application Functions 2

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	FC 302 only	Change during operation	Conversion index	Type
24-0* Fire Mode							
24-00	Fire Mode Function	[0] Disabled	2 set-ups		TRUE	-	Uint8
24-01	Fire Mode Configuration	[0] Open-loop	All set-ups		TRUE	-	Uint8
24-02	Fire Mode Unit	null	All set-ups		TRUE	-	Uint8
24-03	Fire Mode Min Reference	SR	All set-ups		TRUE	-3	Int32
24-04	Fire Mode Max Reference	SR	All set-ups		TRUE	-3	Int32
24-05	Fire Mode Preset Reference	0.00%	All set-ups		TRUE	-2	Int16
24-06	Fire Mode Reference Source	[0] No function	All set-ups		TRUE	-	Uint8
24-07	Fire Mode Feedback Source	[0] No function	All set-ups		TRUE	-	Uint8
24-09	Fire Mode Alarm Handling	[1] Trip, Critical Alarms	2 set-ups		FALSE	-	Uint8
24-1* Drive Bypass							
24-10	Drive Bypass Function	[0] Disabled	2 set-ups		TRUE	-	Uint8
24-11	Drive Bypass Delay Time	0 s	2 set-ups		TRUE	0	Uint16

6.2.23 25-** Cascade Controller

Par. No. #	Parameter description	Default value (SR = Size related)	4 set-up	FC 302 only	Change during operation	Conversion index	Type
25-0* System Settings							
25-00	Cascade Controller	[0] Disabled	2 set-ups		FALSE	-	Uint8
25-02	Motor Start	[0] Direct on Line	2 set-ups		FALSE	-	Uint8
25-04	Pump Cycling	[0] Disabled	All set-ups		TRUE	-	Uint8
25-05	Fixed Lead Pump	[1] Yes	2 set-ups		FALSE	-	Uint8
25-06	Number of Pumps	2 N/A	2 set-ups		FALSE	0	Uint8
25-2* Bandwidth Settings							
25-20	Staging Bandwidth	10 %	All set-ups		TRUE	0	Uint8
25-21	Override Bandwidth	100 %	All set-ups		TRUE	0	Uint8
25-22	Fixed Speed Bandwidth	casco_staging_bandwidth (P2520)	All set-ups		TRUE	0	Uint8
25-23	SBW Staging Delay	15 s	All set-ups		TRUE	0	Uint16
25-24	SBW De-staging Delay	15 s	All set-ups		TRUE	0	Uint16
25-25	OBW Time	10 s	All set-ups		TRUE	0	Uint16
25-26	Destage At No-Flow	[0] Disabled	All set-ups		TRUE	-	Uint8
25-27	Stage Function	[1] Enabled	All set-ups		TRUE	-	Uint8
25-28	Stage Function Time	15 s	All set-ups		TRUE	0	Uint16
25-29	De-stage Function	[1] Enabled	All set-ups		TRUE	-	Uint8
25-30	De-stage Function Time	15 s	All set-ups		TRUE	0	Uint16
25-4* Staging Settings							
25-40	Ramp-down Delay	10.0 s	All set-ups		TRUE	-1	Uint16
25-41	Ramp-up Delay	2.0 s	All set-ups		TRUE	-1	Uint16
25-42	Staging Threshold	SR	All set-ups		TRUE	0	Uint8
25-43	De-staging Threshold	SR	All set-ups		TRUE	0	Uint8
25-44	Staging Speed [RPM]	0 RPM	All set-ups		TRUE	67	Uint16
25-45	Staging Speed [Hz]	0.0 Hz	All set-ups		TRUE	-1	Uint16
25-46	De-staging Speed [RPM]	0 RPM	All set-ups		TRUE	67	Uint16
25-47	De-staging Speed [Hz]	0.0 Hz	All set-ups		TRUE	-1	Uint16
25-5* Alternation Settings							
25-50	Lead Pump Alternation	[0] Off	All set-ups		TRUE	-	Uint8
25-51	Alternation Event	[0] External	All set-ups		TRUE	-	Uint8
25-52	Alternation Time Interval	24 h	All set-ups		TRUE	74	Uint16
25-53	Alternation Timer Value	0 N/A	All set-ups		TRUE	0	VisStr[7]
25-54	Alternation Predefined Time	SR	All set-ups		TRUE	0	TimeOfDayWoDate
25-55	Alternate if Load < 50%	[1] Enabled	All set-ups		TRUE	-	Uint8
25-56	Staging Mode at Alternation	[0] Slow	All set-ups		TRUE	-	Uint8
25-58	Run Next Pump Delay	0.1 s	All set-ups		TRUE	-1	Uint16
25-59	Run-on Line Delay	0.5 s	All set-ups		TRUE	-1	Uint16

Par. No. #	Parameter description	Default value	4 set-up	FC 302 only	Change during operation	Conversion index	Type
25-8* Status							
25-80	Cascade Status	0 N/A	All set-ups		TRUE	0	VisStr[25]
25-81	Pump Status	0 N/A	All set-ups		TRUE	0	VisStr[25]
25-82	Lead Pump	0 N/A	All set-ups		TRUE	0	Uint8
25-83	Relay Status	0 N/A	All set-ups		TRUE	0	VisStr[4]
25-84	Pump ON Time	0 h	All set-ups		TRUE	74	Uint32
25-85	Relay ON Time	0 h	All set-ups		TRUE	74	Uint32
25-86	Reset Relay Counters	[0] Do not reset	All set-ups		TRUE	-	Uint8
25-9* Service							
25-90	Pump Interlock	[0] Off	All set-ups		TRUE	-	Uint8
25-91	Manual Alternation	0 N/A	All set-ups		TRUE	0	Uint8

6.2.24 26-** Analog I / O Option MCB 109

Par. No. #	Parameter description	Default value	4 set-up	FC 302 only	Change during operation	Conversion index	Type
26-0* Analog I/O Mode							
26-00	Terminal X42/1 Mode	[1] Voltage	All set-ups		TRUE	-	Uint8
26-01	Terminal X42/3 Mode	[1] Voltage	All set-ups		TRUE	-	Uint8
26-02	Terminal X42/5 Mode	[1] Voltage	All set-ups		TRUE	-	Uint8
26-1* Analog Input X42/1							
26-10	Terminal X42/1 Low Voltage	0.07 V	All set-ups		TRUE	-2	Int16
26-11	Terminal X42/1 High Voltage	10.00 V	All set-ups		TRUE	-2	Int16
26-14	Term. X42/1 Low Ref./Feedb. Value	0.000 N/A	All set-ups		TRUE	-3	Int32
26-15	Term. X42/1 High Ref./Feedb. Value	100.000 N/A	All set-ups		TRUE	-3	Int32
26-16	Term. X42/1 Filter Time Constant	0.001 s	All set-ups		TRUE	-3	Uint16
26-17	Term. X42/1 Live Zero	[1] Enabled	All set-ups		TRUE	-	Uint8
26-2* Analog Input X42/3							
26-20	Terminal X42/3 Low Voltage	0.07 V	All set-ups		TRUE	-2	Int16
26-21	Terminal X42/3 High Voltage	10.00 V	All set-ups		TRUE	-2	Int16
26-24	Term. X42/3 Low Ref./Feedb. Value	0.000 N/A	All set-ups		TRUE	-3	Int32
26-25	Term. X42/3 High Ref./Feedb. Value	100.000 N/A	All set-ups		TRUE	-3	Int32
26-26	Term. X42/3 Filter Time Constant	0.001 s	All set-ups		TRUE	-3	Uint16
26-27	Term. X42/3 Live Zero	[1] Enabled	All set-ups		TRUE	-	Uint8
26-3* Analog Input X42/5							
26-30	Terminal X42/5 Low Voltage	0.07 V	All set-ups		TRUE	-2	Int16
26-31	Terminal X42/5 High Voltage	10.00 V	All set-ups		TRUE	-2	Int16
26-34	Term. X42/5 Low Ref./Feedb. Value	0.000 N/A	All set-ups		TRUE	-3	Int32
26-35	Term. X42/5 High Ref./Feedb. Value	100.000 N/A	All set-ups		TRUE	-3	Int32
26-36	Term. X42/5 Filter Time Constant	0.001 s	All set-ups		TRUE	-3	Uint16
26-37	Term. X42/5 Live Zero	[1] Enabled	All set-ups		TRUE	-	Uint8
26-4* Analog Out X42/7							
26-40	Terminal X42/7 Output	[0] No operation	All set-ups		TRUE	-	Uint8
26-41	Terminal X42/7 Min. Scale	0.00%	All set-ups		TRUE	-2	Int16
26-42	Terminal X42/7 Max. Scale	100.00%	All set-ups		TRUE	-2	Int16
26-43	Terminal X42/7 Bus Control	0.00%	All set-ups		TRUE	-2	N2
26-44	Terminal X42/7 Timeout Preset	0.00%	1 set-up		TRUE	-2	Uint16
26-5* Analog Out X42/9							
26-50	Terminal X42/9 Output	[0] No operation	All set-ups		TRUE	-	Uint8
26-51	Terminal X42/9 Min. Scale	0.00%	All set-ups		TRUE	-2	Int16
26-52	Terminal X42/9 Max. Scale	100.00%	All set-ups		TRUE	-2	Int16
26-53	Terminal X42/9 Bus Control	0.00%	All set-ups		TRUE	-2	N2
26-54	Terminal X42/9 Timeout Preset	0.00%	1 set-up		TRUE	-2	Uint16
26-6* Analog Out X42/11							
26-60	Terminal X42/11 Output	[0] No operation	All set-ups		TRUE	-	Uint8
26-61	Terminal X42/11 Min. Scale	0.00%	All set-ups		TRUE	-2	Int16
26-62	Terminal X42/11 Max. Scale	100.00%	All set-ups		TRUE	-2	Int16
26-63	Terminal X42/11 Bus Control	0.00%	All set-ups		TRUE	-2	N2
26-64	Terminal X42/11 Timeout Preset	0.00%	1 set-up		TRUE	-2	Uint16

7 General Specifications

Line Power 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%

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

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

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

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

* Voltage and power dependent

Torque characteristics:	
Starting torque (Constant torque)	maximum 110% for 1 min.*
Starting torque	maximum 135% up to 0.5 sec.*
Overload torque (Constant torque)	maximum 110% for 1 min.*

**Percentage relates to the nominal torque of the adjustable frequency drive.*

Cable lengths and cross-sections:	
Max. motor cable length, shielded/armored	492 ft [150 m]
Max. motor cable length, unshielded/unarmored	984 ft [300 m]
Max. cross-section to motor, line power, load sharing and brake *	
Maximum cross-section to control terminals, rigid wire	0.0023 in^2 [1.5 mm^2]/16 AWG (2 x 0.00112^2 in [0.75 mm^2])
Maximum cross-section to control terminals, flexible cable	0.0016 in^2 [1 mm^2]/18 AWG
Maximum cross-section to control terminals, cable with enclosed core	0.0008 in^2 [0.5 mm^2]/20 AWG
Minimum cross-section to control terminals	0.039 in2 [0.25 mm2]

** See Line Power Supply tables for more information!*

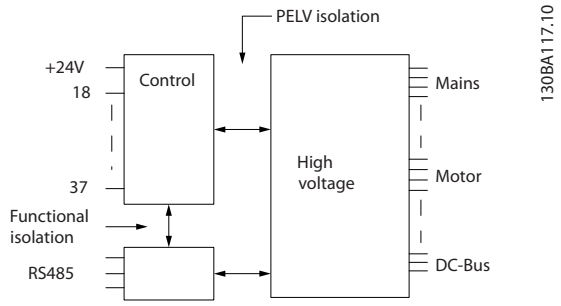
Digital inputs:	
Programmable digital inputs	4 (6)
Terminal number	18, 19, 27 [1], 29 [1], 32, 33,
Logic	PNP or NPN
Voltage level	0–24V DC
Voltage level, logic'0' PNP	< 5 V DC
Voltage level, logic'1' PNP	> 10 V DC
Voltage level, logic '0' NPN	> 19 V DC
Voltage level, logic '1' NPN	< 14 V DC
Maximum voltage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

Input resistance, R_i	approx. 4 kΩ

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

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

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



Pulse inputs:	
Programmable pulse inputs	2
Terminal number pulse	29, 33
Max. frequency at terminal, 29, 33	110kHz (push-pull driven)
Max. frequency at terminal, 29, 33	5kHz (open collector)
Min. frequency at terminal 29, 33	4Hz
Voltage level	see section on Digital input
Maximum voltage on input	28V DC
Input resistance, R_i	approx. 4kΩ
Pulse input accuracy (0.1–1 kHz)	Max. error: 0.1% of full scale
Analog output:	
Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	0/4 - 20mA
Max. resistor load to common at analog output	500 Ω
Accuracy on analog output	Max. error: 0.8% of full scale
Resolution on analog output	8 bit

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

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

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

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

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

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

Control card, 24 V DC output:	
Terminal number	12, 13
Max. load	200mA

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

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

1) IEC 60947 parts 4 and 5

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

2) Overvoltage Category II

3) UL applications 300V AC 2A

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

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

Control characteristics:	
Resolution of output frequency at 0–1000Hz	+/- 0.003Hz
System response time (terminals 18, 19, 27, 29, 32, 33)	≤ 2ms
Speed control range (open-loop)	1:100 of synchronous speed
Speed accuracy (open-loop)	30–4000 rpm: Maximum error of ±8 rpm

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

Surroundings:	
Enclosure, frame size D and E	IP 00, IP 21, IP 54
Enclosure, frame size F	IP 21, IP 54
Vibration test	0.7 g
Relative humidity	5%–95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43) H_2S test	class kD
Test method according to IEC 60068-2-43 H2S (10 days)	
Ambient temperature (at 60 AVM switching mode)	
- with derating	max. 131°F [55°C][1)]
- with full output power, typical EFF2 motors	max. 122°F [50°C][1)]
- at full continuous FC output current	max. 113°F [45°C][1)]

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

Minimum ambient temperature during full-scale operation	32°F [0°C]
Minimum ambient temperature at reduced performance	14°F [- 10 °C]
Temperature during storage/transport	-13°–+149°/158°F [-25°–+65°/70°°C]
Maximum altitude above sea level without derating	3280 ft [1000 m]
Maximum altitude above sea level with derating	9842 ft [3000 m]

Derating for high altitude, see section on special conditions.

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

See section on special conditions!

Control card performance:	
Scan interval	5ms
Control card, USB serial communication	
USB standard	1.1 (Full speed)
USB plug	USB type B “device” plug

CAUTION

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

Protection and Features:

- Electronic thermal motor protection against overload.
- Temperature monitoring of the heatsink ensures that the adjustable frequency drive trips if the temperature reaches a predefined level. An overload temperature cannot be reset until the temperature of the heatsink is below the values stated in the tables on the following pages (guideline - these temperatures may vary for different power sizes, frame sizes, enclosure ratings, etc.).
- The adjustable frequency drive is protected against short-circuits on motor terminals U, V, W.

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

Line Power Supply 6 x 380–500V AC				
	P315	P355	P400	P450
Typical Shaft output at 400 V [kW]	315	355	400	450
Typical Shaft output at 460 V [HP]	450	500	600	600
Typical Shaft output at 500 V [kW]	355	400	500	530
Enclosure IP21	F8/F9	F8/F9	F8/F9	F8/F9
Enclosure IP54	F8/F9	F8/F9	F8/F9	F8/F9
Output current				
Continuous (at 400 V) [A]	600	648	745	800
Intermittent (60 sec overload) (at 400 V) [A]	660	724	820	880
Continuous (at 460/ 500 V) [A]	540	590	678	730
Intermittent (60 sec overload) (at 460/ 500 V) [A]	594	649	746	803
Continuous KVA (at 400 V) [KVA]	416	456	516	554
Continuous KVA (at 460 V) [KVA]	430	470	540	582
Continuous KVA (at 500 V) [KVA]	468	511	587	632
Max. input current				
Continuous (at 400 V) [A]	590	647	733	787
Continuous (at 460/ 500 V) [A]	531	580	667	718
Max. cable size, line power [mm^2 (AWG[2)])]	4x90 (3/0)	4x90 (3/0)	4x240 (500 mcm)	4x240 (500 mcm)
Max. cable size, motor [mm^2 (AWG[2)])]	4x240 (4x500 mcm)	4x240 (4x500 mcm)	4x240 (4x500 mcm)	4x240 (4x500 mcm)
Max. cable size, brake [mm^2 (AWG[2)])	2 x 185 (2 x 350 mcm)	2 x 185 (2 x 350 mcm)	2 x 185 (2 x 350 mcm)	2 x 185 (2 x 350 mcm)
Max. external electrical fuses [A] 1	700			
Estimated power loss at 400 V [W] [4)]	6790	7701	8879	9670
Estimated power loss at 460 V [W]	6082	6953	8089	8803
Weight,enclosure IP21, IP 54 [kg]	440/656			
Efficiency[4)]	0.98			
Output frequency	0–600Hz			
Heatsink overtemp. trip	203°F [95°C]			
Power card ambient trip	154.4°F [68°C]			
* High overload = 160% torque during 60 sec, Normal overload = 110% torque during 60 sec.				

Line Power Supply 6 x 380–500V AC						
	P500	P560	P630	P710	P800	P1000
Typical Shaft output at 400 V [kW]	500	560	630	710	800	1000
Typical Shaft output at 460 V [HP]	650	750	900	1000	1200	1350
Typical Shaft output at 500 V [kW]	560	630	710	800	1000	1100
EnclosureIP21, 54 without/ with options cabinet	F10/F11	F10/F11	F10/F11	F10/F11	F12/F13	F12/F13
Output current						
Continuous (at 400 V) [A]	880	990	1120	1260	1460	1720
Intermittent (60 sec overload) (at 400 V) [A]	968	1089	1232	1386	1606	1892
Continuous (at 460/ 500 V) [A]	780	890	1050	1160	1380	1530
Intermittent (60 sec overload) (at 460/ 500 V) [A]	858	979	1155	1276	1518	1683
Continuous KVA (at 400 V) [KVA]	610	686	776	873	1012	1192
Continuous KVA (at 460 V) [KVA]	621	709	837	924	1100	1219
Continuous KVA (at 500 V) [KVA]	675	771	909	1005	1195	1325
Max. input current						
Continuous (at 400 V) [A]	857	964	1090	1227	1422	1675
Continuous (at 460/ 500 V) [A]	759	867	1022	1129	1344	1490
Max. cable size,motor [mm^2 (AWG[2)])]	8x150 (8x300 mcm)				12x150 (12x300 mcm)	
Max. cable size, line power [mm^2 (AWG[2)])]	6x120 (6x250 mcm)					
Max. cable size, brake [mm^2 (AWG[2)])	4x185 (4x350 mcm)				6x185 (6x350 mcm)	
Max. external electrical fuses [A] 1	900			1500		
Estimated power loss at 400 V [W] [4)]	10647	12338	13201	15436	18084	20358
Estimated power loss at 460 V [W]	9414	11006	12353	14041	17137	17752
F9/F11/F13 max. added losses A1 RFI, CB or Disconnect, & contactor F9/F11/F13	963	1054	1093	1230	2280	2541
Max. panel options losses	400					
Weight, enclosure IP21, IP 54 [kg]	1004/ 1299	1004/ 1299	1004/ 1299	1004/ 1299	1246/ 1541	1246/ 1541
Weight Rectifier Module [kg]	102	102	102	102	136	136
Weight Inverter Module [kg]	102	102	102	136	102	102
Efficiency[4)]	0.98					
Output frequency	0–600Hz					
Heatsink overtemp. trip	203°F [95°C]					
Power card ambient trip	154.4°F [68°C]					
* High overload = 160% torque during 60 sec., Normal overload = 110% torque during 60 sec.						

Line Power Supply 3 x 525–690V AC				
	P450	P500	P560	P630
Typical Shaft output at 550 V [kW]	355	400	450	500
Typical Shaft output at 575 V [HP]	450	500	600	650
Typical Shaft output at 690 V [kW]	450	500	560	630
Enclosure IP21	F8/F9	F8/F9	F8/F9	F8/F9
Enclosure IP54	F8/F9	F8/F9	F8/F9	F8/F9
Output current				
Continuous (at 550 V) [A]	470	523	596	630
Intermittent (60 sec overload) (at 550 V) [A]	517	575	656	693
Continuous (at 575/690 V) [A]	450	500	570	630
Intermittent (60 sec overload) (at 575/690 V) [A]	495	550	627	693
Continuous KVA (at 550 V) [KVA]	448	498	568	600
Continuous KVA (at 575 V) [KVA]	448	498	568	627
Continuous KVA (at 690 V) [KVA]	538	598	681	753
Max. input current				
Continuous (at 550 V) [A]	453	504	574	607
Continuous (at 575 V) [A]	434	482	549	607
Continuous (at 690 V) [A]	434	482	549	607
Max. cable size, line power [mm^2 (AWG)]	4x85 (3/0)			
Max. cable size, motor [mm^2 (AWG)]	4 x 250 (500 mcm)			
Max. cable size, brake [mm^2 (AWG)]	2 x 185 (2 x 350 mcm)	2 x 185 (2 x 350 mcm)	2 x 185 (2 x 350 mcm)	2 x 185 (2 x 350 mcm)
Max. external electrical fuses [A] 1	630			
Estimated power loss at 600 V [W] 4)	6132	6903	8343	9244
Estimated power loss at 690 V [W] 4)	6449	7249	8727	9673
Weight, enclosure IP21, IP 54 [kg]	440/656			
Efficiency4)	0.98			
Output frequency	0–500 Hz			
Heatsink overtemp. trip	185°F [85°C]			
Power card ambient trip	154.4°F [68°C]			
* High overload = 160% torque during 60 sec, Normal overload = 110% torque during 60 sec.				

Line Power Supply 3 x 525–690V AC			
	P710	P800	P900
Typical Shaft output at 550 V [kW]	560	670	750
Typical Shaft output at 575 V [HP]	750	950	1050
Typical Shaft output at 690 V [kW]	710	800	900
Enclosure IP21, 54 without/with options cabinet	F10/F11	F10/F11	F10/F11
Output current			
Continuous (at 550 V) [A]	763	889	988
Intermittent (60 sec overload) (at 550 V) [A]	839	978	1087
Continuous (at 575/690 V) [A]	730	850	945
Intermittent (60 sec overload) (at 575/690 V) [A]	803	935	1040
Continuous KVA (at 550 V) [KVA]	727	847	941
Continuous KVA (at 690 V) [KVA]	872	1016	1129
Max. input current			
Continuous (at 550 V) [A]	743	866	962
Continuous (at 575 V) [A]	711	828	920
Continuous (at 690 V) [A]	711	828	920
Max. cable size, motor [mm^2 (AWG[2)])]	8x150 (8x300 mcm)		
Max. cable size, line power [mm^2 (AWG[2)])]	6x120 (6x250 mcm)		
Max. cable size, brake [mm^2 (AWG[2)])	4x185 (4x350 mcm)		
Max. external electrical fuses [A] 1	900		
Estimated power loss at 600 V [W] [4)]	10771	12272	13835
Estimated power loss at 690V [W] [4)]	11315	12903	14533
F3/F4 Max added losses CB or Disconnect & Contactor	427	532	615
Max panel options losses	400		
Weight, enclosure IP21, IP 54 [kg]	1004/ 1299	1004/ 1299	1004/ 1299
Weight, Rectifier Module [kg]	102	102	102
Weight, Inverter Module [kg]	102	102	136
Efficiency[4)]	0.98		
Output frequency	0–500 Hz		
Heatsink overtemp. trip	185°F [85°C]		
Power card ambient trip	154.4°F [68°C]		
* High overload = 160% torque during 60 sec., Normal overload = 110% torque during 60 sec.			

Line Power Supply 3 x 525–690V AC			
	P1M0	P1M2	P1M4
Typical Shaft output at 550 V [kW]	850	1000	1100
Typical Shaft output at 575 V [HP]	1150	1350	1550
Typical Shaft output at 690 V [kW]	1000	1200	1400
Enclosure IP21, 54 without/with options cabinet	F12/F13	F12/F13	F12/F13
Output current			
Continuous (at 550 V) [A]	1108	1317	1479
Intermittent (60 sec overload) (at 550 V) [A]	1219	1449	1627
Continuous (at 575/690 V) [A]	1060	1260	1415
Intermittent (60 sec overload) (at 575/690 V) [A]	1166	1386	1557
Continuous KVA (at 550 V) [KVA]	1056	1255	1409
Continuous KVA (at 690 V) [KVA]	1267	1506	1691
Max. input current			
Continuous (at 550 V) [A]	1079	1282	1440
Continuous (at 575 V) [A]	1032	1227	1378
Continuous (at 690 V) [A]	1032	1227	1378
Max. cable size, motor [mm^2 (AWG[2)])]	12x150 (12x300 mcm)		
Max. cable size, line power F12 [mm^2 (AWG[2)])]	8x240 (8x500 mcm)		
Max. cable size, line power F13 [mm^2 (AWG[2)])]	8x400 (8x900 mcm)		
Max. cable size, brake [mm^2 (AWG[2)])	6x185 (6x350 mcm)		
Max. external electrical fuses [A] 1	1600	2000	2500
Estimated power loss at 600 V [W] [4)]	15592	18281	20825
Estimated power loss at 690V [W] [4)]	16375	19207	21857
F3/F4 Max added losses CB or Disconnect & Contactor	665	863	1044
Max panel options losses	400		
Weight, enclosure IP21, IP 54 [kg]	1246/ 1541	1246/ 1541	1280/1575
Weight, Rectifier Module [kg]	136	136	136
Weight, Inverter Module [kg]	102	102	136
Efficiency[4)]	0.98		
Output frequency	0–500 Hz		
Heatsink overtemp. trip	185°F [85°C]		
Power card ambient trip	154.4°F [68°C]		
* High overload = 160% torque during 60 sec., Normal overload = 110% torque during 60 sec.			

1) For type of fuse, see section Fuses.

2) American Wire Gauge.

3) Measured using 16.4 ft. [5 m] shielded motor cables at rated load and rated frequency.

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

8 Warnings and Alarms

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

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

In the event of an alarm, the adjustable frequency drive will have tripped. Alarms must be reset to restart operation once their cause has been rectified.

This may be done in four ways:

1. By using the [RESET] control button on the LCP.
2. Via a digital input with the "Reset" function.
3. Via serial communication/optional serial communication bus.
4. By resetting automatically using the [Auto Reset] function, which is a default setting for VLT HVAC Drive Drive, see *14-20 Reset Mode* in the FC 100 Programming Guide

NOTE!

After a manual reset using the [RESET] button on the LCP, the [AUTO ON] or [HAND ON] button must be pressed to restart the motor.

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

⚠CAUTION

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

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No.	Description	Warning	Alarm/ Trip	Alarm/Trip Lock	Parameter Reference
1	10 Volts low	X			
2	Live zero error	(X)	(X)		6-01
3	No motor	(X)			1-80
4	Mains phase loss	(X)	(X)	(X)	14-12
5	DC link voltage high	X			
6	DC link voltage low	X			
7	DC overvoltage	X	X		
8	DC undervoltage	X	X		
9	Inverter overloaded	X	X		
10	Motor ETR overtemperature	(X)	(X)		1-90
11	Motor thermistor over-temperature	(X)	(X)		1-90
12	Torque limit	X	X		
13	Overcurrent	X	X	X	
14	Ground fault	X	X	X	
15	Hardware mismatch		X	X	
16	Short Circuit		X	X	
17	Control word timeout	(X)	(X)		8-04
23	Internal Fan Fault	X			
24	External Fan Fault	X			14-53
25	Brake resistor short-circuited	X			
26	Brake resistor power limit	(X)	(X)		2-13
27	Brake chopper short-circuited	X	X		
28	Brake check	(X)	(X)		2-15
29	Drive overtemperature	X	X	X	
30	Motor phase U missing	(X)	(X)	(X)	4-58
31	Motor phase V missing	(X)	(X)	(X)	4-58
32	Motor phase W missing	(X)	(X)	(X)	4-58
33	Inrush fault		X	X	
34	Fieldbus communication fault	X	X		
35	Out of frequency range	X	X		
36	Mains failure	X	X		
37	Phase Imbalance	X	X		
38	Internal fault		X	X	
39	Heatsink sensor		X	X	
40	Overload of Digital Output Terminal 27	(X)			5-00, 5-01
41	Overload of Digital Output Terminal 29	(X)			5-00, 5-02
42	Overload of Digital Output On X30/6	(X)			5-32
42	Overload of Digital Output On X30/7	(X)			5-33
46	Pwr. card supply		X	X	
47	24 V supply low	X	X	X	
48	1.8 V supply low		X	X	
49	Speed limit	X	(X)		1-86
50	AMA calibration failed		X		
51	AMA check U_{nom} and I_{nom}		X		
52	AMA low I_{nom}		X		
53	AMA motor too big		X		
54	AMA motor too small		X		
55	AMA Parameter out of range		X		
56	AMA interrupted by user		X		

No.	Description	Warning	Alarm/ Trip	Alarm/Trip Lock	Parameter Reference
57	AMA timeout		X		
58	AMA internal fault	X	X		
59	Current limit	X			
60	External Interlock	X			
62	Output Frequency at Maximum Limit	X			
64	Voltage Limit	X			
65	Control Board Over-temperature	X	X	X	
66	Heat sink Temperature Low	X			
67	Option Configuration has Changed		X		
69	Pwr. Card Temp		X	X	
70	Illegal FC configuration			X	
71	PTC 1 Safe Stop	X	X[1)]		
72	Dangerous Failure			X[1)]	
73	Safe Stop Auto Restart				
76	Power Unit Set-up	X			
79	Illegal PS config		X	X	
80	Drive Initialized to Default Value		X		
91	Analog input 54 wrong settings			X	
92	NoFlow	X	X		22-2*
93	Dry Pump	X	X		22-2*
94	End of Curve	X	X		22-5*
95	Broken Belt	X	X		22-6*
96	Start Delayed	X			22-7*
97	Stop Delayed	X			22-7*
98	Clock Fault	X			0-7*
201	Fire M was Active				
202	Fire M Limits Exceeded				
203	Missing Motor				
204	Locked Rotor				
243	Brake IGBT	X	X		
244	Heatsink temp	X	X	X	
245	Heatsink sensor		X	X	
246	Pwr.card supply		X	X	
247	Pwr.card temp		X	X	
248	Illegal PS config		X	X	
250	New spare parts			X	
251	New Type Code		X	X	

Table 8.1 Alarm/Warning code list

(X) Dependent on parameter

1) Cannot be Auto reset via 14-20 Reset Mode

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

LED indication	
Warning	yellow
Alarm	flashing red
Trip locked	yellow and red

Table 8.2 LED Indication

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

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

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

8.1.1 Fault Messages

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

This condition can be caused by a short in a connected potentiometer or improper wiring of the potentiometer.

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

WARNING/ALARM 2, Live zero error
This warning or alarm will only appear if programmed by the user 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. This condition can be caused by broken wiring or faulty device sending the signal.

Troubleshooting:

Check 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).

Make sure that the drive programming and switch settings match the analog signal type.

Perform Input Terminal Signal Test.

WARNING/ALARM 3, No motor
No motor has been connected to the output of the adjustable frequency drive. This warning or alarm will only appear if programmed by the user in *1-80 Function at Stop*.

Troubleshooting: Check the connection between the drive and the motor.

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

Troubleshooting: Check the supply voltage and supply currents to the adjustable frequency drive.

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 drive voltage rating. The adjustable frequency drive 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 drive voltage rating. The adjustable frequency drive is still active.

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

Troubleshooting:

Connect a brake resistor

Extend the ramp time

Change the ramp type

Activate functions in *2-10 Brake Function*

Increase *14-26 Trip Delay at Inverter Fault*

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

Troubleshooting:

Make sure that the supply voltage matches the adjustable frequency drive voltage.

Perform Input voltage test

Perform soft charge and rectifier circuit test

WARNING/ALARM 9, Inverter overloaded
The adjustable frequency drive is about to cut out because of an overload (current too high for too long). The counter for electronic, thermal inverter protection gives a warning at 98% and trips at 100%, while giving an alarm. The adjustable frequency drive *cannot* be reset until the counter is below 90%.
The fault is that the adjustable frequency drive is overloaded by more than 100% for too long.

Troubleshooting:

Compare the output current shown on the LCP with the drive rated current.

Compare the output current shown on the LCP with measured motor current.

Display the Thermal Drive Load on the keypad and monitor the value. When running above the drive continuous current rating, the counter should increase. When running below the drive continuous current rating, the counter should decrease.

NOTE: See the derating section in the Design Guide for more details if a high switching frequency is required.

WARNING/ALARM 10, Motor overload temperature

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According to the electronic thermal protection (ETR), the motor is too hot. Select whether the adjustable frequency drive gives a warning or an alarm when the counter reaches 100% in *1-90 Motor Thermal Protection*. The fault is that the motor is overloaded by more than 100% for too long.

Troubleshooting:

Check if the motor is overheating.

If the motor is mechanically overloaded

That the motor *1-24 Motor Current* is set correctly.

Motor data in parameters 1-20 through 1-25 are set correctly.

The setting in *1-91 Motor External Fan*.

Run AMA in *1-29 Automatic Motor Adaptation (AMA)*.

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WARNING/ALARM 11, Motor thermistor overtemp

The thermistor or the thermistor connection is disconnected. Select whether the adjustable frequency drive gives a warning or an alarm when the counter reaches 100% in *1-90 Motor Thermal Protection*.

Troubleshooting:

Check if the motor is overheating.

Check if the motor is mechanically overloaded.

Check that the thermistor is connected correctly between terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply), or between terminal 18 or 19 (digital input PNP only) and terminal 50.

If a KTY sensor is used, check for correct connection between terminal 54 and 55.

If using a thermal switch or thermistor, check the programming of *1-93 Thermistor Source* matches sensor wiring.

If using a KTY sensor, check the programming of parameters 1-95, 1-96, and 1-97 match sensor wiring.

WARNING/ALARM 12, Torque limit

The torque is higher than the value in *4-16 Torque Limit Motor Mode* or the torque is higher than the value in *4-17 Torque Limit Generator Mode*. *14-25 Trip Delay at Torque Limit* can be used to change this from a warning only condition to a warning followed by an alarm.

WARNING/ALARM 13, Overcurrent

The inverter peak current limit (approx. 200% of the rated current) is exceeded. The warning lasts about 1.5 sec. Then the adjustable frequency drive trips and issues an alarm. If extended mechanical brake control is selected, trip can be reset externally.

Troubleshooting:

This fault may be caused by shock loading or fast acceleration with high inertia loads.

Turn off the adjustable frequency drive. Check if the motor shaft can be turned.

Make sure that the motor size matches the adjustable frequency drive.

Incorrect motor data in parameters 1-20 through 1-25.

ALARM 14, Ground fault

There is a discharge from the output phases to ground, either in the cable between the adjustable frequency drive and the motor or in the motor itself.

Troubleshooting:

Turn off the adjustable frequency drive and remove the ground fault.

Measure the resistance to ground of the motor leads and the motor with a megohmmeter to check for ground faults in the motor.

Perform 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 your Danfoss supplier:

15-40 FC Type

15-41 Power Section

15-42 Voltage

15-43 Software Version

15-45 Actual Typecode String

15-49 SW ID Control Card

15-50 SW ID Power Card

15-60 Option Mounted

15-61 Option SW Version

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

Turn off the adjustable frequency drive and remove the short circuit.

WARNING/ALARM 17, Control word timeout
There is no communication to the adjustable frequency drive.
The warning will only be active when *8-04 Control Timeout Function* is NOT set to OFF.
If *8-04 Control Timeout Function* is set to *Stop* and *Trip*, a warning appears and the adjustable frequency drive ramps down until it trips, while giving an alarm.

Troubleshooting:

Check connections on the serial communication cable.

Increase *8-03 Control Timeout Time*

Check the operation of the communication equipment.

Verify proper installation based on EMC requirements.

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

For the D, E, and F Frame drives, the regulated voltage to the fans is monitored.

Troubleshooting:

Check fan resistance.

Check soft charge fuses.

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

For the D, E, and F Frame drives, the regulated voltage to the fans is monitored.

Troubleshooting:

Check fan resistance.

Check soft charge fuses.

WARNING 25, Brake resistor short circuit
The brake resistor is monitored during operation. If it short circuits, the brake function is disconnected and the warning appears. The adjustable frequency drive still works, but without the brake function. Turn off the adjustable frequency drive 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 percentage, as a mean value over the last 120 seconds, on the basis of the resistance value of the brake resistor, and the intermediate circuit voltage. The warning is active when the dissipated braking energy is higher than 90%. If *Trip* [2] has been selected in *2-13 Brake Power Monitoring*, the adjustable frequency drive cuts out and issues this alarm, when the dissipated braking energy is higher than 100%.

WARNING/ALARM 27, Brake chopper fault
The brake transistor is monitored during operation and if it short-circuits, the brake function disconnects and issues a warning. The adjustable frequency drive is still able to run, but since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.
Turn off the adjustable frequency drive and remove the brake resistor.
This alarm/ warning could also occur should the brake resistor overheat. Terminal 104 to 106 are available as brake resistor. Klixon inputs, see section Brake Resistor Temperature Switch.

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

ALARM 29, Heatsink temp
The maximum temperature of the heatsink has been exceeded. The temperature fault will not be reset until the temperature falls below a defined heatsink temperature.

The trip and reset point are different based on the drive power size.

Troubleshooting:

- Ambient temperature too high.
- Too long motor cable.
- Incorrect clearance above and below the drive.
- Dirty heatsink.
- Blocked air flow around the drive.
- Damaged heatsink fan.

For the D, E, and F Frame drives, this alarm is based on the temperature measured by the heatsink sensor mounted inside the IGBT modules. For the F Frame drives, this alarm can also be caused by the thermal sensor in the rectifier module.

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Troubleshooting:

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

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

Turn off the adjustable frequency drive and check motor phase U.

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

Turn off the adjustable frequency drive and check motor phase V.

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

Turn off the adjustable frequency drive and check motor phase W.

ALARM 33, Inrush fault
Too many power-ups have occurred within a short time period. Let unit cool to operating temperature.

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

WARNING/ALARM 35, Out of frequency range:
This warning is active if the output frequency has reached the high limit (set in par. 4-53) or low limit (set in par. 4-52). In *Process Control, Closed-loop* (par. 1-00) this warning is displayed.

WARNING/ALARM 36, Mains failure
This warning/alarm is only active if the supply voltage to the adjustable frequency drive is lost and *14-10 Line Failure* is NOT set to OFF. Check the fuses to the adjustable frequency drive.

ALARM 38, Internal fault
It may be necessary to contact your Danfoss supplier. Some typical alarm messages:

0	Serial port cannot be initialized. Serious hardware failure
256-258	Power EEPROM data is defect or too old
512	Control board EEPROM data is defect or too old
513	Communication time out reading EEPROM data
514	Communication time out reading EEPROM data
515	Application Orientated Control cannot recognize the EEPROM data
516	Cannot write to the EEPROM because a write command is on progress
517	Write command is under timeout
518	Failure in the EEPROM
519	Missing or invalid Barcode data in EEPROM
783	Parameter value outside of min/max limits
1024-1279	A CAN message that has to be sent, couldn't be sent
1281	Digital Signal Processor flash timeout
1282	Power micro software version mismatch
1283	Power EEPROM data version mismatch
1284	Cannot read Digital Signal Processor software version
1299	Option SW in slot A is too old
1300	Option SW in slot B is too old
1302	Option SW in slot C1 is too old
1315	Option SW in slot A is not supported (not allowed)
1316	Option SW in slot B is not supported (not allowed)
1318	Option SW in slot C1 is not supported (not allowed)
1379	Option A did not respond when calculating Platform Version.
1380	Option B did not respond when calculating Platform Version.
1536	An exception in the Application Orientated Control is registered. Debug information written in LCP
1792	DSP watchdog is active. Debugging of power part data Motor Orientated 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	H083x: option in slot x has issued a legal power-up wait
2304	Could not read any data from power EEPROM
2305	Missing SW version from power unit
2314	Missing power unit data from power unit
2315	Missing SW version from power unit
2316	Missing io_statepage from power unit
2324	Power card configuration is determined to be incorrect at power-up
2330	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 to small
3072-5122	Parameter value is outside its limits
5123	Option in slot A: Hardware incompatible with control board hardware
5124	Option in slot B: Hardware incompatible with control board hardware
5125	Option in slot C0: Hardware incompatible with control board hardware
5126	Option in slot C1: Hardware incompatible with control board hardware
5376-6231	Out of memory

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ALARM 39, Heatsink sensor
No feedback from the heatsink 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 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 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 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 short-circuit connection. Check *5-33 Term X30/7 Digi Out (MCB 101)*.

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

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

WARNING 47, 24 V supply low
The 24V DC is measured on the control card. The external 24V DC backup power supply may be overloaded; otherwise, contact your Danfoss supplier.

WARNING 48, 1.8 V supply low
The 1.8V DC supply used on the control card is outside of allowable limits. The power supply is measured on the control card.

WARNING 49, Speed limit
When the speed is not within the specified range in par. 4-11 and par. 4-13, the drive will show a warning. When the speed is below the specified limit in *1-86 Trip Speed Low [RPM]* (except when starting or stopping), the drive will trip.

ALARM 50, AMA calibration failed
Contact your Danfoss supplier.

ALARM 51, AMA check Unom and Inom
The setting of the motor voltage, motor current, and motor power is presumably wrong. Check the settings.

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 be carried out.

ALARM 54, AMA motor too small
The motor is too small for the AMA to be carried out.

ALARM 55, AMA Parameter out of range
The parameter values found from the motor are outside acceptable range.

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

ALARM 57, AMA timeout
Try to start the AMA again a number of times, until the AMA is carried out. Please note that repeated runs may heat the motor to a level where the resistances Rs and Rr are increased. In most cases, however, this 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*.

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 adjustable frequency drive (via serial communication, digital I/O, or by pressing reset button on keypad).

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

WARNING 64, Voltage limit
The load and speed combination demands a motor voltage higher than the actual DC link voltage.

WARNING/ALARM/TRIP 65, Control card over temperature
Control card overtemperature: The cutout temperature of the control card is 176°F [80°C].

WARNING 66, Heatsink temperature low
This warning is based on the temperature sensor in the IGBT module.

Troubleshooting:

The heatsink temperature measured as 32°F [0°C] could indicate that the temperature sensor is defective causing the fan speed to increase to the maximum. If the sensor wire between the IGBT and the gate drive card is disconnected, this warning would result. 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.

ALARM 68, Safe stop activated
Safe stop 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 the reset key). See *5-19 Terminal 37 Safe Stop*.

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.

Make sure that the filters for the door fans are not blocked.

Check that the connector plate is properly installed on IP 21 and IP 54 (NEMA 1 and NEMA 12) drives.

ALARM 70, Illegal FC Configuration
The current control board and power board combination is illegal.

ALARM 72, Dangerous failure
Safe stop with trip lock. Unexpected signal levels on safe stop and digital input from the MCB 112 PTC thermistor card.

WARNING 73, Safe stop auto restart
Safe stopped. Note that with automatic restart enabled, the motor may start when the fault is cleared.

WARNING 76, Power Unit Set-up
The required number of power units does not match the detected number of active power units.

Troubleshooting:

When replacing an F frame module, this will occur if the power specific data in the module power card does not match the rest of the drive. Please confirm the spare part and its power card are the correct part number.

WARNING 77, Reduced power mode:
This warning indicates that the drive is operating in reduced power mode (i.e., less than the allowed number of inverter sections). This warning will be generated on power cycle when the drive is set to run with fewer inverters and will remain on.

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

ALARM 80, Drive initialized to default value
Parameter settings are initialized to default settings after a manual reset.

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

ALARM 92, No flow
A no-load situation has been detected in the system. See parameter group 22-2*.

ALARM 93, Dry pump
A no-flow situation and high speed indicates that the pump has run dry. See parameter group 22-2*.

ALARM 94, End of curve
Feedback stays lower than the setpoint which may indicate leakage in the pipe system. See parameter group 22-5*.

ALARM 95, Broken belt
Torque is below the torque level set for no load, indicating a broken belt. See parameter group 22-6*.

ALARM 96, Start delayed
Motor start has been delayed due to short-cycle protection active. See parameter group 22-7*.

WARNING 97, Stop delayed
Stopping the motor has been delayed due to short cycle protection is active. See parameter group 22-7*.

WARNING 98, Clock fault
Clock Fault. Time is not set or RTC clock (if mounted) has failed. See parameter group 0-7*.

WARNING 201, Fire Mode Was Active
Fire mode has been active.

WARNING 202, Fire Mode Limits Exceeded
Fire mode has suppressed one or more warranty voiding alarms.

WARNING 203, Missing Motor
A multi-motor underload situation was detected, this could be due to, for example, a missing motor.

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WARNING 204, Locked Rotor
A multi-motor overload situation was detected, which could be due to, e.g., a locked rotor.

ALARM 243, Brake IGBT
This alarm is only for F Frame drives. 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 F2 or F4 drive.

2 = right inverter module in F1 or F3 drive.

3 = right inverter module in F2 or F4 drive.

5 = rectifier module.

ALARM 244, Heatsink temperature
This alarm is only for F Frame drives. 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 F2 or F4 drive.

2 = right inverter module in F1 or F3 drive.

3 = right inverter module in F2 or F4 drive.

5 = rectifier module.

ALARM 245, Heatsink sensor
This alarm is only for F Frame drives. 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 F2 or F4 drive.

2 = right inverter module in F1 or F3 drive.

3 = right inverter module in F2 or F4 drive.

5 = rectifier module.

ALARM 246, Power card supply
This alarm is only for F Frame drives. 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 F2 or F4 drive.

2 = right inverter module in F1 or F3 drive.

3 = right inverter module in F2 or F4 drive.

5 = rectifier module.

ALARM 247, Power card temperature
This alarm is only for F Frame drives. 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 F2 or F4 drive.

2 = right inverter module in F1 or F3 drive.

3 = right inverter module in F2 or F4 drive.

5 = rectifier module.

ALARM 248, Illegal power section configuration
This alarm is only for F Frame drives. 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 F2 or F4 drive.

2 = right inverter module in F1 or F3 drive.

3 = right inverter module in F2 or F4 drive.

5 = rectifier module.

ALARM 250, New spare part
The power or switch mode power supply has been exchanged. The adjustable frequency drive type code must be restored in the EEPROM. Select the correct type code in *14-23 Typecode Setting* according to the label on the unit. Remember to select 'Save to EEPROM' to complete.

ALARM 251, New type code
The adjustable frequency drive has a new type code.

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