Contents

1 Introduction

> **VLT HVAC Drive**
> **FC 100 Series**
> **Software version: 3.4.x**
>
> CE   c UL us   C

> This guide can be used with all VLT HVAC Drive frequency converters with software version 3.4.x.
> The actual software version number can be read from
> par. 15-43 *Software Version*.

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1.1.2 Available Literature for VLT HVAC Drive

- Operating Instructions MG.11.Ax.yy provide the necessary information for getting the frequency converter up and running.

- Operating Instructions VLT HVAC Drive High Power, MG.11.Fx.yy

- Design Guide MG.11.Bx.yy entails all technical information about the frequency converter and customer design and applications.

- Programming Guide MG.11.Cx.yy provides information on how to programme and includes complete parameter descriptions.

- Mounting Instruction, Analog I/O Option MCB109, MI.38.Bx.yy

- Application Note, Temperature Derating Guide, MN.11.Ax.yy

- PC-based Configuration Tool MCT 10, MG.10.Ax.yy enables the user to configure the frequency converter from a Windows™ based PC environment.

- Danfoss VLT® Energy Box software at *www.danfoss.com/BusinessAreas/DrivesSolutions* then choose PC Software Download

- VLT HVAC Drive Drive Applications, MG.11.Tx.yy

- Operating Instructions VLT HVAC Drive Profibus, MG.33.Cx.yy

- Operating Instructions VLT HVAC Drive Device Net, MG.33.Dx.yy

- Operating Instructions VLT HVAC Drive BACnet, MG.11.Dx.yy

- Operating Instructions VLT HVAC Drive LonWorks, MG.11.Ex.yy

- Operating Instructions VLT HVAC Drive Metasys, MG.11.Gx.yy

- Operating Instructions VLT HVAC Drive FLN, MG.11.Zx.yy

- Output Filter Design Guide, MG.90.Nx.yy

- Brake Resistor Design Guide, MG.90.Ox.yy

x = Revision number
yy = Language code

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

1.1.3 Abbreviations and Standards

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

Table 1.1: Abbreviation and standards table

1

1.1.4 Frequency Converter Identification

Below is an example of an identification label. This label is situated on the frequency converter and shows the type and options fitted to the unit. See below for details of how to read the Type code string (T/C).

Illustration 1.1: This example shows an identification label.

NOTE
Please have T/C (type code) number and serial number ready before contacting Danfoss.

1.1.5 Type Code String low and medium power

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	
F	C	-		0		P					T				H						X	X	S	X	X	X	X	A		B		C					D		

130BA052.14

Description	Pos	Possible choice
Product group & FC Series	1-6	FC 102
Power rating	8-10	1.1- 90 kW (P1K1 - P90K)
Number of phases	11	Three phases (T)
Mains voltage	11-12	T 2: 200-240 VAC T 4: 380-480 VAC T 6: 525-600 VAC
Enclosure	13-15	E20: IP20 E21: IP 21/NEMA Type 1 E55: IP 55/NEMA Type 12 E66: IP66 P21: IP21/NEMA Type 1 w/backplate P55: IP55/NEMA Type 12 w/backplate
RFI filter	16-17	H1: RFI filter class A1/B H2: RFI filter class A2 H3: RFI filter class A1/B (reduced cable length) Hx: No RFI filter
Brake	18	X: No brake chopper included B: Brake chopper included T: Safe Stop U: Safe + brake
Display	19	G: Graphical Local Control Panel (GLCP) N: Numeric Local Control Panel (NLCP) X: No Local Control Panel
Coating PCB	20	X. No coated PCB C: Coated PCB
Mains option	21	X: No Mains disconnect switch and Load Sharing 1: With Mains disconnect switch (IP55 only) 8: Mains disconnect and Load Sharing D: Load Sharing See Chapter 8 for max. cable sizes.
Adaptation	22	X: Standard 0: European metric thread in cable entries.
Adaptation	23	Reserved
Software release	24-27	Actual software
Software language	28	
A options	29-30	AX: No options A0: MCA 101 Profibus DP V1 A4: MCA 104 DeviceNet AG: MCA 108 Lonworks AJ: MCA 109 BACnet gateway
B options	31-32	BX: No option BK: MCB 101 General purpose I/O option BP: MCB 105 Relay option BO: MCB 109 Analog I/O option
C0 options MCO	33-34	CX: No options

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Description	Pos	Possible choice
C1 options	35	X: No options
C option software	36-37	XX: Standard software
D options	38-39	DX: No option D0: DC back-up

Table 1.2: Type code description.

The various Options and Accessories are described further in the *VLT HVAC Drive Design Guide, MG.11.BX.YY*.

2

2 Safety

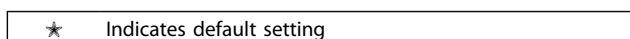## 2.1.1 Symbols

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

2.1.2 High Voltage Warning

⚠️ **WARNING!**

The voltage of the frequency converter and the MCO 101 option card is dangerous whenever it is connected to mains. Incorrect installation of the motor or frequency converter may causedeath, serious injury or damage to the equipment. Consequently, it is essential to comply with the instructions in this manual as well as local and national rules and safety regulations.

2.1.3 Safety Note

⚠️ **WARNING!**

The voltage of the frequency converter is dangerous whenever connected to mains. Incorrect installation of the motor, frequency converter or fieldbus may cause death, serious personal injury or damage to the equipment. Consequently, the instructions in this manual, as well as national and local rules and safety regulations, must be complied with.

Safety Regulations

1. The frequency converter must be disconnected from mains if repair work is to be carried out. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.

2. The [STOP/RESET] key on the LCP of the frequency converter does not disconnect the equipment from mains and is thus not to be used as a safety switch.

3. Correct protective earthing of the equipment must be established, the user must be protected against supply voltage, and the motor must be protected against overload in accordance with applicable national and local regulations.

4. The earth leakage currents are higher than 3.5 mA.

5. Protection against motor overload is set by par. 1-90 *Motor Thermal Protection*. If this function is desired, set par. 1-90 *Motor Thermal Protection* to data value [ETR trip] (default value) or data value [ETR warning]. Note: The function is initialized at 1.16 x rated motor current and rated motor frequency. For the North American market: The ETR functions provide class 20 motor overload protection in accordance with NEC.

6. Do not remove the plugs for the motor and mains supply while the frequency converter is connected to mains. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.

7. Please note that the frequency converter has more voltage inputs than L1, L2 and L3, when load sharing (linking of DC intermediate circuit) and external 24 V DC have been installed. Check that all voltage inputs have been disconnected and that the necessary time has passed before commencing repair work.

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Installation at high altitudes

⚠️ **CAUTION!**

380 - 500 V, enclosure A, B and C: At altitudes above 2 km, please contact Danfoss regarding PELV.
380 - 500 V, enclosure D, E and F: At altitudes above 3 km, please contact Danfoss regarding PELV.
525 - 690 V: At altitudes above 2 km, please contact Danfoss regarding PELV.

⚠️ **WARNING!**

Warning against Unintended Start

1. The motor can be brought to a stop by means of digital commands, bus commands, references or a local stop, while the frequency converter is connected to mains. If personal safety considerations make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient.

2. While parameters are being changed, the motor may start. Consequently, the stop key [STOP/RESET] must always be activated; following which data can be modified.

3. A motor that has been stopped may start if faults occur in the electronics of the frequency converter, or if a temporary overload or a fault in the supply mains or the motor connection ceases.

⚠️ **WARNING!**

Touching the electrical parts may be fatal - even after the equipment has been disconnected from mains.

Also make sure that other voltage inputs have been disconnected, such as external 24 V DC, load sharing (linkage of DC intermediate circuit), as well as the motor connection for kinetic back up. Refer to the Operating Instructions for further safety guidelines.

⚠️ **WARNING!**

The frequency converter DC link capacitors remain charged after power has been disconnected. To avoid an electrical shock hazard, disconnect the frequency converter from the mains before carrying out maintenance. Wait at least as follows before doing service on the frequency converter:

Voltage	Min. Waiting Time (Minutes)				
(V)	4	15	20	30	40
200 - 240	1.1 - 3.7 kW	5.5 - 45 kW			
380 - 480	1.1 - 7.5 kW	11 - 90 kW	110 - 250 kW		315 - 1000 kW
525 - 600	1.1 - 7.5 kW	11 - 90 kW			
525 - 690		11 - 90 kW	45 - 400 kW	450 - 1400 kW	
Be aware that there may be high voltage on the DC link even when the LEDs are turned off.					

2.1.4 Before Commencing Repair Work

1. Disconnect the frequency converter from mains

2. Disconnect DC bus terminals 88 and 89

3. Wait at least the time mentioned in section General Warning above

4. Remove motor cable

2.1.5 Special Conditions

Electrical ratings:
The rating indicated on the nameplate of the frequency converter is based on a typical 3-phase mains power supply, within the specified voltage, current and temperature range, which is expected to be used in most applications.

The frequency converters also support other special applications, which affect the electrical ratings of the frequency converter.
Special conditions which affect the electrical ratings might be:

- Single phase applications

- High temperature applications which require derating of the electrical ratings

- Marine applications with more severe environmental conditions.

Other applications might also affect the electrical ratings.

Consult the relevant sections in this manual and in the *VLT HVAC Drive Design Guide, MG.11.BX.YY* for information about the electrical ratings.

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Installation requirements:

The overall electrical safety of the frequency converter requires special installation considerations regarding:

- Fuses and circuit breakers for over-current and short-circuit protection

- Selection of power cables (mains, motor, brake, loadsharing and relay)

- Grid configuration (grounded delta transformer leg, IT,TN, etc.)

- Safety of low-voltage ports (PELV conditions).

Consult the relevant clauses in these instructions and in the VLT HVAC Drive Design Guide for information about the installation requirements.

2.1.6 Installation at High Altitudes (PELV)

⚠ **WARNING!**

Hazardous Voltage!
By altitudes above 2 km, please contact Danfoss regarding PELV.
Avoid un-intended start
While the frequency converter is connected to mains, the motor can be started/stopped using digital commands, bus commands, references or via the LCP.

- **Disconnect the frequency converter from mains whenever personal safety considerations make it necessary to avoid unintended start.**

- **To avoid unintended start, always activate the [OFF] key before changing parameters.**

- **Unless terminal 37 is turned off, an electronic fault, temporary overload, a fault in the mains supply, or lost motor connection may cause a stopped motor to start.**

Failure to follow recommendations could result in death or serious injury.

2.1.7 Avoid Unintended Start

⚠ **WARNING!**

While the frequency converter is connected to mains, the motor can be started/stopped using digital commands, bus commands, references or via the Local Control Panel.

- **Disconnect the frequency converter from mains whenever personal safety considerations make it necessary to avoid unintended start.**

- **To avoid unintended start, always activate the [OFF] key before changing parameters.**

- **Unless terminal 37 is turned off, an electronic fault, temporary overload, a fault in the mains supply, or lost motor connection may cause a stopped motor to start.**

2.1.8 Safe Stop of the Frequency Converter

For versions fitted with a Safe Stop terminal 37 input, the frequency converter 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 *VLT HVAC Drive Design Guide* must be followed! The information and instructions of the Operating Instructions are not sufficient for a correct and safe use of the Safe Stop functionality!

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Prüf- und Zertifizierungsstelle
im BG-PRÜFZERT

BGIA
Berufsgenossenschaftliches
Institut für Arbeitsschutz

Hauptverband der gewerblichen
Berufsgenossenschaften

Translation
In any case, the German
original shall prevail.

Type Test Certificate

	05 06004

No. of certificate

Name and address of the holder of the certificate: (customer)	Danfoss Drives A/S, Ulnaes 1 DK-6300 Graasten, Dänemark
Name and address of the manufacturer:	Danfoss Drives A/S, Ulnaes 1 DK-6300 Graasten, Dänemark

Ref. of customer:	Ref. of Test and Certification Body: Apf/Köh VE-Nr. 2003 23220	Date of Issue: 13.04.2005

Product designation:	Frequency converter with integrated safety functions
Type:	VLT® Automation Drive FC 302
Intended purpose:	Implementation of safety function „Safe Stop"
Testing based on:	EN 954-1, 1997-03, DKE AK 226.03, 1998-06, EN ISO 13849-2; 2003-12, EN 61800-3, 2001-02, EN 61800-5-1, 2003-09,
Test certificate:	No.: 2003 23220 from 13.04.2005
Remarks:	The presented types of the frequency converter FC 302 meet the requirements laid down in the test bases. With correct wiring a category 3 according to DIN EN 954-1 is reached for the safety function.

The type tested complies with the provisions laid down in the directive 98/37/EC (Machinery).

Further conditions are laid down in the Rules of Procedure for Testing and Certification of April 2004.

Head of certification body

(Prof. Dr. rer. nat. Dietmar Reinert)

Certification officer

(Dipl.-Ing. R. Apfeld)

PZB10E
01.05

Postal adress:	Office:	Phone: 0 22 41/2 31-02
53754 Sankt Augustin	Alte Heerstraße 111 53757 Sankt Augustin	Fax: 0 22 41/2 31-22 34

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Illustration 2.1: This certificate also covers FC 102 and FC 202.

2.1.9 IT Mains

⚠ **WARNING!**

IT mains
Do not connect frequency converters with RFI-filters to mains supplies with a voltage between phase and earth of more than 440 V for 400 V converters and 760 V for 690 V converters.
For 400 V IT mains and delta earth (grounded leg), mains voltage may exceed 440 V between phase and earth.
For 690 V IT mains and delta earth (grounded leg), mains voltage may exceed 760 V between phase and earth.
Failure to follow recommendations could result in death or serious injury.

Par. 14-50 *RFI Filter* can be used to disconnect the internal RFI capacitors from the RFI filter to ground.

2.1.10 Disposal Instruction

	Equipment containing electrical components must 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.
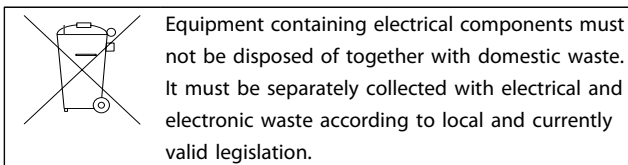
3 Mechanical Installation

3.1 Before Starting

3.1.1 Checklist
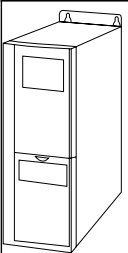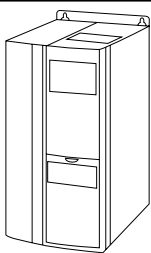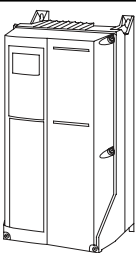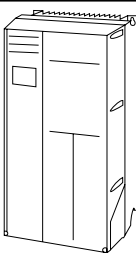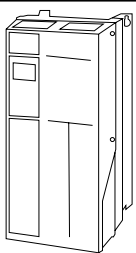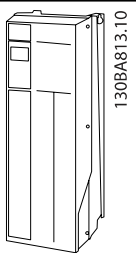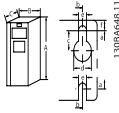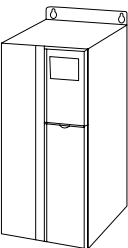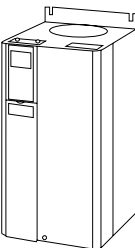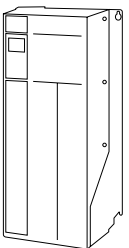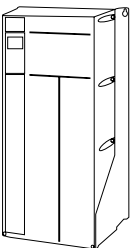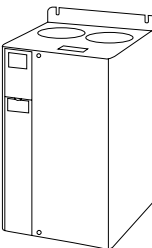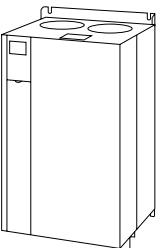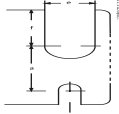
When unpacking the frequency converter, ensure that the unit is undamaged and complete. Use the following table to identify the packaging:

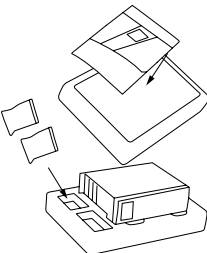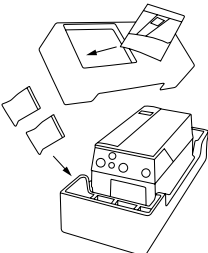| Enclosure type:	A2 (IP 20-21)	A3 (IP 20-21)	A4 (IP 55-66)	A5 (IP 55-66)	B1/B3 (IP 20-21-55-66)	B2/B4 (IP 20-21-55-66)	C1/C3 (IP 20-21-55-66)	C2*/C4 (IP 20-21-55-66)
	130BA295.10				130BA288.10			
Unit size (kW):								
200-240 V	1.1-2.2	3.0-3.7	1.1-2.2	1.1-3.7	5.5-11/ 5.5-11	15/ 15-18.5	18.5-30/ 22-30	37-45/ 37-45
380-480 V	1.1-4.0	5.5-7.5	1.1-4.0	1.1-7.5	11-18.5/ 11-18.5	22-30/ 22-37	37-55/ 45-55	75-90/ 75-90
525-600 V		1.1-7.5		1.1-7.5	11-18.5/ 11-18.5	22-30/ 22-37	37-55/ 45-55	75-90/ 75-90

Table 3.1: Unpacking table

Please note that a selection of screwdrivers (phillips or cross-thread screwdriver and torx), a side-cutter, drill and knife is also recommended to have handy for unpacking and mounting the frequency converter. The packaging for these enclosures contains, as shown: Accessories bag(s), documentation and the unit. Depending on options fitted there may be one or two bags and one or more booklets.

3

3.2.1 Mechanical Front Views

A2	A3	A4	A5	B1	B2
130BA809.10	130BA810.10	130BB458.10	130BA811.10	130BA812.10	130BA813.10
IP20/21*	IP20/21*	IP55/66	IP55/66	IP21/55/66	IP21/55/66

		Top and bottom mounting holes.			

B3	B4	C1	C2	C3	C4
130BA826.10	130BA827.10	130BA814.10	130BA815.10	130BA828.10	130BA829.10
IP20/21*	IP20/21*	IP21/55/66	IP21/55/66	IP20/21*	IP20/21*

Top and bottom mounting holes. (B4+C3+C4 only)

Accessory bags containing necessary brackets, screws and connectors are included with the drives upon delivery.

* IP21 can be established with a kit as described in the section: IP 21/ IP 4X/ TYPE 1 Enclosure Kit in the Design Guide.

3.2.2 Mechanical Dimensions
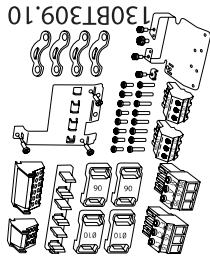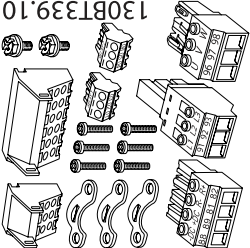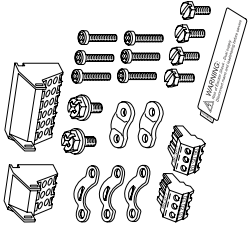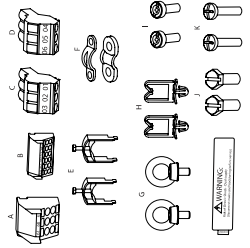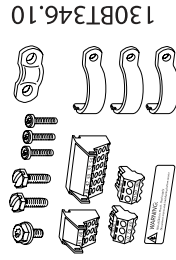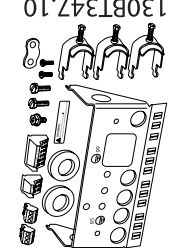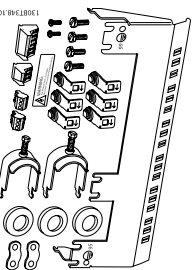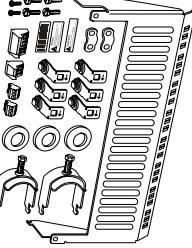
Mechanical Dimensions

		A2	A3	A4	A5	B1	B2	B3	B4	C1	C2	C3	C4
Frame size (kW):													
200-240 V		1.1-2.2	3.0-3.7	1.1-2.2	1.1-3.7	5.5-11	15	5.5-11	15-18.5	18.5-30	37-45	22-30	37-45
380-480 V		1.1-4.0	5.5-7.5	1.1-4.0	1.1-7.5	11-18.5	22-30	11-18.5	22-37	37-55	75-90	45-55	75-90
525-600 V			1.1-7.5		1.1-7.5	11-18.5	22-30	11-18.5	22-37	37-55	75-90	45-55	75-90
IP		20 / 21	20 / 21	55/66	55/66	21/ 55/66	21/ 55/66	20	20	21/ 55/66	21/ 55/66	20	20
NEMA		Chassis / Type 1	Chassis / Type 1	Type 12	Type 12	Type 1/12	Type 1/12	Chassis	Chassis	Type 1/12	Type 1/12	Chassis	Chassis
Height (mm)													
Enclosure	A**	246	246	390	420	480	650	350	460	680	770	490	600
..with de-coupling plate	A2	374	374	-	-	-	-	419	595	-	-	630	800
Back plate	A1	268	268	390	420	480	650	399	520	680	770	550	660
Distance between mount. holes	a	257	257	401	402	454	624	380	495	648	739	521	631
Width (mm)													
Enclosure	B	90	130	130	242	242	242	165	231	308	370	308	370
With one C option	B	130	170	170	242	242	242	205	231	308	370	308	370
Back plate	B	90	130	130	242	242	242	165	231	308	370	308	370
Distance between mount. holes	b	70	110	110	215	210	210	140	200	272	334	270	330
Depth (mm)													
Without option A/B	C	205	205	175	200	260	260	248	242	310	335	333	333
With option A/B	C*	220	220	175	200	260	260	262	242	310	335	333	333
Screw holes (mm)													
	c	8.0	8.0	8.2	8.2	12	12	8	-	12	12	-	-
Diameter ø	d	11	11	12	12	19	19	12	-	19	19	-	-
Diameter ø	e	5.5	5.5	6.5	6.5	9	9	6.8	8.5	9.0	9.0	8.5	8.5
	f	9	9	6	9	9	9	7.9	15	9.8	9.8	17	17
Max weight (kg)		4.9	6.6	9.7	14	23	27	12	23.5	45	65	35	50

* Depth of enclosure will vary with different options installed.

** The free space requirements are above and below the bare enclosure height measurement A. See section *Mechanical Mounting* for further information.

3.2.3 Accessory Bags

Accessory Bags: Find the following parts included in the frequency converter accessory bags

Frame sizes A1, A2 and A3

Frame size B3

Frame size A5

Frame size B4

Frame sizes B1 and B2

Frame size C3

Frame sizes C1 and C2

Frame size C4

1 + 2 only available in units with brake chopper. For DC link connection (Load sharing) the connector 1 can be ordered separately (Code no. 130B1064)

An eight pole connector is included in accessory bag for FC 102 without Safe Stop.

3.2.4 Mechanical Mounting

All IP20 enclosure sizes as well as IP21/ IP55 enclosure sizes except A2 and A3 allow side-by-side installation.

If the IP 21 Enclosure kit (130B1122 or 130B1123) is used on enclosure A2 or A3, there must be a clearance between the drives of min. 50 mm.

For optimal cooling conditions allow a free air passage above and below the frequency converter. See table below.
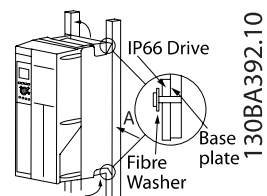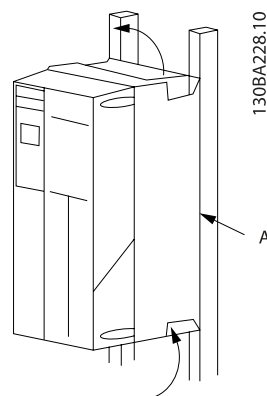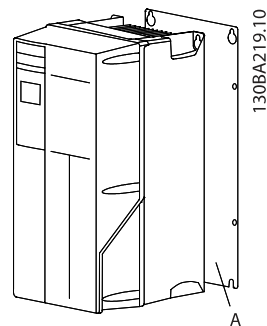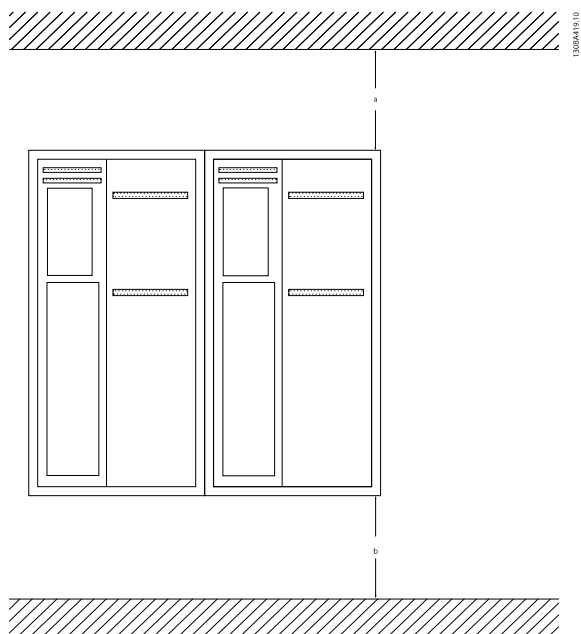
Air passage for different enclosures												
Enclo sure:	A2	A3	A4	A5	B1	B2	B3	B4	C1	C2	C3	C4
a (mm):	100	100	100	100	200	200	200	200	200	225	200	225
b (mm):	100	100	100	100	200	200	200	200	200	225	200	225

1. Drill holes in accordance with the measurements given.

2. You must provide screws suitable for the surface on which you want to mount the frequency converter. Re-tighten all four screws.

Mounting frame sizes A4, A5, B1, B2, B3, B4, C1, C2, C3 and C4 on a non-solid back wall, the frequency converter must be provided with a
backplate A due to insufficient cooling air over the heat sink.

With heavier drives (B4, C3, C4) use a lift. First wall-mount the 2 lower bolts - then lift the drive onto the lower bolts - finally fasten the drive against the wall with the 2 top bolts.

3.2.5 Safety Requirements of Mechanical Installation

⚠️ **WARNING!**

Pay attention to the requirements that apply to integration and field mounting kit. Observe the information in the list to avoid serious injury or equipment damage, especially when installing large units.

CAUTION!
The frequency converter is cooled by means of air circulation.
To protect the unit from overheating, it must be ensured that the ambient temperature *does not exceed the maximum temperature stated for the frequency converter* and that the 24-hour average temperature *is not exceeded*. Locate the maximum temperature and 24-hour average in the paragraph *Derating for Ambient Temperature*.
If the ambient temperature is in the range of 45 °C - 55 °C, derating of the frequency converter will become relevant, see *Derating for Ambient Temperature*.
The service life of the frequency converter is reduced if derating for ambient temperature is not taken into account.

3.2.6 Field Mounting

For field mounting the IP 21/IP 4X top/TYPE 1 kits or IP 54/55 units are recommended.

3.2.7 Panel Through Mounting

A Panel Through Mount Kit is available for frequency converter series VLT HVAC Drive, VLT Aqua Drive and VLT AutomationDrive.

In order to increase heatsink cooling and reduce panel depth, the frequency converter may be mounted in a through panel. Furthermore the in-built fan can then be removed.

The kit is available for enclosures A5 through C2.

NOTE
This kit cannot be used with cast front covers. IP21 plastic cover must be used instead.

Information on ordering numbers is found in the *Design Guide*, section *Ordering Numbers.*
More detailed information is available in the *Panel Through Mount Kit instruction, MI.33.HX.YY,* where yy=language code.

4 Electrical Installation

4.1 How to Connect

4.1.1 Cables General

NOTE

For the VLT HVAC Drive High Power series mains and motor connections, please see VLT HVAC Drive *High Power Operating Instructions MG.11.FX.YY.*

Details of terminal tightening torques.

NOTE

Cables General

All cabling must comply with national and local regulations on cable cross-sections and ambient temperature. Copper (60/75 °C) conductors are recommended.

Enclo-sure	Power (kW)			Torque (Nm)					
	200-240V	380-480V	525-600 V	Mains	Motor	DC connection	Brake	Earth	Relay
A2	1.1 - 3.0	1.1 - 4.0	1.1 - 4.0	1.8	1.8	1.8	1.8	3	0.6
A3	3.7	5.5 - 7.5	5.5 - 7.5	1.8	1.8	1.8	1.8	3	0.6
A4	1.1-2.2	1.1-4		1.8	1.8	1.8	1.8	3	0.6
A5	1.1 - 3.7	1.1 - 7.5	1.1 - 7.5	1.8	1.8	1.8	1.8	3	0.6
B1	5.5 - 11	11 - 18.5	11 - 18.5	1.8	1.8	1.5	1.5	3	0.6
B2	-	22	22	4.5	4.5	3.7	3.7	3	0.6
	15	30	30	4.5[2]	4.5[2]	3.7	3.7	3	0.6
B3	5.5 - 11	11 - 18.5	11 - 18.5	1.8	1.8	1.8	1.8	3	0.6
B4	15 - 18.5	22 - 37	22 - 37	4.5	4.5	4.5	4.5	3	0.6
C1	18.5 - 30	37 - 55	37 - 55	10	10	10	10	3	0.6
C2	37 - 45	75 - 90	75 - 90	14/24[1]	14/24[1]	14	14	3	0.6
C3	22 - 30	45 - 55	45 - 55	10	10	10	10	3	0.6
C4	37 - 45	75 - 90	75 - 90	14/24 [1]	14/24 [1]	14	14	3	0.6
High Power									
Enclo-sure		380-480 V		Mains	Motor	DC connection	Brake	Earth	Relay
D1/D3		110-132		19	19	9.6	9.6	19	0.6
D2/D4		160-250		19	19	9.6	9.6	19	0.6
E1/E2		315-450		19	19	19	9.6	19	0.6
F1-F3[3]		500-710	710-900	19	19	19	9.6	19	0.6
F2-F4[3]		800-1000	1000-1400	19	19	19	9.6	19	0.6

Table 4.1: Tightening of terminals

1) For different cable dimensions x/y, where x ≤ 95 mm² and y ≥ 95 mm².

2) Cable dimensions above 18.5 kW ≥ 35 mm² and below 22 kW ≤ 10 mm².

3) For data on the F frame sizes consult FC 100 High Power Operating Instructions.

4.1.2 Electrical Installation and Control Cables
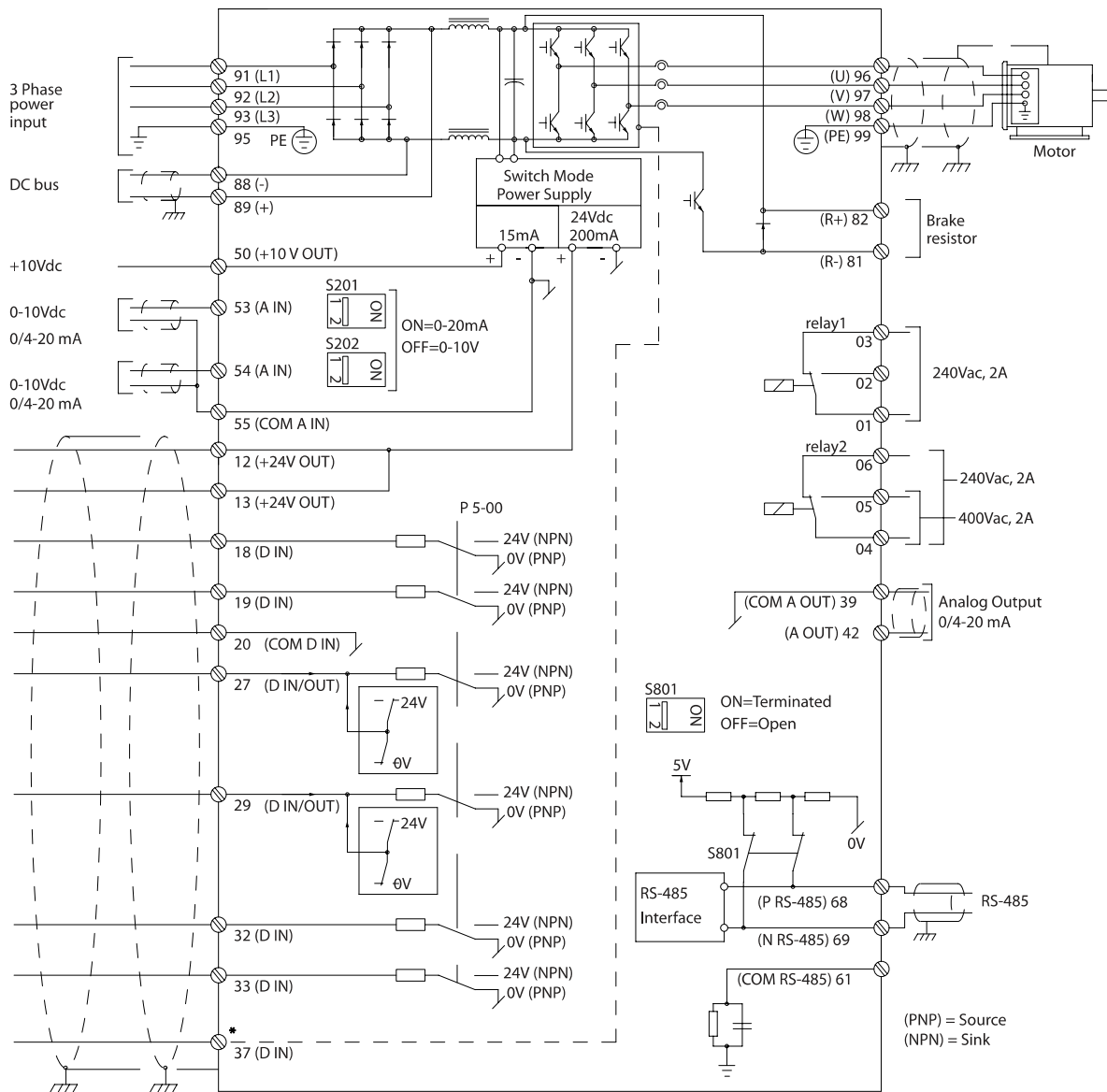
Illustration 4.1: Diagram showing all electrical terminals. (Terminal 37 present for units with Safe Stop Function only.)

4

Terminal number	Terminal description	Parameter number	Factory default
1+2+3	Terminal 1+2+3-Relay1	5-40	No operation
4+5+6	Terminal 4+5+6-Relay2	5-40	No operation
12	Terminal 12 Supply	-	+24 V DC
13	Terminal 13 Supply	-	+24 V DC
18	Terminal 18 Digital Input	5-10	Start
19	Terminal 19 Digital Input	5-11	No operation
20	Terminal 20	-	Common
27	Terminal 27 Digital Input/Output	5-12/5-30	Coast inverse
29	Terminal 29 Digital Input/Output	5-13/5-31	Jog
32	Terminal 32 Digital Input	5-14	No operation
33	Terminal 33 Digital Input	5-15	No operation
37	Terminal 37 Digital Input	-	Safe Stop
42	Terminal 42 Analog Output	6-50	Speed 0-HighLim
53	Terminal 53 Analog Input	3-15/6-1*/20-0*	Reference
54	Terminal 54 Analog Input	3-15/6-2*/20-0*	Feedback

Table 4.2: Terminal connections

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

If this occurs, break the screen or insert a 100 nF capacitor between screen and chassis.

NOTE
The common of digital / analog inputs and outputs should be connected to separate common terminals 20, 39, and 55. This will avoid ground current interference among groups. For example, it avoids switching on digital inputs disturbing analog inputs.

NOTE
Control cables must be screened/armoured.

4.1.3 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-circuit and over-current protected according to the national/international regulations.

⚠ WARNING!

Short-circuit protection:
The frequency converter 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 frequency converter provides full short-circuit protection in case of a short-circuit on the motor output.

⚠ WARNING!

Over-current protection
Provide overload protection to avoid fire hazard due to overheating of the cables in the installation. Over current protection must always be carried out according to national regulations. The frequency converter is equipped with an internal over current protection that can be used for upstream overload protection (UL-applications excluded). See par. 4-18 *Current Limit* in the *VLT HVAC Drive Programming Guide* . Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 A_rms (symmetrical), 500 V/600 V maximum.

Over-current protection
If UL/cUL is not to be complied with, Danfoss recommends using the fuses mentioned in the table below, which will ensure compliance with EN50178.
In case of malfunction, not following the recommendation may result in unnecessary damage to the frequency converter.

Non-UL compliance fuses

Frequency converter	Max. fuse size	Voltage	Type
200-240 V - T2			
1K1-1K5	16A[1]	200-240 V	type gG
2K2	25A[1]	200-240 V	type gG
3K0	25A[1]	200-240 V	type gG
3K7	35A[1]	200-240 V	type gG
5K5	50A[1]	200-240 V	type gG
7K5	63A[1]	200-240 V	type gG
11K	63A[1]	200-240 V	type gG
15K	80A[1]	200-240 V	type gG
18K5	125A[1]	200-240 V	type gG
22K	125A[1]	200-240 V	type gG
30K	160A[1]	200-240 V	type gG
37K	200A[1]	200-240 V	type aR
45K	250A[1]	200-240 V	type aR
380-480 V - T4			
1K1-1K5	10A[1]	380-500 V	type gG
2K2-3K0	16A[1]	380-500 V	type gG
4K0-5K5	25A[1]	380-500 V	type gG
7K5	35A[1]	380-500 V	type gG
11K-15K	63A[1]	380-500 V	type gG
18K	63A[1]	380-500 V	type gG
22K	63A[1]	380-500 V	type gG
30K	80A[1]	380-500 V	type gG
37K	100A[1]	380-500 V	type gG
45K	125A[1]	380-500 V	type gG
55K	160A[1]	380-500 V	type gG
75K	250A[1]	380-500 V	type aR
90K	250A[1]	380-500 V	type aR
1) Max. fuses - see national/international regulations for selecting an applicable fuse size.			

Table 4.3: Non-UL fuses 200 V to 480 V

If UL/cUL is not to be complied with, we recommend using the following fuses, which will ensure compliance with EN50178:

Frequency Converter	Voltage	Type
P110 - P250	380 - 480 V	type gG
P315 - P450	380 - 480 V	type gR

Table 4.4: Compliance with EN50178

UL compliance fuses

Frequency converter	Bussmann	Bussmann	Bussmann	SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
200-240 V							
kW	Type RK1	Type J	Type T	Type RK1	Type RK1	Type CC	Type RK1
K25-K37	KTN-R05	JKS-05	JJN-05	5017906-005	KLN-R005	ATM-R05	A2K-05R
K55-1K1	KTN-R10	JKS-10	JJN-10	5017906-010	KLN-R10	ATM-R10	A2K-10R
1K5	KTN-R15	JKS-15	JJN-15	5017906-015	KLN-R15	ATM-R15	A2K-15R
2K2	KTN-R20	JKS-20	JJN-20	5012406-020	KLN-R20	ATM-R20	A2K-20R
3K0	KTN-R25	JKS-25	JJN-25	5012406-025	KLN-R25	ATM-R25	A2K-25R
3K7	KTN-R30	JKS-30	JJN-30	5012406-030	KLN-R30	ATM-R30	A2K-30R
5K5	KTN-R50	JKS-50	JJN-50	5012406-050	KLN-R50	-	A2K-50R
7K5	KTN-R50	JKS-60	JJN-60	5012406-050	KLN-R60	-	A2K-50R
11K	KTN-R60	JKS-60	JJN-60	5014006-063	KLN-R60	A2K-60R	A2K-60R
15K	KTN-R80	JKS-80	JJN-80	5014006-080	KLN-R80	A2K-80R	A2K-80R
18K5	KTN-R125	JKS-150	JJN-125	2028220-125	KLN-R125	A2K-125R	A2K-125R
22K	KTN-R125	JKS-150	JJN-125	2028220-125	KLN-R125	A2K-125R	A2K-125R
30K	FWX-150	-	-	2028220-150	L25S-150	A25X-150	A25X-150
37K	FWX-200	-	-	2028220-200	L25S-200	A25X-200	A25X-200
45K	FWX-250	-	-	2028220-250	L25S-250	A25X-250	A25X-250

Table 4.5: UL fuses, 200 - 240 V

Frequency converter	Bussmann	Bussmann	Bussmann	SIBA	Littel fuse	Ferraz-Shawmut	Ferraz-Shawmut
380-480 V, 525-600 V							
kW	Type RK1	Type J	Type T	Type RK1	Type RK1	Type CC	Type RK1
K37-1K1	KTS-R6	JKS-6	JJS-6	5017906-006	KLS-R6	ATM-R6	A6K-6R
1K5-2K2	KTS-R10	JKS-10	JJS-10	5017906-010	KLS-R10	ATM-R10	A6K-10R
3K0	KTS-R15	JKS-15	JJS-15	5017906-016	KLS-R16	ATM-R16	A6K-16R
4K0	KTS-R20	JKS-20	JJS-20	5017906-020	KLS-R20	ATM-R20	A6K-20R
5K5	KTS-R25	JKS-25	JJS-25	5017906-025	KLS-R25	ATM-R25	A6K-25R
7K5	KTS-R30	JKS-30	JJS-30	5012406-032	KLS-R30	ATM-R30	A6K-30R
11K	KTS-R40	JKS-40	JJS-40	5014006-040	KLS-R40	-	A6K-40R
15K	KTS-R40	JKS-40	JJS-40	5014006-040	KLS-R40	-	A6K-40R
18K	KTS-R50	JKS-50	JJS-50	5014006-050	KLS-R50	-	A6K-50R
22K	KTS-R60	JKS-60	JJS-60	5014006-063	KLS-R60	-	A6K-60R
30K	KTS-R80	JKS-80	JJS-80	2028220-100	KLS-R80	-	A6K-80R
37K	KTS-R100	JKS-100	JJS-100	2028220-125	KLS-R100		A6K-100R
45K	KTS-R125	JKS-150	JJS-150	2028220-125	KLS-R125		A6K-125R
55K	KTS-R150	JKS-150	JJS-150	2028220-160	KLS-R150		A6K-150R
75K	FWH-220	-	-	2028220-200	L50S-225		A50-P225
90K	FWH-250	-	-	2028220-250	L50S-250		A50-P250

Table 4.6: UL fuses, 380 - 600 V

KTS-fuses from Bussmann may substitute KTN for 240 V frequency converters.

FWH-fuses from Bussmann may substitute FWX for 240 V frequency converters.

KLSR fuses from LITTEL FUSE may substitute KLNR fuses for 240 V frequency converters.

L50S fuses from LITTEL FUSE may substitute L50S fuses for 240 V frequency converters.

A6KR fuses from FERRAZ SHAWMUT may substitute A2KR for 240 V frequency converters.

A50X fuses from FERRAZ SHAWMUT may substitute A25X for 240 V frequency converters.

4.1.4 Earthing and IT Mains

⚠ WARNING!

The earth connection cable cross section must be at least 10 mm² or 2 rated mains wires terminated separately according to *EN 50178 or IEC 61800-5-1* unless national regulations specify differently. Always comply with national and local regulations. on cable cross-sections.

The mains is connected to the main disconnect switch if this is included.

⚠ CAUTION!

Check that mains voltage corresponds to the mains voltage of the frequency converter name plate.
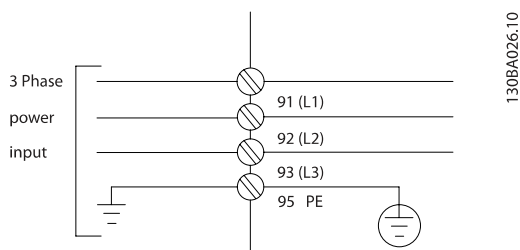
Illustration 4.2: Terminals for mains and earthing.

⚠ WARNING!

IT Mains
Do not connect 400 V frequency converters with RFI-filters to mains supplies with a voltage between phase and earth of more than 440 V.
For IT mains and delta earth (grounded leg), mains voltage may exceed 440 V between phase and earth.

4.1.5 Mains Wiring Overview
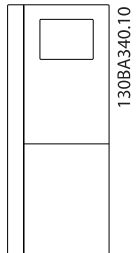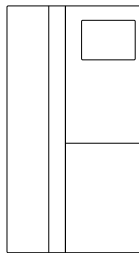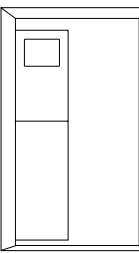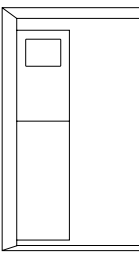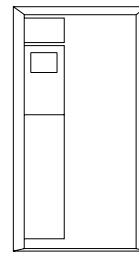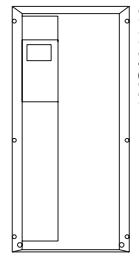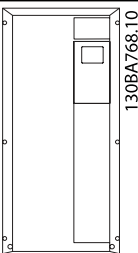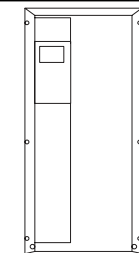
Enclosure:	A2 (IP 20/IP 21)	A3 (IP 20/IP 21)	A4 (IP 55/IP 66)	A5 (IP 55/IP 66)	B1 (IP 21/IP 55/IP 66)	B2 (IP 21/IP 55/IP 66)
	130BA340.10	130BA341.10	130BA342.10	130BA342.10	130BA343.10	130BA344.10
Motor size:						
200-240 V	1.1-3.0 kW	3.7 kW	1.1-2.2 kW	1.1-3.7 kW	5.5-11 kW	15 kW
380-480 V	1.1-4.0 kW	5.5-7.5 kW	1.1-.4 kW	1.1-7.5 kW	11-18.5 kW	22-30 kW
525-600 V		1.1-7.5 kW		1.1-7.5 kW	11-18.5 kW	22-30 kW
Enclosure:	B3 (IP 20)	B4 (IP 20)	C1 (IP 21/IP 55/66)	C2 (IP 21/IP 55/66)	C3 (IP 20)	C4 (IP20)
Goto:	4.1.5		4.1.6	4.1.6	4.1.7	
	130BA768.10	130BA344.10	130BA344.10	130BA344.10	130BA344.10	130BA344.10
Motor size:						
200-240 V	5.5-11 kW	15-18.5 kW	18.5-30 kW	37-45 kW	22-30 kW	37-45 kW
380-480 V	11-18.5 kW	22-37 kW	37-55 kW	75-90 kW	45-55 kW	75-90 kW
525-600 V	11-18.5 kW	22-37 kW	37-55 kW	75-90 kW	45-55 kW	75-90 kW
Goto:		4.1.8			4.1.9	

Table 4.7: Mains wiring table.

4.1.6 Mains Connection for A2 and A3

Illustration 4.3: First mount the two screws on the mounting plate, slide it into place and tighten fully.

> ⚠️ **WARNING!**
>
> The earth connection cable cross section must be at least 10 mm^2 or 2 rated mains wires terminated separately according to *EN 50178/IEC 61800-5-1*.
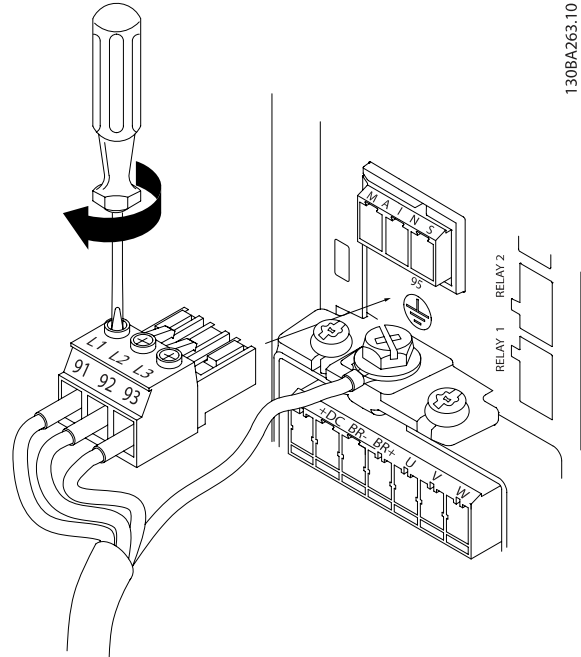
Illustration 4.5: Then mount mains plug and tighten wires.
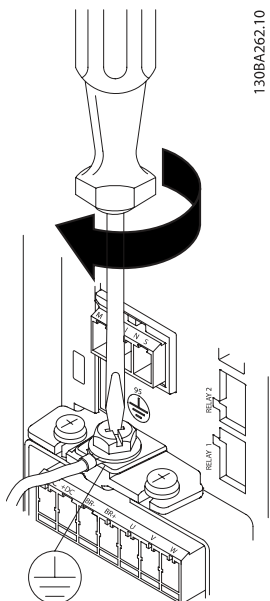
Illustration 4.4: When mounting cables, first mount and tighten earth cable.
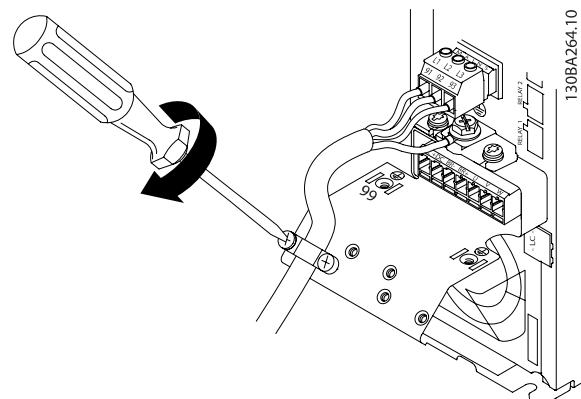
Illustration 4.6: Finally tighten support bracket on mains wires.

NOTE
With single phase A3 use L1 and L2 terminals.

4.1.7 Mains Connection for A4/A5
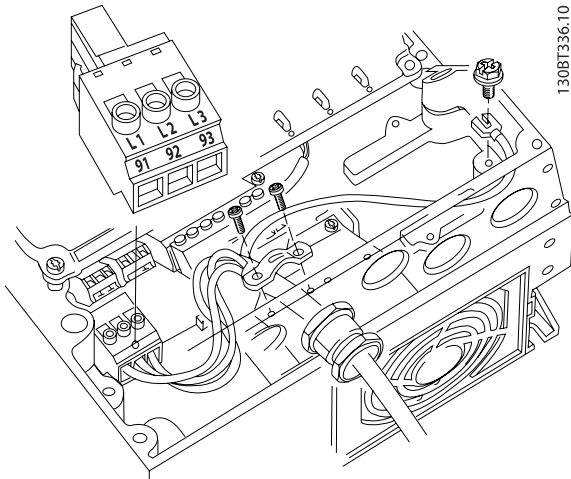
Illustration 4.7: How to connect to mains and earthing without mains disconnect switch. Note that a cable clamp is used.
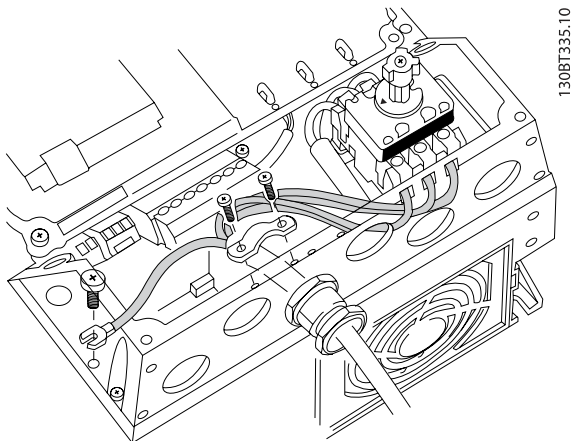
Illustration 4.8: How to connect to mains and earthing with mains disconnect switch.

NOTE
With single phase A5 use L1 and L2 terminals.

4.1.8 Mains Connection for B1, B2 and B3
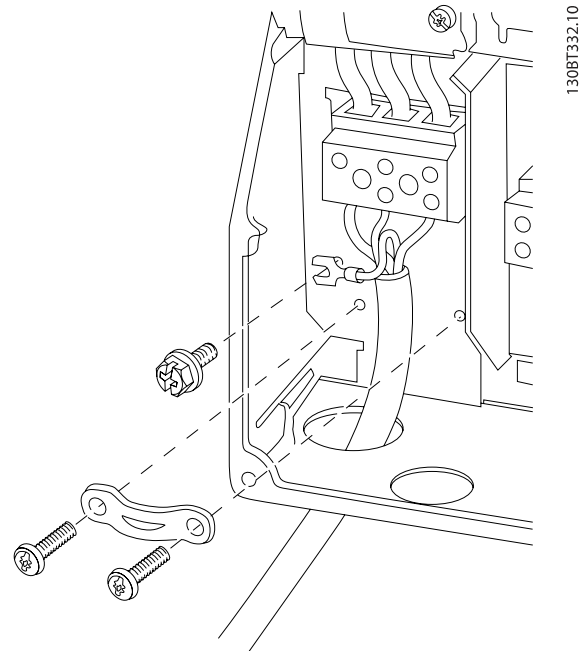
Illustration 4.9: How to connect to mains and earthing for B1 and B2
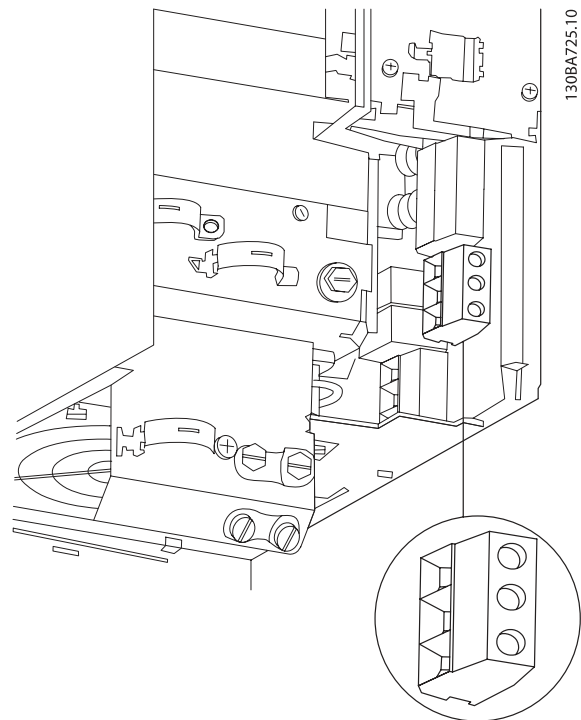
Illustration 4.10: How to connect to mains and earthing for B3 without RFI.

130BA720.10
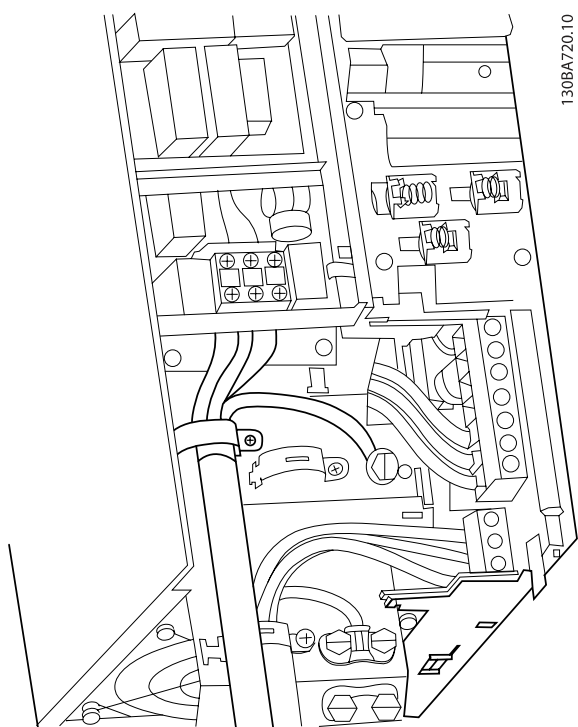
Illustration 4.11: How to connect to mains and earthing for B3 with RFI.

4.1.9 Mains Connection for B4, C1 and C2

130BA714.10
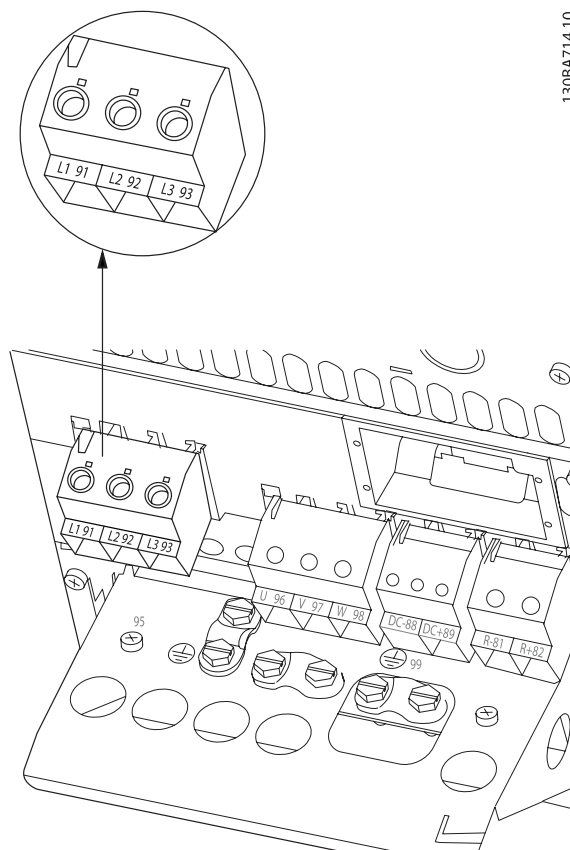
Illustration 4.12: How to connect to mains and earthing for B4.

NOTE
With single phase B1 use L1 and L2 terminals.

NOTE
For correct cable dimensions please see the section *General Specifications* at the back of this manual.

4

4
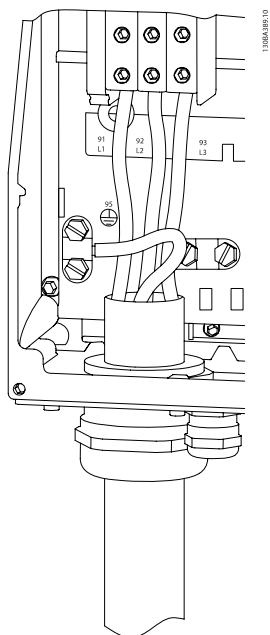
Illustration 4.13: How to connect to mains and earthing for C1 and C2.

4.1.10 Mains Connection for C3 and C4
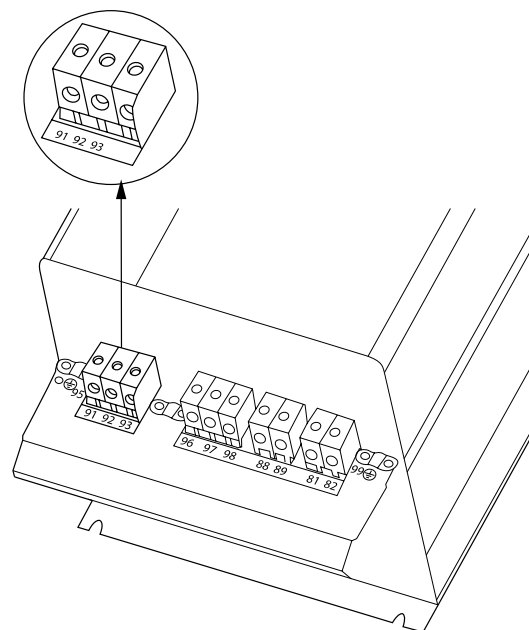
Illustration 4.14: How to connect C3 to mains and earthing.
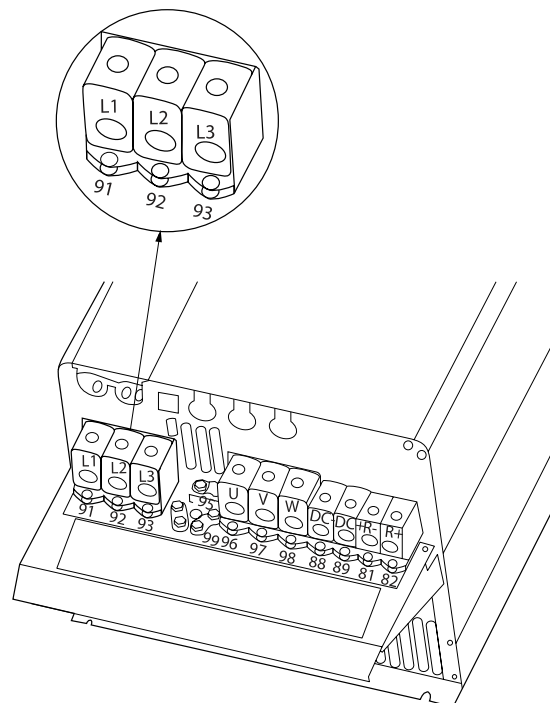
Illustration 4.15: How to connect C4 to mains and earthing.

4.1.11 How to Connect Motor - Introduction

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

- Use a screened/armoured motor cable to comply with EMC emission specifications (or install the cable in metal conduit).

- Keep the motor cable as short as possible to reduce the noise level and leakage currents.

- Connect the motor cable screen/armour to both the decoupling plate of the frequency converter and to the metal of the motor. (Same applies to both ends of metal conduit if used instead of screen.)

- Make the screen connections with the largest possible surface area (cable clamp or by using an EMC cable gland). This is done by using the supplied installation devices in the frequency converter.

- Avoid terminating the screen by twisting the ends (pigtails), as this will spoil high frequency screening effects.

- If it is necessary to break the continuity of the screen to install a motor isolator or motor relay, the continuity must be maintained with the lowest possible HF impedance.

Cable length and cross-section
The frequency converter has been tested with a given length of cable and a given cross-section of that cable. If the cross-section is increased, the cable capacitance - and thus the leakage current - may increase, and the cable length must be reduced correspondingly.

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

Precautions while using Aluminium conductors
Aluminium conductors are not recommended for cable cross sections below 35 mm². Terminals can accept aluminium conductors but the conductor surface has to be clean and the oxidation must be removed and sealed by neutral acid free Vaseline grease before the conductor is connected.

Furthermore, the terminal screw must be retightened after two days due to the softness of the aluminium. It is crucial to ensure the connection makes a gas tight joint, otherwise the aluminium surface will oxidize again.

All types of three-phase asynchronous standard motors can be connected to the frequency converter. Normally, small motors are star-connected (230/400 V, D/Y). Large motors are delta-connected (400/690 V, D/Y). Refer to the motor name plate for correct connection mode and voltage.
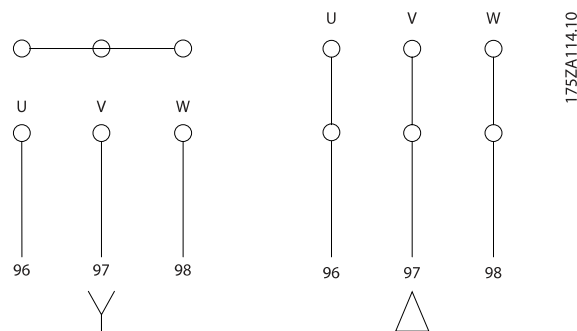
Illustration 4.16: Terminals for motor connection

CAUTION!
In motors without phase insulation paper or other insulation reinforcement suitable for operation with voltage supply (such as a frequency converter), fit a sine-wave filter on the output of the frequency converter. (Motors that comply with IEC 60034-17 do not require a Sine-wave filter).

No.	96	97	98	Motor voltage 0-100% of mains voltage.
	U	V	W	3 cables out of motor
	U1	V1	W1	6 cables out of motor, Delta-connected
	W2	U2	V2	
	U1	V1	W1	6 cables out of motor, Star-connected U2, V2, W2 to be interconnected separately (optional terminal block)
No.	99			Earth connection
	PE			

Table 4.8: 3 and 6 cable motor connection.
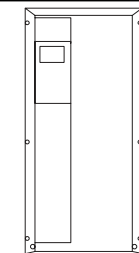
4.1.12 Motor Wiring Overview

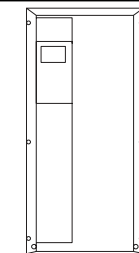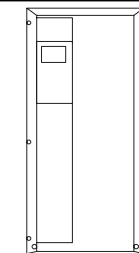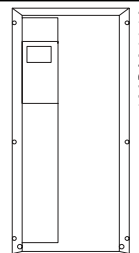| Enclosure:	A2 (IP 20/IP 21)	A3 (IP 20/IP 21)	A4 (IP 55/IP 66)	A5 (IP 55/IP 66)	B1 (IP 21/IP 55/ IP 66)	B2 (IP 21/IP 55/ IP 66)
Motor size:						
200-240 V	1.1-3.0 kW	3.7 kW	1.1-2.2 kW	1.1-3.7 kW	5.5-11 kW	15 kW
380-480 V	1.1-4.0 kW	5.5-7.5 kW	1.1-4 kW	1.1-7.5 kW	11-18.5 kW	22-30 kW
525-600 V		1.1-7.5 kW		1.1-7.5 kW	11-18.5 kW	22-30 kW
Goto:	**4.1.12**		**4.1.13**	**4.1.13**	**4.1.14**	
Enclosure:	B3 (IP 20)	B4 (IP 20)	C1 (IP 21/IP 55/66)	C2 (IP 21/IP 55/66)	C3 (IP 20)	C4 (IP20)
Motor size:						
200-240 V	5.5-11 kW	15-18.5 kW	18.5-30 kW	37-45 kW	22-30 kW	37-45 kW
380-480 V	11-18.5 kW	22-37 kW	37-55 kW	75-90 kW	45-55 kW	75-90 kW
525-600 V	11-18.5 kW	22-37 kW	37-55 kW	75-90 kW	45-55 kW	75-90 kW
Goto:	**4.1.15**		**4.1.16**		**4.1.17**	

Table 4.9: Motor wiring table.

4.1.13 Motor Connection for A2 and A3

Follow these drawings step by step for connecting the motor to the frequency converter.
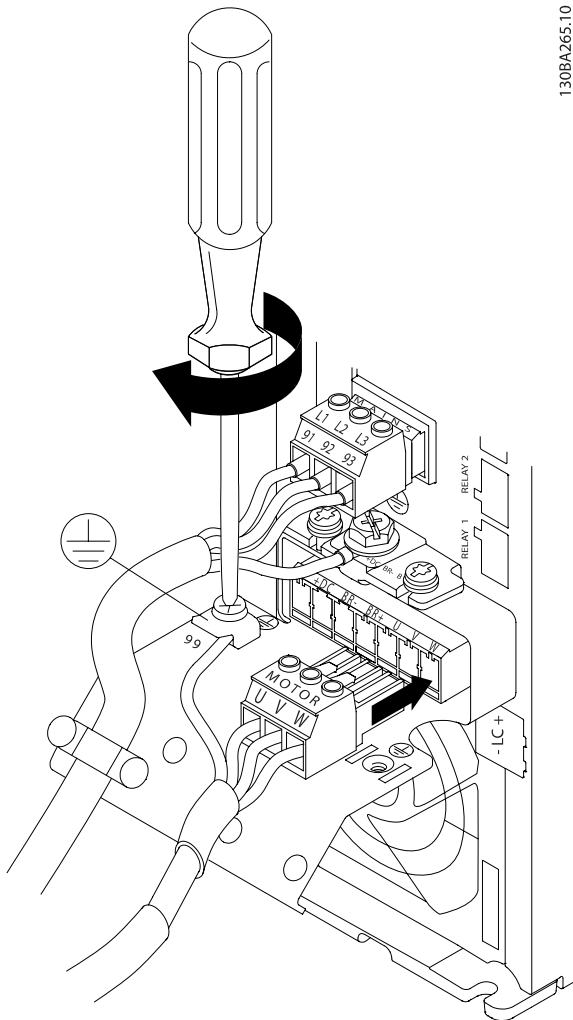
Illustration 4.17: First terminate the motor earth, then place motor U, V and W wires in plug and tighten.
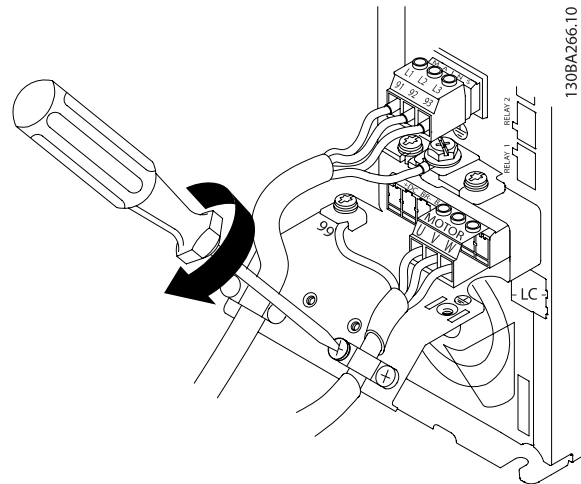
Illustration 4.18: Mount cable clamp to ensure 360 degree connection between chassis and screen, note the outer insulation of the motor cable is removed under the clamp.

4.1.14 Motor Connection for A4/A5
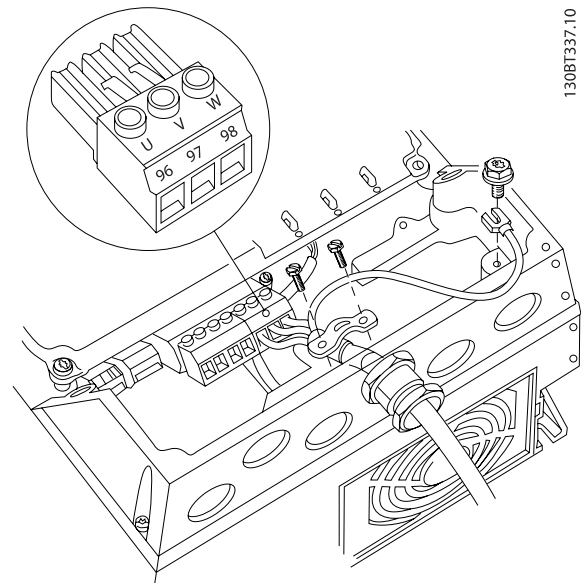
Illustration 4.19: First terminate the motor earth, then place motor U, V and W wires in terminal and tighten. Please ensure that the outer insulation of the motor cable is removed under the EMC clamp.

4

4.1.15 Motor Connection for B1 and B2
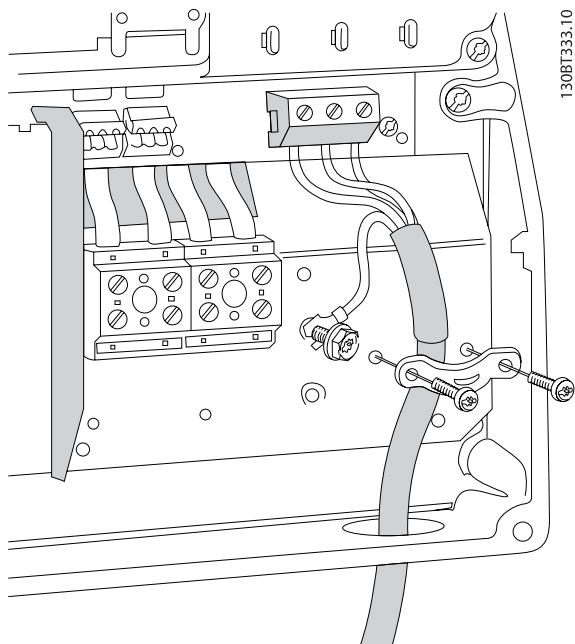
First terminate the motor earth, then Place motor U, V and W wires in terminal and tighten. Please ensure that the outer insulation of the motor cable is removed under the EMC clamp.

First terminate the motor earth, then Place motor U, V and W wires in terminal and tighten. Please ensure that the outer insulation of the motor cable is removed under the EMC clamp.
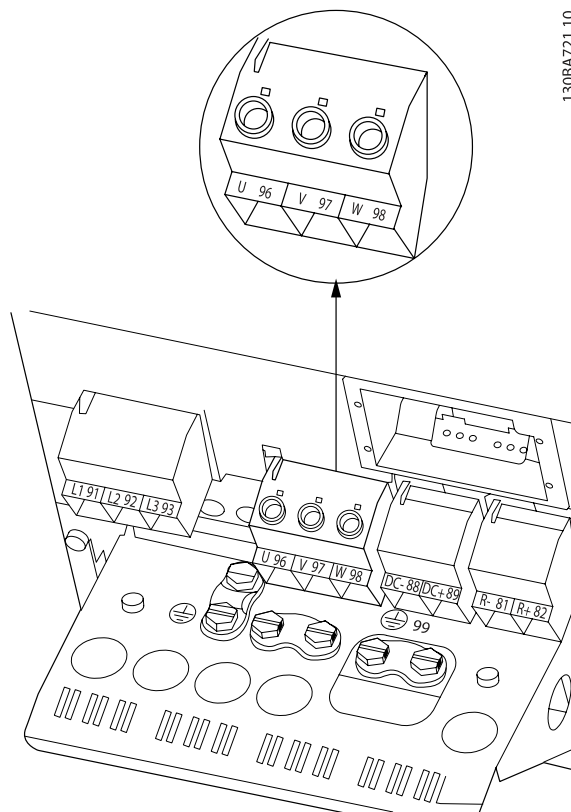
4.1.16 Motor Connection for B3 and B4
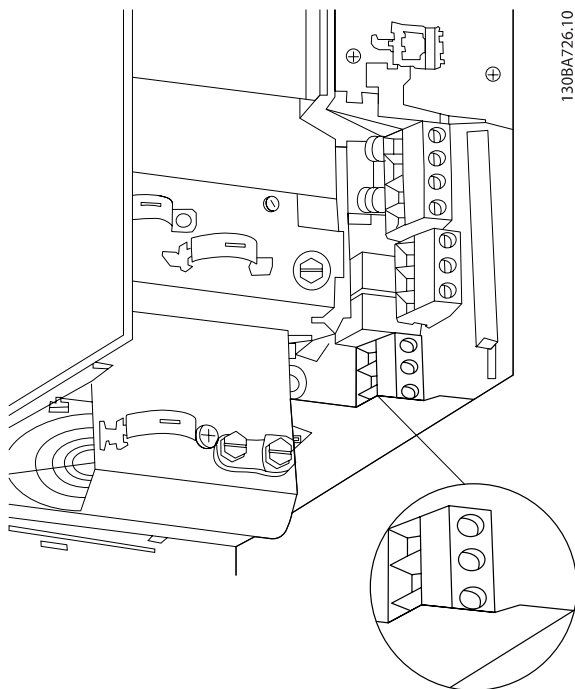
First terminate the motor earth, then Place motor U, V and W wires in terminal and tighten. Please ensure that the outer insulation of the motor cable is removed under the EMC clamp.

4.1.17 Motor Connection for C1 and C2
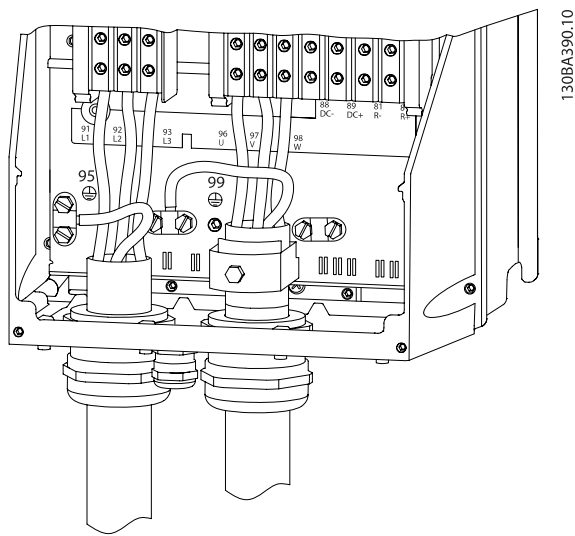
First terminate the motor earth, then Place motor U, V and W wires in terminal and tighten. Please ensure that the outer insulation of the motor cable is removed under the EMC clamp.

First terminate the motor earth, then place motor U, V and W wires into the appropriate terminals and tighten. Please ensure that the outer insulation of the motor cable is removed under the EMC clamp.

4.1.18 Motor Connection for C3 and C4
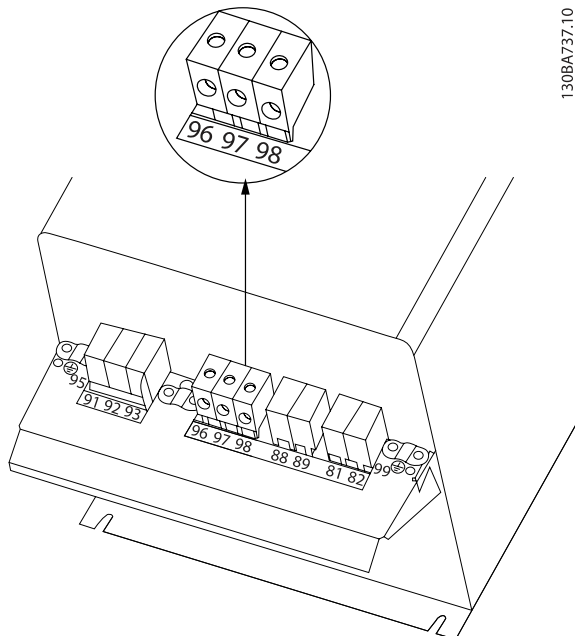
4.1.19 Wiring Example and Testing

The following section describes how to terminate control wires and how to access them. For an explanation of the function, programming and wiring of the control terminals, please see chapter, *How to programme the frequency converter*.

First terminate the motor earth, then place motor U, V and W wires into the appropriate terminals and tighten. Please ensure that the outer insulation of the motor cable is removed under the EMC clamp.

4.1.20 DC Bus Connection

The DC bus terminal is used for DC back-up, with the intermediate circuit being supplied from an external source.

Terminal number 88 and 89 are used.

Illustration 4.21: DC bus connections for enclosure B4.

Illustration 4.20: DC bus connections for enclosure B3.
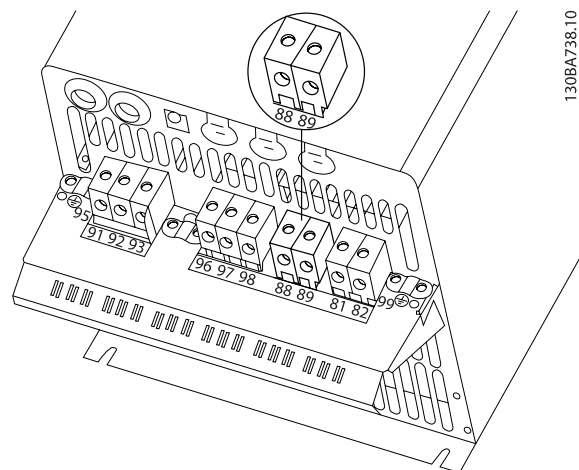
Illustration 4.22: DC bus connections for enclosure C3.

4
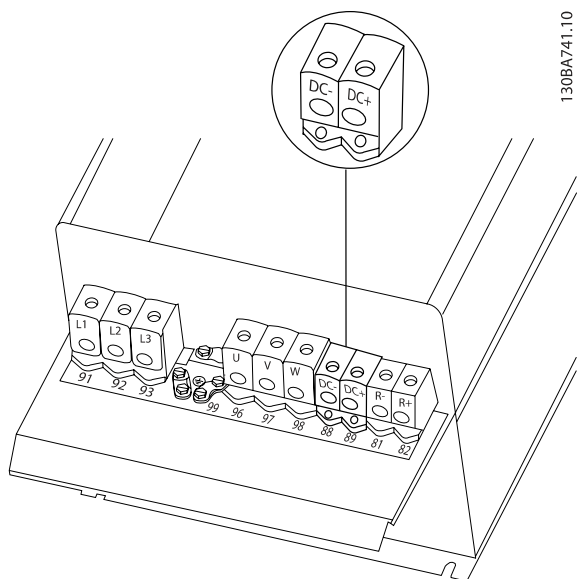
Illustration 4.23: DC bus connections for enclosure C4.
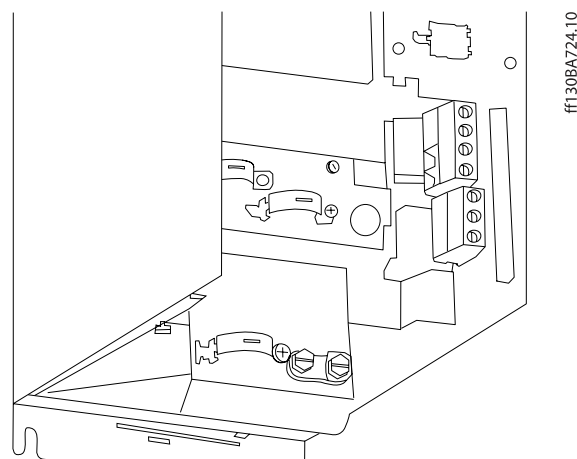
Illustration 4.24: Brake connection terminal for B3.

Please contact Danfoss if you require further information.

4.1.21 Brake Connection Option

The connection cable to the brake resistor must be screened/armoured.

Brake resistor		
Terminal number	81	82
Terminals	R-	R+

⚠ CAUTION!

Dynamic brake calls for extra equipment and safety considerations. For further information, please contact Danfoss.

1. Use cable clamps to connect the screen to the metal cabinet of the frequency converter and to the decoupling plate of the brake resistor.

2. Dimension the cross-section of the brake cable to match the brake current.

⚠ WARNING!

Voltages up to 975 V DC (@ 600 V AC) may occur between the terminals.
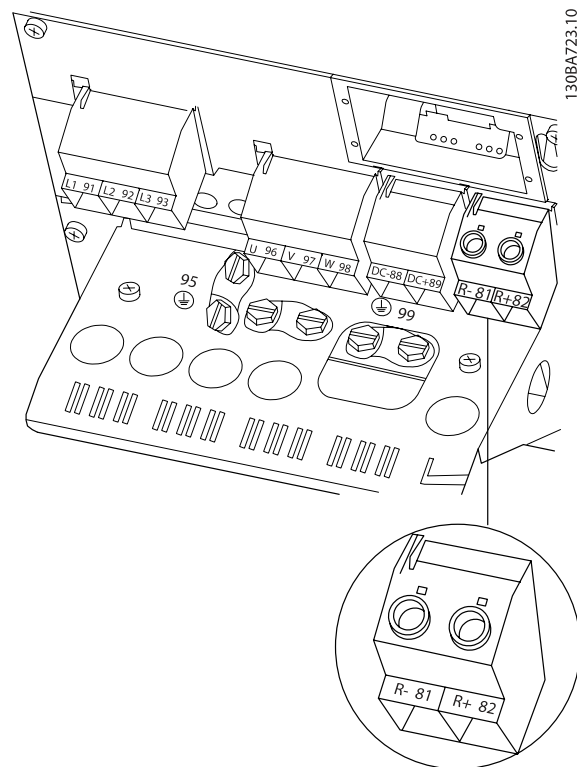
Illustration 4.25: Brake connection terminal for B4.
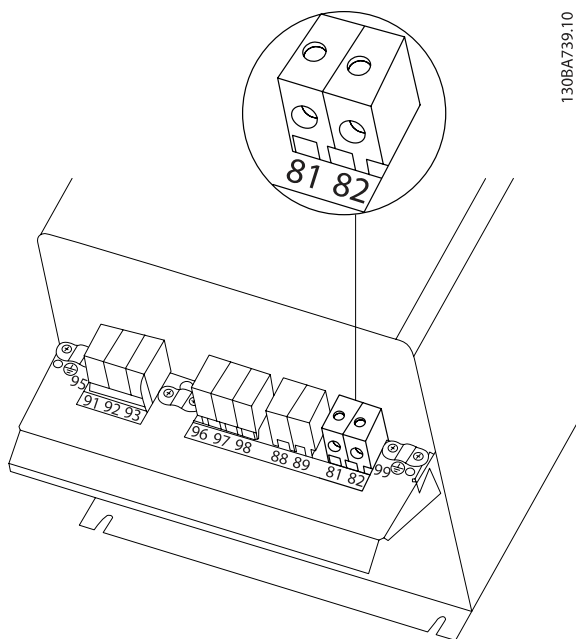
Illustration 4.26: Brake connection terminal for C3.

⚠️ **WARNING!**

If a short circuit in the brake IGBT occurs, prevent power dissipation in the brake resistor by using a mains switch or contactor to disconnect the mains for the frequency converter. Only the frequency converter shall control the contactor.

⚠️ **CAUTION!**

Place the brake resistor in an environment free of fire risk and ensure that no external objects can fall into the brake resistor through ventilation slots.
Do not cover ventilation slots and grids.

4.1.22 Relay Connection

To set relay output, see par. group 5-4* Relays.

No.	01 - 02	make (normally open)
	01 - 03	break (normally closed)
	04 - 05	make (normally open)
	04 - 06	break (normally closed)
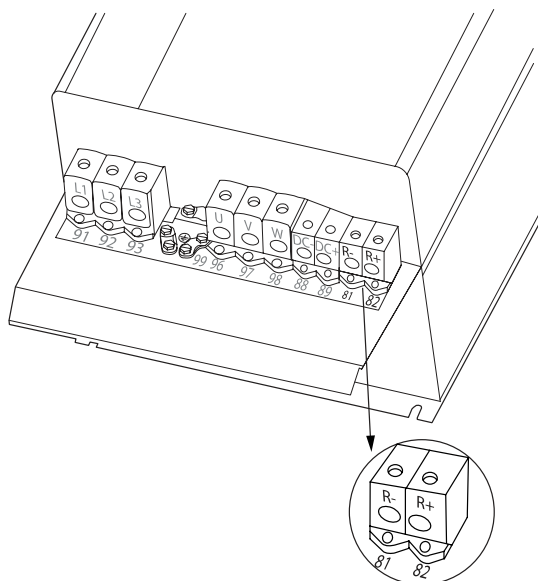
Illustration 4.27: Brake connection terminal for C4.

4
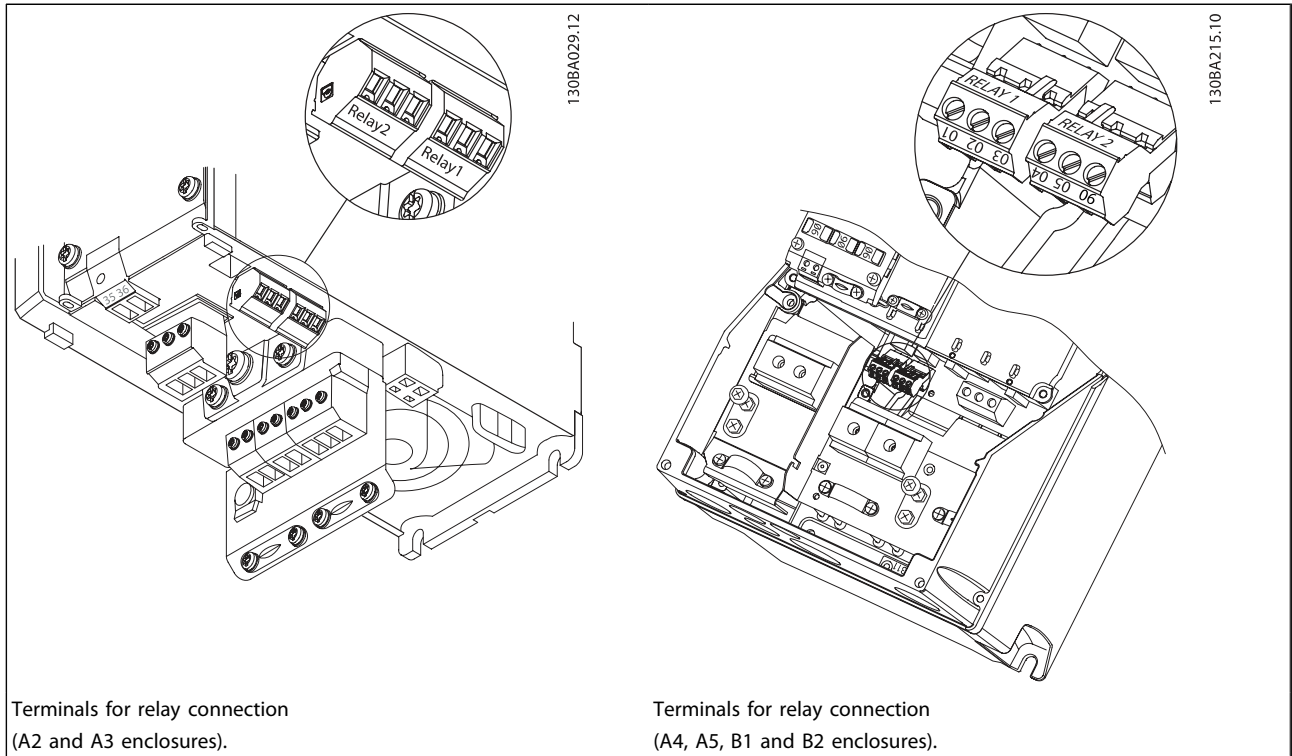
Terminals for relay connection
(A2 and A3 enclosures).

Terminals for relay connection
(A4, A5, B1 and B2 enclosures).
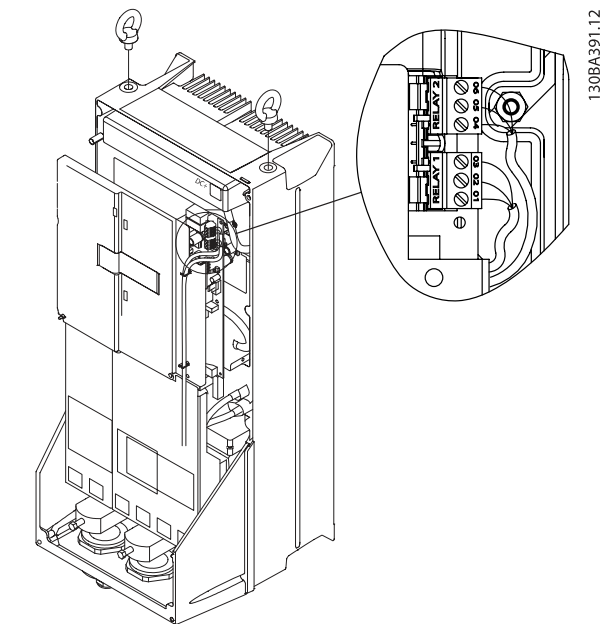
Illustration 4.28: Terminals for relay connection (C1 and C2 enclosures).
The relay connections are shown in the cut-out with relay plugs (from the Accessory Bag) fitted.
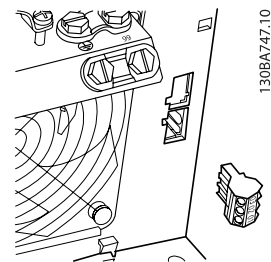
Illustration 4.29: Terminals for relay connections for B3. Only one relay input is fitted from the factory. When the second relay is needed remove knock-out.
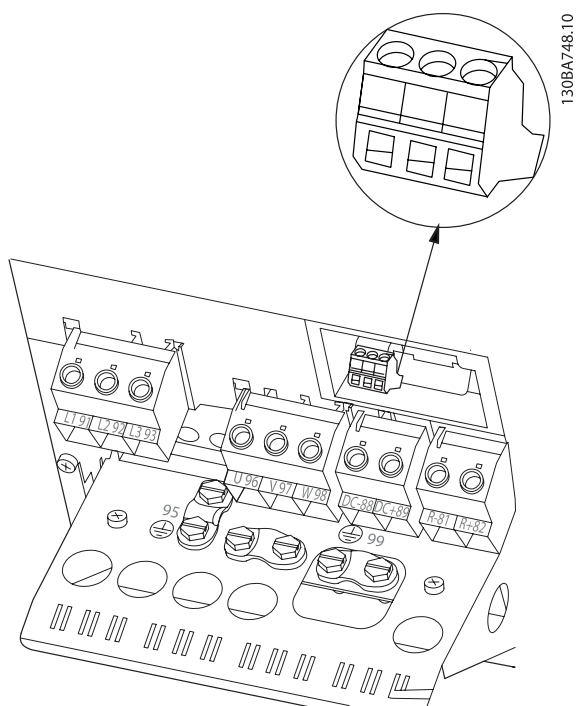
Illustration 4.30: Terminals for relay connections for B4.
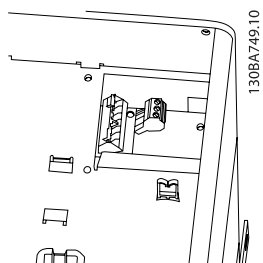
Illustration 4.31: Terminals for relay connections for C3 and C4. Located in the upper right corner of the frequency converter.

Relay 1 and relay 2 are programmed in par. 5-40 *Function Relay*, par. 5-41 *On Delay, Relay*, and par. 5-42 *Off Delay, Relay*.

Additional relay outputs by using option module MCB 105.
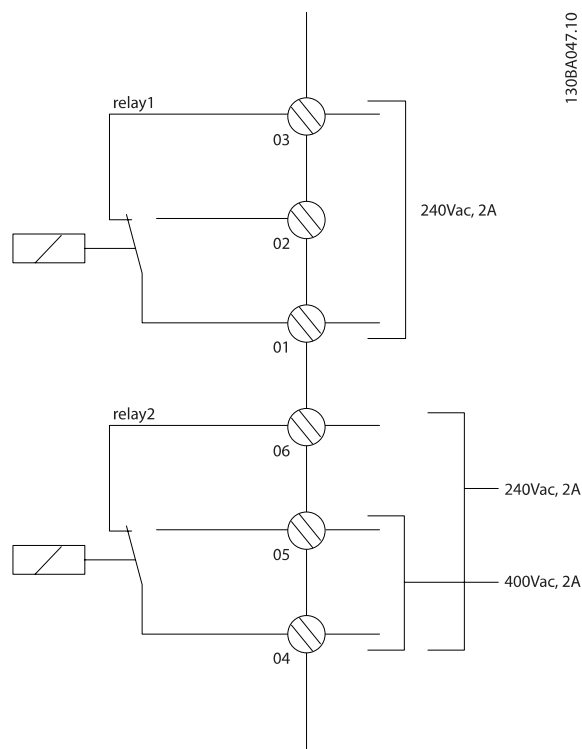
4.1.23 Relay Output

Relay 1

- Terminal 01: common
- Terminal 02: normal open 240 V AC
- Terminal 03: normal closed 240 V AC

Relay 2

- Terminal 04: common
- Terminal 05: normal open 400 V AC
- Terminal 06: normal closed 240 V AC

4.1.24 Access to Control Terminals

All terminals to the control cables are located underneath the terminal cover on the front of the frequency converter. Remove the terminal cover with a screwdriver.
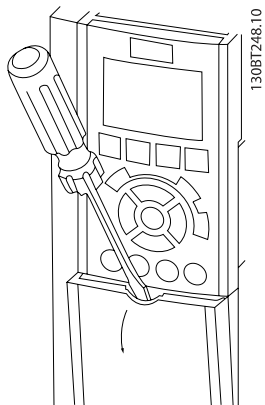
Illustration 4.32: Access to control terminals for A2, A3, B3, B4, C3 and C4 enclosures

Remove front-cover to access control terminals. When replacing the front-cover, please ensure proper fastening by applying a torque of 2 Nm.
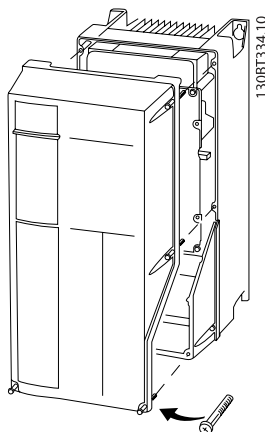
Illustration 4.33: Access to control terminals for A4, A5, B1, B2, C1 and C2 enclosures

4.1.25 Control Terminals

Drawing reference numbers:

1.　　10-pole plug digital I/O.

2.　　3-pole plug RS-485 Bus.

3.　　6-pole analog I/O.

4.　　USB connection.
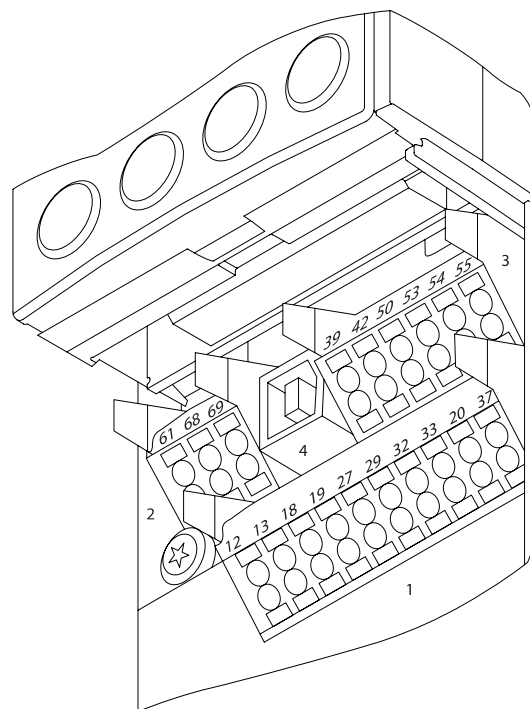
Illustration 4.34: Control terminals (all enclosures)

4.1.26 How to Test Motor and Direction of Rotation

⚠ **WARNING!**

Note that unintended motor start can occur, ensure no personnel or equipment is in danger!

Please follow these steps to test the motor connection and direction of rotation. Start with no power to the unit.
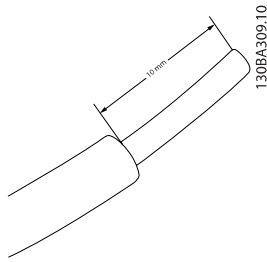
Illustration 4.35:
Step 1: First remove the insulation on both ends of a 50 to 70 mm piece of wire.
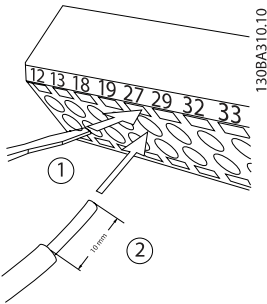
Illustration 4.36:
Step 2: Insert one end in terminal 27 using a suitable terminal screwdriver. (Note: For units with Safe Stop function, the existing jumper between terminal 12 and 37 should not be removed for the unit to be able to run!)
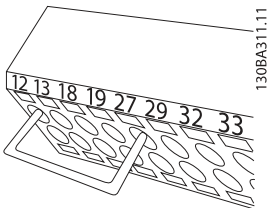
Illustration 4.37:
Step 3: Insert the other end in terminal 12 or 13. (Note: For units with Safe Stop function, the existing jumper between terminal 12 and 37 should not be removed for the unit to be able to run!)
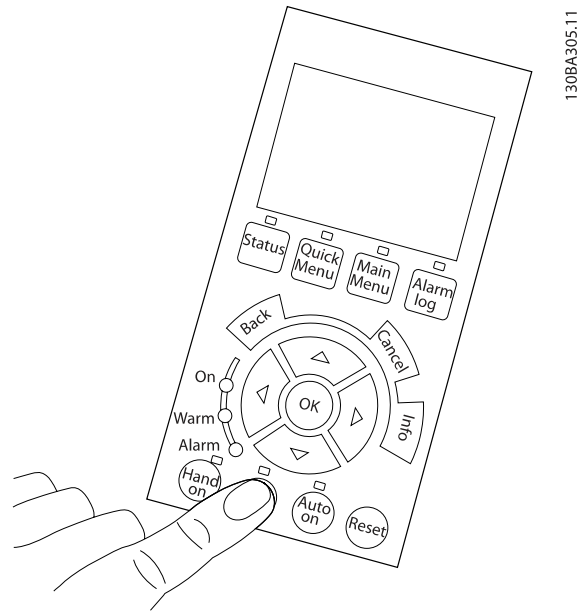
Illustration 4.38:
Step 4: Power-up the unit and press the [Off] button. In this state the motor should not rotate. Press [Off] to stop the motor at any time. Note the LED at the [OFF] button should be lit. If alarms or warnings are flashing, please see chapter 7 regarding these.
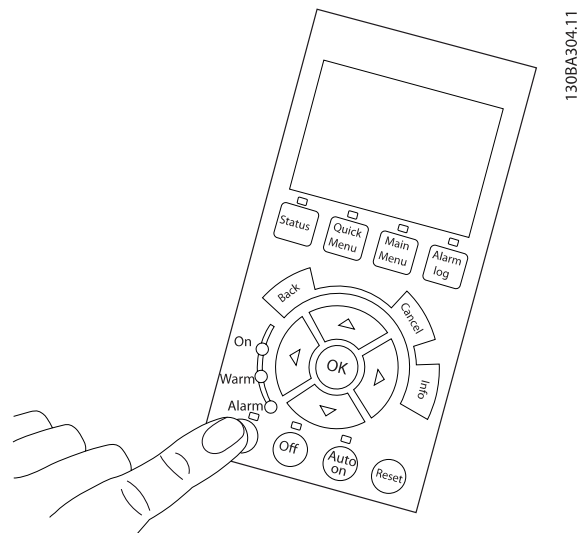
Illustration 4.39:
Step 5: By pressing the [Hand on] button, the LED above the button should be lit and the motor may rotate.

4
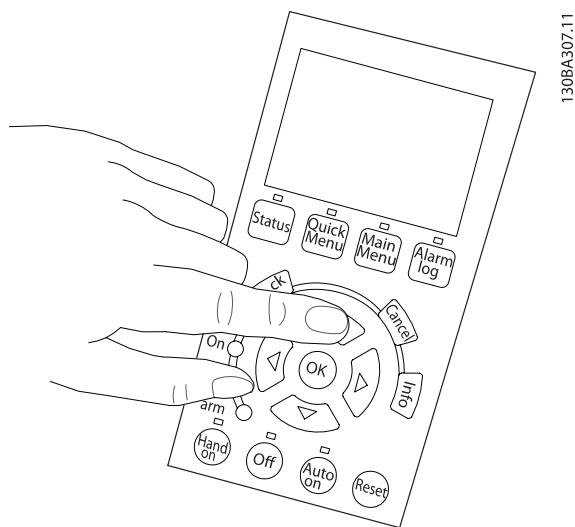
Illustration 4.40:
Step 6: The speed of the motor can be seen in the LCP. It can be adjusted by pushing the up ▲ and down ▼ arrow buttons.
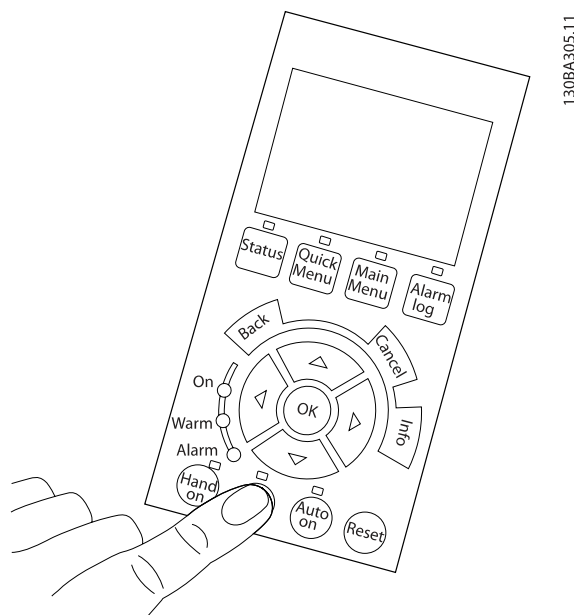
Illustration 4.42:
Step 8: Press the [Off] button to stop the motor again.
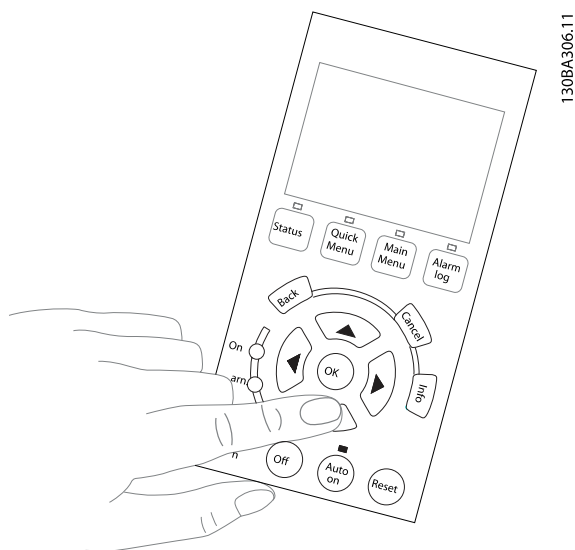
Illustration 4.41:
Step 7: To move the cursor, use the left ◄ and right ► arrow buttons. This enables changing the speed in larger increments.
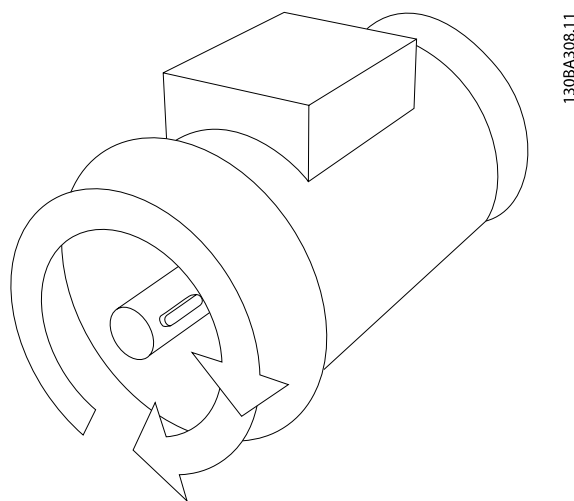
Illustration 4.43:
Step 9: Change two motor wires if the desired rotation of direction is not achieved.

⚠ **WARNING!**

Remove mains power from the frequency converter before changing motor wires.

4

4.1.27 Switches S201, S202, and S801

Switches S201 (Al 53) and S202 (Al 54) are used to select a current (0-20 mA) or a voltage (0 to 10 V) 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).

Please note that the switches may be covered by an option, if fitted.

Default setting:

S201 (Al 53) = OFF (voltage input)

S202 (Al 54) = OFF (voltage input)

S801 (Bus termination) = OFF
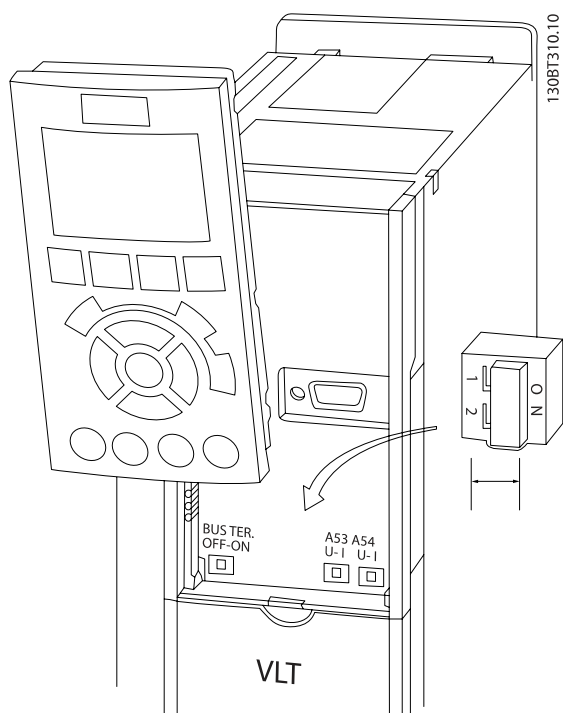
Illustration 4.44: Switches location.

4.2 Final Optimisation and Test

To optimise motor shaft performance and optimise the frequency converter for the connected motor and installation, please follow these steps. Ensure that frequency converter and motor are connected and that power is applied to frequency converter.

⚠ **CAUTION!**

Before power up ensure that connected equipment is ready for use.

Step 1: Locate motor name plate

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

130BT307.10
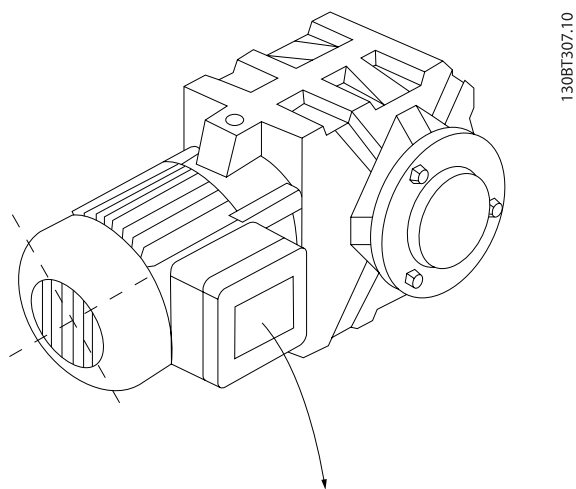
BAUER D-7 3734 ESLINGEN				
3~ MOTOR NR. 1827421 2003				
S/E005A9				
	1,5	KW		
n₂ 31,5	/min.	400	Y	V
n₁ 1400	/min.		50	Hz
COS θ 0,80			3,6	A
1,7L				
B	IP 65	H1/1A		

Illustration 4.45: Motor name plate example

Step 2: Enter motor name plate data in following parameter list
To access list first press [QUICK MENU] key then select "Q2 Quick Setup".

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

Table 4.10: Motor related parameters

Step 3: Activate Automatic Motor Adaptation (AMA)Activate Auto Tune
Performing AMA ensures best possible performance. AMA automatically takes measurements from the specific motor connected and compensates for installation variances.

1. Connect terminal 27 to terminal 12 or use [QUICK MENU] and "Q2 Quick Setup" and set Terminal 27 par. 5-12 *Terminal 27 Digital Input* to *No function [0]*

2. Press [QUICK MENU], select "Q3 Function Setups", select "Q3-1 General Settings", select "Q3-10 Adv. Motor Settings" and scroll down to par. 1-29 *Automatic Motor Adaptation (AMA)* Automatic Motor Adaption.

3. Press [OK] to activate the AMA par. 1-29 *Automatic Motor Adaptation (AMA)*.

4. Choose between complete or reduced AMA. If sine wave filter is mounted, run only reduced AMA, or remove sine wave filter during AMA procedure.

5. Press [OK] key. Display should show "Press [Hand on] to start".

6. Press [Hand on] key. A progress bar indicates if AMA is in progress.

Stop the AMA during operation

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

Successful AMA

1. The display shows "Press [OK] to finish AMA".

2. Press the [OK] key to exit the AMA state.

Unsuccessful AMA

1. The frequency converter enters into alarm mode. A description of the alarm can be found in the *Troubleshooting* section.

2. "Report Value" in the [Alarm Log] shows the last measuring sequence carried out by the AMA, before the frequency converter entered alarm mode. This number along with the description of the alarm will assist troubleshooting. If contacting Danfoss Service, make sure to mention number and alarm description.

NOTE
Unsuccessful AMA is often caused by incorrectly entered motor name plate data or too big difference between the motor power size and the frequency converter power size.

Step 4: Set speed limit and ramp time

Set up the desired limits for speed and ramp time.

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

Par. 4-11 *Motor Speed Low Limit [RPM]* or par. 4-12 *Motor Speed Low Limit [Hz]*

Par. 4-13 *Motor Speed High Limit [RPM]* or par. 4-14 *Motor Speed High Limit [Hz]*

Par. 3-41 *Ramp 1 Ramp Up Time* Ramp-up Time 1 [s]
Par. 3-42 *Ramp 1 Ramp Down Time* Ramp-down Time 1 [s]

See the section *How to programme the frequency converter, Quick Menu Mode* for an easy set-up of these parameters.

5 Commissioning and Application Examples

5.1 Commissioning

5.1.1 Quick Menu Mode

Parameter Data

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

1. Press Quick Menu button

2. Use the [▲] and [▼] buttons to find the parameter you want to change

3. Press [OK]

4. Use [▲] and [▼] buttons to select the correct parameter setting

5. Press [OK]

6. To move to a different digit within a parameter setting, use the [◄] and [►] buttons

7. Highlighted area indicates digit selected for change

8. Press [Cancel] button to disregard change, or press [OK] to accept change and enter the new setting

Example of changing parameter data

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

1. Press Quick Menu key

2. Choose Function Setups with the [▼] button

3. Press [OK]

4. Choose Application Settings with the [▼] button

5. Press [OK]

6. Press [OK] again for Fan Functions

7. Choose Broken Belt Function by pressing [OK]

8. With [▼] button, choose [2] Trip

The frequency converter will now trip if a broken fan-belt is detected.

Select [My Personal Menu] to display personal parameters:

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

Select [Changes Made] to get information about:

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

- The changes made since default setting.

Select [Loggings]:

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

Quick Setup

Efficient Parameter Set-up for VLT HVAC Drive Applications:

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

Example of using the Quick Setup option:

Assume you want to set the Ramp Down Time to 100 seconds:

1. Select [Quick Setup]. The first par. 0-01 *Language* in Quick Setup appears

2. Press [▼] repeatedly until par. 3-42 *Ramp 1 Ramp Down Time* appears with the default setting of 20 seconds

3. Press [OK]

4. Use the [◄] button to highlight the 3rd digit before the comma

5. Change '0' to '1' by using the [▲] button

6. Use the [►] button to highlight the digit '2'

7. Change '2' to '0' with the [▼] button

8. Press [OK]

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

NOTE

A complete description of the function is found in the parameter sections of this manual.
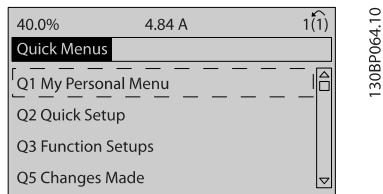
Illustration 5.1: Quick Menu view.

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

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

Table 5.1: Quick Setup parameters

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

** Par. 5-40 *Function Relay*, is an array, where one may choose between Relay1 [0] or Relay2 [1]. Standard setting is Relay1 [0] with the default choice Alarm [9].
See the parameter description in the section *Commonly Used Parameters*.
For a detailed information about settings and programming, please see the *VLT HVAC Drive Programming Guide, MG. 11.CX.YY*

x=version number
y=language

NOTE

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

5.1.2 RS-485 Bus Connection

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

If more than one frequency converter is connected to a master, use parallel connections.
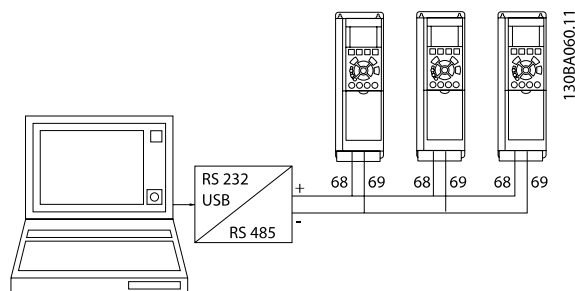
Illustration 5.2: Connection example.

In order to avoid potential equalizing currents in the screen, earth the cable screen 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 for ON. For more information, see the paragraph *Switches S201, S202, and S801*.

5.1.3 How to Connect a PC to the Frequency Converter

To control or program the frequency converter from a PC, install the PC-based Configuration Tool MCT 10.

The PC is connected via a standard (host/device) USB cable, or via the RS-485 interface as shown in the VLT HVAC Drive *Design Guide, chapter How to Install > Installation of misc. connections*.

NOTE
The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. The USB connection is connected to protection earth on the frequency converter. Use only an isolated laptop as PC connection to the USB connector on the frequency converter.
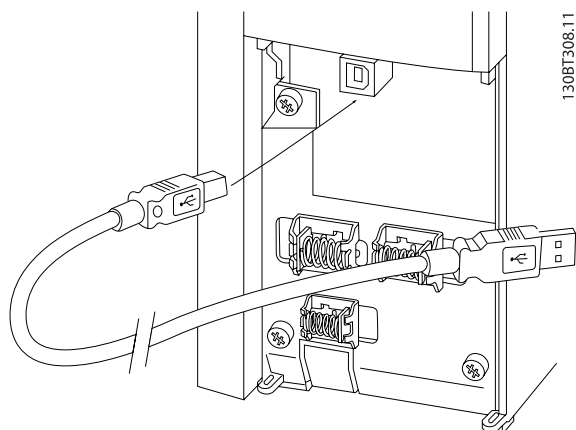
Illustration 5.3: For control cable connections, see section on *Control Terminals*.

- Planning a communication network off-line. MCT 10 contains a complete frequency converter database

- Commissioning frequency converters on line

- Saving settings for all frequency converters

- Replacing a frequency converter in a network

- Simple and accurate documentation of frequency converter settings after commissioning.

- Expanding an existing network

- Future developed frequency converters will be supported

MCT 10 set-up software supports Profibus DP-V1 via a Master class 2 connection. It makes it possible to on line read/write parameters in a frequency converter via the Profibus network. This will eliminate the need for an extra communication network.

5.1.4 PC Software Tools

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

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

Save frequency converter settings:

1. Connect a PC to the unit via USB com port. (NOTE: Use a PC, which is isolated from the mains, in conjunction with the USB port. Failure to do so may damage equipment.)

2. Open MCT 10 Set-up Software

3. Choose "Read from drive"

4. Choose "Save as"

All parameters are now stored in the PC.

Load frequency converter settings:

1. Connect a PC to the frequency converter via USB com port

2. Open MCT 10 Set-up software

3. 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 frequency converter.

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

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

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

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

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

5.1.5 Tips and Tricks

- For the majority of HVAC applications the Quick Menu, Quick Set-up and Function Set-up provides the simplest and quickest access to all the typical parameters required

- Whenever possible, performing an AMA, will ensure best shaft performance

- Contrast of the display can be adjusted by pressing [Status] and [▲] for darker display or by pressing [Status] and [▼] for brighter display

- Under [Quick Menu] and [Changes Made] all parameters that have been changed from factory settings are displayed

- Press and hold [Main Menu] key for 3 seconds for access to any parameter

- For service purposes it is recommended to copy all parameters to the LCP, see par. 0-50 *LCP Copy* for further information

5.1.6 Quick Transfer of Parameter Settings when Using GLCP

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

⚠ WARNING!

Stop the motor before performing any of these operations.

Data storage in LCP:

1. Go to par. 0-50 *LCP Copy*

2. Press the [OK] key

3. Select "All to LCP"

4. Press the [OK] key

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

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

Data transfer from LCP to Frequency converter:

1. Go to par. 0-50 *LCP Copy*

2. Press the [OK] key

3. Select "All from LCP"

4. Press the [OK] key

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

5.1.7 Initialisation to Default Settings

There are two ways to initialise the frequency converter to default: Recommended initialisation and manual initialisation. Please be aware that they have different impact according to the below description.

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

1. Select par. 14-22 *Operation Mode*

2. Press [OK]

3. Select "Initialisation" (for NLCP select "2")

4. Press [OK]

5. Remove power to unit and wait for display to turn off.

6. Reconnect power and the frequency converter is reset. Note that first start-up takes a few more seconds

7. Press [Reset]

```
Par. 14-22 Operation Mode initialises all except:
Par. 14-50 RFI Filter
Par. 8-30 Protocol
Par. 8-31 Address
Par. 8-32 Baud Rate
Par. 8-35 Minimum Response Delay
Par. 8-36 Max Response Delay
Par. 8-37 Maximum Inter-Char Delay
Par. 15-00 Operating Hours to par. 15-05 Over Volt's
Par. 15-20 Historic Log: Event to par. 15-22 Historic Log: Time
Par. 15-30 Alarm Log: Error Code to par. 15-32 Alarm Log: Time
```

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

Manual initialisation

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

1. Disconnect from mains and wait until the display turns off.

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

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

3. Release the keys after 5 s

4. The frequency converter is now programmed according to default settings

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

5.2 Application Examples

5.2.1 Start/Stop

Terminal 18 = start/stop par. 5-10 *Terminal 18 Digital Input* [8] *Start*
Terminal 27 = No operation par. 5-12 *Terminal 27 Digital Input* [0] *No operation* (Default *coast inverse*

> Par. 5-10 *Terminal 18 Digital Input = Start* (default)
>
> Par. 5-12 *Terminal 27 Digital Input = coast inverse* (default)
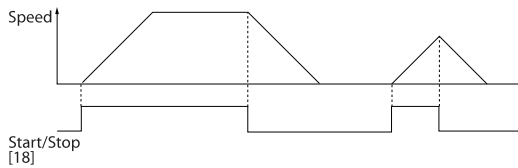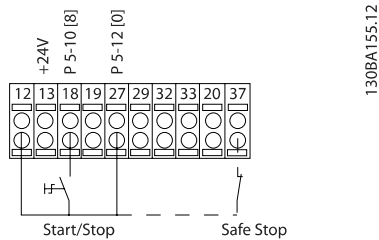
Illustration 5.4: Terminal 37: Available only with Safe Stop Function!

5.2.2 Pulse Start/Stop

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

> Par. 5-10 *Terminal 18 Digital Input = Latched start*
>
> Par. 5-12 *Terminal 27 Digital Input = Stop inverse*
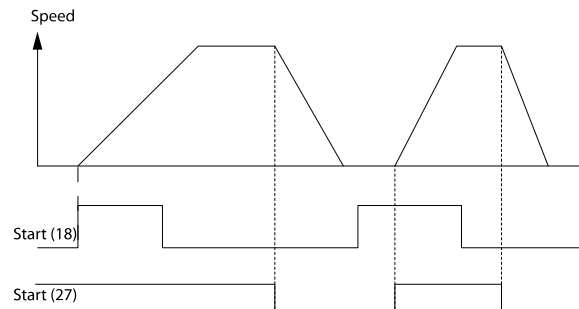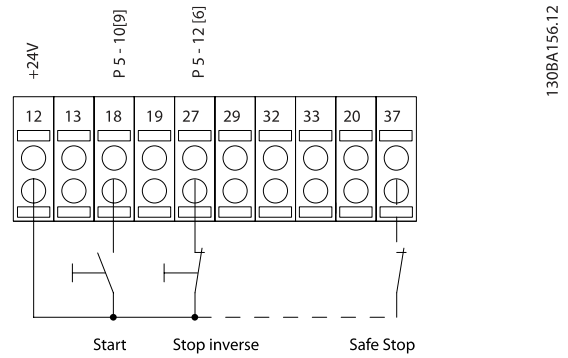
Illustration 5.5: Terminal 37: Available only with Safe Stop Function!

5.2.3 Automatic Motor Adaptation (AMA)

AMA is an algorithm to measure the electrical motor parame-
ters on a motor at standstill. This means that AMA itself does
not supply any torque.
AMA is useful when commissioning systems and optimising
the adjustment of the frequency converter to the applied
motor. This feature is particularly used where the default
setting does not apply to the connected motor.
Par. 1-29 *Automatic Motor Adaptation (AMA)* allows a choice of
complete AMA with determination of all electrical motor
parameters or reduced AMA with determination of the stator
resistance Rs only.
The duration of a total AMA varies from a few minutes on
small motors to more than 15 minutes on large motors.

Limitations and preconditions:

- For the AMA to determine the motor parameters
  optimally, enter the correct motor nameplate data in
  par. 1-20 *Motor Power [kW]* to par. 1-28 *Motor
  Rotation Check*.

- For the best adjustment of the frequency converter,
  carry out AMA on a cold motor. Repeated AMA runs
  may lead to a heating of the motor, which results in
  an increase of the stator resistance, Rs. Normally, this
  is not critical.

- AMA can only be carried out if the rated motor
  current is minimum 35% of the rated output current
  of the frequency converter. AMA can be carried out
  on up to one oversize motor.

- It is possible to carry out a reduced AMA test with a
  Sine-wave filter installed. Avoid carrying out a
  complete AMA with a Sine-wave filter. If an overall
  setting is required, remove the Sine-wave filter while
  running a total AMA. After completion of the AMA,
  reinsert the Sine-wave filter.

- If motors are coupled in parallel, use only reduced
  AMA if any.

- Avoid running a complete AMA when using synchro-
  nous motors. If synchronous motors are applied, run
  a reduced AMA and manually set the extended
  motor data. The AMA function does not apply to
  permanent magnet motors.

- The frequency converter does not produce motor
  torque during an AMA. During an AMA, it is impera-
  tive that the application does not force the motor
  shaft to run, which is known to happen with e.g.
  wind milling in ventilation systems. This disturbs the
  AMA function.

5

6 How to Operate the Frequency Converter

6.1.1 Three Ways of Operating

The frequency converter can be operated in three ways:

1. Graphical Local Control Panel (GLCP), see 5.1.2

2. Numeric Local Control Panel (NLCP), see 5.1.3

3. RS-485 serial communication or USB, both for PC connection, see 5.1.4

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

6.1.2 How to Operate 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 indicator lights (LED's) - selecting mode, changing parameters and switching between display functions.

3. Navigation keys and indicator lights (LEDs).

4. Operation keys and indicator lights (LEDs).

Graphical display:
The LCD-display is back-lit with a total of 6 alpha-numeric lines. All data is displayed on the LCP which can show up to 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.
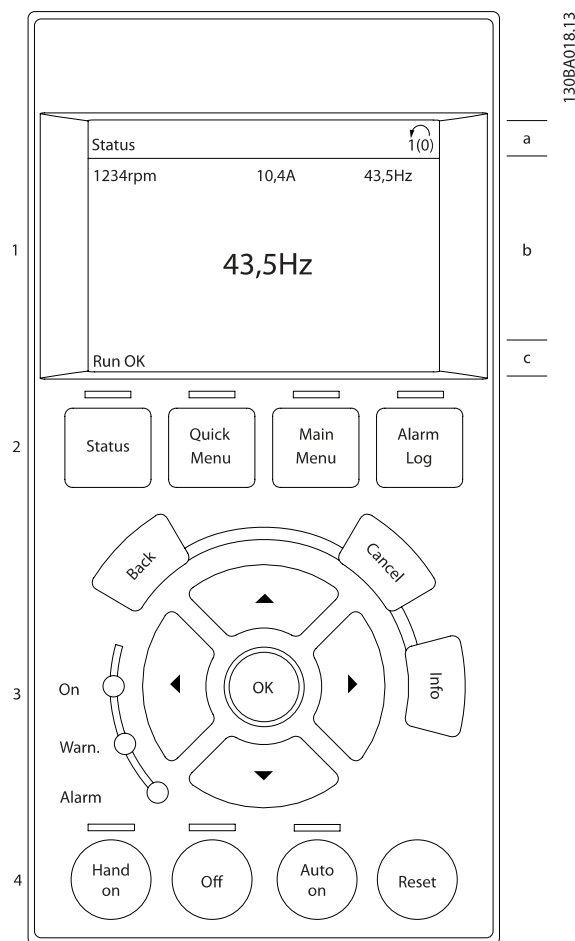
The display is divided into 3 sections:

Top section (a) shows the status when in status mode or up to 2 variables when not in status mode and in the case of Alarm/Warning.

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

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

The **Bottom section** (c) always shows the state of the frequency converter in Status mode.

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

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

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

Status display I:

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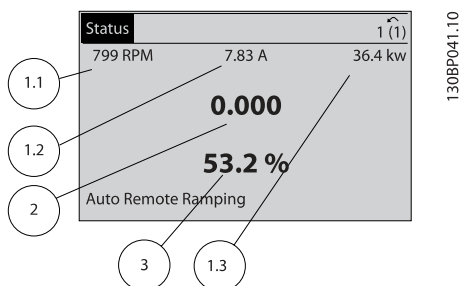
Status display II:

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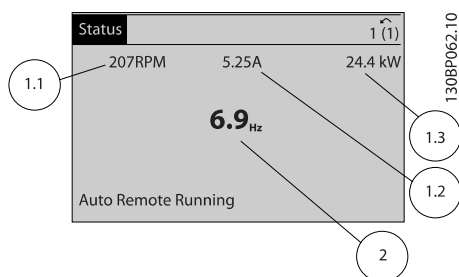
Status display III:

This state displays the event and action of the Smart Logic Control. For further information, see section *Smart Logic Control*.
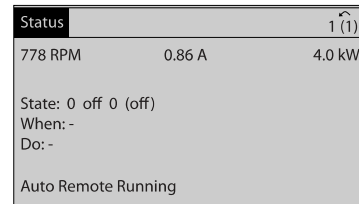
Display Contrast Adjustment

Press [status] and [▲] for darker display
Press [status] and [▼] for brighter display
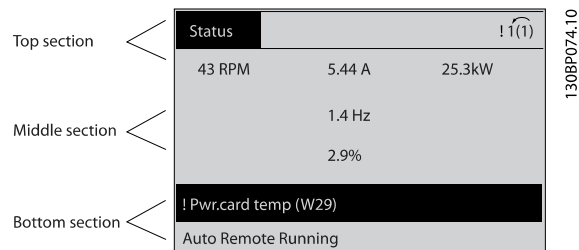
Indicator lights (LEDs):

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 frequency converter receives power from mains 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.
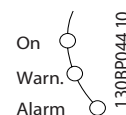
GLCP keys

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

[Status]
indicates the status of the frequency converter and/or the motor. 3 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 read-out mode.

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

The [Quick Menu] consists of:
- My Personal Menu
- Quick Set-up
- Function Set-up
- Changes Made
- Loggings

The Function set-up provides quick and easy access to all parameters required for the majority of VLT HVAC Drive applications including most VAV and CAV supply and return fans, cooling tower fans, Primary, Secondary and Condenser Water Pumps and other pump, fan and compressor applications. Amongst other features it also includes parameters for selecting which variables to display on the LCP, digital preset speeds, scaling of analog references, closed loop single zone and multi-zone applications and specific functions related to Fans, Pumps and Compressors.

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

[Main Menu]
is used for programming all parameters.The Main Menu parameters can be accessed immediately unless a password has been created via par. 0-60 *Main Menu Password*, par. 0-61 *Access to Main Menu w/o Password*, par. 0-65 *Personal Menu Password* or par. 0-66 *Access to Personal Menu w/o Password*. For the majority of VLT HVAC Drive applications it is not necessary to access the Main Menu parameters but instead the Quick Menu, Quick Set-up and Function Set-up provides 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 manoeuvre to the alarm number and press [OK]. Information is displayed about the condition of the frequency converter before it enters the alarm mode.

The Alarm log button on the LCP allows access to both Alarm log and Maintenance log.

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

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

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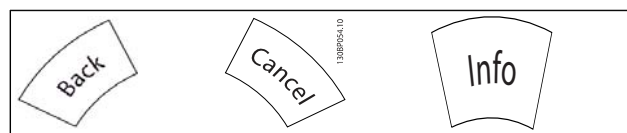
Navigation Keys

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.
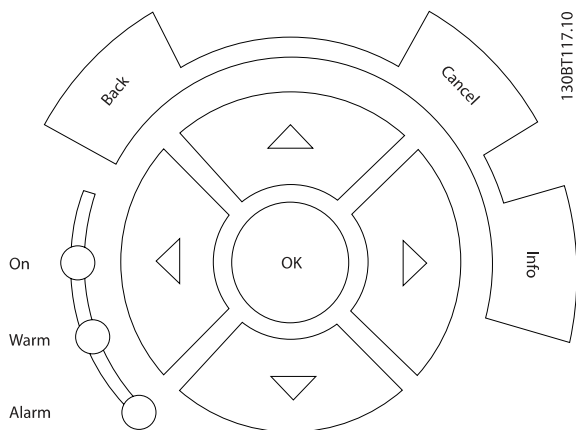
Operation Keys for local control are found at the bottom of the control panel.
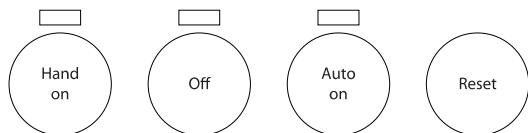
[Hand On]

enables control of the frequency converter via the GLCP. [Hand On] also starts the motor, and it is now possible to enter the motor speed data by means of the arrow keys. The key can be selected as *Enable* [1] or *Disable* [0] via 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
- Reversing
- Set-up select lsb - Set-up select msb
- Stop command from serial communication
- Quick stop
- DC brake

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

[Off]

stops the connected motor. The key can be selected as Enable [1] or Disable [0] via 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 mains supply.

[Auto on]

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

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

[Reset]

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

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

6

6.1.3 How to Operate Numeric LCP (NLCP)

The following instructions are valid for the NLCP (LCP 101).

The control panel is divided into four functional groups:
1. Numeric display.
2. Menu key and indicator lights (LEDs) - changing parameters and switching between display functions.
3. Navigation keys and indicator lights (LEDs).
4. Operation keys and indicator lights (LEDs).

NOTE
Parameter copy is not possible with Numeric Local Control Panel (LCP101).

Select one of the following modes:
Status Mode: Displays the status of the frequency converter or the motor.
If an alarm occurs, the NLCP automatically switches to status mode.
A number of alarms can be displayed.

Quick Setup or **Main Menu Mode**: Display parameters and parameter settings.
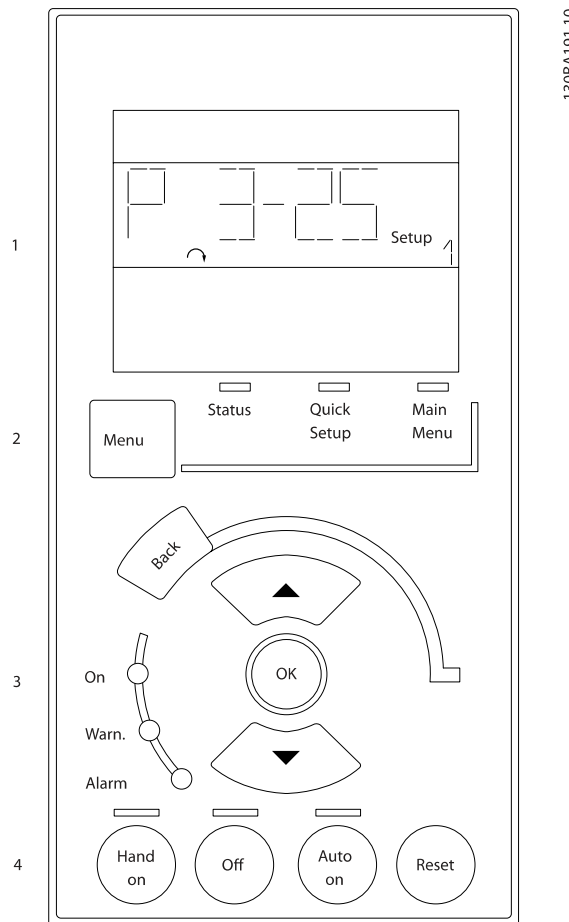
Illustration 6.1: Numerical LCP (NLCP)

Illustration 6.2: Status display example

Illustration 6.3: Alarm display example

Indicator lights (LEDs):
- Green LED/On: Indicates if control section is on.
- Yellow LED/Wrn.: Indicates a warning.
- Flashing red LED/Alarm: Indicates an alarm.

Menu key

Select one of the following modes:

- Status

- Quick Setup

- Main Menu

Main Menu

is used for programming all parameters.

The parameters can be accessed immediately unless a password has been created via par. 0-60 *Main Menu Password*, par. 0-61 *Access to Main Menu w/o Password*, par. 0-65 *Personal Menu Password* or par. 0-66 *Access to Personal Menu w/o Password*.

Quick Setup is used to set up the frequency converter using only the most essential parameters.

The parameter values can be changed using the up/down arrows when the value is flashing.

Select Main Menu by pressing the [Menu] key a number of times until the Main Menu LED is lit.

Select the parameter group [xx-__] and press [OK]

Select the parameter [__-xx] and press [OK]

If the parameter is an array parameter select the array number and press [OK]

Select the wanted data value and press [OK]

Navigation keys

[Back]

for stepping backwards

Arrow [▲] [▼]

keys are used for manoeuvring between parameter groups, parameters and within parameters

[OK]

is used for choosing a parameter marked by the cursor and for enabling the change of a parameter.
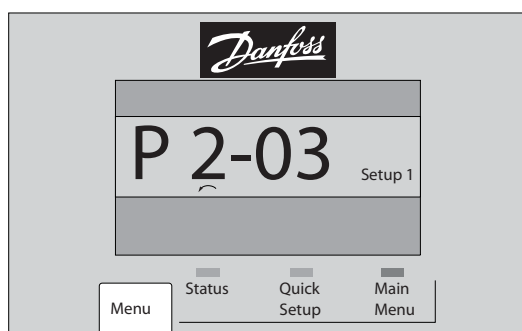
Illustration 6.4: Display example

Operation keys

Keys for local control are found at the bottom of the control panel.
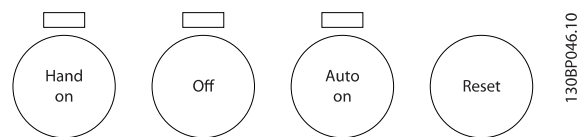
Illustration 6.5: Operation keys of the numerical LCP (NLCP)

[Hand on]

enables control of the frequency converter via the LCP. [Hand on] also starts the motor and it is now possible to enter the motor speed data by means of the arrow keys. The key can be *Enabled* [1] or *Disabled* [0] via par. 0-40 *[Hand on] Key on LCP*.

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

The following control signals will still be active when [Hand on] is activated:

- [Hand on] - [Off] - [Auto on]

- Reset

- Coasting stop inverse

- Reversing

- Set-up select lsb - Set-up select msb

- Stop command from serial communication

- Quick stop

- DC brake

[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 be stopped by disconnecting the mains supply.

[Auto on]

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

NOTE

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

[Reset]

is used for resetting the frequency converter after an alarm (trip). The key can be *Enabled* [1] or *Disabled* [0] via par. 0-43 *[Reset] Key on LCP*.

7 How to Programme the Frequency Converter

7.1 How to Programme

7.1.1 Function Set-ups

The Function set-up provides quick and easy access to all parameters required for the majority of VLT HVAC Drive applications including most VAV and CAV supply and return fans, cooling tower fans, Primary, Secondary and Condenser Water Pumps and other pump, fan and compressor applications.

How to access Function set-up - example
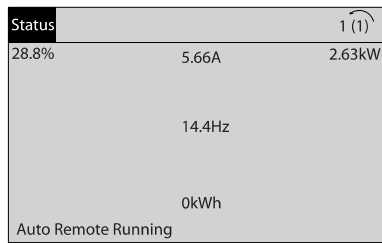
Illustration 7.1: Step 1: Turn on the frequency converter (yellow LED lights)
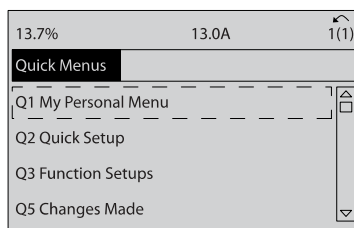
Illustration 7.2: Step 2: Press the [Quick Menus] button (Quick Menus choices appear).
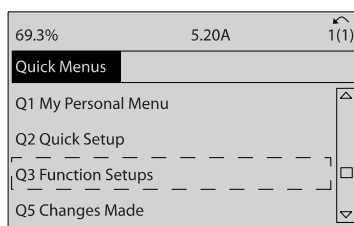
Illustration 7.3: Step 3: Use the up/down navigation keys to scroll down to Function set-ups. Press [OK].
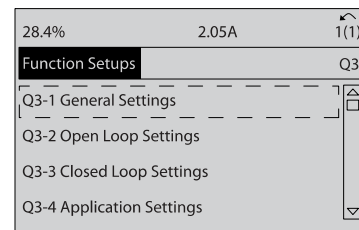
Illustration 7.4: Step 4: Function set-ups choices appear. Choose Q3-1 *General Settings*. Press [OK].
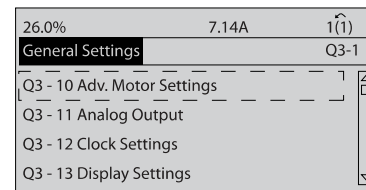
Illustration 7.5: Step 5: Use the up/down navigation keys to scroll down to i.e. Q3-11 *Analog Outputs*. Press [OK].
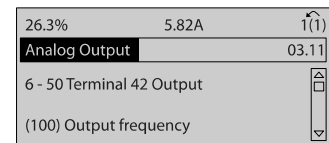
Illustration 7.6: Step 6: Choose par. 6-50. Press [OK].
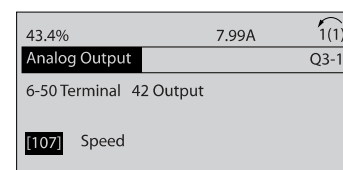
Illustration 7.7: Step 7: Use the up/down navigation keys to select between the different choices. Press [OK].

Function Set-ups parameters

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

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

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

7

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

7

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

See also *VLT HVAC Drive Programming Guide* for a detailed description of the Function Setups parameter groups.

7.1.2 Main Menu Mode

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

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

All parameters can be changed in the Main Menu. The configuration of the unit (par. 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.
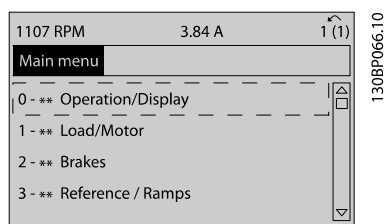
Illustration 7.8: Display example.

7.1.3 Changing Data

1.   Press [Quick Menu] or [Main Menu] key.

2.   Use [▲] and [▼] keys 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 keys. Cursor indicates digit selected to change. [▲] key increases the value, [▼] key decreases the value.

7.   Press [Cancel] key to disregard change, or press [OK] key to accept change and enter new setting.

7.1.4 Changing a Text Value

If the selected parameter is a text value, change the text value by means of 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].

Illustration 7.9: Display example.

7.1.5 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.

Illustration 7.10: Display example.

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

Illustration 7.11: Display example.

7.1.6 Changing of Data Value, Step-by-Step

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

7.1.7 Read-out and Programming of Indexed Parameters

Parameters are indexed when placed in a rolling stack.
Par. 15-30 *Alarm Log: Error Code* to par. 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 par. 3-10 *Preset Reference* as another example:
Choose the parameter, press [OK], and use the up/down navigation keys 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.

7.2 Commonly Used Parameters - Explanations

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

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
[37]	Display Text 1	Enables an individual text string to be written, for display in the LCP or to be read via serial communication.
[38]	Display Text 2	Enables an individual text string to be written, for display in the LCP or to be read via serial communication.
[39]	Display Text 3	Enables an individual text string to be written, for display in the LCP or to be read via serial communication.
[89]	Date and Time Readout	Displays the current date and time.
[953]	Profibus Warning Word	Displays Profibus communication warnings.
[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.
[1115]	LON Warning Word	Shows the LON-specific warnings.
[1117]	XIF Revision	Shows the version of the external interface file of the Neuron C chip on the LON option.
[1118]	LonWorks Revision	Shows the software version of the application program of the Neuron C chip on the LON option.
[1501]	Running Hours	View the number of running hours of the motor.
[1502]	kWh Counter	View the mains power consumption in kWh.
[1600]	Control Word	View the Control Word sent from the frequency converter 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.

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0-20 Display Line 1.1 Small		
Option:		Function:
[1603]	Status Word	Present status word
[1605]	Main Actual Value [%]	View the two-byte word sent with the Status word to the bus Master reporting the Main Actual Value.
[1609]	Custom Readout	View the user-defined readouts as defined in par. 0-30 *Custom Readout Unit*, par. 0-31 *Custom Readout Min Value* and par. 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 frequency converter in Hz.
[1614]	Motor Current	Phase current of the motor measured as effective value.
[1615]	Frequency [%]	Motor frequency, i.e. the output frequency from the frequency converter in percent.
[1616]	Torque [Nm]	Present motor load as a percentage of the rated motor torque.
[1617]	Speed [RPM]	Motor speed reference. Actual speed will depend on slip compensation being used (compensation set in par. 1-62 *Slip Compensation*). If not used, actual speed will be the value read in the display minus motor slip.
[1618]	Motor Thermal	Thermal load on the motor, calculated by the ETR function. See also parameter group 1-9* Motor Temperature.
[1622]	Torque [%]	Shows the actual torque produced, in percentage.
[1626]	Power Filtered [kW]	
[1627]	Power Filtered [hp]	
[1630]	DC Link Voltage	Intermediate circuit voltage in the frequency converter.
[1632]	Brake Energy /s	Present brake power transferred to an external brake resistor. Stated as an instantaneous value.
[1633]	Brake Energy / 2 min	Brake power transferred to an external brake resistor. The mean power is calculated continuously for the most recent 120 seconds.
[1634]	Heatsink Temp.	Present heat sink temperature of the frequency converter. The cut-out limit is

0-20 Display Line 1.1 Small		
Option:		Function:
		95 ± 5° C; cutting back in occurs at 70 ± 5° C.
[1635]	Inverter Thermal	Percentage load of the inverters
[1636]	Inv. Nom. Current	Nominal current of the frequency converter
[1637]	Inv. Max. Current	Maximum current of the frequency converter
[1638]	SL Controller State	State of the event executed by the control
[1639]	Control Card Temp.	Temperature of the control card.
[1643]	Timed Actions Status	
[1650]	External Reference	Sum of the external reference as a percentage, i.e. the sum of analog/pulse/bus.
[1652]	Feedback [Unit]	Reference value from programmed digital input(s).
[1653]	Digi Pot Reference	View the contribution of the digital potentiometer to the actual reference Feedback.
[1654]	Feedback 1 [Unit]	View the value of Feedback 1. See also par. 20-0*.
[1655]	Feedback 2 [Unit]	View the value of Feedback 2. See also par. 20-0*.
[1656]	Feedback 3 [Unit]	View the value of Feedback 3. See also par. 20-0*.
[1658]	PID Output [%]	Returns the Drive Closed Loop PID controller output value in percent.
[1660]	Digital Input	Displays the status of the digital inputs. Signal low = 0; Signal high = 1. Regarding order, see par. 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 par. 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.

0-20 Display Line 1.1 Small		
Option:		Function:
[1667]	Pulse Input #29 [Hz]	Actual value of the frequency applied at terminal 29 as a pulse input.
[1668]	Pulse 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.
[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 par. 6-60 *Terminal X30/8 Output* to select the variable to be shown.
[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 STW	Extended fieldbus 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 communications)
[1693]	Warning Word 2	One or more warnings in a Hex code (used for serial communications)
[1694]	Ext. Status Word	One or more status conditions in a Hex code (used for serial communications)
[1695]	Ext. Status Word 2	One or more status conditions in a Hex code (used for serial communications)

0-20 Display Line 1.1 Small		
Option:		Function:
[1696]	Maintenance Word	The bits reflect the status for the programmed Preventive Maintenance Events in parameter group 23-1*
[1830]	Analog Input X42/1	Shows the value of the signal applied to terminal X42/1 on the Analog I/O card.
[1831]	Analog Input X42/3	Shows the value of the signal applied to terminal X42/3 on the Analog I/O card.
[1832]	Analog Input X42/5	Shows the value of the signal applied to terminal X42/5 on the Analog I/O card.
[1833]	Analog Out X42/7 [V]	Shows the value of the signal applied to terminal X42/7 on the Analog I/O card.
[1834]	Analog Out X42/9 [V]	Shows the value of the signal applied to terminal X42/9 on the Analog I/O card.
[1835]	Analog Out X42/11 [V]	Shows the value of the signal applied to terminal X42/11 on the Analog I/O card.
[1836]	Analog Input X48/2 [mA]	
[1837]	Temp. Input X48/4	
[1838]	Temp. Input X48/7	
[1839]	Temp. Input X48/10	
[1850]	Sensorless Readout [unit]	
[2117]	Ext. 1 Reference [Unit]	The value of the reference for extended Closed Loop Controller 1
[2118]	Ext. 1 Feedback [Unit]	The value of the feedback signal for extended Closed Loop Controller 1
[2119]	Ext. 1 Output [%]	The value of the output from extended Closed Loop Controller 1
[2137]	Ext. 2 Reference [Unit]	The value of the reference for extended Closed Loop Controller 2
[2138]	Ext. 2 Feedback [Unit]	The value of the feedback signal for extended Closed Loop Controller 2
[2139]	Ext. 2 Output [%]	The value of the output from extended Closed Loop Controller 2
[2157]	Ext. 3 Reference [Unit]	The value of the reference for extended Closed Loop Controller 3
[2158]	Ext. 3 Feedback [Unit]	The value of the feedback signal for extended Closed Loop Controller 3
[2159]	Ext. 3 Output [%]	The value of the output from extended Closed Loop Controller 3

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0-20 Display Line 1.1 Small		
Option:		**Function:**
[2230]	No-Flow Power	The calculated No Flow Power for the actual operating speed
[2316]	Maintenance Text	
[2580]	Cascade Status	Status for the operation of the Cascade Controller
[2581]	Pump Status	Status for the operation of each individual pump controlled by the Cascade Controller
[3110]	Bypass Status Word	
[3111]	Bypass Running Hours	
[9913]	Idle time	
[9914]	Paramdb requests in queue	
[9920]	HS Temp. (PC1)	
[9921]	HS Temp. (PC2)	
[9922]	HS Temp. (PC3)	
[9923]	HS Temp. (PC4)	
[9924]	HS Temp. (PC5)	
[9925]	HS Temp. (PC6)	
[9926]	HS Temp. (PC7)	
[9927]	HS Temp. (PC8)	

NOTE
Please consult the *VLT HVAC Drive Programming Guide, MG.11.CX.YY* for detailed information.

0-21 Display Line 1.2 Small		
Select a variable for display in line 1, middle position.		
Option:		**Function:**
[1614] *	Motor Current	The options are the same as those listed in par. 0-20 *Display Line 1.1 Small*.

0-22 Display Line 1.3 Small		
Select a variable for display in line 1, right position.		
Option:		**Function:**
[1610] *	Power [kW]	The options are the same as those listed in par. 0-20 *Display Line 1.1 Small*.

0-23 Display Line 2 Large		
Select a variable for display in line 2.		
Option:		**Function:**
[1613] *	Frequency	The options are the same as those listed in par. 0-20 *Display Line 1.1 Small*.

0-24 Display Line 3 Large		
Select a variable for display in line 3.		
Option:		**Function:**
[1502] *	kWh Counter	The options are the same as those listed in par. 0-20 *Display Line 1.1 Small*.

0-37 Display Text 1		
Range:		**Function:**
0*	[0 - 0]	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 1 in par. 0-20 *Display Line 1.1 Small*, par. 0-21 *Display Line 1.2 Small*, par. 0-22 *Display Line 1.3 Small*, par. 0-23 *Display Line 2 Large* or par. 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*	[0 - 0]	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 par. 0-20 *Display Line 1.1 Small*, par. 0-21 *Display Line 1.2 Small*, par. 0-22 *Display Line 1.3 Small*, par. 0-23 *Display Line 2 Large* or par. 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*	[0 - 0]	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 3 in par. 0-20 *Display Line 1.1 Small*, par. 0-21 *Display Line 1.2 Small*, par. 0-22 *Display Line 1.3 Small*, par. 0-23 *Display Line 2 Large* or par. 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:**
Application dependent*	[Application dependant]	Sets the date and time of the internal clock. The format to be used is set in par. 0-71 *Date Format* and par. 0-72 *Time Format*.

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

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 par. 0-76 *DST/Summertime Start* and par. 0-77 *DST/Summertime End*.
[0] *	Off	
[2]	Manual	

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

0-77 DST/Summertime End		
Range:		**Function:**
Application dependent*	[Application dependant]	Sets the date and time when summertime/DST ends. The date is programmed in the format selected in par. 0-71 *Date Format*.

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 frequency converter is part of a closed loop control system based on an

1-00 Configuration Mode		
Option:		**Function:**
		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 par. 20-** or via the Function Setups accessed by pressing the [Quick Menus] button.

NOTE
This parameter cannot be changed when motor is running.

NOTE
When set for Closed Loop, the commands Reversing and Start Reversing will not reverse the direction of the motor.

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

1-03 Torque Characteristics

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

1-20 Motor Power [kW]

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

1-21 Motor Power [HP]

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

1-22 Motor Voltage

Range:		Function:
Application dependent*	[Application dependant]	Enter the nominal motor voltage according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit.

1-22 Motor Voltage

Range:		Function:
		This parameter cannot be adjusted while the motor is running.

1-23 Motor Frequency

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

NOTE
This parameter cannot be adjusted while the motor is running.

1-24 Motor Current

Range:		Function:
Application dependent*	[Application dependant]	Enter the nominal motor current value from the motor nameplate data. This data is used for calculating motor torque, motor thermal protection etc.

NOTE
This parameter cannot be adjusted while the motor is running.

1-25 Motor Nominal Speed

Range:		Function:
Application dependent*	[100 - 60000 RPM]	Enter the nominal motor speed value from the motor nameplate data. This data is used for calculating automatic motor compensations.

NOTE
This parameter cannot be adjusted while the motor is running.

1-28 Motor Rotation Check

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

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

⚠ WARNING!

Mains power must be removed before disconnecting motor phase cables.

1-29 Automatic Motor Adaptation (AMA)		
Option:	Function:	
		The AMA function optimizes dynamic motor performance by automatically optimizing the advanced motor parameters par. 1-30 *Stator Resistance (Rs)* to par. 1-35 *Main Reactance (Xh))* while the motor is stationary.
[0] *	Off	No function
[1]	Enable complete AMA	performs AMA of the stator resistance R_S, the rotor resistance R_r, the stator leakage reactance X_1, the rotor leakage reactance X_2 and the main reactance X_h.
[2]	Enable reduced AMA	Performs a reduced AMA of the stator resistance R_s in the system only. Select this option if an LC filter is used between the frequency converter and the motor.

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

NOTE

- **For the best adaptation of the frequency converter, run AMA on a cold motor**

- **AMA cannot be performed while the motor is running**

NOTE
Avoid generating external torque during AMA.

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

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

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

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

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

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

7

1-86 Trip Speed Low [RPM]		
Range:		**Function:**
Application dependent*	[Application dependant]	Set the desired motor speed for trip limit. If the Trip Speed is set to 0, the function is not active. If the speed at any time after the start (or during a stop) falls below the value in the parameter, the drive will trip with an alarm [A49] Speed Limit. Function at stop.
0 RPM*	[Application dependant]	

NOTE
This parameter is only available if par. 0-02 *Motor Speed Unit* is set to [RPM].

1-87 Trip Speed Low [Hz]		
Range:		**Function:**
Application dependent*	[Application dependant]	If the Trip Speed is set to 0, the function is not active.
		If the speed at any time after the start (or during a stop) falls below the value in the parameter, the drive will trip with an alarm [A49] Speed Limit. Function at stop.
0.0 Hz*	[Application dependant]	

NOTE
This parameter is only available if par. 0-02 *Motor Speed Unit* is set to [Hz].

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

1-90 Motor Thermal Protection		
Option:		**Function:**
[1]	Thermistor warning	Activates a warning when the connected thermistor in the motor reacts in the event of motor over-temperature.
[2]	Thermistor trip	Stops (trips) the frequency converter when the connected thermistor in the motor reacts in the event of motor over-temperature.
[3]	ETR warning 1	
[4] *	ETR trip 1	
[5]	ETR warning 2	
[6]	ETR trip 2	
[7]	ETR warning 3	
[8]	ETR trip 3	
[9]	ETR warning 4	
[10]	ETR trip 4	

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

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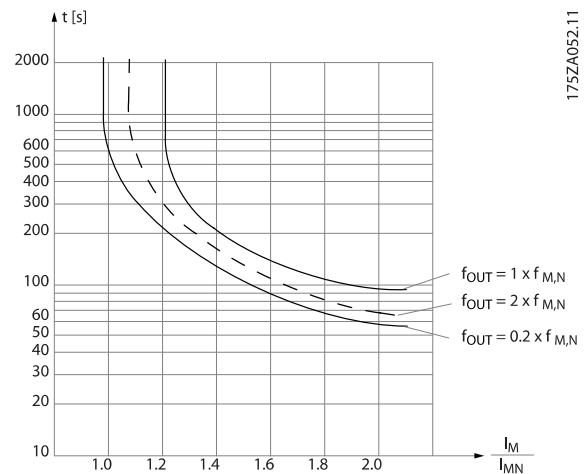
In order to maintain PELV, all connections made to the control terminals must be PELV, e.g. thermistor must be reinforced/ double insulated

NOTE
Danfoss recommends using 24 VDC as thermistor supply voltage.

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

NOTE
This parameter cannot be adjusted while the motor is running.

NOTE
Digital input should be set to [0] *PNP - Active at 24V* in par. 5-00.

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

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

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

2-16 AC brake Max. Current		
Range:		Function:
100.0 %*	[Application dependant]	Enter the maximum permissible current when using AC brake to avoid overheating of motor windings. The AC brake function is available in Flux mode only (FC 302 only).

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

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

3-02 Minimum Reference		
Range:		Function:
Application dependent*	[Application dependant]	Enter the Minimum Reference. The Minimum Reference is the lowest value obtainable by summing all references. The Minimum Reference value and unit matches the configuration choice made in par. 1-00 *Configuration Mode* and par. 20-12 *Reference/Feedback Unit*, respectively. **NOTE** This parameter is used in open loop only.

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3-03 Maximum Reference

Range:		Function:
Application dependent*	[Application dependant]	Enter the maximum acceptable value for the remote reference. The Maximum Reference value and unit matches the configuration choice made in par. 1-00 *Configuration Mode* and par. 20-12 *Reference/Feedback Unit*, respectively. **NOTE** **If operating with par. 1-00 *Configuration Mode* set for Closed Loop [3], par. 20-14 *Maximum Reference/Feedb.* must be used.**

3-10 Preset Reference

Array [8]

Range:		Function:
0.00 %*	[-100.00 - 100.00 %]	Enter up to eight different preset references (0-7) in this parameter, using array programming. The preset reference is stated as a percentage of the value Ref$_{MAX}$ (par. 3-03 *Maximum Reference*, for closed loop see par. 20-14 *Maximum Reference/Feedb.*). When using preset references, select Preset ref. bit 0 / 1 / 2 [16], [17] or [18] for the corresponding digital inputs in parameter group 5-1* Digital Inputs.

12   (+24V)

Preset   76543210

10101010 — 29   [P 5-13=Preset ref. bit 0]

11001100 — 32   [P 5-14=Preset ref. bit 1]

11110000 — 33   [P 5-15=Preset ref. bit 2]
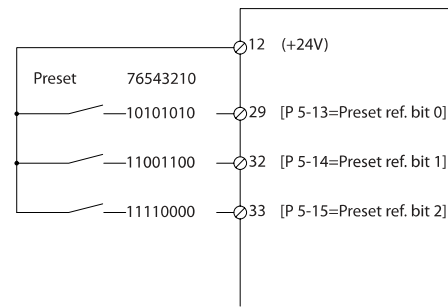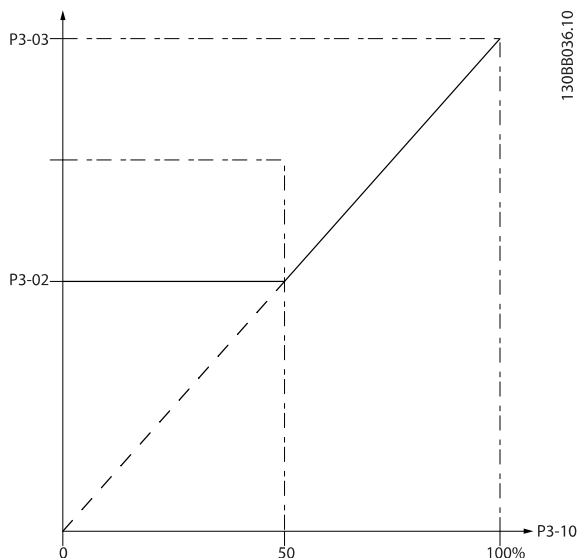
130BA149.10

3-11 Jog Speed [Hz]

Range:		Function:
Application dependent*	[Application dependant]	The jog speed is a fixed output speed at which the frequency converter is running when the jog function is activated. See also par. 3-80 *Jog Ramp Time*.
Application dependent*	[Application dependant]	

3-15 Reference 1 Source

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

P3-03

P3-02

0   50   100%   P3-10

130BB036.10

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

3-19 Jog Speed [RPM]		
Range:		Function:
Application dependent*	[Application dependant]	Enter a value for the jog speed n_{JOG}, which is a fixed output speed. The frequency converter runs at this speed when the jog function is activated. The maximum limit is defined in par. . See also par. 3-80 *Jog Ramp Time*.

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

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

3-42 Ramp 1 Ramp Down Time		
Range:		Function:
Application dependent*	[Application dependant]	Enter the ramp-down time, i.e. the deceleration time from par. 1-25 *Motor Nominal Speed* to 0 RPM. Choose a ramp-down time such that no over-voltage 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 par. 4-18 *Current Limit*. See ramp-up time in par. 3-41 *Ramp 1 Ramp Up Time*.

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

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

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

4-11 Motor Speed Low Limit [RPM]		
Range:		Function:
Application dependent*	[Application dependant]	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 par. 4-13 *Motor Speed High Limit [RPM]*.

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

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4-13 Motor Speed High Limit [RPM]		
Range:		**Function:**
Application dependent*	[Application dependant]	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 par. 4-11 *Motor Speed Low Limit [RPM]*. Only par. 4-11 *Motor Speed Low Limit [RPM]* or par. 4-12 *Motor Speed Low Limit [Hz]* will be displayed depending on other parameters in the Main Menu and depending on default settings dependant on global location.

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

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

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

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

4-53 Warning Speed High		
Range:		**Function:**
Application dependent*	[Application dependant]	Enter the n_{HIGH} value. When the motor speed exceeds this limit (n_{HIGH}), the display reads SPEED HIGH. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02. Programme

4-53 Warning Speed High		
Range:		**Function:**
		the upper signal limit of the motor speed, n_{HIGH}, within the normal working range of the frequency converter. Refer to the drawing in this section.

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

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

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

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

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

Please note that this parameter cannot be adjusted while the motor is running.

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

This parameter cannot be adjusted while the motor is running.

5-12 Terminal 27 Digital Input		
Same options and functions as par. 5-1*, except for *Pulse input*.		
Option:		**Function:**
[0] *	No operation	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inv	
[5]	DC-brake inverse	
[6]	Stop inverse	
[7]	External interlock	
[8]	Start	
[9]	Latched start	
[10]	Reversing	
[11]	Start reversing	
[14]	Jog	
[15]	Preset reference on	
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	
[19]	Freeze reference	
[20]	Freeze output	
[21]	Speed up	
[22]	Speed down	
[23]	Set-up select bit 0	
[24]	Set-up select bit 1	
[34]	Ramp bit 0	
[36]	Mains failure inverse	
[37]	Fire Mode	
[52]	Run permissive	
[53]	Hand start	
[54]	Auto start	
[55]	DigiPot increase	
[56]	DigiPot decrease	
[57]	DigiPot clear	
[62]	Reset Counter A	
[65]	Reset Counter B	
[66]	Sleep Mode	
[68]	Timed Actions Disabled	
[69]	Constant OFF Actions	

5-12 Terminal 27 Digital Input		
Same options and functions as par. 5-1*, except for *Pulse input*.		
Option:		**Function:**
[70]	Constant ON Actions	
[78]	Reset Maint. Word	
[120]	Lead Pump Start	
[121]	Lead Pump Alternation	
[130]	Pump 1 Interlock	
[131]	Pump 2 Interlock	
[132]	Pump 3 Interlock	

5-13 Terminal 29 Digital Input		
Same options and functions as par. 5-1*.		
Option:		**Function:**
[0]	No operation	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inv	
[5]	DC-brake inverse	
[6]	Stop inverse	
[7]	External interlock	
[8]	Start	
[9]	Latched start	
[10]	Reversing	
[11]	Start reversing	
[14] *	Jog	
[15]	Preset reference on	
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	
[19]	Freeze reference	
[20]	Freeze output	
[21]	Speed up	
[22]	Speed down	
[23]	Set-up select bit 0	
[24]	Set-up select bit 1	
[30]	Counter input	
[32]	Pulse input	
[34]	Ramp bit 0	
[36]	Mains failure inverse	
[37]	Fire Mode	
[52]	Run permissive	
[53]	Hand start	
[54]	Auto start	
[55]	DigiPot increase	
[56]	DigiPot decrease	
[57]	DigiPot clear	
[60]	Counter A (up)	
[61]	Counter A (down)	
[62]	Reset Counter A	
[63]	Counter B (up)	
[64]	Counter B (down)	
[65]	Reset Counter B	
[66]	Sleep Mode	

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5-13 Terminal 29 Digital Input

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

Option:		Function:
[68]	Timed Actions Disabled	
[69]	Constant OFF Actions	
[70]	Constant ON Actions	
[78]	Reset Maint. Word	
[120]	Lead Pump Start	
[121]	Lead Pump Alternation	
[130]	Pump 1 Interlock	
[131]	Pump 2 Interlock	
[132]	Pump 3 Interlock	

5-14 Terminal 32 Digital Input

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

5-15 Terminal 33 Digital Input

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

5-40 Function Relay

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

Option:		Function:
[0] *	No operation	
[1]	Control ready	
[2]	Drive ready	
[3]	Drive rdy/rem ctrl	
[4]	Standby / no warning	
[5] *	Running	Default setting for relay 2.
[6]	Running / no warning	
[8]	Run on ref/no warn	
[9] *	Alarm	Default setting for relay 1.
[10]	Alarm or warning	
[11]	At torque limit	
[12]	Out of current range	
[13]	Below current, low	
[14]	Above current, high	
[15]	Out of speed range	
[16]	Below speed, low	
[17]	Above speed, high	
[18]	Out of feedb. range	
[19]	Below feedback, low	
[20]	Above feedback, high	
[21]	Thermal warning	
[25]	Reverse	
[26]	Bus OK	

5-40 Function Relay

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

Option:		Function:
[27]	Torque limit & stop	
[28]	Brake, no brake war	
[29]	Brake ready, no fault	
[30]	Brake fault (IGBT)	
[35]	External Interlock	
[36]	Control word bit 11	
[37]	Control word bit 12	
[40]	Out of ref range	
[41]	Below reference, low	
[42]	Above ref, high	
[45]	Bus ctrl.	
[46]	Bus ctrl, 1 if timeout	
[47]	Bus ctrl, 0 if timeout	
[60]	Comparator 0	
[61]	Comparator 1	
[62]	Comparator 2	
[63]	Comparator 3	
[64]	Comparator 4	
[65]	Comparator 5	
[70]	Logic rule 0	
[71]	Logic rule 1	
[72]	Logic rule 2	
[73]	Logic rule 3	
[74]	Logic rule 4	
[75]	Logic rule 5	
[80]	SL digital output A	
[81]	SL digital output B	
[82]	SL digital output C	
[83]	SL digital output D	
[84]	SL digital output E	
[85]	SL digital output F	
[160]	No alarm	
[161]	Running reverse	
[165]	Local ref active	
[166]	Remote ref active	
[167]	Start command act.	
[168]	Hand / Off	
[169]	Auto mode	
[180]	Clock Fault	
[181]	Prev. Maintenance	
[190]	No-Flow	
[191]	Dry Pump	
[192]	End Of Curve	
[193]	Sleep Mode	
[194]	Broken Belt	
[195]	Bypass Valve Control	

5-40 Function Relay

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

Option:		Function:
[196]	Fire Mode	
[197]	Fire Mode was Act.	
[198]	Drive Bypass	
[211]	Cascade Pump 1	
[212]	Cascade Pump 2	
[213]	Cascade Pump 3	

6-01 Live Zero Timeout Function

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

6-02 Fire Mode Live Zero Timeout Function

Option:		Function:
		The function set in par. 6-01 *Live Zero Timeout Function* will be activated if the input signal on analogue inputs is below 50% of the value defined in parameter group 6-1* to 6-6* "Terminal xx Low Current" or "Terminal xx Low Voltage" for a time period defined in par. 6-00 *Live Zero Timeout Time*.
[0] *	Off	
[1]	Freeze output	
[2]	Stop	
[3]	Jogging	
[4]	Max. speed	

6-10 Terminal 53 Low Voltage

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

6-11 Terminal 53 High Voltage

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

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6-12 Terminal 53 Low Current		
Range:		Function:
4.00 mA*	[Application dependant]	Enter the low current value. This reference signal should correspond to the low reference/feedback value, set in par. 6-14 *Terminal 53 Low Ref./Feedb. Value.* The value must be set at >2 mA in order to activate the Live Zero Time-out Function in par. 6-01 *Live Zero Timeout Function.*

6-13 Terminal 53 High Current		
Range:		Function:
20.00 mA*	[Application dependant]	Enter the high current value corresponding to the high reference/feedback set in par. 6-15 *Terminal 53 High Ref./Feedb. Value.*

6-14 Terminal 53 Low Ref./Feedb. Value		
Range:		Function:
0.000*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the low voltage/low current set in par. 6-10 *Terminal 53 Low Voltage* and par. 6-12 *Terminal 53 Low Current.*

6-15 Terminal 53 High Ref./Feedb. Value		
Range:		Function:
Application dependent*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the high voltage/high current value set in par. 6-11 *Terminal 53 High Voltage* and par. 6-13 *Terminal 53 High Current.*

6-16 Terminal 53 Filter Time Constant		
Range:		Function:
0.001 s*	[0.001 - 10.000 s]	Enter the time constant. This is a first-order digital low pass filter time constant for suppressing electrical noise in terminal 53. A high time constant value improves dampening but also increases the time delay through the filter. This parameter cannot be adjusted while the motor is running.

6-17 Terminal 53 Live Zero		
Option:		Function:
		This parameter makes it possible to disable the Live Zero monitoring. E.g. to be used if the analog outputs are used as part of a de-central I/O system (e.g. when not as part of any frequency converter related control functions, but feeding a Building Management system with data).
[0]	Disabled	
[1] *	Enabled	

6-20 Terminal 54 Low Voltage		
Range:		Function:
0.07 V*	[Application dependant]	Enter the low voltage value. This analog input scaling value should correspond to the low reference/feedback value, set in par. 6-24 *Terminal 54 Low Ref./Feedb. Value.*

6-21 Terminal 54 High Voltage		
Range:		Function:
10.00 V*	[Application dependant]	Enter the high voltage value. This analog input scaling value should correspond to the high reference/feedback value set in par. 6-25 *Terminal 54 High Ref./Feedb. Value.*

6-22 Terminal 54 Low Current		
Range:		Function:
4.00 mA*	[Application dependant]	Enter the low current value. This reference signal should correspond to the low reference/feedback value, set in par. 6-24 *Terminal 54 Low Ref./Feedb. Value.* The value must be set at >2 mA in order to activate the Live Zero Time-out Function in par. 6-01 *Live Zero Timeout Function.*

6-23 Terminal 54 High Current		
Range:		Function:
20.00 mA*	[Application dependant]	Enter the high current value corresponding to the high reference/feedback value set in par. 6-25 *Terminal 54 High Ref./Feedb. Value.*

6-24 Terminal 54 Low Ref./Feedb. Value		
Range:		Function:
0.000*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the low voltage/low current value set in par. 6-20 *Terminal 54 Low Voltage* and par. 6-22 *Terminal 54 Low Current.*

6-25 Terminal 54 High Ref./Feedb. Value		
Range:		Function:
100.000*	[-999999.999 - 999999.999]	Enter the analog input scaling value that corresponds to the high voltage/high current value set in par. 6-21 *Terminal 54 High Voltage* and par. 6-23 *Terminal 54 High Current.*

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6-26 Terminal 54 Filter Time Constant		
Range:		Function:
0.001 s*	[0.001 - 10.000 s]	Enter the time constant. This is a first-order digital low pass filter time constant for suppressing electrical noise in terminal 54. A high time constant value improves dampening but also increases the time delay through the filter. This parameter cannot be adjusted while the motor is running.

6-27 Terminal 54 Live Zero		
Option:		Function:
		This parameter makes it possible to disable the Live Zero monitoring. E.g. to be used if the analog outputs are used as part of a de-central I/O system (e.g. when not as part of any frequency converter related control functions, but feeding a Building Management System with data).
[0]	Disabled	
[1] *	Enabled	

6-50 Terminal 42 Output		
Option:		Function:
		Select the function of Terminal 42 as an analog current output. A motor current of 20 mA corresponds to Imax.
[0] *	No operation	
[100]	Output freq. 0-100	0 - 100 Hz, (0-20 mA)
[101]	Reference Min-Max	Minimum reference - Maximum reference, (0-20 mA)
[102]	Feedback +-200%	-200% to +200% of par. 20-14 Maximum Reference/Feedb., (0-20 mA)
[103]	Motor cur. 0-Imax	0 - Inverter Max. Current (par. 16-37 Inv. Max. Current), (0-20 mA)
[104]	Torque 0-Tlim	0 - Torque limit (par. 4-16 Torque Limit Motor Mode), (0-20 mA)
[105]	Torque 0-Tnom	0 - Motor rated torque, (0-20 mA)
[106]	Power 0-Pnom	0 - Motor rated power, (0-20 mA)
[107] *	Speed 0-HighLim	0 - Speed High Limit (par. 4-13 Motor Speed High Limit [RPM] and par. 4-14 Motor Speed High Limit [Hz]), (0-20 mA)
[113]	Ext. Closed Loop 1	0 - 100%, (0-20 mA)
[114]	Ext. Closed Loop 2	0 - 100%, (0-20 mA)
[115]	Ext. Closed Loop 3	0 - 100%, (0-20 mA)
[130]	Out frq 0-100 4-20mA	0 - 100 Hz

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

NOTE

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

6-51 Terminal 42 Output Min Scale		
Range:		Function:
0.00 %*	[0.00 - 200.00 %]	Scale for the minimum output (0 or 4 mA) of the analogue signal at terminal 42. Set the value to be the **percentage** of the full range of the variable selected in par. 6-50 *Terminal 42 Output*.

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6-52 Terminal 42 Output Max Scale		
Range:		**Function:**
100.00 %*	[0.00 - 200.00 %]	Scale for the maximum output (20 mA) of the analog signal at terminal 42. Set the value to be the percentage of the full range of the variable selected in par. 6-50 *Terminal 42 Output*. It is possible to get a value lower than 20 mA at full scale by programming values >100% by using a formula as follows:

20 *mA* / *desired maximum current* × 100 %

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

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 par. 6-51 *Terminal 42 Output Min Scale* to 0%
Output signal 20 mA is needed at 50 Hz (50% of range) - set par. 6-52 *Terminal 42 Output Max Scale* to 50%
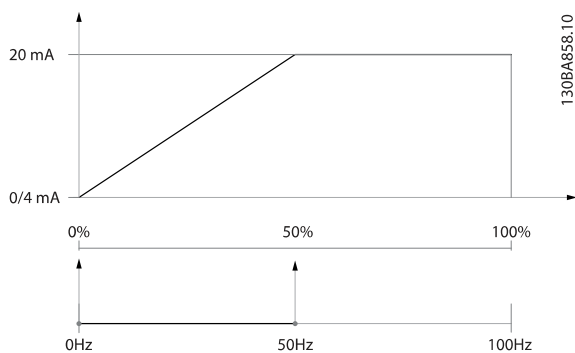
EXAMPLE 2:
Variable= FEEDBACK, range= -200% to +200%
Range needed for output= 0-100%
Output signal 0 or 4 mA is needed at 0% (50% of range) - set par. 6-51 *Terminal 42 Output Min Scale* to 50%
Output signal 20 mA is needed at 100% (75% of range) - set par. 6-52 *Terminal 42 Output Max Scale* to 75%
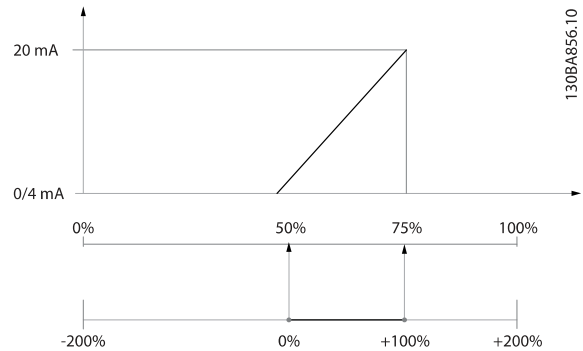
EXAMPLE 3:
Variable value= REFERENCE, range= Min ref - Max ref
Range needed for output= Min ref (0%) - Max ref (100%), 0-10 mA
Output signal 0 or 4 mA is needed at Min ref - set par. 6-51 *Terminal 42 Output Min Scale* to 0%
Output signal 10 mA is needed at Max ref (100% of range) - set par. 6-52 *Terminal 42 Output Max Scale* to 200% (20 mA / 10 mA x 100%=200%).

14-01 Switching Frequency		
Option:		**Function:**
		Select the inverter switching frequency. Changing the switching frequency can help to reduce acoustic noise from the motor. **NOTE** The output frequency value of the frequency converter must never exceed 1/10 of the switching frequency. When the motor is running, adjust the switching frequency in par. 14-01 *Switching Frequency* until the motor is as noiseless as possible. See also par. 14-00 *Switching Pattern* and the section *Derating*.
[0]	1.0 kHz	

14-01 Switching Frequency

Option:		Function:
[1]	1.5 kHz	
[2]	2.0 kHz	
[3]	2.5 kHz	
[4]	3.0 kHz	
[5]	3.5 kHz	
[6]	4.0 kHz	
[7] *	5.0 kHz	
[8]	6.0 kHz	
[9]	7.0 kHz	
[10]	8.0 kHz	
[11]	10.0 kHz	
[12]	12.0 kHz	
[13]	14.0 kHz	
[14]	16.0 kHz	

20-00 Feedback 1 Source

Option:		Function:
		Up to three different feedback signals can be used to provide the feedback signal for the frequency converter's PID Controller. This parameter defines which input will be used as the source of the first feedback signal. Analog input X30/11 and Analog input X30/12 refer to inputs on the optional General Purpose I/O board.
[0]	No function	
[1]	Analog input 53	
[2] *	Analog input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog Input X42/1	
[10]	Analog Input X42/3	
[11]	Analog Input X42/5	
[15]	Analog Input X48/2	
[100]	Bus feedback 1	
[101]	Bus feedback 2	
[102]	Bus feedback 3	
[104]	Sensorless Flow	Requires set up by MCT10 with sensorless specific plug in.
[105]	Sensorless Pressure	Requires set up by MCT10 with sensorless specific plug in.

NOTE

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

20-01 Feedback 1 Conversion

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

20-02 Feedback 1 Source Unit

Option:		Function:
		This parameter determines the unit that is used for this Feedback Source, prior to applying the feedback conversion of par. 20-01 *Feedback 1 Conversion*. This unit is not used by the PID Controller.
[0] *		
[1]	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	

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20-02 Feedback 1 Source Unit

Option:		Function:
[23]	m³/s	
[24]	m³/min	
[25]	m³/h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft³/s	
[126]	ft³/min	
[127]	ft³/h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in²	
[172]	in WG	
[173]	ft WG	
[174]	in Hg	
[180]	HP	

NOTE
This parameter is only available when using pressure to temperature feedback conversion.
If the choice Linear [0] is selected in par. 20-01 *Feedback 1 Conversion*, then the setting of any choice in par. 20-02 *Feedback 1 Source Unit* does not matter as conversion will be one-to-one.

20-03 Feedback 2 Source

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

20-04 Feedback 2 Conversion

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

20-05 Feedback 2 Source Unit

Option:	Function:
	See par. 20-02 *Feedback 1 Source Unit* for details.

20-06 Feedback 3 Source

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

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

20-08 Feedback 3 Source Unit	
Option: Function:	
	See par. 20-02 *Feedback 1 Source Unit* for details.

20-12 Reference/Feedback Unit	
Option: Function:	
	See par. 20-02 *Feedback 1 Source Unit* for details.

20-13 Minimum Reference/Feedb.		
Range:		Function:
0.000 ProcessCtrlUnit*	[Application dependant]	Enter the desired minimum value for the remote reference when operating with par. 1-00 *Configuration Mode* set for Closed Loop [3] operation. Units are set in par. 20-12 *Reference/Feedback Unit*. Minimum feedback will be -200% of either the value set in par. 20-13 *Minimum Reference/Feedb.* or in par. 20-14 *Maximum Reference/ Feedb.*, which ever numeric value is the highest.

NOTE
If operating with par. 1-00 *Configuration Mode* set for Open Loop [0], par. 3-02 *Minimum Reference* must be used.

20-14 Maximum Reference/Feedb.		
Range:		Function:
100.000 ProcessCtrlUnit*	[Application dependant]	Enter the maximum reference/ feedback for closed loop operation. The setting determines the highest value obtainable by summing all reference sources for closed loop operation. The setting determines 100% feedback in open and closed loop (total feedback range: -200% to +200%).

NOTE
If operating with par. 1-00 *Configuration Mode* set for Open Loop [0], par. 3-03 *Maximum Reference* must be used.

NOTE
The dynamics of the PID controller will depend on the value set in this parameter. Please see also par. 20-93 *PID Proportional Gain*.
Par. 20-13 and par. 20-14 also determine the feedback range when using feedback for display readout with par. 1-00 *Configuration Mode* set for Open Loop [0]. Same condition as above.

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

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20-20 Feedback Function		
Option:		Function:
[3] *	Minimum	*Minimum* [3] sets up the PID Controller to compare Feedback 1, Feedback 2 and Feedback 3 and use the lowest value as the feedback. **NOTE** **Any unused feedbacks must be set to *No Function* in par. 20-00 *Feedback 1 Source*, par. 20-03 *Feedback 2 Source*, or par. 20-06 *Feedback 3 Source*. Only setpoint 1 will be used. The sum of Setpoint 1 and any other references that are enabled (see par. group 3-1*) will be used as the PID Controller's setpoint reference.**
[4]	Maximum	*Maximum* [4] sets up the PID Controller to compare Feedback 1, Feedback 2 and Feedback 3 and use the highest value as the feedback. **NOTE** **Any unused feedbacks must be set to *No Function* in par. 20-00 *Feedback 1 Source*, par. 20-03 *Feedback 2 Source*, or par. 20-06 *Feedback 3 Source*.** Only Setpoint 1 will be used. The sum of Setpoint 1 and any other references that are enabled (see par. group 3-1*) will be used as the PID Controller's setpoint reference.
[5]	Multi Setpoint Min	*Multi-setpoint minimum* [5] sets up the PID Controller to calculate the difference between Feedback 1 and Setpoint 1, Feedback 2 and Setpoint 2, and Feedback 3 and Setpoint 3. It will use the feedback/setpoint pair in which the feedback is the farthest below its corresponding setpoint reference. If all feedback signals are above their corresponding setpoints, the PID Controller will use the feedback/setpoint pair in which the difference between the feedback and setpoint is the least. **NOTE** **If only two feedback signals are used, the feedback that is not to be used must be set to *No Function* in par. 20-00 *Feedback 1 Source*, par. 20-03 *Feedback 2 Source* or par. 20-06 *Feedback 3 Source*. Note that each setpoint reference will be the sum of its respective parameter value (par. 20-21 *Setpoint 1*, par. 20-22 *Setpoint 2* and par. 20-23 *Setpoint 3*) and any other references that are enabled (see par. group 3-1*).**

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

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

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

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

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

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

Example 1 – Multi zone, single setpoint
In an office building, a VAV (variable air volume) VLT HVAC Drive system must ensure a minimum pressure at selected VAV boxes. Due to the varying pressure losses in each duct, the pressure at each VAV box cannot be assumed to be the

same. The minimum pressure required is the same for all VAV boxes. This control method can be set up by setting par. 20-20 *Feedback Function* to option [3], Minimum, and entering the desired pressure in par. 20-21 *Setpoint 1*. The PID

Controller will increase the speed of the fan if any one feedback is below the setpoint and decrease the speed of the fan if all feedbacks are above the setpoint.
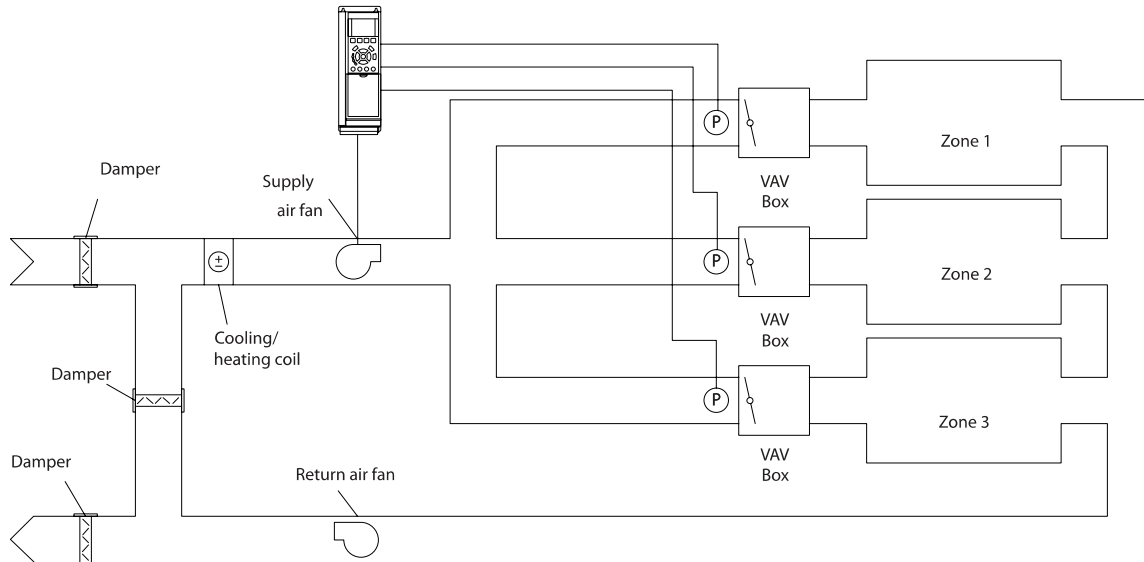
Example 2 – Multi zone, multi setpoint

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

20-21 Setpoint 1		
Range:		**Function:**
0.000 ProcessCtrlUnit*	[-999999.999 - 999999.999 ProcessCtrlUnit]	Setpoint 1 is used in Closed Loop Mode to enter a setpoint reference that is used by the frequency converter's PID Controller. See the description of par. 20-20 *Feedback Function*. **NOTE** **Setpoint reference entered here is added to any other references that are enabled (see par. group 3-1*).**

20-22 Setpoint 2		
Range:		**Function:**
0.000 ProcessCtrlUnit*	[-999999.999 - 999999.999 ProcessCtrlUnit]	Setpoint 2 is used in Closed Loop Mode to enter a setpoint reference that may be used by the

20-22 Setpoint 2		
Range:		**Function:**
		frequency converter's PID Controller. See the description of *Feedback Function*, par. 20-20 *Feedback Function*.

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

20-70 Closed Loop Type		
Option:		**Function:**
		This parameter defines the application response. The default mode should be sufficient for most applications. If the application response speed is known, it can be selected here. This will decrease the time needed for carrying out PID autotuning. The setting has no impact on the value of the tuned parameters and is used only for the autotuning sequence.
[0] *	Auto	
[1]	Fast Pressure	
[2]	Slow Pressure	
[3]	Fast Temperature	
[4]	Slow Temperature	

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20-71 PID Performance

Option:		Function:
[0] *	Normal	Normal setting of this parameter will be suitable for pressure control in fan systems.
[1]	Fast	Fast setting would generally be used in pumping systems, where a faster control response is desirable.

20-72 PID Output Change

Range:		Function:
0.10*	[0.01 - 0.50]	This parameter sets the magnitude of step change during autotuning. The value is a percentage of full speed. I.e. if maximum output frequency inpar. 4-13 *Motor Speed High Limit [RPM]*/ par. 4-14 *Motor Speed High Limit [Hz]* is set to 50Hz, 0.10 is 10% of 50Hz, which is 5Hz. This parameter should be set to a value resulting in feedback changes of between 10% and 20% for best tuning accuracy.

20-73 Minimum Feedback Level

Range:		Function:
-999999.000 ProcessCtrlUnit*	[Application dependant]	The minimum allowable feedback level should be entered here in User units as defined in par. 20-12 *Reference/Feedback Unit*. If the level falls below par. 20-73 *Minimum Feedback Level*, autotuning is aborted and an error message will appear on the LCP.

20-74 Maximum Feedback Level

Range:		Function:
999999.000 ProcessCtrlUnit*	[Application dependant]	The maximum allowable feedback level should be entered here in User units as defined in par. 20-12 *Reference/Feedback Unit*. If the level rises above par. 20-74 *Maximum Feedback Level*, autotuning is aborted and an error message will appear on the LCP.

20-79 PID Autotuning

Option:		Function:
		This parameter starts the PID autotuning sequence. Once the autotuning has successfully completed and the settings have been accepted or rejected by the user, by pressing [OK] or [Cancel] buttons on the LCP at the end of tuning, this parameter is reset to [0] Disabled.
[0] *	Disabled	
[1]	Enabled	

20-81 PID Normal/ Inverse Control

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

20-82 PID Start Speed [RPM]

Range:		Function:
Application dependent*	[Application dependant]	When the frequency converter 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 frequency converter 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 par. 0-02 *Motor Speed Unit* is set to [0], RPM.**

20-83 PID Start Speed [Hz]

Range:		Function:
Application dependent*	[Application dependant]	When the frequency converter is first started, it initially ramps up to this output frequency in Open Loop Mode, following the active Ramp Up Time. When the output frequency programmed here is reached, the frequency converter 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 par. 0-02 *Motor Speed Unit* is set to [1], Hz.**

20-93 PID Proportional Gain

Range:		Function:
0.50*	[0.00 - 10.00]	

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

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

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

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

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 (par. 4-13 *Motor Speed High Limit [RPM]*, par. 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 frequency converter must be set for Open Loop (par. 1-00 *Configuration Mode*). Note that it is important also to set par. 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 par. 4-13 *Motor Speed High Limit [RPM]* or par. 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 Contoller as settings will be reset when changing from Closed to Open Loop in par. 1-00 *Configuration Mode*.

NOTE
Carry out the tuning with the same settings in par. 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 22-3* 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 par. 4-11 *Motor Speed Low Limit [RPM]* or par. 4-12 *Motor Speed Low Limit [Hz]*.

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

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NOTE

Do not set par. 14-20 *Reset Mode*, to [13] Infinite auto reset, when par. 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's 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 stay detected to activate signal for actions. If detection disappears before run out of the timer, 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.
[3]	Man. Reset Alarm	The drive will stop running and activate a Dry pump alarm [A93]. A drive digital output or a serial communication bus can communicate an alarm to other equipment.

NOTE

Low Power Detection must be Enabled (par. 22-21 *Low Power Detection*) and commissioned (using either parameter group 22-3*, *No Flow Power Tuning*, or par. 22-20 *Low Power Auto Set-up*) in order to use Dry Pump Detection.

NOTE

Do not set par. 14-20 *Reset Mode*, to [13] Infinite auto reset, when par. 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

22-40 Minimum Run Time		
Range:		**Function:**
10 s*	[0 - 600 s]	Set the desired minimum running time for the motor after a start command (digital input or Bus) before entering Sleep Mode.

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

22-42 Wake-up Speed [RPM]		
Range:		**Function:**
Application dependent*	[Application dependant]	To be used if par. 0-02 *Motor Speed Unit* has been set for RPM (parameter not visible if Hz selected). Only to be used if par. 1-00 *Configuration Mode* is set for Open Loop and speed reference is applied by an external controller. Set the reference speed at which the Sleep Mode should be cancelled.

22-43 Wake-up Speed [Hz]		
Range:		**Function:**
Application dependent*	[Application dependant]	To be used if par. 0-02 *Motor Speed Unit*, has been set for Hz (parameter not visible if RPM selected). Only to be used if par. 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 the Sleep Mode should be cancelled.

22-44 Wake-up Ref./FB Difference		
Range:		Function:
10 %*	[0 - 100 %]	Only to be used if par. 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 set point for the pressure (Pset) before cancel-ling the Sleep Mode.

NOTE

If used in application where the integrated PI controller is set for inverse control (e.g. cooling tower applications) in par. 20-71 *PID Performance*, the value set in par. 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 par. 1-00 *Configuration Mode*, is set for Closed Loop and the integrated PI controller is used. In systems with e.g. constant pressure control, it is advantageous to increase the system pressure before the motor is stopped. This will extend the time in which the motor is stopped and help to avoid frequent start/stop. Set the desired over pressure/temperature in percentage of set point for the pressure (Pset)/ temperature before entering the Sleep Mode. If setting for 5%, the boost pressure will be Pset*1.05. The negative values can be used for e.g. 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 par. 1-00 *Configuration Mode* is set for Closed Loop and the integrated PI control-ler is used for controlling the pressure. Set the maximum time for which boost mode will be allowed. If the set time is exceeded, Sleep Mode will be entered, not waiting for the set boost pressure to be reached.

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

22-60 Broken Belt Function	
Selects the action to be performed if the Broken Belt condition is detected	
Option:	Function:
	communication bus can communicate an alarm to other equipment.

NOTE

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

NOTE

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

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

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

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

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

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

NOTE
Does not work in cascade mode.

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

22-81 Square-linear Curve Approximation		
Range:		Function:
100 %*	[0 - 100 %]	**Example 1:** Adjustment of this parameter allows the shape of the control curve to be adjusted. 0 = Linear 100% = Ideal shape (theoretical).

NOTE
Not visible when running in cascade.
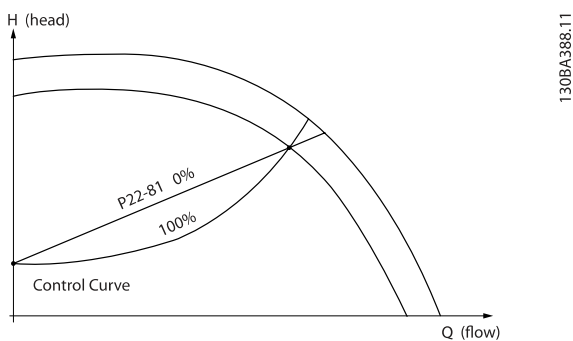
22-82 Work Point Calculation		
Option:		Function:
		Example 1: Speed at System Design Working Point is known:

22-82 Work Point Calculation		
Option:		Function:
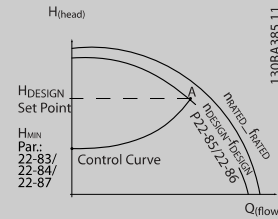
From the data sheet showing characteristics for the specific equipment at different speeds, simply reading across from the H$_{DESIGN}$ point and the Q$_{DESIGN}$ point allows us to find point A, which is the System Design Working Point. The pump characteristics at this point should be identified and 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 par. 22-81 *Square-linear Curve Approximation* then allows the shape of the control curve to be adjusted infinitely.

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$_{MIN}$ as described above, allows the frequency converter to calculate the reference point B and thus to plot the control curve which will also include the System design Working Point A.
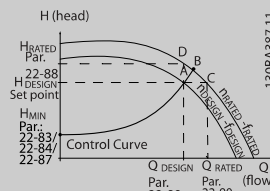
[0] *	Disabled	*Disabled [0]*: Work Point Calculation not active. To be used if speed at design point is known (see table above).

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22-82 Work Point Calculation		
Option:	Function:	
[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 par. 22-83 *Speed at No-Flow [RPM]* par. 22-84 *Speed at No-Flow [Hz]*, par. 22-87 *Pressure at No-Flow Speed*, par. 22-88 *Pressure at Rated Speed*, par. 22-89 *Flow at Design Point* and par. 22-90 *Flow at Rated Speed*.

22-83 Speed at No-Flow [RPM]		
Range:		Function:
Application dependent*	[Application dependant]	Resolution 1 RPM. The speed of the motor at which flow Is zero and minimum pressure H$_{MIN}$ is achieved should be entered here in RPM. Alternatively, the speed in Hz can be entered in par. 22-84 *Speed at No-Flow [Hz]*. If it has been decided to use RPM in par. 0-02 *Motor Speed Unit* then par. 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.

22-84 Speed at No-Flow [Hz]		
Range:		Function:
Application dependent*	[Application dependant]	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 par. 22-83 *Speed at No-Flow [RPM]*. If it has been decided to use Hz in par. 0-02 *Motor Speed Unit* then par. 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.

22-85 Speed at Design Point [RPM]		
Range:		Function:
Application dependent*	[Application dependant]	Resolution 1 RPM. Only visible when par. 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 par. 22-86 *Speed at Design Point [Hz]*. If it has been decided to use RPM in

22-85 Speed at Design Point [RPM]		
Range:		Function:
		par. 0-02 *Motor Speed Unit* then par. 22-83 *Speed at No-Flow [RPM]* should also be used.

22-86 Speed at Design Point [Hz]		
Range:		Function:
Application dependent*	[Application dependant]	Resolution 0.033 Hz. Only visible when par. 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 par. 22-85 *Speed at Design Point [RPM]*. If it has been decided to use Hz in par. 0-02 *Motor Speed Unit*, then par. 22-83 *Speed at No-Flow [RPM]* should also be used.

22-87 Pressure at No-Flow Speed		
Range:		Function:
0.000*	[Application dependant]	Enter the pressure H$_{MIN}$ corresponding to Speed at No Flow in Reference/Feedback Units.

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

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

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

22-89 Flow at Design Point		
Range:		Function:
0.000*	[0.000 - 999999.999]	Enter the value corresponding to the Flow at Design Point. No units necessary.

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

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

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7.3.1 Parameter Set-Up

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

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

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

Table 7.1: Parameter Groups

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

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

7.3.2 0-** Operation and Display

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver- sion index	Type
0-0* Basic Settings						
0-01	Language	[0] English	1 set-up	TRUE	-	Uint8
0-02	Motor Speed Unit	[1] Hz	2 set-ups	FALSE	-	Uint8
0-03	Regional Settings	[0] International	2 set-ups	FALSE	-	Uint8
0-04	Operating State at Power-up	[0] Resume	All set-ups	TRUE	-	Uint8
0-05	Local Mode Unit	[0] As Motor Speed Unit	2 set-ups	FALSE	-	Uint8
0-1* Set-up Operations						
0-10	Active Set-up	[1] Set-up 1	1 set-up	TRUE	-	Uint8
0-11	Programming Set-up	[9] Active Set-up	All set-ups	TRUE	-	Uint8
0-12	This Set-up Linked to	[0] Not linked	All set-ups	FALSE	-	Uint8
0-13	Readout: Linked Set-ups	0 N/A	All set-ups	FALSE	0	Uint16
0-14	Readout: Prog. Set-ups / Channel	0 N/A	All set-ups	TRUE	0	Int32
0-2* LCP Display						
0-20	Display Line 1.1 Small	1602	All set-ups	TRUE	-	Uint16
0-21	Display Line 1.2 Small	1614	All set-ups	TRUE	-	Uint16
0-22	Display Line 1.3 Small	1610	All set-ups	TRUE	-	Uint16
0-23	Display Line 2 Large	1613	All set-ups	TRUE	-	Uint16
0-24	Display Line 3 Large	1502	All set-ups	TRUE	-	Uint16
0-25	My Personal Menu	SR	1 set-up	TRUE	0	Uint16
0-3* LCP Custom Readout						
0-30	Custom Readout Unit	[1] %	All set-ups	TRUE	-	Uint8
0-31	Custom Readout Min Value	SR	All set-ups	TRUE	-2	Int32
0-32	Custom Readout Max Value	100.00 CustomReadou- tUnit	All set-ups	TRUE	-2	Int32
0-37	Display Text 1	0 N/A	1 set-up	TRUE	0	VisStr[25]
0-38	Display Text 2	0 N/A	1 set-up	TRUE	0	VisStr[25]
0-39	Display Text 3	0 N/A	1 set-up	TRUE	0	VisStr[25]
0-4* LCP Keypad						
0-40	[Hand on] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-41	[Off] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-42	[Auto on] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-43	[Reset] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-44	[Off/Reset] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-45	[Drive Bypass] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-5* Copy/Save						
0-50	LCP Copy	[0] No copy	All set-ups	FALSE	-	Uint8
0-51	Set-up Copy	[0] No copy	All set-ups	FALSE	-	Uint8
0-6* Password						
0-60	Main Menu Password	100 N/A	1 set-up	TRUE	0	Int16
0-61	Access to Main Menu w/o Password	[0] Full access	1 set-up	TRUE	-	Uint8
0-65	Personal Menu Password	200 N/A	1 set-up	TRUE	0	Int16
0-66	Access to Personal Menu w/o Password	[0] Full access	1 set-up	TRUE	-	Uint8
0-7* Clock Settings						
0-70	Date and Time	SR	All set-ups	TRUE	0	TimeOfDay
0-71	Date Format	null	1 set-up	TRUE	-	Uint8
0-72	Time Format	null	1 set-up	TRUE	-	Uint8
0-74	DST/Summertime	[0] Off	1 set-up	TRUE	-	Uint8
0-76	DST/Summertime Start	SR	1 set-up	TRUE	0	TimeOfDay

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

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7.3.3 1-** Load / Motor

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
1-0* General Settings						
1-00	Configuration Mode	null	All set-ups	TRUE	-	Uint8
1-03	Torque Characteristics	[3] Auto Energy Optim. VT	All set-ups	TRUE	-	Uint8
1-06	Clockwise Direction	[0] Normal	All set-ups	FALSE	-	Uint8
1-2* Motor Data						
1-20	Motor Power [kW]	SR	All set-ups	FALSE	1	Uint32
1-21	Motor Power [HP]	SR	All set-ups	FALSE	-2	Uint32
1-22	Motor Voltage	SR	All set-ups	FALSE	0	Uint16
1-23	Motor Frequency	SR	All set-ups	FALSE	0	Uint16
1-24	Motor Current	SR	All set-ups	FALSE	-2	Uint32
1-25	Motor Nominal Speed	SR	All set-ups	FALSE	67	Uint16
1-28	Motor Rotation Check	[0] Off	All set-ups	FALSE	-	Uint8
1-29	Automatic Motor Adaptation (AMA)	[0] Off	All set-ups	FALSE	-	Uint8
1-3* Adv. Motor Data						
1-30	Stator Resistance (Rs)	SR	All set-ups	FALSE	-4	Uint32
1-31	Rotor Resistance (Rr)	SR	All set-ups	FALSE	-4	Uint32
1-35	Main Reactance (Xh)	SR	All set-ups	FALSE	-4	Uint32
1-36	Iron Loss Resistance (Rfe)	SR	All set-ups	FALSE	-3	Uint32
1-39	Motor Poles	SR	All set-ups	FALSE	0	Uint8
1-5* Load Indep. Setting						
1-50	Motor Magnetisation at Zero Speed	100 %	All set-ups	TRUE	0	Uint16
1-51	Min Speed Normal Magnetising [RPM]	SR	All set-ups	TRUE	67	Uint16
1-52	Min Speed Normal Magnetising [Hz]	SR	All set-ups	TRUE	-1	Uint16
1-58	Flystart Test Pulses Current	30 %	All set-ups	FALSE	0	Uint16
1-59	Flystart Test Pulses Frequency	200 %	All set-ups	FALSE	0	Uint16
1-6* Load Depen. Setting						
1-60	Low Speed Load Compensation	100 %	All set-ups	TRUE	0	Int16
1-61	High Speed Load Compensation	100 %	All set-ups	TRUE	0	Int16
1-62	Slip Compensation	0 %	All set-ups	TRUE	0	Int16
1-63	Slip Compensation Time Constant	SR	All set-ups	TRUE	-2	Uint16
1-64	Resonance Dampening	100 %	All set-ups	TRUE	0	Uint16
1-65	Resonance Dampening Time Constant	5 ms	All set-ups	TRUE	-3	Uint8
1-7* Start Adjustments						
1-71	Start Delay	0.0 s	All set-ups	TRUE	-1	Uint16
1-73	Flying Start	[0] Disabled	All set-ups	TRUE	-	Uint8
1-77	Compressor Start Max Speed [RPM]	SR	All set-ups	TRUE	67	Uint16
1-78	Compressor Start Max Speed [Hz]	SR	All set-ups	TRUE	-1	Uint16
1-79	Compressor Start Max Time to Trip	5.0 s	All set-ups	TRUE	-1	Uint8
1-8* Stop Adjustments						
1-80	Function at Stop	[0] Coast	All set-ups	TRUE	-	Uint8
1-81	Min Speed for Function at Stop [RPM]	SR	All set-ups	TRUE	67	Uint16
1-82	Min Speed for Function at Stop [Hz]	SR	All set-ups	TRUE	-1	Uint16
1-86	Trip Speed Low [RPM]	SR	All set-ups	TRUE	67	Uint16
1-87	Trip Speed Low [Hz]	SR	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

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7.3.4 2-** Brakes

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
2-0* DC-Brake						
2-00	DC Hold/Preheat Current	50 %	All set-ups	TRUE	0	Uint8
2-01	DC Brake Current	50 %	All set-ups	TRUE	0	Uint16
2-02	DC Braking Time	10.0 s	All set-ups	TRUE	-1	Uint16
2-03	DC Brake Cut In Speed [RPM]	SR	All set-ups	TRUE	67	Uint16
2-04	DC Brake Cut In Speed [Hz]	SR	All set-ups	TRUE	-1	Uint16
2-1* Brake Energy Funct.						
2-10	Brake Function	[0] Off	All set-ups	TRUE	-	Uint8
2-11	Brake Resistor (ohm)	SR	All set-ups	TRUE	-2	Uint32
2-12	Brake Power Limit (kW)	SR	All set-ups	TRUE	0	Uint32
2-13	Brake Power 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	Over-voltage Control	[2] Enabled	All set-ups	TRUE	-	Uint8

7.3.5 3-** Reference / Ramps

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
3-0* Reference Limits						
3-02	Minimum Reference	SR	All set-ups	TRUE	-3	Int32
3-03	Maximum Reference	SR	All set-ups	TRUE	-3	Int32
3-04	Reference Function	null	All set-ups	TRUE	-	Uint8
3-1* References						
3-10	Preset Reference	0.00 %	All set-ups	TRUE	-2	Int16
3-11	Jog Speed [Hz]	SR	All set-ups	TRUE	-1	Uint16
3-13	Reference Site	[0] Linked to Hand / Auto	All set-ups	TRUE	-	Uint8
3-14	Preset Relative Reference	0.00 %	All set-ups	TRUE	-2	Int32
3-15	Reference 1 Source	[1] Analog input 53	All set-ups	TRUE	-	Uint8
3-16	Reference 2 Source	[20] Digital pot.meter	All set-ups	TRUE	-	Uint8
3-17	Reference 3 Source	[0] No function	All set-ups	TRUE	-	Uint8
3-19	Jog Speed [RPM]	SR	All set-ups	TRUE	67	Uint16
3-4* Ramp 1						
3-41	Ramp 1 Ramp Up Time	SR	All set-ups	TRUE	-2	Uint32
3-42	Ramp 1 Ramp Down Time	SR	All set-ups	TRUE	-2	Uint32
3-5* Ramp 2						
3-51	Ramp 2 Ramp Up Time	SR	All set-ups	TRUE	-2	Uint32
3-52	Ramp 2 Ramp Down Time	SR	All set-ups	TRUE	-2	Uint32
3-8* Other Ramps						
3-80	Jog Ramp Time	SR	All set-ups	TRUE	-2	Uint32
3-81	Quick Stop Ramp Time	SR	2 set-ups	TRUE	-2	Uint32
3-82	Starting Ramp Up Time	SR	2 set-ups	TRUE	-2	Uint32
3-9* Digital Pot.Meter						
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	SR	All set-ups	TRUE	-3	TimD

7.3.6 4-** Limits / Warnings

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
4-1* Motor Limits						
4-10	Motor Speed Direction	[2] Both directions	All set-ups	FALSE	-	Uint8
4-11	Motor Speed Low Limit [RPM]	SR	All set-ups	TRUE	67	Uint16
4-12	Motor Speed Low Limit [Hz]	SR	All set-ups	TRUE	-1	Uint16
4-13	Motor Speed High Limit [RPM]	SR	All set-ups	TRUE	67	Uint16
4-14	Motor Speed High Limit [Hz]	SR	All set-ups	TRUE	-1	Uint16
4-16	Torque Limit Motor Mode	SR	All set-ups	TRUE	-1	Uint16
4-17	Torque Limit Generator Mode	100.0 %	All set-ups	TRUE	-1	Uint16
4-18	Current Limit	SR	All set-ups	TRUE	-1	Uint32
4-19	Max Output Frequency	SR	All set-ups	FALSE	-1	Uint16
4-5* Adj. Warnings						
4-50	Warning Current Low	0.00 A	All set-ups	TRUE	-2	Uint32
4-51	Warning Current High	ImaxVLT (P1637)	All set-ups	TRUE	-2	Uint32
4-52	Warning Speed Low	0 RPM	All set-ups	TRUE	67	Uint16
4-53	Warning Speed High	outputSpeedHighLimit (P413)	All set-ups	TRUE	67	Uint16
4-54	Warning Reference Low	-999999.999 N/A	All set-ups	TRUE	-3	Int32
4-55	Warning Reference High	999999.999 N/A	All set-ups	TRUE	-3	Int32
4-56	Warning Feedback Low	-999999.999 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
4-57	Warning Feedback High	999999.999 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
4-58	Missing Motor Phase Function	[2] Trip 1000 ms	All set-ups	TRUE	-	Uint8
4-6* Speed Bypass						
4-60	Bypass Speed From [RPM]	SR	All set-ups	TRUE	67	Uint16
4-61	Bypass Speed From [Hz]	SR	All set-ups	TRUE	-1	Uint16
4-62	Bypass Speed To [RPM]	SR	All set-ups	TRUE	67	Uint16
4-63	Bypass Speed To [Hz]	SR	All set-ups	TRUE	-1	Uint16
4-64	Semi-Auto Bypass Set-up	[0] Off	All set-ups	FALSE	-	Uint8

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7.3.7 5-** Digital In / Out

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 24V	All set-ups	FALSE	-	Uint8
5-01	Terminal 27 Mode	[0] Input	All set-ups	TRUE	-	Uint8
5-02	Terminal 29 Mode	[0] Input	All set-ups	TRUE	-	Uint8
5-1* Digital Inputs						
5-10	Terminal 18 Digital Input	[8] Start	All set-ups	TRUE	-	Uint8
5-11	Terminal 19 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-12	Terminal 27 Digital Input	null	All set-ups	TRUE	-	Uint8
5-13	Terminal 29 Digital Input	[14] Jog	All set-ups	TRUE	-	Uint8
5-14	Terminal 32 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-15	Terminal 33 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-16	Terminal X30/2 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-17	Terminal X30/3 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-18	Terminal X30/4 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-3* Digital Outputs						
5-30	Terminal 27 Digital Output	[0] No operation	All set-ups	TRUE	-	Uint8
5-31	Terminal 29 Digital Output	[0] No operation	All set-ups	TRUE	-	Uint8
5-32	Term X30/6 Digi Out (MCB 101)	[0] No operation	All set-ups	TRUE	-	Uint8
5-33	Term X30/7 Digi Out (MCB 101)	[0] No operation	All set-ups	TRUE	-	Uint8
5-4* Relays						
5-40	Function Relay	null	All set-ups	TRUE	-	Uint8
5-41	On Delay, Relay	0.01 s	All set-ups	TRUE	-2	Uint16
5-42	Off Delay, Relay	0.01 s	All set-ups	TRUE	-2	Uint16
5-5* Pulse Input						
5-50	Term. 29 Low Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-51	Term. 29 High Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-52	Term. 29 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
5-53	Term. 29 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
5-54	Pulse Filter Time Constant #29	100 ms	All set-ups	FALSE	-3	Uint16
5-55	Term. 33 Low Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-56	Term. 33 High Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-57	Term. 33 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
5-58	Term. 33 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
5-59	Pulse Filter Time Constant #33	100 ms	All set-ups	FALSE	-3	Uint16
5-6* Pulse Output						
5-60	Terminal 27 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
5-62	Pulse Output Max Freq #27	5000 Hz	All set-ups	TRUE	0	Uint32
5-63	Terminal 29 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
5-65	Pulse Output Max Freq #29	5000 Hz	All set-ups	TRUE	0	Uint32
5-66	Terminal X30/6 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
5-68	Pulse Output Max Freq #X30/6	5000 Hz	All set-ups	TRUE	0	Uint32
5-9* Bus Controlled						
5-90	Digital & Relay Bus Control	0 N/A	All set-ups	TRUE	0	Uint32
5-93	Pulse Out #27 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
5-94	Pulse Out #27 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
5-95	Pulse Out #29 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
5-96	Pulse Out #29 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
5-97	Pulse Out #X30/6 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
5-98	Pulse Out #X30/6 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16

7.3.8 6-** Analog In / Out

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
6-0* Analog I/O Mode						
6-00	Live Zero Timeout Time	10 s	All set-ups	TRUE	0	Uint8
6-01	Live Zero Timeout Function	[0] Off	All set-ups	TRUE	-	Uint8
6-02	Fire Mode Live Zero Timeout Function	[0] Off	All set-ups	TRUE	-	Uint8
6-1* Analog Input 53						
6-10	Terminal 53 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
6-11	Terminal 53 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
6-12	Terminal 53 Low Current	4.00 mA	All set-ups	TRUE	-5	Int16
6-13	Terminal 53 High Current	20.00 mA	All set-ups	TRUE	-5	Int16
6-14	Terminal 53 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
6-15	Terminal 53 High Ref./Feedb. Value	SR	All set-ups	TRUE	-3	Int32
6-16	Terminal 53 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
6-17	Terminal 53 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
6-2* Analog Input 54						
6-20	Terminal 54 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
6-21	Terminal 54 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
6-22	Terminal 54 Low Current	4.00 mA	All set-ups	TRUE	-5	Int16
6-23	Terminal 54 High Current	20.00 mA	All set-ups	TRUE	-5	Int16
6-24	Terminal 54 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
6-25	Terminal 54 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
6-26	Terminal 54 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
6-27	Terminal 54 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
6-3* Analog Input X30/11						
6-30	Terminal X30/11 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
6-31	Terminal X30/11 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
6-34	Term. X30/11 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
6-35	Term. X30/11 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
6-36	Term. X30/11 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
6-37	Term. X30/11 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
6-4* Analog Input X30/12						
6-40	Terminal X30/12 Low Voltage	0.07 V	All set-ups	TRUE	-2	Int16
6-41	Terminal X30/12 High Voltage	10.00 V	All set-ups	TRUE	-2	Int16
6-44	Term. X30/12 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
6-45	Term. X30/12 High Ref./Feedb. Value	100.000 N/A	All set-ups	TRUE	-3	Int32
6-46	Term. X30/12 Filter Time Constant	0.001 s	All set-ups	TRUE	-3	Uint16
6-47	Term. X30/12 Live Zero	[1] Enabled	All set-ups	TRUE	-	Uint8
6-5* Analog Output 42						
6-50	Terminal 42 Output	null	All set-ups	TRUE	-	Uint8
6-51	Terminal 42 Output Min Scale	0.00 %	All set-ups	TRUE	-2	Int16
6-52	Terminal 42 Output Max Scale	100.00 %	All set-ups	TRUE	-2	Int16
6-53	Terminal 42 Output Bus Control	0.00 %	All set-ups	TRUE	-2	N2
6-54	Terminal 42 Output Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
6-6* Analog Output X30/8						
6-60	Terminal X30/8 Output	[0] No operation	All set-ups	TRUE	-	Uint8
6-61	Terminal X30/8 Min. Scale	0.00 %	All set-ups	TRUE	-2	Int16
6-62	Terminal X30/8 Max. Scale	100.00 %	All set-ups	TRUE	-2	Int16
6-63	Terminal X30/8 Output Bus Control	0.00 %	All set-ups	TRUE	-2	N2
6-64	Terminal X30/8 Output Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16

7.3.9 8-** Communication and Options

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	SR	1 set-up	TRUE	-1	Uint32
8-04	Control Timeout Function	[0] Off	1 set-up	TRUE	-	Uint8
8-05	End-of-Timeout Function	[1] Resume set-up	1 set-up	TRUE	-	Uint8
8-06	Reset Control Timeout	[0] Do not reset	All set-ups	TRUE	-	Uint8
8-07	Diagnosis Trigger	[0] Disable	2 set-ups	TRUE	-	Uint8
8-1* Control Settings						
8-10	Control Profile	[0] FC profile	All set-ups	FALSE	-	Uint8
8-13	Configurable Status Word STW	[1] Profile Default	All set-ups	TRUE	-	Uint8
8-3* FC Port Settings						
8-30	Protocol	null	1 set-up	TRUE	-	Uint8
8-31	Address	SR	1 set-up	TRUE	0	Uint8
8-32	Baud Rate	null	1 set-up	TRUE	-	Uint8
8-33	Parity / Stop Bits	null	1 set-up	TRUE	-	Uint8
8-34	Estimated cycle time	0 ms	2 set-ups	TRUE	-3	Uint32
8-35	Minimum Response Delay	SR	1 set-up	TRUE	-3	Uint16
8-36	Maximum Response Delay	SR	1 set-up	TRUE	-3	Uint16
8-37	Maximum Inter-Char Delay	SR	1 set-up	TRUE	-5	Uint16
8-4* FC MC protocol set						
8-40	Telegram Selection	[1] Standard telegram 1	2 set-ups	TRUE	-	Uint8
8-42	PCD write configuration	SR	All set-ups	TRUE	-	Uint16
8-43	PCD read configuration	SR	All set-ups	TRUE	-	Uint16
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	Initialisation Password	SR	1 set-up	TRUE	0	VisStr[20]
8-8* FC Port Diagnostics						
8-80	Bus Message Count	0 N/A	All set-ups	TRUE	0	Uint32
8-81	Bus Error Count	0 N/A	All set-ups	TRUE	0	Uint32
8-82	Slave Messages Rcvd	0 N/A	All set-ups	TRUE	0	Uint32
8-83	Slave Error Count	0 N/A	All set-ups	TRUE	0	Uint32
8-84	Slave Messages Sent	0 N/A	All set-ups	TRUE	0	Uint32
8-85	Slave Timeout Errors	0 N/A	All set-ups	TRUE	0	Uint32
8-89	Diagnostics Count	0 N/A	1 set-up	TRUE	0	Int32
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

7.3.10 9-** Profibus

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	SR	2 set-ups	TRUE	-	Uint16
9-16	PCD Read Configuration	SR	2 set-ups	TRUE	-	Uint16
9-18	Node Address	126 N/A	1 set-up	TRUE	0	Uint8
9-22	Telegram Selection	[108] PPO 8	1 set-up	TRUE	-	Uint8
9-23	Parameters for Signals	0	All set-ups	TRUE	-	Uint16
9-27	Parameter Edit	[1] Enabled	2 set-ups	FALSE	-	Uint16
9-28	Process Control	[1] Enable cyclic master	2 set-ups	FALSE	-	Uint8
9-44	Fault Message Counter	0 N/A	All set-ups	TRUE	0	Uint16
9-45	Fault Code	0 N/A	All set-ups	TRUE	0	Uint16
9-47	Fault Number	0 N/A	All set-ups	TRUE	0	Uint16
9-52	Fault Situation Counter	0 N/A	All set-ups	TRUE	0	Uint16
9-53	Profibus Warning Word	0 N/A	All set-ups	TRUE	0	V2
9-63	Actual Baud Rate	[255] No baudrate 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

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7.3.11 10-** CAN Fieldbus

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	SR	2 set-ups	TRUE	0	Uint8
10-05	Readout Transmit Error Counter	0 N/A	All set-ups	TRUE	0	Uint8
10-06	Readout Receive Error Counter	0 N/A	All set-ups	TRUE	0	Uint8
10-07	Readout Bus Off Counter	0 N/A	All set-ups	TRUE	0	Uint8
10-1* DeviceNet						
10-10	Process Data Type Selection	null	All set-ups	TRUE	-	Uint8
10-11	Process Data Config Write	SR	2 set-ups	TRUE	-	Uint16
10-12	Process Data Config Read	SR	2 set-ups	TRUE	-	Uint16
10-13	Warning Parameter	0 N/A	All set-ups	TRUE	0	Uint16
10-14	Net Reference	[0] Off	2 set-ups	TRUE	-	Uint8
10-15	Net Control	[0] Off	2 set-ups	TRUE	-	Uint8
10-2* COS Filters						
10-20	COS Filter 1	0 N/A	All set-ups	FALSE	0	Uint16
10-21	COS Filter 2	0 N/A	All set-ups	FALSE	0	Uint16
10-22	COS Filter 3	0 N/A	All set-ups	FALSE	0	Uint16
10-23	COS Filter 4	0 N/A	All set-ups	FALSE	0	Uint16
10-3* Parameter Access						
10-30	Array Index	0 N/A	2 set-ups	TRUE	0	Uint8
10-31	Store Data Values	[0] Off	All set-ups	TRUE	-	Uint8
10-32	Devicenet Revision	0 N/A	All set-ups	TRUE	0	Uint16
10-33	Store Always	[0] Off	1 set-up	TRUE	-	Uint8
10-34	DeviceNet Product Code	120 N/A	1 set-up	TRUE	0	Uint16
10-39	Devicenet F Parameters	0 N/A	All set-ups	TRUE	0	Uint32

7.3.12 11-** LonWorks

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

7.3.13 13-** Smart Logic Controller

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	SR	2 set-ups	TRUE	-3	Int32
13-2* Timers						
13-20	SL Controller Timer	SR	1 set-up	TRUE	-3	TimD
13-4* Logic Rules						
13-40	Logic Rule Boolean 1	null	2 set-ups	TRUE	-	Uint8
13-41	Logic Rule Operator 1	null	2 set-ups	TRUE	-	Uint8
13-42	Logic Rule Boolean 2	null	2 set-ups	TRUE	-	Uint8
13-43	Logic Rule Operator 2	null	2 set-ups	TRUE	-	Uint8
13-44	Logic Rule Boolean 3	null	2 set-ups	TRUE	-	Uint8
13-5* States						
13-51	SL Controller Event	null	2 set-ups	TRUE	-	Uint8
13-52	SL Controller Action	null	2 set-ups	TRUE	-	Uint8

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7.3.14 14-** Special Functions

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion 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	Mains Failure	[0] No function	All set-ups	FALSE	-	Uint8
14-11	Mains Voltage at Mains Fault	SR	All set-ups	TRUE	0	Uint16
14-12	Function at Mains Imbalance	[0] Trip	All set-ups	TRUE	-	Uint8
14-2* Reset Functions						
14-20	Reset Mode	null	All set-ups	TRUE	-	Uint8
14-21	Automatic Restart Time	10 s	All set-ups	TRUE	0	Uint16
14-22	Operation Mode	[0] Normal operation	All set-ups	TRUE	-	Uint8
14-23	Typecode Setting	null	2 set-ups	FALSE	-	Uint8
14-25	Trip Delay at Torque Limit	60 s	All set-ups	TRUE	0	Uint8
14-26	Trip Delay at Inverter Fault	SR	All set-ups	TRUE	0	Uint8
14-28	Production Settings	[0] No action	All set-ups	TRUE	-	Uint8
14-29	Service Code	0 N/A	All set-ups	TRUE	0	Int32
14-3* Current Limit Ctrl.						
14-30	Current Lim Ctrl, Proportional Gain	100 %	All set-ups	FALSE	0	Uint16
14-31	Current Lim Ctrl, Integration Time	0.020 s	All set-ups	FALSE	-3	Uint16
14-32	Current Lim Ctrl, Filter Time	26.0 ms	All set-ups	TRUE	-4	Uint16
14-4* Energy Optimising						
14-40	VT Level	66 %	All set-ups	FALSE	0	Uint8
14-41	AEO Minimum Magnetisation	SR	All set-ups	TRUE	0	Uint8
14-42	Minimum AEO Frequency	10 Hz	All set-ups	TRUE	0	Uint8
14-43	Motor Cosphi	SR	All set-ups	TRUE	-2	Uint16
14-5* Environment						
14-50	RFI Filter	[1] On	1 set-up	FALSE	-	Uint8
14-51	DC Link Compensation	[1] On	1 set-up	TRUE	-	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	SR	1 set-up	FALSE	0	Uint8
14-6* Auto Derate						
14-60	Function at Over Temperature	[0] Trip	All set-ups	TRUE	-	Uint8
14-61	Function at Inverter Overload	[0] Trip	All set-ups	TRUE	-	Uint8
14-62	Inv. Overload Derate Current	95 %	All set-ups	TRUE	0	Uint16

7.3.15 15-** Drive Information

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver- sion index	Type
15-0* Operating Data						
15-00	Operating Hours	0 h	All set-ups	FALSE	74	Uint32
15-01	Running Hours	0 h	All set-ups	FALSE	74	Uint32
15-02	kWh Counter	0 kWh	All set-ups	FALSE	75	Uint32
15-03	Power Up's	0 N/A	All set-ups	FALSE	0	Uint32
15-04	Over Temp's	0 N/A	All set-ups	FALSE	0	Uint16
15-05	Over Volt's	0 N/A	All set-ups	FALSE	0	Uint16
15-06	Reset kWh Counter	[0] Do not reset	All set-ups	TRUE	-	Uint8
15-07	Reset Running Hours Counter	[0] Do not reset	All set-ups	TRUE	-	Uint8
15-08	Number of Starts	0 N/A	All set-ups	FALSE	0	Uint32
15-1* Data Log Settings						
15-10	Logging Source	0	2 set-ups	TRUE	-	Uint16
15-11	Logging Interval	SR	2 set-ups	TRUE	-3	TimD
15-12	Trigger Event	[0] False	1 set-up	TRUE	-	Uint8
15-13	Logging Mode	[0] Log always	2 set-ups	TRUE	-	Uint8
15-14	Samples Before Trigger	50 N/A	2 set-ups	TRUE	0	Uint8
15-2* Historic Log						
15-20	Historic Log: Event	0 N/A	All set-ups	FALSE	0	Uint8
15-21	Historic Log: Value	0 N/A	All set-ups	FALSE	0	Uint32
15-22	Historic Log: Time	0 ms	All set-ups	FALSE	-3	Uint32
15-23	Historic Log: Date and Time	SR	All set-ups	FALSE	0	TimeOfDay
15-3* Alarm Log						
15-30	Alarm Log: Error Code	0 N/A	All set-ups	FALSE	0	Uint8
15-31	Alarm Log: Value	0 N/A	All set-ups	FALSE	0	Int16
15-32	Alarm Log: Time	0 s	All set-ups	FALSE	0	Uint32
15-33	Alarm Log: Date and Time	SR	All set-ups	FALSE	0	TimeOfDay
15-4* Drive Identification						
15-40	FC Type	0 N/A	All set-ups	FALSE	0	VisStr[6]
15-41	Power Section	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-42	Voltage	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-43	Software Version	0 N/A	All set-ups	FALSE	0	VisStr[5]
15-44	Ordered Typecode String	0 N/A	All set-ups	FALSE	0	VisStr[40]
15-45	Actual Typecode String	0 N/A	All set-ups	FALSE	0	VisStr[40]
15-46	Frequency Converter 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	Frequency Converter 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]
15-55	Vendor URL	0 N/A	All set-ups	FALSE	0	VisStr[40]
15-56	Vendor Name	0 N/A	All set-ups	FALSE	0	VisStr[40]
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]

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

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7.3.16 16-** Data Readouts

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
16-0* General Status						
16-00	Control Word	0 N/A	All set-ups	FALSE	0	V2
16-01	Reference [Unit]	0.000 ReferenceFeed-backUnit	All set-ups	FALSE	-3	Int32
16-02	Reference [%]	0.0 %	All set-ups	FALSE	-1	Int16
16-03	Status Word	0 N/A	All set-ups	FALSE	0	V2
16-05	Main Actual Value [%]	0.00 %	All set-ups	FALSE	-2	N2
16-09	Custom Readout	0.00 CustomReadoutUnit	All set-ups	FALSE	-2	Int32
16-1* Motor Status						
16-10	Power [kW]	0.00 kW	All set-ups	FALSE	1	Int32
16-11	Power [hp]	0.00 hp	All set-ups	FALSE	-2	Int32
16-12	Motor Voltage	0.0 V	All set-ups	FALSE	-1	Uint16
16-13	Frequency	0.0 Hz	All set-ups	FALSE	-1	Uint16
16-14	Motor Current	0.00 A	All set-ups	FALSE	-2	Int32
16-15	Frequency [%]	0.00 %	All set-ups	FALSE	-2	N2
16-16	Torque [Nm]	0.0 Nm	All set-ups	FALSE	-1	Int32
16-17	Speed [RPM]	0 RPM	All set-ups	FALSE	67	Int32
16-18	Motor Thermal	0 %	All set-ups	FALSE	0	Uint8
16-22	Torque [%]	0 %	All set-ups	FALSE	0	Int16
16-26	Power Filtered [kW]	0.000 kW	All set-ups	FALSE	0	Int32
16-27	Power Filtered [hp]	0.000 hp	All set-ups	FALSE	-3	Int32
16-3* Drive Status						
16-30	DC Link Voltage	0 V	All set-ups	FALSE	0	Uint16
16-32	Brake Energy /s	0.000 kW	All set-ups	FALSE	0	Uint32
16-33	Brake Energy /2 min	0.000 kW	All set-ups	FALSE	0	Uint32
16-34	Heatsink Temp.	0 °C	All set-ups	FALSE	100	Uint8
16-35	Inverter Thermal	0 %	All set-ups	FALSE	0	Uint8
16-36	Inv. Nom. Current	SR	All set-ups	FALSE	-2	Uint32
16-37	Inv. Max. Current	SR	All set-ups	FALSE	-2	Uint32
16-38	SL Controller State	0 N/A	All set-ups	FALSE	0	Uint8
16-39	Control Card Temp.	0 °C	All set-ups	FALSE	100	Uint8
16-40	Logging Buffer Full	[0] No	All set-ups	TRUE	-	Uint8
16-43	Timed Actions Status	[0] Timed Actions Auto	All set-ups	TRUE	-	Uint8
16-49	Current Fault Source	0 N/A	All set-ups	TRUE	0	Uint8
16-5* Ref. & Feedb.						
16-50	External Reference	0.0 N/A	All set-ups	FALSE	-1	Int16
16-52	Feedback [Unit]	0.000 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
16-53	Digi Pot Reference	0.00 N/A	All set-ups	FALSE	-2	Int16
16-54	Feedback 1 [Unit]	0.000 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
16-55	Feedback 2 [Unit]	0.000 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
16-56	Feedback 3 [Unit]	0.000 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
16-58	PID Output [%]	0.0 %	All set-ups	TRUE	-1	Int16
16-6* Inputs & Outputs						
16-60	Digital Input	0 N/A	All set-ups	FALSE	0	Uint16
16-61	Terminal 53 Switch Setting	[0] Current	All set-ups	FALSE	-	Uint8
16-62	Analog Input 53	0.000 N/A	All set-ups	FALSE	-3	Int32
16-63	Terminal 54 Switch Setting	[0] Current	All set-ups	FALSE	-	Uint8
16-64	Analog Input 54	0.000 N/A	All set-ups	FALSE	-3	Int32
16-65	Analog Output 42 [mA]	0.000 N/A	All set-ups	FALSE	-3	Int16

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

7.3.17 18-** Info & Readouts

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	SR	All set-ups	FALSE	0	TimeOfDay
18-1* Fire Mode Log						
18-10	Fire Mode Log: Event	0 N/A	All set-ups	FALSE	0	Uint8
18-11	Fire Mode Log: Time	0 s	All set-ups	FALSE	0	Uint32
18-12	Fire Mode Log: Date and Time	SR	All set-ups	FALSE	0	TimeOfDay
18-3* Inputs & Outputs						
18-30	Analog Input X42/1	0.000 N/A	All set-ups	FALSE	-3	Int32
18-31	Analog Input X42/3	0.000 N/A	All set-ups	FALSE	-3	Int32
18-32	Analog Input X42/5	0.000 N/A	All set-ups	FALSE	-3	Int32
18-33	Analog Out X42/7 [V]	0.000 N/A	All set-ups	FALSE	-3	Int16
18-34	Analog Out X42/9 [V]	0.000 N/A	All set-ups	FALSE	-3	Int16
18-35	Analog Out X42/11 [V]	0.000 N/A	All set-ups	FALSE	-3	Int16
18-5* Ref. & Feedb.						
18-50	Sensorless Readout [unit]	0.000 SensorlessUnit	All set-ups	FALSE	-3	Int32

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7.3.18 20-** FC Closed Loop

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
20-0* Feedback						
20-00	Feedback 1 Source	[2] Analog input 54	All set-ups	TRUE	-	Uint8
20-01	Feedback 1 Conversion	[0] Linear	All set-ups	FALSE	-	Uint8
20-02	Feedback 1 Source Unit	null	All set-ups	TRUE	-	Uint8
20-03	Feedback 2 Source	[0] No function	All set-ups	TRUE	-	Uint8
20-04	Feedback 2 Conversion	[0] Linear	All set-ups	FALSE	-	Uint8
20-05	Feedback 2 Source Unit	null	All set-ups	TRUE	-	Uint8
20-06	Feedback 3 Source	[0] No function	All set-ups	TRUE	-	Uint8
20-07	Feedback 3 Conversion	[0] Linear	All set-ups	FALSE	-	Uint8
20-08	Feedback 3 Source Unit	null	All set-ups	TRUE	-	Uint8
20-12	Reference/Feedback Unit	null	All set-ups	TRUE	-	Uint8
20-13	Minimum Reference/Feedb.	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
20-14	Maximum Reference/Feedb.	100.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
20-2* Feedback/Setpoint						
20-20	Feedback Function	[3] Minimum	All set-ups	TRUE	-	Uint8
20-21	Setpoint 1	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
20-22	Setpoint 2	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
20-23	Setpoint 3	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
20-3* Feedb. Adv. Conv.						
20-30	Refrigerant	[0] R22	All set-ups	TRUE	-	Uint8
20-31	User Defined Refrigerant A1	10.0000 N/A	All set-ups	TRUE	-4	Uint32
20-32	User Defined Refrigerant A2	-2250.00 N/A	All set-ups	TRUE	-2	Int32
20-33	User Defined Refrigerant A3	250.000 N/A	All set-ups	TRUE	-3	Uint32
20-34	Duct 1 Area [m2]	0.500 m2	All set-ups	TRUE	-3	Uint32
20-35	Duct 1 Area [in2]	750 in2	All set-ups	TRUE	0	Uint32
20-36	Duct 2 Area [m2]	0.500 m2	All set-ups	TRUE	-3	Uint32
20-37	Duct 2 Area [in2]	750 in2	All set-ups	TRUE	0	Uint32
20-38	Air Density Factor [%]	100 %	All set-ups	TRUE	0	Uint32
20-6* Sensorless						
20-60	Sensorless Unit	null	All set-ups	TRUE	-	Uint8
20-69	Sensorless Information	0 N/A	All set-ups	TRUE	0	VisStr[25]
20-7* PID Autotuning						
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 ProcessCtr-lUnit	2 set-ups	TRUE	-3	Int32
20-74	Maximum Feedback Level	999999.000 ProcessCtr-lUnit	2 set-ups	TRUE	-3	Int32
20-79	PID Autotuning	[0] Disabled	All set-ups	TRUE	-	Uint8
20-8* PID Basic Settings						
20-81	PID Normal/ Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
20-82	PID Start Speed [RPM]	SR	All set-ups	TRUE	67	Uint16
20-83	PID Start Speed [Hz]	SR	All set-ups	TRUE	-1	Uint16
20-84	On Reference Bandwidth	5 %	All set-ups	TRUE	0	Uint8
20-9* PID Controller						
20-91	PID Anti Windup	[1] On	All set-ups	TRUE	-	Uint8
20-93	PID Proportional Gain	0.50 N/A	All set-ups	TRUE	-2	Uint16
20-94	PID Integral Time	20.00 s	All set-ups	TRUE	-2	Uint32
20-95	PID Differentiation Time	0.00 s	All set-ups	TRUE	-2	Uint16
20-96	PID Diff. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16

7.3.19 21-** Ext. Closed Loop

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 Autotuning	[0] Disabled	All set-ups	TRUE	-	Uint8
21-1* Ext. CL 1 Ref./Fb.						
21-10	Ext. 1 Ref./Feedback Unit	[1] %	All set-ups	TRUE	-	Uint8
21-11	Ext. 1 Minimum Reference	0.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
21-12	Ext. 1 Maximum Reference	100.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
21-13	Ext. 1 Reference Source	[0] No function	All set-ups	TRUE	-	Uint8
21-14	Ext. 1 Feedback Source	[0] No function	All set-ups	TRUE	-	Uint8
21-15	Ext. 1 Setpoint	0.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
21-17	Ext. 1 Reference [Unit]	0.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
21-18	Ext. 1 Feedback [Unit]	0.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
21-19	Ext. 1 Output [%]	0 %	All set-ups	TRUE	0	Int32
21-2* Ext. CL 1 PID						
21-20	Ext. 1 Normal/Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
21-21	Ext. 1 Proportional Gain	0.01 N/A	All set-ups	TRUE	-2	Uint16
21-22	Ext. 1 Integral Time	10000.00 s	All set-ups	TRUE	-2	Uint32
21-23	Ext. 1 Differentation Time	0.00 s	All set-ups	TRUE	-2	Uint16
21-24	Ext. 1 Dif. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16
21-3* Ext. CL 2 Ref./Fb.						
21-30	Ext. 2 Ref./Feedback Unit	[1] %	All set-ups	TRUE	-	Uint8
21-31	Ext. 2 Minimum Reference	0.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
21-32	Ext. 2 Maximum Reference	100.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
21-33	Ext. 2 Reference Source	[0] No function	All set-ups	TRUE	-	Uint8
21-34	Ext. 2 Feedback Source	[0] No function	All set-ups	TRUE	-	Uint8
21-35	Ext. 2 Setpoint	0.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
21-37	Ext. 2 Reference [Unit]	0.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
21-38	Ext. 2 Feedback [Unit]	0.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
21-39	Ext. 2 Output [%]	0 %	All set-ups	TRUE	0	Int32
21-4* Ext. CL 2 PID						
21-40	Ext. 2 Normal/Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
21-41	Ext. 2 Proportional Gain	0.01 N/A	All set-ups	TRUE	-2	Uint16
21-42	Ext. 2 Integral Time	10000.00 s	All set-ups	TRUE	-2	Uint32
21-43	Ext. 2 Differentation 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
21-5* Ext. CL 3 Ref./Fb.						
21-50	Ext. 3 Ref./Feedback Unit	[1] %	All set-ups	TRUE	-	Uint8
21-51	Ext. 3 Minimum Reference	0.000 ExtPID3Unit	All set-ups	TRUE	-3	Int32
21-52	Ext. 3 Maximum Reference	100.000 ExtPID3Unit	All set-ups	TRUE	-3	Int32
21-53	Ext. 3 Reference Source	[0] No function	All set-ups	TRUE	-	Uint8
21-54	Ext. 3 Feedback Source	[0] No function	All set-ups	TRUE	-	Uint8
21-55	Ext. 3 Setpoint	0.000 ExtPID3Unit	All set-ups	TRUE	-3	Int32
21-57	Ext. 3 Reference [Unit]	0.000 ExtPID3Unit	All set-ups	TRUE	-3	Int32
21-58	Ext. 3 Feedback [Unit]	0.000 ExtPID3Unit	All set-ups	TRUE	-3	Int32
21-59	Ext. 3 Output [%]	0 %	All set-ups	TRUE	0	Int32

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Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
21-6* Ext. CL 3 PID						
21-60	Ext. 3 Normal/Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
21-61	Ext. 3 Proportional Gain	0.01 N/A	All set-ups	TRUE	-2	Uint16
21-62	Ext. 3 Integral Time	10000.00 s	All set-ups	TRUE	-2	Uint32
21-63	Ext. 3 Differentation 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

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7.3.20 22-** Application Functions

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
22-01	Power Filter Time	0.50 s	2 set-ups	TRUE	-2	Uint16
22-2* No-Flow Detection						
22-20	Low Power Auto Set-up	[0] Off	All set-ups	FALSE	-	Uint8
22-21	Low Power Detection	[0] Disabled	All set-ups	TRUE	-	Uint8
22-22	Low Speed Detection	[0] Disabled	All set-ups	TRUE	-	Uint8
22-23	No-Flow Function	[0] Off	All set-ups	TRUE	-	Uint8
22-24	No-Flow Delay	10 s	All set-ups	TRUE	0	Uint16
22-26	Dry Pump Function	[0] Off	All set-ups	TRUE	-	Uint8
22-27	Dry Pump Delay	10 s	All set-ups	TRUE	0	Uint16
22-3* No-Flow Power Tuning						
22-30	No-Flow Power	0.00 kW	All set-ups	TRUE	1	Uint32
22-31	Power Correction Factor	100 %	All set-ups	TRUE	0	Uint16
22-32	Low Speed [RPM]	SR	All set-ups	TRUE	67	Uint16
22-33	Low Speed [Hz]	SR	All set-ups	TRUE	-1	Uint16
22-34	Low Speed Power [kW]	SR	All set-ups	TRUE	1	Uint32
22-35	Low Speed Power [HP]	SR	All set-ups	TRUE	-2	Uint32
22-36	High Speed [RPM]	SR	All set-ups	TRUE	67	Uint16
22-37	High Speed [Hz]	SR	All set-ups	TRUE	-1	Uint16
22-38	High Speed Power [kW]	SR	All set-ups	TRUE	1	Uint32
22-39	High Speed Power [HP]	SR	All set-ups	TRUE	-2	Uint32
22-4* Sleep Mode						
22-40	Minimum Run Time	10 s	All set-ups	TRUE	0	Uint16
22-41	Minimum Sleep Time	10 s	All set-ups	TRUE	0	Uint16
22-42	Wake-up Speed [RPM]	SR	All set-ups	TRUE	67	Uint16
22-43	Wake-up Speed [Hz]	SR	All set-ups	TRUE	-1	Uint16
22-44	Wake-up Ref./FB Difference	10 %	All set-ups	TRUE	0	Int8
22-45	Setpoint Boost	0 %	All set-ups	TRUE	0	Int8
22-46	Maximum Boost Time	60 s	All set-ups	TRUE	0	Uint16
22-5* End of Curve						
22-50	End of Curve Function	[0] Off	All set-ups	TRUE	-	Uint8
22-51	End of Curve Delay	10 s	All set-ups	TRUE	0	Uint16
22-6* Broken Belt Detection						
22-60	Broken Belt Function	[0] Off	All set-ups	TRUE	-	Uint8
22-61	Broken Belt Torque	10 %	All set-ups	TRUE	0	Uint8
22-62	Broken Belt Delay	10 s	All set-ups	TRUE	0	Uint16
22-7* Short Cycle Protection						
22-75	Short Cycle Protection	[0] Disabled	All set-ups	TRUE	-	Uint8
22-76	Interval between Starts	start_to_start_min_on_time (P2277)	All set-ups	TRUE	0	Uint16
22-77	Minimum Run Time	0 s	All set-ups	TRUE	0	Uint16
22-78	Minimum Run Time Override	[0] Disabled	All set-ups	FALSE	-	Uint8
22-79	Minimum Run Time Override Value	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
22-8* Flow Compensation						
22-80	Flow Compensation	[0] Disabled	All set-ups	TRUE	-	Uint8
22-81	Square-linear Curve Approximation	100 %	All set-ups	TRUE	0	Uint8
22-82	Work Point Calculation	[0] Disabled	All set-ups	TRUE	-	Uint8
22-83	Speed at No-Flow [RPM]	SR	All set-ups	TRUE	67	Uint16
22-84	Speed at No-Flow [Hz]	SR	All set-ups	TRUE	-1	Uint16

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
22-85	Speed at Design Point [RPM]	SR	All set-ups	TRUE	67	Uint16
22-86	Speed at Design Point [Hz]	SR	All set-ups	TRUE	-1	Uint16
22-87	Pressure at No-Flow Speed	0.000 N/A	All set-ups	TRUE	-3	Int32
22-88	Pressure at Rated Speed	999999.999 N/A	All set-ups	TRUE	-3	Int32
22-89	Flow at Design Point	0.000 N/A	All set-ups	TRUE	-3	Int32
22-90	Flow at Rated Speed	0.000 N/A	All set-ups	TRUE	-3	Int32

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7.3.21 23-** Time Based Funtions

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
23-0* Timed Actions						
23-00	ON Time	SR	2 set-ups	TRUE	0	TimeOfDayWoDate
23-01	ON Action	[0] Disabled	2 set-ups	TRUE	-	Uint8
23-02	OFF Time	SR	2 set-ups	TRUE	0	TimeOfDayWoDate
23-03	OFF Action	[1] No action	2 set-ups	TRUE	-	Uint8
23-04	Occurrence	[0] All days	2 set-ups	TRUE	-	Uint8
23-0* Timed Actions Settings						
23-08	Timed Actions Mode	[0] Timed Actions Auto	2 set-ups	TRUE	-	Uint8
23-09	Timed Actions Reactivation	[1] Enabled	2 set-ups	TRUE	-	Uint8
23-1* Maintenance						
23-10	Maintenance Item	[1] Motor bearings	1 set-up	TRUE	-	Uint8
23-11	Maintenance Action	[1] Lubricate	1 set-up	TRUE	-	Uint8
23-12	Maintenance Time Base	[0] Disabled	1 set-up	TRUE	-	Uint8
23-13	Maintenance Time Interval	1 h	1 set-up	TRUE	74	Uint32
23-14	Maintenance Date and Time	SR	1 set-up	TRUE	0	TimeOfDay
23-1* Maintenance Reset						
23-15	Reset Maintenance Word	[0] Do not reset	All set-ups	TRUE	-	Uint8
23-16	Maintenance Text	0 N/A	1 set-up	TRUE	0	VisStr[20]
23-5* Energy Log						
23-50	Energy Log Resolution	[5] Last 24 Hours	2 set-ups	TRUE	-	Uint8
23-51	Period Start	SR	2 set-ups	TRUE	0	TimeOfDay
23-53	Energy Log	0 N/A	All set-ups	TRUE	0	Uint32
23-54	Reset Energy Log	[0] Do not reset	All set-ups	TRUE	-	Uint8
23-6* Trending						
23-60	Trend Variable	[0] Power [kW]	2 set-ups	TRUE	-	Uint8
23-61	Continuous Bin Data	0 N/A	All set-ups	TRUE	0	Uint32
23-62	Timed Bin Data	0 N/A	All set-ups	TRUE	0	Uint32
23-63	Timed Period Start	SR	2 set-ups	TRUE	0	TimeOfDay
23-64	Timed Period Stop	SR	2 set-ups	TRUE	0	TimeOfDay
23-65	Minimum Bin Value	SR	2 set-ups	TRUE	0	Uint8
23-66	Reset Continuous Bin Data	[0] Do not reset	All set-ups	TRUE	-	Uint8
23-67	Reset Timed Bin Data	[0] Do not reset	All set-ups	TRUE	-	Uint8
23-8* Payback Counter						
23-80	Power Reference Factor	100 %	2 set-ups	TRUE	0	Uint8
23-81	Energy Cost	1.00 N/A	2 set-ups	TRUE	-2	Uint32
23-82	Investment	0 N/A	2 set-ups	TRUE	0	Uint32
23-83	Energy Savings	0 kWh	All set-ups	TRUE	75	Int32
23-84	Cost Savings	0 N/A	All set-ups	TRUE	0	Int32

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7.3.22 24-** Application Functions 2

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conversion index	Type
24-0* Fire Mode						
24-00	Fire Mode Function	[0] Disabled	2 set-ups	TRUE	-	Uint8
24-01	Fire Mode Configuration	[0] Open Loop	All set-ups	TRUE	-	Uint8
24-02	Fire Mode Unit	null	All set-ups	TRUE	-	Uint8
24-03	Fire Mode Min Reference	SR	All set-ups	TRUE	-3	Int32
24-04	Fire Mode Max Reference	SR	All set-ups	TRUE	-3	Int32
24-05	Fire Mode Preset Reference	0.00 %	All set-ups	TRUE	-2	Int16
24-06	Fire Mode Reference Source	[0] No function	All set-ups	TRUE	-	Uint8
24-07	Fire Mode Feedback Source	[0] No function	All set-ups	TRUE	-	Uint8
24-09	Fire Mode Alarm Handling	[1] Trip, Critical Alarms	2 set-ups	FALSE	-	Uint8
24-1* Drive Bypass						
24-10	Drive Bypass Function	[0] Disabled	2 set-ups	TRUE	-	Uint8
24-11	Drive Bypass Delay Time	0 s	2 set-ups	TRUE	0	Uint16
24-9* Multi-Motor Funct.						
24-90	Missing Motor Function	[0] Off	All set-ups	TRUE	-	Uint8
24-91	Missing Motor Coefficient 1	0.0000 N/A	All set-ups	TRUE	-4	Int32
24-92	Missing Motor Coefficient 2	0.0000 N/A	All set-ups	TRUE	-4	Int32
24-93	Missing Motor Coefficient 3	0.0000 N/A	All set-ups	TRUE	-4	Int32
24-94	Missing Motor Coefficient 4	0.000 N/A	All set-ups	TRUE	-3	Int32
24-95	Locked Rotor Function	[0] Off	All set-ups	TRUE	-	Uint8
24-96	Locked Rotor Coefficient 1	0.0000 N/A	All set-ups	TRUE	-4	Int32
24-97	Locked Rotor Coefficient 2	0.0000 N/A	All set-ups	TRUE	-4	Int32
24-98	Locked Rotor Coefficient 3	0.0000 N/A	All set-ups	TRUE	-4	Int32
24-99	Locked Rotor Coefficient 4	0.000 N/A	All set-ups	TRUE	-3	Int32

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7.3.23 25-** Cascade Pack Controller

Par. No. #	Parameter description	Default value	4-set-up	Change during operation	Conver-sion index	Type
25-0* System Settings						
25-00	Cascade Controller	[0] Disabled	2 set-ups	FALSE	-	Uint8
25-02	Motor Start	[0] Direct on Line	2 set-ups	FALSE	-	Uint8
25-04	Pump Cycling	[0] Disabled	All set-ups	TRUE	-	Uint8
25-05	Fixed Lead Pump	[1] Yes	2 set-ups	FALSE	-	Uint8
25-06	Number of Pumps	2 N/A	2 set-ups	FALSE	0	Uint8
25-2* Bandwidth Settings						
25-20	Staging Bandwidth	10 %	All set-ups	TRUE	0	Uint8
25-21	Override Bandwidth	100 %	All set-ups	TRUE	0	Uint8
25-22	Fixed Speed Bandwidth	casco_staging_bandwidth (P2520)	All set-ups	TRUE	0	Uint8
25-23	SBW Staging Delay	15 s	All set-ups	TRUE	0	Uint16
25-24	SBW Destaging Delay	15 s	All set-ups	TRUE	0	Uint16
25-25	OBW Time	10 s	All set-ups	TRUE	0	Uint16
25-26	Destage At No-Flow	[0] Disabled	All set-ups	TRUE	-	Uint8
25-27	Stage Function	[1] Enabled	All set-ups	TRUE	-	Uint8
25-28	Stage Function Time	15 s	All set-ups	TRUE	0	Uint16
25-29	Destage Function	[1] Enabled	All set-ups	TRUE	-	Uint8
25-30	Destage Function Time	15 s	All set-ups	TRUE	0	Uint16
25-4* Staging Settings						
25-40	Ramp Down Delay	10.0 s	All set-ups	TRUE	-1	Uint16
25-41	Ramp Up Delay	2.0 s	All set-ups	TRUE	-1	Uint16
25-42	Staging Threshold	SR	All set-ups	TRUE	0	Uint8
25-43	Destaging Threshold	SR	All set-ups	TRUE	0	Uint8
25-44	Staging Speed [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
25-45	Staging Speed [Hz]	0.0 Hz	All set-ups	TRUE	-1	Uint16
25-46	Destaging Speed [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
25-47	Destaging Speed [Hz]	0.0 Hz	All set-ups	TRUE	-1	Uint16
25-5* Alternation Settings						
25-50	Lead Pump Alternation	[0] Off	All set-ups	TRUE	-	Uint8
25-51	Alternation Event	[0] External	All set-ups	TRUE	-	Uint8
25-52	Alternation Time Interval	24 h	All set-ups	TRUE	74	Uint16
25-53	Alternation Timer Value	0 N/A	All set-ups	TRUE	0	VisStr[7]
25-54	Alternation Predefined Time	SR	All set-ups	TRUE	0	TimeOfDayWo-Date
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 Mains Delay	0.5 s	All set-ups	TRUE	-1	Uint16
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

7.3.24 26-** Analog I / O Option MCB 109

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

8 Troubleshooting

8.1 Alarms and Warnings

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

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

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

This may be done in four ways:

1. By using the [RESET] control button on the LCP.

2. Via a digital input with the "Reset" function.

3. Via serial communication/optional fieldbus.

4. By resetting automatically using the [Auto Reset] function, which is a default setting for VLT HVAC Drive Drive, see par. 14-20 *Reset Mode* in the **FC 100 Programming Guide**

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

If an alarm cannot be reset, the reason may be that its cause has not been rectified, or the alarm is trip-locked (see also table on following page).

⚠️ **CAUTION!**

Alarms that are trip-locked offer additional protection, means that the mains supply must be switched off before the alarm can be reset. After being switched back on, the frequency converter is no longer blocked and may be reset as described above once the cause has been rectified.
Alarms that are not trip-locked can also be reset using the automatic reset function in par. 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 par. 1-90 *Motor Thermal Protection*. After an alarm or trip, the motor carries on coasting, and the alarm and warning flash on the frequency converter. Once the problem has been rectified, only the alarm continues flashing.

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

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

Table 8.1: Alarm/Warning code list

(X) Dependent on parameter

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

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

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

Table 8.2: LED Indication

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

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

The alarm words, warning words and extended status words can be read out via serial bus or optional fieldbus for diagnosis. See also par. 16-90 *Alarm Word*, par. 16-92 *Warning Word* and par. 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 par. 6-01 *Live Zero Timeout Function*. The signal on one of the analog inputs is less than 50% of the minimum value programmed for that input. This condition can be caused by broken wiring or faulty device sending the signal.

Troubleshooting:

Check connections on all the analog input terminals. Control card terminals 53 and 54 for signals, terminal 55 common. MCB 101 terminals 11 and 12 for signals, terminal 10 common. MCB 109 terminals 1, 3, 5 for signals, terminals 2, 4, 6 common).

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

Perform Input Terminal Signal Test.

WARNING/ALARM 3, No motor
No motor has been connected to the output of the frequency converter. This warning or alarm will only appear if programmed by the user in par. 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 mains voltage imbalance is too high. This message also appears for a fault in the input rectifier on the frequency converter. Options are programmed at par. 14-12 *Function at Mains Imbalance*.

Troubleshooting: Check the supply voltage and supply currents to the frequency converter.

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

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

Troubleshooting:

Connect a brake resistor

Extend the ramp time

Change the ramp type

Activate functions in par. 2-10 *Brake Function*

Increase par. 14-26 *Trip Delay at Inverter Fault*

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

Troubleshooting:

Check that the supply voltage matches the frequency converter voltage.

Perform Input voltage test

Perform soft charge and rectifier circuit test

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

Troubleshooting:

Come the output current shown on the LCP keypad with the drive rated current.

Come the output current shown on the LCP keypad with measured motor current.

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

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

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WARNING/ALARM 10, Motor overload temperature

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

Troubleshooting:

Check if motor is over heating.

If the motor is mechanically overloaded

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

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

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

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

WARNING/ALARM 11, Motor thermistor over temp

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

Troubleshooting:

Check if motor is over heating.

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 par. 1-93 *Thermistor Source* matches sensor wiring.

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

WARNING/ALARM 12, Torque limit

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

WARNING/ALARM 13, Over current

The inverter peak current limit (approx. 200% of the rated current) is exceeded. The warning lasts about 1.5 sec., then the frequency converter 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 frequency converter. Check if the motor shaft can be turned.

Check that the motor size matches the frequency converter.

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

ALARM 14, Earth (ground) fault

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

Troubleshooting:

Turn off the frequency converter and remove the earth fault.

Measure the resistance to ground of the motor leads and the motor with a megohmmeter to check for earth 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:

Par. 15-40 *FC Type*

Par. 15-41 *Power Section*

Par. 15-42 *Voltage*

Par. 15-43 *Software Version*

Par. 15-45 *Actual Typecode String*

Par. 15-49 *SW ID Control Card*

Par. 15-50 *SW ID Power Card*

Par. 15-60 *Option Mounted*

Par. 15-61 *Option SW Version*

ALARM 16, Short circuit

There is short-circuiting in the motor or on the motor terminals.

Turn off the frequency converter and remove the short-circuit.

WARNING/ALARM 17, Control word timeout

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

Troubleshooting:

Check connections on the serial communication cable.

Increase par. 8-03 *Control Timeout Time*

Check 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 par. 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 par. 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 frequency converter still works, but without the brake function. Turn off the frequency converter and replace the brake resistor (see par. 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 power is higher than 90%. If *Trip* [2] has been selected in par. 2-13 *Brake Power Monitoring*, the frequency converter cuts out and issues this alarm, when the dissipated braking power is higher than 100%.

WARNING/ALARM 27, Brake chopper fault

The brake transistor is monitored during operation and if it short-circuits, the brake function disconnects and issues a warning. The frequency converter 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 frequency converter 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 par. 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 frequency converter and the motor is missing.

Turn off the frequency converter and check motor phase U.

ALARM 31, Motor phase V missing

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

Turn off the frequency converter and check motor phase V.

ALARM 32, Motor phase W missing

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

Turn off the frequency converter 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.

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

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

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

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-telegram that has to be sent, couldn't be sent
1281	Digital Signal Processor flash timeout
1282	Power micro software version mismatch
1283	Power EEPROM data version mismatch
1284	Cannot read Digital Signal Processor software version
1299	Option SW in slot A is too old
1300	Option SW in slot B is too old
1302	Option SW in slot C1 is too old
1315	Option SW in slot A is not supported (not allowed)
1316	Option SW in slot B is not supported (not allowed)
1318	Option SW in slot C1 is not supported (not allowed)
1379	Option A did not respond when calculating Platform Version.
1380	Option B did not respond when calculating Platform Version.
1536	An exception in the Application Orientated Control is registered. Debug information written in LCP
1792	DSP watchdog is active. Debugging of power part data Motor Orientated Control data not transferred correctly
2049	Power data restarted
2064-2072	H081x: option in slot x has restarted
2080-2088	H082x: option in slot x has issued a powerup-wait
2096-2104	H083x: option in slot x has issued a legal powerup-wait

2304	Could not read any data from power EEPROM
2305	Missing SW version from power unit
2314	Missing power unit data from power unit
2315	Missing SW version from power unit
2316	Missing io_statepage from power unit
2324	Power card configuration is determined to be incorrect at power up
2330	Power size information between the power cards does not match
2561	No communication from DSP to ATACD
2562	No communication from ATACD to DSP (state running)
2816	Stack overflow Control board module
2817	Scheduler slow tasks
2818	Fast tasks
2819	Parameter thread
2820	LCP Stack overflow
2821	Serial port overflow
2822	USB port overflow
2836	cfListMempool to small
3072-5122	Parameter value is outside its limits
5123	Option in slot A: Hardware incompatible with Control board hardware
5124	Option in slot B: Hardware incompatible with Control board hardware
5125	Option in slot C0: Hardware incompatible with Control board hardware
5126	Option in slot C1: Hardware incompatible with Control board hardware
5376-6231	Out of memory

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 par. 5-00 *Digital I/O Mode* and par. 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 par. 5-00 *Digital I/O Mode* and par. 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. 5-32 *Term X30/6 Digi Out (MCB 101).*

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

ALARM 46, Power card supply

The supply on the power card is out of range.

There are three power supplies generated by the switch mode power supply (SMPS) on the power card: 24 V, 5V, +/- 18V. 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 mains voltage, all three supplied are monitored.

WARNING 47, 24 V supply low

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

WARNING 48, 1.8 V supply low

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

WARNING 49, Speed limit

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

ALARM 50, AMA calibration failed

Contact your Danfoss supplier.

ALARM 51, AMA check Unom and Inom

The setting of motor voltage, motor current, and motor power is presumably wrong. Check the settings.

ALARM 52, AMA low Inom

The motor current is too low. Check the settings.

ALARM 53, AMA motor too big

The motor is too big for the AMA to be carried out.

ALARM 54, AMA motor too small

The motor is too big for the AMA to be carried out.

ALARM 55, AMA Parameter out of range

The parameter values found from the motor are outside acceptable range.

ALARM 56, AMA interrupted by user

The AMA has been interrupted by the user.

ALARM 57, AMA timeout

Try to start the AMA again a number of times, until the AMA is carried out. Please note that repeated runs may heat the motor to a level where the resistance Rs and Rr are increased. In most cases, however, this is not critical.

ALARM 58, AMA internal fault

Contact your Danfoss supplier.

WARNING 59, Current limit

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

WARNING 60, External interlock

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

WARNING 62, Output frequency at maximum limit

The output frequency is higher than the value set in par. 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 over temperature: The cutout temperature of the control card is 80° C.

WARNING 66, Heatsink temperature low

This warning is based on the temperature sensor in the IGBT module.

Troubleshooting:

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

ALARM 67, Option module configuration has changed

One or more options have either been added or removed since the last power-down.

ALARM 68, Safe stop activated

Safe stop has been activated. To resume normal operation, apply 24 V DC to terminal 37, then send a reset signal (via Bus, Digital I/O, or by pressing the reset key. See par. .

ALARM 69, Power card temperature

The temperature sensor on the power card is either too hot or too cold.

Troubleshooting:

Check the operation of the door fans.

Check that the filters for the door fans are not blocked.

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

ALARM 70, Illegal FC Configuration

Actual combination of control board and power board is illegal.

ALARM 72, Dangerous failure

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

WARNING 73, Safe stop auto restart

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

WARNING 76, Power Unit Setup

The required number of power units does not match the detected number of active power units.

Troubleshooting:

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

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

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

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

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

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

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

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

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

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

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

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

WARNING 201, Fire Mode was Active
Fire Mode has been active.

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

WARNING 203, Missing Motor
A multi-motor under-load situation was detected, this could be due to e.g. a missing motor.

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

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

    1 = left most inverter module.

    2 = middle inverter module in F2 or F4 drive.

    2 = right inverter module in F1 or F3 drive.

    3 = right inverter module in F2 or F4 drive.

    5 = rectifier module.

ALARM 244, Heatsink temperature
This alarm is only for F Frame drives. It is equivalent to Alarm 29. The report value in the alarm log indicates which power module generated the alarm:

    1 = left most inverter module.

    2 = middle inverter module in F2 or F4 drive.

    2 = right inverter module in F1 or F3 drive.

    3 = right inverter module in F2 or F4 drive.

    5 = rectifier module.

ALARM 245, Heatsink sensor
This alarm is only for F Frame drives. It is equivalent to Alarm 39. The report value in the alarm log indicates which power module generated the alarm:

    1 = left most inverter module.

    2 = middle inverter module in F2 or F4 drive.

    2 = right inverter module in F1 or F3 drive.

    3 = right inverter module in F2 or F4 drive.

    5 = rectifier module.

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

    1 = left most inverter module.

    2 = middle inverter module in F2 or F4 drive.

    2 = right inverter module in F1 or F3 drive.

    3 = right inverter module in F2 or F4 drive.

    5 = rectifier module.

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

    1 = left most inverter module.

    2 = middle inverter module in F2 or F4 drive.

    2 = right inverter module in F1 or F3 drive.

    3 = right inverter module in F2 or F4 drive.

    5 = rectifier module.

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

1 = left most inverter module.

2 = middle inverter module in F2 or F4 drive.

2 = right inverter module in F1 or F3 drive.

3 = right inverter module in F2 or F4 drive.

5 = rectifier module.

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

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

8.2 Acoustic Noise or Vibration

If the motor or the equipment driven by the motor - e.g. a fan blade - is making noise or vibrations at certain frequencies, try the following:

- Speed Bypass, parameter group 4-6*

- Over-modulation, par. 14-03 *Overmodulation* set to off

- Switching pattern and -frequency parameter group 14-0*

- Resonance Dampening, par. 1-64 *Resonance Dampening*

8

9 Specifications

9.1 General Specifications
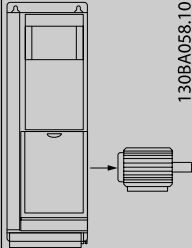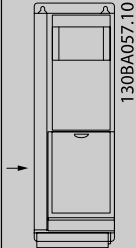
Mains supply 200 - 240 VAC – Normal overload 110% for 1 minute		P1K1	P1K5	P2K2	P3K0	P3K7
Frequency converter		P1K1	P1K5	P2K2	P3K0	P3K7
Typical Shaft Output [kW]		1.1	1.5	2.2	3	3.7
IP 20 / Chassis (A2+A3 may be converted to IP21 using a conversion kit. (Please see also items *Mechanical mounting* in Operating Instructions and *IP 21/Type 1 Enclosure kit* in the Design Guide.))		A2	A2	A2	A3	A3
IP 55 / NEMA 12		A4/A5	A4/A5	A4/A5	A5	A5
IP 66 / NEMA 12		A5	A5	A5	A5	A5
Typical Shaft Output [HP] at 208 V		1.5	2.0	2.9	4.0	4.9
Output current						
	Continuous (3 x 200-240 V) [A]	6.6	7.5	10.6	12.5	16.7
	Intermittent (3 x 200-240 V) [A]	7.3	8.3	11.7	13.8	18.4
	Continuous kVA (208 V AC) [kVA]	2.38	2.70	3.82	4.50	6.00
	Max. cable size:					
	(mains, motor, brake) [mm² /AWG] [2)]			4/10		
Max. input current						
	Continuous (3 x 200-240 V) [A]	5.9	6.8	9.5	11.3	15.0
	Intermittent (3 x 200-240 V) [A]	6.5	7.5	10.5	12.4	16.5
	Max. pre-fuses[1)] [A]	20	20	20	32	32
	Environment					
	Estimated power loss at rated max. load [W] [4)]	63	82	116	155	185
	Weight enclosure IP20 [kg]	4.9	4.9	4.9	6.6	6.6
	Weight enclosure IP21 [kg]	5.5	5.5	5.5	7.5	7.5
	Weight enclosure IP55 [kg]	9.7/13.5	9.7/13.5	9.7/13.5	13.5	13.5
	Weight enclosure IP 66 [kg]	9.7/13.5	9.7/13.5	9.7/13.5	13.5	13.5
	Efficiency [3)]	0.96	0.96	0.96	0.96	0.96

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Table 9.1: Mains Supply 200 - 240 VAC

Mains supply 3 x 200 - 240 VAC - Normal overload 110% for 1 minute

		P5K5	P7K5	P11K	P15K	P18K	P22K	P30K	P37K	P45K
IP 20 / Chassis (B3+4 and C3+4 may be converted to IP21 using a conversion kit. (Please see also items *Mechanical mounting* in Operating Instructions and *IP 21/Type 1 Enclosure kit* in the Design Guide.))		B3	B3	B3	B4	B4	C3	C3	C4	C4
IP 21 / NEMA 1		B1	B1	B1	B2	C1	C1	C1	C2	C2
IP 55 / NEMA 12		B1	B1	B1	B2	C1	C1	C1	C2	C2
IP 66 / NEMA 12		B1	B1	B1	B2	C1	C1	C1	C2	C2
Frequency converter		P5K5	P7K5	P11K	P15K	P18K	P22K	P30K	P37K	P45K
Typical Shaft Output [kW]		5.5	7.5	11	15	18.5	22	30	37	45
Typical Shaft Output [HP] at 208 V		7.5	10	15	20	25	30	40	50	60

Output current

		P5K5	P7K5	P11K	P15K	P18K	P22K	P30K	P37K	P45K
Continuous (3 x 200-240 V) [A]		24.2	30.8	46.2	59.4	74.8	88.0	115	143	170
Max. cable size (mains) [mm²/AWG]		16/6	16/6	16/6	35/2	35/2	35/2	70/3/0	70/3/0	185/ kcmil350
Continuous (3 x 200-240 V) [A]		22.0	28.0	42.0	54.0	68.0	80.0	104.0	130.0	154.0
Intermittent (3 x 200-240 V) [A]		24.2	30.8	46.2	59.4	74.8	88.0	114.0	143.0	169.0
Max. pre-fuses[1] [A]		63	63	63	80	125	125	160	200	250
Environment:										
Estimated power loss at rated max. load [W] [4]		269	310	447	602	737	845	1140	1353	1636
Weight enclosure IP20 [kg]		12	12	12	23.5	23.5	35	35	50	50
Weight enclosure IP21 [kg]		23	23	23	27	45	45	45	65	65
Weight enclosure IP55 [kg]		23	23	23	27	45	45	45	65	65
Weight enclosure IP 66 [kg]		23	23	23	27	45	45	45	65	65
Efficiency [3]		0.96	0.96	0.96	0.96	0.96	0.97	0.97	0.97	0.97
Intermittent (3 x 200-240 V) [A]		26.6	33.9	50.8	65.3	82.3	96.8	127	157	187
Continuous kVA (208 V AC) [kVA]		8.7	11.1	16.6	21.4	26.9	31.7	41.4	51.5	61.2
Max. cable size: (mains, motor, brake) [mm²/AWG] [2]		10/7	10/7	10/7	50/1/0 (B4=35/2)	50/1/0 (B4=35/2)	50/1/0 (B4=35/2)	95/4/0	95/4/0	120/250 MCM
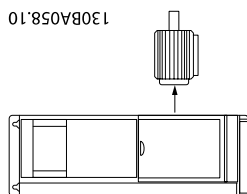
Table 9.2: Mains Supply 3 x 200 - 240 VAC

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Mains Supply 3 x 380 - 480 VAC - Normal overload 110% for 1 minute

Frequency converter	P1K1	P1K5	P2K2	P3K0	P4K0	P5K5	P7K5
Typical Shaft Output [kW]	1.1	1.5	2.2	3	4	5.5	7.5
Typical Shaft Output [HP] at 460 V	1.5	2.0	2.9	4.0	5.0	7.5	10
IP 20 / Chassis (A2+A3 may be converted to IP21 using a conversion kit. (Please see also items *Mechanical mounting* in Operating Instructions and *IP 21/Type 1 Enclosure kit* in the Design Guide.))	A2	A2	A2	A2	A2	A3	A3
IP 55 / NEMA 12	A4/A5	A4/A5	A4/A5	A4/A5	A4/A5	A5	A5
IP 66 / NEMA 12	A4/A5	A4/A5	A4/A5	A4/A5	A4/A5	A5	A5
Output current							
Continuous (3 x 380-440 V) [A]	3	4.1	5.6	7.2	10	13	16
Intermittent (3 x 380-440 V) [A]	3.3	4.5	6.2	7.9	11	14.3	17.6
Continuous (3 x 441-480 V) [A]	2.7	3.4	4.8	6.3	8.2	11	14.5
Intermittent (3 x 441-480 V) [A]	3.0	3.7	5.3	6.9	9.0	12.1	15.4
Continuous kVA (400 V AC) [kVA]	2.1	2.8	3.9	5.0	6.9	9.0	11.0
Continuous kVA (460 V AC) [kVA]	2.4	2.7	3.8	5.0	6.5	8.8	11.6
Max. cable size: (mains, motor, brake) [(mm²/ AWG] [2]				4/10			
Max. input current							
Continuous (3 x 380-440 V) [A]	2.7	3.7	5.0	6.5	9.0	11.7	14.4
Intermittent (3 x 380-440 V) [A]	3.0	4.1	5.5	7.2	9.9	12.9	15.8
Continuous (3 x 441-480 V) [A]	2.7	3.1	4.3	5.7	7.4	9.9	13.0
Intermittent (3 x 441-480 V) [A]	3.0	3.4	4.7	6.3	8.1	10.9	14.3
Max. pre-fuses[1)] [A]	10	10	20	20	20	32	32
Environment							
Estimated power loss at rated max. load [W] [4)]	58	62	88	116	124	187	255
Weight enclosure IP20 [kg]	4.8	4.9	4.9	4.9	4.9	6.6	6.6
Weight enclosure IP 21 [kg]							
Weight enclosure IP 55 [kg]	9.7/13.5	9.7/13.5	9.7/13.5	9.7/13.5	9.7/13.5	14.2	14.2
Weight enclosure IP 66 [kg]	9.7/13.5	9.7/13.5	9.7/13.5	9.7/13.5	9.7/13.5	14.2	14.2
Efficiency [3)]	0.96	0.97	0.97	0.97	0.97	0.97	0.97

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Table 9.3: Mains Supply 3 x 380 - 480 VAC

Mains Supply 3 x 380 - 480 VAC - Normal overload 110% for 1 minute

	P11K	P15K	P18K	P22K	P30K	P37K	P45K	P55K	P75K	P90K
Frequency converter	P11K	P15K	P18K	P22K	P30K	P37K	P45K	P55K	P75K	P90K
Typical Shaft Output [kW]	11	15	18.5	22	30	37	45	55	75	90
Typical Shaft Output [HP] at 460 V	15	20	25	30	40	50	60	75	100	125
IP 20 / Chassis (B3+4 and C3+4 may be converted to IP21 using a conversion kit (Please contact Danfoss))	B3	B3	B3	B4	B4	B4	C3	C3	C4	C4
IP 21 / NEMA 1	B1	B1	B1	B2	B2	C1	C1	C1	C2	C2
IP 55 / NEMA 12	B1	B1	B1	B2	B2	C1	C1	C1	C2	C2
IP 66 / NEMA 12	B1	B1	B1	B2	B2	C1	C1	C1	C2	C2
Output current										
Continuous (3 x 380-439 V) [A]	24	32	37.5	44	61	73	90	106	147	177
Intermittent (3 x 380-439 V) [A]	26.4	35.2	41.3	48.4	67.1	80.3	99	117	162	195
Continuous (3 x 440-480 V) [A]	21	27	34	40	52	65	80	105	130	160
Intermittent (3 x 440-480 V) [A]	23.1	29.7	37.4	44	61.6	71.5	88	116	143	176
Continuous kVA (400 V AC) [kVA]	16.6	22.2	26	30.5	42.3	50.6	62.4	73.4	102	123
Continuous kVA 460 V AC) [kVA]	16.7	21.5	27.1	31.9	41.4	51.8	63.7	83.7	104	128
Max. cable size: (mains, motor, brake) [mm²/ AWG] [2]	10/7	10/7	10/7	35/2	35/2		50/1/0 (B4=35/2)		95/ 4/0	120/ MCM250
With mains disconnect switch included:	16/6	16/6	16/6			35/2		35/2	70/3/0	185/ kcmil350
Max. input current										
Continuous (3 x 380-439 V) [A]	22	29	34	40	55	66	82	96	133	161
Intermittent (3 x 380-439 V) [A]	24.2	31.9	37.4	44	60.5	72.6	90.2	106	146	177
Continuous (3 x 440-480 V) [A]	19	25	31	36	47	59	73	95	118	145
Intermittent (3 x 440-480 V) [A]	20.9	27.5	34.1	39.6	51.7	64.9	80.3	105	130	160
Max. pre-fuses[1] [A]	63	63	63	63	80	100	125	160	250	250
Environment										
Estimated power loss at rated max. load [W] [4]	278	392	465	525	698	739	843	1083	1384	1474
Weight enclosure IP20 [kg]	12	12	12	23.5	23.5	23.5	35	35	50	50
Weight enclosure IP 21 [kg]	23	23	23	27	27	45	45	45	65	65
Weight enclosure IP 55 [kg]	23	23	23	27	27	45	45	45	65	65
Weight enclosure IP 66 [kg]	23	23	23	27	27	45	45	45	65	65
Efficiency [3]	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.99
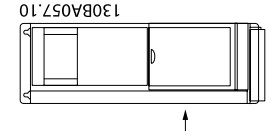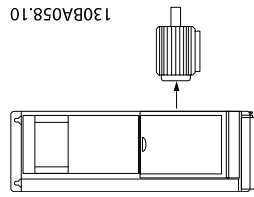
Table 9.4: Mains Supply 3 x 380 - 480 VAC

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Mains supply 3 x 525 - 600 VAC Normal overload 110% for 1 minute

Size:	P1K1	P1K5	P2K2	P3K0	P3K7	P4K0	P5K5	P7K5	P11K	P15K	P18K	P22K	P30K	P37K	P45K	P55K	P75K	P90K
Typical Shaft Output [kW]	1.1	1.5	2.2	3	3.7	4	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
IP 20 / Chassis	A3	A3	A3	A3	A2	A3	A3	A3	B3	B3	B3	B4	B4	B4	C3	C3	C4	C4
IP 21 / NEMA 1	A3	A3	A3	A3	A2	A3	A3	A3	B1	B1	B1	B2	B2	C1	C1	C1	C2	C2
IP 55 / NEMA 12	A5	A5	A5	A5	A5	A5	A5	A5	B1	B1	B1	B2	B2	C1	C1	C1	C2	C2
IP 66 / NEMA 12	A5	A5	A5	A5	A5	A5	A5	A5	B1	B1	B1	B2	B2	C1	C1	C1	C2	C2
Output current																		
Continuous (3 x 525-550 V) [A]	2.6	2.9	4.1	5.2	-	6.4	9.5	11.5	19	23	28	36	43	54	65	87	105	137
Intermittent (3 x 525-550 V) [A]	2.9	3.2	4.5	5.7	-	7.0	10.5	12.7	21	25	31	40	47	59	72	96	116	151
Continuous (3 x 525-600 V) [A]	2.4	2.7	3.9	4.9	-	6.1	9.0	11.0	18	22	27	34	41	52	62	83	100	131
Intermittent (3 x 525-600 V) [A]	2.6	3.0	4.3	5.4	-	6.7	9.9	12.1	20	24	30	37	45	57	68	91	110	144
Continuous kVA (525 V AC) [kVA]	2.5	2.8	3.9	5.0	-	6.1	9.0	11.0	18.1	21.9	26.7	34.3	41	51.4	61.9	82.9	100	130.5
Continuous kVA (575 V AC) [kVA]	2.4	2.7	3.9	4.9	-	6.1	9.0	11.0	17.9	21.9	26.9	33.9	40.8	51.8	61.7	82.7	99.6	130.5
Max. cable size, IP 21/55/66 (mains, motor, brake) [mm²]/[AWG] [2]	4/10								10/7			25/4			50/1/0		95/4/0	120/MCM2 50
Max. cable size, IP 20 (mains, motor, brake) [mm²]/[AWG] [2]	4/10								16/6			35/2			50/1/0		95/4/0	150/MCM2 50 [5]
With mains disconnect switch included:	4/10								16/6			35/2					70/3/0	185/ kcmil3 50

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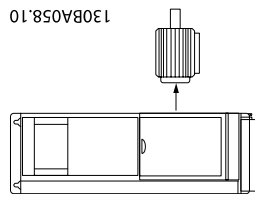
Table 9.5: [5] With brake and load sharing 95/ 4/0

Mains supply 3 x 525 - 600 VAC Normal overload 110% for 1 minute - continued

Size:	P1K1	P1K5	P2K2	P3K0	P3K7	P4K0	P5K5	P7K5	P11K	P15K	P18K	P22K	P30K	P37K	P45K	P55K	P75K	P90K
Max. input current																		
Continuous (3 x 525-600 V) [A]	2.4	2.7	4.1	5.2	-	5.8	8.6	10.4	17.2	20.9	25.4	32.7	39	49	59	78.9	95.3	124.3
Intermittent (3 x 525-600 V) [A]	2.7	3.0	4.5	5.7	-	6.4	9.5	11.5	19	23	28	36	43	54	65	87	105	137
Max. pre-fuses[1] [A]	10	10	20	20	-	20	32	32	63	63	63	63	80	100	125	160	250	250
Environment:																		
Estimated power loss at rated max. load [W] [4]	50	65	92	122	-	145	195	261	300	400	475	525	700	750	850	1100	1400	1500
Weight enclosure IP20 [kg]	6.5	6.5	6.5	6.5	-	6.5	6.6	6.6	12	12	12	23.5	23.5	23.5	35	35	50	50
Weight enclosure IP21/55 [kg]	13.5	13.5	13.5	13.5	13.5	13.5	14.2	14.2	23	23	23	27	27	27	45	45	65	65
Efficiency [4]	0.97	0.97	0.97	0.97	-	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98

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Table 9.6: [5] With brake and load sharing 95/ 4/0

Mains supply (L1, L2, L3):

Supply voltage	200-240 V ±10%, 380-480 V ±10%, 525-690 V ±10%

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

Supply frequency	50/60 Hz ±5%
Max. imbalance temporary between mains phases	3.0 % of rated supply voltage
True Power Factor ()	≥ 0.9 nominal at rated load
Displacement Power Factor (cos) near unity	(> 0.98)
Switching on input supply L1, L2, L3 (power-ups) ≤ enclosure type A	maximum twice/min.
Switching on input supply L1, L2, L3 (power-ups) ≥ enclosure type B, C	maximum once/min.
Switching on input supply L1, L2, L3 (power-ups) ≥ enclosure type D, E, F	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 - 1000 Hz*
Switching on output	Unlimited
Ramp times	1 - 3600 sec.

* Dependent on power size.

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 frequency converter's nominal torque.

Cable lengths and cross sections:

Max. motor cable length, screened/armoured	VLT HVAC Drive: 150 m
Max. motor cable length, unscreened/unarmoured	VLT HVAC Drive: 300 m
Max. cross section to motor, mains, load sharing and brake *	
Maximum cross section to control terminals, rigid wire	1.5 mm^2/16 AWG (2 x 0.75 mm^2)
Maximum cross section to control terminals, flexible cable	1 mm^2/18 AWG
Maximum cross section to control terminals, cable with enclosed core	0.5 mm^2/20 AWG
Minimum cross section to control terminals	0.25 mm^2

* See Mains Supply tables for more information!

Digital inputs:

Programmable digital inputs	4 (6)
Terminal number	18, 19, 27 [1], 29 [1], 32, 33,
Logic	PNP or NPN
Voltage level	0 - 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.

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Analog inputs:

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

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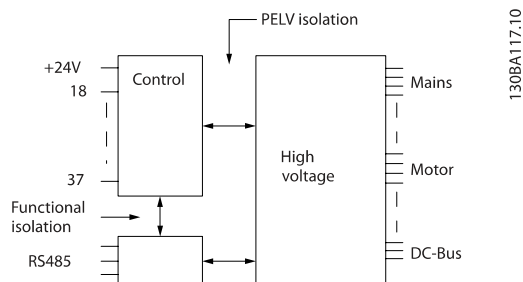
Pulse inputs:

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.

Control card, 24 V DC output:

Terminal number	12, 13
Max. load	: 200 mA

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

Relay outputs:

Programmable relay outputs	2
Relay 01 Terminal number	1-3 (break), 1-2 (make)
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, 0.2A
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 2A

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

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

Surroundings:

Enclosure type A	IP 20/Chassis, IP 21kit/Type 1, IP55/Type12, IP 66/Type12
Enclosure type B1/B2	IP 21/Type 1, IP55/Type12, IP 66/12
Enclosure type B3/B4	IP20/Chassis
Enclosure type C1/C2	IP 21/Type 1, IP55/Type 12, IP66/12
Enclosure type C3/C4	IP20/Chassis
Enclosure type D1/D2/E1	IP21/Type 1, IP54/Type12
Enclosure type D3/D4/E2	IP00/Chassis
Enclosure type F1/F3	IP21, 54/Type1, 12
Enclosure type F2/F4	IP21, 54/Type1, 12
Enclosure kit available ≤ enclosure type D	IP21/NEMA 1/IP 4$_X$ on top of enclosure
Vibration test enclosure A, B, C	1.0 g
Vibration test enclosure D, E, F	0.7 g
Relative humidity	5% - 95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43) H$_2$S test	class Kd
Test method according to IEC 60068-2-43 H2S (10 days)	
Ambient temperature (at 60 AVM switching mode)	
- with derating	max. 55° C[1]
- with full output power of typical EFF2 motors (up to 90% output current)	max. 50 ° C[1]
- at full continuous FC output current	max. 45 ° C[1]

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

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

Derating for high altitude, see section on special conditions

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	: 5 ms

Control card, USB serial communication:

USB standard	1.1 (Full speed)
USB plug	USB type B "device" plug

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

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Protection and Features:

- Electronic thermal motor protection against overload.

- Temperature monitoring of the heatsink ensures that the frequency converter trips if the temperature reaches 95 ℃ ± 5℃. An overload temperature cannot be reset until the temperature of the heatsink is below 70 ℃ ± 5℃ (Guideline - these temperatures may vary for different power sizes, enclosures etc.). The frequency converter has an auto derating function to avoid it's heatsink reaching 95 deg C.

- The frequency converter is protected against short-circuits on motor terminals U, V, W.

- If a mains phase is missing, the frequency converter trips or issues a warning (depending on the load).

- Monitoring of the intermediate circuit voltage ensures that the frequency converter trips if the intermediate circuit voltage is too low or too high.

- The frequency converter is protected against earth faults on motor terminals U, V, W.

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9.2 Special Conditions

9.2.1 Purpose of Derating

Derating must be taken into account when using the frequency converter at low air pressure (heights), at low speeds, with long motor cables, cables with a large cross section or at high ambient temperature. The required action is described in this section.

9.2.2 Derating for Ambient Temperature

90% frequency converter output current can be maintained up to max. 50 °C ambient temperature.

With a typical full load current of EFF 2 motors, full output shaft power can be maintained up to 50 °C.
For more specific data and/or derating information for other motors or conditions, please contact Danfoss.

9.2.3 Automatic Adaptations to Ensure Performance

The frequency converter constantly checks for critical levels of internal temperature, load current, high voltage on the intermediate circuit and low motor speeds. As a response to a critical level, the frequency converter can adjust the switching frequency and / or change the switching pattern in order to ensure the performance of the frequency converter. The capability to automatically reduce the output current extends the acceptable operating conditions even further.

9.2.4 Derating for Low Air Pressure

The cooling capability of air is decreased at lower air pressure.

Below 1000 m altitude no derating is necessary but above 1000 m the ambient temperature (T_{AMB}) or max. output current (I_{out}) should be derated in accordance with the shown diagram.
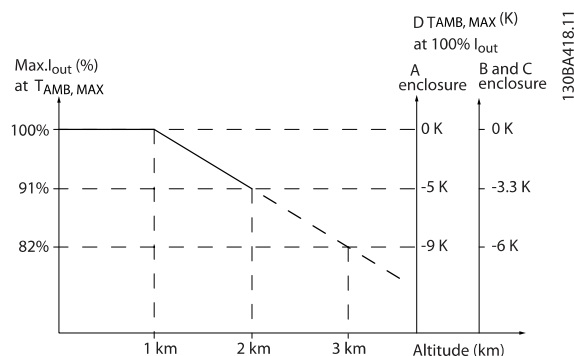
Illustration 9.1: Derating of output current versus altitude at $T_{AMB, MAX}$ for frame sizes A, B and C. At altitudes above 2 km, please contact Danfoss regarding PELV.

An alternative is to lower the ambient temperature at high altitudes and thereby ensure 100% output current at high altitudes. As an example of how to read the graph, the situation at 2 km is elaborated. At a temperature of 45° C ($T_{AMB, MAX}$ - 3.3 K), 91% of the rated output current is available. At a temperature of 41.7° C, 100% of the rated output current is available.
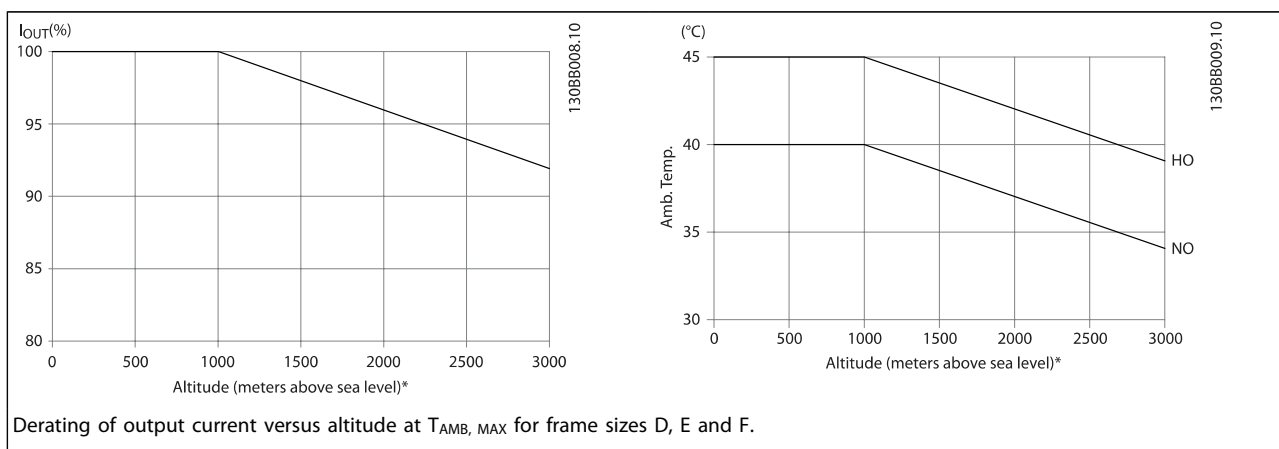
Derating of output current versus altitude at $T_{AMB, MAX}$ for frame sizes D, E and F.

9.2.5 Derating for Running at Low Speed

When a motor is connected to a frequency converter, it is necessary to check that the cooling of the motor is adequate. The level of heating depends on the load on the motor, as well as the operating speed and time.

Constant torque applications (CT mode)

A problem may occur at low RPM values in constant torque applications. In a constant torque application s a motor may over-heat at low speeds due to less cooling air from the motor integral fan.
Therefore, if the motor is to be run continuously at an RPM value lower than half of the rated value, the motor must be supplied with additional air-cooling (or a motor designed for this type of operation may be used).

An alternative is to reduce the load level of the motor by choosing a larger motor. However, the design of the frequency converter puts a limit to the motor size.

Variable (Quadratic) torque applications (VT)

In VT applications such as centrifugal pumps and fans, where the torque is proportional to the square of the speed and the power is proportional to the cube of the speed, there is no need for additional cooling or de-rating of the motor.

In the graphs shown below, the typical VT curve is below the maximum torque with de-rating and maximum torque with forced cooling at all speeds.

Maximum load for a standard motor at 40 °C driven by a frequency converter type VLT FCxxx
Legend: − − − −Typical torque at VT load —•—•—Max torque with forced cooling ————Max torque
Note 1) Over-syncronous speed operation will result in the available motor torque decreasing inversely proportional with the increase in speed. This must be considered during the design phase to avoid over-loading of the motor.

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