MAKING MODERN LIVING POSSIBLE

Instruction Manual 12-Pulse High Power

VLT® AQUA Drive FC 200

VLT®
THE REAL DRIVE

ENGINEERING
TOMORROW

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EU DECLARATION OF CONFORMITY

Danfoss A/S

Danfoss Drives A/S

declares under our sole responsibility that the

Product category: Frequency Converter
Type designation(s): FC-202XYYYZZ**********

Character X: N or P
Character YYY: K25, K37, K55, K75, 1K1, 1K5, 2K2, 3K0, 3K7, 4K0, 5K5, 7K5, 11K, 15K, 18K, 22K, 30K, 37K, 45K, 55K, 75K, 90K, 110, 132, 150, 160, 200, 250, 315, 355, 400, 450, 500, 560, 630, 710, 800, 900, 1M0, 1M2, 1M4
Character ZZ: S2, S4, T2, T4, T6, T7
* may be any number or letter indicating drive options which do not impact this DoC.
The meaning of the 39 characters in the type code string can be found in appendix 00729776.

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

Low Voltage Directive 2014/35/EU

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

EMC Directive 2014/30/EU

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

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

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

Date: 2020.09.15 Place of issue:	Issued by	Date: 2020.09.15 Place of issue:	Approved by
Graasten, DK	**Signature:** **Name: Gert Kjær** **Title: Senior Director, GDE**	Graasten, DK	**Signature:** **Name: Michael Termansen** **Title: VP, PD Center Denmark**

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

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

Machine Directive 2006/42/EC

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

Other standards considered:

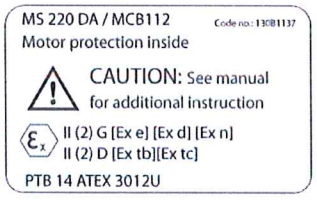
EN ISO 13849-1:2015 (Safe Stop function, PL d (MTTFd=14000 years, DC=90%, Category 3)	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
EN/IEC 61508-1:2011, EN/IEC 61508-2:2011 (Safe Stop function, SIL 2 (PFH = 1E-10/h, 1E-8/h for specific variants,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

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

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

Based on EU harmonized standard:

EN 50495: 2010	Safety devices required for safe functioning of equipment with respect to explosion risks.



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

Contents

1 How to Read the Instruction Manual

1.1.1 Copyright, Limitation of Liability and Revision Rights

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It has been assumed that all devices will be sitting behind a firewall that does packet filtering and the environment has well-implemented restrictions on the software that can run inside the firewall. All nodes are assumed to be "trusted" nodes.

1.1.2 Symbols

Symbols used in this manual

NOTE!

Indicates something to be noted by the reader.

⚠CAUTION

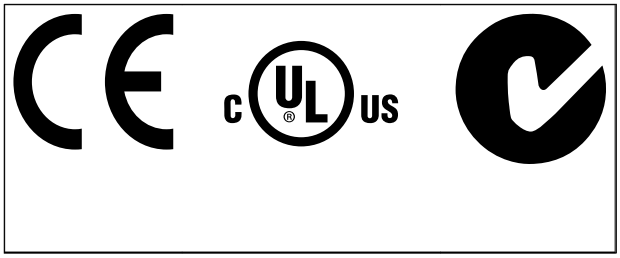
Indicates a general warning.

⚠WARNING

Indicates a high-voltage warning.

★	Indicates default setting

1.1.3 Approvals



1.1.4 Available literature for VLT® AQUA Drive FC 200

- VLT® AQUA Drive Instruction Manual MG.20.Mx.yy provides the neccessary information for getting the drive up and running.
- VLT® AQUA Drive High Power Instruction Manual MG.20.Px.yy provides the neccessary information for getting the HP drive up and running.
- VLT® AQUA Drive Design Guide MG.20.Nx.yy contains all the technical information about the drive and customer design and applications.
- VLT® AQUA Drive Programming Guide MN. 20.Ox.yy provides information on how to program and includes complete parameter descriptions.
- VLT® AQUA Drive FC 200 Profibus MG.33.Cx.yy
- VLT® AQUA Drive FC 200 DeviceNet MG.33.Dx.yy
- Output Filters Design Guide MG.90.Nx.yy
- VLT® AQUA Drive FC 200 Cascade Controller MI. 38.Cx.yy
- Application Note MN20A102: Submersible Pump Application

- Application Note MN20B102: Master/Follower Operation Application
- Application Note MN20F102: Drive Closed-loop and Sleep Mode
- Instruction MI.38.Bx.yy: Installation Instruction for Mounting Brackets Enclosure type A5, B1, B2, C1 and C2 IP21, IP55 or IP66
- Instruction MI.90.Lx.yy: Analog I/O Option MCB109
- Instruction MI.33.Hx.yy: Panel through mount kit

x = Revision number
yy = Language code

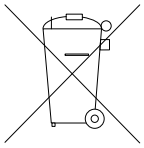
Danfoss technical literature is also available online at *www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.htm*.

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		
DCT	Drive Control Tool		
Joule	Energy	J = N·m	ft-lb, Btu
°F	Fahrenheit		
f	Frequency	Hz	Hz
kHz	Kilohertz	kHz	kHz
mA	Milliampere		
ms	Millisecond		
min	Minute		
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 Drive 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– V	425–1350 hp [315–1000 kW]	40 minutes
525–690 V	535–1875 hp [400–1400 kW]	30 minutes

VLT AQUA Drive
FC 200 Series

Software version: 1.6x

This guide can be used with all adjustable frequency drives with software version 1.6x or later. The actual software version number can be read 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
380–480V: 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 *Elec. OL trip* or *Elec. OL warning*. For the North American market: Electronic Thermal Overload 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.

2

⚠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 in² [10 mm²] or 2 rated ground wires terminated separately. For proper grounding for EMC, see section *Grounding* in the *How to Install* chapter.

Residual Current Device

The drive 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. Protective grounding of the adjustable frequency drive and the use of RCDs must always follow national and local regulations.

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 keypad::

- 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 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 are placed in the same installation panel, you can use an non-shielded cable instead of a shielded one.

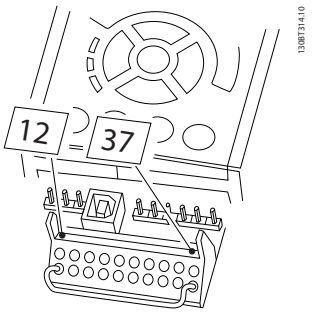


Figure 2.1 Bridge jumper between terminal 37 and 24 VDC

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.

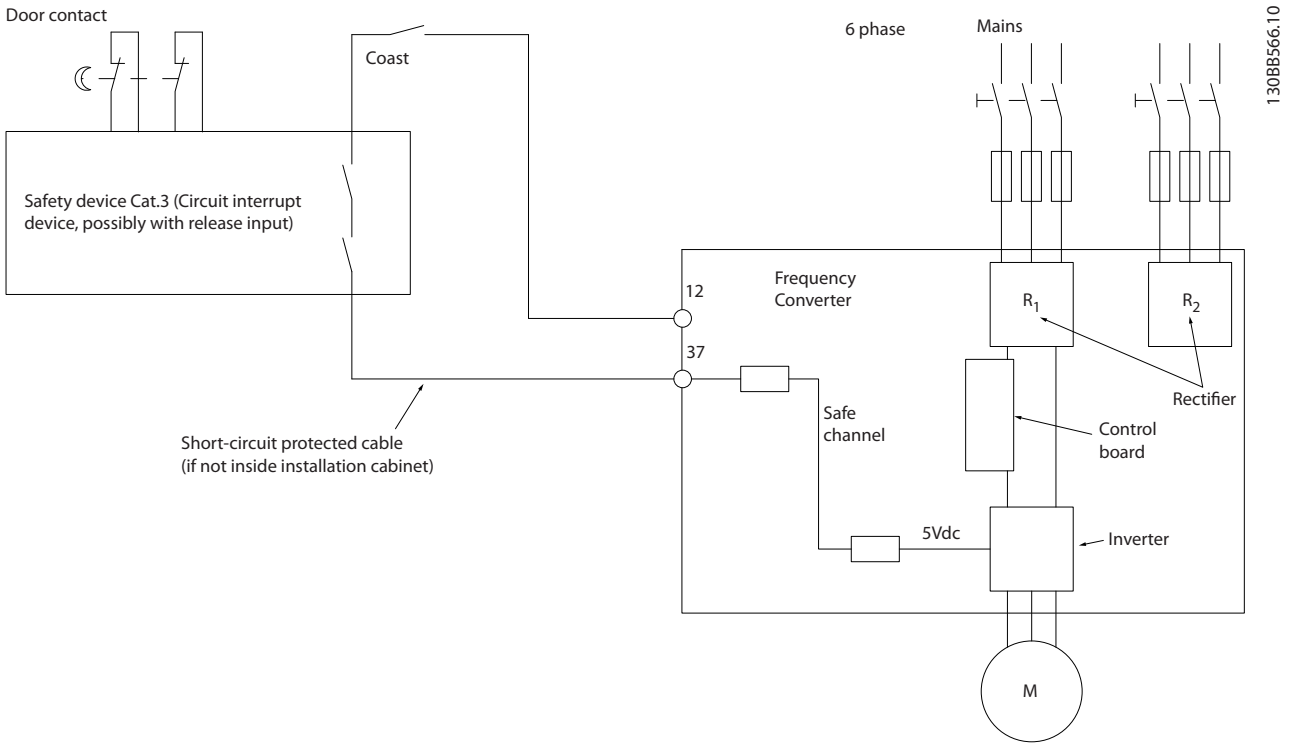


Figure 2.2 Essential aspects of an installation to achieve a Stopping Category 0 (EN 60204-1) with safety Category 3 (EN 954-1).

2.1.8 IT Line Power

14-50 RFI 1 can be used to disable the factory installed A1/B1 RFI filter option. If this is done, it will reduce the RFI performance to A2 level. For the 525–690V adjustable frequency drives, *14-50 RFI 1* is not available as there is no A1/B1 Factory Installed RFI Filter option.

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.
- Ensure that the drive is properly protected per local regulations.

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 4X unit size and 52 unit size (IP00) Units, use a bar to avoid bending the lifting holes of the adjustable frequency drive.

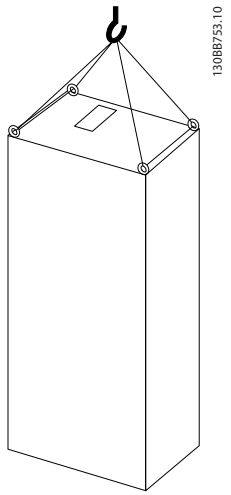


Figure 3.1 Recommended lifting method, Unit Size .

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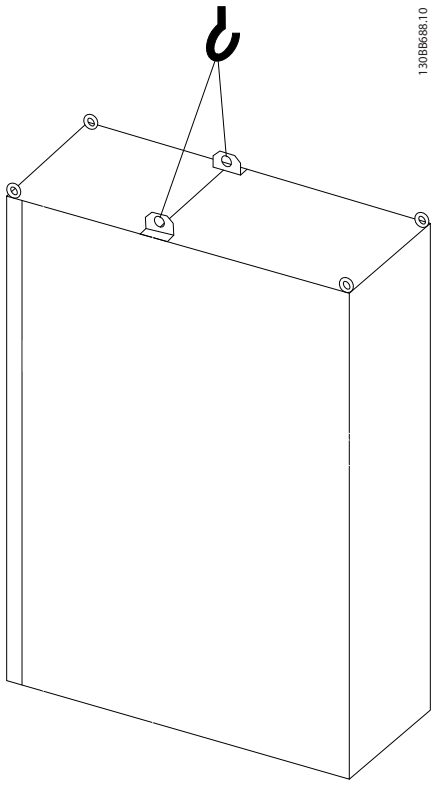


Figure 3.2 Recommended lifting method, Unit Size 63 (460V, 600–900 HP, 575/600V, 900–1150 HP).

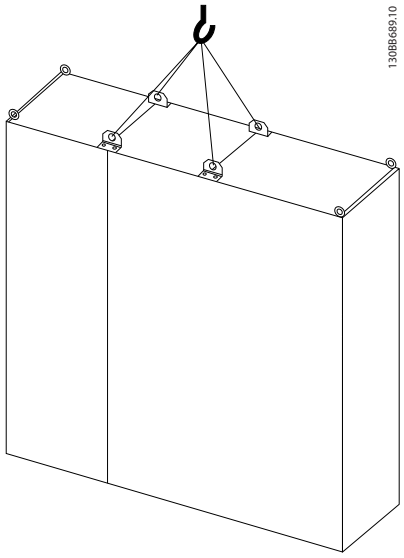


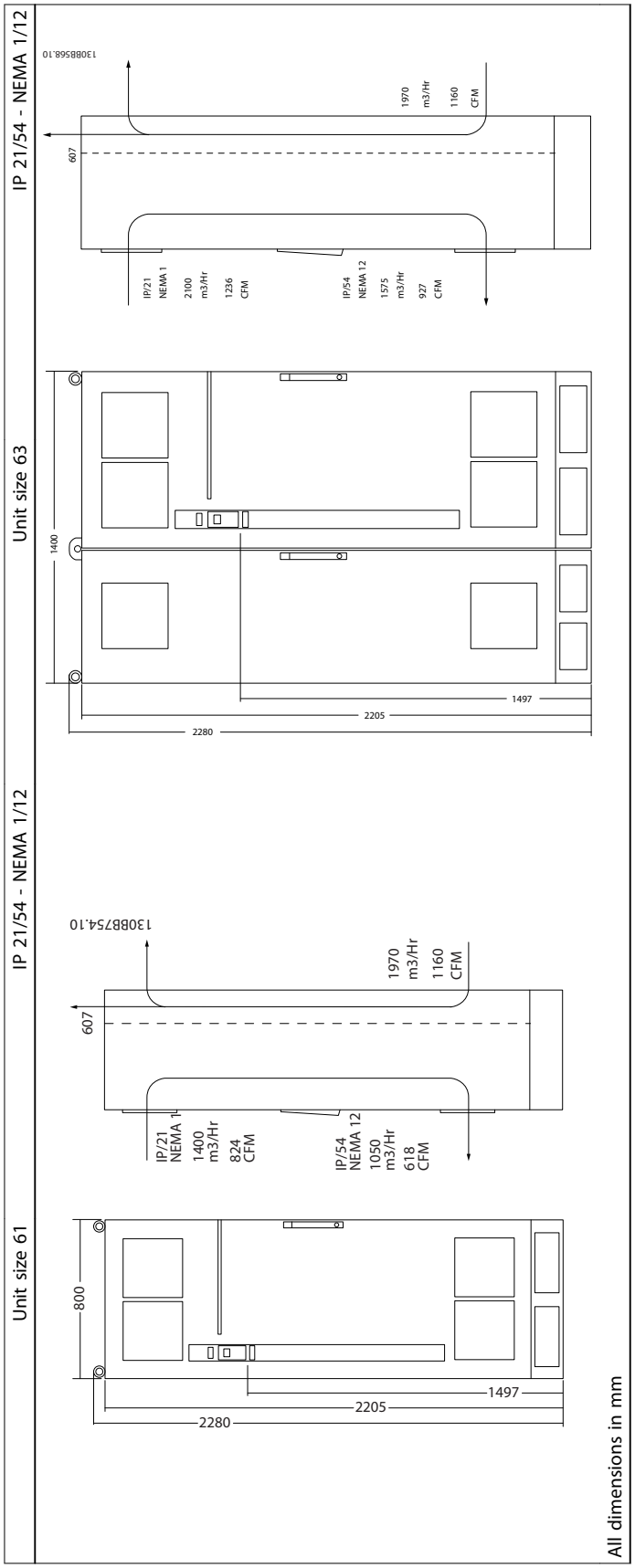
Figure 3.3 Recommended lifting method, Unit Size 64 (460V, 1000–1200 HP, 575/600V, 1250–1350 HP).

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 unit sizes6X 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 unit sizes 6X.

3

3.1.5 Mechanical Dimensions



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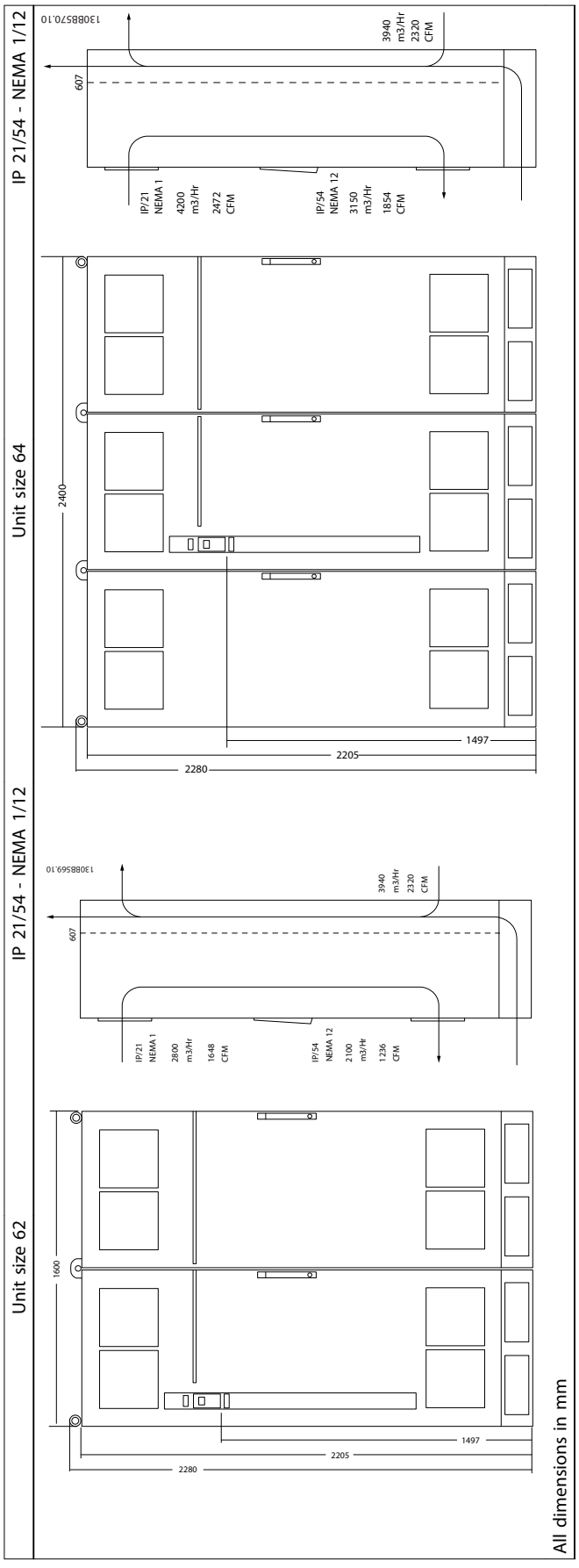
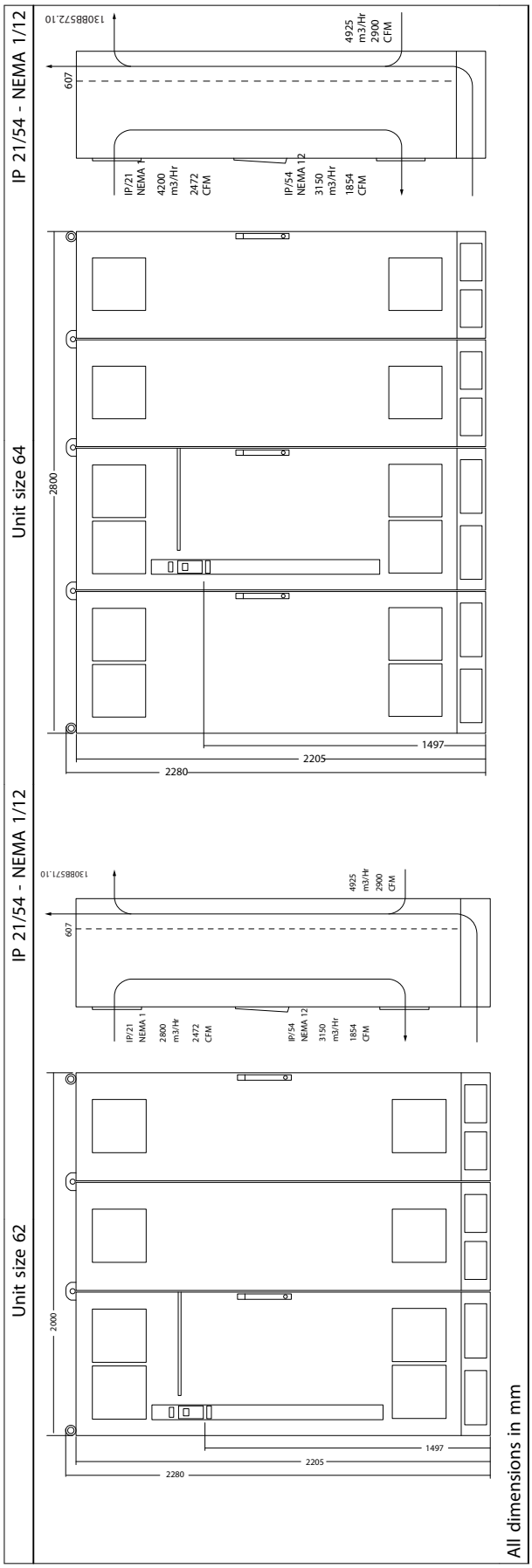
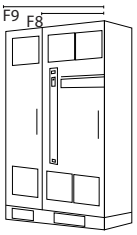
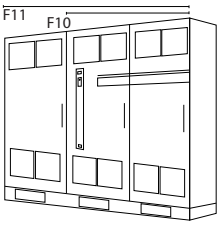
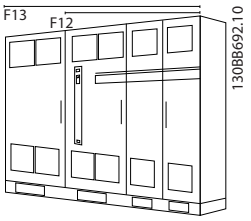

IP 21/54 - NEMA 1/12
Unit size 64
130BB570.10
3940 m3/Hr 2320 CFM
607
IP/21 NEMA 1
4200 m3/Hr
2472 CFM
IP/54 NEMA 12
3150 m3/Hr
1854 CFM
2400
1497
2205
2280
IP 21/54 - NEMA 1/12
Unit size 62
130BB569.10
3940 m3/Hr 2320 CFM
607
IP/21 NEMA 1
2800 m3/Hr
1648 CFM
IP/54 NEMA 12
2100 m3/Hr
1236 CFM
1600
1497
2205
2280
All dimensions in mm


IP 21/54 - NEMA 1/12
Unit size 64
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
Unit size 62
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, Unit Sizes 4 and 5							
Unit size		**51**		**61**	**62**	**63**	**64**
							
Heavy-duty rated power - 160% overload torque		**425–600 hp [315–450 kW] (380–480 V) 535–850 hp [400–630 kW] (525–690 V)**		**675–950 hp [500–710 kW] (380–480 V) 950–1200 hp [710–900 kW] (525–690 V)**		**1075–1350 hp [800–1000 kW] (380–480 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]

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/Nema 12 drive types.
- 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 Unit Size 51IP 21/Nema 1 and IP 54/Nema 12 drive 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.

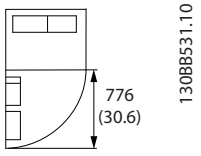


Figure 3.4 Space in front of

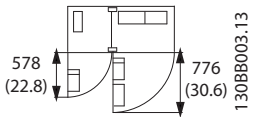


Figure 3.5 Space in front of

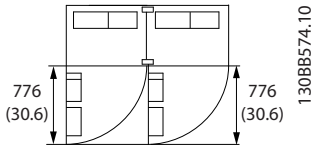


Figure 3.6 Space in front of

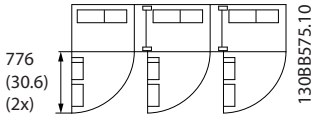


Figure 3.7 Space in front of

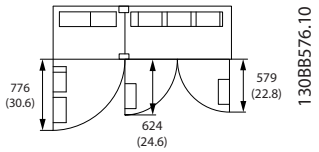


Figure 3.8 Space in front of

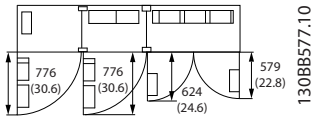


Figure 3.9 Space in front of

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, 61, 62, 63, F11, F12 and 64 The , F1061 and 62 consist of an inverter cabinet on the right and rectifier cabinet on the left. The , F1163 and 64 have an additional options cabinet left of the rectifier cabinet. The 63 is an 61 with an additional options cabinet. The F11 is an 62 with an additional options cabinet. The F13 is an 62 with an additional options cabinet.

Terminal locations - Unit Sizes 61 and 63

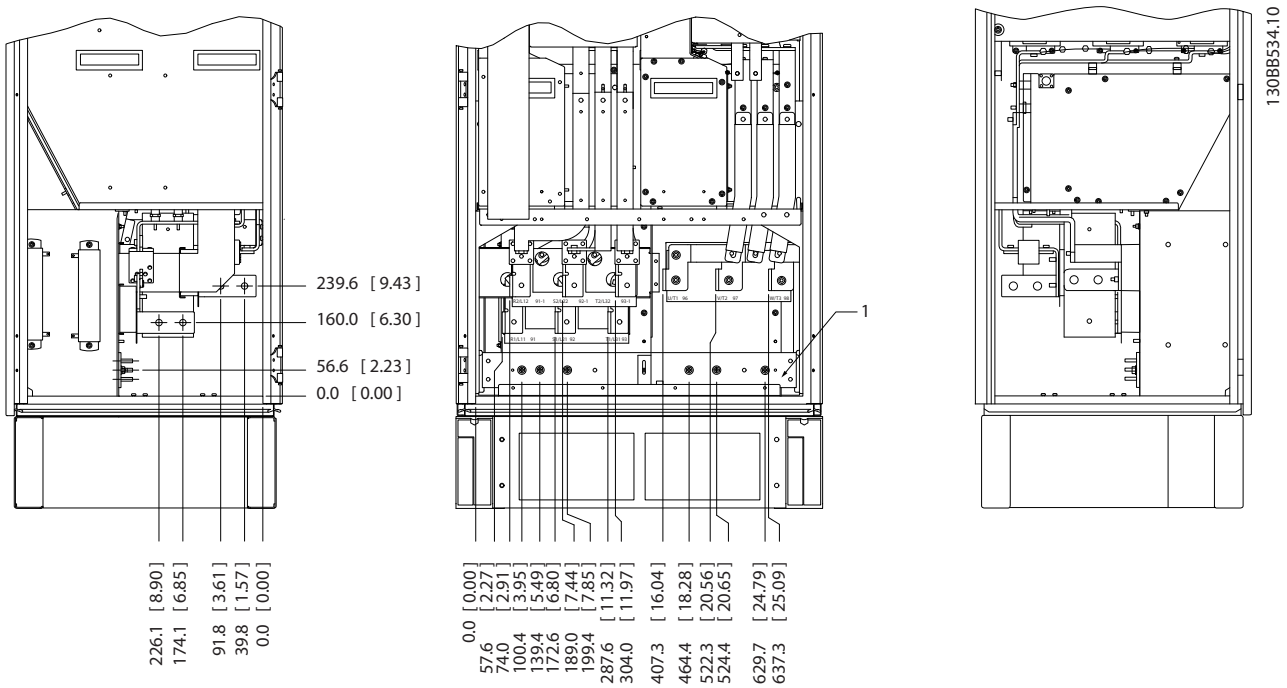


Figure 3.10 Terminal locations - Inverter and Rectifier Cabinet - and (front, left and right side view). The connector plate is 1.65 in [42 mm] below .0 level.
1) Ground bar

Terminal locations - Unit Sizes 61 and 63

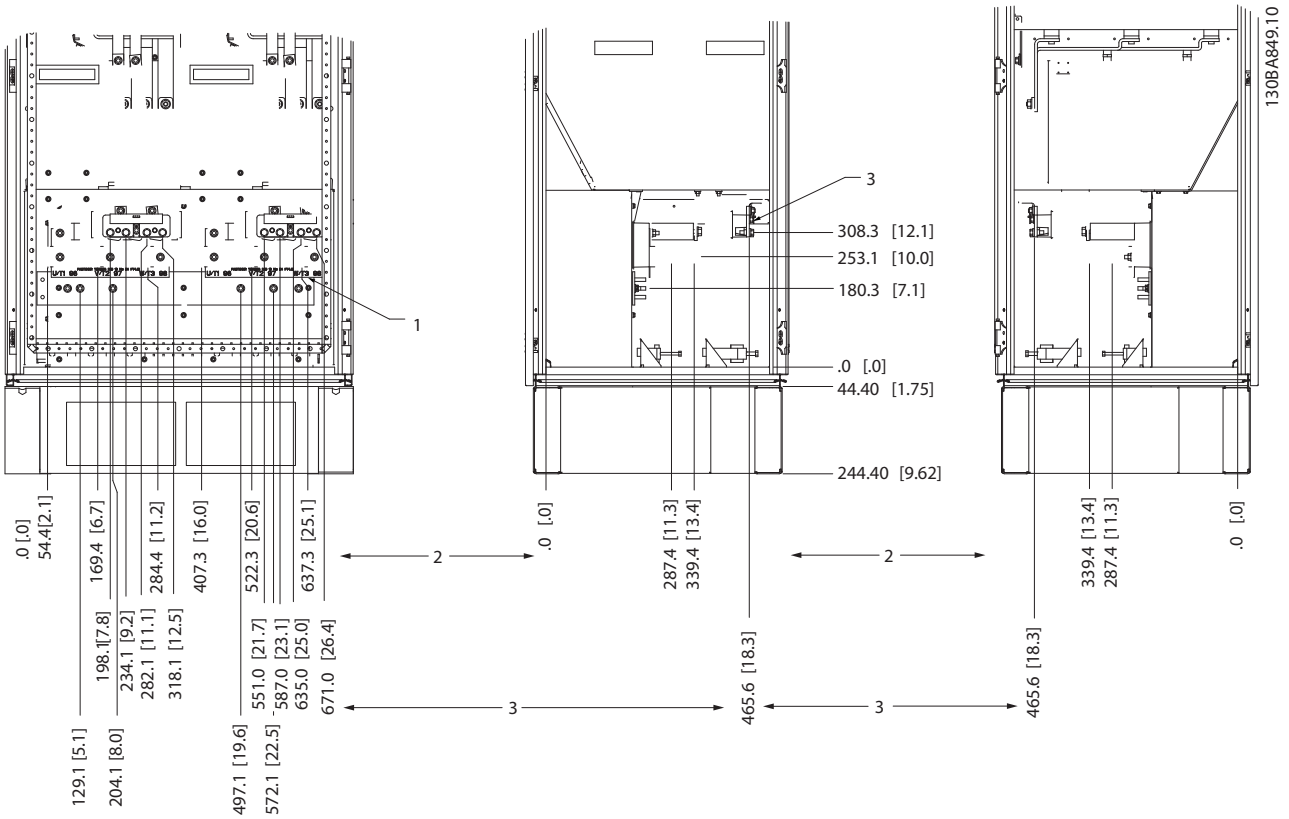


Figure 3.11 Terminal locations - Inverter Cabinet (front, left and right side view). The connector plate is 1.65 in [42 mm] below .0 level.

1) Ground bar

2) Motor terminals

3) Brake terminals

3

Terminal locations - Unit Sizes 62/64

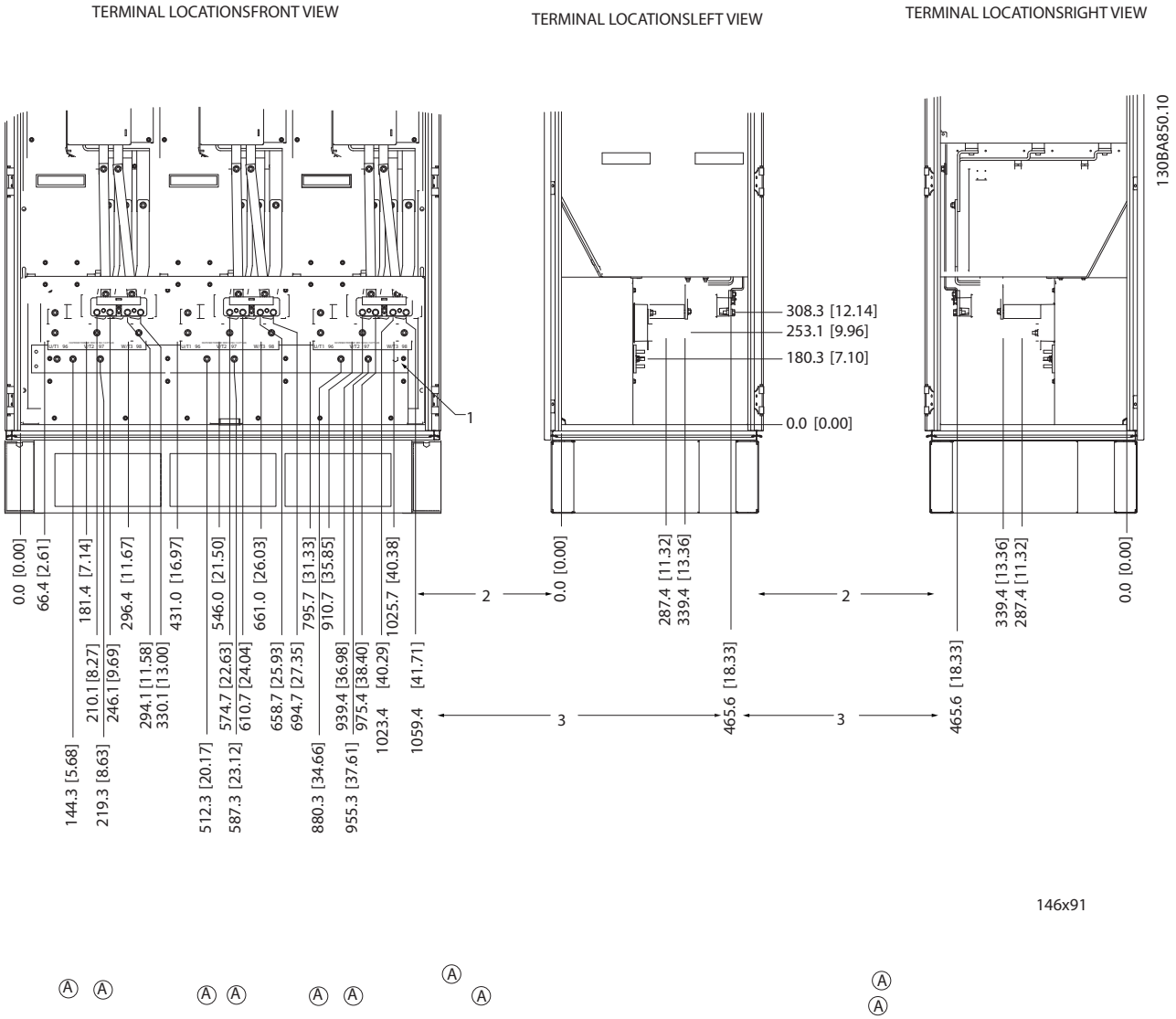


Figure 3.12 Terminal locations - Inverter Cabinet (front, left and right side view). The connector plate is 1.65 in [42 mm] below .0 level.
1) Ground bar

Terminal locations - Rectifier ()

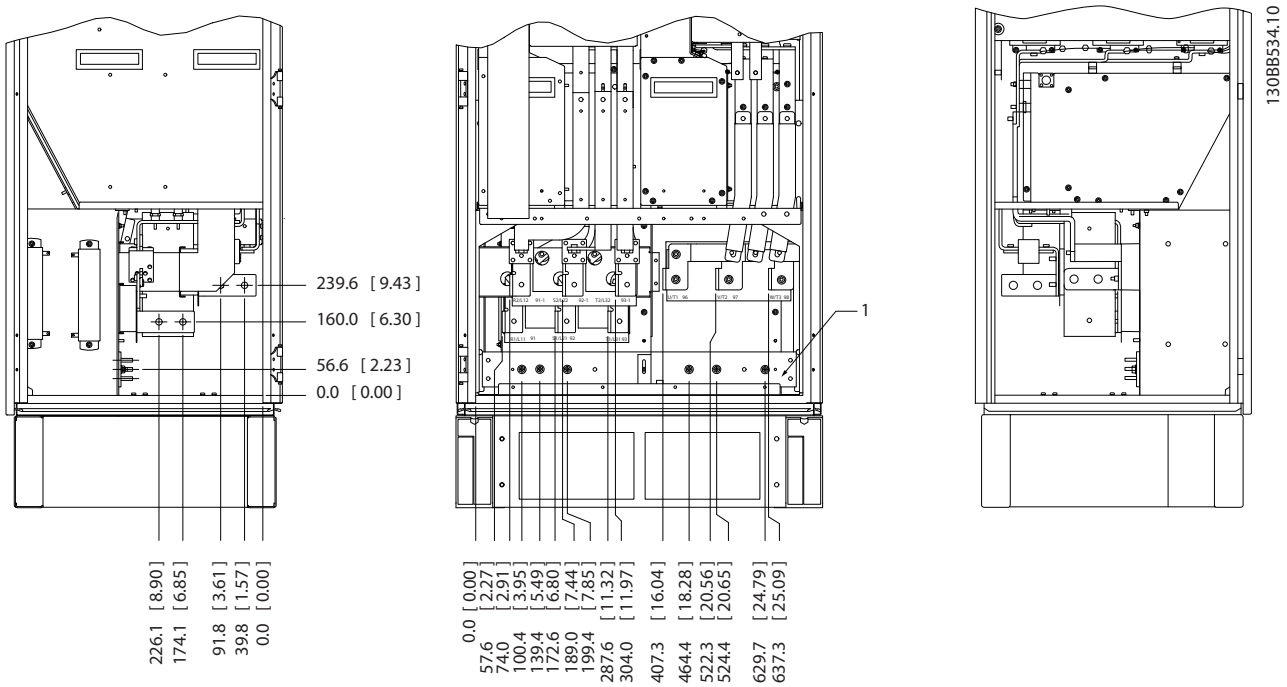


Figure 3.13 Terminal locations - Rectifier (left side, front and right side view). The connector plate is 1.65 in [42 mm] below .0 level.

1) Load share Terminal (-)

2) Ground bar

3) Load share Terminal (+)

3

Terminal locations - Options Cabinet Frame Size F9

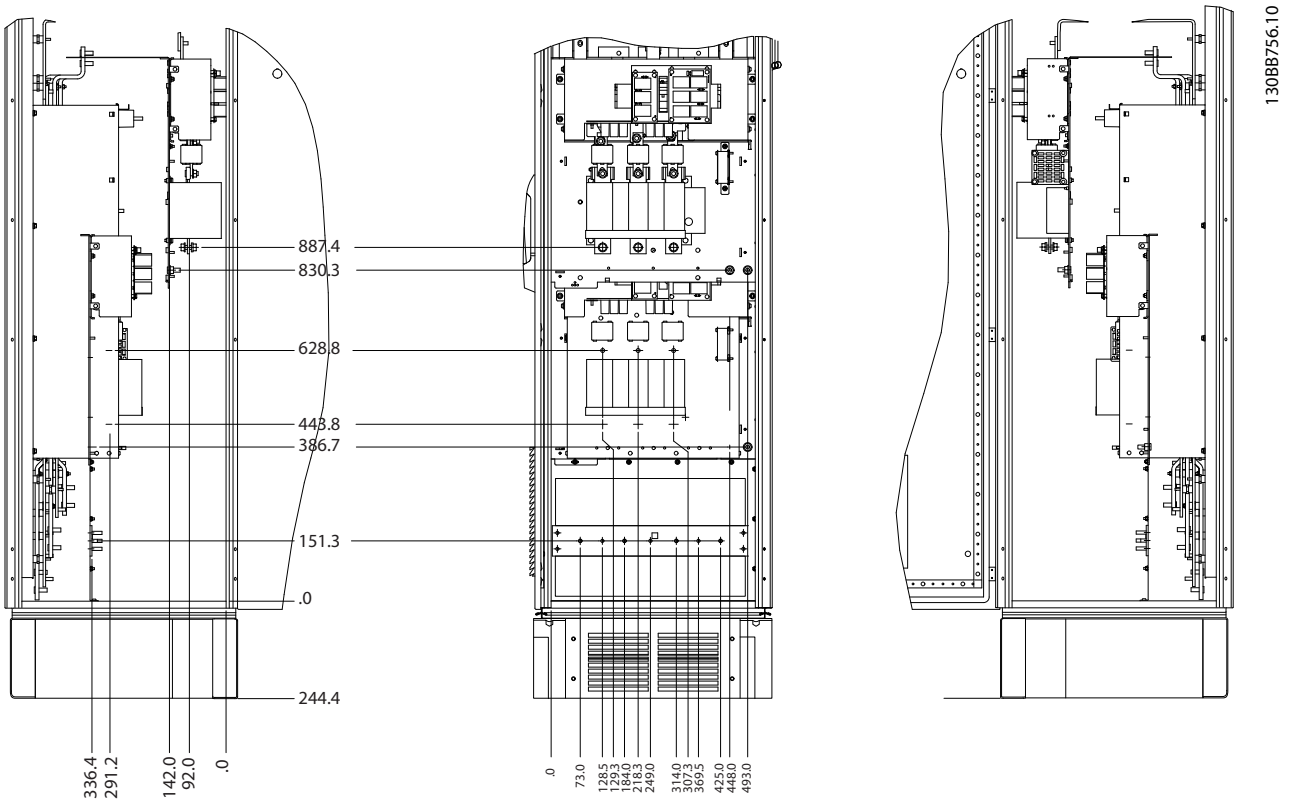


Figure 3.14 Terminal locations - Options cabinet (left side, front and right side view).

Terminal locations - Options Cabinet Frame Size F11/F13

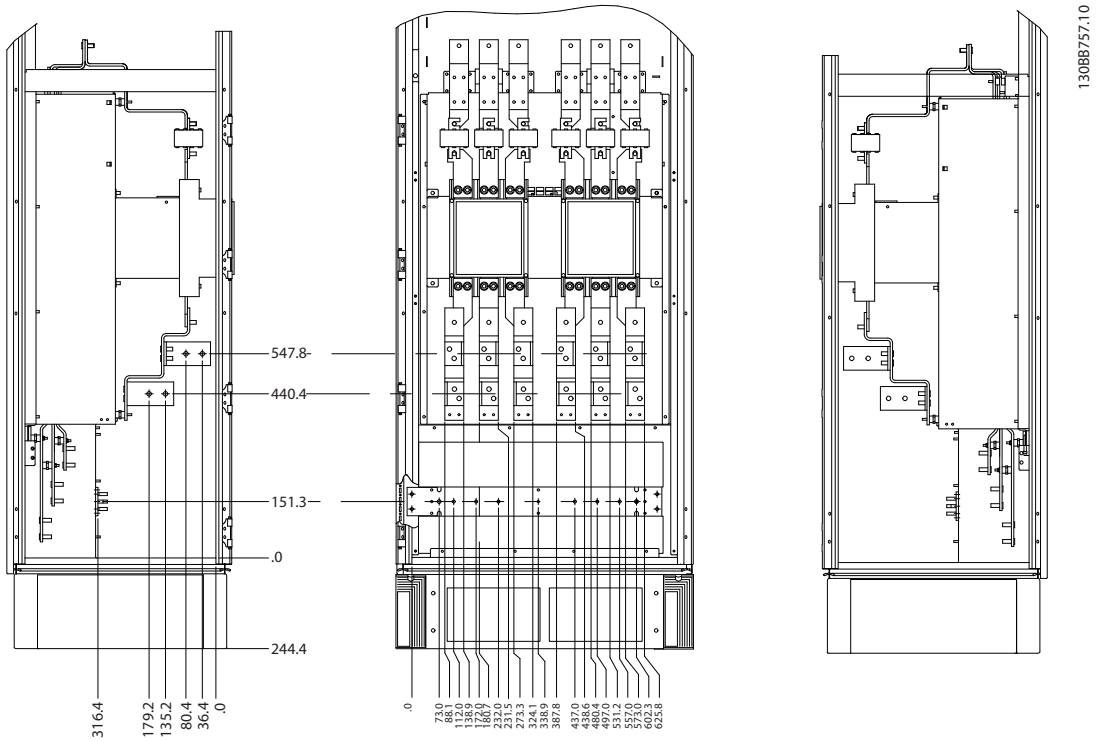


Figure 3.15 Terminal locations - Options cabinet (left side, front and right side view).

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 drive types in Rittal TS8 Units utilizing the fan of the adjustable frequency drive for forced air cooling of the backchannel. Please consult GE for more details.
The air out the top of the Unit 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 Unit. 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.

Unit Size 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. Unit Sizes 5X contain multiple fans.*

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.

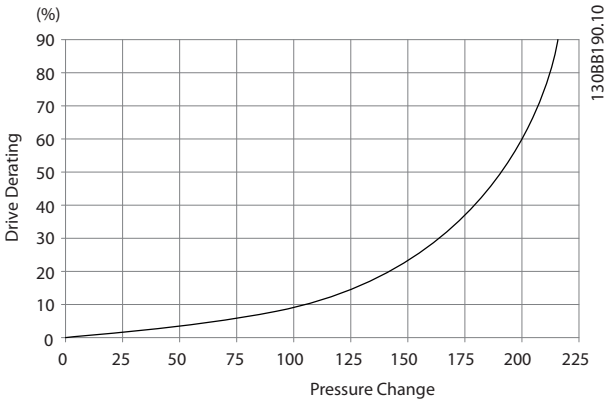


Figure 3.16 Unit Size 61, 62, 63 and 64 Derating vs. Pressure Change
Drive air flow: 985 m^3/h (580 cfm)

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

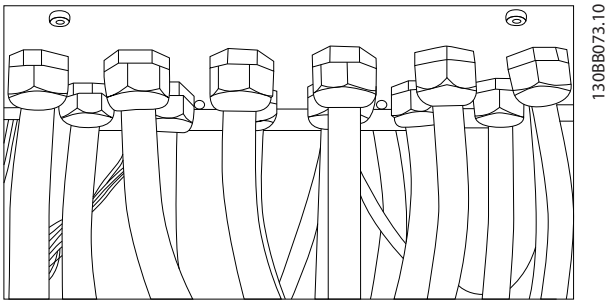
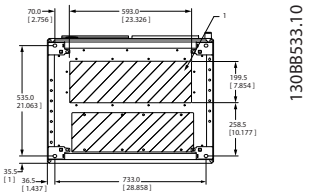
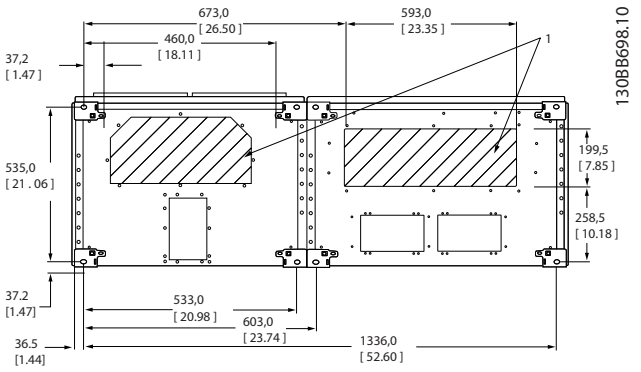


Figure 3.17 Example of proper installation of the connector plate.

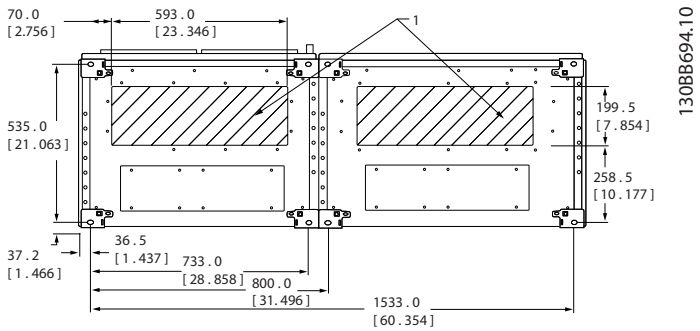
Unit Size 61



Unit Size 62

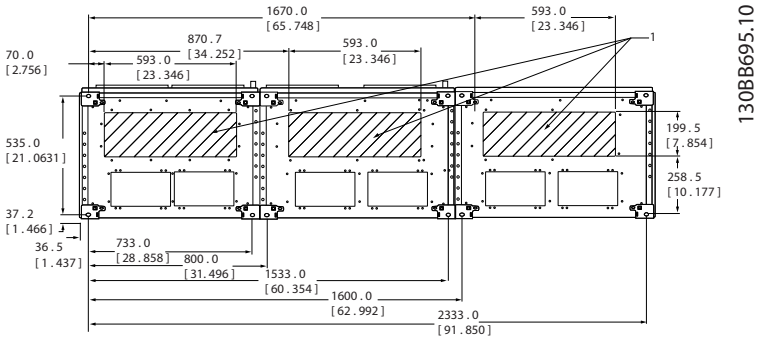


Unit Size 63

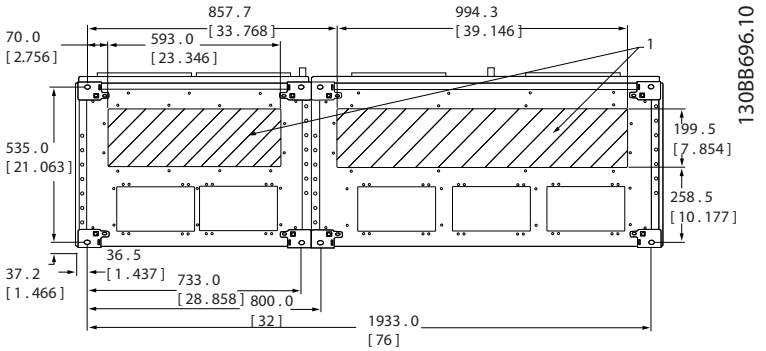


3

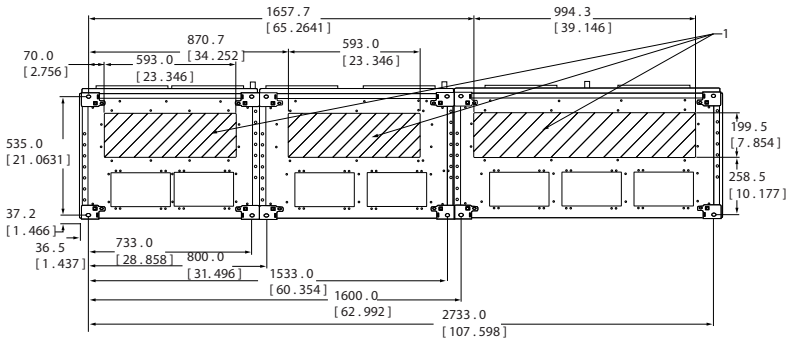
Unit Size 64



Unit Size 64



Unit Size 64



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

3.3 Frame size F Panel Options

4 How to Install

4.1 Electrical Installation

4.1.1 Power Connections

4

Cabling and Fusing

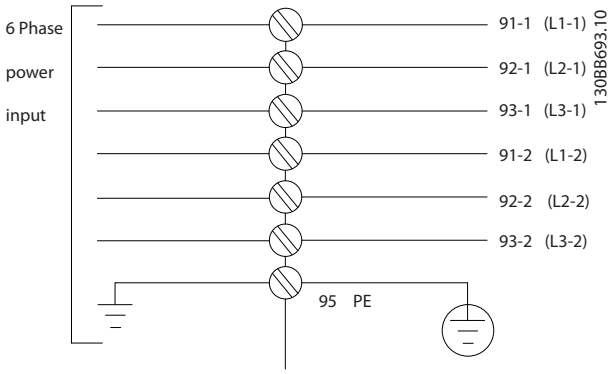
NOTE!

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 please see fuse in the tables of the fuse section. Always ensure that proper fusing is done according to local regulations.



NOTE!

Use a shielded/armored motor cable to comply with EMC emission specifications. For more information, see *EMC specifications* in the /FC 300*Design Guide*.

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

4

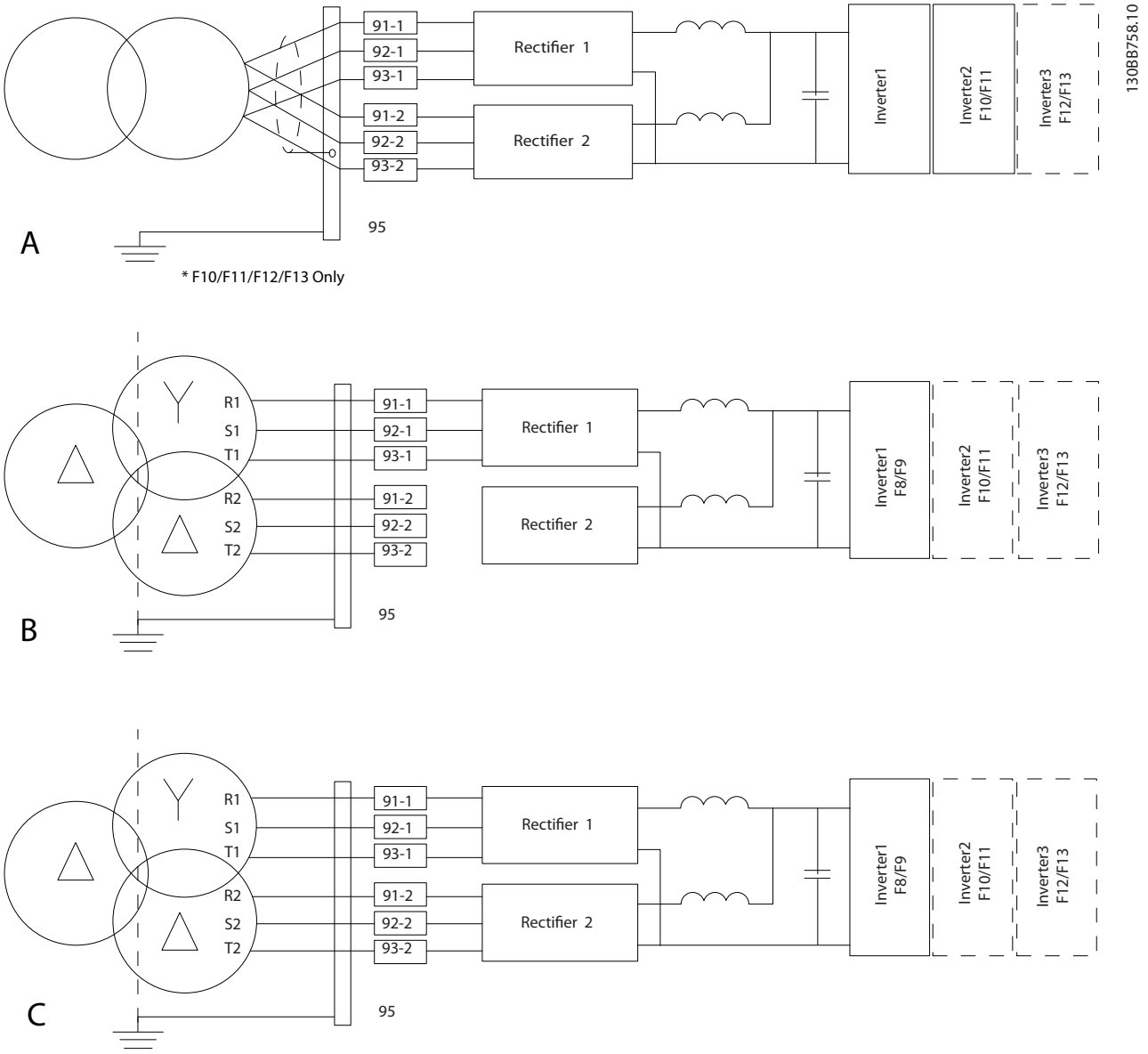


Figure 4.1

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.

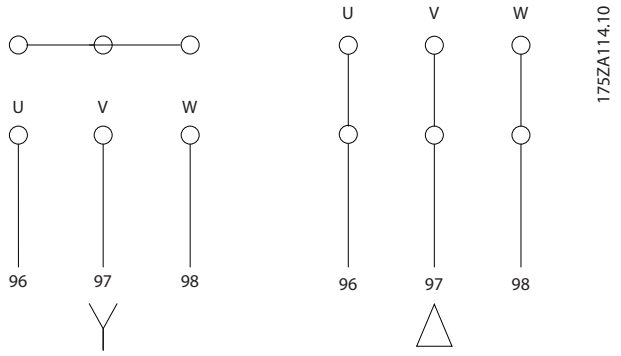
Cable-length and cross-section:
The adjustable frequency drive has been EMC tested with a given length of cable. Keep the motor cable as short as possible to reduce the noise level and leakage currents.

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



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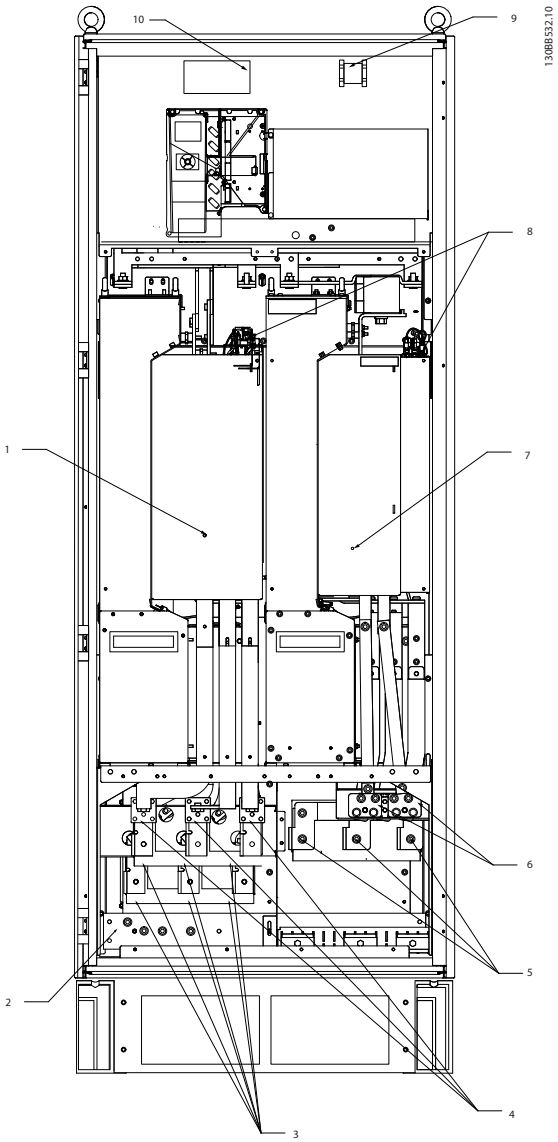


Figure 4.2 Rectifier and Inverter Cabinet, unit sizes 61, 62, 63 and 64.

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

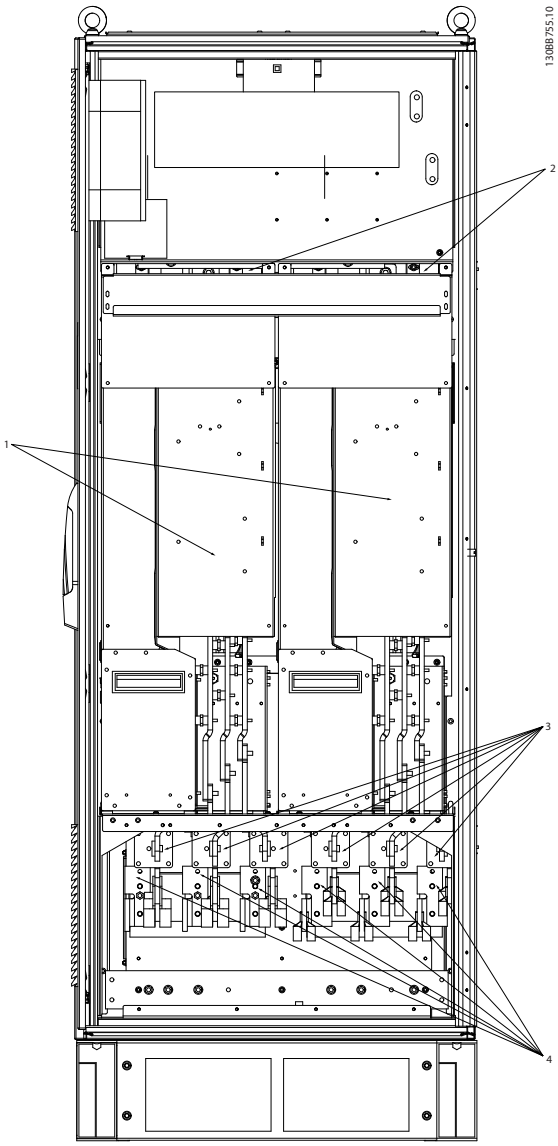


Figure 4.3 Rectifier Cabinet, unit sizes 61, 62, 63 and 64.

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-					

4

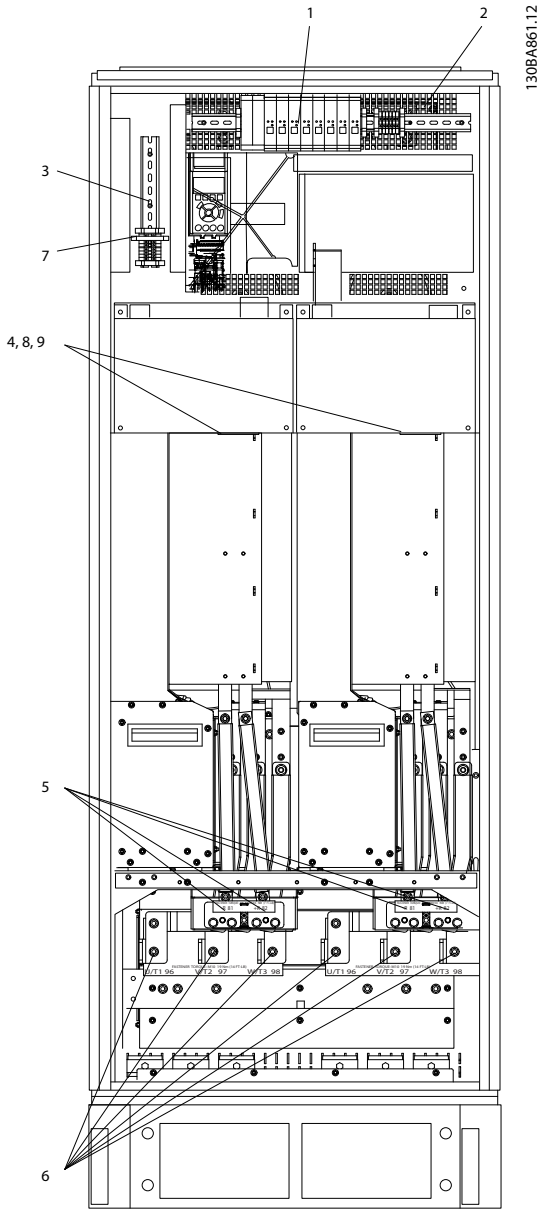


Figure 4.4 Inverter Cabinet, unit sizes 61 and 63.

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		

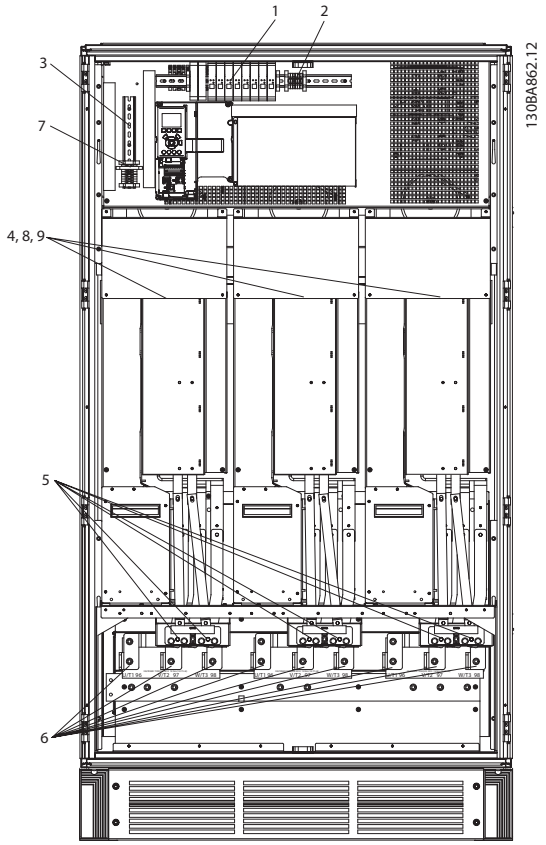


Figure 4.5 Inverter Cabinet, unit sizes 62 and 64

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

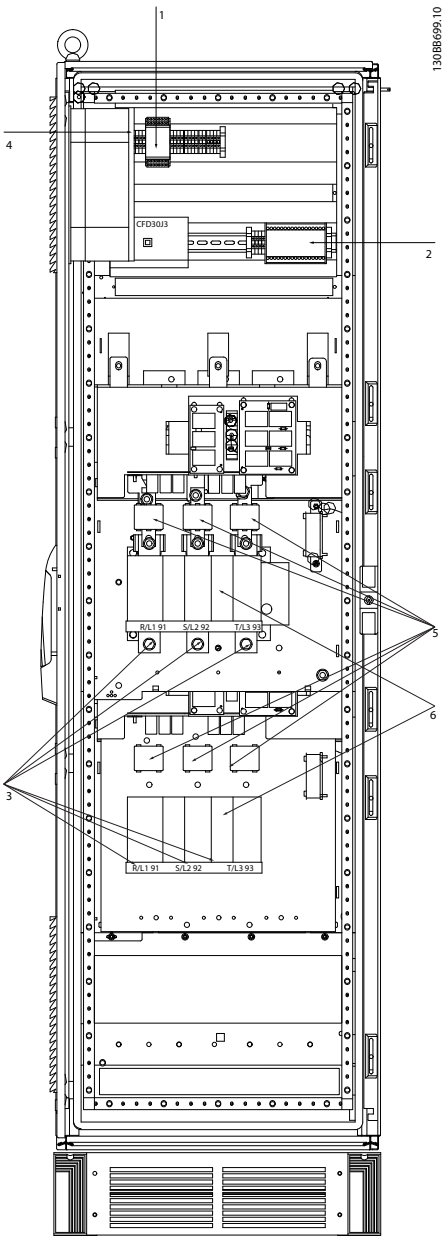


Figure 4.6 Options Cabinet, frame size F9

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 Drives with Factory-installed A1/B1 RFI Filter Option:

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) 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].
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).
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.

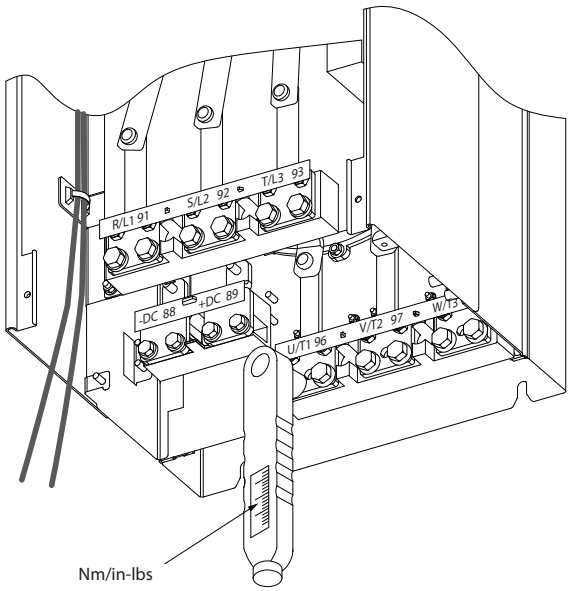


Figure 4.7 Always use a torque wrench to tighten the bolts.

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.

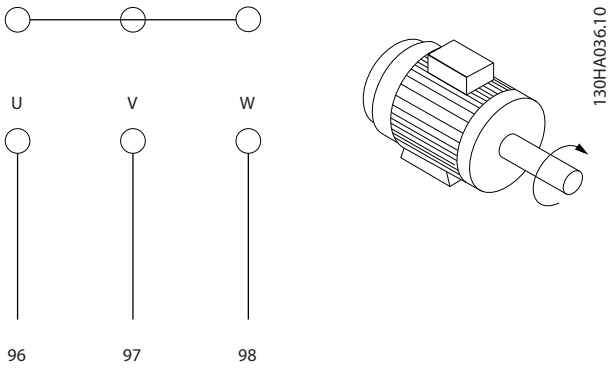
4

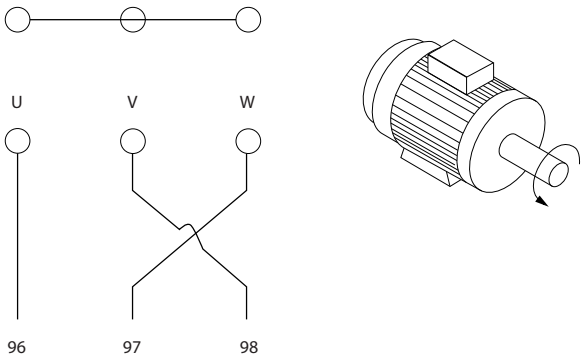
4.1.7 Motor Cable

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* and reversing.

Unit Size 6X Requirements

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.

Unit Size 61/63 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.

Unit Size 62 and 64 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.

4.1.8 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 factory-installed A1/B1 RFI Filter option..

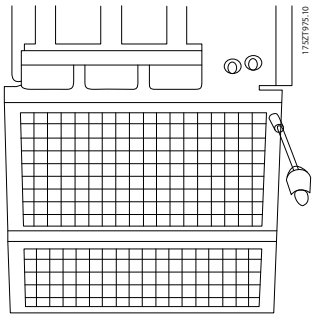


Figure 4.8 Mount the EMC shield.

4.1.9 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 4.1*). 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.

4.1.10 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

4.1.11 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. 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 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 4.1 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 4.2 Line Fuses, 525–690V

AF-650 GP	Bussmann PN*	Rating	Siba
600 HP	170M8611	1100 A, 1000 V	20 781 32.1000
650 HP	170M8611	1100 A, 1000 V	20 781 32.1000
750 HP	170M6467	1400 A, 700 V	20 681 32.1400
900 HP	170M6467	1400 A, 700 V	20 681 32.1400
1000 HP	170M8611	1100 A, 1000 V	20 781 32.1000
1200 HP	170M6467	1400 A, 700 V	20 681 32.1400

Table 4.3 Inverter Module DC Link Fuses, 380–480V

AF-650 GP	Bussmann PN*	Rating	Siba
900 HP	170M8611	1100 A, 1000 V	20 781 32. 1000
1000 HP	170M8611	1100 A, 1000 V	20 781 32. 1000
1200 HP	170M8611	1100 A, 1000 V	20 781 32. 1000
1250 HP	170M8611	1100 A, 1000 V	20 781 32. 1000
1350 HP	170M8611	1100 A, 1000 V	20 781 32. 1000
	170M8611	1100A, 1000V	20 781 32.1000

Table 4.4 525–690V

**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	, 380– V	LPJ-6 SP or SPI	6 A, 600 V	Any listed Class J Dual Element, Time Delay, 6 A
	750–1350 HP, 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	600–1200HP, 380–480 V	LPJ-10 SP or SPI	10 A, 600 V	Any listed Class J Dual Element, Time Delay, 10 A
	750–1350 HP, 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	600–1200HP, 380–480 V	LPJ-15 SP or SPI	15 A, 600 V	Any listed Class J Dual Element, Time Delay, 15 A
	750–1350 HP, 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	600–1200HP, 380–480 V	LPJ-25 SP or SPI	25 A, 600 V	Any listed Class J Dual Element, Time Delay, 25 A
	750–1350 HP, 525–690 V	LPJ-20 SP or SPI	20 A, 600 V	Any listed Class J Dual Element, Time Delay, 20 A

Table 4.5 Manual Motor Controller Fuses

Unit Sizes	Bussmann PN*	Rating
	KTK-4	4 A, 600V

Table 4.6 SMPS Fuse

Size/Type	Bussmann PN*	LittelFuse	Rating
400–1200HP, 380–480 V		KLK-15	15A, 600V
650–1350HP, 525–690 V		KLK-15	15A, 600V

Table 4.7 Fan Fuses

Unit Sizes	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 4.8 30 A Fuse Protected Terminal Fuse

Unit Sizes	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 4.9 Control Transformer Fuse

Unit Sizes	Bussmann PN*	Rating
F8-F13	GMC-800MA	800mA, 250V

Table 4.10 NAMUR Fuse

4.1.12 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

4.1.13 Motor Bearing Currents

All motors installed with 425 hp [315 kW] 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

4.1.14 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.

Field Installed Network Module options connection
Connections are made to the network options on the control card. For details, see the relevant network instructions. The cable must be placed in the provided path inside the adjustable frequency drive and tied down together with other control wires.

Installation of field-installed 24 volt external DC supply option module (OPC24VPS)
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 I/O or network 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.

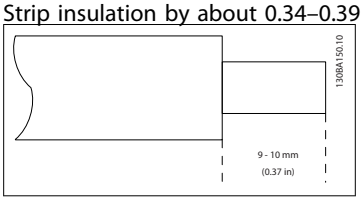
4.1.15 Access to Control Terminals

All terminals to the control cables are located beneath the LCP. They are accessed by opening the door of the Nema 1 / Nema 12 or removing the covers of the IP00 Open Chassis version.

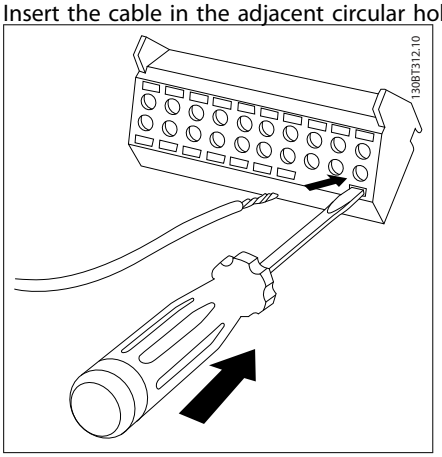
4.1.16 Electrical Installation, Control Terminals

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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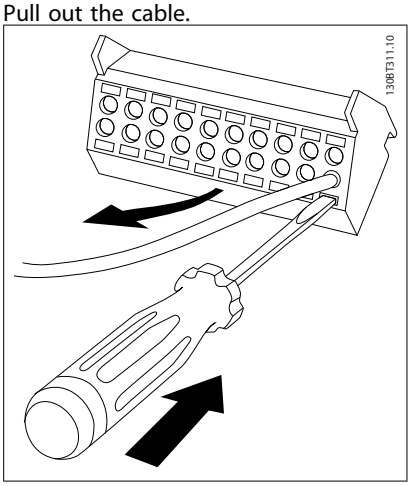
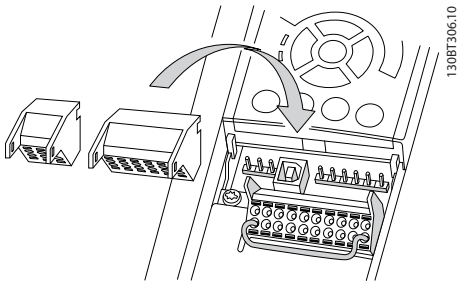
To remove the cable from the terminal:

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



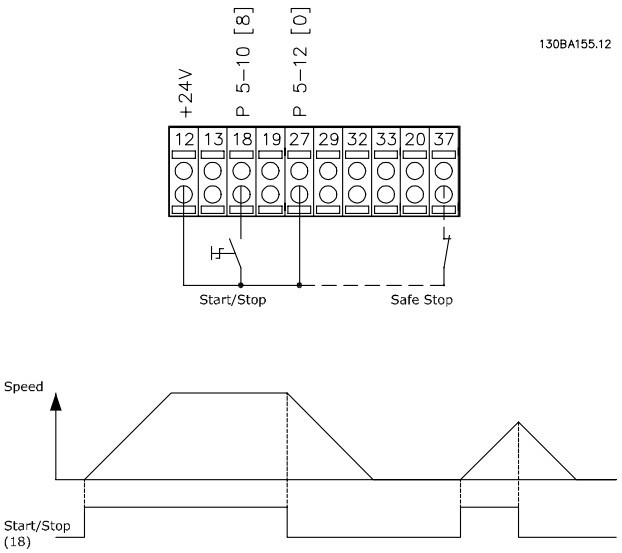
[1)] Max. 0.015 x 0.1 in [0.4 x 2.5 mm]



4.2 Connection Examples

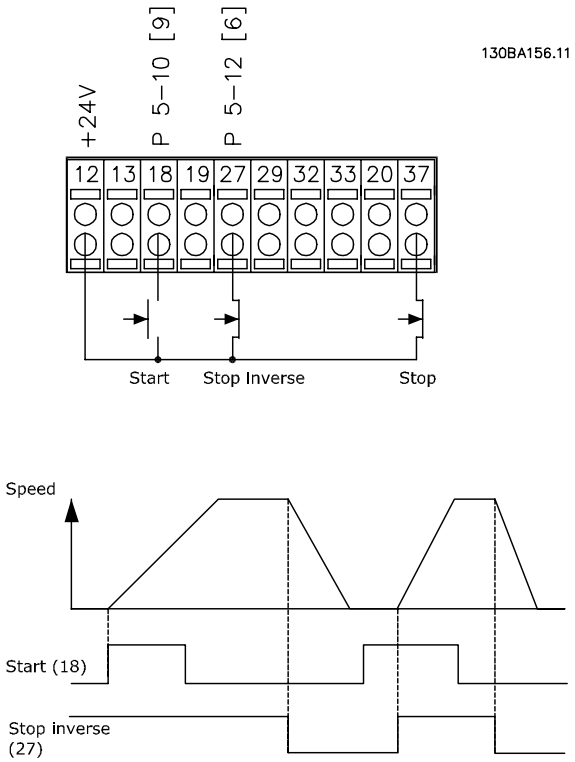
4.2.1 Start/Stop

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



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*



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4.2.3 Speed Up/Down

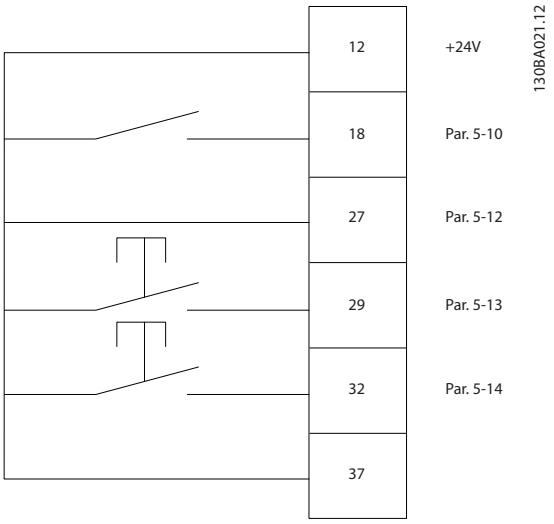
Terminals 29/32 = Speed up/down

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]



4.2.4 Potentiometer Reference

Voltage reference via a potentiometer

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

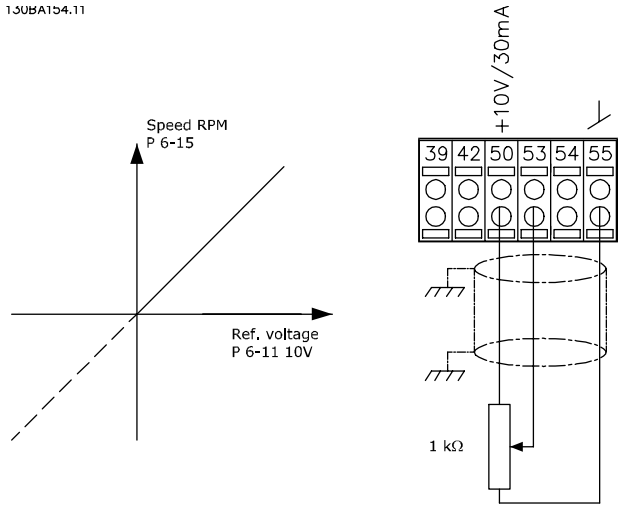
Terminal 53, Low Voltage = 0V

Terminal 53, High Voltage = 10V

Terminal 53, Low Ref./Feedback = 0 RPM

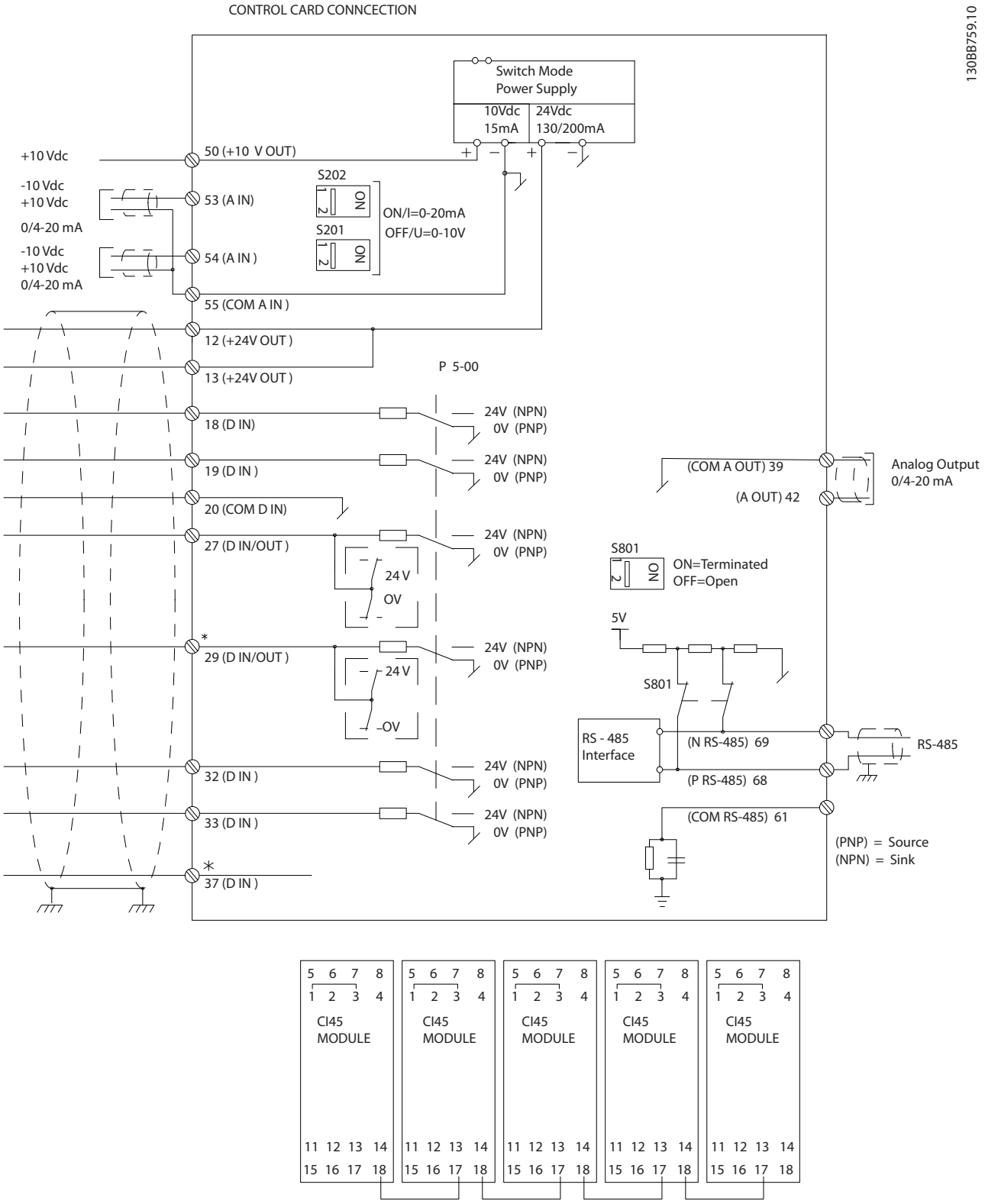
Terminal 53, High Ref./Feedback = 1500 RPM

Switch S201 = OFF (U)



4.3 Electrical Installation - additional

4.3.1 Electrical Installation, Control Cables



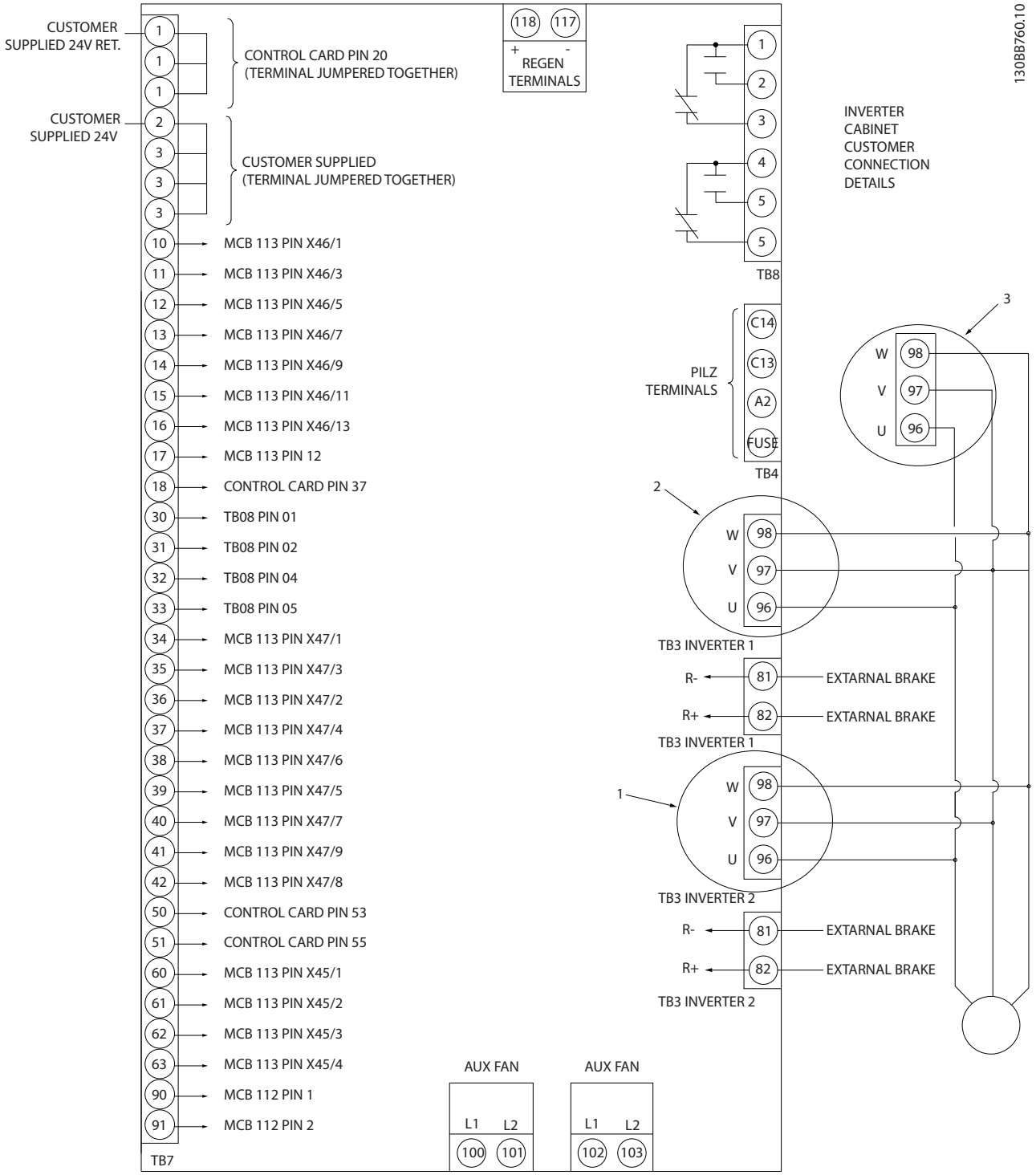


Figure 4.9 Diagram showing all electrical terminals without options

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

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

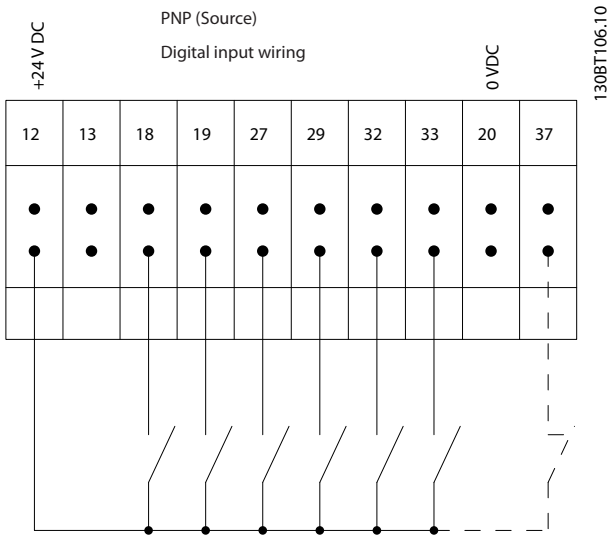
3) F12/F13 = (3) sets of terminals.

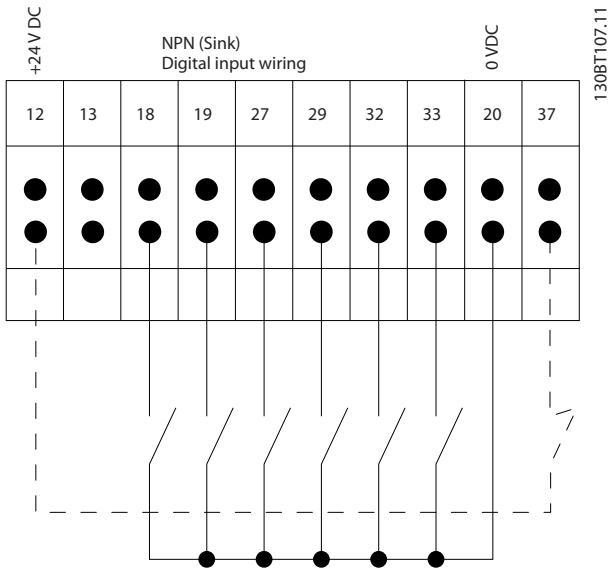
In rare cases, very long control cables and analog signals may, depending on installation, result in 50/60 Hz ground loops due to noise from line power supply cables.

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.

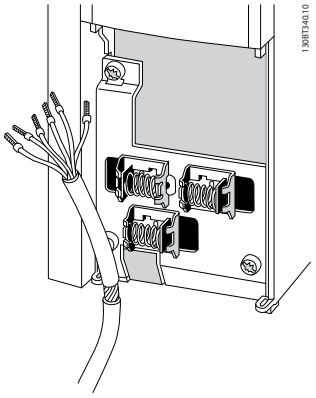
Input polarity of control terminals





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.

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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:

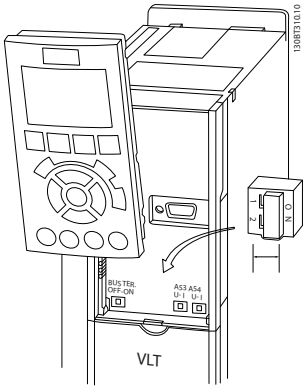
S201 (A53) = OFF (voltage input)

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.



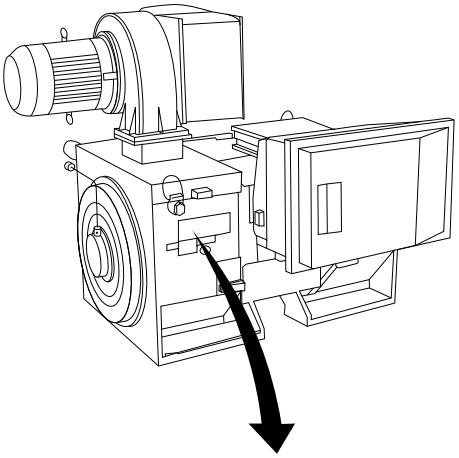
4.4 Final Set-up and Test

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 "Quick Set-up". Use the up and down arrow keys to navigate to the parameters associated with the motor nameplate values.

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 Auto-tune

Performing an auto tune will ensure optimum performance. The auto tune measures the values from the motor model equivalent diagram.

1. Activate the auto tune *1-29 Automatic Motor Adaptation (AMA)*.
2. Choose between complete or reduced auto-tune. If a sine-wave filter is mounted, run only the reduced auto-tune, or remove the sine-wave filter and run complete Auto-tune.
3. Press the [OK] key. The display shows “Press [Hand] to start”.
4. Press the [Hand] key. A progress bar indicates if the auto tune is in progress.

Stop the Auto Tune during operation

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

Successful Auto Tune

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

Unsuccessful Auto Tune

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 Auto Tune 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 auto-tune is often caused by incorrectly entering 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 accel/decel times.

3-02 Minimum Reference
3-03 Maximum Reference

Table 4.11 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 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 overload 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).

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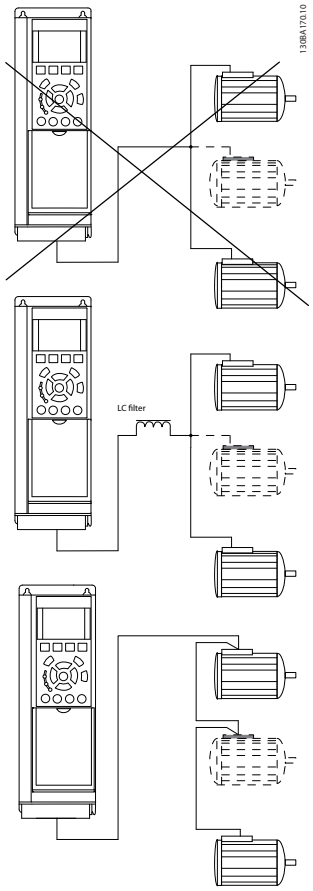


Problems may arise at start and at low RPM values if motor sizes are widely different because small motors' relatively high ohmic resistance in the stator calls for a higher voltage at start and at low RPM values.

5 How to operate the adjustable frequency drive

5.1.1 Ways of Operation

The adjustable frequency drive can be operated in 3 ways:

1. Graphical Local Control Panel (GLCP), see 6.1.2
2. Numeric Local Control Panel (NLCP), see 6.1.3
3. RS-485 serial communication or USB, both for PC connection, see 6.1.4

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

5.1.2 How to operate the Graphical LCP (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 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:

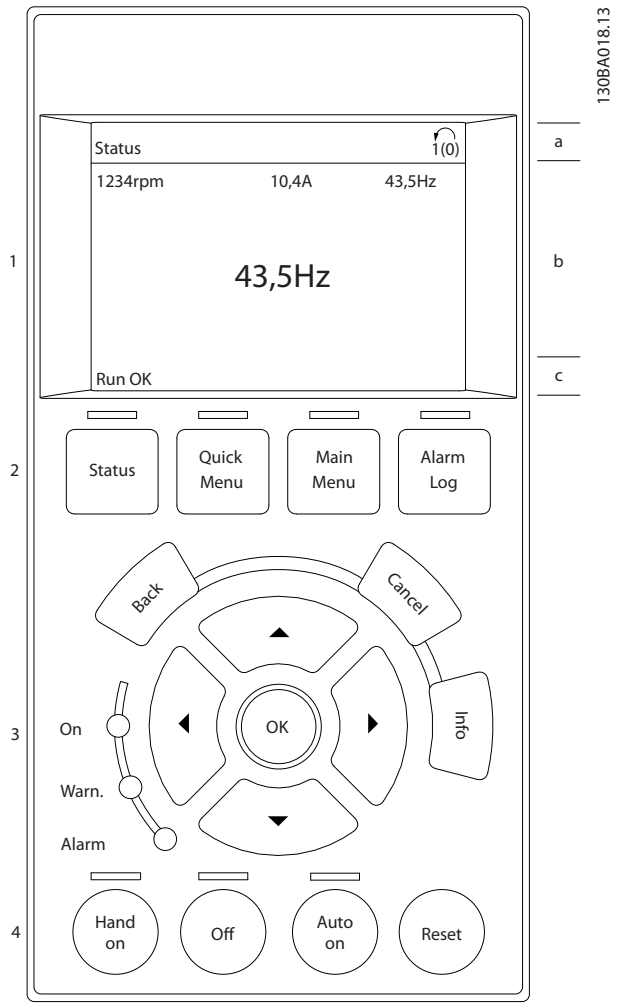
a. **Status line:** Status messages displaying icons and graphics.

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 3 sections:

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



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

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

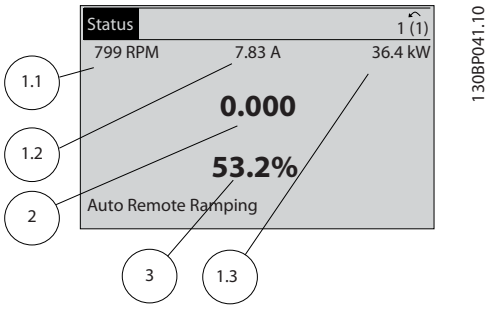
It is possible to toggle between three status read-out displays by pressing the [Status] key.
Operating variables with different formatting are shown in each status screen - see below.

5

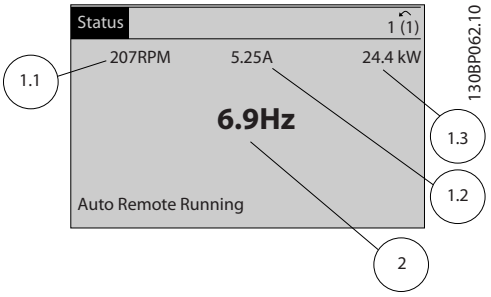
Several values or measurements can be linked to each of the displayed operating variables. The values/ measurements to be displayed can be defined via par. 0-20, 0-21, 0-22, 0-23, and 0-24, which can be accessed via [QUICK MENU], "Q3 Function Set-ups", "Q3-1 General Settings", "Q3-11 Display Settings".

Each value / measurement readout parameter selected in par. 0-20 to par. 0-24 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.

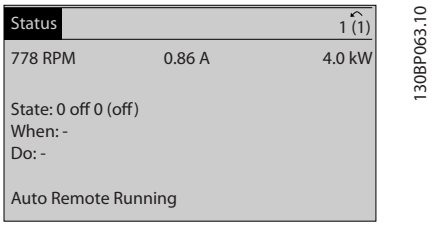
Status display I
This readout state is standard after start-up or initialization. Use [INFO] to obtain information about the value/ measurement linked to the displayed operating variables (1.1, 1.2, 1.3, 2, and 3).
See the operating variables shown in the display in this figure. 1.1, 1.2 and 1.3 are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



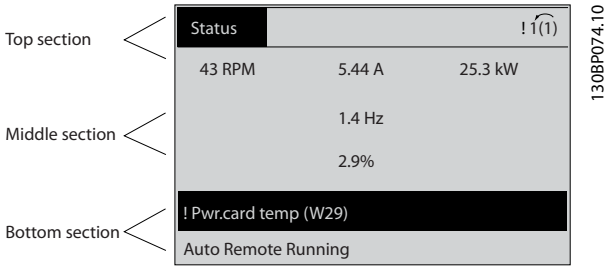
Status display II
See the operating variables (1.1, 1.2, 1.3, and 2) shown in the display in this figure.
In the example, Speed, Motor current, Motor power and Frequency are selected as variables in the first and second lines.
1.1, 1.2 and 1.3 are shown in small size. 2 is shown in large size.



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



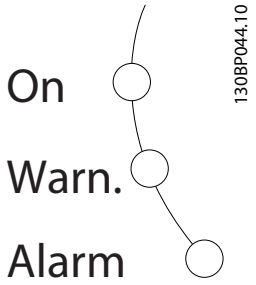
Bottom section
always shows the state of the adjustable frequency drive in status mode.



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 functions can be programmed here.**

The [Quick Menu] consists of:

- **Q1: My Personal Menu**
- **Q2: Quick Setup**
- **Q3: Function Setups**
- **Q5: Changes Made**
- **Q6: Loggings**

The Function set-up provides quick and easy access to all parameters required for the majority of water and wastewater applications including variable torque, constant torque, pumps, dosing pumps, well pumps, booster pumps, mixer pumps, aeration blowers and other pump and fan 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 water and wastewater applications.

The Quick Menu parameters can be accessed immediately unless a password has been created via par. 0-60, 0-61, 0-65 or 0-66.

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 par. 0-60, 0-61, 0-65 or 0-66. For the majority of water and wastewater applications it is not necessary to access the main menu parameters, but instead the quick menu, quick set-up and function set-ups provide the simplest and quickest access to the typical required parameters.

It is possible to switch directly between Main Menu mode and Quick Menu mode.

Parameter shortcut can be carried out by pressing down the [Main Menu] key for 3 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 navigate to the alarm number and press [OK]. Information is displayed about the condition of the adjustable frequency drive before it enters alarm mode.

[Back]

reverts to the previous step or layer in the navigation structure.

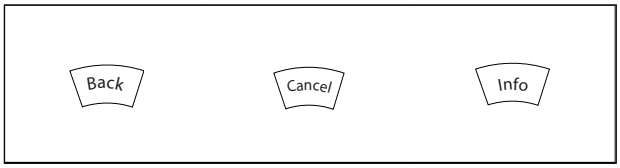
[Cancel]

the last change or command will be canceled 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].

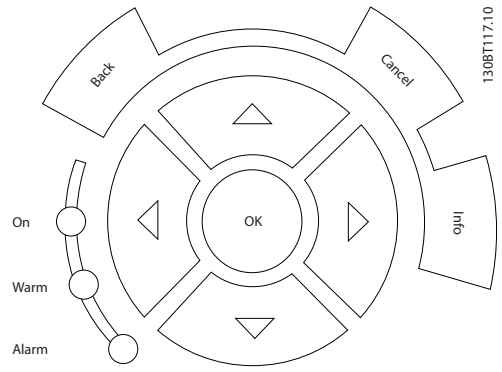


Navigation keys

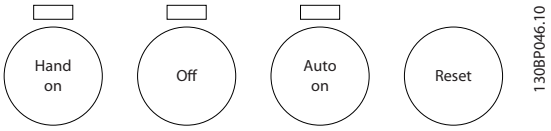
The four navigation arrows are used to navigate between the different choices available in **[Quick Menu]**, **[Main Menu]** and **[Alarm Log]**. Use the keys to move the cursor.

[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 makes it possible to give the motor speed reference using the arrow keys. The key can be *Enabled* [1] or *Disabled* [0] via par. *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 (motor coasting to stop)
- Reversing
- Set-up select lsb - Set-up select msb
- Stop command from serial communication
- Quick stop
- DC brake

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 *Enabled* [1] or *Disabled* [0] via par. *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 *Enabled* [1] or *Disabled* [0] via par. *0-42 [Auto on] key on LCP*.

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). The key can be *Enabled* [1] or *Disabled* [0] via par. 0-43 *Reset Keys 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 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 left or right arrow 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.

5.1.4 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].

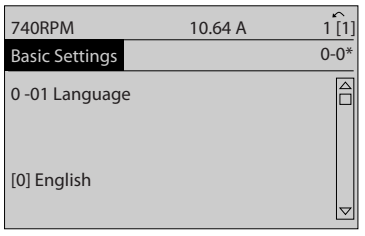


Figure 5.1 Display example.

Choose a parameter group from the main menu and press [OK]. Then further select the parameter sub-groups by using the up and down arrows and then press [OK].
The middle section of the keypad display shows the parameters. Press [OK] to select the parameters; the display now shows the selected parameter's value.

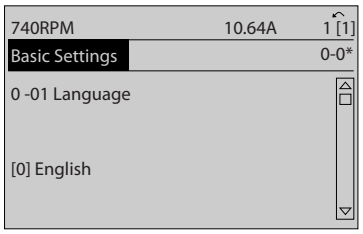


Figure 5.2 Display example.

5.1.5 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.

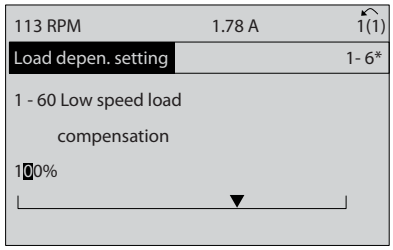


Figure 5.3 Display example.

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].

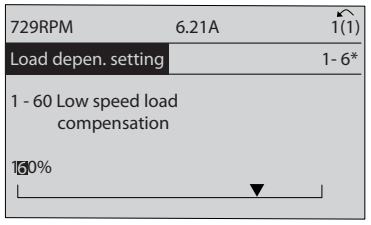


Figure 5.4 Display example.

5.1.6 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.

5.1.7 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.

5

5.1.8 Tips and tricks

*	For the majority of water and wastewater applications, the Quick Menu, Quick Set-up and Function Set-ups provide the simplest and quickest access to all of 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 the 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 par 0-50 for further information.

Table 5.1 Tips and Tricks

5.1.9 Quick Transfer of Parameter Settings When Using Keypad

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

⚠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 keypad indicated by the progress bar. When 100% is reached, press [OK].

The keypad 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 graphical keypad are now transferred to the adjustable frequency drive indicated by the progress bar. When 100% is reached, press [OK].

5.1.10 Restore Factory Settings

There are two ways to restore the drive to factory settings: Recommended restore and manual restore.
Please be aware that they have different impacts according to the below description.

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

1. Select *14-22 Operation Mode*
2. Press [OK]
3. Select [2] Restore Factory Settings
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 restores 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*

Manual restore

NOTE!

When carrying out manual restore, serial communication, RFI filter settings and fault log settings are reset.

.

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 keypad

3. Release the keys after 5 sec.

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

The Manual Restore restores all except:
15-00 Operating Hours
15-03 Power-ups
15-04 Over Temps
15-05 Over Volts

5.1.11 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.

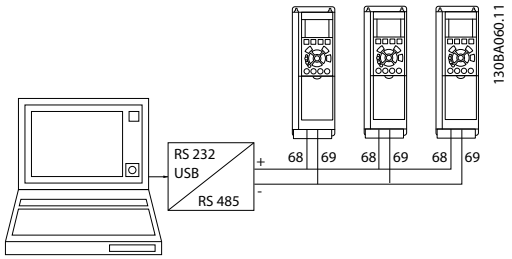


Figure 5.5 Connection example.

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*.

5.1.12 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 Drive Control Tool DCT 10.
The PC is connected via a standard (host/device) USB cable, or via the RS-485 interface as shown in the *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 as PC connection to the USB connector on the adjustable frequency drive.

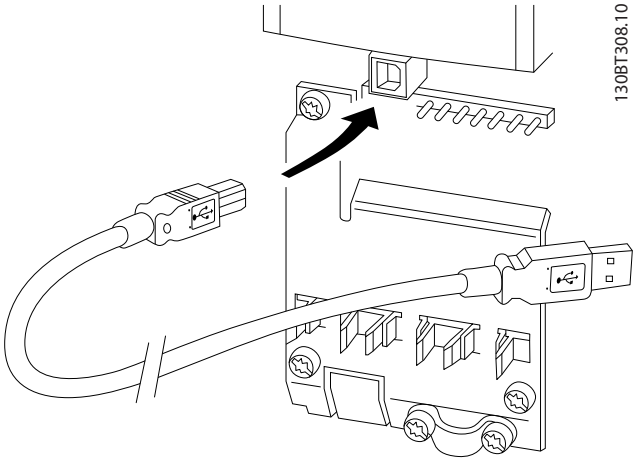


Figure 5.6 For control cable connections, see section on *Control Terminals*.

5.1.13 PC Software Tools

PC-based Drive Control Tool DCT 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 Drive Control Tool DCT 10. Please check the section on *Available Literature* for detailed information on this tool.

Drive Control Tool DCT 10
DCT 10 has been designed as an easy to use interactive tool for setting parameters in our adjustable frequency drives. .
The DCT 10 Drive Control Tool will be useful for:

- Planning a communication network off-line. DCT 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.

Drive Control Tool DCT 10 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 Drives Control Tool DCT 10 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 Drives Control Tool DCT 10 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 Drives Control Tool DCT 10 Software is available*from GE or the website: www.geelectrical.com/drives*.

The Drives Control Tool DCT 10 software modules
The following modules are included in the software package:

DCT 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
Logic Controller Set-up

Ordering number:
Please contact GE or visit: www.geelectrical.com/drives

6 How to program the adjustable frequency drive

6.1 How to program

6.1.1 Parameter set-up

Overview of parameter groups

Group	Title	Function
0-	Operation/Display	Parameters related to the fundamental functions of the adjustable frequency drive, function of the LCP buttons and configuration of the LCP display.
1-	Load / Motor	Parameter group for motor settings.
2-	Brakes	Parameter group for setting brake features in the adjustable frequency drive.
3-	Reference / Ramps	Parameters for reference handling, defining limitations, and configuring the reaction of the adjustable frequency drive to changes.
4-	Limits / Warnings	Parameter group for configuring limits and warnings.
5-	Digital In/Out	Parameter group for configuring the digital inputs and outputs.
6-	Analog In/Out	Parameter group for configuring the analog inputs and outputs.
8-	Communication and Options	Parameter group for configuring communications and options.
9-	Profibus	Parameter group for Profibus-specific parameters.
10-	DeviceNet Serial Communication Bus	Parameter group for DeviceNet-specific parameters.
13-	Smart Logic	Parameter group for Smart Logic Control
14-	Special Functions	Parameter group for configuring special adjustable frequency drive functions.
15-	Drive Information	Parameter group containing adjustable frequency drive information such as operating data, hardware configuration and software versions.
16-	Data Readouts	Parameter group for data readouts, such as current references, voltages, control, alarm, warning and status words.
18-	Info and Readouts	This parameter group contains the last 10 Preventive Maintenance logs.
20-	Drive Closed-loop	This parameter group is used for configuring the closed-loop PID controller that controls the output frequency of the unit.
21-	Extended Closed-loop	Parameters for configuring the three extended closed-loop PID controllers.
22-	Application Functions	These parameters monitor water applications.
23-	Time-based Functions	These parameters are for actions to be performed on a daily or weekly basis, such as different references for working hours/non-working hours.
25-	Basic Cascade Controller Functions	Parameters for configuring the Basic Cascade Controller for sequence control of multiple pumps.
26-	Analog I/0 Option MCB 109	Parameters for configuring the Analog I/0 Option MCB 109.
27-	Extended Cascade Control	Parameters for configuring the extended cascade control.
29-	Water Application Functions	Parameters for setting water specific functions.
31-	Bypass Option	Parameters for configuring the bypass option

Table 6.1 Parameter Groups

Parameter descriptions and selections are displayed on the Graphic LCP or Numeric LCP in the display area (See Section 5 for details.) Access the parameters by pressing the [Quick Menu] or [Main Menu] key on the control panel. The quick menu is used primarily for commissioning the unit at start-up by providing those 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 water applications but if other special functions are required, they must be programmed in parameter group 5 or 6.

6.1.2 Quick Menu Mode

The GLCP provides access to all parameters listed under the Quick Menus. To set parameters using the [Quick Menu] button:

Pressing [Quick Menu] the list indicates the different areas contained in the quick menu.

Efficient parameter set-up for water applications
The parameters can easily be set up for the vast majority of the water and wastewater applications only by using the **[Quick Menu]**.

The best way to set parameters using the [Quick Menu] is by following the steps below:

1. Press [Quick Setup] for selecting basic motor settings, ramp times, etc.
2. Press [Function Set-ups] for setting up the required functionality of the adjustable frequency drive - if not already covered by the settings in [Quick Setup].
3. Choose between *General Settings, Open-loop Settings* and *Closed-loop Settings*.

It is recommended to do the set-up in the order listed.

Figure 6.1 Quick Menu view.

Par.	Designation	[Units]
0-01	Language	
1-20	Motor Power	[kW]
1-22	Motor Voltage	[V]
1-23	Motor Frequency	[Hz]
1-24	Motor Current	[A]
1-25	Motor Nominal Speed	[RPM]
3-41	Ramp 1 Ramp-up Time	[s]
3-42	Ramp 1 Ramp-down Time	[s]
4-11	Motor Speed Low Limit	[RPM]
4-13	Motor Speed High Limit	[RPM]
1-29	Automatic Motor Adaptation (AMA)	

Table 6.2 Quick Setup parameters. Please see section *Commonly Used Parameters - Explanations*

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

For detailed parameter descriptions, please see the following section on *Commonly Used Parameters - Explanations*.

6.1.3 Q1 My Personal Menu

Parameters defined by the user can be stored in Q1 My Personal Menu.

Select *My Personal Menu* to display only the parameters, which have been pre-selected and programmed as personal parameters. For example, a pump or equipment OEM may have pre-programmed these to be in My Personal Menu during factory commissioning to make on-site commissioning / fine tuning simpler. These parameters are selected in par. 0-25 *My Personal Menu*. Up to 20 different parameters can be defined in this menu.

Q1 My Personal Menu
20-21 Setpoint 1
20-93 PID Proportional Gain
20-94 PID Integral Time

6.1.4 Q2 Quick Set-up

The parameters in Q2 Quick Set-up are the basic parameters which are always needed to set up the adjustable frequency drive for operation.

Q2 Quick Set-up	
Parameter number and name	**Unit**
0-01 Language	
1-20 Motor Power	kW
1-22 Motor Voltage	V
1-23 Motor Frequency	Hz
1-24 Motor Current	A
1-25 Motor Nominal Speed	RPM
3-41 Ramp 1 Ramp-up Time	s
3-42 Ramp 1 Ramp-down Time	s
4-11 Motor Speed Low Limit	RPM
4-13 Motor Speed High Limit	RPM
1-29 Automatic Motor Adaptation (AMA)	

6.1.5 Q3 Function Setups

The Function Setup provides quick and easy access to all parameters required for the majority of water and wastewater applications including variable torque, constant torque, pumps, dosing pumps, well pumps, booster pumps, mixer pumps, aeration blowers and other pump and fan 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 water and wastewater applications.

How to access Function Setups - example:

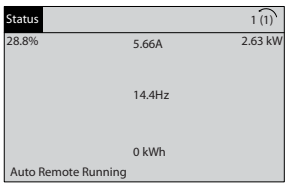


Figure 6.2 Step 1: Turn on the adjustable frequency drive (on LED lights).

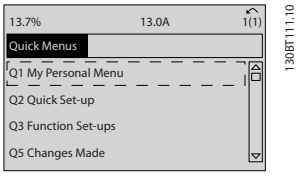


Figure 6.3 Step 2: Press the [Quick Menus] button (Quick Menus choices appear).

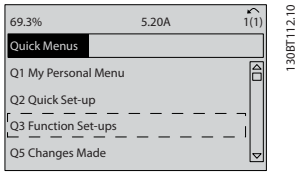


Figure 6.4 Step 3: Use the up/down navigation keys to scroll down to Function Setups. Press [OK].

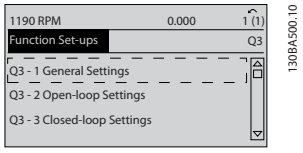


Figure 6.5 Step 4: Function Setups choices appear. Choose 03-1 *General Settings*. Press [OK].

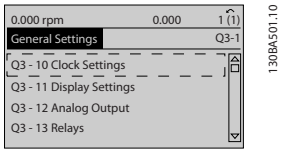


Figure 6.6 Step 5: Use the up/down navigation keys to scroll down to, e.g., 03-12 *Analog Outputs*. Press [OK].

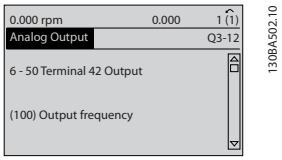


Figure 6.7 Step 6: Choose parameter 6-50 *Terminal 42 Output*. Press [OK].

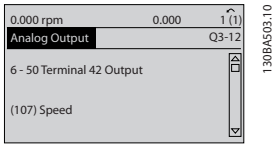


Figure 6.8 Step 7: Use the up/down navigation keys to select between the different choices. Press [OK].

The Function Setup parameters are grouped in the following way:

Q3-1 General Settings			
Q3-10 Clock Settings	**Q3-11 Display Settings**	**Q3-12 Analog Output**	**Q3-13 Relays**
0-70 Set Date and Time	0-20 Display Line 1.1 Small	6-50 Terminal 42 Output	Relay 1 ⇒ 5-40 Function Relay
0-71 Date Format	0-21 Display Line 1.2 Small	6-51 Terminal 42 Output Min Scale	Relay 2 ⇒ 5-40 Function Relay
0-72 Time Format	0-22 Display Line 1.3 Small	6-52 Terminal 42 Output Max Scale	Option relay 7 ⇒ 5-40 Function Relay
0-74 DST/Summertime	0-23 Display Line 2 Large		Option relay 8 ⇒ 5-40 Function Relay
0-76 DST/Summertime Start	0-24 Display Line 3 Large		Option relay 9 ⇒ 5-40 Function Relay
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	6-14 Terminal 53 Low Ref/Feedb. Value
5-15 Terminal 33 Digital Input	6-15 Terminal 53 High Ref/Feedb. Value

Q3-3 Closed-loop Settings	
Q3-30 Feedback Settings	**Q3-31 PID Settings**
1-00 Configuration Mode	20-81 PID Normal/Inverse Control
20-12 Reference/Feedb.Unit	20-82 PID Start Speed [RPM]
3-02 Minimum Reference	20-21 Setpoint 1
3-03 Maximum Reference	20-93 PID Proportional Gain
6-20 Terminal 54 Low Voltage	20-94 PID Integral Time
6-21 Terminal 54 High Voltage	
6-24 Terminal 54 Low Ref/Feedb Value	
6-25 Terminal 54 High Ref/Feedb Value	
6-00 Live Zero Timeout Time	
6-01 Live Zero Timeout Function	

6.1.6 Q5 Changes Made

Q5 Changes Made can be used for fault finding.

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 par. 0-20 and par. 0-24 can be viewed. It is possible to store up to 120 samples in the memory for later reference.

Please notice that the parameters listed in the below tables for Q5 only serve as examples since they will vary depending on the programming of the particular adjustable frequency drive.

Q5-1 Last 10 Changes
20-94 PID Integral Time
20-93 PID Proportional Gain

Q5-2 Since Factory Setting
20-93 PID Proportional Gain
20-94 PID Integral Time

Q5-3 Input Assignments
Analog Input 53
Analog Input 54

6.1.7 Q6 Loggings

Q6 Loggings can be used for fault finding.

Please notice that the parameters listed in the table for Q6 below only serve as examples since they will vary depending on the programming of the particular adjustable frequency drive.

Q6 Loggings
Reference
Analog Input 53
Motor Current
Frequency
Feedback
Energy Log
Trending Cont Bin
Trending Timed Bin
Trending Comparison

6.1.8 Main Menu Mode

The keypad provides 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 LCP.
Lines 2 through 5 on the display show a list of parameter groups which can be chosen by toggling the up and down buttons.

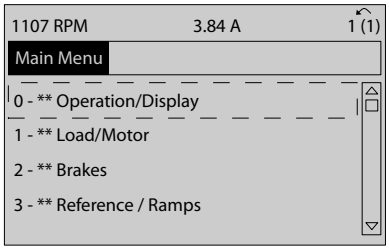


Figure 6.9 Display example.

Each parameter has character(s) and number which remain the same regardless of the programming mode. In main menu mode, the parameters are further divided into groups: Macros, Keypad Set-up, Parameter Data Set, Parameter Data Check, Drive Information, Data Readouts, Logs & I/O Option Status, and Advanced Parameter Data Set.

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.

6.1.9 Parameter Selection

Main Menu Item	Parameter Groups:
Keypad Set-Up	K-##
Parameter Data Set	F-##, E-##, C-##, P-##, H-##, AN-##, SP-##, O-##, AO-##, DN-##, PB-##, LN-##, BN-##
Drive Information	ID-##
Data Readouts	DR-##
Logs & I/O Option Status	LG-##
Advanced Parameter Data Set	AP-##, FB-##, T-##, CL-##, XC-##, PC-##, LC-##, B-##

Table 6.3 Parameter Groups in Main Menu Items

Group no.	Parameter group:
K-##	Keypad Set-Up
F-##	Fundamental Parameters
E-##	Digital In/Out
C-##	Frequency Control Functions
P-##	Motor Data
H-##	High Perf Parameters
AN-##	Analog In/Out
SP-##	Special Functions
O-##	Options / Comms
AO-##	Analog I/O Option
DN-##	DeviceNet
PB-##	Profibus
LN-##	LonWorks
BN-##	BACnet
ID-##	Drive Information
DR-##	Data Readouts
LG-##	Logs & I/O Opt. Status
AP-##	HVAC Appl. Param.
FB-##	Fire/Bypass Operation
EN-##	EtherNet
T-##	Timed Functions
CL-##	PID Closed-loop
XC-##	Ext. PID Closed-loop
PC-##	Pump Controller
LC-##	Logic Controller
B-##	Braking Functions

Table 6.4 Parameter groups.

Choose a parameter group from the main menu and press [OK]. Then further select the parameter sub-groups by using the up and down arrows and then press [OK].
The middle section of the keypad display shows the parameters. Press [OK] to select the parameters; the display now shows the selected parameter's value.

6.2 Commonly Used Parameters - Explanations

6.2.1 Main Menu

The main menu includes all available parameters in the VLT® AQUA Drive FC 200 adjustable frequency drive.
All parameters are grouped logically with a group name indicating the function of the parameter group.
All parameters are listed by name and number in the section *Parameter Options* in this Instruction Manual.

All parameters included in the quick menus (Q1, Q2, Q3, Q5 and Q6) can be found in the following.

Some of the most commonly used parameters for VLT® AQUA Drive applications are also explained in the following section.

For a detailed explanation of all parameters, please refer to the VLT® AQUA Drive Programming Guide MG.20.OX.YY which is available at www.danfoss.com or by ordering it from the local Danfoss office.

Parameters related to the fundamental functions of the , function of the LCP buttons and configuration of the LCP display.

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]	German	Part of Language packages 1 - 4
[2]	French	Part of Language package 1
[3]	Danish	Part of Language package 1
[4]	Spanish	Part of Language package 1
[5]	Italian	Part of Language package 1
[6]	Swedish	Part of Language package 1
[7]	Dutch	Part of Language package 1
[10]	Chinese	Language package 2
[20]	Finnish	Part of Language package 1
[22]	English US	Part of Language package 4
[27]	Greek	Part of Language package 4
[28]	Portuguese	Part of Language package 4
[36]	Slovenian	Part of Language package 3
[39]	Korean	Part of Language package 2
[40]	Japanese	Part of Language package 2
[41]	Turkish	Part of Language package 4
[42]	Traditional Chinese	Part of Language package 2
[43]	Bulgarian	Part of Language package 3
[44]	Serbian	Part of Language package 3
[45]	Romanian	Part of Language package 3
[46]	Hungarian	Part of Language package 3
[47]	Czech	Part of Language package 3
[48]	Polish	Part of Language package 4
[49]	Russian	Part of Language package 3
[50]	Thai	Part of Language package 2
[51]	Bahasa Indonesian	Part of Language package 2

0-20 Display Line 1.1 Small

Option:		Function:
		Select a variable for display in line 1, left position.
[0]	None	No display value selected
[953]	Profibus Warning Word	Displays Profibus communication warnings.

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0-20 Display Line 1.1 Small		
Option:		Function:
[1005]	Readout Transmit Error Counter	View the number of CAN control transmission errors since the last power-up.
[1006]	Readout Receive Error Counter	View the number of CAN control receipt errors since the last power-up.
[1007]	Readout Bus Off Counter	View the number of Bus Off events since the last power-up.
[1013]	Warning Parameter	View a DeviceNet-specific warning word. One separate bit is assigned to every warning.
[1230]		
[1472]		
[1473]		
[1474]		
[1501]	Running Hours	View the number of running hours of the motor.
[1502]	kWh Counter	View the line power consumption in kWh.
[1600]	Control Word	View the control word sent from the adjustable frequency drive via the serial communication port in hex code.
[1601] *	Reference [Unit]	Total reference (sum of digital/ analog/preset/bus/freeze ref./catch up and slow-down) in selected unit.
[1602]	Reference %	Total reference (sum of digital/ analog/preset/bus/freeze ref./catch up and slow-down) in percent.
[1603]	Status Word	Present status word
[1605]	Main Actual Value [%]	One or more warnings in a Hex code
[1609]	Custom Readout	View the user-defined readouts as defined in *0-30 Custom Readout Unit*, *0-31 Custom Readout Min Value* and *0-32 Custom Readout Max Value*.
[1610]	Power [kW]	Actual power consumed by the motor in kW.
[1611]	Power [hp]	Actual power consumed by the motor in HP.
[1612]	Motor voltage	Voltage supplied to the motor.
[1613]	Frequency	Motor frequency, i.e., the output frequency from the adjustable frequency drive in Hz.

0-20 Display Line 1.1 Small		
Option:		Function:
[1614]	Motor Current	Phase current of the motor measured as effective value.
[1615]	Frequency [%]	Motor frequency, i.e., the output frequency from the adjustable frequency drive in percent.
[1616]	Torque [Nm]	Present motor load as a percentage of the rated motor torque.
[1617] *	Speed [RPM]	Speed in RPM (revolutions per minute), i.e., the motor shaft speed in closed-loop based on the entered motor nameplate data, the output frequency and the load on the adjustable frequency drive.
[1618]	Motor Thermal	Thermal load on the motor, calculated by the ETR function. See also parameter group 1-9* Motor Temperature.
[1619]	KTY sensor temperature	
[1620]	Motor Angle	
[1622]	Torque [%]	Shows the actual torque produced, in percentage.
[1625]		
[1630]	DC Link Voltage	Intermediate circuit voltage in the adjustable frequency drive.
[1632]	Brake Energy /s	Present braking energy transferred to an external brake resistor. Stated as an instantaneous value.
[1633]	Brake Energy /2 min	Braking energy transferred to an external brake resistor. The mean power is calculated continuously for the most recent 120 seconds.
[1634]	Heatsink Temp.	Present heatsink temperature of the adjustable frequency drive. The cut-out limit is 203°F ±41°F [95°C ± 5°C]; cutting back in occurs at 158°F ±41°F [70°C ± 5°C].
[1635]	Inverter Thermal	Percentage load of the inverters
[1636]	Inv. Nom. Current	Nominal current of the adjustable frequency drive.
[1637]	Inv. Max. Current	Maximum current of the adjustable frequency drive.
[1638]	SL Controller State	State of the event executed by the control

0-20 Display Line 1.1 Small		
Option:		**Function:**
[1639]	Control Card Temp.	Temperature of the control card.
[1650]	External Reference	Sum of the external reference as a percentage, i.e., the sum of analog/pulse/bus.
[1651]	Pulse Reference	
[1652]	Feedback [Unit]	Signal value in units from the programmed digital input(s).
[1653]	Digi Pot Reference	View the contribution of the digital potentiometer to the actual reference Feedback.
[1660]	Digital Input	Displays the status of the digital inputs. Signal low = 0; Signal high = 1. Regarding order, see *16-60 Digital Input*. Bit 0 is at the extreme right.
[1661]	Terminal 53 Switch Setting	Setting of input terminal 53. Current = 0; Voltage = 1.
[1662]	Analog Input 53	Actual value at input 53 either as a reference or protection value.
[1663]	Terminal 54 Switch Setting	Setting of input terminal 54. Current = 0; Voltage = 1.
[1664]	Analog Input 54	Actual value at input 54 either as reference or protection value.
[1665]	Analog Output 42 [mA]	Actual value at output 42 in mA. Use *6-50 Terminal 42 Output* to select the variable to be represented by output 42.
[1666]	Digital Output [bin]	Binary value of all digital outputs.
[1667]	Freq. Input #29 [Hz]	Actual value of the frequency applied at terminal 29 as a pulse input.
[1668]	Freq. Input #33 [Hz]	Actual value of the frequency applied at terminal 33 as a pulse input.
[1669]	Pulse Output #27 [Hz]	Actual value of pulses applied to terminal 27 in digital output mode.
[1670]	Pulse Output #29 [Hz]	Actual value of pulses applied to terminal 29 in digital output mode.
[1671]	Relay Output [bin]	View the setting of all relays.
[1672]	Counter A	View the present value of Counter A.
[1673]	Counter B	View the present value of Counter B.

0-20 Display Line 1.1 Small		
Option:		**Function:**
[1674]	Prec. Stop Counter	
[1675]	Analog In X30/11	Actual value of the signal on input X30/11 (General Purpose I/O Card. Option)
[1676]	Analog In X30/12	Actual value of the signal on input X30/12 (General Purpose I/O Card. Optional)
[1677]	Analog Out X30/8 [mA]	Actual value at output X30/8 (General Purpose I/O Card. Optional) Use *6-60 Terminal X30/8 Output* to select the variable to be shown.
[1678]		
[1679]		
[1680]	Fieldbus CTW 1	Control word (CTW) received from the bus master.
[1682]	Fieldbus REF 1	Main reference value sent with control word via the serial communications network, e.g., from the BMS, PLC or other master controller.
[1684]	Comm. Option Status	Extended serial communication option status word.
[1685]	FC Port CTW 1	Control word (CTW) received from the bus master.
[1686]	FC Port REF 1	Status word (STW) sent to the bus master.
[1690]	Alarm Word	One or more alarms in a Hex code (used for serial communications)
[1691]	Alarm word 2	One or more alarms in a Hex code (used for serial communications)
[1692]	Warning Word	One or more warnings in a Hex code (used for serial communi-cations)
[1693]	Warning word 2	One or more warnings in a Hex code (used for serial communi-cations)
[1694]	Ext. Status Word	One or more status conditions in a Hex code (used for serial communications)
[3401]	PCD 1 Write to MCO	
[3402]	PCD 2 Write to MCO	
[3403]	PCD 3 Write to MCO	

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0-20 Display Line 1.1 Small		
Option:		Function:
[3404]	PCD 4 Write to MCO	
[3405]	PCD 5 Write to MCO	
[3406]	PCD 6 Write to MCO	
[3407]	PCD 7 Write to MCO	
[3408]	PCD 8 Write to MCO	
[3409]	PCD 9 Write to MCO	
[3410]	PCD 10 Write to MCO	
[3421]	PCD 1 Read from MCO	
[3422]	PCD 2 Read from MCO	
[3423]	PCD 3 Read from MCO	
[3424]	PCD 4 Read from MCO	
[3425]	PCD 5 Read from MCO	
[3426]	PCD 6 Read from MCO	
[3427]	PCD 7 Read from MCO	
[3428]	PCD 8 Read from MCO	
[3429]	PCD 9 Read from MCO	
[3430]	PCD 10 Read from MCO	
[3440]	Digital Inputs	
[3441]	Digital Outputs	
[3450]	Actual Position	
[3451]	Commanded Position	
[3452]	Actual Master Position	
[3453]	Slave Index Position	
[3454]	Master Index Position	
[3455]	Curve Position	
[3456]	Track Error	
[3457]	Synchronizing Error	
[3458]	Actual Velocity	
[3459]	Actual Master Velocity	

0-20 Display Line 1.1 Small		
Option:		Function:
[3460]	Synchronizing Status	
[3461]	Axis Status	
[3462]	Program Status	
[3470]	MCO Alarm Word 1	
[3471]	MCO Alarm Word 2	
[9913]		
[9914]		
[9920]		
[9921]		
[9922]		
[9923]		
[9924]		
[9925]		
[9926]		
[9927]		

0-21 Display Line 1.2 Small		
Option:		Function:
		Select a variable for display in line 1, middle position.
[1662] *	Analog input 53	The options are the same as those listed for par. 0-20 *Display Line 1.1 Small*.

0-22 Display Line 1.3 Small		
Option:		Function:
		Select a variable for display in line 1, right position.
[1614] *	Motor Current	The options are the same as those listed for *0-20 Display Line 1.1 Small*.

0-23 Display Line 2 Large		
Option:		Function:
		Select a variable for display in line 2.
[1615] *	Frequency	The options are the same as those listed for par. 0-20 *Display Line 1.1 Small*

0-24 Display Line 3 Large		
Option:		Function:
[1652] *	Feedback [Unit]	The options are the same as those listed for *0-20 Display Line 1.1 Small*.
		Select a variable for display in line 2.

0-37 Display Text 1		
Range:		**Function:**
0 N/A*	[0 - 0 N/A]	In this parameter, it is possible to write an individual text string for display in the LCP or to be read via serial communication. If it is to be displayed permanently, select Display Text 1 in *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* or *0-24 Display Line 3 Large*. Use the [▲] or [▼] buttons on the LCP to change a character. Use the [◄] and [►] buttons to move the cursor. When a character is highlighted by the cursor, it can be changed. Use the [▲] or [▼] buttons on the LCP to change a character. A character can be inserted by placing the cursor between two characters and pressing [▲] or [▼].

0-38 Display Text 2		
Range:		**Function:**
0 N/A*	[0 - 0 N/A]	In this parameter, it is possible to write an individual text string for display in the LCP or to be read via serial communication. If to be displayed permanently select Display Text 2 in *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* or *0-24 Display Line 3 Large*. Use the [▲] or [▼] buttons on the LCP to change a character. Use the [◄] and [►] buttons to move the cursor. When a character is highlighted by the cursor, this character can be changed. A character can be inserted by placing the cursor between two characters and pressing [▲] or [▼].

0-39 Display Text 3		
Range:		**Function:**
0 N/A*	[0 - 0 N/A]	In this parameter, it is possible to write an individual text string for display in the LCP or to be read via serial communication. If it is to be displayed permanently, select Display Text 3 in *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* or *0-24 Display Line 3 Large*. Use the [▲] or [▼] buttons on the LCP to change a character. Use the [◄] and [►] buttons to move the cursor. When a character is highlighted by the cursor, this character can be changed. A character can be inserted by placing the cursor between two characters and pressing [▲] or [▼].

0-70 Date and Time		
Range:		**Function:**
Size related*	[0–0]	

0-71 Date Format		
Option:		**Function:**
[0] *	YYYY-MM-DD	Sets the date format to be used in the LCP.
[1]	DD-MM-YYYY	Sets the date format to be used in the LCP.
[2]	MM/DD/YYYY	Sets the date format to be used in the LCP.

0-72 Time Format		
Option:		**Function:**
		Sets the time format to be used in the LCP.
[0] *	24 h	
[1]	12 h	

0-74 DST/Summertime		
Option:		**Function:**
		Choose how Daylight Saving Time/Summertime should be handled. For manual DST/Summertime enter the start date and end date in *0-76 DST/Summertime Start* and *0-77 DST/Summertime End*.
[0] *	OFF	
[2]	Manual	

0-76 DST/Summertime Start		
Range:		**Function:**
0 N/A*	[0 - 0 N/A]	Sets the date and time when summertime/DST starts. The date is programmed in the format selected in *0-71 Date Format*.

0-77 DST/Summertime End		
Range:		**Function:**
0 N/A*	[0 - 0 N/A]	

6.2.2 General Settings

Define whether the adjustable frequency drive operates in open-loop or closed-loop.

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 CL-## 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.

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

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.

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.

1-24 Motor Current		
Range:		Function:
		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.

1-29 Automatic Motor Adaptation (AMA)		
Option:		Function:
		The Auto Tune 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.
[0] *	Off	No function
[1]	Enable complete AMA	performs Auto Tune 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 Auto Tune 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 Auto Tune function by pressing [Hand] after selecting [1] or [2]. After a normal sequence, the display will read: “Press [OK] to finish Auto Tune”. After pressing the [OK] key, the adjustable frequency drive is ready for operation.

NOTE!

- For the best results of the adjustable frequency drive, run Auto Tune on a cold motor
- Auto Tune cannot be performed while the motor is running.

NOTE!

Avoid generating external torque during Auto Tune.

NOTE!

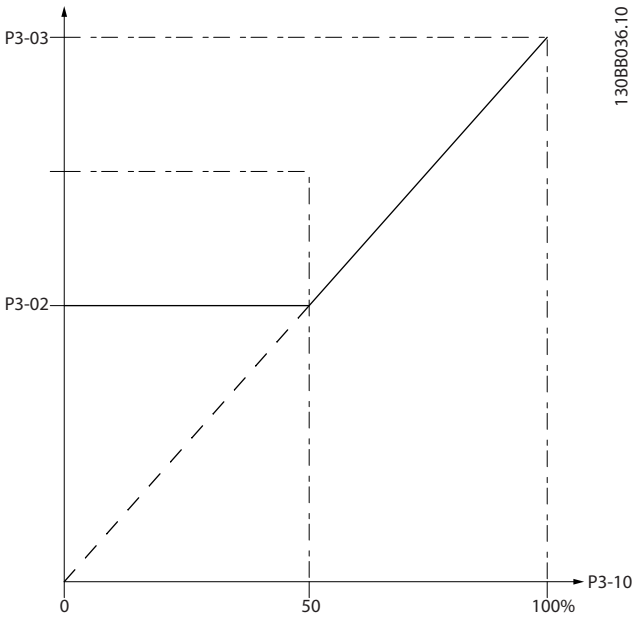
If one of the settings in parameter group P-## Motor Data is changed, *1-30 Stator Resistance (Rs)* to *1-39 Motor Poles*, the advanced motor parameters will return to default setting.
This parameter cannot be adjusted while the motor is running.

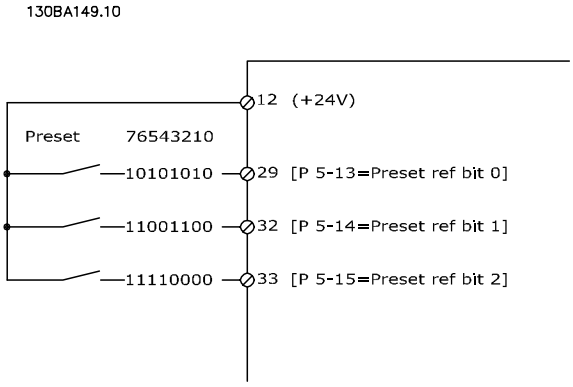
NOTE!

Full Auto Tune should be run without filter only while reduced Auto Tune should be run with filter.

6.2.3 3-0* Reference Limits

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





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

$$par.\ F-07 = \frac{tacc \times nnorm\,[par.P-06]}{ref\,[rpm]}[s]$$

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

$$par.\ F-08 = \frac{tdec \times nnorm\,[par.P-06]}{ref\,[rpm]}[s]$$

3-84 Initial Ramp Time		
Range:		**Function:**
0.00 s*	[0.00– 60.00 s]	Enter the initial ramp-up time from zero speed to Motor Speed Low Limit, *4-11 Motor Speed Low Limit [RPM]* or *4-12 Motor Speed Low Limit [Hz]*. Submersible deep well pumps can be damaged by running below minimum speed. A fast ramp time below minimum pump speed is recommended. This parameter may be applied as a fast ramp rate from zero speed to Motor Speed Low Limit.

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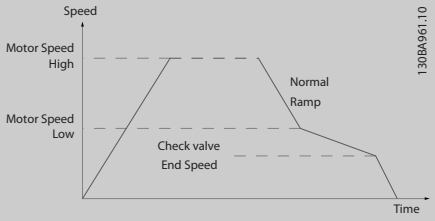
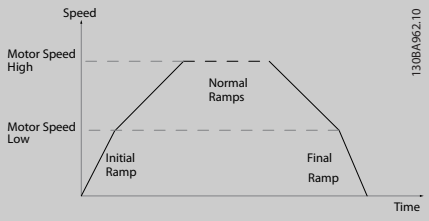
3-85 Check Valve Ramp Time		
Range:		**Function:**
0.00 s*	[0.00–60.00 s]	In order to protect ball check valves in a stop situation, the check valve ramp can be utilized as a slow ramp rate from *4-11 Motor Speed Low Limit [RPM]* or *4-12 Motor Speed Low Limit [Hz]*, to Check Valve Ramp End Speed, set by the user in or . When is different from 0 seconds, the Check Valve Ramp Time is effectuated and will be used to ramp down the speed from Motor Speed Low Limit to the Check Valve End Speed in or .. 

3-86 Check Valve Ramp End Speed [RPM]	
Range:	**Function:**

3-87 Check Valve Ramp End Speed [Hz]	
Range:	**Function:**

3-88 Final Ramp Time		
Range:		**Function:**
0.00 s*	[0.00–60.00 s]	Enter the Final Ramp Time to be used when ramping down from Motor Speed Low Limit, *4-11 Motor Speed Low Limit [RPM]* or *4-12 Motor Speed Low Limit [Hz]*, to zero speed. Submersible deep well pumps can be damaged by running below minimum speed. A fast ramp time below minimum pump speed is recommended. This parameter may be applied as a fast ramp rate from Motor Speed Low Limit to zero speed. 

6.2.4 Limits and Warnings

Parameter group for configuring limits and warnings.

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]*.

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 carrier 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]*.

Parameter group for configuring the digital input and output.

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.

6.2.5 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 *term 32, 33
Reset	[1]	All
Coast inverse	[2]	All
Coast and reset inverse	[3]	All
DC brake inverse	[5]	All
Stop inverse	[6]	All
External interlock	[7]	All
Start	[8]	All *term 18
Latched start	[9]	All
Reversing	[10]	All *term 19
Start reversing	[11]	All
Jog	[14]	All *term 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
Slow	[22]	All
Set-up select bit 0	[23]	All
Set-up select bit 1	[24]	All
Pulse input	[32]	term 29, 33
Ramp bit 0	[34]	All
Mains failure inverse	[36]	All
Run Permissive	[52]	
Hand start	[53]	
Auto start	[54]	
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]	
Reset Maintenance Word	[78]	
Lead Pump Start	[120]	
Lead Pump Alternation	[121]	
Pump 1 Interlock	[130]	
Pump 2 Interlock	[131]	
Pump 3 Interlock	[132]	

All = Terminals 18, 19, 27, 29, 32, X30/2, X30/3, X30/4. X30/ are the terminals on MCB 101.

Functions dedicated to only one digital input are stated in the associated parameter.

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All digital inputs can be programmed to these functions:

[0]	No operation	No reaction to signals transmitted to terminal.
[1]	Reset	Resets adjustable frequency drive after a TRIP/ALARM. Not all alarms can be reset.
[2]	Coast inverse	Leaves motor in free mode. Logic '0' => coasting stop. (Default Digital input 27): Coasting stop, inverted input (NC).
[3]	Coast and reset inverse	Reset and coasting stop Inverted input (NC). Leaves motor in free mode and resets the adjustable frequency drive. Logic '0' => coasting stop and reset.
[5]	DC brake inverse	Inverted input for DC braking (NC). Stops motor by energizing it with a DC current for a certain time period. See *2-01 DC Brake Current* to *2-03 DC Brake Cut-in Speed [RPM]*. The function is only active when the value in *2-02 DC Braking Time* is different from 0. Logic '0' => DC braking.
[6]	Stop inverse	Stop Inverted function. Generates a stop function when the selected terminal goes from logical level '1' to '0'. The stop is performed according to the selected ramp time (*3-42 Ramp 1 Ramp-down Time* and *3-52 Ramp 2 Ramp-down Time*. When the adjustable frequency drive is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the adjustable frequency drive stops, configure a digital output to Torque limit & stop [27] and connect this digital output to a digital input that is configured as coast.
[7]	External Interlock	Same function as Coasting stop, inverse, but External Interlock generates the alarm message 'external fault' on the display when the terminal which is programmed for Coast Inverse is logic '0'. The alarm message will also be active via digital outputs and relay outputs, if programmed for External Interlock. The alarm can be reset using a digital input or the [RESET] key if the cause for the External Interlock has been removed. A delay can be programmed in *22-00 External Interlock Delay*. After applying a signal to the input, the reaction described above will be delayed with the time set in *22-00 External Interlock Delay*.
[8]	Start	Select start for a start/stop command. Logic '1' = start, logic '0' = stop. (Default Digital input 18)
[9]	Latched start	Motor starts, if a pulse is applied for min. 2 ms. Motor stops when Stop inverse is activated
[10]	Reversing	Changes direction of motor shaft rotation. Select Logic '1' to reverse. The reversing signal only changes the direction of rotation. It does not activate the start function. Select both directions in *4-10 Motor Speed Direction*. (Default Digital input 19).
[11]	Start reversing	Used for start/stop and for reversing on the same wire. Signals on start are not allowed at the same time.
[14]	Jog	Used for activating jog speed. See *3-11 Jog Speed [Hz]*. (Default Digital input 29)
[15]	Preset reference on	Used for shifting between external reference and preset reference. It is assumed that *External/preset* [1] has been selected in *3-04 Reference Function*. Logic '0' = external reference active; logic '1' = one of the eight preset references is active.
[16]	Preset ref bit 0	Enables a choice between one of the eight preset references according to the table below.
[17]	Preset ref bit 1	Enables a choice between one of the eight preset references according to the table below.
[18]	Preset ref bit 2	Enables a choice between one of the eight preset references according to the table below.
[19]	Freeze ref	Freezes actual reference. The frozen reference is now the point of enable/ condition for Speed up and Slow to be used. If Speed up/down is used, the speed change always follows ramp 2 (*3-51 Ramp 2 Ramp-up Time* and *3-52 Ramp 2 Ramp-down Time*) in the range 0 - *3-03 Maximum Reference Maximum Reference*.
[20]	Freeze output	Freezes actual motor frequency (Hz). The frozen motor frequency is now the point of enable/condition for Speed up and Slow to be used. If Speed up/down is used, the

Preset ref. bit	**2**	**1**	**0**
Preset ref. 0	0	0	0
Preset ref. 1	0	0	1
Preset ref. 2	0	1	0
Preset ref. 3	0	1	1
Preset ref. 4	1	0	0
Preset ref. 5	1	0	1
Preset ref. 6	1	1	0
Preset ref. 7	1	1	1

		speed change always follows ramp 2 (*3-51 Ramp 2 Ramp-up Time* and *3-52 Ramp 2 Ramp-down Time*) in the range 0 - *1-23 Motor Frequency*. When Freeze output is active, the adjustable frequency drive cannot be stopped via a low 'start [13]' signal. Stop the adjustable frequency drive via a terminal programmed for Coasting inverse [2] or Coast and reset, inverse [3].
[21]	Speed up	For digital control of the up/down speed is desired (motor potentiometer). Activate this function by selecting either Freeze reference or Freeze output. When Speed up is activated for less than 400 msec. the resulting reference will be increased by 0.1%. If Speed up is activated for more than 400 msec. the resulting reference will ramp according to Ramp 1 in *3-41 Ramp 1 Ramp-up Time*.
[22]	Slow	Same as Speed up [21].
[23]	Set-up select bit 0	Selects one of the four set-ups. Set *0-10 Active Set-up* to Multi Set-up.
[24]	Set-up select bit 1	Same as Set-up select bit 0 [23]. (Default Digital input 32)
[32]	Pulse input	Select Pulse input when using a pulse sequence as either reference or feedback. Scaling is done in par. group 5-5*.
[34]	Ramp bit 0	Select which ramp to use. Logic "0" will select ramp 1 while logic "1" will select ramp 2.
[36]	Mains failure inverse	Activates *14-10 Line Failure*. Line failure inverse is active in the Logic "0" situation.
[52]	Run Permissive	The input terminal, for which the Run permissive has been programmed must be logic "1" before a start command can be accepted. Run permissive has a logic 'AND' function related to the terminal which is programmed for *START* [8], *Jog* [14] or *Freeze Output* [20], which means that in order to start running the motor, both conditions must be fulfilled. If Run Permissive is programmed on multiple terminals, Run permissive needs only be logic '1' on one of the terminals for the function to be carried out. The digital output signal for Run Request (*Start* [8], *Jog* [14] or *Freeze output* [20]) programmed in par. group 5-3* Digital outputs, or par. group 5-4* Relays, will not be affected by Run Permissive.
[53]	Hand start	A signal applied will put the adjustable frequency drive into hand mode as if button *Hand On* on the LCP has been pressed and a normal stop command will be overridden. If disconnecting the signal, the motor will stop. To make any other start commands valid, another digital input must be assigned to *Auto-Start* and a signal applied to this. The *Hand On* and *Auto On* buttons on the LCP has no impact. The *Off* button on the LCP will override *Hand Start* and *Auto-Start*. Press either the *Hand On* or *Auto On* button to make *Hand Start* and *Auto-Start* active again. If no signal on neither *Hand Start* nor *Auto-Start*, the motor will stop regardless of any normal Start command applied. If signal applied to both *Hand Start* and *Auto-Start*, the function will be *Auto-Start*. If pressing the *Off* button on the LCP, the motor will stop regardless of signals on *Hand Start* and *Auto-Start*.
[54]	Auto start	A signal applied will put the adjustable frequency drive into auto mode as if the LCP button *Auto On* has been pressed. See also *Hand Start* [53]
[55]	DigiPot Increase	Uses the input as an INCREASE signal to the Digital Potentiometer function described in parameter group 3-9*
[56]	DigiPot Decrease	Uses the input as a DECREASE signal to the Digital Potentiometer function described in parameter group 3-9*
[57]	DigiPot Clear	Uses the input to CLEAR the Digital Potentiometer reference described in parameter group 3-9*
[60]	Counter A (up)	(Terminal 29 or 33 only) Input for increment counting in the SLC counter.
[61]	Counter A (down)	(Terminal 29 or 33 only) Input for decrement counting in the SLC counter.
[62]	Reset Counter A	Input for reset of counter A.
[63]	Counter B (up)	(Terminal 29 and 33 only) Input for increment counting in the SLC counter.
[64]	Counter B (down)	(Terminal 29 and 33 only) Input for decrement counting in the SLC counter.
[65]	Reset Counter B	Input for reset of counter B.
[66]	Sleep Mode	Forces adjustable frequency drive into sleep mode (see par. group 22-4*, *Sleep Mode*). Reacts on the rising edge of signal applied!
[78]	Reset Preventive Maintenance Word	Resets all data in *16-96 Maintenance Word* to 0.

The setting options below are all related to the cascade controller. Wiring diagrams and settings for parameter, see par. group 25-** for more details.

[120]	Lead Pump Start	Starts/stops the lead pump (controlled by the adjustable frequency drive). A start requires that also a System Start signal has been applied, e.g., to one of the digital inputs set for *Start* [8]!
[121]	Lead Pump Alternation	Forces alternation of the lead pump in a cascade controller. *Lead Pump Alternation*, *25-50 Lead Pump Alternation* must be set to either *At Command* [2] or *At Staging or At Command* [3]. *Alternation Event*, *25-51 Alternation Event* can be set to any of the four options.
[130 - 138]	Pump1 Interlock - Pump9 Interlock	The function will depend on the setting in *25-06 Number Of Pumps*. If set to *No* [0], then Pump1 refers to the pump controlled by relay RELAY1 etc. If set to *Yes* [1], Pump1 refers to the pump controlled by the adjustable frequency drive only (without any of the built-in relays involved) and Pump2 to the pump controlled by the relay RELAY1. Variable speed pump (lead) cannot be interlocked in the basic cascade controller. See table below:

Setting in Par. 5-1*	Setting in *25-06 Number Of Pumps*	
	[0] No	[1] Yes
[130] Pump1 Interlock	Controlled by RELAY1 (only if not lead pump)	Adjustable frequency drive controlled (cannot be interlocked)
[131] Pump2 Interlock	Controlled by RELAY2	Controlled by RELAY1
[132] Pump3 Interlock	Controlled by RELAY3	Controlled by RELAY2
[133] Pump4 Interlock	Controlled by RELAY4	Controlled by RELAY3
[134] Pump5 Interlock	Controlled by RELAY5	Controlled by RELAY4
[135] Pump6 Interlock	Controlled by RELAY6	Controlled by RELAY5
[136] Pump7 Interlock	Controlled by RELAY7	Controlled by RELAY6
[137] Pump8 Interlock	Controlled by RELAY8	Controlled by RELAY7
[138] Pump9 Interlock	Controlled by RELAY9	Controlled by RELAY8

5-13 Terminal 29 Digital Input

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

E-05 Terminal 32 Digital Input

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

E-06 Terminal 33 Digital Input

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

5-30 Terminal 27 Digital Output

Same options and functions as parameter group 5-3*.

Option:		Function:
[0] *	No operation	

5-40 Function Relay

Option:		Function:
		Select options to define the function of the relays. The selection of each mechanical relay is realized in an array parameter.
[0] *	No operation	
[1]	Control ready	
[2]	Drive ready	
[3]	Drive rdy/rem ctrl	
[4]	Enable / no warning	
[5]	VLT running	
[6]	Running / no warning	
[7]	Run in range/no warn	
[8]	Run on ref/no warn	
[9]	Alarm	
[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	
[22]	Ready,no thermal W	
[23]	Remote,ready,no TW	

5-40 Function Relay		
Option:		Function:
[24]	Ready, voltage OK	
[25]	Reverse	
[26]	Bus OK	
[27]	Torque limit stop	
[28]	Brake: No Brake War	
[29]	Brake ready, no fault	
[30]	Brake fault (IGBT)	
[31]	Relay 123	
[32]	Mech brake ctrl	
[33]	Safe stop active	
[36]	Control word bit 11	
[37]	Control word bit 12	
[40]	Out of ref range	
[41]	Below reference, low	
[42]	Above ref, high	
[45]	Bus ctrl.	
[46]	Bus ctrl, 1 if timeout	
[47]	Bus ctrl, 0 if timeout	
[51]	MCO controlled	
[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	
[120]	Local ref active	
[121]	Remote ref active	
[122]	No alarm	
[123]	Start command activ	
[124]	Running reverse	
[125]	Drive in hand mode	
[126]	Drive in auto mode	

5-53 Term. 29 High Ref./Feedb. Value		
Range:		Function:
100.000 N/A*	[-999999.999 - 999999.999 N/A]	Enter the high reference value [RPM] for the motor shaft speed and the high feedback value, see also *5-58 Term. 33 High Ref./ Feedb. Value*.

6.2.6 AN-## Analog In/Out

Parameter group for configuring the analog input and output.

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.

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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*.

6-20 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 value set in *6-21 Terminal 54 High Voltage* and *6-23 Terminal 54 High Current*.

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 *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 (F-17 and F-15)
[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%

6-50 Terminal 42 Output		
Option:		**Function:**
[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.*.

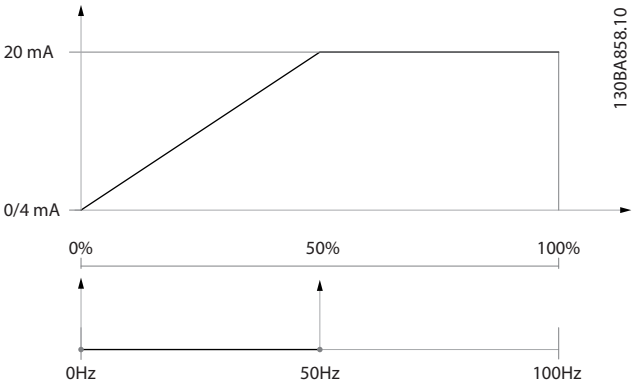
6-51 Terminal 42 Output Min Scale		
Range:		**Function:**
0.00 %*	[0.00 - 200.00 %]	

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

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

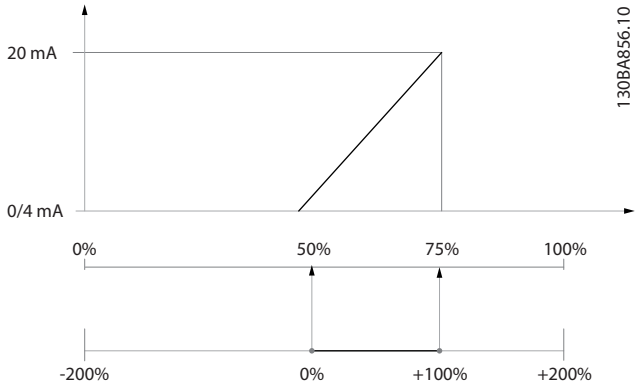
$i.e.\ 10mA: \frac{20\ mA}{10\ mA} \times 100\ \% = 200\ \%$

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%

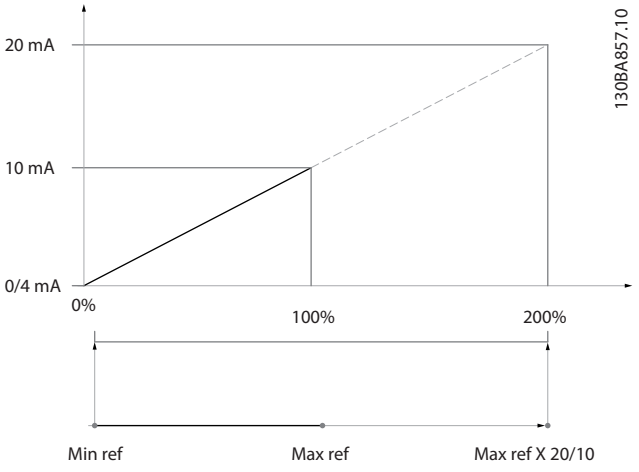


EXAMPLE 2:
Variable= FEEDBACK, range= -200% to +200%
Range needed for output= 0–100%

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%).



6.2.7 Drive Closed-loop, 20-**

This parameter group is used for configuring the closed-Loop PID controller that controls the output frequency of the adjustable frequency drive.

20-12 Reference/Feedback Unit	
Option:	**Function:**

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*. **NOTE!** **Setpoint reference entered here is added to any other references that are enabled (see par. C-30 and par. C-34).**

20-81 PID Normal/ Inverse Control		
Option:		**Function:**
[0] *	Normal	
[1]	Inverse	*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. *Inverse* [1] causes the adjustable frequency drive's output frequency to increase when the feedback is greater than the setpoint reference.

20-82 PID Start Speed [RPM]		
Range:		**Function:**
0 RPM*	[0 - par. 4-13 RPM]	When the adjustable frequency drive is first started, it initially ramps up to this output speed in open-loop mode, following the active ramp-up time. When the output speed programmed here is reached, the adjustable frequency drive will automatically switch to closed-loop mode and the PID controller will begin to function. This is useful in applications in which the driven load must first quickly accelerate to a minimum speed when it is started. **NOTE!** **This parameter will only be visible if *0-02 Motor Speed Unit* is set to [0], RPM.**

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:

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

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.

6.2.8 22-** Miscellaneous

This group contains parameters used for monitoring water/ wastewater applications.

22-20 Low Power Auto Set-up		
Start of auto set-up of power data for No-Flow Power tuning.		
Option:		**Function:**
[0] *	OFF	
[1]	Enabled	When set for *Enabled*, an auto set-up sequence is activated, automatically setting speed to approx. 50% and 85% of rated motor speed (*4-13 Motor Speed High Limit [RPM]*, *4-14 Motor Speed High Limit [Hz]*). At those two speeds, the power consumption is automatically measured and stored. Before enabling Auto Set-up: 1. Close valve(s) in order to create a no-flow condition 2. The adjustable frequency drive must be set for open-loop (*1-00 Configuration Mode*). Note that it is important also to set *1-03 Torque Characteristics*.

NOTE!

Auto set-up must be done when the system has reached normal operating temperature!

NOTE!

It is important that the *4-13 Motor Speed High Limit [RPM]* or *4-14 Motor Speed High Limit [Hz]* is set to the max. operational speed of the motor!
It is important to do the auto set-up before configuring the integrated PI controller as settings will be reset when changing from closed to open-loop in *1-00 Configuration Mode*.

NOTE!

Carry out the tuning with the same settings in *1-03 Torque Characteristics*, as for operation after the tuning.

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 AP-3# for proper operation!

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]*.

6

22-23 No-Flow Function		
Common actions for Low Power Detection and Low Speed Detection (Individual selections not possible).		
Option:		**Function:**
[0] *	OFF	The drive will not respond to a No Flow condition.
[1]	Sleep Mode	The drive will enter sleep mode and stop when a No Flow condition is detected. See parameter group AP-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	
[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.

22-26 Dry Pump Function		
Select desired action for dry pump operation.		
Option:		**Function:**
		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 AP-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.

22-27 Dry Pump Delay		
Range:		**Function:**
10 s*	[0 - 600 s]	Defines for how long the Dry Pump condition must be active before activating Warning or Alarm

22-30 No-Flow Power		
Range:		**Function:**
0.00 kW*	[0.00 - 0.00 kW]	Readout of calculated no-flow power at actual speed. If power drops to the display value, the adjustable frequency drive will consider the condition as a no-flow situation.

22-31 Power Correction Factor		
Range:		**Function:**
100 %*	[1 - 400 %]	Make corrections to the calculated power at *22-30 No-Flow Power*. If No Flow is detected when it should not be detected, the setting should be decreased. However, if No Flow is not detected when it should be detected, the setting should be increased to above 100%.

22-32 Low Speed [RPM]		
Range:		**Function:**
0 RPM*	[0 - par. 22-36 RPM]	To be used if *0-02 Motor Speed Unit* has been set for RPM (parameter not visible if Hz selected). Set used speed to the 50% level. This function is used for storing values needed to tune No-Flow Detection.

22-33 Low Speed [Hz]		
Range:		**Function:**
0 Hz*	[0.0 - par. 22-37 Hz]	To be used if *0-02 Motor Speed Unit* has been set for Hz (parameter not visible if RPM selected). Set used speed to the 50% level. The function is used for storing values needed to tune No-Flow Detection.

22-34 Low Speed Power [kW]		
Range:		**Function:**
0 kW*	[0.00 - 0.00 kW]	To be used if *0-03 Regional Settings* has been set for International (parameter not visible if North America selected). Set power consumption to 50% speed level. This function is used for storing values needed to tune No-Flow Detection.

22-35 Low Speed Power [HP]		
Range:		**Function:**
0 hp*	[0.00 - 0.00 hp]	To be used if *0-03 Regional Settings* has been set for North America (parameter not visible if International selected). Set power consumption to 50% speed level. This function is used for storing values needed to tune No-Flow Detection.

22-36 High Speed [RPM]		
Range:		**Function:**
0 RPM*	[0 - par. 4-13 RPM]	To be used if *0-02 Motor Speed Unit* has been set for RPM (parameter not visible if Hz selected). Set used speed for the 85% level. The function is used for storing values needed to tune No-Flow Detection.

22-37 High Speed [Hz]		
Range:		**Function:**
0.0 Hz*	[0.0 - par. 4-14 Hz]	To be used if *0-02 Motor Speed Unit* has been set for Hz (parameter not visible if RPM selected). Set used speed for the 85% level.

22-37 High Speed [Hz]		
Range:		**Function:**
		The function is used for storing values needed to tune No-Flow Detection.

22-38 High Speed Power [kW]		
Range:		**Function:**
0 kW*	[0.00 - 0.00 kW]	To be used if *0-03 Regional Settings* has been set for International (parameter not visible if North America selected). Set power consumption to 85% speed level. This function is used for storing values needed to tune No-Flow Detection.

22-39 High Speed Power [HP]		
Range:		**Function:**
0 hp*	[0.00 - 0.00 hp]	To be used if *0-03 Regional Settings* has been set for North America (parameter not visible if International selected). Set power consumption to 85% speed level. This function is used for storing values needed to tune No-Flow Detection.

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.

6

6

22-43 Wake-up Speed [Hz]		
Range:		**Function:**
0 Hz*	[par. 4-12 - par. 4-14 Hz]	To be used if *0-02 Motor Speed Unit* has been set for Hz (parameter not visible if RPM selected). Only to be used if *1-00 Configuration Mode* is set for open-loop and speed reference is applied by an external controller controlling the pressure. Set the reference speed at which sleep mode should be canceled.

22-44 Wake-up Ref./FB Difference		
Range:		**Function:**
10%*	[0–100%]	Only to be used if *1-00 Configuration Mode* is set for closed-loop and the integrated PI controller is used for controlling the pressure. Set the pressure drop allowed in percentage of setpoint for the pressure (Pset) before canceling sleep mode. **NOTE!** **If used in an application where the integrated PI controller is set for inverse control in *20-71 Tuning Mode*, the value set in *22-44 Wake-up Ref./FB Difference* will automatically be added.**

22-45 Setpoint Boost		
Range:		**Function:**
0 %*	[-100 - 100 %]	Only to be used if *1-00 Configuration Mode*, is set for closed-loop and the integrated PI controller is used. For example, in systems with constant pressure control, it is advantageous to increase the system pressure before the motor is stopped. This will extend the time during which the motor is stopped and help to avoid frequent start/stop. Set the desired overpressure/temperature as a percentage of the setpoint for the pressure (Pset)/ temperature before entering sleep mode. If set at 5%, the boost pressure will be Pset*1.05. The negative values can be used, for example, for cooling tower control, where a negative change is needed.

22-46 Maximum Boost Time		
Range:		**Function:**
60 s*	[0 - 600 s]	Only to be used if *1-00 Configuration Mode* is set for closed-loop and the integrated PI controller is used for controlling the pressure. Set the maximum time for which boost mode will be allowed. If the set time is exceeded,

22-46 Maximum Boost Time		
Range:		**Function:**
		sleep mode will be entered and will not wait for the set boost pressure to be reached.

22-50 End of Curve Function		
Option:		**Function:**
[0] *	OFF	End of Curve monitoring not active.
[1]	Warning	The drive will continue to run, but activate a End of Curve warning [W94]. 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 End of Curve alarm [A 94]. A drive digital output or a serial communication bus can communicate an alarm to other equipment.

NOTE!

Automatic restart will reset the alarm and start the system again.

NOTE!

Do not set *14-20 Reset Mode*, to [13] Infinite auto reset, when *22-50 End of Curve Function* is set to [2] Alarm. Doing so will cause the drive to continuously cycle between running and stopping when a End of Curve 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 End of Curve Function.

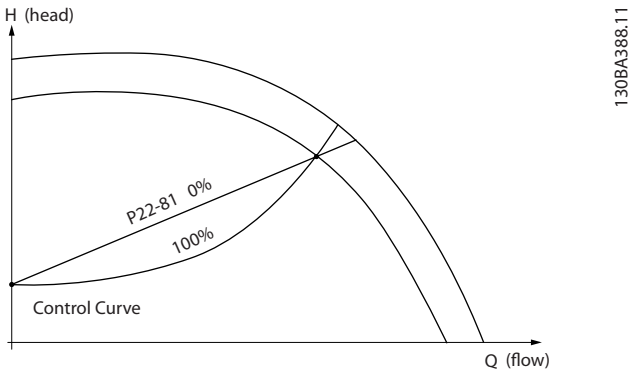
22-51 End of Curve Delay		
Range:		**Function:**
10 s*	[0 - 600 s]	When an end of curve condition is detected, a timer is activated. When the time set in this parameter expires and the End of Curve condition has been steady in the entire period, the function set in *22-50 End of Curve Function* will be activated. If the condition disappears before the timer expires, the timer will be reset.

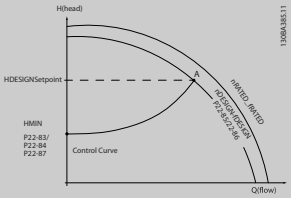
22-80 Flow Compensation		
Option:		**Function:**
[0] *	Disabled	[0] *Disabled*: Setpoint compensation not active.
[1]	Enabled	[1] *Enabled*: Setpoint compensation is active. Enabling this parameter allows the Flow Compensated Setpoint operation.

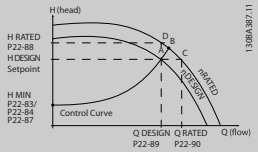
22-81 Square-linear Curve Approximation		
Range:		**Function:**
100 %*	[0 - 100 %]	

NOTE!

Not visible when running in cascade.



22-82 Work Point Calculation		
Option:		**Function:**
		Example 1: Speed at system design working point is known:  From the data sheet showing characteristics for the specific equipment at different speeds, simply reading across from the H_{DESIGN} point and the Q_{DESIGN} point allows us to find point A, which is the system design working point. The pump characteristics at this point should be identified and the associated speed programmed. Closing the valves and adjusting the speed until H_{MIN} has been achieved allows the speed at the no flow point to be identified. Adjustment of *22-81 Square-linear Curve Approximation* then allows the shape of the control curve to be adjusted infinitely.

22-82 Work Point Calculation		
Option:		**Function:**
		Example 2: Speed at system design working point is not known: Where the speed at system design working point is unknown, another reference point on the control curve needs to be determined by means of the data sheet. By looking at the curve for the rated speed and plotting the design pressure (H_{DESIGN}, Point C), the flow at that pressure Q_{RATED} can be determined. Similarly, by plotting the design flow (Q_{DESIGN}, Point D), the pressure H_D at that flow can be determined. Knowing these two points on the pump curve, along with H_{MIN} described above, allows the adjustable frequency drive to calculate the reference point B and thus to plot the control curve that will also include the system design working point A. 
[0] *	Disabled	*Disabled* [0]: Work point calculation is not active. To be used if speed at design point is known (see table above).
[1]	Enabled	*Enabled [1]*: Work point calculation is active. Enabling this parameter allows the calculation of the unknown System Design Working Point at 50/60 Hz speed, from the input data set in *22-83 Speed at No-Flow [RPM]* *22-84 Speed at No-Flow [Hz]*, *22-87 Pressure at No-Flow Speed*, *22-88 Pressure at Rated Speed*, *22-89 Flow at Design Point* and *22-90 Flow at Rated Speed*.

22-84 Speed at No-Flow [Hz]		
Range:		**Function:**
50.0 Hz*	[0.0 - par. 22-86 Hz]	Resolution 0.033 Hz. The speed of the motor at which flow has effectively stopped and minimum pressure H_{MIN} is achieved should be entered here in Hz. Alternatively, the speed in RPM can be entered in *22-83 Speed at No-Flow [RPM]*. If it has been decided to use Hz in *0-02 Motor Speed Unit*, then *22-86 Speed at Design Point [Hz]* should also be used. Closing the valves and reducing the speed until minimum pressure H_{MIN} is achieved will determine this value.

6

22-85 Speed at Design Point [RPM]		
Range:		**Function:**
1500. RPM*	[par. 22-83 - 60000. RPM]	Resolution 1 RPM. Only visible when *22-82 Work Point Calculation* is set to *Disable*. The speed of the motor at which the system design working point is achieved should be entered here in RPM. Alternatively, the speed in Hz can be entered in *22-86 Speed at Design Point [Hz]*. If it has been decided to use RPM in *0-02 Motor Speed Unit*, then *22-83 Speed at No-Flow [RPM]* should also be used.

22-86 Speed at Design Point [Hz]		
Range:		**Function:**
50/60.0 Hz*	[par. 22-84 - par. 4-19 Hz]	Resolution 0.033 Hz. Only visible when *22-82 Work Point Calculation* is set to *Disable*. The speed of the motor at which the system design working point is achieved should be entered here in Hz. Alternatively, the speed in RPM can be entered in *22-85 Speed at Design Point [RPM]*. If it has been decided to use Hz in *0-02 Motor Speed Unit*, then *22-83 Speed at No-Flow [RPM]* should also be used.

22-87 Pressure at No-Flow Speed		
Range:		**Function:**
0.000 N/A*	[0.000 - par. 22-88 N/A]	Enter the pressure H_{MIN} corresponding to Speed at No Flow in Reference/Feedback Units.

Please also see *22-82 Work Point Calculation* point D.

22-88 Pressure at Rated Speed		
Range:		**Function:**
999999.999 N/A*	[par. 22-87 - 999999.999 N/A]	Enter the value corresponding to the Pressure at Rated Speed, in Reference/Feedback Units. This value can be defined using the pump datasheet.

22-83 Speed at No-Flow [RPM]		
Range:		**Function:**
300. RPM*	[0 - par. 22-85 RPM]	Resolution 1 RPM. The speed of the motor at which the flow is zero and the minimum pressure H_{MIN} is achieved should be entered here in RPM. Alternatively, the speed in Hz can be entered in *22-84 Speed at No-Flow [Hz]*. If it has been decided to use RPM in *0-02 Motor Speed Unit*, then *22-85 Speed at Design Point [RPM]* should also be used. Closing the valves and reducing the speed until minimum pressure H_{MIN} is achieved will determine this value.

Please also see *22-82 Work Point Calculation* point C.

22-90 Flow at Rated Speed		
Range:		**Function:**
0.000 N/A*	[0.000 - 999999.999 N/A]	Enter the value corresponding to Flow at Rated Speed. This value can be defined using the pump datasheet.

6.2.9 T-0#

Use *Timed Actions* for actions needing to be performed on a daily or weekly basis, e.g., different references for working hours / non-working hours. Up to 10 Timed Actions can be programmed in the adjustable frequency drive. The Timed Action number is selected from the list when entering parameter group T-0# from the LCP. *23-00 ON Time – 23-04 Occurrence* then refer to the selected Timed Action number. Each Timed Action is divided into an ON time and an OFF time, in which two different actions may be performed.

The clock control (parameter group *K-7* Clock Settings*) of Timed Actions can be overridden from *Timed Actions Auto* (clock controlled) to *Timed Actions Disabled*, *Constant OFF Actions* or *Constant ON Actions* either in*T-08 Timed Actions Mode* or with commands applied to the digital inputs (*[68] Timed Actions Disabled, [69] Constant OFF Actions or [70] Constant ON Actions*, in parameter group *E-0* Digital Inputs*.

Display lines 2 and 3 in the LCP show the status for Timed Actions Mode (*0-23 Display Line 2 Large* and *0-24 Display Line 3 Large*, setting).

NOTE!

A change in mode via the digital inputs can only take place if *T-08 Timed Actions Mode* is set for *[0] Times Actions Auto*.
If commands are applied simultaneously to the digital inputs for Constant OFF and Constant ON, Timed Actions mode will change to Timed Actions Auto and the two commands will be disregarded.
If *0-70 Set Date and Time* is not set or the adjustable frequency drive is set to HAND or OFF mode (e.g., via the LCP), Timed Actions mode will be change to *Timed Actions Disabled*.
The Timed Actions have a higher priority than the same actions/commands activated by the digital inputs or the Smart Logic Controller.

NOTE!

The clock (parameter group K-7#) must be correctly programmed for Timed Actions to function correctly.

NOTE!

When mounting an Analog I/O OPCAIO option card, a battery backup of the date and time is included.

23-00 ON Time		
Array [10]		
Range:		**Function:**
0 N/A*	[0 - 0 N/A]	Sets the ON time for the timed action. **NOTE!** **The adjustable frequency drive has no backup of the clock function and the set date/time will reset to default (2000-01-01 00:00) after a power-down unless the Analog I/O option module (OPCAIO) with battery backup of the Real Time Clock is installed. In *0-79 Clock Fault*, it is possible to program for a warning in case the clock has not been set properly, e.g., after a power-down.**

23-01 ON Action		
Arra [10]		
Option:		**Function:**
		Select the action during ON Time. See *13-52 SL Controller Action* for descriptions of the options.
[0] *	DISABLED	
[1]	No action	
[2]	Select set-up 1	
[3]	Select set-up 2	

23-01 ON Action		
Arra [10]		
Option:		**Function:**
[4]	Select set-up 3	
[5]	Select set-up 4	
[10]	Select preset ref 0	
[11]	Select preset ref 1	
[12]	Select preset ref 2	
[13]	Select preset ref 3	
[14]	Select preset ref 4	
[15]	Select preset ref 5	
[16]	Select preset ref 6	
[17]	Select preset ref 7	
[18]	Select ramp 1	
[19]	Select ramp 2	
[22]	Run	
[23]	Run reverse	
[24]	Stop	
[26]	Dcstop	
[27]	Coast	
[28]	Freeze output	
[29]	Start timer 0	
[30]	Start timer 1	
[31]	Start timer 2	
[32]	Set digital out A low	
[33]	Set digital out B low	
[34]	Set digital out C low	
[35]	Set digital out D low	
[36]	Set digital out E low	
[37]	Set digital out F low	
[38]	Set digital out A high	
[39]	Set digital out B high	
[40]	Set digital out C high	
[41]	Set digital out D high	
[42]	Set digital out E high	
[43]	Set digital out F high	
[60]	Reset Counter A	
[61]	Reset Counter B	
[70]	Start Timer 3	
[71]	Start Timer 4	
[72]	Start Timer 5	
[73]	Start Timer 6	
[74]	Start Timer 7	

23-02 OFF Time		
Array [10]		
Range:		**Function:**
0 N/A*	[0 - 0 N/A]	Sets the OFF time for the timed action. **NOTE!** **The adjustable frequency drive has no backup of the clock function and the set date/time will reset to default (2000-01-01 00:00) after a power-down unless the Analog I/O option module (OPCAIO) with battery backup of the Real Time Clock is installed. In *0-79 Clock Fault*, it is possible to program for a warning in case the clock has not been set properly, e.g., after a power-down.**

23-03 OFF Action		
Array [10]		
Option:		**Function:**
		Select the action during OFF Time. See *13-52 SL Controller Action* for descriptions of the options.
[0] *	DISABLED	
[1]	No action	
[2]	Select set-up 1	
[3]	Select set-up 2	
[4]	Select set-up 3	
[5]	Select set-up 4	
[10]	Select preset ref 0	
[11]	Select preset ref 1	
[12]	Select preset ref 2	
[13]	Select preset ref 3	
[14]	Select preset ref 4	
[15]	Select preset ref 5	
[16]	Select preset ref 6	
[17]	Select preset ref 7	
[18]	Select ramp 1	
[19]	Select ramp 2	
[22]	Run	
[23]	Run reverse	
[24]	Stop	
[26]	Dcstop	
[27]	Coast	
[28]	Freeze output	
[29]	Start timer 0	
[30]	Start timer 1	
[31]	Start timer 2	
[32]	Set digital out A low	
[33]	Set digital out B low	
[34]	Set digital out C low	

23-03 OFF Action		
Array [10]		
Option:		**Function:**
[35]	Set digital out D low	
[36]	Set digital out E low	
[37]	Set digital out F low	
[38]	Set digital out A high	
[39]	Set digital out B high	
[40]	Set digital out C high	
[41]	Set digital out D high	
[42]	Set digital out E high	
[43]	Set digital out F high	
[60]	Reset Counter A	
[61]	Reset Counter B	
[70]	Start Timer 3	
[71]	Start Timer 4	
[72]	Start Timer 5	
[73]	Start Timer 6	
[74]	Start Timer 7	

23-04 Occurrence		
Array [10]		
Option:		**Function:**
		Select the day(s) to which the timed action applies. Specify working/non-working days in *0-81 Working Days*, *0-82 Additional Working Days* and *0-83 Additional Non-Working Days*.
[0] *	All days	
[1]	Working days	
[2]	Non-working days	
[3]	Monday	
[4]	Tuesday	
[5]	Wednesday	
[6]	Thursday	
[7]	Friday	
[8]	Saturday	
[9]	Sunday	

6.2.10 Water Application Functions, 29-**

The group contains parameters used for monitoring water/wastewater applications.

29-00 Pipe Fill Enable	
Option:	**Function:**

29-01 Pipe Fill Speed [RPM]		
Range:		**Function:**
Size related*	[par. 4-11 - par. 4-13 RPM]	

29-02 Pipe Fill Speed [Hz]		
Range:		**Function:**
Size related*	[par. 4-12 - par. 4-14 Hz]	

29-03 Pipe Fill Time	
Range:	**Function:**

29-04 Pipe Fill Rate		
Range:		**Function:**
0.001 ProcessCtrlUnit*	[0.001– 999999.999 ProcessCtrlUnit]	Specifies the filling rate in units/second using the PI controller. Filling rate units are feedback units/second. This function is used for filling up vertical pipe systems but will be active when the filling time has expired regardless until the pipe fill setpoint set in is reached.

29-05 Filled Setpoint		
Range:		**Function:**
0.000 ProcessCtrlUnit*	[-999999.999– 999999.999 ProcessCtrlUnit]	Specifies the filled setpoint at which the pipe fill function will be disabled and the PID controller will take control. This function can be used both for horizontal and vertical pipe systems.

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6.3 Parameter Options

6.3.1 Default settings

Changes during operation:
"TRUE" means that the parameter can be changed while the adjustable frequency drive is in operation and "FALSE" means that the adjustable frequency drive must be stopped before a change can be made.

4 set-up:
'All set-up': the parameter can be set individually in each of the four set-ups, i.e., one single parameter can have four different data values.
'1 set-up': the data value will be the same in all set-ups.

6

SR:
Size related

N/A:
No default value available.

Conversion index:
This number refers to a conversion figure used when writing or reading by means of an adjustable frequency drive.

Conv. index	100	75	74	70	67	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6
Conv. factor	1	3600000	3600	60	1/60	1000000	100000	10000	1000	100	10	1	0.1	0.01	0.001	0.0001	0.00001	0.000001

Data type	Description	Type
2	Integer 8	Int8
3	Integer 16	Int16
4	Integer 32	Int32
5	Unsigned 8	Uint8
6	Unsigned 16	Uint16
7	Unsigned 32	Uint32
9	Visible String	VisStr
33	Normalized value 2 bytes	N2
35	Bit sequence of 16 Boolean variables	V2
54	Time difference w/o date	TimD

6.3.2 Operation/Display 0-**

Par. No. #	Parameter description	Default value	4 set-up	FC 302 only	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	[0] RPM	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	1601	All set-ups		TRUE	-	Uint16
0-21	Display Line 1.2 Small	1662	All set-ups		TRUE	-	Uint16
0-22	Display Line 1.3 Small	1614	All set-ups		TRUE	-	Uint16
0-23	Display Line 2 Large	1613	All set-ups		TRUE	-	Uint16
0-24	Display Line 3 Large	1652	All set-ups		TRUE	-	Uint16
0-25	My Personal Menu	ExpressionLimit	1 set-up		TRUE	0	Uint16
0-3* LCP Custom Readout							
0-30	Custom Readout Unit	[1] %	All set-ups		TRUE	-	Uint8
0-31	Custom Readout Min Value	ExpressionLimit	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	Uint16
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	Uint16
0-66	Access to Personal Menu w/o Password	[0] Full access	1 set-up		TRUE	-	Uint8

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion index	Type
0-7* Clock Settings						
0-70	Date and Time	ExpressionLimit	All set-ups	TRUE	0	TimeOfDay
0-71	Date Format	[0] YYYY-MM-DD	1 set-up	TRUE	-	Uint8
0-72	Time Format	[0] 24 h	1 set-up	TRUE	-	Uint8
0-74	DST/Summertime	[0] Off	1 set-up	TRUE	-	Uint8
0-76	DST/Summertime Start	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
0-77	DST/Summertime End	ExpressionLimit	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	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
0-83	Additional Non-Working Days	ExpressionLimit	1 set-up	TRUE	0	TimeOfDay
0-89	Date and Time Readout	0 N/A	All set-ups	TRUE	0	VisStr[25]

6.3.3 Load/Motor 1-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conversion index	Type
1-0* General Settings						
1-00	Configuration Mode	null	All set-ups	TRUE	-	Uint8
1-01	Motor Control Principle	null	All set-ups	FALSE	-	Uint8
1-03	Torque Characteristics	[3] Auto Energy Optim. VT	All set-ups	TRUE	-	Uint8
1-1* Motor Selection						
1-10	Motor Construction	[0] Asynchron	All set-ups	FALSE	-	Uint8
1-2* Motor Data						
1-20	Motor Power [kW]	ExpressionLimit	All set-ups	FALSE	1	Uint32
1-21	Motor Power [HP]	ExpressionLimit	All set-ups	FALSE	-2	Uint32
1-22	Motor Voltage	ExpressionLimit	All set-ups	FALSE	0	Uint16
1-23	Motor Frequency	ExpressionLimit	All set-ups	FALSE	0	Uint16
1-24	Motor Current	ExpressionLimit	All set-ups	FALSE	-2	Uint32
1-25	Motor Nominal Speed	ExpressionLimit	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* Adv. Motor Data						
1-30	Stator Resistance (Rs)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
1-31	Rotor Resistance (Rr)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
1-35	Main Reactance (Xh)	ExpressionLimit	All set-ups	FALSE	-4	Uint32
1-36	Iron Loss Resistance (Rfe)	ExpressionLimit	All set-ups	FALSE	-3	Uint32
1-39	Motor Poles	ExpressionLimit	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]	ExpressionLimit	All set-ups	TRUE	67	Uint16
1-52	Min Speed Normal Magnetizing [Hz]	ExpressionLimit	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	ExpressionLimit	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
1-74	Start Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
1-75	Start Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
1-76	Start Current	0.00 A	All set-ups	TRUE	-2	Uint32

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion index	Type
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
1-74	Start Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
1-75	Start Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
1-76	Start Current	0.00 A	All set-ups	TRUE	-2	Uint32
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]	ExpressionLimit	All set-ups	TRUE	67	Uint16
1-82	Min. Speed for Function at Stop [Hz]	ExpressionLimit	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 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

6.3.4 Brakes 2-**

Par. No. #	Parameter description	Default value	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]	ExpressionLimit	All set-ups	TRUE	67	Uint16
2-04	DC Brake Cut-in Speed [Hz]	ExpressionLimit	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)	ExpressionLimit	All set-ups	TRUE	0	Uint16
2-12	Braking Energy Limit (kW)	ExpressionLimit	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

6.3.5 Reference / Ramps 3-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion index	Type
3-0* Reference Limits						
3-02	Minimum Reference	ExpressionLimit	All set-ups	TRUE	-3	Int32
3-03	Maximum Reference	ExpressionLimit	All set-ups	TRUE	-3	Int32
3-04	Reference Function	[0] Sum	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]	ExpressionLimit	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	[0] No function	All set-ups	TRUE	-	Uint8
3-17	Reference 3 Source	[0] No function	All set-ups	TRUE	-	Uint8
3-19	Jog Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
3-4* Ramp 1						
3-41	Ramp 1 Ramp-up Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-42	Ramp 1 Ramp-down Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-5* Ramp 2						
3-51	Ramp 2 Ramp-up Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-52	Ramp 2 Ramp-down Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-8* Other Ramps						
3-80	Jog Ramp Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-81	Quick Stop Ramp Time	ExpressionLimit	2 set-ups	TRUE	-2	Uint32
3-84	Initial Ramp Time	0.00 s	All set-ups	TRUE	-2	Uint16
3-85	Check Valve Ramp Time	0.00 s	All set-ups	TRUE	-2	Uint16
3-86	Check Valve Ramp End Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
3-87	Check Valve Ramp End Speed [HZ]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
3-88	Final Ramp Time	0.00 s	All set-ups	TRUE	-2	Uint16
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	ExpressionLimit	All set-ups	TRUE	-3	TimD

6.3.6 Limits / Warnings 4-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conversion index	Type
4-1* Motor Limits						
4-10	Motor Speed Direction	[0] Clockwise	All set-ups	FALSE	-	Uint8
4-11	Motor Speed Low Limit [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
4-12	Motor Speed Low Limit [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
4-13	Motor Speed High Limit [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
4-14	Motor Speed High Limit [Hz]	ExpressionLimit	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	ExpressionLimit	All set-ups	TRUE	-1	Uint32
4-19	Max. Output Frequency	ExpressionLimit	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	outputSpeed-HighLimit (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 Referen-ceFeedbackUnit	All set-ups	TRUE	-3	Int32
4-57	Warning Feedback High	999999.999 Referen-ceFeedbackUnit	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]	ExpressionLimit	All set-ups	TRUE	67	Uint16
4-61	Bypass Speed From [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
4-62	Bypass Speed To [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
4-63	Bypass Speed To [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
4-64	Semi-Auto Bypass Set-up	[0] Off	All set-ups	FALSE	-	Uint8

6.3.7 Digital In/Out 5-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion 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	[0] No operation	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
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

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion index	Type
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

6.3.8 Analog In/Out 6-**

Par. No. #	Parameter description	Default value	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
6-1* 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	ExpressionLimit	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	[100] Output freq. 0-100	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

6.3.9 Comm. and Options 8-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion 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	ExpressionLimit	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
8-14	Configurable Control Word CTW	[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	ExpressionLimit	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	ExpressionLimit	1 set-up	TRUE	-3	Uint16
8-36	Max Response Delay	ExpressionLimit	1 set-up	TRUE	-3	Uint16
8-37	Maximum Inter-Char Delay	ExpressionLimit	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	ExpressionLimit	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 Message Rcvd	0 N/A	All set-ups	TRUE	0	Uint32
8-83	Slave Error Count	0 N/A	All set-ups	TRUE	0	Uint32
8-9* 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

6.3.10 Profibus 9-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion 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	ExpressionLimit	2 set-ups	TRUE	-	Uint16
9-16	PCD Read Configuration	ExpressionLimit	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	Error 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	Error 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

6.3.11 CAN Fieldbus 10-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion 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	ExpressionLimit	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	ExpressionLimit	2 set-ups	TRUE	-	Uint16
10-12	Process Data Config Read	ExpressionLimit	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	ExpressionLimit	All set-ups	TRUE	0	Uint16
10-33	Store Always	[0] Off	1 set-up	TRUE	-	Uint8
10-34	DeviceNet Product Code	130 N/A	1 set-up	TRUE	0	Uint16
10-39	DeviceNet F Parameters	0 N/A	All set-ups	TRUE	0	Uint32

6.3.12 Smart Logic 13-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion 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	ExpressionLimit	2 set-ups	TRUE	-3	Int32
13-2* Timers						
13-20	SL Controller Timer	ExpressionLimit	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

6.3.13 Special Functions 14-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion index	Type
14-0* Inverter Switching						
14-00	Switching Pattern	null	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	ExpressionLimit	All set-ups	TRUE	0	Uint16
14-12	Function at Line Imbalance	[3] Derate	All set-ups	TRUE	-	Uint8
14-2* Reset Functions						
14-20	Reset Mode	[10] Automatic reset x 10	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	ExpressionLimit	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	ExpressionLimit	All set-ups	TRUE	0	Uint8
14-42	Minimum AEO Frequency	10 Hz	All set-ups	TRUE	0	Uint8
14-43	Motor Cos-Phi	ExpressionLimit	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
14-55	Output Filter	[0] No Filter	1 set-up	FALSE	-	Uint8
14-59	Actual Number of Inverter Units	ExpressionLimit	1 set-up	FALSE	0	Uint8
14-6* Auto Derate						
14-60	Function at Overtemperature	[1] Derate	All set-ups	TRUE	-	Uint8
14-61	Function at Inverter Overload	[1] Derate	All set-ups	TRUE	-	Uint8
14-62	Inv. Overload Derate Current	95 %	All set-ups	TRUE	0	Uint16
14-8* Options						
14-80	Option Supplied by External 24VDC	[0] No	2 set-ups	FALSE	-	Uint8

6.3.14 Adj. Freq. Drive Information 15-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conversion 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	ExpressionLimit	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	ExpressionLimit	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	ExpressionLimit	All set-ups	FALSE	0	TimeOfDay
15-34	Alarm Log: Setpoint	0.000 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
15-35	Alarm Log: Feedback	0.000 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
15-36	Alarm Log: Current Demand	0 %	All set-ups	FALSE	0	Uint8
15-37	Alarm Log: Process Ctrl Unit	[0]	All set-ups	FALSE	-	Uint8
15-4* Drive Identification						
15-40	Adj. Freq. Drive 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

6.3.15 Data Readouts 16-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conversion index	Type
16-0* General Status						
16-00	Control Word	0 N/A	All set-ups	TRUE	0	V2
16-01	Reference [Unit]	0.000 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
16-02	Reference [%]	0.0%	All set-ups	TRUE	-1	Int16
16-03	Status Word	0 N/A	All set-ups	TRUE	0	V2
16-05	Main Actual Value [%]	0.00%	All set-ups	TRUE	-2	N2
16-09	Custom Readout	0.00 CustomReadoutUnit	All set-ups	TRUE	-2	Int32
16-1* Motor Status						
16-10	Power [kW]	0.00 kW	All set-ups	TRUE	1	Int32
16-11	Power [hp]	0.00 hp	All set-ups	TRUE	-2	Int32
16-12	Motor Voltage	0.0 V	All set-ups	TRUE	-1	Uint16
16-13	Frequency	0.0 Hz	All set-ups	TRUE	-1	Uint16
16-14	Motor Current	0.00 A	All set-ups	TRUE	-2	Int32
16-15	Frequency [%]	0.00%	All set-ups	TRUE	-2	N2
16-16	Torque [Nm]	0.0 Nm	All set-ups	TRUE	-1	Int32
16-17	Speed [RPM]	0 RPM	All set-ups	TRUE	67	Int32
16-18	Motor Thermal	0 %	All set-ups	TRUE	0	Uint8
16-22	Torque [%]	0 %	All set-ups	TRUE	0	Int16
16-3* Drive Status						
16-30	DC Link Voltage	0 V	All set-ups	TRUE	0	Uint16
16-32	Brake Energy /s	0.000 kW	All set-ups	TRUE	0	Uint32
16-33	Brake Energy/2 min	0.000 kW	All set-ups	TRUE	0	Uint32
16-34	Heatsink Temp.	0 °C	All set-ups	TRUE	100	Uint8
16-35	Inverter Thermal	0 %	All set-ups	TRUE	0	Uint8
16-36	Inv. Nom. Current	ExpressionLimit	All set-ups	TRUE	-2	Uint32
16-37	Inv. Max. Current	ExpressionLimit	All set-ups	TRUE	-2	Uint32
16-38	SL Controller State	0 N/A	All set-ups	TRUE	0	Uint8
16-39	Control Card Temp.	0 °C	All set-ups	TRUE	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	TRUE	-1	Int16
16-52	Feedback [Unit]	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
16-53	Digi Pot Reference	0.00 N/A	All set-ups	TRUE	-2	Int16
16-54	Feedback 1 [Unit]	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
16-55	Feedback 2 [Unit]	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
16-56	Feedback 3 [Unit]	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
16-58	PID Output [%]	0.0%	All set-ups	TRUE	-1	Int16
16-59	Adjusted Setpoint	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32

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

6.3.16 Data Readouts 2 18-**

Par. No. #	Parameter description	Default value	4 set-up	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	ExpressionLimit	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

6.3.17 Adj. Freq. Drive Closed-loop 20-**

Par. No. #	Parameter description	Default value	4 set-up	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
20-2* Feedback/Setpoint						
20-20	Feedback Function	[4] Maximum	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
20-7* 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]	ExpressionLimit	All set-ups	TRUE	67	Uint16
20-83	PID Start Speed [Hz]	ExpressionLimit	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	2.00 N/A	All set-ups	TRUE	-2	Uint16
20-94	PID Integral Time	8.00 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

6.3.18 Ext. Closed-loop 21-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion index	Type
21-0* Ext. CL Autotuning						
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	[0]	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	0.50 N/A	All set-ups	TRUE	-2	Uint16
21-22	Ext. 1 Integral Time	20.00 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	[0]	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	0.50 N/A	All set-ups	TRUE	-2	Uint16
21-42	Ext. 2 Integral Time	20.00 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	Change during operation	Conver-sion index	Type
21-5* Ext. CL 3 Ref./Fb.						
21-50	Ext. 3 Ref./Feedback Unit	[0]	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	0.50 N/A	All set-ups	TRUE	-2	Uint16
21-62	Ext. 3 Integral Time	20.00 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

6.3.19 Application Functions 22-**

Par. No. #	Parameter description	Default value	4 set-up	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]	ExpressionLimit	All set-ups	TRUE	67	Uint16
22-33	Low Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
22-34	Low Speed Power [kW]	ExpressionLimit	All set-ups	TRUE	1	Uint32
22-35	Low Speed Power [HP]	ExpressionLimit	All set-ups	TRUE	-2	Uint32
22-36	High Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
22-37	High Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
22-38	High Speed Power [kW]	ExpressionLimit	All set-ups	TRUE	1	Uint32
22-39	High Speed Power [HP]	ExpressionLimit	All set-ups	TRUE	-2	Uint32
22-4* Sleep Mode						
22-40	Minimum Run Time	60 s	All set-ups	TRUE	0	Uint16
22-41	Minimum Sleep Time	30 s	All set-ups	TRUE	0	Uint16
22-42	Wake-up Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
22-43	Wake-up Speed [Hz]	ExpressionLimit	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	4 set-up	Change during operation	Conver-sion 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]	ExpressionLimit	All set-ups	TRUE	67	Uint16
22-84	Speed at No-Flow [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
22-85	Speed at Design Point [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
22-86	Speed at Design Point [Hz]	ExpressionLimit	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

6.3.20 Timed Actions 23-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conversion index	Type
23-0* Timed Actions						
23-00	ON Time	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDayWoDate
23-01	ON Action	[0] Disabled	2 set-ups	TRUE	-	Uint8
23-02	OFF Time	ExpressionLimit	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	ExpressionLimit	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	ExpressionLimit	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	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDay
23-64	Timed Period Stop	ExpressionLimit	2 set-ups	TRUE	0	TimeOfDay
23-65	Minimum Bin Value	ExpressionLimit	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

6.3.21 Cascade Controller 25-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conversion index	Type
25-0* System Settings						
25-00	Cascade Controller	null	2 set-ups	FALSE	-	Uint8
25-02	Motor Start	[0] Direct on Line	2 set-ups	FALSE	-	Uint8
25-04	Pump Cycling	null	All set-ups	TRUE	-	Uint8
25-05	Fixed Lead Pump	null	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	ExpressionLimit	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	null	All set-ups	TRUE	-	Uint8
25-28	Stage Function Time	15 s	All set-ups	TRUE	0	Uint16
25-29	De-stage Function	null	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	ExpressionLimit	All set-ups	TRUE	0	Uint8
25-43	De-staging Threshold	ExpressionLimit	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	null	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	ExpressionLimit	All set-ups	TRUE	0	TimeOfDay-WoDate
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	Change during operation	Conver-sion 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

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

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion 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

6.3.23 Cascade CTL Option 27-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion index	Type
27-0* Control & Status						
27-01	Pump Status	[0] Ready	All set-ups	TRUE	-	Uint8
27-02	Manual Pump Control	[0] No Operation	2 set-ups	TRUE	-	Uint8
27-03	Current Runtime Hours	0 h	All set-ups	TRUE	74	Uint32
27-04	Pump Total Lifetime Hours	0 h	All set-ups	TRUE	74	Uint32
27-1* Configuration						
27-10	Cascade Controller	[0] Disabled	2 set-ups	FALSE	-	Uint8
27-11	Number Of Drives	1 N/A	2 set-ups	FALSE	0	Uint8
27-12	Number Of Pumps	ExpressionLimit	2 set-ups	FALSE	0	Uint8
27-14	Pump Capacity	100 %	2 set-ups	FALSE	0	Uint16
27-16	Runtime Balancing	[0] Balanced Priority 1	2 set-ups	TRUE	-	Uint8
27-17	Motor Starters	[0] Direct Online	2 set-ups	FALSE	-	Uint8
27-18	Spin Time for Unused Pumps	ExpressionLimit	All set-ups	TRUE	0	Uint16
27-19	Reset Current Runtime Hours	[0] Do not reset	All set-ups	TRUE	-	Uint8
27-2* Bandwidth Settings						
27-20	Normal Operating Range	ExpressionLimit	All set-ups	TRUE	0	Uint8
27-21	Override Limit	100 %	All set-ups	TRUE	0	Uint8
27-22	Fixed Speed Only Operating Range	ExpressionLimit	All set-ups	TRUE	0	Uint8
27-23	Staging Delay	15 s	All set-ups	TRUE	0	Uint16
27-24	De-staging Delay	15 s	All set-ups	TRUE	0	Uint16
27-25	Override Hold Time	10 s	All set-ups	TRUE	0	Uint16
27-27	Min Speed De-stage Delay	ExpressionLimit	All set-ups	TRUE	0	Uint16
27-3* Staging Speed						
27-31	Stage On Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
27-32	Stage On Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
27-33	Stage Off Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
27-34	Stage Off Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
27-4* Staging Settings						
27-40	Auto-tune Staging Settings	[1] Enabled	All set-ups	TRUE	-	Uint8
27-41	Ramp-down Delay	10.0 s	All set-ups	TRUE	-1	Uint16
27-42	Ramp-up Delay	2.0 s	All set-ups	TRUE	-1	Uint16
27-43	Staging Threshold	ExpressionLimit	All set-ups	TRUE	0	Uint8
27-44	De-staging Threshold	ExpressionLimit	All set-ups	TRUE	0	Uint8
27-45	Staging Speed [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
27-46	Staging Speed [Hz]	0.0 Hz	All set-ups	TRUE	-1	Uint16
27-47	De-staging Speed [rpm]	0 RPM	All set-ups	TRUE	67	Uint16
27-48	De-staging Speed [Hz]	0.0 Hz	All set-ups	TRUE	-1	Uint16
27-5* Alternate Settings						
27-50	Automatic Alternation	[0] Disabled	All set-ups	FALSE	-	Uint8
27-51	Alternation Event	null	All set-ups	TRUE	-	Uint8
27-52	Alternation Time Interval	0 min	All set-ups	TRUE	70	Uint16
27-53	Alternation Timer Value	0 min	All set-ups	TRUE	70	Uint16
27-54	Alternation At Time of Day	[0] Disabled	All set-ups	TRUE	-	Uint8
27-55	Alternation Predefined Time	ExpressionLimit	All set-ups	TRUE	0	TimeOfDay-WoDate
27-56	Alternate Capacity is <	0 %	All set-ups	TRUE	0	Uint8
27-58	Run Next Pump Delay	0.1 s	All set-ups	TRUE	-1	Uint16

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conver-sion index	Type
27-6* Digital Inputs						
27-60	Terminal X66/1 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
27-61	Terminal X66/3 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
27-62	Terminal X66/5 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
27-63	Terminal X66/7 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
27-64	Terminal X66/9 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
27-65	Terminal X66/11 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
27-66	Terminal X66/13 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
27-7* Connections						
27-70	Relay	[0] Standard Relay	2 set-ups	FALSE	-	Uint8
27-9* Readouts						
27-91	Cascade Reference	0.0 %	All set-ups	TRUE	-1	Int16
27-92	% Of Total Capacity	0 %	All set-ups	TRUE	0	Uint16
27-93	Cascade Option Status	[0] Disabled	All set-ups	TRUE	-	Uint8

6.3.24 Water Application Functions 29-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conversion index	Type
29-0* Pipe Fill						
29-00	Pipe Fill Enable	[0] Disabled	2 set-ups	FALSE	-	Uint8
29-01	Pipe Fill Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
29-02	Pipe Fill Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
29-03	Pipe Fill Time	0.00 s	All set-ups	TRUE	-2	Uint32
29-04	Pipe Fill Rate	0.001 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
29-05	Filled Setpoint	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32

6.3.25 Bypass Option 31-**

Par. No. #	Parameter description	Default value	4 set-up	Change during operation	Conversion index	Type
31-00	Bypass Mode	[0] Drive	All set-ups	TRUE	-	Uint8
31-01	Bypass Start Time Delay	30 s	All set-ups	TRUE	0	Uint16
31-02	Bypass Trip Time Delay	0 s	All set-ups	TRUE	0	Uint16
31-03	Test Mode Activation	[0] Disabled	All set-ups	TRUE	-	Uint8
31-10	Bypass Status Word	0 N/A	All set-ups	FALSE	0	V2
31-11	Bypass Running Hours	0 h	All set-ups	FALSE	74	Uint32
31-19	Remote Bypass Activation	[0] Disabled	2 set-ups	TRUE	-	Uint8

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	525–600 V ±10%

AC line voltage low / line drop-out:
During low AC line voltage or a line drop-out, the drive continues until the intermediate circuit voltage drops below the minimum stop level, which corresponds typically to 15% below the drive's lowest rated supply voltage. Power-up and full torque cannot be expected at AC line voltage lower than 10% below the 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, 480/600 V maximum.

Motor output (U, V, W):	
Output voltage	0–100% of supply voltage
Output frequency	0–800* Hz
Switching on output	Unlimited
Accel/Decel 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 AF-600 FP 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 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!*

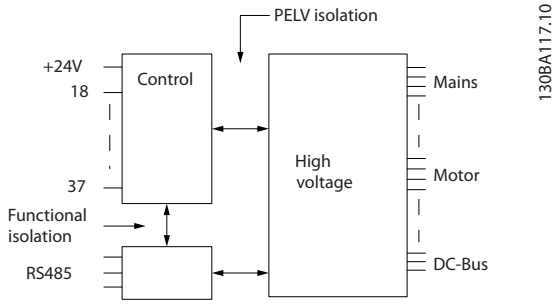
Digital inputs:	
Programmable digital inputs	4 (6)
Terminal number	18, 19, 27 [1)], 29, 32, 33,
Logic	PNP or NPN
Voltage level	0–24 V DC
Voltage level, logic'0' PNP	< 5 V DC
Voltage level, logic'1' PNP	> 10 V DC
Voltage level, logic '0' NPN	> 19 V DC
Voltage level, logic '1' NPN	< 14 V DC
Maximum voltage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

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

1) Terminals 27 and 29 can also be programmed as output.

Analog inputs:	
Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	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	110 kHz (push-pull driven)
Max. frequency at terminal, 29, 33	5 kHz (open collector)
Min. frequency at terminal 29, 33	4 Hz
Voltage level	see section on Digital input
Maximum voltage on input	28 V DC
Input resistance, R_i	approx. 4 kΩ
Pulse input accuracy (0.1–1 kHz)	Max. error: 0.1% of full scale
Analog output:	
Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	0/4–20 mA
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	0–24 V
Max. output current (sink or source)	40 mA
Max. load at frequency output	1 kΩ
Max. capacitive load at frequency output	10 nF
Minimum output frequency at frequency output	0 Hz
Maximum output frequency at frequency output	32 kHz
Accuracy of frequency output	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.

7

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

1) IEC 60947 t 4 and 5

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

2) Overvoltage Category II

3) UL applications 300 V AC 2 A

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

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

Control characteristics:	
Resolution of output frequency at 0–1000Hz	+/- 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 4X and 5X	IP 00, IP 21, IP 54
Enclosure, frame size 6X	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)	
- with derating	max. 131°F [55°C][1)]
- with full output power, typical EFF2 motors	max. 122°F [50°C][1)]
- at full continuous drive output current	max. 113°F [45°C][1)]

[1)] For more information on derating see the AF-600 FP, 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, Unit 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 380–480V AC				
	350 HP	450 HP	500 HP	550 HP
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 480 V [kW]	355	400	500	530
IP21/Nema 1 Drive Type	F8/F9	F8/F9	F8/F9	F8/F9
IP54/Nema 12 Drive Type	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/ 480 V) [A]	540	590	678	730
Intermittent (60 sec overload) (at 460/ 480 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 480 V) [KVA]	468	511	587	632
Max. input current				
Continuous (at 400 V) [A]	590	647	733	787
Continuous (at 460/ 480 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,Unit Size 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]			
* Heavy Duty = 160% torque during 60 sec, Light Duty = 110% torque during 60 sec.				

Line Power Supply 6 x 380–480V AC						
	650 HP	750 HP	900 HP	1000 HP	1200 HP	1400 HP
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 480 V [kW]	560	630	710	800	1000	1100
IP21/Nema 1 and IP54/Nema 12 Drive Types 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/ 480 V) [A]	780	890	1050	1160	1380	1530
Intermittent (60 sec overload) (at 460/ 480 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 480 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/ 480 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
max. added losses A1 RFI, CB or Disconnect, & contactor	963	1054	1093	1230	2280	2541
Max. panel options losses	400					
Weight, Unit Size 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]					
* Heavy Duty = 160% torque during 60 sec., Light Duty = 110% torque during 60 sec.						

Line Power Supply 3 x 525–690V AC				
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
IP21/Nema 1 Drive Type	F8/F9	F8/F9	F8/F9	F8/F9
IP54/Nema Drive Type	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, Unit Size 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]			
* Heavy Duty = 160% torque during 60 sec, Light Duty = 110% torque during 60 sec.				

Line Power Supply 3 x 525–690V AC			
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
IP21/Nema 1 and IP54/Nema 12 Drive Types 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
63/64 Max added losses CB or Disconnect & Contactor	427	532	615
Max panel options losses	400		
Weight, Unit Size 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]		
* Heavy Duty = 160% torque during 60 sec., Light Duty = 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 Troubleshooting

8.1 Alarms and Warnings

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 keypad.
2. Via a digital input with the "Reset" function.
3. Via serial communication/optional network.
4. By resetting automatically using the [Auto Reset] function, which is a default setting for AF-600 FP Drive, see *14-20 Reset Mode* in AF-600 FP Programming Guide

After a manual reset using the [RESET] button on the LCP, the [AUTO] or [HAND] 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 on following page).

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.

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
1	10 Volts low	X			
2	Live zero error	(X)	(X)		par. AN-01
3	No motor	(X)			par. H-80
4	Mains phase loss	(X)	(X)	(X)	par. SP-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)		par. F-10
11	Motor thermistor over-temperature	(X)	(X)		par. F-10
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)		par. O-04
23	Internal Fan Fault	X			
24	External Fan Fault	X			par. SP-53
29	Drive overtemperature	X	X	X	
30	Motor phase U missing	(X)	(X)	(X)	par. E-78
31	Motor phase V missing	(X)	(X)	(X)	par. E-78
32	Motor phase W missing	(X)	(X)	(X)	par. E-78
33	Inrush fault		X	X	
34	Fieldbus communication fault	X	X		
36	Mains failure	X	X		
38	Internal fault		X	X	
39	Heatsink sensor		X	X	
40	Overload of Digital Output Terminal 27	(X)			par. E-00, E-51
41	Overload of Digital Output Terminal 29	(X)			par. E-00, E-51
42	Overload of Digital Output On X30/6 (OPCGPIO)	(X)			par. E-56
42	Overload of Digital Output On X30/7 (OPCGPIO)	(X)			par. E-57
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			
50	Auto Tune calibration failed		X		
51	Auto Tune check U_{nom} and I_{nom}		X		
52	Auto Tune low I_{nom}		X		
53	Auto Tune motor too big		X		
54	Auto Tune motor too small		X		
55	Auto Tune parameter out of range		X		
56	Auto Tune interrupted by user		X		
57	Auto Tune timeout		X		
58	Auto Tune internal fault	X	X		
59	Current limit	X			
61	Tracking Error	(X)	(X)		par. H-20
62	Output Frequency at Maximum Limit	X			
65	Control Board Overtemperature	X	X	X	
66	Heat sink Temperature Low	X			
67	Option Configuration has Changed		X		
68	Safe Stop Activated		X[1)]		
69	Pwr. Card Temp		X	X	
70	Illegal Drive configuration			X	
72	Dangerous Failure			X[1)]	
73	Safe Stop Auto Restart				
77	Reduced power mode	X			
79	Illegal PS config		X	X	
80	Drive Restored to Factory Settings		X		
85	Profibus/Profisafe Error				
92	No-Flow	X	X		par. AP-2#
93	Dry Pump	X	X		par. AP-2#
94	End of Curve	X	X		par. AP-5#
95	Broken Belt	X	X		par. AP-6#
96	Start Delayed	X			par. AP-7#
97	Stop Delayed	X			par. AP-7#
98	Clock Fault	X			par. K-7#

Table 8.1 Alarm/Warning Code List

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
220	Overload Trip		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 part			X	
251	New Model Number		X	X	

Table 8.2 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 (Par. E-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

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	Auto Tune Running
2	00000004	4	Ground 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 Elec. OL Over	Motor Elec. OL 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	Auto Tune 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			
19	00080000	524288	U phase Loss		
20	00100000	1048576	V phase Loss		
21	00200000	2097152	W phase Loss	Speed Limit	
22	00400000	4194304	Fieldbus Fault	Fieldbus Fault	
23	00800000	8388608	24 V 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 Restored to Factory Settings	Unused	
30	40000000	1073741824		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 parameter 6-01, Live Zero Timeout Function. The signal on one of the analog inputs is less than 50% of the minimum value programmed for that input. This condition can be caused by broken wiring or faulty device sending the signal.

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 parameter 1-80, Function at Stop.

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

WARNING/ALARM 4, Mains phase 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 parameter 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 24 V backup supply is connected. If no 24 V backup supply is connected, the adjustable frequency drive trips after a fixed time delay. The time delay varies with unit size.

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. 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
According to the electronic thermal protection, 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 parameter 1-91, Motor External Fan.

Run AMA in parameter 1-29.

WARNING/ALARM 11, Motor thermistor over temp
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 parameter 1-93 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* (in motor operation) or the torque is higher than the value in *4-17 Torque Limit Generator Mode* (in regenerative operation). Parameter 14-25 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 (for each option slot)

15-61 Option SW Version (for each option slot)

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 Word Timeout Function* is NOT set to OFF.
If *8-04 Control Word 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 Word 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: There is a risk of substantial power being transmitted to the brake resistor if the brake transistor is short-circuited.

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 parameter 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.

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, Network communication fault
The network 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 parameter 4-53) or low limit (set in parameter 4-52). In *Process Control, Closed-loop* (parameter 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 time out
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
1301	Option SW in slot C0 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)
1317	Option SW in slot C0 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.
1381	Option C0 did not respond when calculating Platform Version.
1382	Option C1 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.
2325	A power card has stopped communicating while main power is applied.
2326	Power card configuration is determined to be incorrect after the delay for power cards to register.
2327	Too many power card locations have been registered as present.
2330	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

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 par. E-56 X30/6 Digital Out (OPCGPIO).

For X30/7, check the load connected to X30/7 or remove short-circuit connection. Check par. E-57 Term X30/7 Digital Out (OPCGPIO).

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: 24 V, 5 V, +/-18 V. When powered with 24 VDC with the MCB 107 option, only the 24 V and 5 V supplies are monitored. When powered with three phase AC line voltage, all three supplied are monitored.

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

WARNING 48, 1.8 V supply low
The 1.8 Volt 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
The speed is not within the specified range in *4-11 Motor Speed Low Limit [RPM]* and *4-13 Motor Speed High Limit [RPM]*.

ALARM 50, Auto Tune calibration failed
Contact your Danfoss supplier.

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

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

ALARM 53, Auto tune motor too big
The motor is too big for the Auto tune to be carried out.

ALARM 54, Auto tune motor too small
The motor is too big for the Auto tune to be carried out.

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

ALARM 56, Auto Tune interrupted by user
The Auto Tune has been interrupted by the user.

ALARM 57, Auto tune timeout
Try to start the Auto Tune again a number of times, until the Auto Tune 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.

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ALARM 58, Auto Tune internal fault
Contact your Danfoss supplier.

WARNING 59, Current limit
The current is higher than the value in par. 4-18, *Current Limit*.

WARNING 60, External interlock
External interlock has been activated. To resume normal operation, apply 24 VDC 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 61, Tracking error
An error has been detected between the calculated motor speed and the speed measurement from the feedback device. The function for Warning/Alarm/Disable is set in par 4-30, *Motor Feedback Loss Function*, error setting in par 4-31, *Motor Feedback Speed Error*, and the allowed error time in par 4-32, *Motor Feedback Loss Timeout*. During a commissioning procedure the function may be effective.

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:

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 VDC to terminal 37, then send a reset signal (via Bus, Digital I/O, or by pressing the reset key. See parameter 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 Drive Configuration
The current control board and power board combination is illegal.

WARNING/ALARM 71, PTC 1 safe stop
Safe Stop has been activated from the MCB 112 PTC Thermistor Card (motor too warm). Normal operation can be resumed when the MCB 112 applies 24 V DC to T-37 again (when the motor temperature reaches an acceptable level) and when the digital input from the MCB 112 is deactivated. When that happens, a reset signal must be sent (via serial communication, digital I/O, or by pressing reset button on keypad). Note that if automatic restart is enabled, the motor may start when the fault is cleared.

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. 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 Restored to Factory Settings
Parameter settings are restored to factory 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.

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. Remember to select 'Save to EEPROM' to complete.

ALARM 251, New model number
The adjustable frequency drive has a new model number.

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