MAKING MODERN LIVING POSSIBLE

Danfoss

VLT® Low Harmonic Drive for AAF006
Instruction Manual
VLT® AutomationDrive

VLT®
THE REAL DRIVE

Contents

1

1 How to Read the Instruction Manual

1.1.1 Copyright, Limitation of Liability and Revision Rights

This publication contains information proprietary to Danfoss. By accepting and using this manual, the user agrees that the information contained herein will be used solely for operating equipment from Danfoss or equipment from other vendors provided that such equipment is intended for communication with Danfoss equipment over a serial communication link. This publication is protected under the copyright laws of Denmark and most other countries.

Danfoss does not warrant that a software program produced according to the guidelines provided in this manual will function properly in every physical, hardware or software environment.

Although Danfoss has tested and reviewed the documentation within this manual, Danfoss makes no warranty or representation, neither expressed nor implied, with respect to this documentation, including its quality, performance, or fitness for a particular purpose.

In no event shall Danfoss be liable for direct, indirect, special, incidental, or consequential damages arising out of the use, or the inability to use information contained in this manual, even if advised of the possibility of such damages. In particular, Danfoss is not responsible for any costs, including but not limited to those incurred as a result of lost profits or revenue, loss or damage of equipment, loss of computer programs, loss of data, the costs to substitute these, or any claims by third parties.

Danfoss reserves the right to revise this publication at any time and to make changes to its contents without prior notice or any obligation to notify former or present users of such revisions or changes.

1.1.2 Available Literature for VLT AutomationDrive

- The *VLT® AutomationDriveInstruction Manual - High Power, MG33UXYY* provides the necessary information for getting the adjustable frequency drive up and running.

- The *VLT® AutomationDriveDesign Guide MG33BXYY* contains all technical information about the adjustable frequency drive and customer design and applications.

- The *VLT® AutomationDriveProgramming Guide MG33MXYY* provides information on how to program and includes complete parameter descriptions.

- The *VLT® AutomationDriveProfibus Instruction Manual MG33CXYY* provides the information required for controlling, monitoring and programming the adjustable frequency drive via a Profibus serial communication bus.

- The *VLT® AutomationDriveDeviceNet Instruction Manual MG33DXYY* provides the information required for controlling, monitoring and programming the adjustable frequency drive via a DeviceNet serial communication bus.

X = Revision number
YY = Language code

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

VLT® AutomationDrive
Instruction Manual
Software version: 6.5x
This Instruction Manual can be used for all VLT Automation Low Harmonic Drive adjustable frequency drives with software version 6.5x. The software version number can be seen from *15-43 Software Version*.

Table 1.1

NOTE
The Low Harmonic Drive has two LCPs, one for the adjustable frequency drive (to the right) and one for the active filter (to the left). Each LCP controls only the unit it is connected to and there is only a start/stop signal between the two units.

1

1.1.3 Approvals
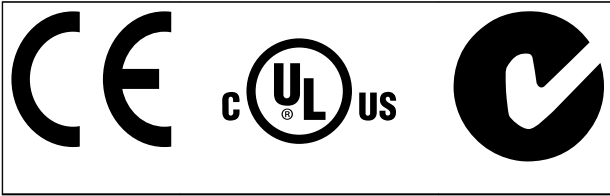
Table 1.2

Symbols

The following symbols are used in this manual.

⚠WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

CAUTION

Indicates a situation that may result in equipment or property damage-only accidents.

NOTE

Indicates highlighted information that should be observed in order to avoid mistakes or operate equipment at less than optimal performance.

Approvals

Table 1.3

2 Safety

2

2.1.1 Safety Note

⚠WARNING

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

Safety Regulations
1. The adjustable frequency drive must be disconnected from line power if repair work is to be carried out. Make sure that the line power supply has been disconnected and that the necessary time has passed before removing motor and line power plugs.

2. The [Off/Reset] key on the LCP of the adjustable frequency drive does not disconnect the equipment from line power and is therefore not to be used as a safety switch.

3. Correct protective grounding 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 ground leakage currents are higher than 3.5 mA.

5. Protection against motor overload is set by *1-90 Motor Thermal Protection*. If this function is desired, set *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. Note that the adjustable frequency drive has voltage inputs other than L1, L2 and L3, when load sharing (linking of DC intermediate circuit) and external 24 V DC have been installed. Make sure that all voltage inputs have been disconnected and that the necessary time has passed before commencing repair work.

Installation at High Altitudes

⚠WARNING

At altitudes above 10,000 feet [3 km], please contact Danfoss regarding PELV.

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 adjustable frequency drive is connected to line power. 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 [Reset] must always be activated; after which data can be modified.
3. A motor that has been stopped may start if faults occur in the electronics of the adjustable frequency drive, or if a temporary overload or a fault in the line power or the motor connection ceases.

⚠WARNING

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

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 backup.

2.1.2 General Warning

⚠WARNING

Touching the electrical parts may be fatal - even after the equipment has been disconnected from line power.
Also make sure that other voltage inputs have been disconnected, (linkage of DC intermediate circuit), as well as the motor connection for kinetic backup.
Before touching any potentially live parts of the adjustable frequency drive, wait at least as follows:
380–480 V, 175–275 hp [132–200 kW], wait at least 20 minutes.
380–480 V, 350–850 hp [250–630 kW], wait at least 40 minutes.
Shorter time is allowed only if indicated on the nameplate for the specific unit. Be aware that there may be high voltage on the DC links even when the control card LEDs are turned off. A red LED is mounted on a circuit board inside both the adjustable frequency drive and the active filter to indicate the DC bus voltages. The red LED will stay lit until the DC link is 50 V DC or lower.

⚠WARNING

Leakage Current
The ground leakage current from the adjustable frequency drive exceeds 3.5 mA. According to IEC 61800-5-1, a reinforced protective ground connection must be ensured by means of: a min. 0.015 in² [10 mm²] Cu or 0.025 in² [16 mm²] Al PE wire or an additional PE wire, with the same cable cross-section as the line power wiring - must be terminated separately.
Residual Current Device
This product can cause a DC current in the protective conductor. Where a residual current device (RCD) is used for extra protection, only an RCD of Type B (time delayed) shall be used on the supply side of this product. See also RCD Application Note MN90GX02.
Protective grounding of the adjustable frequency drive and the use of RCDs must always follow national and local regulations.

2.1.3 Before Commencing Repair Work

1. Disconnect the adjustable frequency drive from line power

2. Disconnect DC bus terminals 88 and 89

3. Wait at least the time mentioned in *2.1.2 General Warning*

2.1.4 Special Conditions

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

The adjustable frequency drives also support other special applications, which affect the electrical ratings of the adjustable frequency drive. Special conditions that 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.

Consult the relevant clauses in these instructions and in the *VLT AutomationDrive Design Guide, MG33BXYY* for information about the electrical ratings.

Installation requirements:
The overall electrical safety of the adjustable frequency drive requires special installation considerations regarding:
- Fuses and circuit breakers for overcurrent and short-circuit protection

- Selection of power cables (line power, motor, brake, load sharing and relay)

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

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

Consult the relevant clauses in these instructions and in the *VLT AutomationDrive Design Guide, MG33BXYY* for information about the installation requirements.

2.1.5 Avoid Unintended Start

⚠WARNING

While the adjustable frequency drive is connected to line power, the motor can be started/stopped using digital commands, bus commands, references or via the LCP.

- **Disconnect the adjustable frequency drive from line power whenever personal safety considerations make it necessary to avoid an unintended start.**

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

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

2

2.1.6 Safe Stop Installation

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

1. The bridge (jumper) between Terminal 37 and 24 V DC must be removed. Cutting or breaking the jumper is not sufficient. Remove it entirely to avoid short-circuiting. See jumper on *Illustration 2.1*.

2. Connect terminal 37 to 24 V DC by a short circuit-protected cable. The 24 V DC voltage supply must be interruptible by an EN954-1 category 3 circuit interrupt device. If the interrupt device and the adjustable frequency drive are placed in the same installation panel, a non-shielded cable can be used instead of a shielded one.
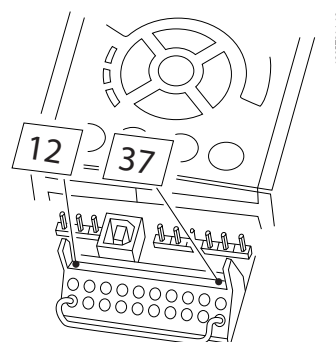
Illustration 2.1 Bridge jumper between terminal 37 and 24 V DC

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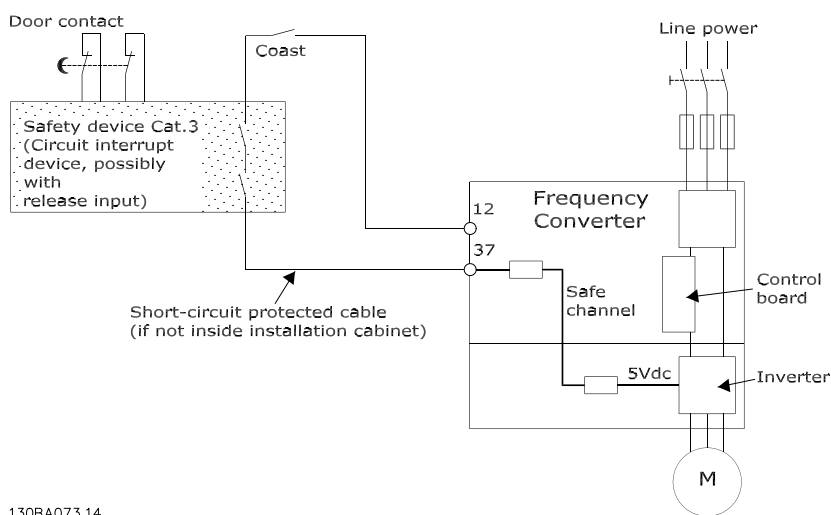
Illustration 2.2 Figure of the essential aspects of an installation to achieve a Stopping Category 0 (EN 60204-1) with Safety Category 3 (EN 954-1).

2.1.7 Safe Stop of the Adjustable Frequency Drive

For versions fitted with a Safe Stop terminal 37 input, the adjustable frequency drive can perform the safety function *Safe Torque Off* (As defined by draft CD IEC 61800-5-2) or *Stop Category 0* (as defined in EN 60204-1).

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

BGIA
Berufsgenossenschaftliches
Institut für Arbeitsschutz

Hauptverband der gewerblichen
Berufsgenossenschaften

Prüf- und Zertifizierungsstelle
im BG-PRÜFZERT

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.

130BA373.11

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

Illustration 2.3

2.1.8 IT Line Power

⚠WARNING

IT line power
Do not connect adjustable frequency drives with RFI filters to line power supplies with a voltage between phase and ground of more than 440 V for 400 Vs and 760 V for 690 V drives.
For 400 V IT line power and grounded leg, AC line voltage may exceed 440 V between phase and ground.

14-50 RFI Filter can be used to disconnect the internal RFI capacitors from the RFI filter to ground. *14-50 RFI Filter* on both the adjustable frequency drive and the filter must be turned off.

2.1.9 Disposal Instructions

	Equipment containing electrical components may not be disposed of together with domestic waste. It must be separately collected with electrical and electronic waste according to local and currently valid legislation.
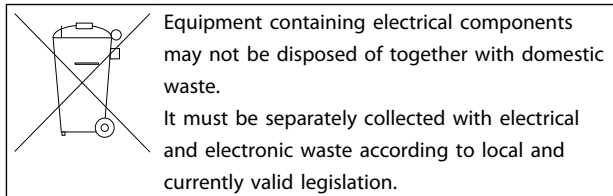
Table 2.1

3 Introduction to the Low Harmonic Drive

3.1.1 Working Principle

The VLT Low Harmonic Drive is a VLT High Power adjustable frequency drive with an integrated active filter. An active filter is a device that actively monitors harmonic distortion levels and injects compensative harmonic current onto the line to cancel out the harmonics.
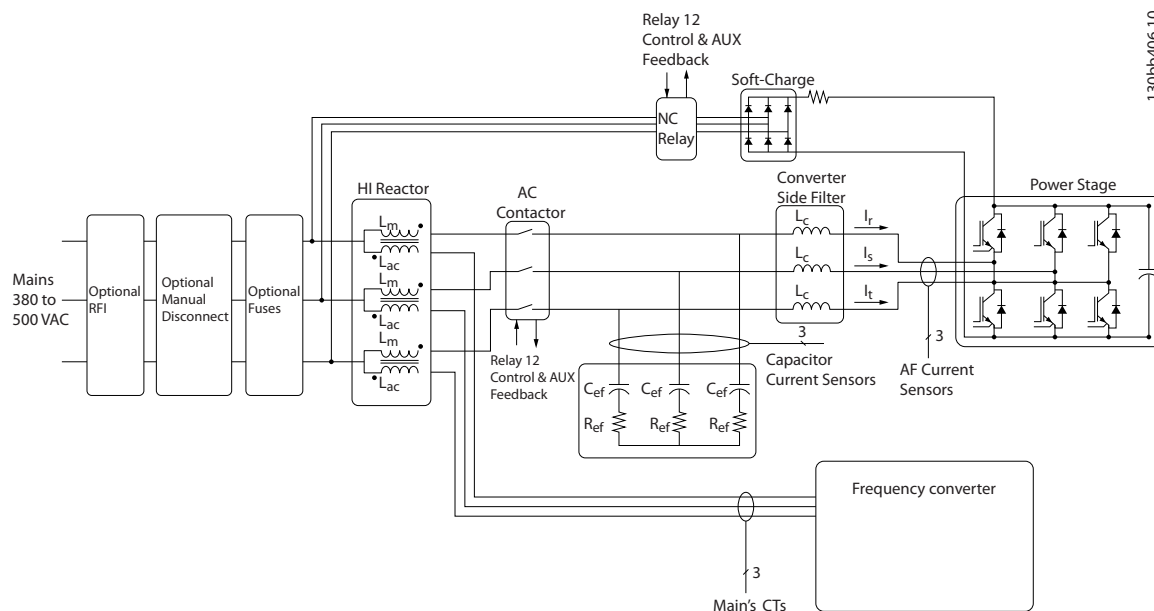
Illustration 3.1 Basic layout for the Low Harmonic Drive

3.1.2 IEEE519 Compliance

Low harmonic drives are designed to draw an ideal sinusoidal current waveform from the supply grid with a power factor of 1. Where traditional non-linear load draws pulse-shaped currents, the low harmonic drive compensates for this via the parallel filter path which lowers the stress on the supply grid. The low harmonic drive meets the toughest harmonic standards and has a THiD of less than 5% at full load for <3% pre-distortion on a 3% unbalanced three-phased grid. The unit is designed to meet IEEE519 recommendations for Isc/Il >20 for both uneven and even individual harmonic levels. The filter portion of a low harmonic drive has a progressive switching frequency which leads to a wide frequency spreads producing lower individual harmonic levels above the 50th.
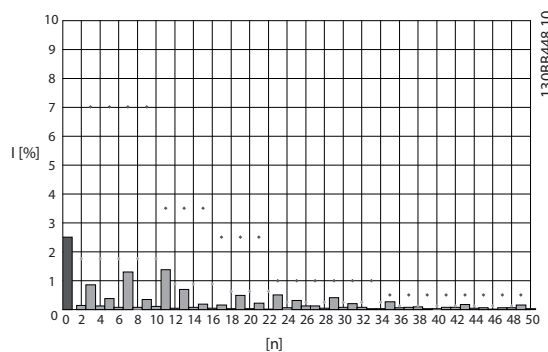
Illustration 3.2 Typical harmonic frequency spectrum and THD value at the line power terminals of the drive

n = harmonic order

◇.....IEEE519 (Isc/IL>20) limits for individual harmonics

3

3.1.3 Ordering Form Type Code

It is possible to design a VLT Low Harmonic Drive according to the application requirements by using the ordering number system.

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
F	C	-	X	0	2	P	X	X	0	T	5	E	2	1	N	2	X	G	C	X	X	X	S	X	X	X	X	X	.	.	X

Table 3.1

Product groups	1-3	⊠
Adjustable frequency drive series	4-6	⊠
Power rating	8-10	⊠
Phases	11	⊠
AC Line Voltage	12	⊠
Enclosure	13-15	⊠
Enclosure type		⊠
Enclosure class		⊠
Control supply voltage		⊠
Hardware configuration		⊠
RFI filter	16-17	⊠
Brake	18	⊠
Display (LCP)	19	⊠
Coating PCB	20	⊠
Line power option	21	⊠
Adaptation A	22	⊠
Adaptation B	23	⊠
Software release	24-27	⊠
Software language	28	⊠
A options	29-30	⊠
B options	31-32	⊠
C0 options, MCO	33-34	⊠
C1 options	35	⊠
C option software	36-37	⊠
D options	38-39	⊠

Table 3.2

To order a VLT Low Harmonic Drive, type the letter "N" in position 16 of the type code string. Not all choices/options are available for each adjustable frequency drive variant. To verify if the appropriate version is available, consult the Drive Configurator on the Internet. For more information on the options available, see the *Design Guide*.

4 How to Install

4.1 How to Get Started

This chapter covers mechanical and electrical installations to and from power terminals and control card terminals. Electrical installation of *options* is described in the relevant Instruction Manual and Design Guides.

The adjustable frequency drive is designed for quick installation and is EMC-compliant. Just follow the steps described below.

⚠ WARNING

Read the safety instructions before installing the unit. Failure to follow recommendations could result in death or serious injury.

Mechanical Installation
- Mechanical mounting

Electrical Installation
- Connection to Line and Protecting Ground
- Motor connection and cables
- Fuses and circuit breakers
- Control terminals - cables

Quick Setup
- Local Control Panel (LCP) of adjustable frequency drive
- Local Control Panel of filter
- Automatic Motor Adaptation, AMA
- Programming

Frame size is depending on enclosure type, power range, and AC line voltage
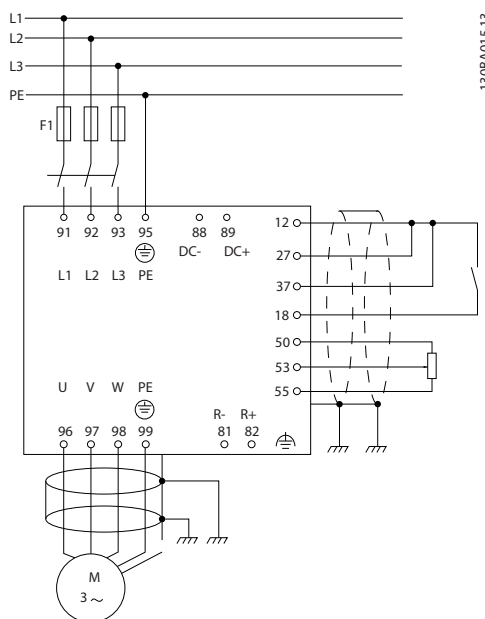
Illustration 4.1 Diagram showing basic installation including line power, motor, start/stop key, and potentiometer for speed adjustment.

4.2 Pre-installation

4.2.1 Planning the Installation Site

CAUTION

Before performing the installation, it is important to plan the installation of the adjustable frequency drive. Neglecting this may result in extra work during and after installation.

Select the best possible operation site by considering the following (see details on the following pages, and the respective VLT AutomationDrive Design Guides):
- Ambient operating temperature
- Installation method
- How to cool the unit
- Position of the adjustable frequency drive.
- Cable routing
- Ensure the power source supplies the correct voltage and necessary current.
- Ensure that the motor current rating is within the maximum current from the adjustable frequency drive.

4

• If the adjustable frequency drive is without built-in fuses, ensure that the external fuses are rated correctly.

4.2.2 Receiving the Adjustable Frequency Drive

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

4.2.3 Transportation and Unpacking

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

4.2.4 Lifting

Always lift the adjustable frequency drive using the dedicated lifting holes. For all D and E frames, use a bar to avoid bending the lifting holes of the adjustable frequency drive.
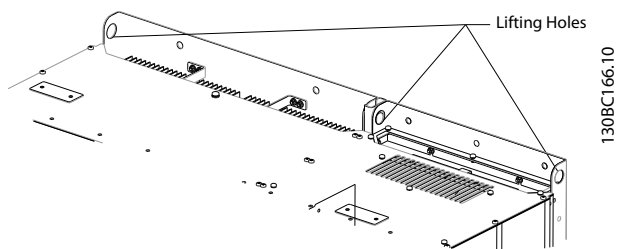
Illustration 4.2 Recommended lifting method, frame sizes D13
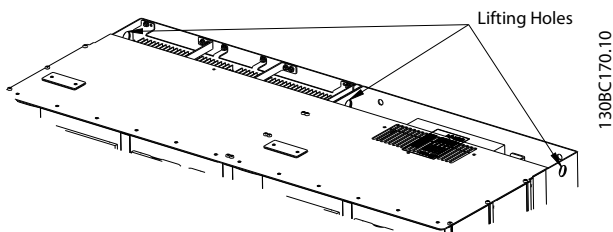
Illustration 4.3 Recommended lifting method, frame sizes E9

⚠️WARNING

The lifting bar must be able to handle the weight of the adjustable frequency drive. See *4.2.5 Mechanical Dimensions* for the weight of the different frame sizes. Maximum diameter for bar is 1 in [2.5 cm]. The angle from the top of the adjustable frequency drive to the lifting cable should be 60° or greater.
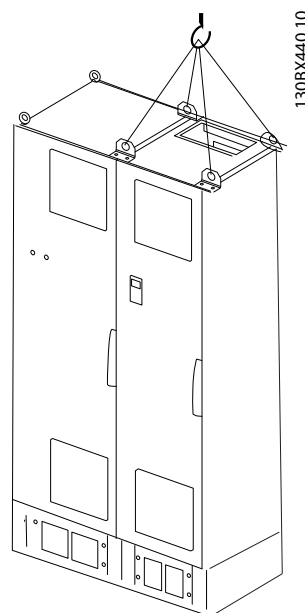
Illustration 4.4 Recommended lifting method, frame size F18 - filter section.
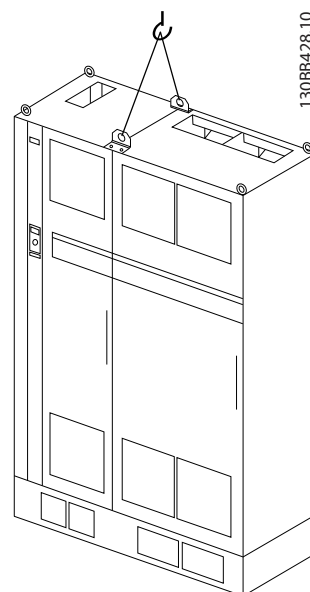
Illustration 4.5 Recommended lifting method, frame size F18 - drive section.

NOTE

The plinth is provided in the same packaging as the unit but is not attached to frame size F during shipment. The plinth is required to allow airflow to the adjustable frequency drive to provide proper cooling. The F frames should be positioned on top of the plinth in the final installation location. The angle from the top of the drive to the lifting cable should be 60° or greater.

In addition to the drawing above, a spreader bar is an acceptable way to lift the F frame.

NOTE

The F frame will be shipped as two pieces. Instructions on how to assemble the pieces can be found in *4.3 Mechanical Installation*.

4.2.5 Mechanical Dimensions
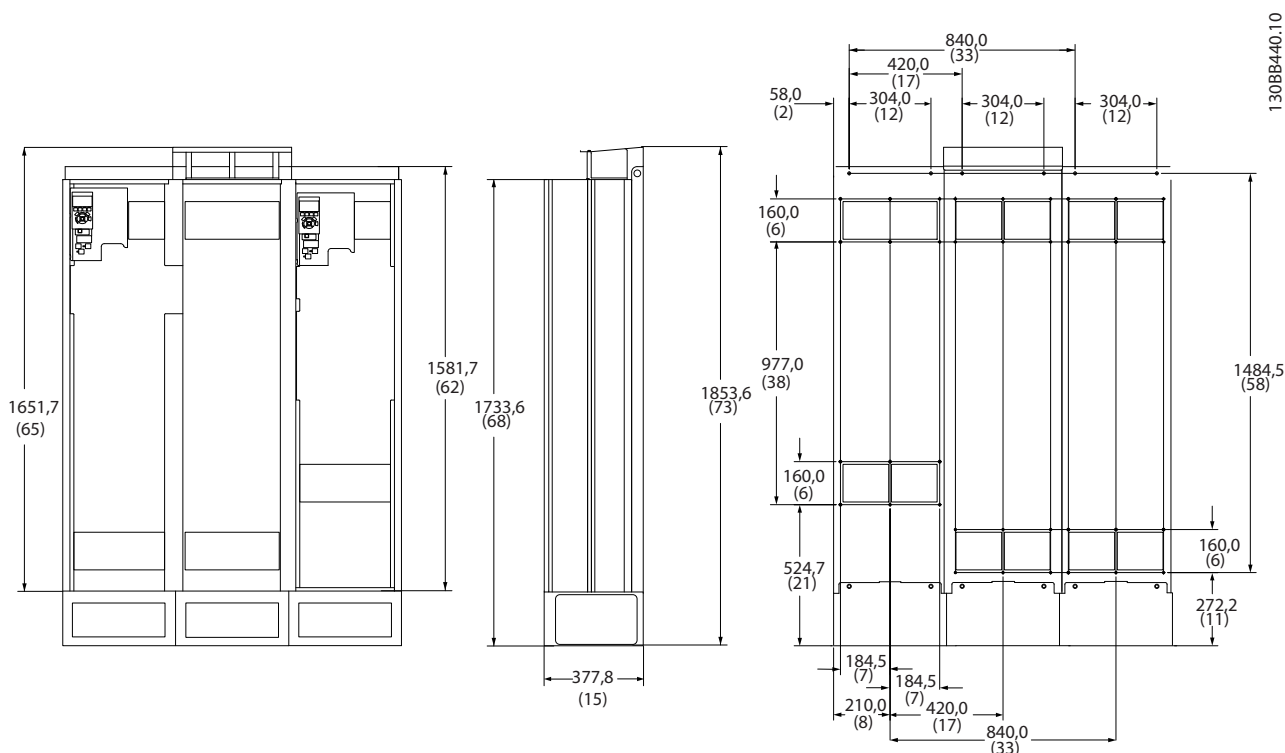
Illustration 4.6 Frame Size D13

4
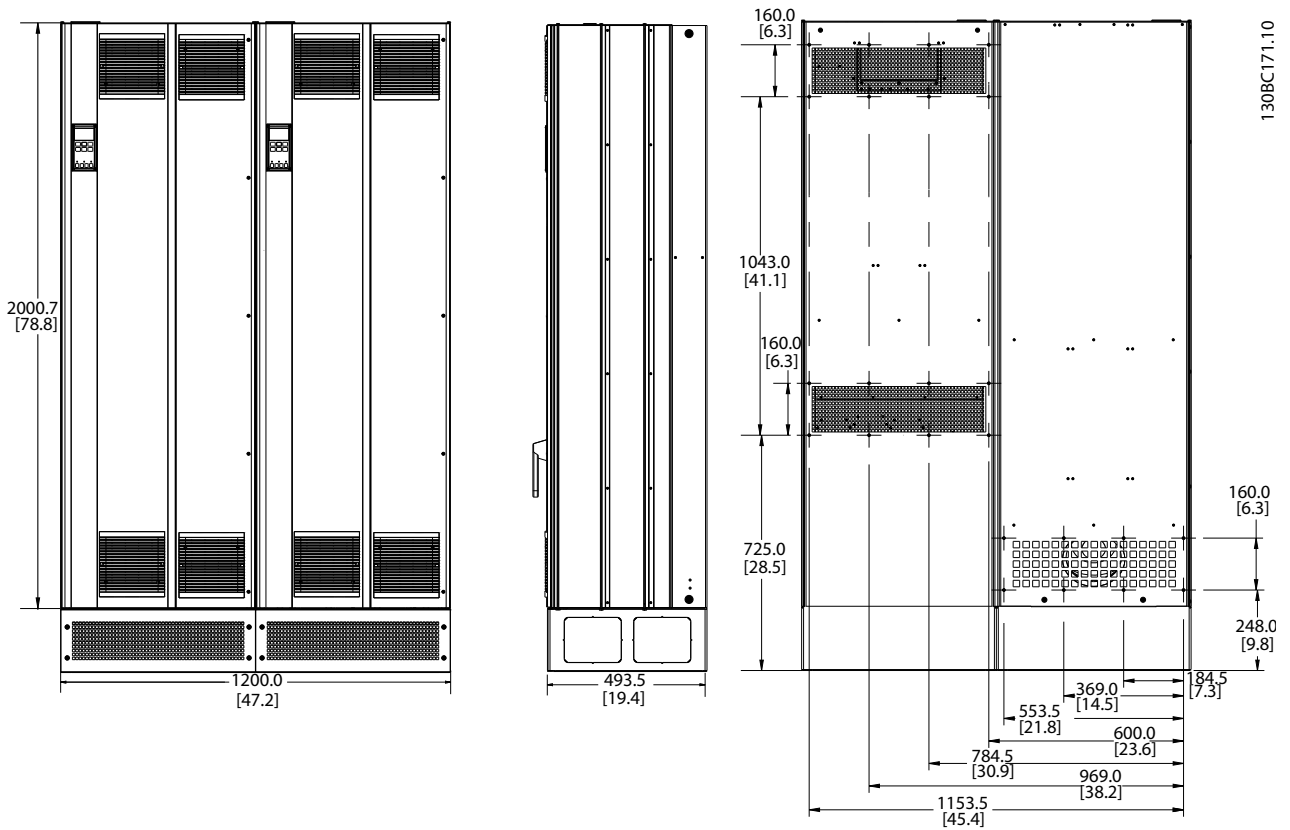
Illustration 4.7 Frame Size E9
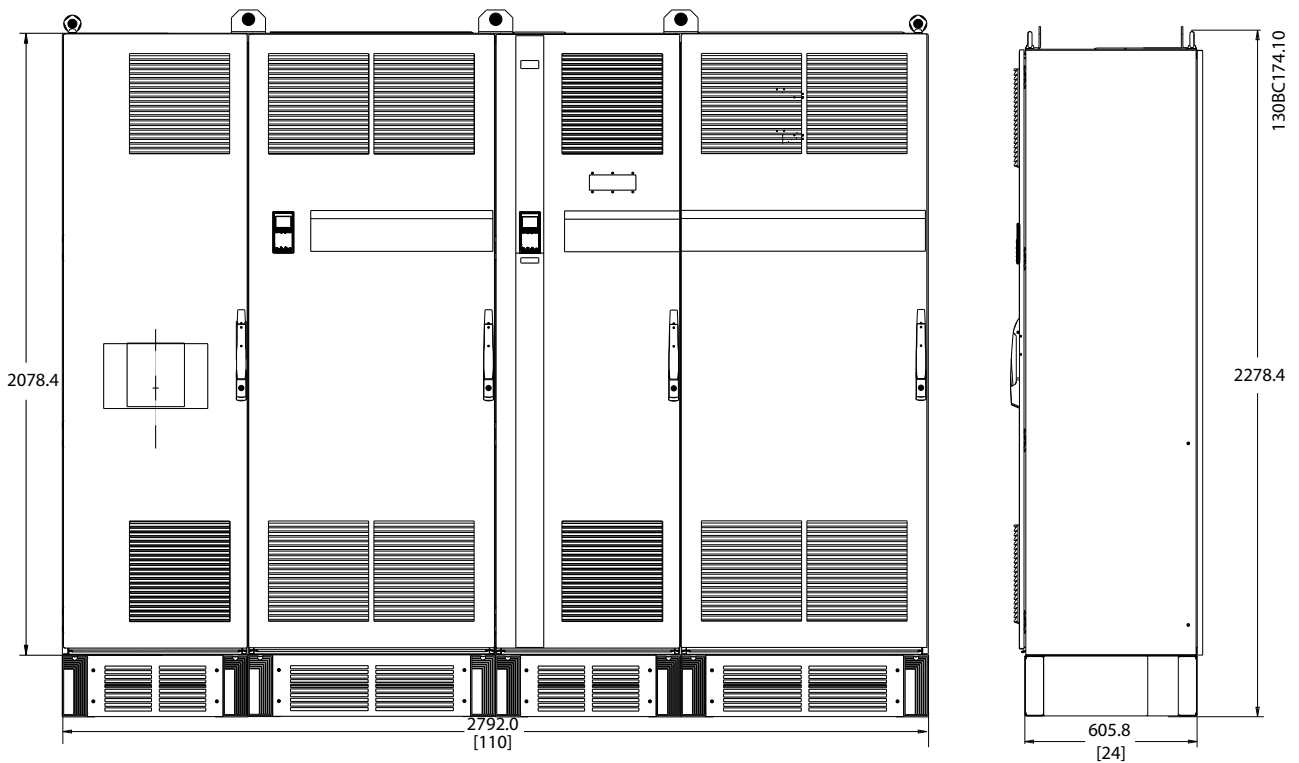
Illustration 4.8 Frame Size F18, front and side view
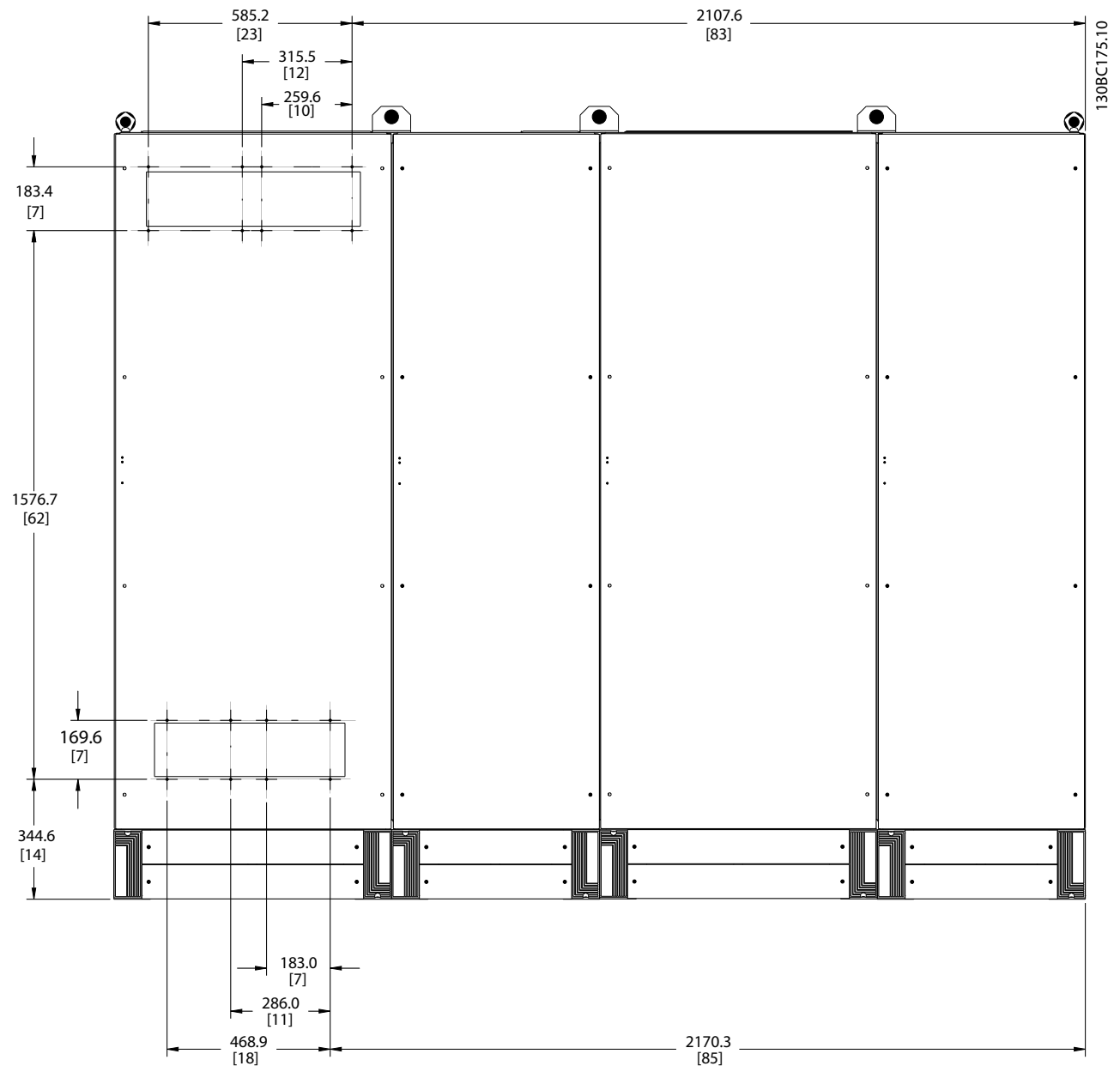
4

Illustration 4.9 Frame Size F18, back view

Mechanical Dimensions and Rated Power			
Frame size		D13	E9
Enclosure protection	IP	21/54	21/54*
	NEMA	Type 1/Type 12	Type 1/Type 12
High overload rated power - 160% overload torque		175–275 hp [132–200 kW] at 400 V (380–480 V)	350–550 hp [250–400 kW] at 400 V (380–480 V)
Drive Dimensions	Height	70.1 in [1,780.5 mm]	78.77 in [2,000.7 mm]
	Width	40.23 in [1,021.9 mm]	47.24 in [1,200 mm]
	Depth	14.87 in [377.8 mm]	19.43 in [193.5 mm]
	Max Weight	860 lb [390 kg]	1490 lb [679 kg]
	Shipping Weight	959 lb [435 kg]	1590 lb [721 kg]

Table 4.1

Frame size		F18
Enclosure protection	IP	21/54
	NEMA	Type 1
High overload rated power - 160% overload torque		600–850 HP [450–630 kW] at 400 V (380–480 V)
Drive Dimensions	Height	89.7 in [2,278.4 mm]
	Width	109.92 in [2,792 mm]
	Depth	23.85 in [605.8 mm]
	Max Weight	4189 lb [1,900 kg]
	Shipping Weight	4987 lb [2,262 kg]

Table 4.2

4.3 Mechanical Installation

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

4.3.1 Tools Needed

Tools needed for mechanical installation:

- Drill with 10 or 12 mm (0.4 or 0.5 in approx) drill

- Tape measure

- Screw driver

- Wrench with relevant metric sockets (7-17 mm)

- Extensions to wrench

- Sheet metal punch for conduits or cable connectors

- Lifting bar to lift the unit (rod or tube max. Ø25 mm (1 inch), able to lift a minimum of 2,200 lbs [1,000 kg]).

- Crane or other lifting aid to place the unit in position

- Torx T50 tool

4.3.2 General Considerations

Space
Ensure proper space above and below the adjustable frequency drive to allow airflow and cable access. In addition, space in front of the unit must be considered to allow the panel door to be opened.
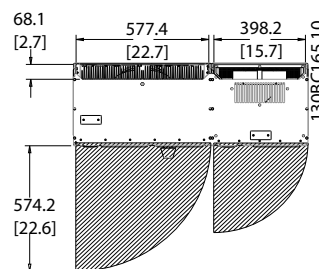
Illustration 4.10 Space in front of IP21/IP54 enclosure type, frame size D13.
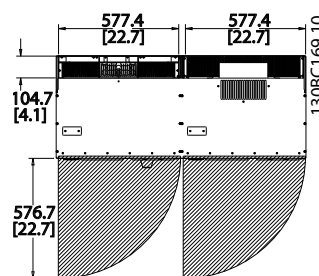
Illustration 4.11 Space in front of IP21/IP54 enclosure type, frame size E9.
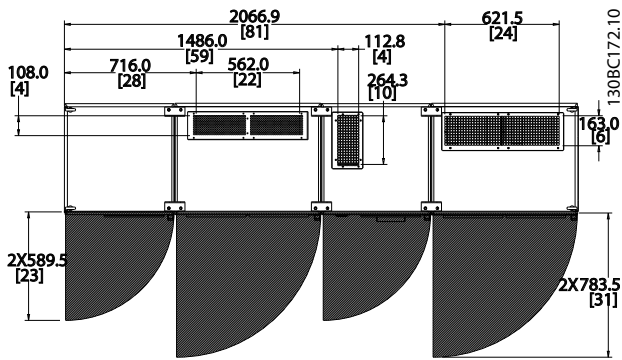
Illustration 4.12 Space in front of IP21/IP54 enclosure type, frame size F18.

Wire access

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

NOTE

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

4.3.3 Terminal Locations - Frame Size D13

Give thought to the following terminal positions when designing the cable access.
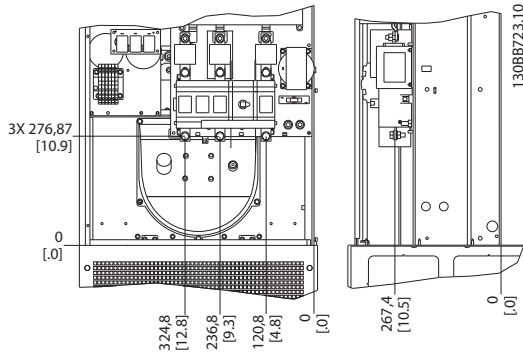
Illustration 4.13 Terminal locations – line cables
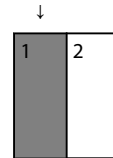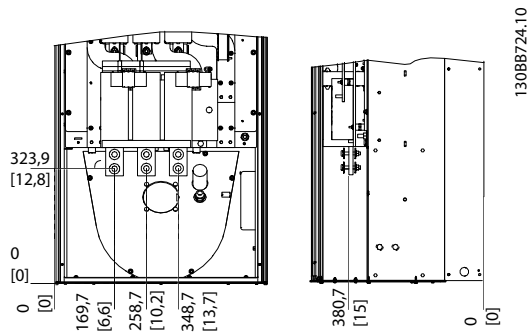
Table 4.3

Illustration 4.13 Terminal locations E9 drive
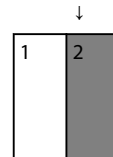
Table 4.4

Be aware that the power cables are heavy and hard to bend. Give thought to the optimum position of the adjustable frequency drive for ensuring easy installation of the cables.

NOTE

All D frames are available with standard input terminals or disconnect switch

4.3.4 Terminal Locations - Frame Size E9

Give thought to the following terminal positions when designing the cable access.

Illustration 4.13 Terminal locations Line Cables

Table 4.5

Illustration 4.13 Terminal locations motor cables
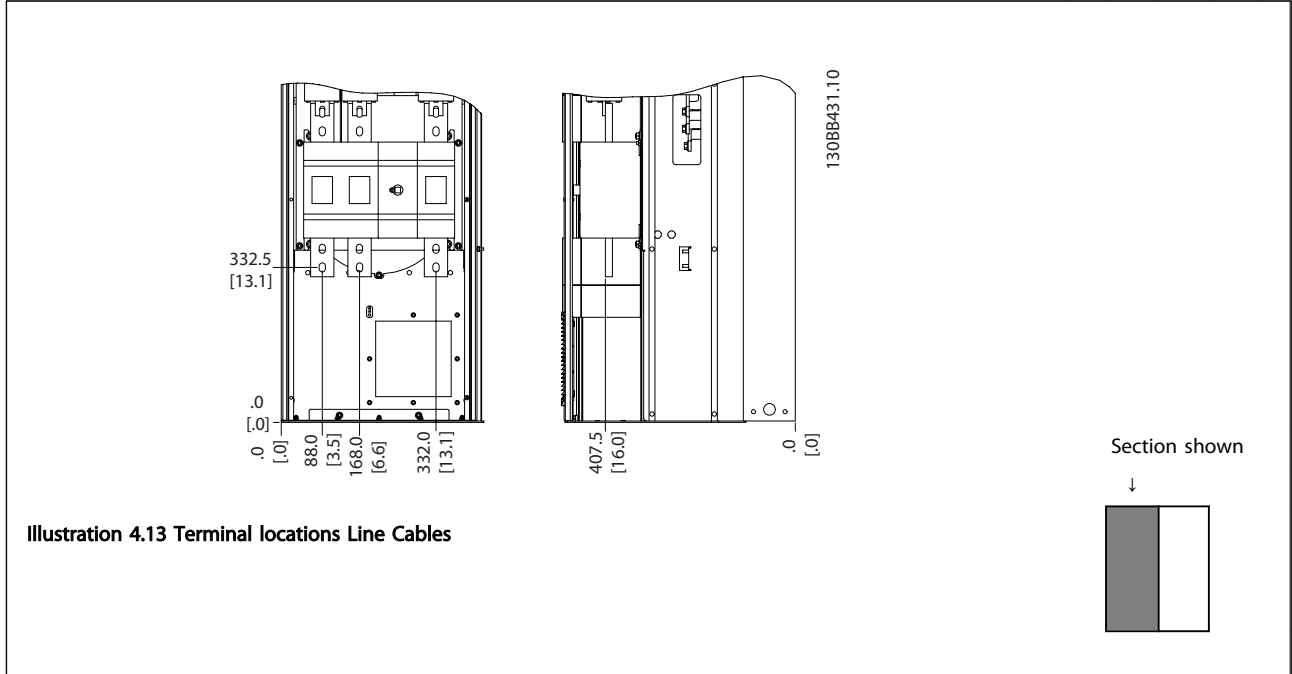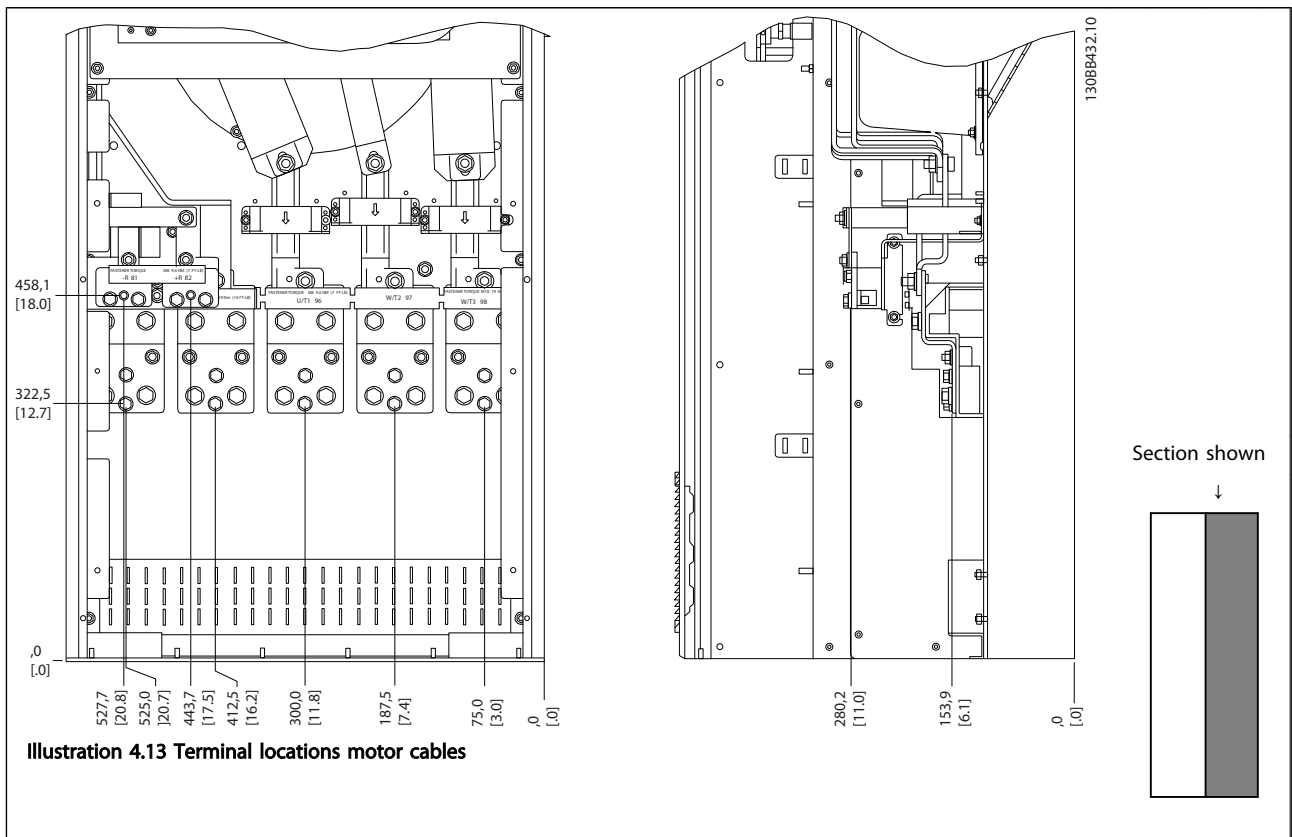
Table 4.6

Note that the power cables are heavy and difficult to bend. Give thought to the optimum position of the adjustable frequency drive for ensuring easy installation of the cables.

Each terminal allows use of up to four cables with cable lugs or use of standard box lug. Ground is connected to relevant termination point in the adjustable frequency drive.
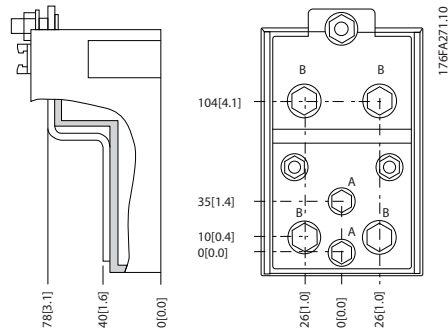
Illustration 4.13 Terminal in details

NOTE

Power connections can be made to positions A or B

4.3.5 Terminal Locations - Frame Size F18

Terminal locations – Filter
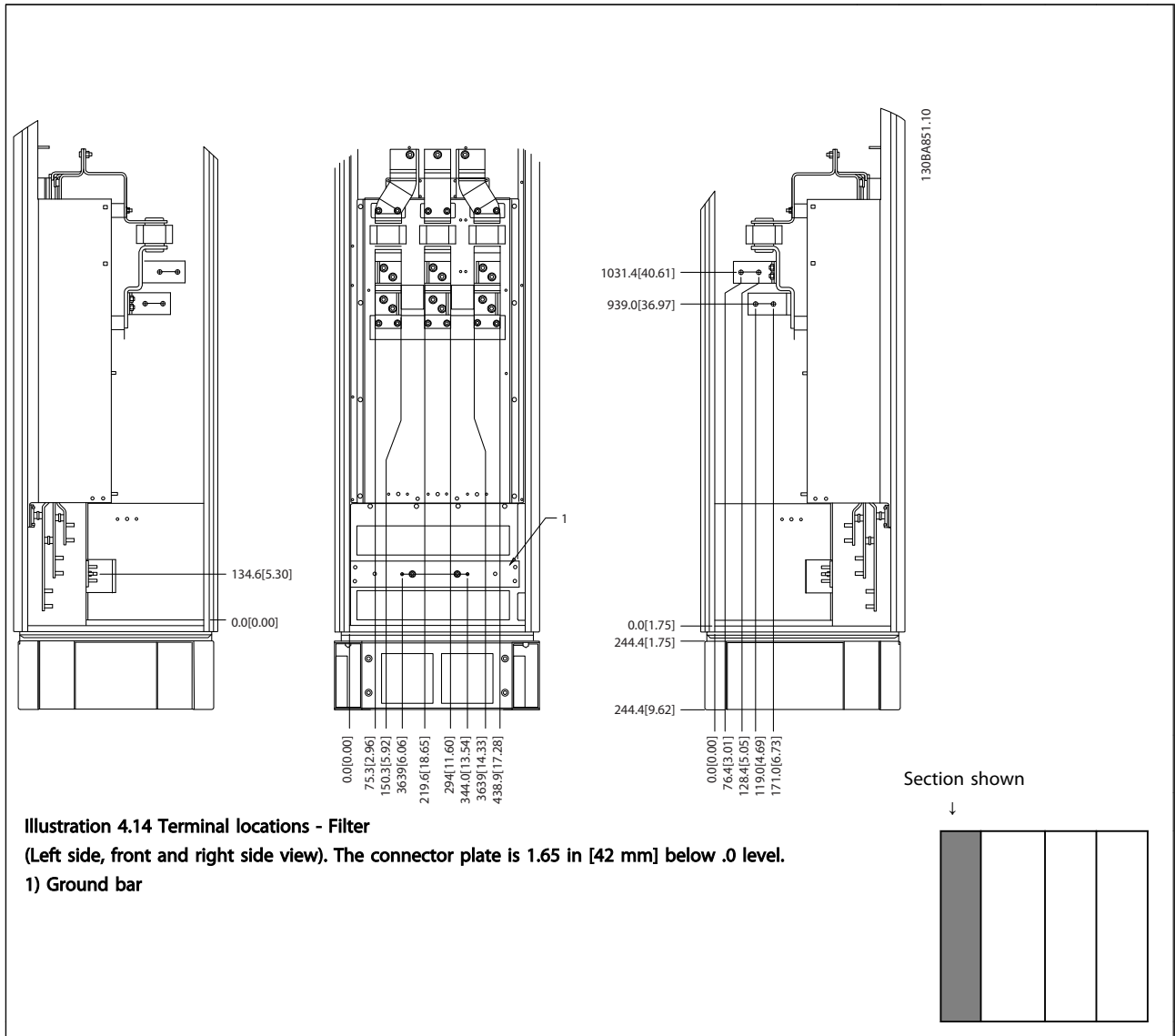
Illustration 4.14 Terminal locations - Filter
(Left side, front and right side view). The connector plate is 1.65 in [42 mm] below .0 level.
1) Ground bar

Table 4.7

Terminal locations – Rectifier

435.5 [17.15]
343.1 [13.51]
193.9 [7.64]
70.4 [2.77]
0.0 [0.00]

1

A B
188.6 [7.42]
136.6 [5.38]
90.1 [3.55]
38.1 [1.50]
0.0 [0.00]

0.0 [0.0]
74.6 [2.9]
125.8 [4.95]
149.6 [5.89]
183.4 [7.22]
218.6 [8.61]
293.6 [11.56]
362.6 [14.28]
373.4 [14.70]
437.6 [17.23]
486.6 [19.16]

2

3

130BA848.11

LOAD SHARE LOCATION		
DIM	F1/F2	F3/F4
A	380.5 [14.98]	29.4 [1.16]
B	432.5 [17.03]	81.4 [3.20]
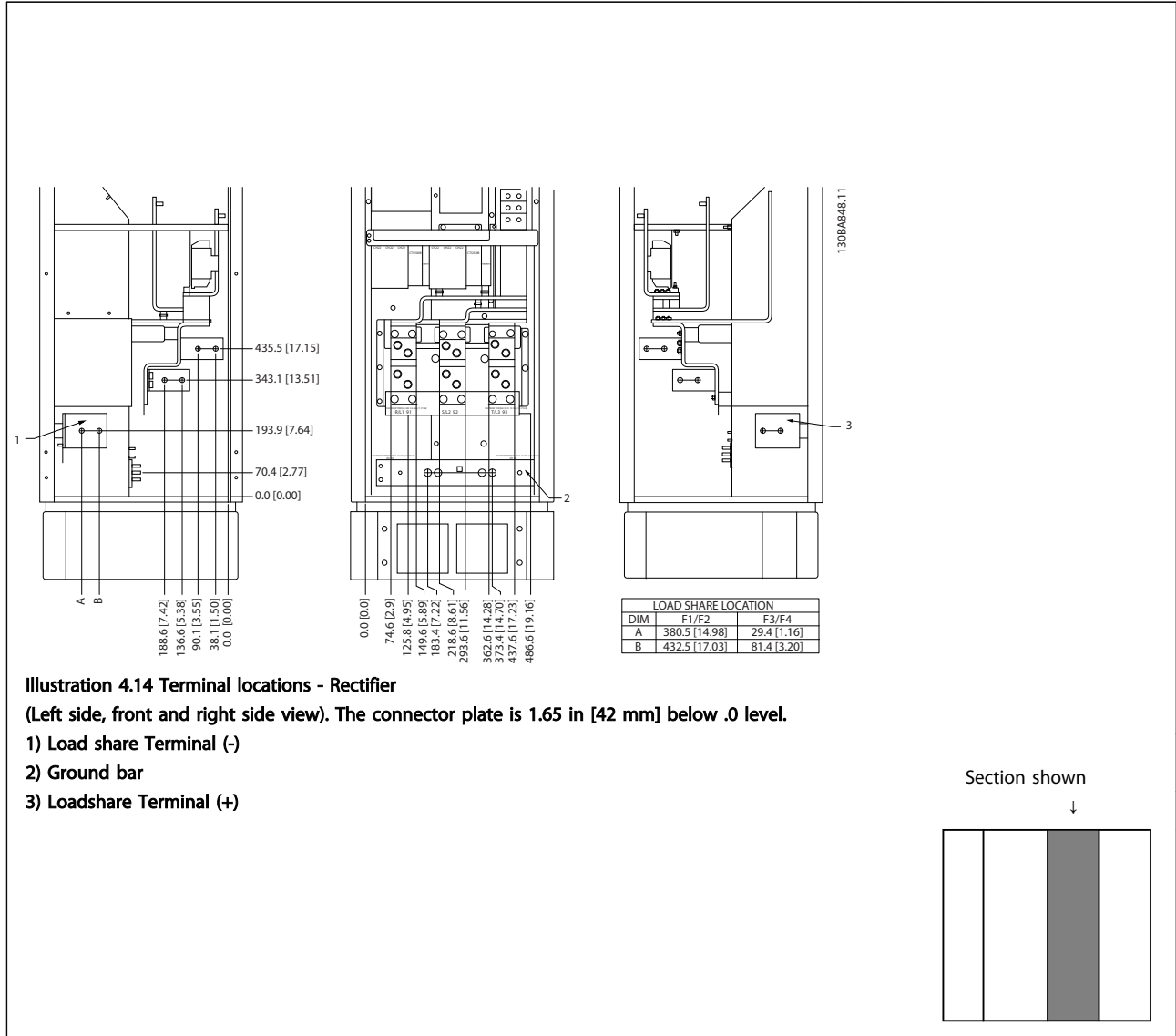
Illustration 4.14 Terminal locations – Rectifier
(Left side, front and right side view). The connector plate is 1.65 in [42 mm] below .0 level.
1) Load share Terminal (-)
2) Ground bar
3) Loadshare Terminal (+)

Section shown
↓

Table 4.8

4

Terminal locations – Inverter
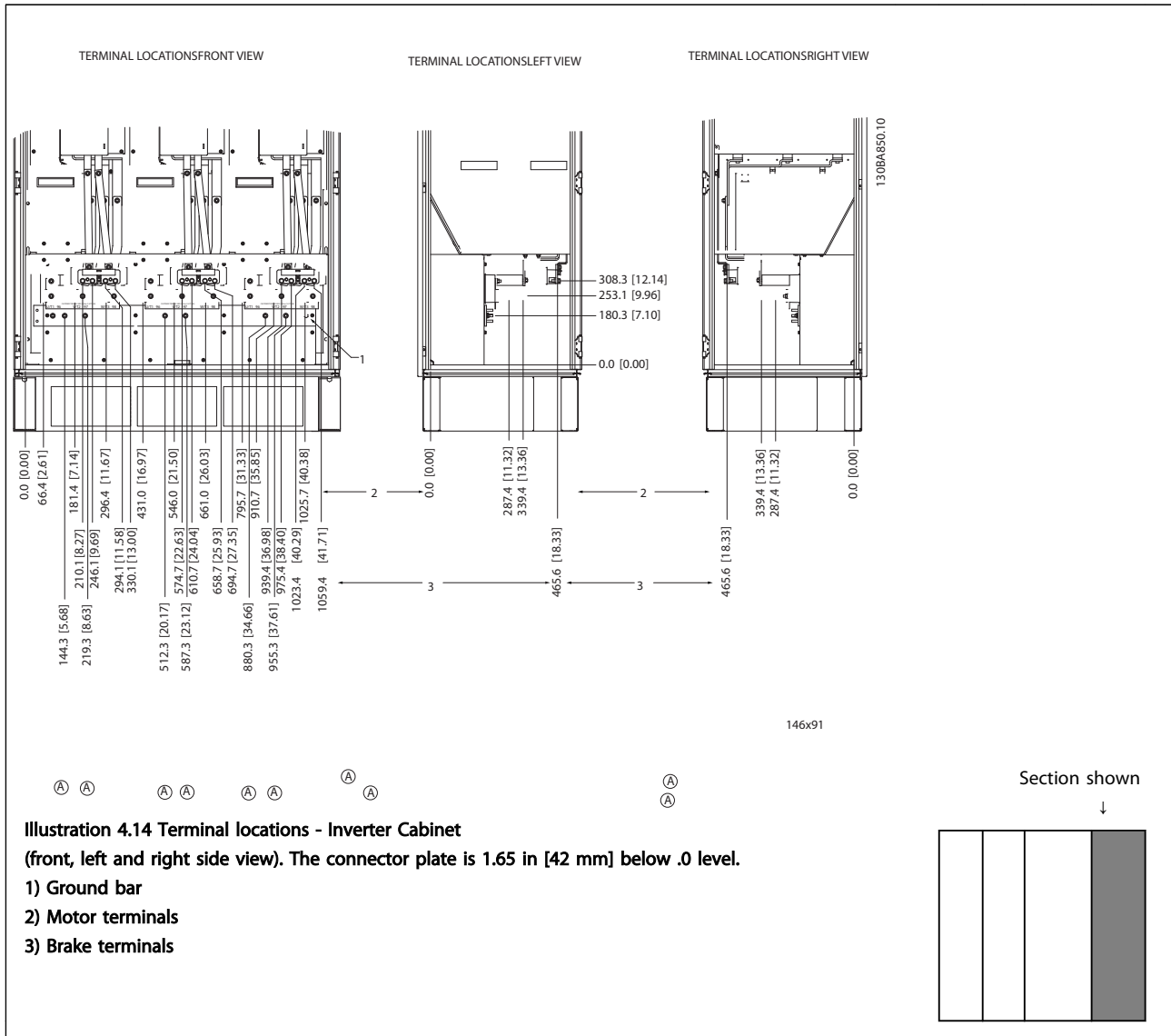
Illustration 4.14 Terminal locations – Inverter Cabinet
(front, left and right side view). The connector plate is 1.65 in [42 mm] below .0 level.
1) Ground bar
2) Motor terminals
3) Brake terminals

Table 4.9

4.3.6 Cooling and Airflow

Cooling

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

Back cooling

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

NOTE

A door fan is required on the enclosure to remove the heat losses not contained in the backchannel of the drive and any additional losses generated from other components installed inside the enclosure. The total required air flow must be calculated so that the appropriate fans can be selected. Some enclosure manufacturers offer software for performing the calculations (i.e., Rittal Therm software).

Airflow

The necessary airflow over the heatsink must be ensured. The flow rate is shown in *Table 4.10*.

Enclosure protection	Frame size	Door fan(s) / Top fan airflow Total airflow of multiple fans	Heatsink fan(s) Total airflow of multiple fans
IP21 / NEMA 1 IP54 / NEMA 12	D13	510 m^3/h (300 cfm)	2,295 m^3/h (1,350 cfm)
	E9 P250	680 m^3/h (400 cfm)	2,635 m^3/h (1,550 cfm)
	E9 P315-P400	680 m^3/h (400 cfm)	2,975 m^3/h (1,750 cfm)
IP21 / NEMA 1	F18	4,900 m^3/h (2,884 cfm)	6,895 m^3/h (4,060 cfm)

Table 4.10 Heatsink Air Flow

NOTE

For the drive section, the fan runs for the following reasons:

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

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

NOTE

For the active filter, the fan runs for the following reasons:

1. Active filter running
2. Active filter not running, but line power current exceeding limit (power size dependent)
3. Specific heatsink temperature exceeded (power size dependent)
4. Specific Power Card ambient temperature exceeded (power size-dependent)
5. Specific Control Card ambient temperature exceeded

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

External ducts

If additional duct work is added externally to the Rittal cabinet, the pressure drop in the ducting must be calculated. Use the charts below to derate the adjustable frequency drive according to the pressure drop.
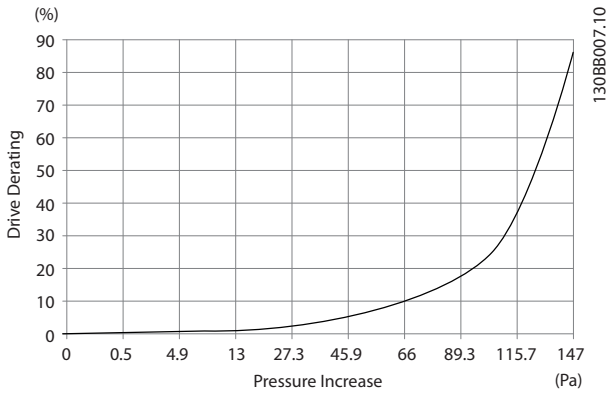
Illustration 4.14 D frame Derating vs. Pressure Change

Drive air flow: 450 cfm (765 m³/h)
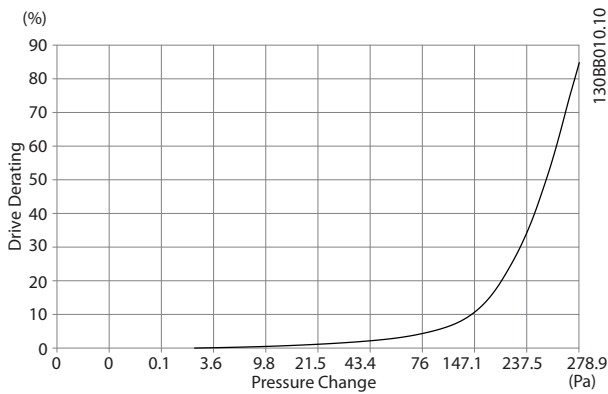
Illustration 4.15 E frame Derating vs. Pressure Change (Small Fan), P315

Drive air flow: 650 cfm (1,105 m³/h)
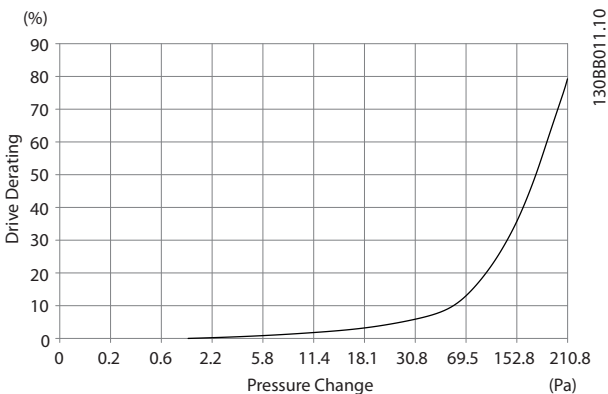
Illustration 4.16 E frame Derating vs. Pressure Change (Large Fan) P355-P450

Drive air flow: 850 cfm (1,445 m³/h)
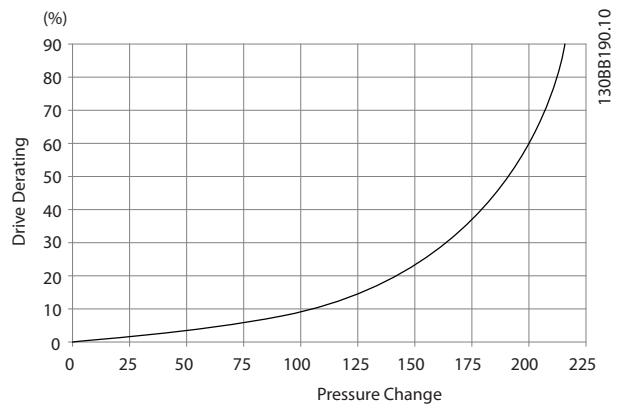
Illustration 4.17 F frame Derating vs. Pressure Change

Drive air flow: 580 cfm (985 m³/h)

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

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

NOTE

The connector plate must be fitted to the adjustable frequency drive to ensure the specified protection degree, as well as ensuring proper cooling of the unit. If the connector plate is not mounted, the adjustable frequency drive may trip on Alarm 69, Pwr. Card Temp
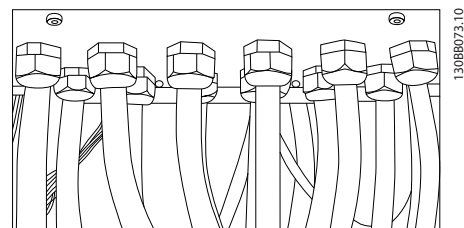
Illustration 4.18 Example of proper installation of the connector plate.

4

600.0
[23.6]

20.0
[.8]

130BC164.10

380.0
[15.0]

560.0
[22.0]

55.9
[2.2]

105.6
[4.2]

187.8
[7.4]

246.0
[9.7]

350.0
[13.8]

181.9
[7.2]

1

350.0
[13.8]

636.9
[25.1]
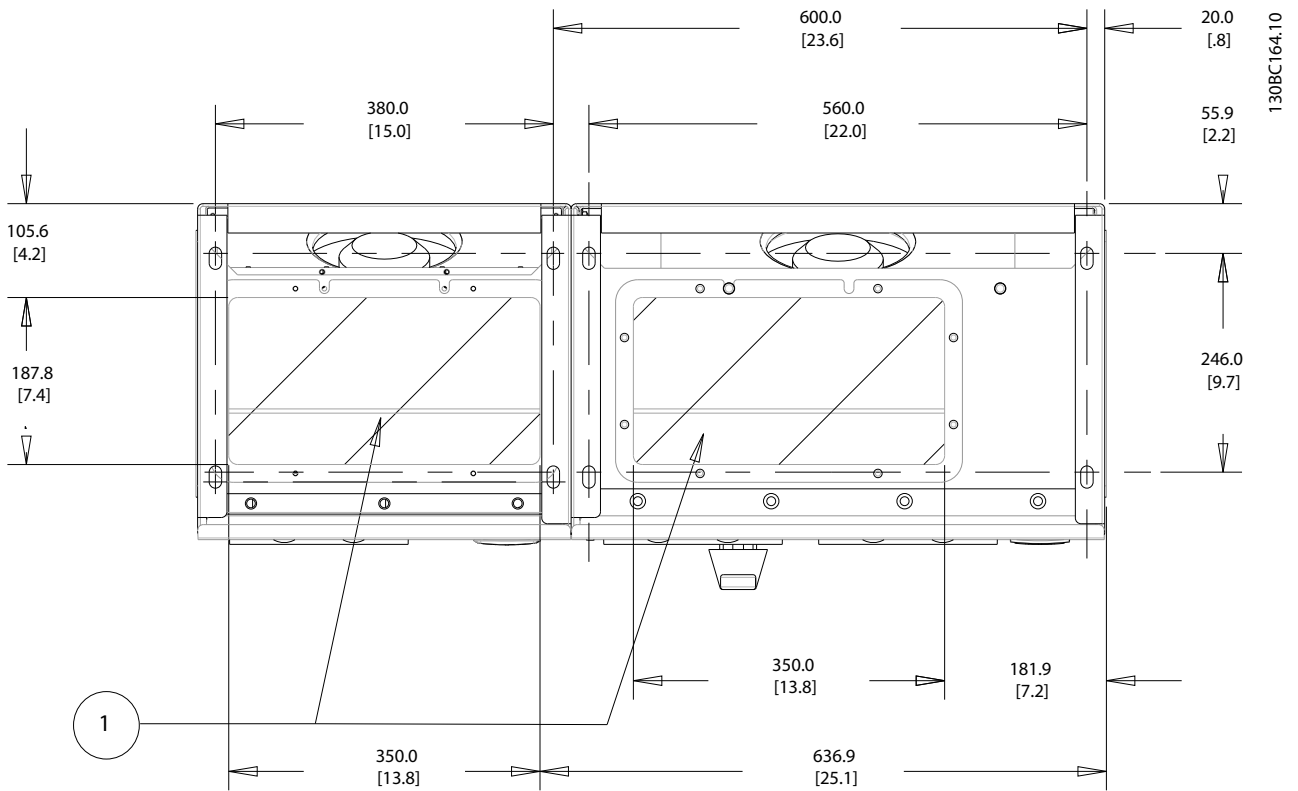
Illustration 4.19 Frame Size D13

560.0
[22.0]

600.0
[23.6]

20.0
[.8]

130BC168.10

560.0
[22.0]

61.4
[2.4]

154.8
[6.1]

257.6
[10.1]

361.7
[14.2]

1

2x520.0
[20.5]

40.0
[1.6]

640.0
[25.2]
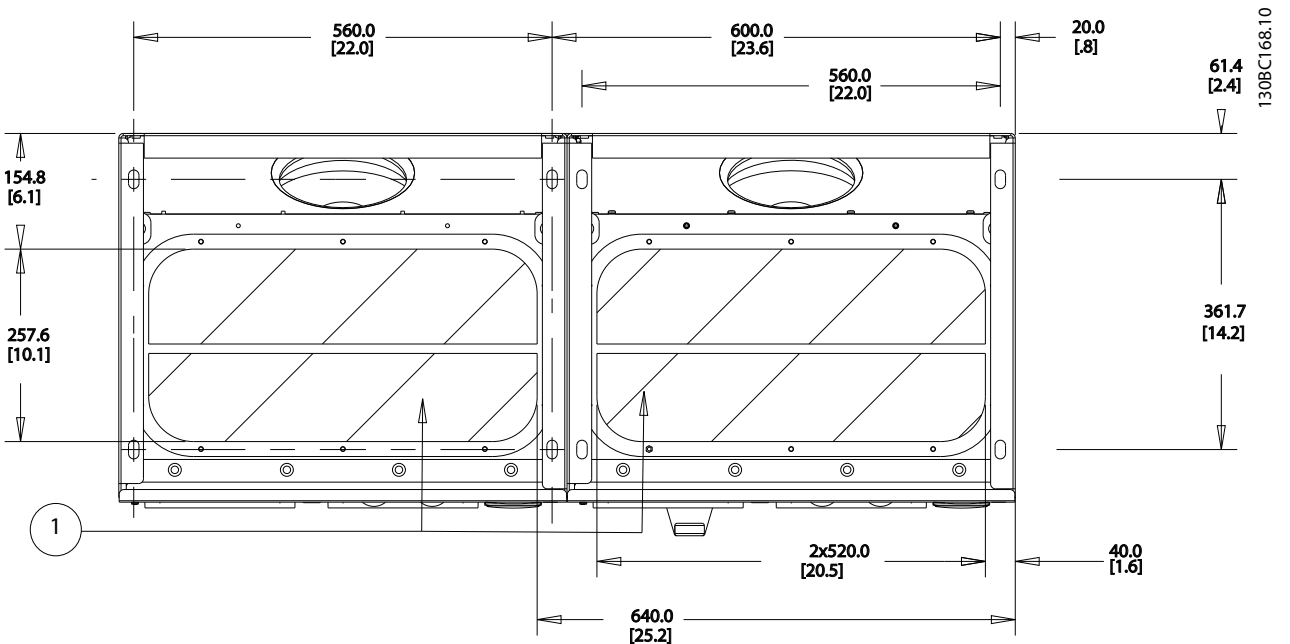
Illustration 4.20 Frame Size E9
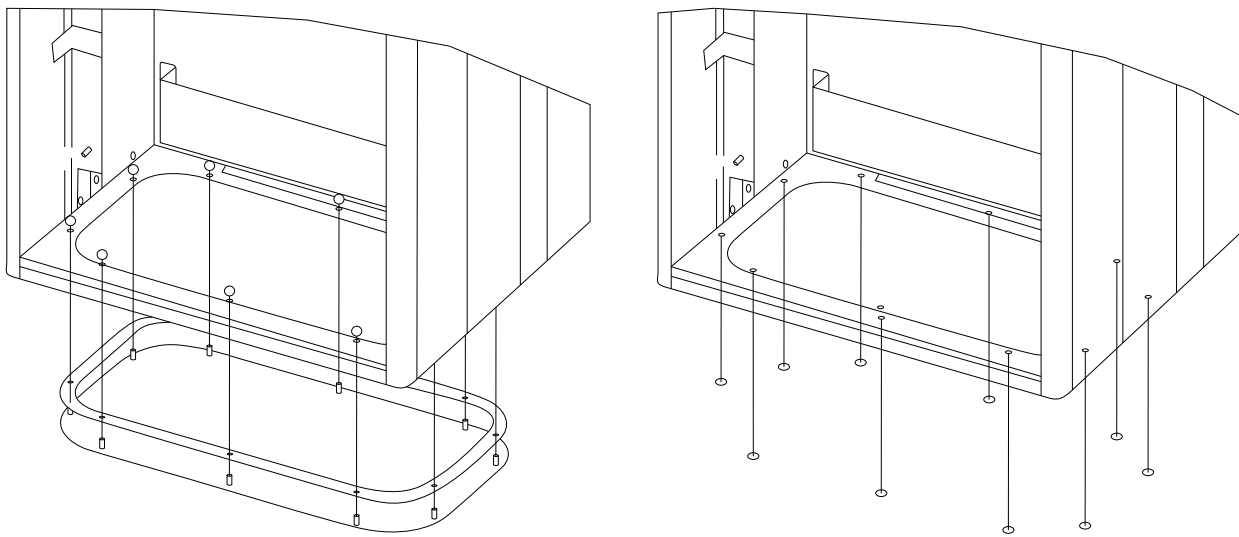
4

Illustration 4.21 Mounting of Bottom Plate, Frame Size E9

The bottom plate of the E frame can be mounted from either inside or outside of the enclosure, allowing flexibility in the installation process, i.e., if mounted from the bottom the connectors and cables can be mounted before the adjustable frequency drive is placed on the pedestal.
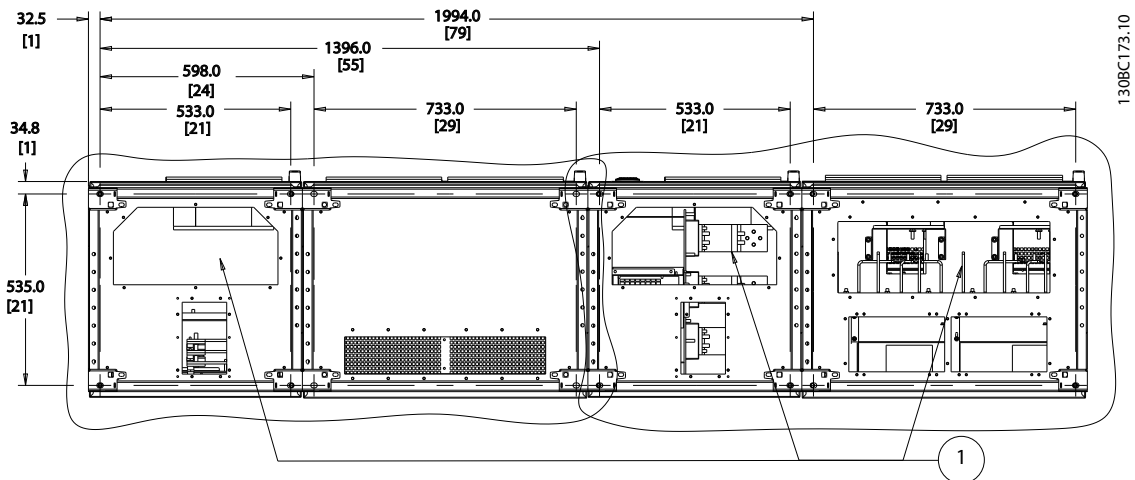
Illustration 4.22

Cable entries viewed from the bottom of the adjustable frequency drive
1) Line cable connection
2) Motor cable connection

4.3.8 IP21 Drip Shield Installation (Frame size D)

To comply with the IP21 rating, a separate drip shield is to be installed as explained below:

- Remove the two front screws.

- Insert the drip shield and replace the screws.

- Torque the screws to 5.6 Nm (50 in-lbs).

NOTE

Drip shield is necessary on both filter and adjustable frequency drive section.
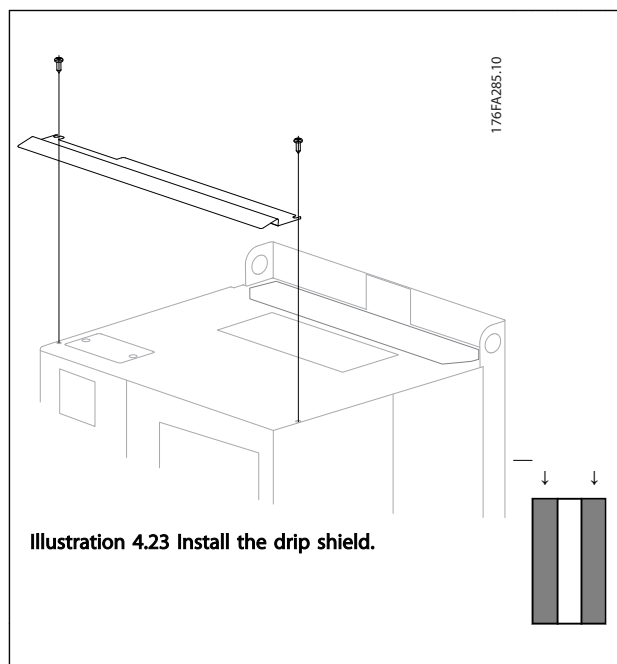
Illustration 4.23 Install the drip shield.

Table 4.11

4.4 Field Installation of Options

4.4.1 Installation of Input Plate Options

This section is for the field installation of input option kits available for adjustable frequency drives in all D and E frames.
Do not attempt to remove RFI filters from input plates. Damage may occur to RFI filters if they are removed from the input plate.

NOTE

Where RFI filters are available, there are two different types of RFI filters depending on the input plate combination and the RFI filters interchangeable. Field installable kits in certain cases are the same for all voltages.

	380–480 V 380–500 V	Fuses	Disconnect Fuses	RFI	RFI Fuses	RFI Disconnect Fuses
D13		176F8443	176F8441	176F8445	176F8449	176F8447
E9	FC 102/ 202: 450 hp [315 kW] FC 302: 350 hp [250 kW]	176F0253	176F0255	176F0257	176F0258	176F0260
	FC 102/ 202: 500–600 hp [355–450 kW] FC 302: 450–550 hp [315–400 kW]	176F0254	176F0256	176F0257	176F0259	176F0262

Table 4.12

NOTE

For further information, please see the Instruction Sheet, *175R5795*

4.4.2 Installation of Line Power Shield for Adjustable Frequency Drives

The line power shield is for installation with D and E frames and satisfy BG-4 requirements.

Ordering numbers:
D frames: 176F0799
E frames: 176F1851

NOTE
For further information, please see the Instruction Sheet, *175R5923*

4.5 Frame Size F Panel Options

Space Heaters and Thermostat
Mounted on the cabinet interior of frame size F adjustable frequency drives, space heaters controlled via automatic thermostat help control humidity inside the enclosure, extending the lifetime of drive components in damp environments. The thermostat default settings turn on the heaters at 10°C (50°F) and turn them off at 15.6°C (60°F).

Cabinet Light with Power Outlet
A light mounted on the cabinet interior of frame size F adjustable frequency drives increases visibility during servicing and maintenance. The housing light includes a power outlet for temporarily powering tools or other devices, available in two voltages:

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

Transformer Tap Set-up
If the Cabinet Light & Outlet and/or the Space Heaters & Thermostat are installed Transformer T1 requires it taps to be set to the proper input voltage. A 380–480/500 V adjustable frequency drive will initially be set to the 525 V tap and a 525–690 V adjustable frequency drive will be set to the 690 V tap to insure no overvoltage of secondary equipment occurs if the tap is not changed prior to power being applied. See *Table 4.13* to set the proper tap at terminal T1 located in the rectifier cabinet. For location in the adjustable frequency drive, see *Illustration 4.14*.

Input Voltage Range	Tap to Select
380–440 V	400 V
441–490 V	460 V

Table 4.13 Tap Setup

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

RCD (Residual Current Device)
Uses the core balance method to monitor ground fault currents in grounded and high-resistance grounded systems (TN and TT systems in IEC terminology). There is a pre-warning (50% of main alarm setpoint) and a main alarm setpoint. Associated with each setpoint is an SPDT alarm relay for external use. Requires an external "window-type" current transformer (supplied and installed by customer).

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

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

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

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

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

Manual Motor Starters
Provide 3-phase power for electric blowers often required for larger motors. Power for the starters is provided from the load side of any supplied contactor, circuit breaker, or disconnect switch. Power is fused before each motor starter, and is off when the incoming power to the adjustable frequency drive is off. Up to two starters are allowed (one if a 30 A, fuse-protected circuit is ordered). Integrated into the adjustable frequency drive's safe-stop circuit.
Unit features include:

4

4

- Operation switch (on/off)

- Short-circuit and overload protection with test function

- Manual reset function

30 Ampere, Fuse-protected Terminals

- 3-phase power matching incoming AC line voltage for powering auxiliary customer equipment

- Not available if two manual motor starters are selected

- Terminals are off when the incoming power to the drive is off

- Power for the fused protected terminals will be provided from the load side of any supplied contactor, circuit breaker, or disconnect switch.

24 V DC Power Supply

- 5 amp, 120 W, 24 V DC

- Protected against output overcurrent, overload, short-circuits and overtemperature

- For powering customer-supplied accessory devices such as sensors, PLC I/O, contactors, temperature probes, LEDs and/or other electronic hardware

- Diagnostics include a dry DC-ok contact, a green DC-ok LED, and a red overload LED

External Temperature Monitoring

Designed for monitoring temperatures of external system components, such as the motor windings and/or bearings. Includes eight universal input modules plus two dedicated thermistor input modules. All ten modules are integrated into the adjustable frequency drive's safe-stop circuit and can be monitored via a serial communication bus network (requires the purchase of a separate module/bus coupler).

Universal inputs (8)
Signal types:
- RTD inputs (including Pt100), 3-wire or 4-wire

- Thermocouple

- Analog current or analog voltage

Additional features:
- One universal output, configurable for analog voltage or analog current

- Two output relays (N.O.)

- Dual-line LC display and LED diagnostics

- Sensor lead wire break, short-circuit, and incorrect polarity detection

- Interface set-up software

Dedicated thermistor inputs (2)
Features:

- Each module is capable of monitoring up to six thermistors in a series

- Fault diagnostics for wire breakage or short-circuits of sensor leads

- ATEX/UL/CSA certification

- A third thermistor input can be provided by the PTC thermistor option card MCB 112, if necessary.

4.6 Electrical Installation

4.6.1 Power Connections

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

The power cable connections are situated as shown below. Dimensioning of cable cross-section must be done in accordance with the current ratings and local legislation. See *8.1.1 Cable Lengths and Cross-sections:* for details.

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

The AC line input connection is fitted to the line power switch if this is included.
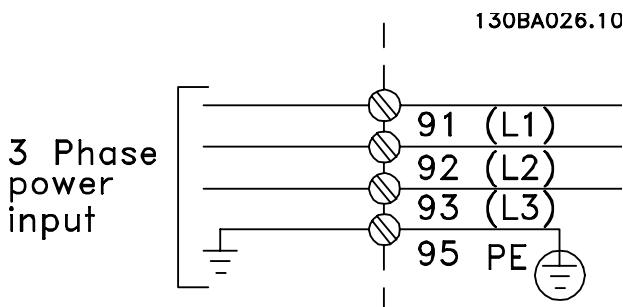
Illustration 4.23

NOTE

To comply with EMC emission specifications, shielded/armored cables are recommended. If a non-shielded/unarmored cable is used, see _4.6.13 Power and Control Wiring for Non-shielded Cables_.

See _8 General Specifications_ for correct dimensioning of motor cable cross-section and length.

Shielding of cables:

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

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

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

Cable-length and cross-section:

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

Switching frequency:

When adjustable frequency drives are used together with sine-wave filters to reduce the acoustic noise from a motor, the switching frequency must be set according to the instructions in _14-01 Switching Frequency_.

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

Table 4.14

[1]Protected Ground Connection

NOTE

In motors without phase insulation paper or other insulation reinforcement suitable for operation with voltage supply (such as an adjustable frequency drive), fit a sine-wave filter on the output of the adjustable frequency drive.
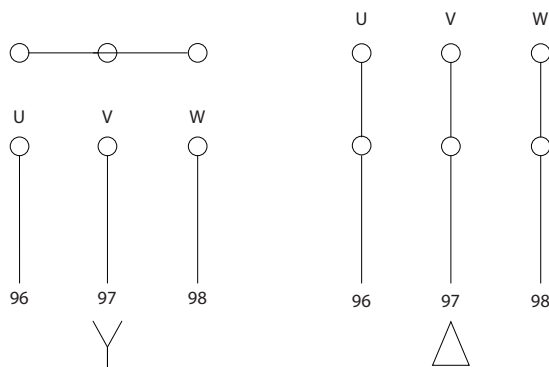
Illustration 4.24

4
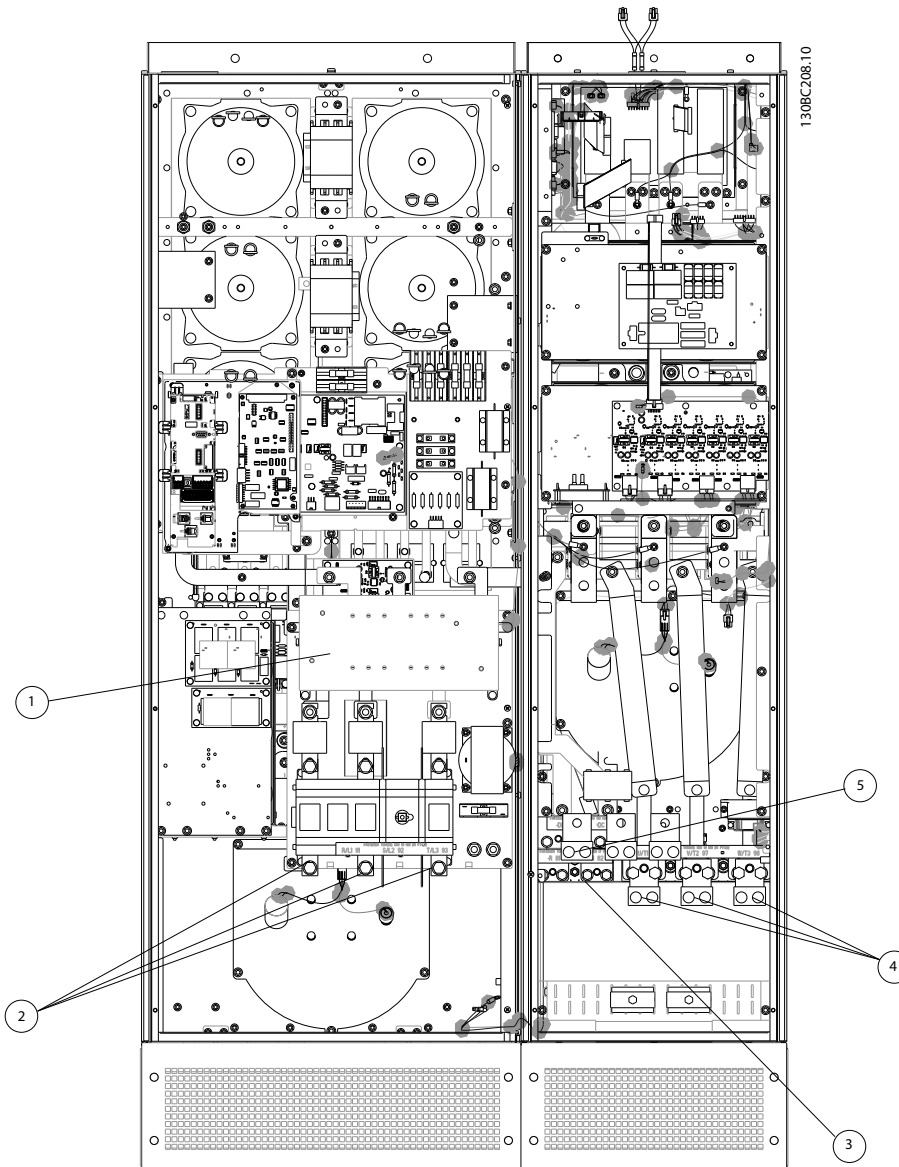
Illustration 4.25 Frame size D13

1)	RFI			4)	Motor			
2)	Line				U	V	W	
	R	S	T		96	97	98	
	L1	L2	L3		T1	T2	T3	
3)	Brake option			5)	Load sharing option			
	-R	+R			-DC	+DC		
	81	82			88	89		
				6)	AUX Fan			
					100	101	102	103
					L1	L2	L1	L2

Table 4.15
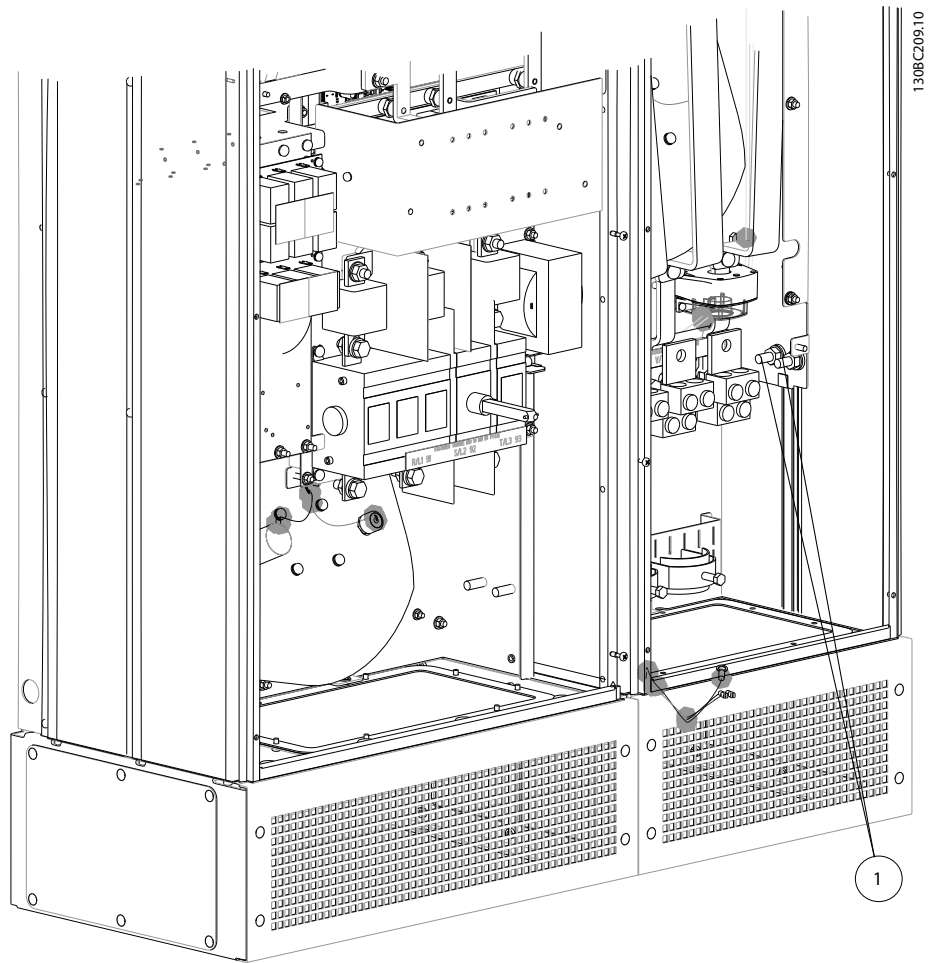
4

Illustration 4.26 Position of Ground Terminals

1	Ground

Table 4.16
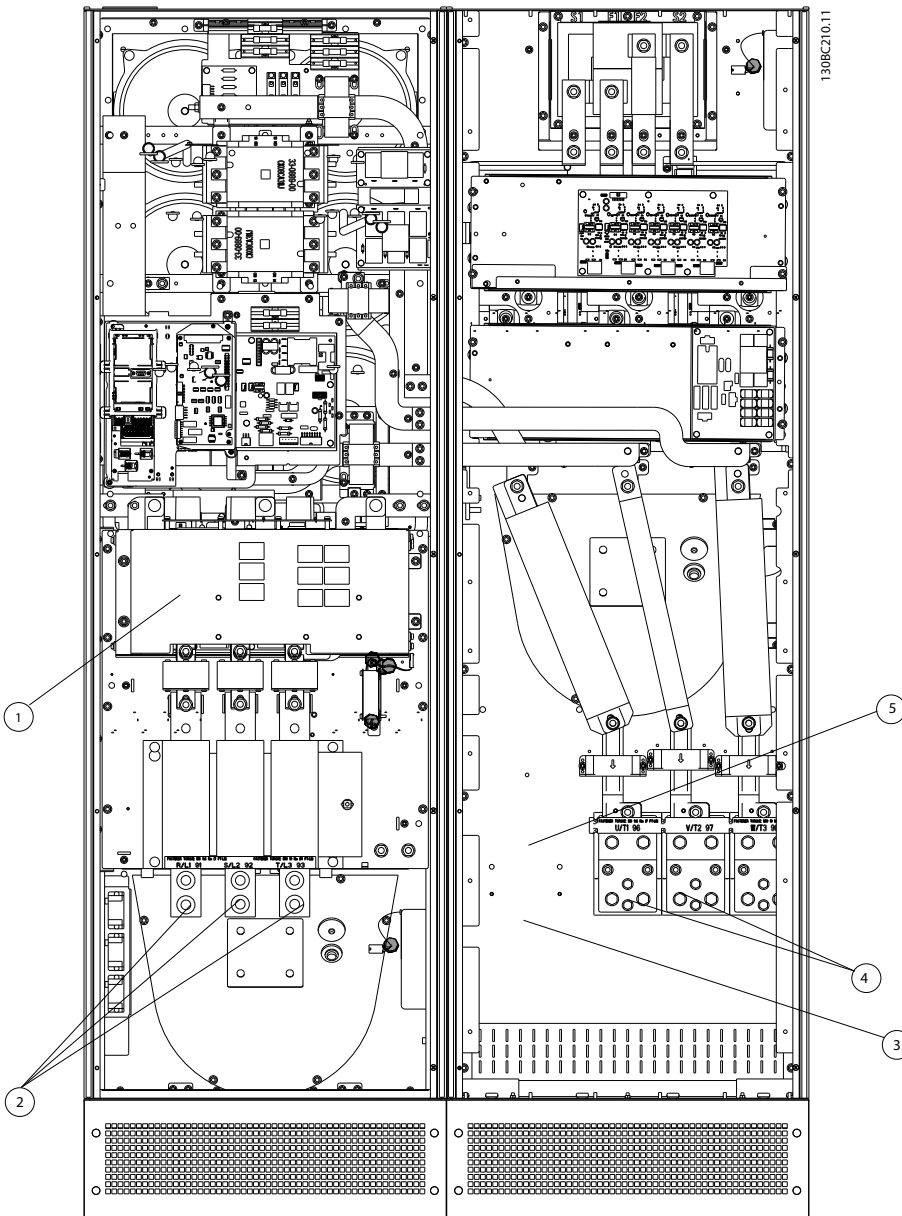
Illustration 4.27 Frame Size E9

1)	RFI			4)	Motor			
2)	Line				U	V	W	
	R	S	T		96	97	98	
	L1	L2	L3		T1	T2	T3	
3)	Brake option			5)	Load sharing option			
	-R	+R			-DC	+DC		
	81	82			88	89		
				6)	AUX Fan			
					100	101	102	103
					L1	L2	L1	L2

Table 4.17

4

130BC211.10
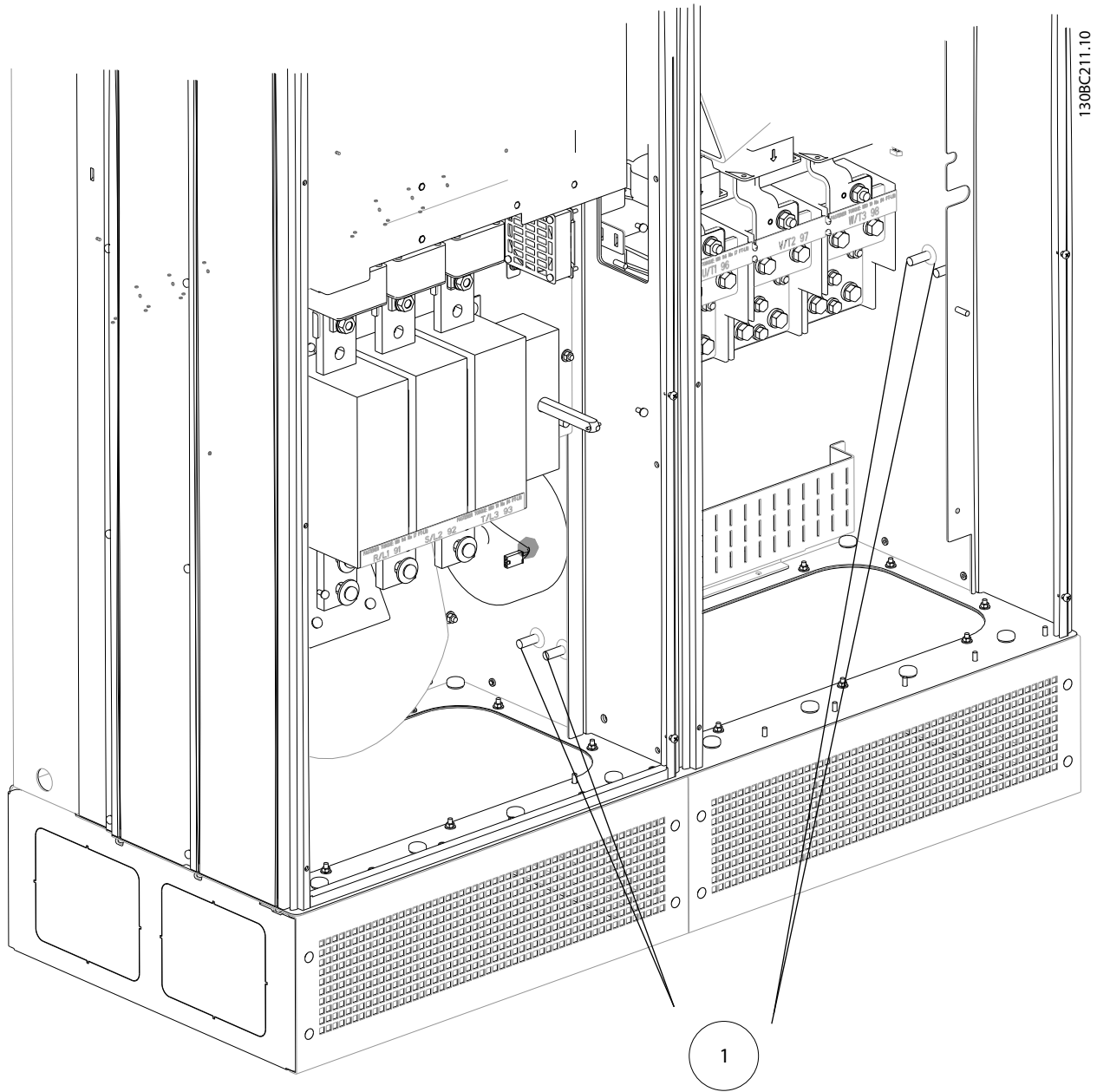
Illustration 4.28 Position of Ground Terminals

1	Ground

Table 4.18

4

Illustration 4.29 Active Filter, frame size F18

Sections shown
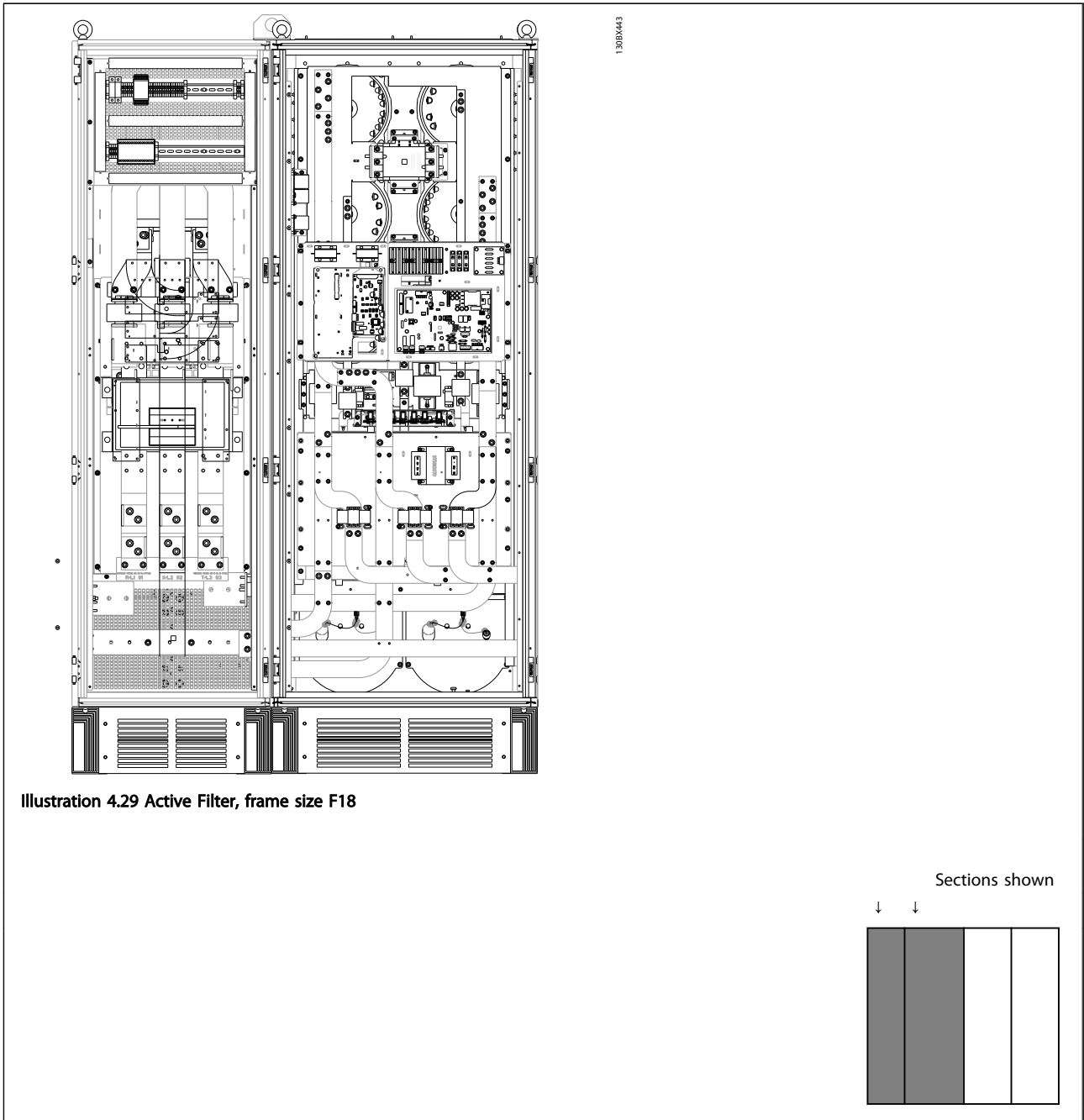
Table 4.19

1)	Line
	R S T
	L1 L2 L3
2)	Bus bars to rectifier section of drive
3)	Fuse block

Table 4.20
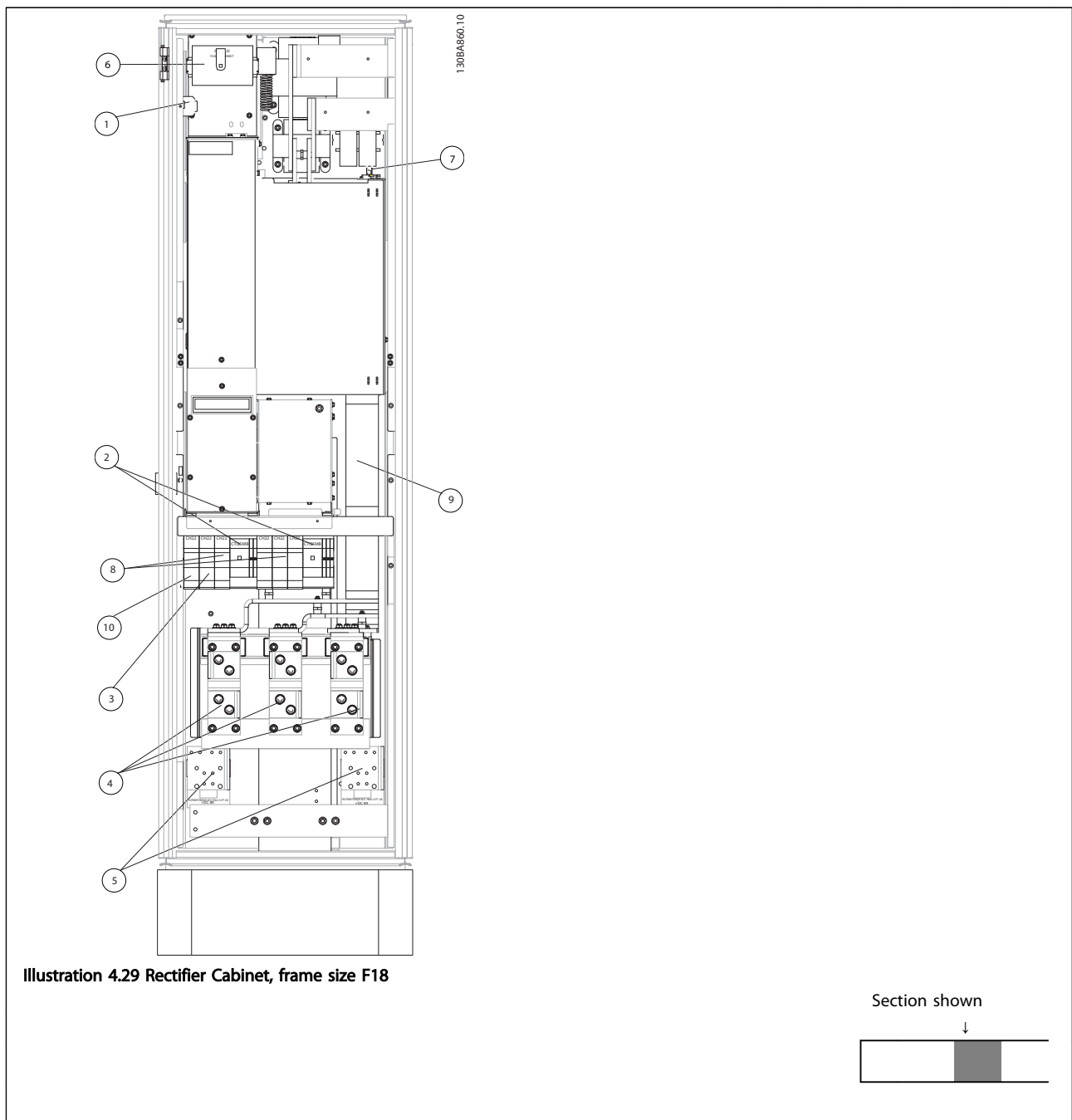
Illustration 4.29 Rectifier Cabinet, frame size F18

Section shown

↓
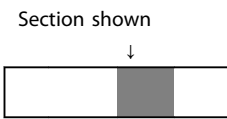
Table 4.21

1)	24 V DC, 5 A		5)	Load sharing
	T1 Output Taps			-DC +DC
	Temp Switch			88 89
	106 104 105	6)		Control Transformer Fuses (2 or 4 pieces). See *4.6.14 Fuses* for part numbers
2)	Manual Motor Starters		7)	SMPS Fuse. See *4.6.14 Fuses* for part numbers
3)	30 A Fuse Protected Power Terminals		8)	Manual Motor Controller fuses (3 or 6 pieces). See *4.6.14 Fuses* for part numbers
4)	Connection point to filter		9)	Line Fuses, F1 and F2 frame (3 pieces). See *4.6.14 Fuses* for part numbers
	R S T		10)	30 Amp Fuse Protected Power fuses
	L1 L2 L3			

Table 4.22
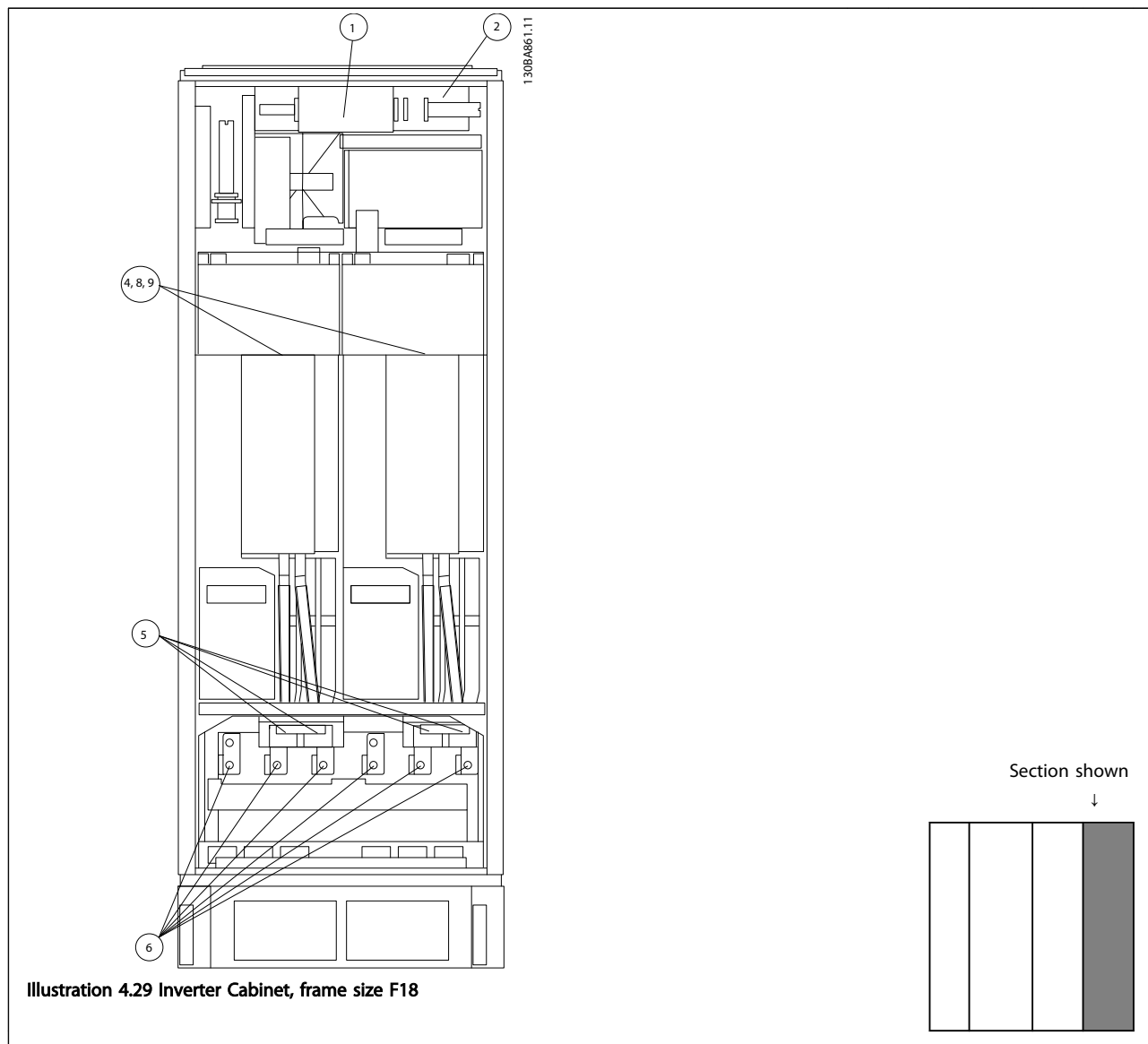
Illustration 4.29 Inverter Cabinet, frame size F18

Section shown
↓

Table 4.23

1)	External Temperature Monitoring			6)	Motor		
2)	AUX Relay				U	V	W
	01	02	03		96	97	98
	04	05	06		T1	T2	T3
3)	NAMUR			7)	NAMUR Fuse. See *4.6.14 Fuses* for part numbers		
4)	AUX Fan			8)	Fan Fuses. See *4.6.14 Fuses* for part numbers		
	100 101 102 103			9)	SMPS Fuses. See *4.6.14 Fuses* for part numbers		
	L1 L2 L1 L2						
5)	Brake						
	-R +R						
	81 82						

Table 4.24

4.6.2 Grounding

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

- Safety grounding: The adjustable frequency drive has a high leakage current and must be grounded appropriately for safety reasons. Always follow local safety regulations.

- High-frequency grounding: Keep the ground wire connections as short as possible.

Connect the different ground systems at the lowest possible conductor impedance. The lowest possible conductor impedance is obtained by keeping the conductor as short as possible and by using the greatest possible surface area.

The metal cabinets of the different devices are mounted on the cabinet rear plate using the lowest possible HF impedance. This prevents having different HF voltages for the individual devices and prevents the risk of radio interference currents running in connection cables that may be used between the devices, as radio interference is reduced.

In order to obtain a low HF impedance, use the fastening bolts of the devices as HF connections to the rear plate. It is necessary to remove insulating paint and the like from the fastening points.

4.6.3 Extra Protection (RCD)

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

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

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

See also the section *Special Conditions* in *VLT® AutomationDrive Design Guide, MG33BXYY*.

4.6.4 RFI Switch

Line power supply isolated from ground
If the adjustable frequency drive is supplied from an isolated line power source (IT line power, floating delta and grounded delta) or TT/TN-S line power with grounded leg, the RFI switch is recommended to be turned off (OFF) [1] via *14-50 RFI Filter* on the adjustable frequency drive and *14-50 RFI Filter* on the filter. For further reference, see IEC 364-3. In case optimum EMC performance is needed,

parallel motors are connected or the motor cable length is above 80 ft [25 m], it is recommended to set *14-50 RFI Filter* to [ON].
[1] Not available for 525–600/690 V adjustable frequency drives in frame sizes D, E and F.
In OFF, the internal RFI capacities (filter capacitors) between the chassis and the intermediate circuit are cut off to avoid damage to the intermediate circuit and to reduce the ground capacity currents (according to IEC 61800-3).
Also refer to the application note *VLT on IT line power, MN. 90.CX.02*. It is important to use isolation monitors that are capable for use together with power electronics (IEC 61557-8).

4.6.5 Torque

When tightening all electrical connections, it is very important to tighten with the correct torque. Too low or too high torque results in a bad electrical connection. Use a torque wrench to ensure correct torque.
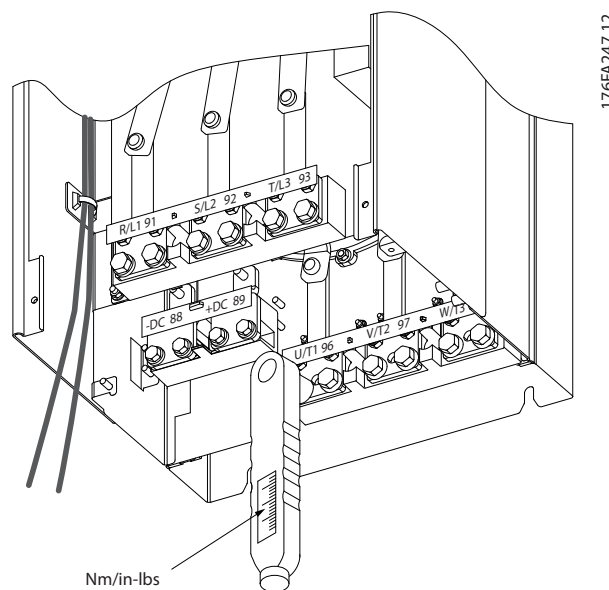
Illustration 4.29 Always use a torque wrench to tighten the bolts.

Frame size	Terminal	Torque	Bolt size
D	Line power Motor	19–40 Nm (168–354 in-lbs)	M10
	Load sharing Brake	8.5–20.5 Nm (75–181 in-lbs)	M8
E	Line power Motor Load sharing	19–40 Nm (168–354 in-lbs)	M10
	Brake	8.5–20.5 Nm (75–181 in-lbs)	M8
F	Line power Motor	19–40 Nm (168–354 in-lbs)	M10
	Load sharing Brake Regen	19–40 Nm (168–354 in-lbs) 8.5–20.5 Nm (75–181 in-lbs) 8.5–20.5 Nm (75–181 in-lbs)	M10 M8 M8

Table 4.25 Torque for terminals

4.6.6 Shielded Cables

NOTE

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

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

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

- EMC cable connectors: generally available cable connectors can be used to ensure an optimum EMC connection.

- EMC cable clamp: Clamps allowing for easy connection are supplied with the adjustable frequency drive.

4.6.7 Motor Cable

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

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

Table 4.26

- Terminal U/T1/96 connected to U-phase

- Terminal V/T2/97 connected to V-phase

- Terminal W/T3/98 connected to W-phase
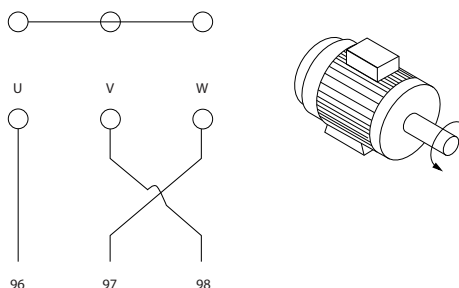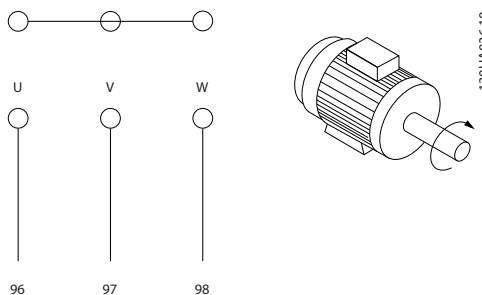
Illustration 4.30

NOTE

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

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

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

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

NOTE

If a retrofit application requires unequal amount of wires per phase, please consult the factory for requirements and documentation or use the top/bottom entry side cabinet option, instruction 177R0097.

4.6.8 Brake Cable Drives with Factory Installed Brake Chopper Option

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

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

Terminal No.	Function
81, 82	Brake resistor terminals

Table 4.27

The connection cable to the brake resistor must be shielded. Connect the shield by means of cable clamps to the conductive backplate at the adjustable frequency drive and to the metal cabinet of the brake resistor.
Size the brake cable cross-section to match the brake torque. See also *Brake Instructions, MI90FXYY* and *MI50SXYY* for further information regarding safe installation.

⚠WARNING

Note that voltages up to 790 V DC, depending on the supply voltage, may occur on the terminals.

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

4.6.9 Brake Resistor Temperature Switch

Frame size D-E-F
Torque: 0.5–0.6 Nm (5 in-lbs)
Screw size: M3

This input can be used to monitor the temperature of an externally connected brake resistor. If the connection between 104 and 106 is removed, the adjustable frequency drive will trip on warning/alarm 27, "Brake IGBT".
A KLIXON switch must be installed that is `normally closed' in series with the existing connection on either 106 or 104. Any connection to this terminal must be double insulated to high voltage to maintain PELV.
Normally closed: 104-106 (factory installed jumper).

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

Table 4.28

⚠CAUTION

If the temperature of the brake resistor gets too high and the thermal switch drops out, the adjustable frequency drive will stop braking. The motor will start coasting.
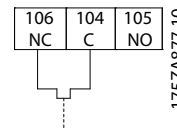
Illustration 4.31

4.6.10 Load Sharing

Terminal No.	Function
88, 89	Load sharing

Table 4.29

The connection cable must be shielded and the max. length from the adjustable frequency drive to the DC bar is limited to 80 ft [25 m].
Load sharing enables the linking of the DC intermediate circuits of several adjustable frequency drives.

⚠WARNING

Please note that voltages up to 1099 V DC may occur on the terminals.
Load sharing calls for extra equipment and safety consider-ations. For further information, see load sharing Instructions MI50NXYY.

⚠WARNING

Please note that a line power disconnect may not isolate the adjustable frequency drive due to DC link connection

4.6.11 AC line input connections

Line power must be connected to terminals 91, 92 and 93 located on the far left of the unit. Ground is connected to the terminal to the right of terminal 93.

Terminal No.	Function
91, 92, 93	Line power R/L1, S/L2, T/L3
94	Ground

Table 4.30

4

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

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

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

4.6.12 External Fan Supply

Frame size D, E, and F
If the adjustable frequency drive is supplied by DC or if the fan must run independently of the power supply, an external power supply can be applied. The connection is made on the power card.

Terminal No.	Function
100, 101	Auxiliary supply S, T
102, 103	Internal supply S, T

Table 4.31

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

4.6.13 Power and Control Wiring for Non-shielded Cables

⚠WARNING
Induced Voltage!
Run motor cables from multiple adjustable frequency drives separately. Induced voltage from output motor cables run together can charge equipment capacitors even with the equipment turned off and locked out. Failure to run output cables separately could result in death or serious injury.

⚠CAUTION
Run drive input power, motor wiring, and control wiring in three separate metallic conduits or raceways for high frequency noise isolation. Failure to isolate power, motor, and control wiring could result in less than optimum controller and associated equipment performance.

Because the power wiring carries high frequency electrical pulses, it is important that input power and motor power are run in separate conduit. If the incoming power wiring is run in the same conduit as the motor wiring, these pulses can couple electrical noise back onto the building power grid. Control wiring should always be isolated from the high voltage power wiring.
When shielded/armored cable is not used, at least three separate conduits must be connected to the panel option (see figure below).

- Power wiring into the enclosure
- Power wiring from the enclosure to the motor
- Control wiring

4.6.14 Fuses

It is recommended to use fuses and/ or circuit breakers on the supply side as protection in case of component break-down inside the adjustable frequency drive (first fault).

NOTE
This is mandatory in order to ensure compliance with IEC 60364 for CE or NEC 2009 for UL.

⚠WARNING
Personnel and property must be protected against the consequence of component breakdown internally in the adjustable frequency drive.

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 protected against short-circuit and overcurrent according to national/international regulations.

NOTE
The recommendations given do not cover branch circuit protection for UL.

Short-circuit protection:
Danfoss recommends using the fuses/circuit breakers mentioned below to protect service personnel and property in case of component breakdown in the adjustable frequency drive.

Non UL compliance

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

P132 - P200	380–480 V	type gG
P250 - P400	380–480 V	type gR

Table 4.32

UL Compliance

380–480 V, frame sizes D, E and F

The fuses below are suitable for use on a circuit capable of delivering 100,000 Arms (symmetrical), 240 V, or 480 V, or 500 V, or 600 V depending on the adjustable frequency drive voltage rating. With the proper fusing, the adjustable frequency drive Short-Circuit Current Rating (SCCR) is 100,000 Arms.

Size/Type	Bussmann E1958 JFHR2**	Bussmann E4273 T/JDDZ**	SIBA E180276 JFHR2	LittelFuse E71611 JFHR2**	Ferraz-Shawmut E60314 JFHR2**	Bussmann E4274 H/JDDZ**	Bussmann E125085 JFHR2*	Internal Option Bussmann
P132	FWH-400	JJS-400	2061032.40	L50S-400	A50-P400	NOS-400	170M4012	170M4016
P160	FWH-500	JJS-500	2061032.50	L50S-500	A50-P500	NOS-500	170M4014	170M4016
P200	FWH-600	JJS-600	2062032.63	L50S-600	A50-P600	NOS-600	170M4016	170M4016

Table 4.33 Frame size D, Line fuses, 380–480 V

Size/Type	Bussmann PN*	Rating	Ferraz	Siba
P250	170M4017	700 A, 700 V	6.9URD31D08A0700	20 610 32.700
P315	170M6013	900 A, 700 V	6.9URD33D08A0900	20 630 32.900
P355	170M6013	900 A, 700 V	6.9URD33D08A0900	20 630 32.900
P400	170M6013	900 A, 700 V	6.9URD33D08A0900	20 630 32.900

Table 4.34 Frame size E, Line fuses, 380–480 V

Size/Type	Bussmann PN*	Rating	Siba	Internal Bussmann Option
P450	170M7081	1600 A, 700 V	20 695 32.1600	170M7082
P500	170M7081	1600 A, 700 V	20 695 32.1600	170M7082
P560	170M7082	2000 A, 700 V	20 695 32.2000	170M7082
P630	170M7082	2000 A, 700 V	20 695 32.2000	170M7082

Table 4.35 Frame size F, Line fuses, 380–480 V

4

Size/Type	Bussmann PN*	Rating	Siba
P450	170M8611	1100 A, 1000 V	20 781 32.1000
P500	170M8611	1100 A, 1000 V	20 781 32.1000
P560	170M6467	1400 A, 700 V	20 681 32.1400
P630	170M6467	1400 A, 700 V	20 681 32.1400

Table 4.36 Frame size F, Inverter module DC Link Fuses, 380–480 V

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

**Any minimum 500 V UL-listed fuse with associated current rating may be used to meet UL requirements.

Supplementary fuses

Frame size	Bussmann PN*	Rating
D, E and F	KTK-4	4 A, 600 V

Table 4.37 SMPS Fuse

Size/Type	Bussmann PN*	LittelFuse	Rating
P132-P250, 380–480 V	KTK-4		4 A, 600 V
P315-P630, 380–480 V		KLK-15	15A, 600 V

Table 4.38 Fan Fuses

Size/Type		Bussmann PN*	Rating	Alternative Fuses
P450-P630, 380–480 V	2.5–4.0 A	LPJ-6 SP or SPI	6 A, 600 V	Any listed Class J Dual Element, Time Delay, 6 A
P450-P630, 380–480 V	4.0–6.3 A	LPJ-10 SP or SPI	10 A, 600 V	Any listed Class J Dual Element, Time Delay, 10 A
P450-P630, 380–480 V	6.3–10 A	LPJ-15 SP or SPI	15 A, 600 V	Any listed Class J Dual Element, Time Delay, 15 A
P450-P630, 380–480 V	10–16 A	LPJ-25 SP or SPI	25 A, 600 V	Any listed Class J Dual Element, Time Delay, 25 A

Table 4.39 Manual Motor Controller Fuses

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

Table 4.40 30 A Fuse Protected Terminal Fuse

Frame size	Bussmann PN*	Rating	Alternative Fuses
D	LP-CC-8/10	0.8A, 600V	Any listed Class CC, 0.8A
E	LP-CC-1 1/2	1.5A, 600V	Any listed Class CC, 1.5A
F	LPJ-6 SP or SPI	6 A, 600 V	Any listed Class J Dual Element, Time Delay, 6 A

Table 4.41 Control Transformer Fuse

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

Table 4.42 NAMUR Fuse

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

Table 4.43 Safety Relay Coil Fuse with PILS Relay

4.6.15 Line Power Disconnectors - Frame Size D, E and F

Frame size	Power & Voltage	Type
D	P132-P200 380–480 V	OT400U12-91
E	P250 380–480 V	ABB OETL-NF600A
E	P315-P400 380–480 V	ABB OETL-NF800A
F	P450 380–480 V	Merlin Gerin NPJF36000S12AAYP
F	P500-P630 380–480 V	Merlin Gerin NRK36000S20AAYP

Table 4.44

4.6.16 F Frame circuit breakers

Frame size	Power & Voltage	Type
F	P450 380–480 V	Merlin Gerin NPJF36120U31AABSCYP
F	P500-P630 380–480 V	Merlin Gerin NRJF36200U31AABSCYP

Table 4.45

4.6.17 F Frame Line Power Contactors

Frame size	Power & Voltage	Type
F	P450-P500 380–480 V	Eaton XTCE650N22A
F	P560-P630 380–480 V	Eaton XTCEC14P22B

Table 4.46

4.6.18 Motor Insulation

For motor cable lengths ≤, the maximum cable length listed in *8 General Specifications* the following motor insulation ratings are recommended because the peak voltage can be up to twice the DC link voltage, 2.8 times the AC line voltage, due to transmission line effects in the motor cable. If a motor has lower insulation rating, it is recommended to use a dU/dt or sine-wave filter.

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

Table 4.47

4.6.19 Motor Bearing Currents

It is recommended that motors of a rating 150 hp [110 kW] or higher operating via adjustable frequency drives should have NDE (Non-Drive End) insulated bearings installed to eliminate circulating bearing currents due to the physical size of the motor. To minimize DE (Drive End) bearing and shaft currents proper grounding of the adjustable frequency drive, motor, driven machine, and motor to the driven machine is required. Although failure due to bearing currents is low and dependent on many

different items, for security of operation the following are mitigation strategies which can be implemented.

Standard Mitigation Strategies:

1. Use an insulated bearing

2. Apply rigorous installation procedures

    Ensure the motor and load motor are aligned

    Strictly follow the EMC Installation guideline

    Reinforce the PE so the high frequency impedance is lower in the PE than the input power leads.

    Provide a good high frequency connection between the motor and the adjustable frequency drive for instance by shielded cable which has a 360° connection in the motor and the adjustable frequency drive

    Make sure that the impedance from adjustable frequency drive to building ground is lower that the grounding impedance of the machine. This can be difficult for pumps- Make a direct ground connection between the motor and load motor.

3. Apply conductive lubrication

4. Try to ensure that the line voltage is balanced to ground. This can be difficult for IT, TT, TN-CS or Grounded leg systems

5.   Use an insulated bearing as recommended by the motor manufacturer (note: Motors from reputable manufacturers will typically have these fitted as standard in motors of this size)

If found to be necessary and after consultation with Danfoss:

6.   Lower the IGBT switching frequency

7.   Modify the inverter waveform, 60° AVM vs. SFAVM

8.   Install a shaft grounding system or use an isolating coupling between motor and load

9.   Use minimum speed settings, if possible.

10. Use a dU/dt or sinus filter

4.6.20 Control Cable Routing

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

Serial communication bus connection
Connections are made to the relevant options on the control card. For details, see the relevant serial communication bus instructions. The cable must be placed in the provided path inside the adjustable frequency drive and tied down together with other control wires (see *Illustration 4.32* and *Illustration 4.33*).
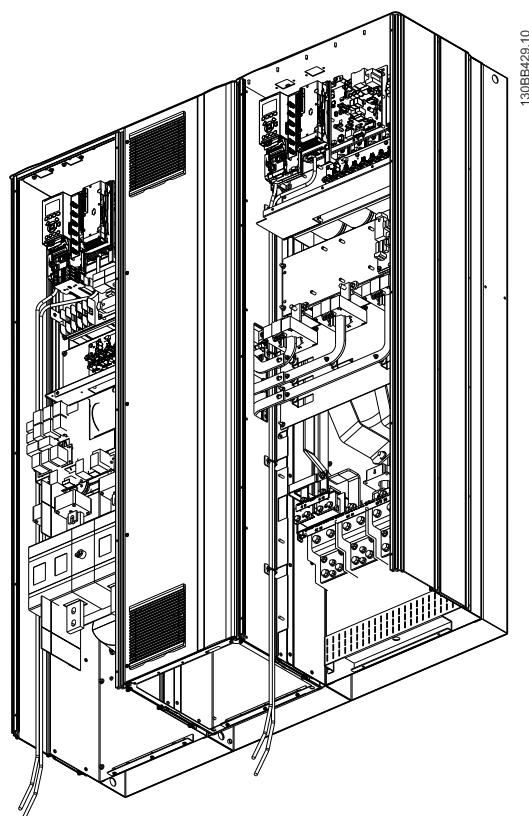
Illustration 4.33 Control card wiring path for the E9
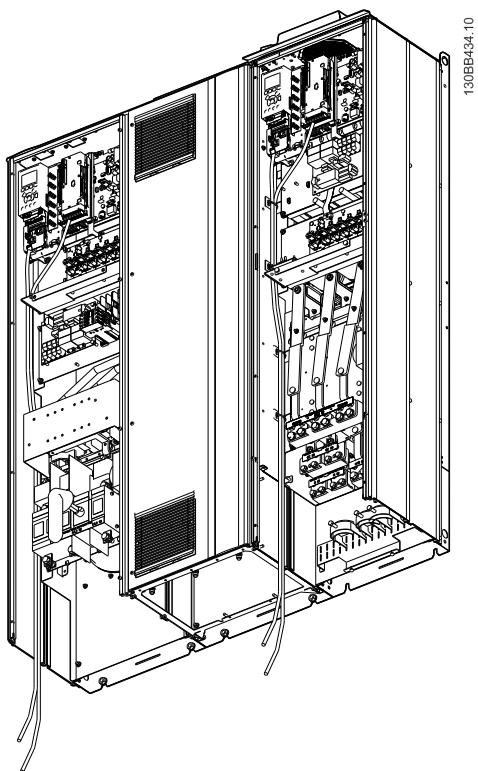
Illustration 4.32 Control card wiring path for the D13

4.6.21 Access to Control Terminals

All terminals to the control cables are located beneath the LCP (both filter and adjustable frequency drive LCP). They are accessed by opening the door of the unit.

4.6.22 Electrical Installation, Control Terminals

To connect the cable to the terminal:

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

9 - 10 mm
(0.37 in)
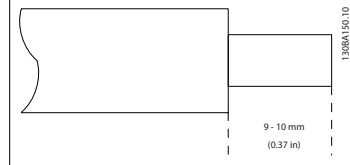
2.   Insert a screwdriver[1] in the square hole.

3.   Insert the cable in the adjacent circular hole.
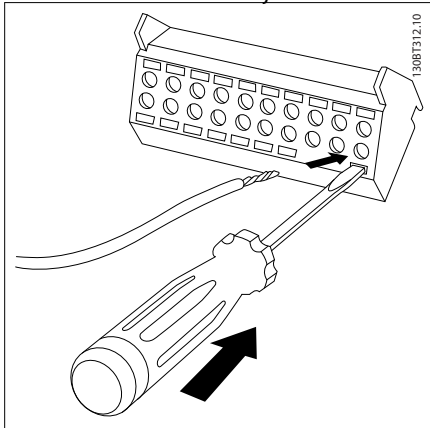
4.   Remove the screwdriver. The cable is now mounted in the terminal.

To remove the cable from the terminal:

1.   Insert a screw driver[1] in the square hole.

2.   Pull out the cable.
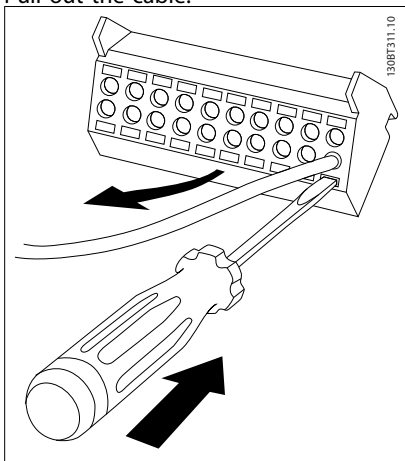
[1] Max. 0.015 x 0.1 in [0.4 x 2.5 mm]
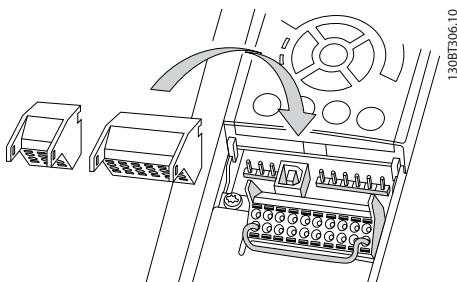
Illustration 4.34

4.7   Connection Examples for Control of Motor with External Signal Provider

NOTE

The following examples refer only to the adjustable frequency drive control card (right LCP), *not* the filter.

4.7.1   Start/Stop

Terminal 18 = *5-10 Terminal 18 Digital Input* [8] *Start*
Terminal 27 = *5-12 Terminal 27 Digital Input* [0] *No operation* (Default *coast inverse*)
Terminal 37 = Safe stop
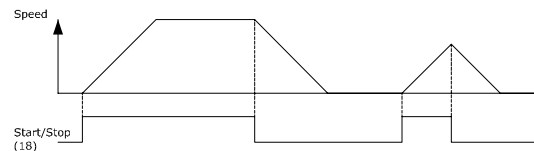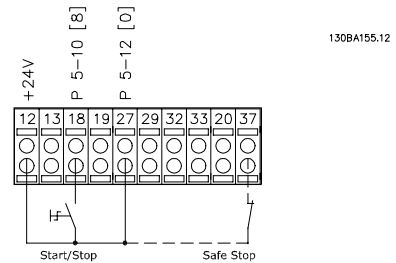
Illustration 4.35

4.7.2   Pulse Start/Stop

Terminal 18 = *5-10 Terminal 18 Digital Input* [9] *Latched start*
Terminal 27= *5-12 Terminal 27 Digital Input* [6] *Stop inverse*
Terminal 37 = Safe stop
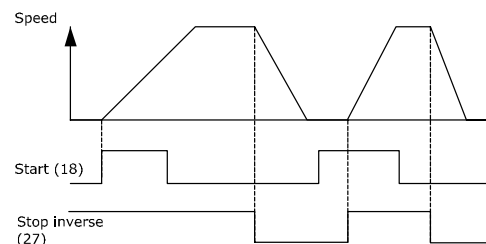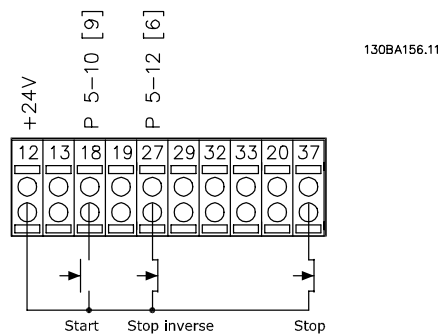
Illustration 4.36

4.7.3 Speed Up/Down

Terminals 29/32 = Speed up/down

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

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

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

Terminal 32 = *5-14 Terminal 32 Digital Input* Slow [22]
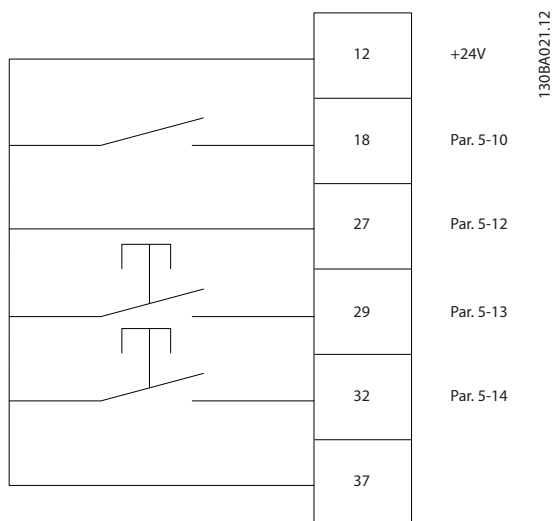
Illustration 4.37

4.7.4 Potentiometer Reference

Voltage reference via a potentiometer

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

Terminal 53, Low Voltage = 0V

Terminal 53, High Voltage = 10V

Terminal 53, Low Ref./Feedback = 0 RPM

Terminal 53, High Ref./Feedback = 1500 RPM

Switch S201 = OFF (U)
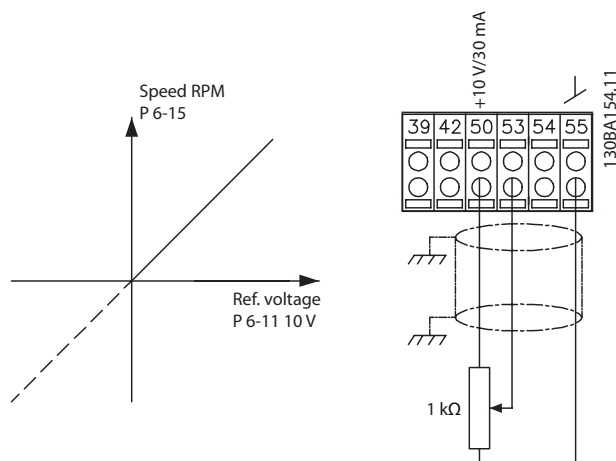
Illustration 4.38

4.8 Electrical Installation - Additional

4.8.1 Electrical Installation, Control Cables
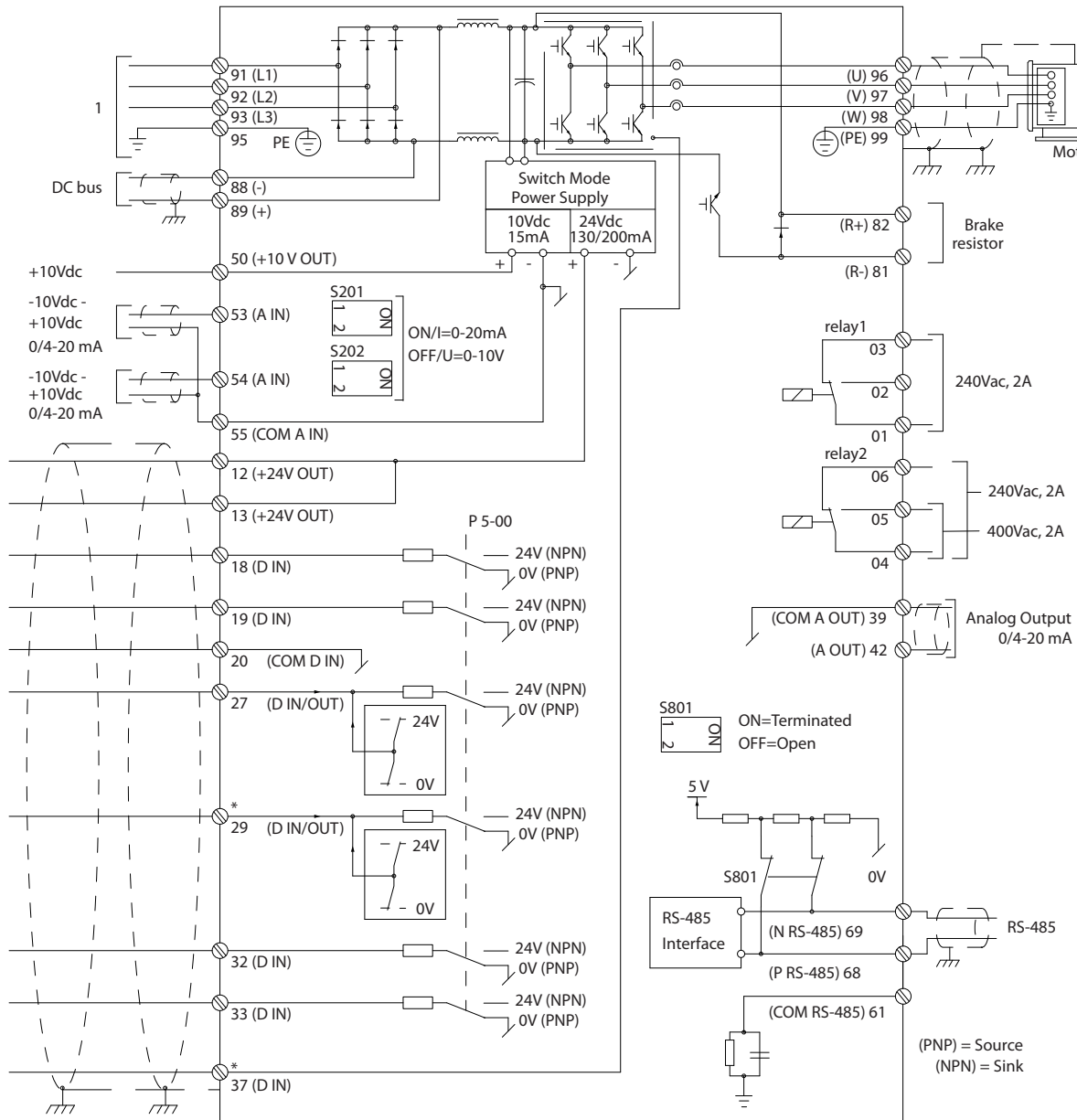
Illustration 4.39 Diagram showing all electrical terminals without options.
1: Connection to filter
Terminal 37 is the input to be used for Safe Stop. For instructions on safe stop installation, refer to the section *Safe Stop Installation* in the adjustable frequency drive Design Guide. See also sections Safe Stop and Safe Stop Installation.

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

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

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

Input polarity of control terminals
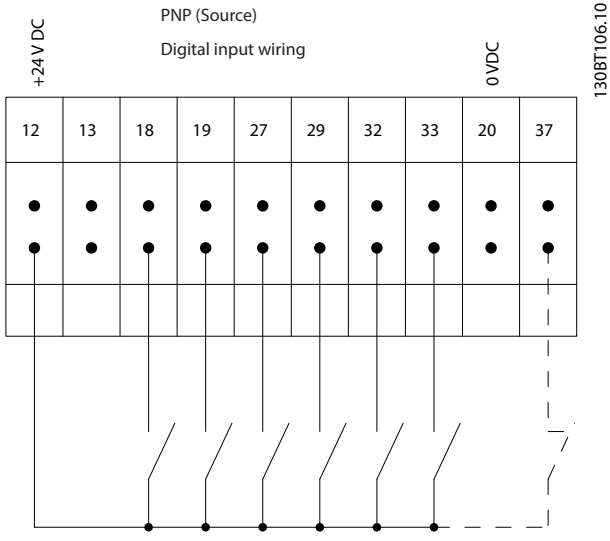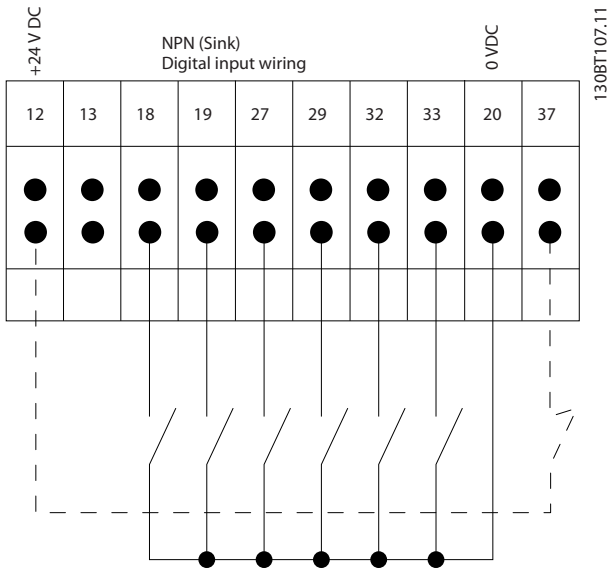
Illustration 4.40
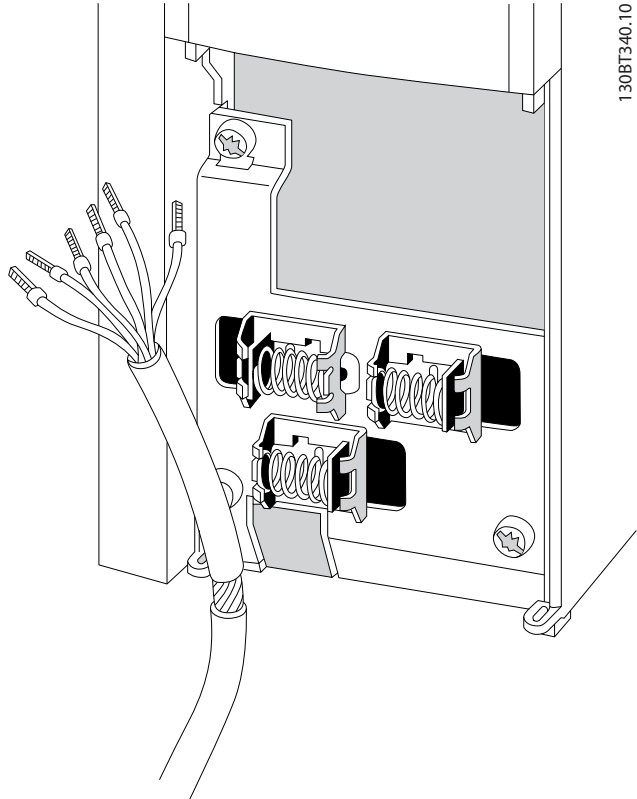
Illustration 4.41

Illustration 4.42

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

NOTE

To comply with EMC emission specifications, shielded/ armored cables are recommended. If a non-shielded/ armored cable is used, see *4.6.13 Power and Control Wiring for Non-shielded Cables*. If non-shielded control cables are used, it is recommended to use ferrite cores to improve EMC performance.

4.8.2 Switches S201, S202, and S801

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

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

See *Illustration 4.39*

Default setting:

S201 (A53) = OFF (voltage input)

S202 (A54) = OFF (voltage input)

S801 (Bus termination) = OFF

NOTE
When changing the function of S201, S202 or S801, be careful not to force the switch over. Removing the LCP fixture (cradle) when operating the switches is recommended. The switches must not be operated while the adjustable frequency drive is powered.
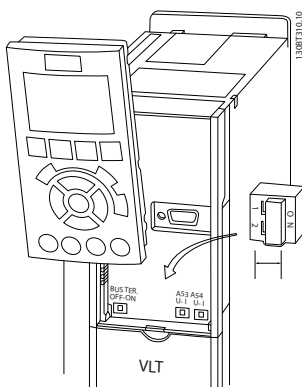
Illustration 4.43

4.9 Final Set-up and Test

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

Step 1. Locate the motor nameplate

NOTE
The motor is either star- (Y) or delta-connected (Δ). This information is located on the motor nameplate data.
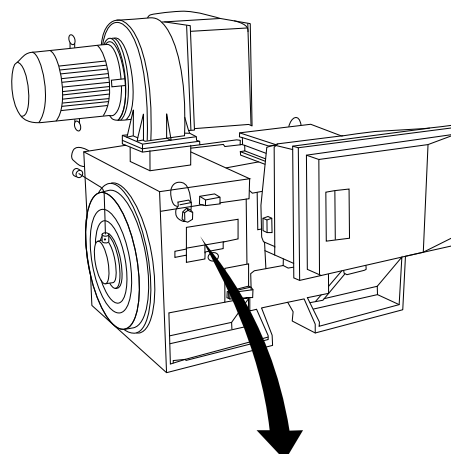
THREE PHASE INDUCTION MOTOR					
MOD MCV 315E	Nr.	135189 12 04		IL/IN 6.5	
kW 400		PRIMARY		SF 1.15	
HP 536	V 690	A 410.6	CONN Y	COS f 0.85	40
mm 1481	V	A	CONN	AMB 40	°C
Hz 50	V	A	CONN	ALT 1000	m
DESIGNN		SECONDARY		RISE 80	°C
DUTY S1	V	A	CONN	ENCLOSURE IP23	
INSUL I	EFFICIENCY %	95.8%	100%	95.8%	75%	WEIGHT 1.83 ton
⚠ CAUTION					

Illustration 4.44

Step 2. Enter the motor nameplate data in this parameter list.
To access this list, first press the [Quick Menu] key, then select "Q2 Quick Setup""Quick".

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

Table 4.48

Step 3. Activate the Automatic Motor Adaptation (AMA)

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

1. Connect terminal 37 to terminal 12 (if terminal 37 is available).

2. Connect terminal 27 to terminal 12 or set *5-12 Terminal 27 Digital Input* to 'No function' (*5-12 Terminal 27 Digital Input* [0])

3. Activate the AMA *1-29 Automatic Motor Adaptation (AMA)*.

4. Choose between complete or reduced AMA. If a sine-wave filter is mounted, run only the reduced

4

AMA, or remove the sine-wave filter during the AMA procedure.

5. Press the [OK] key. The display shows "Press [Hand On] to start".

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

Stop the AMA during operation

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

Successful AMA

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

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

Unsuccessful AMA

1. The adjustable frequency drive enters into alarm mode. A description of the alarm can be found in the *Warnings and Alarms* chapter.

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

NOTE

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

Step 4. Set speed limit and ramp time

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

Set up the desired limits for speed and ramp time

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

4.10 Additional Connections

4.10.1 Mechanical Brake Control

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

- Control the brake using any relay output or digital output (terminal 27 or 29).

- Keep the output closed (voltage-free) as long as the adjustable frequency drive is unable to 'support' the motor, such as when the load is too heavy, for example.

- Select *Mechanical brake control* [32] in parameter group 5-4* for applications with an electro-mechanical brake.

- The brake is released when the motor current exceeds the preset value in *2-20 Release Brake Current*.

- The brake is engaged when the output frequency is less than the frequency set in *2-21 Activate Brake Speed [RPM]* or *2-22 Activate Brake Speed [Hz]*, and only if the adjustable frequency drive carries out a stop command.

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

4.10.2 Parallel Connection of Motors

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

NOTE
Installations with cables connected in a common joint as in *Illustration 4.45*, **is only recommended for short cable lengths.**

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

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

Illustration 4.45 Installations with cables connected in a common joint

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

4.10.3 Motor Thermal Protection

The electronic thermal relay in the adjustable frequency drive has received UL-approval for single motor protection, when *1-90 Motor Thermal Protection* is set for *ETR Trip* and *1-24 Motor Current* is set to the rated motor current (see motor nameplate).

For thermal motor protection, it is also possible to use the MCB 112 PTC thermistor card option. This card provides an ATEX certificate to protect motors in explosion hazard areas, Zone 1/21 and Zone 2/22. When *1-90 Motor Thermal Protection* is set to [20] ATEX ETR is combined with the use of MCB 112, it is possible to control an Ex-e motor in explosion hazardous areas. Consult the programming guide for details on how to set up the adjustable frequency drive for safe operation of Ex-e motors.

4

5 How to Operate the Low Harmonic Drive

5.1.1 Ways of Operation

The Low Harmonic Drive can be operated in two ways:
1. Graphical Local Control Panel (GLCP)
2. RS-485 serial communication or USB, both for PC connection

5.1.2 How to Operate the Graphical LCP (GLCP)

The Low Harmonic Drive is equipped with two LCPs, one on the adjustable frequency drive section (to the right) of the drive and one on the active filter section (to the left). The filter LCP is operated the same way as the adjustable frequency drive LCP. Each LCP controls only the unit it is connected to and there is no communication between the two LCPs.

NOTE
The active filter should be in auto mode, i.e., the [Auto On] key must be pressed on the filter LCP.

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

The GLCP is divided into four functional groups:
1. Graphical display with Status lines.
2. Menu keys and indicator lights (LEDs) - selecting mode, changing parameters and switching between display functions.
3. Navigation keys and LEDs (LEDs).
4. Operation keys and LEDs.

Graphical display:
The LCD display is back lit with a total of 6 alpha-numeric lines. All data is displayed on the LCP which can show up to five operating variables while in [Status] mode. *Illustration 5.1* shows an example of the adjustable frequency drive LCP. The filter LCP looks identical but displays information related to the filter operation.

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

The display is divided into three sections:

Top section (a)
shows the status when in status mode, or up to two variables when not in status mode and in the event of an alarm/warning.
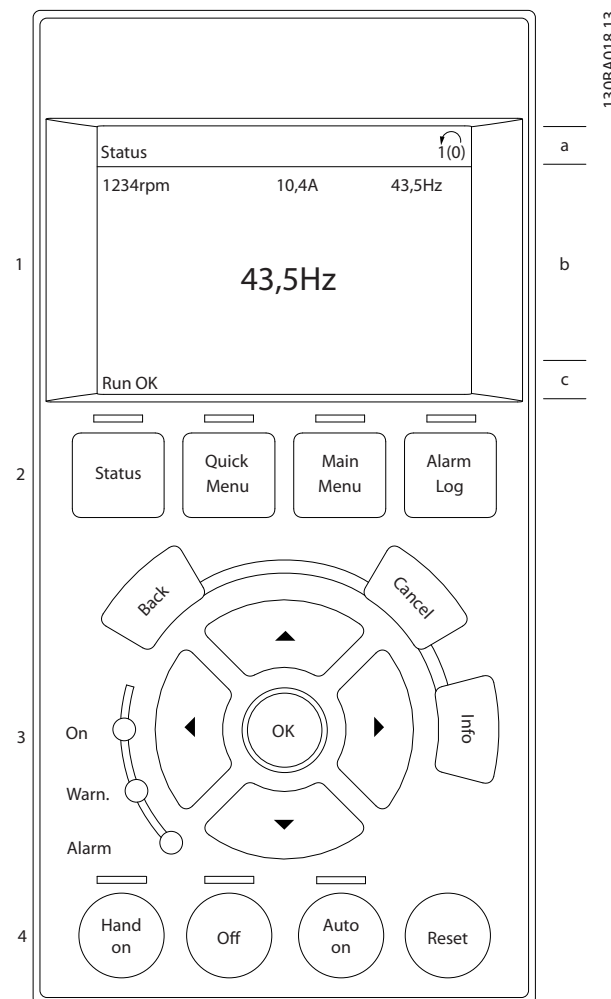
Illustration 5.1 LCP

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

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

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

Several values or measurements can be linked to each of the displayed operating variables. The values/measurements to be displayed can be defined via parameters 0-20, 0-21, 0-22, 0-23, and 0-24.

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

Status display I

This readout state is standard after start-up or initialization.
Press [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 *Illustration 5.2*. 1.1, 1.2 and 1.3 are shown in small size. 2 and 3 are shown in medium size.
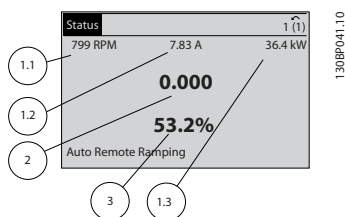
Illustration 5.2 Status Display I - Operating Variables

Status display II

See the operating variables (1.1, 1.2, 1.3, and 2) shown in the display in *Illustration 5.3*.
In the example, Speed, Motor current, Motor power and Frequency are selected as variables in the first and second lines.
1.1, 1.2 and 1.3 are shown in small size. 2 is shown in large size.
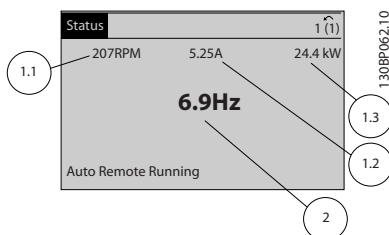
Illustration 5.3 Status Display II - Operating Variables

Status display III:

This state displays the event and action of the Smart Logic Control. For further information, see the section *Smart Logic Control*.
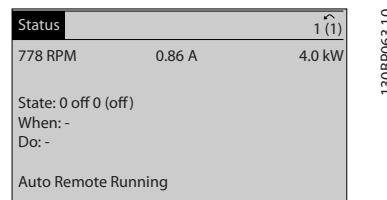
Illustration 5.4 Status Display III - Operating Variables

NOTE

Status display III is not available on the filter LCP.

Bottom section (c)

always shows the state of the adjustable frequency drive in status mode.
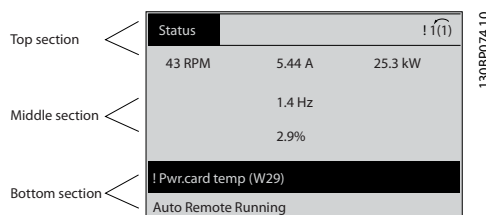
Illustration 5.5

Display contrast adjustment

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

LEDs:

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

- Green LED/On: Control section is working.

- Yellow LED/Warn.: Indicates a warning.

- Flashing Red LED/Alarm: Indicates an alarm.

Illustration 5.6

5
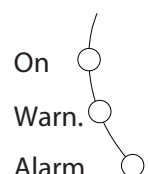
GLCP keys
Menu keys
The menu keys are divided into functions. The keys below the display and indicator lamps are used for parameter set-up, including choice of display indication during normal operation.

Illustration 5.7

[Status]
Indicates the status of the adjustable frequency drive (and/or the motor) or the filter respectively. On the drive LCP, 3 different readouts can be chosen by pressing the [Status] key:
5 line readouts, 4 line readouts or Smart Logic Control. Smart Logic Control is not available for the filter.
Use **[Status]** for selecting the mode of display or for changing back to display mode from either the quick menu mode, the main menu mode or alarm mode. Also use the [Status] key to toggle single or double readout mode.

[Quick Menu]
Allows quick set-up of the adjustable frequency drive or the filter. The most common functions can be programmed here.

The [Quick Menu] consists of:
- Q1: My Personal Menu
- Q2: Quick Setup
- Q5: Changes Made
- Q6: Loggings

Since the active filter is an integrated part of the Low Harmonic Drive, only a minimum of programming is necessary. The filter LCP is mainly used to display information about filter operation such as THD of voltage or current, corrected current, injected current or Cos φ and True Power Factor.

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

[Main Menu]
is used for programming all parameters.
The Main Menu parameters can be accessed immediately unless a password has been created via parameters 0-60, 0-61, 0-65 or 0-66.
It is possible to switch directly between Main Menu mode and Quick Menu mode.

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

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

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

Illustration 5.8

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

Illustration 5.9

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

Illustration 5.10

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.
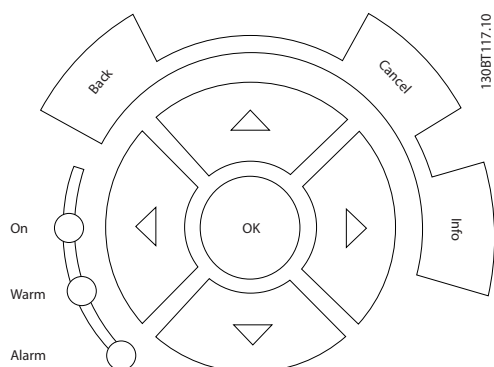
Illustration 5.11

Operation keys

for local control are found at the bottom of the control panel.
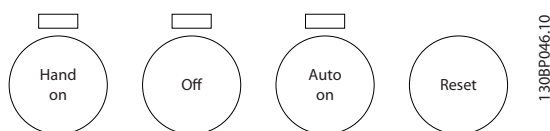
Illustration 5.12

[Hand on]

enables control of the adjustable frequency drive via the GLCP. [Hand on] also starts the motor, and makes it possible to give the motor speed reference using the arrow keys. The key can be *Enabled* [1] or *Disabled* [0] via *0-40 [Hand on] Key on LCP*.

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

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

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 (when pressed on the adjustable frequency drive LCP) or the filter (when pressed on the filter LCP). The key can be *Enabled* [1] or *Disabled* [0] via *0-41 [Off] Key on LCP*. If no external stop function is

selected and the [Off] key is inactive, the motor can only be stopped by disconnecting the line power supply.

[Auto on]

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

NOTE

[Auto on] must be pressed on the filter LCP.

NOTE

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

[Reset]

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

The parameter shortcut

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

5.1.3 Changing Data

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

2. Use [▲] and [▼] to find parameter group to edit.

3. Press [OK].

4. Use [▲] and [▼] to find parameter to edit.

5. Press [OK].

6. Use [▲] and [▼] to select correct parameter setting. Or, to move to digits within a number, use [◄] and [►]. The cursor indicates the digit selected to be changed. The [▲] key increases the value, the [▼] key decreases the value.

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

5.1.4 Changing a Text Value

If the selected parameter is a text value, it can be changed by using the up/down navigation keys.
The up key increases the value, and the down key decreases the value. Place the cursor on the value to be saved and press [OK].
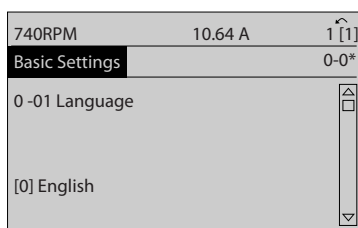
Illustration 5.13 Display example.

5.1.5 Changing a Group of Numeric Data Values

If the chosen parameter represents a numeric data value, change the chosen data value by means of the [◄] and [►] navigation keys as well as the up/down [▲] [▼] navigation keys. Use the [◄] and [►] navigation keys to move the cursor horizontally.
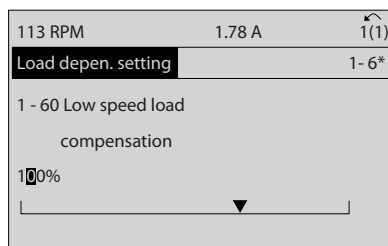
Illustration 5.14 Display example.

Use the up/down navigation keys to change the data value. The up key increases the data value, while the down key reduces it. Place the cursor on the value to be saved and press [OK].
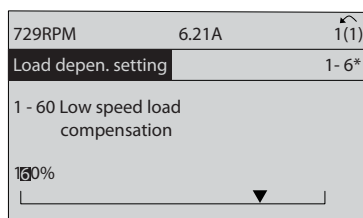
Illustration 5.15 Display example.

5.1.6 Changing Data Values, Step-by-Step

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

5.1.7 Read-out and Programming of Indexed Parameters

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

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

5.1.8 Quick Transfer of Parameter Settings when Using GLCP

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

⚠ WARNING

Stop the motor before performing any of these operations.

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

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

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

Data transfer from LCP to adjustable frequency drive:
1. Go to *0-50 LCP Copy*
2. Press the [OK] key

3.   Select "All from LCP"

4.   Press the [OK] key

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

5.1.9 Initialization to Default Settings

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

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

1.   Select *14-22 Operation Mode*

2.   Press [OK]

3.   Select *Initialization* (for NLCP select "2")

4.   Press [OK]

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

6.   Reconnect power and the adjustable frequency drive is reset.

NOTE

First start-up takes a few more seconds.

7.   Press [Reset]

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

NOTE

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

Manual initialization

NOTE

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

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

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

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

3. Release the keys after 5 sec.

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

This parameter initializes everything except:
15-00 Operating Hours
15-03 Power Up's
15-04 Over Temp's
15-05 Over Volt's

5.1.10 RS-485 Bus Connection

Both filter portion and adjustable frequency drive can be connected to a controller (or master) together with other loads 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-).

Always use parallel connections for the Low harmonic Drive to ensure that both filter and drive part is connected.
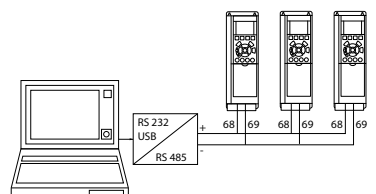
Illustration 5.16 Connection example.

In order to avoid potential equalizing currents in the shield, ground 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 to ON.
For more information, see the paragraph *Switches S201, S202, and S801*.

5.1.11 How to Connect a PC to the Adjustable Frequency Drive

To control or program the adjustable frequency drive (and the filter part) from a PC, install the PC-based Configuration Tool MCT 10.

The PC is connected via a standard (host/device) USB cable to both devices, 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 ground protection on the adjustable frequency drive. Use only an isolated laptop as PC connection to the USB connector on the adjustable frequency drive.
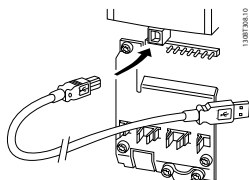
Illustration 5.17 For control cable connections, see *4.8.1 Electrical Installation, Control Cables* .

5.1.12 PC Software Tools

PC-based Configuration Tool MCT 10
The low harmonic drive is equipped with two serial communication ports. Danfoss provides a PC tool for communication between PC and adjustable frequency drive, PC-based Configuration Tool MCT 10. Check *1.1.2 Available Literature for VLT AutomationDrive* for detailed information on this tool.

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

- Planning a communication network offline. MCT 10 contains a complete adjustable frequency drive database

- Commissioning adjustable frequency drives online.

- Saving settings for all adjustable frequency drives.

- Replacing an adjustable frequency drive in a network.

- Simple and accurate documentation of adjustable frequency drive settings after commissioning.

- Expanding an existing network

- Adjustable frequency drives developed in the future will be fully supported.

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

Save adjustable frequency drive settings:
1.   Connect a PC to the unit via the USB COM port.

NOTE

Use a PC that is isolated from line power, in conjunction with the USB port. Failure to do so may damage equipment.
2.   Open MCT 10 Set-up Software

3.   Select *Read from drive*

4.   Select *Save as*

All parameters are now stored on the PC.

Load adjustable frequency drive settings:
1.   Connect a PC to the adjustable frequency drive via the USB com port

2.   Open MCT 10 Set-up software

3.   Choose *Open* – stored files will be shown

4.   Open the appropriate file

5.   Choose *Write to drive*

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

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

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

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

Table 5.1

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

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

6 How to Program the Low Harmonic Drive

6.1 How to Program the Adjustable Frequency Drive

6.1.1 Quick Set-up Parameters

0-01 Language	
Option:	Function:
	Defines the language to be used in the display. The adjustable frequency drive can be delivered with four different language packages. English and German are included in all packages. English cannot be erased or manipulated.
[0] * English	Part of Language packages 1 - 4
[1] Deutsch	Part of Language packages 1 - 4
[2] Francais	Part of Language package 1
[3] Dansk	Part of Language package 1
[4] Spanish	Part of Language package 1
[5] Italiano	Part of Language package 1
Svenska	Part of Language package 1
[7] Nederlands	Part of Language package 1
[10] Chinese	Part of Language package 2
Suomi	Part of Language package 1
[22] English US	Part of Language package 4
Greek	Part of Language package 4
Bras.port	Part of Language package 4
Slovenian	Part of Language package 3
Korean	Part of Language package 2
Japanese	Part of Language package 2
Turkish	Part of Language package 4
Trad.Chinese	Part of Language package 2
Bulgarian	Part of Language package 3
Srpski	Part of Language package 3
Romanian	Part of Language package 3
Magyar	Part of Language package 3
Czech	Part of Language package 3
Polski	Part of Language package 4

0-01 Language	
Option:	Function:
Russian	Part of Language package 3
Thai	Part of Language package 2
Bahasa Indonesia	Part of Language package 2
[52] Hrvatski	

1-20 Motor Power [kW]		
Range:		Function:
Application dependent*	[Application dependant]	

1-22 Motor Voltage		
Range:		Function:
Size related*	[10. - 1000. V]	

1-23 Motor Frequency		
Range:		Function:
Application dependent*	[20 - 1000 Hz]	Min - Max motor frequency: 20–1000 Hz. Select the motor frequency value from the motor nameplate data. If a value different from 50 Hz or 60 Hz is selected, it is necessary to adapt the load independent settings in *1-50 Motor Magnetisation at Zero Speed* to *1-53 Model Shift Frequency*. For 87 Hz operation with 230/400 V motors, set the nameplate data for 230V/50 Hz. Adapt *4-13 Motor Speed High Limit [RPM]* and *3-03 Maximum Reference* to the 87 Hz application.
Application dependent*	[20 - 1000 Hz]	

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

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

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

NOTE

This parameter cannot be changed while the motor is running.

5-12 Terminal 27 Digital Input		
Option: Function:		

Select the function from the available digital input range.

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

Table 6.1

6

1-29 Automatic Motor Adaptation (AMA)		
Option:		**Function:**
		The AMA function optimizes dynamic motor performance by automatically optimizing the advanced motor parameters (parameters 1-30 to 1-35) at motor standstill. Activate the AMA function by pressing [Hand on] after selecting [1] or [2]. See also the section *Automatic Motor Adaptation*. After a normal sequence, the display will read: "Press [OK] to finish AMA". After pressing the [OK] key, the adjustable frequency drive is ready for operation. This parameter cannot be adjusted while the motor is running.
[0] *	OFF	
[1]	Enable complete AMA	Performs AMA of the stator resistance R_S, the rotor resistance R_r, the stator leakage reactance X_1, the rotor leakage reactance X_2 and the main reactance X_h . **FC 301:** The complete AMA does not include X_h measurement for FC 301. Instead, the X_h value is determined from the motor database. Par. 1-35 may be adjusted to obtain optimal start performance.
[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 drive and the motor.

Note:

- For the best adaptation of the adjustable frequency drive, run the AMA on a cold motor.

- AMA cannot be performed while the motor is running.

- AMA cannot be performed on permanent magnet motors.

NOTE

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

NOTE

Avoid generating external torque during AMA.

NOTE

If one of the settings in parameter group 1-2* is changed, parameters 1-30 to 1-39, the advanced motor parameters, will return to default setting.

3-02 Minimum Reference	
Range:	Function:
Application dependent* [Application dependant]	

3-03 Maximum Reference		
Range:		Function:
Application dependent*	[Application dependant]	Enter the maximum reference. The maximum reference is the highest value obtainable by adding all references together. **The Maximum Reference unit matches:** • The choice of configuration in *1-00 Configuration Mode*: for *Speed closed-loop* [1], RPM; for *Torque* [2], Nm. • The unit selected in *3-00 Reference Range*.

3-41 Ramp 1 Ramp up Time	
Range:	Function:
Application dependent* [Application dependant]	

3-42 Ramp 1 Ramp Down Time	
Range:	Function:
Application dependent* [Application dependant]	

6.1.2 Basic Set-up Parameters

0-02 Motor Speed Unit		
Option:		Function:
		The display showing depends on settings in *0-02 Motor Speed Unit* and *0-03 Regional Settings*. The default setting of *0-02 Motor Speed Unit* and *0-03 Regional Settings* depends on which region of the world the adjustable frequency drive is supplied to, but can be re-programmed as required. **NOTE** **Changing the *Motor Speed Unit* will reset certain parameters to their initial value. It is recommended to select the motor speed unit first before modifying other parameters.**
[0]	RPM	Selects display of motor speed variables and parameters (i.e., references, feedbacks and limits) in terms of motor speed (RPM).
[1] *	Hz	Selects display of motor speed variables and parameters (i.e., references, feedbacks and limits) in terms of output frequency to the motor (Hz).

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

0-50 LCP Copy		
Option:		Function:
[0] *	No copy	
[1]	All to LCP	Copies all parameters in all set-ups from the adjustable frequency drive memory to the LCP memory.
[2]	All from LCP	Copies all parameters in all set-ups from the LCP memory to the adjustable frequency drive memory.
[3]	Size indep. from LCP	Copy only the parameters that are independent of the motor size. The latter selection can be used to program several adjustable frequency drives with the same function without disturbing motor data.
[4]	File from MCO to LCP	
[5]	File from LCP to MCO	
[6]	Data from DYN to LCP	
[7]	Data from LCP to DYN	

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

1-03 Torque Characteristics		
Option:		Function:
		Select the torque characteristic required. VT and AEO are both energy saving operations.
[0] *	Constant torque	Motor shaft output provides constant torque under variable speed control.
[1]	Variable torque	Motor shaft output provides variable torque under variable speed control. Set the variable torque level in *14-40 VT Level*.
[2]	Auto Energy Optim.	Automatically optimizes energy consumption by minimizing magnetization and frequency via *14-41 AEO Minimum Magnetisation* and *14-42 Minimum AEO Frequency*.
[5]	Constant Power	The function provides a constant power in the field weakening area. The torque shape of motor mode is used as a limit in the generatoric mode. This is done to limit the power in generatoric mode that otherwise becomes considerable larger than in motor mode, due to the high DC link voltage available in generatoric mode.

1-03 Torque Characteristics	
Option:	Function:
	$P_{shaft}[W] = \omega_{mech}[rad/s] \times T[Nm]$ This relationship with the constant power is illustrated in the following graph: **Illustration 6.1**

NOTE

This parameter cannot be adjusted while the motor is running.

1-04 Overload Mode		
Option:		Function:
[0] *	High torque	Allows up to 160% over torque.
[1]	Normal torque	For oversized motor - allows up to 110% overtorque.

NOTE

This parameter cannot be adjusted while the motor is running.

1-90 Motor Thermal Protection		
Option:		Function:
		Thermal motor protection can be implemented using a range of techniques: • Via a PTC sensor in the motor windings connected to one of the analog or digital inputs (*1-93 Thermistor Source*). See *6.1.3.1 PTC Thermistor Connection*. • Via a KTY sensor in the motor winding connected to an analog input (*1-96 KTY Thermistor Resource*). See *6.1.3.2 KTY Sensor Connection*. • 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 $f_{M,N}$. See *6.1.3.3 ETR* and . • Via a mechanical thermal switch (Klixon type). See *6.1.3.4 ATEX ETR*.

1-90 Motor Thermal Protection		
Option:		Function:
		For the North American market: The ETR functions provide class 20 motor overload protection in accordance with NEC.
[0] *	No protection	Continuously overloaded motor, when no warning or trip of the adjustable frequency drive is required.
[1]	Thermistor warning	Activates a warning when the connected thermistor or KTY sensor in the motor reacts in the event of motor overtemperature.
[2]	Thermistor trip	Stops (trips) adjustable frequency drive when connected thermistor or KTY sensor in the motor reacts in the event of motor overtemperature. The thermistor cut-out value must be > 3 kΩ. Integrate a thermistor (PTC sensor) in the motor for winding protection.
[3]	ETR warning 1	Calculates the load when Set-up 1 is active and activates a warning on the display when the motor is overloaded. Program a warning signal via one of the digital outputs.
[4]	ETR trip 1	Calculates the load when Set-up 1 is active and stops (trips) the adjustable frequency drive when the motor is overloaded. Program a warning signal via one of the digital outputs. The signal appears in the event of a warning, or if the adjustable frequency drive trips (thermal warning).
[5]	ETR warning 2	
[6]	ETR trip 2	
[7]	ETR warning 3	
[8]	ETR trip 3	
[9]	ETR warning 4	
[10]	ETR trip 4	
[20]	ATEX ETR	Activates the thermal monitoring function for Ex-e motors for ATEX. Enables *1-94 ATEX ETR cur.lim. speed reduction*, *1-98 ATEX ETR interpol. points freq.* and *1-99 ATEX ETR interpol points current*.
[21]	Advanced ETR	

NOTE

If [20] is selected, follow the instructions exactly as described in the dedicated chapter in the VLT° AutomationDrive design guide and the instructions given by the motor manufacturer.

6

NOTE

If [20] is selected, *4-18 Current Limit* must be set to 150%.

6.1.3.1 PTC Thermistor Connection
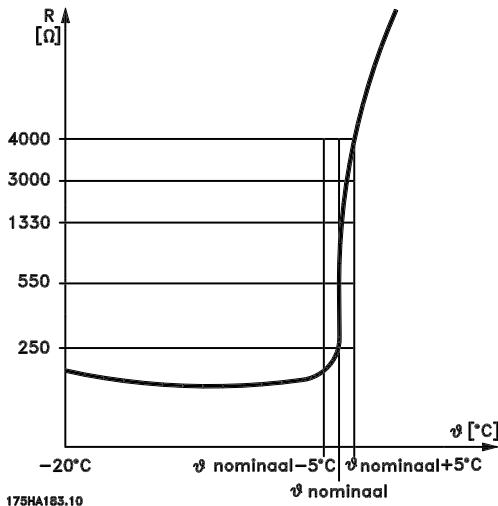
Illustration 6.2 PTC profile

Using a digital input and 10 V as power supply:
Example: The adjustable frequency drive trips when the motor temperature is too high.
Parameter set-up:
Set *1-90 Motor Thermal Protection* to *Thermistor Trip* [2]
Set *1-93 Thermistor Source* to *Digital Input* [6]
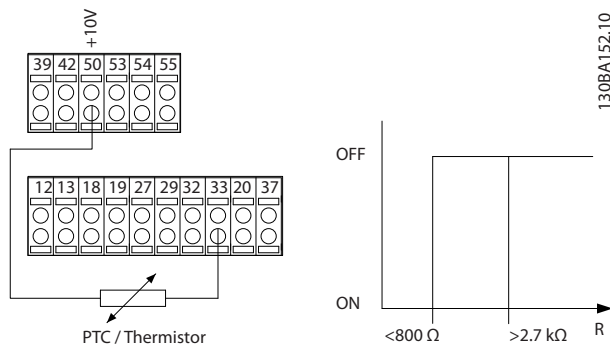
Illustration 6.3

Using an analog input and 10 V as power supply:
Example: The adjustable frequency drive trips when the motor temperature is too high.
Parameter set-up:
Set *1-90 Motor Thermal Protection* to *Thermistor Trip* [2]
Set *1-93 Thermistor Source* to *Analog Input 54* [2]
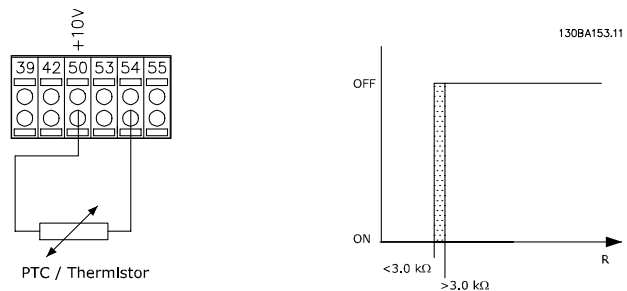
Illustration 6.4

Input Digital/analog	Supply Voltage	Threshold Cut-out Values
Digital	10 V	< 800 Ω - > 2.7 kΩ
Analog	10 V	< 3.0 kΩ - > 3.0 kΩ

Table 6.2

NOTE

Ensure that the chosen supply voltage follows the specification of the thermistor element utilized.

6.1.3.2 KTY Sensor Connection

(FC 302 only)

KTY sensors are used especially in permanent magnet servo motors (PM motors) for dynamic adjusting of motor parameters as stator resistance (*1-30 Stator Resistance (Rs)*) for PM motors and also rotor resistance (*1-31 Rotor Resistance (Rr)*) for asynchronous motors, depending on winding temperature. The calculation is:

$Rs = Rs_{20°\ C} \times (1\ +\ \alpha_{cu} \times \Delta T)\ [\Omega]$ where $\alpha_{cu} = 0.00393$

KTY sensors can be used for motor protecting (*1-97 KTY Threshold level*).
FC 302 can handle three types of KTY sensors, defined in *1-95 KTY Sensor Type*. The actual sensor temperature can be read out from *16-19 KTY sensor temperature*.
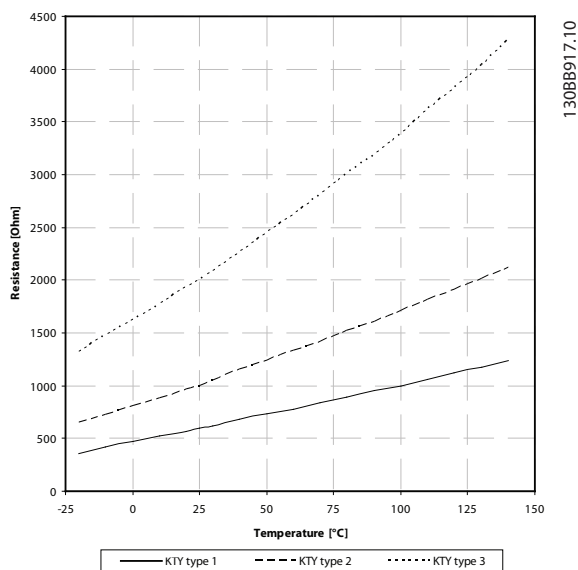
Illustration 6.5 KTY type selection

KTY Sensor 1: KTY 84-1 with 1 kΩ at 212°F [100°C]
KTY Sensor 2: KTY 81-1, KTY 82-1 with 1 kΩ at 77°F [25°C]
KTY Sensor 3: KTY 81-2, KTY 82-2 with 2 kΩ at 77°F [25°C]

NOTE

If the temperature of the motor is utilized through a thermistor or KTY sensor, the PELV is not complied with in the event of short-circuits between motor windings and sensor. In order to comply with PELV, the sensor must be extra isolated.

6.1.3.3 ETR

The calculations estimate the need for a lower load at lower speed due to less cooling from the fan incorporated in the motor.
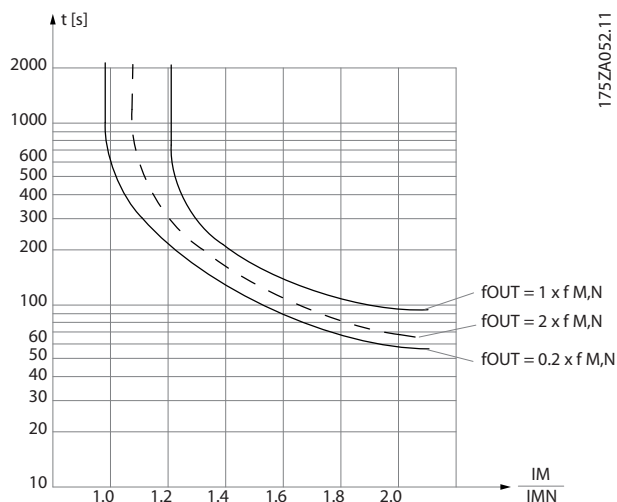
Illustration 6.6 ETR profile

6.1.3.4 ATEX ETR

The B option MCB 112 PTC Thermistor option offers ATEX approved monitoring of motor temperature. Alternatively, an external ATEX approved PTC protection device can be used.

NOTE

Only ATEX Ex-e approved motors may be used for this function. See motor nameplate, approval certificate, data sheet or contact motor supplier.

When controlling an Ex-e motor with "Increased Safety", it is important to ensure certain limitations. The parameters that must be programmed are presented in the following application example.

Parameters	
Function	**Setting**
1-90 Motor Thermal Protection	[20] ATEX ETR
1-94 ATEX ETR cur.lim. speed reduction	20%
1-98 ATEX ETR interpol. points freq.	Motor nameplate
1-99 ATEX ETR interpol points current	
1-23 Motor Frequency	Enter the same value as for *4-19 Max Output Frequency*
4-19 Max Output Frequency	Motor nameplate, possibly reduced for long motor cables, sinus filter or reduced supply voltage
4-18 Current Limit	Forced to 150% by 1-90 [20]
5-15 Terminal 33 Digital Input	[80] PTC Card 1
5-19 Terminal 37 Safe Stop	[4] PTC 1 Alarm
14-01 Switching Frequency	Check that the default value fulfils the requirement for Motor nameplate. If not, use the sine-wave filter.
14-26 Trip Delay at Inverter Fault	0

Table 6.3

⚠️CAUTION

It is mandatory to compare the minimum switching frequency requirement stated by the motor manufacturer to the minimum switching frequency of the adjustable frequency drive the default value in *14-01 Switching Frequency*. If the adjustable frequency drive does not meet this requirement, a sine-wave filter must be used.

More information about ATEX ETR Thermal Monitoring can be found in the Application Note MN33GXYY.

6.1.3.5 Klixon

The Klixon type thermal circuit breaker uses a KLIXON® metal dish. At a predetermined overload, the heat caused by the current through the disc causes a trip.

Using a digital input and 24 V as power supply:
Example: The adjustable frequency drive trips when the motor temperature is too high.
Parameter set-up:
Set *1-90 Motor Thermal Protection* to *Thermistor Trip* [2]
Set *1-93 Thermistor Source* to *Digital Input* [6]

Illustration 6.7

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

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

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

2-10 Brake Function		
Option:	**Function:**	
[0] *	Off	No brake resistor is installed.
[1]	Resistor brake	A brake resistor is incorporated in the system, for dissipating surplus brake energy as heat.

2-10 Brake Function		
Option:	**Function:**	
		Connecting a brake resistor allows a higher DC link voltage during braking (generating operation). The resistor brake function is only active in adjustable frequency drives with an integral dynamic brake.
[2]	AC brake	Is selected to improve braking without using a brake resistor. This parameter controls an overmagnetization of the motor when running with a generatoric load. This function can improve the OVC function. Increasing the electrical losses in the motor allows the OVC function to increase the braking torque without exceeding the overvoltage limit. Please note that AC brake is not as effective as dynamic breaking with resistor. AC brake is for VVC^plus and flux mode in both open-loop and closed-loop.

2-11 Brake Resistor (ohm)		
Range:		**Function:**
Size related*	[5.00 - 65535.00 Ohm]	Set the brake resistor value in Ohms. This value is used for monitoring the power to the brake resistor in *2-13 Brake Power Monitoring*. This parameter is only active in adjustable frequency drives with an integral dynamic brake. Use this parameter for values without decimals. For a selection with two decimals, use *30-81 Brake Resistor (ohm)*.

2-12 Brake Power Limit (kW)		
Range:		**Function:**
Size related*	[0.001 - 2000.000 kW]	

2-13 Brake Power Monitoring		
Option:	**Function:**	
		This parameter is only active in adjustable frequency drives with an integral dynamic brake. This parameter enables monitoring of the power to the brake resistor. The power is calculated on the basis of the resistance (*2-11 Brake Resistor (ohm)*), the DC link voltage, and the resistor duty time.
[0] *	Off	No braking energy monitoring required.
[1]	Warning	Activates a warning on the display when the power transmitted over 120 s exceeds 100% of the monitoring limit (*2-12 Brake Power Limit (kW)*). The warning disappears when the transmitted power falls below 80% of the monitoring limit.

2-13 Brake Power Monitoring		
Option:	Function:	
[2]	Trip	Trips adjustable frequency drive and displays an alarm when the calculated power exceeds 100% of the monitoring limit.
[3]	Warning and trip	Activates both of the above, including warning, trip and alarm.

If power monitoring is set to [0] *Off* or [1] *Warning*, the brake function remains active, even if the monitoring limit is exceeded. This may lead to thermal overload of the resistor. It is also possible to generate a warning via a relay/digital output. The measuring accuracy of the power monitoring depends on the accuracy of the resistance of the resistor (better than ± 20%).

2-15 Brake Check		
Option:	Function:	
		Select type of test and monitoring function to check the connection to the brake resistor, or whether a brake resistor is present, and then display a warning or an alarm in the event of a fault. **NOTE** **The brake resistor disconnection function is tested during power-up. However, the brake IGBT test is performed when there is no braking. A warning or trip disconnects the brake function.** The testing sequence is as follows: 1. The DC link ripple amplitude is measured for 300 ms without braking. 2. The DC link ripple amplitude is measured for 300 ms with the brake turned on. 3. If the DC link ripple amplitude while braking is lower than the DC link ripple amplitude before braking + 1%: *Brake check has failed by returning a warning or alarm*. 4. If the DC link ripple amplitude while braking is higher than the DC link ripple amplitude before braking + 1%: *Brake check is OK*.
[0] *	Off	Monitors brake resistor and brake IGBT for a short-circuit during operation. If a short-circuit occurs, warning 25 appears.
[1]	Warning	Monitors brake resistor and brake IGBT for a short-circuit, and runs a test for brake resistor disconnection during power-up.
[2]	Trip	Monitors for a short-circuit or disconnection of the brake resistor, or a short-circuit of the brake IGBT. If a fault occurs, the adjustable frequency

2-15 Brake Check		
Option:	Function:	
		drive cuts out while displaying an alarm (trip locked).
[3]	Stop and trip	Monitors for a short-circuit or disconnection of the brake resistor, or a short-circuit of the brake IGBT. If a fault occurs, the adjustable frequency drive ramps down to coast and then trips. A trip lock alarm is displayed (e.g., warning 25, 27 or 28).
[4]	AC brake	Monitors for a short-circuit or disconnection of the brake resistor, or a short-circuit of the brake IGBT. If a fault occurs, the adjustable frequency drive performs a controlled ramp-down. This option is available for FC 302 only.
[5]	Trip Lock	

NOTE
Remove a warning arising in connection with *[0] Off* or *[1] Warning* by cycling the line power supply. The fault must be corrected first. For *[0] Off* or *[1] Warning* , the adjustable frequency drive keeps running even if a fault is located.

This parameter is only active in adjustable frequency drives with an integral dynamic brake.

6.1.4 2-2* Mechanical Brake

Parameters for controlling operation of an electro-magnetic (mechanical) brake, typically required in hoisting applications.
To control a mechanical brake, a relay output (relay 01 or relay 02) or a programmed digital output (terminal 27 or 29) is required. Normally, this output must be closed during periods when the adjustable frequency drive is unable to 'hold' the motor, e.g., due to an excessive load. Select *[32] Mechanical Brake Control* for applications with an electro-magnetic brake in *5-40 Function Relay*, *5-30 Terminal 27 Digital Output*, or *5-31 Terminal 29 Digital Output*. When selecting *[32] Mechanical brake control*, the mechanical brake is closed from start up until the output current is above the level selected in *2-20 Release Brake Current*. During stop, the mechanical brake activates when the speed falls below the level specified in *2-21 Activate Brake Speed [RPM]*. If the adjustable frequency drive enters an alarm condition or an overcurrent or overvoltage situation, the mechanical brake immediately cuts in. This is also the case during safe stop.

NOTE
Protection mode and trip delay features (*14-25 Trip Delay at Torque Limit* and *14-26 Trip Delay at Inverter Fault*) may delay the activation of the mechanical brake in an alarm condition. These features must be disabled in hoisting applications.

6
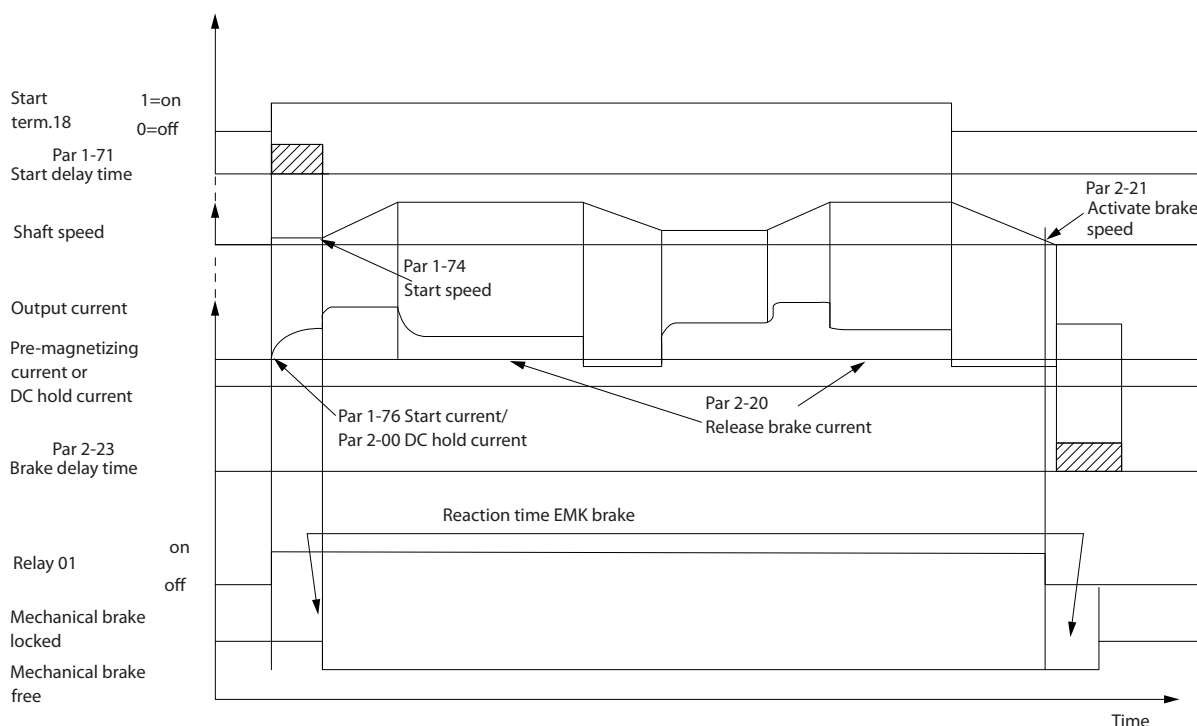
Illustration 6.8

2-20 Release Brake Current

Range:		Function:
Application dependent*	[Application dependant]	Set the motor current for release of the mechanical brake, when a start condition is present. The default value is the maximum current the inverter can provide for the particular power size. The upper limit is specified in *16-37 Inv. Max. Current*. **NOTE** **When Mechanical brake control output is selected but no mechanical brake is connected, the function will not work by default setting due to too low motor current.**

2-21 Activate Brake Speed [RPM]

Range:		Function:
Application dependent*	[0 - 30000 RPM]	Set the motor speed for activation of the mechanical brake, when a stop condition is present. The upper speed limit is specified in *4-53 Warning Speed High*.

2-22 Activate Brake Speed [Hz]

Range:		Function:
Application dependent*	[Application dependant]	

2-23 Activate Brake Delay

Range:		Function:
0.0 s*	[0.0 - 5.0 s]	Enter the brake delay time of the coast after ramp-down time. The shaft is held at zero speed with full holding torque. Ensure that the mechanical brake has locked the load before the motor enters coast mode. See *Mechanical Brake Control* in the *FC 300 Design Guide, MG33BXYY*.

2-24 Stop Delay

Range:		Function:
0.0 s*	[0.0 - 5.0 s]	Set the time interval from the moment when the motor is stopped until the brake closes. This parameter is a part of the stopping function.

2-25 Brake Release Time

Range:		Function:
0.20 s*	[0.00 - 5.00 s]	This value defines the time it takes for the mechanical brake to open. This parameter must act as a timeout when brake feedback is activated.

2-26 Torque Ref		
Range:		Function:
0.00 %*	[Application dependant]	

2-27 Torque Ramp Time		
Range:	Function:	
0.2 s*	[0.0 - 5.0 s]	The value defines the duration of the torque ramp in clockwise direction.

2-28 Gain Boost Factor		
Range:		Function:
1.00*	[1.00 - 4.00]	Only active in flux closed-loop. The function ensures a smooth transition from torque control mode to speed control mode when the motor takes over the load from the brake.
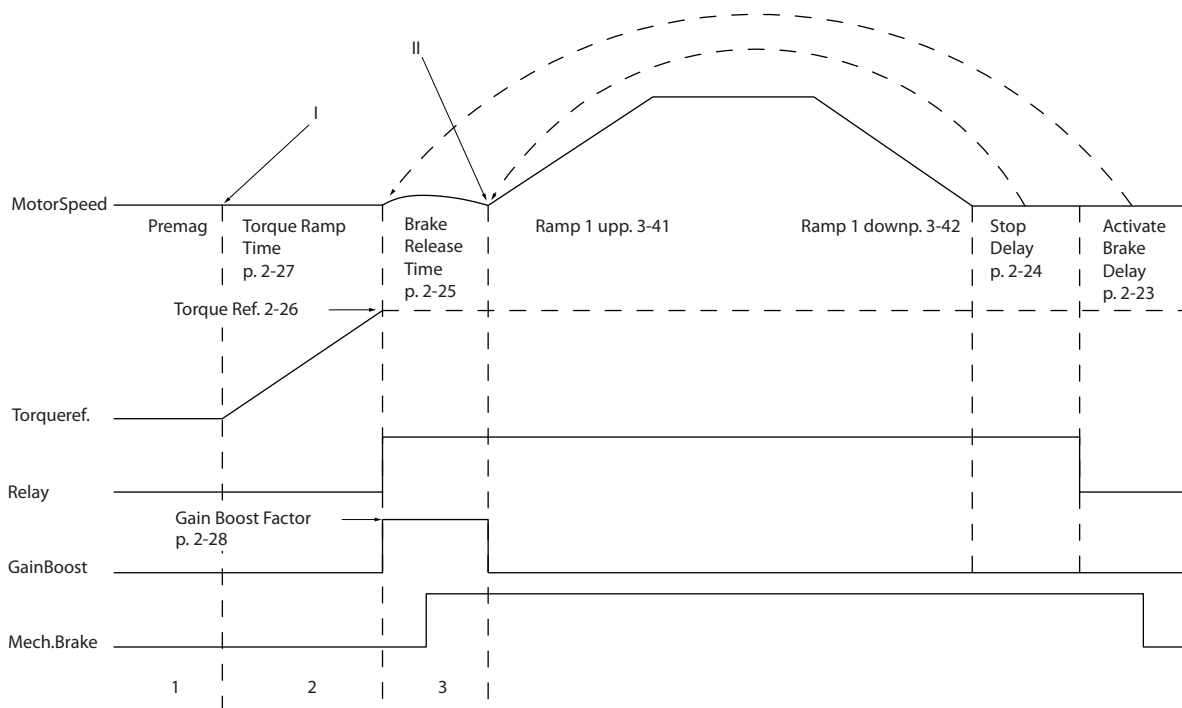
Illustration 6.9 Brake release sequence for hoist mechanical brake control

I) *Activate brake delay*: The adjustable frequency drive starts again from the *mechanical brake engaged* position.

II) *Stop delay*: When the time between successive starts is shorter than the setting in *2-24 Stop Delay*, the adjustable frequency drive starts without applying the mechanical brake (e.g., reversing).

3-10 Preset Reference		
Array [8] Range: 0-7		
Range:		Function:
0.00 %*	[-100.00 - 100.00 %]	
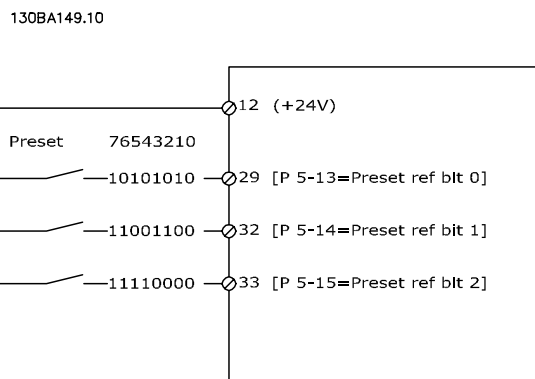
Illustration 6.10

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

Table 6.4

3-11 Jog Speed [Hz]

Range:		Function:
Application dependent*	[Application dependant]	

3-15 Reference Resource 1

Option:		Function:
		Select the reference input to be used for the first reference signal. *3-15 Reference Resource 1, 3-16 Reference Resource 2* and *3-17 Reference Resource 3* define up to three different reference signals. The sum of these reference signals defines the actual reference.
[0]	No function	
[1] *	Analog input 53	
[2]	Analog input 54	
[7]	Frequency input 29	
[8]	Frequency input 33	
[11]	Local bus reference	
[20]	Digital pot.meter	
[21]	Analog input X30-11	(General Purpose I/O Option Module)
[22]	Analog input X30-12	(General Purpose I/O Option Module)
[29]	Analog Input X48/2	

3-16 Reference Resource 2

Option:		Function:
		Select the reference input to be used for the second reference signal. *3-15 Reference Resource 1, 3-16 Reference Resource 2* and *3-17 Reference Resource 3* define up to three different reference signals. The sum of these reference signals defines the actual reference.
[0]	No function	
[1]	Analog input 53	
[2]	Analog input 54	
[7]	Frequency input 29	
[8]	Frequency input 33	
[11]	Local bus reference	
[20] *	Digital pot.meter	

3-16 Reference Resource 2

Option:		Function:
[21]	Analog input X30-11	
[22]	Analog input X30-12	
[29]	Analog Input X48/2	

3-17 Reference Resource 3

Option:		Function:
		Select the reference input to be used for the third reference signal. *3-15 Reference Resource 1, 3-16 Reference Resource 2* and *3-17 Reference Resource 3* define up to three different reference signals. The sum of these reference signals defines the actual reference.
[0]	No function	
[1]	Analog input 53	
[2]	Analog input 54	
[7]	Frequency input 29	
[8]	Frequency input 33	
[11] *	Local bus reference	
[20]	Digital pot.meter	
[21]	Analog input X30-11	
[22]	Analog input X30-12	
[29]	Analog Input X48/2	

5-00 Digital I/O Mode

Option:		Function:
		Digital inputs and programmed digital outputs are pre-programmable for operation either in PNP or NPN systems.
[0] *	PNP	Action on positive directional pulses (↕). PNP systems are pulled down to GND.
[1]	NPN	Action on negative directional pulses (↕). NPN systems are pulled up to +24 V, internally in the adjustable frequency drive.

NOTE
Once this parameter has been changed, it must be activated by performing a power cycle.

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.

NOTE
This parameter cannot be changed 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 is available for FC 302 only.

6.1.5 Digital Inputs

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

Digital input function	Select	Terminal
No operation	[0]	All *term 32, 33
Reset	[1]	All
Coast inverse	[2]	All *term 27
Coast and reset inverse	[3]	All
Quick stop inverse	[4]	All
DC brake inverse	[5]	All
Stop inverse	[6]	All
Start	[8]	All *term 18
Latched start	[9]	All
Reversing	[10]	All *term 19
Start reversing	[11]	All
Enable start forward	[12]	All
Enable start reverse	[13]	All
Jog	[14]	All *term 29
Preset reference on	[15]	All
Preset ref bit 0	[16]	All
Preset ref bit 1	[17]	All
Preset ref bit 2	[18]	All
Freeze reference	[19]	All
Freeze output	[20]	All
Speed up	[21]	All
Slow	[22]	All
Set-up select bit 0	[23]	All
Set-up select bit 1	[24]	All
Precise stop inverse	[26]	18, 19
Precise start, stop	[27]	18, 19
Catch up	[28]	All
Slow-down	[29]	All
Counter input	[30]	29, 33
Pulse input Edge Trigged	[31]	29, 33
Pulse input Time Based	[32]	29, 33
Ramp bit 0	[34]	All
Ramp bit 1	[35]	All
Latched precise start	[40]	18, 19
Latched precise stop inverse	[41]	18, 19
External interlock	[51]	
DigiPot increase	[55]	All
DigiPot decrease	[56]	All
DigiPot Clear	[57]	All

Digital input function	Select	Terminal
Digipot Hoist	[58]	All
Counter A (up)	[60]	29, 33
Counter A (down)	[61]	29, 33
Reset Counter A	[62]	All
Counter B (up)	[63]	29, 33
Counter B (down)	[64]	29, 33
Reset Counter B	[65]	All
Mech. Brake Feedb.	[70]	All
Mech. Brake Feedb. Inv.	[71]	All
PID Error Inv.	[72]	All
PID Reset I-part	[73]	All
PID enable	[74]	All
PTC Card 1	[80]	All
Profidrive OFF2	[91]	
Profidrive OFF3	[92]	
Start edge triggered	[98]	
Safe Option Reset	[100]	

Table 6.5

FC 300 standard terminals are 18, 19, 27, 29, 32 and 33.
MCB 101 terminals are X30/2, X30/3 and X30/4.
Terminal 29 functions as an output only in FC 302.

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

All digital inputs can be programmed to these functions:

[0]	No operation	No reaction to signals transmitted to the terminal.
[1]	Reset	Resets adjustable frequency drive after a TRIP/ALARM. Not all alarms can be reset.
[2]	Coast inverse	(Default Digital input 27): Coasting stop, inverted input (NC). The adjustable frequency drive leaves the motor in free mode. Logic '0' => coasting stop.
[3]	Coast and reset inverse	Reset and coasting stop Inverted input (NC). Leaves the motor in free mode and resets the adjustable frequency drive. Logic '0' => coasting stop and reset.
[4]	Quick stop inverse	Inverted input (NC). Generates a stop in accordance with the quick-stop ramp time set in *3-81 Quick Stop Ramp Time*. When motor stops, the shaft is in free mode. Logic '0' => quick stop.
[5]	DC brake inverse	Inverted input for DC braking (NC). Stops motor by energizing it with a DC current for a certain time period. See *2-01 DC Brake Current* to *2-03 DC Brake Cut In Speed [RPM]*. The function is only active when the value in *2-02 DC Braking Time* is different from 0. Logic '0' => DC braking.
[6]	Stop inverse	Stop Inverted function. Generates a stop function when the selected terminal goes

from logical level '1' to '0'. The stop is performed according to the selected ramp time (*3-42 Ramp 1 Ramp Down Time*, *3-52 Ramp 2 Ramp down Time*, *3-62 Ramp 3 Ramp down Time*, *3-72 Ramp 4 Ramp Down Time*).

NOTE
When the adjustable frequency drive is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the adjustable frequency drive stops, configure a digital output to [27] Torque limit & stop and connect this digital output to a digital input that is configured as coast.

[8]	Start	(Default Digital input 18): Select start for a start/stop command. Logic '1' = start, logic '0' = stop.
[9]	Latched start	The motor starts, if a pulse is applied for min. 2ms. The motor stops when Stop inverse is activated or a reset command (via DI) is given.
[10]	Reversing	(Default Digital input 19). Change the direction of motor shaft rotation. Select Logic '1' to reverse. The reversing signal only changes the direction of rotation. It does not activate the start function. Select both directions in *4-10 Motor Speed Direction*. The function is not active in process closed-loop.
[11]	Start reversing	Used for start/stop and for reversing on the same wire. Signals on start are not allowed at the same time.
[12]	Enable start forward	Disengages the counter-clockwise movement and allows for the clockwise direction.
[13]	Enable start reverse	Disengages the clockwise movement and allows for the counter-clockwise direction.
[14]	Jog	(Default Digital input 29): Use to activate jog speed. See *3-11 Jog Speed [Hz]*.
[15]	Preset reference on	Shifts between external reference and preset reference. It is assumed that *[1] External/preset* has been selected in *3-04 Reference Function*. Logic '0' = external reference active; logic '1' = one of the eight preset references is active.
[16]	Preset ref bit 0	Preset ref. bit 0,1, and 2 enables a choice between one of the eight preset references according to *Table 6.6*.
[17]	Preset ref bit 1	Same as Preset ref bit 0 [16].
[18]	Preset ref bit 2	Same as Preset ref bit 0 [16].

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

Table 6.6 Preset Ref. Bit

[19]	Freeze ref	Freezes the actual reference, which is now the point of enable/condition for Speed up and Slow to be used. If Speed up/down is used, the speed change always follows ramp 2 (*3-51 Ramp 2 Ramp up Time* and *3-52 Ramp 2 Ramp down Time*) in the range 0 - *3-03 Maximum Reference*.
[20]	Freeze output	Freezes the actual motor frequency (Hz), which is now the point of enable/condition for Speed up and Slow to be used. If Speed up/down is used, the speed change always follows ramp 2 (*3-51 Ramp 2 Ramp up Time* and *3-52 Ramp 2 Ramp down Time*) in the range 0 - *1-23 Motor Frequency*. **NOTE** **When freeze output is active, the adjustable frequency drive cannot be stopped via a low 'start [8]' signal. Stop the adjustable frequency drive via a terminal programmed for Coast inverse [2] or Coast and reset inv.**
[21]	Speed up	Select Speed up and Slow if digital control of the up/down speed is desired (motor potentiometer). Activate this function by selecting either Freeze reference or Freeze output. When Speed up/down is activated for less than 400 msec, the resulting reference will be increased/decreased by 0.1%. If Speed up/down is activated for more than 400 msec, the resulting reference will follow the setting in ramping up/down parameter 3-x1/ 3-x2.

	Shut down	Catch up
Unchanged speed	0	0
Reduced by %-value	1	0
Increased by %-value	0	1
Reduced by %-value	1	1

Table 6.7

[22]	Slow	Same as Speed up [21].
[23]	Set-up select bit 0	Select Set-up select bit 0 or Select Set-up select bit 1 to select one of the four set-ups. Set *0-10 Active Set-up* to Multi Set-up.
[24]	Set-up select bit 1	(Default Digital input 32): Same as Set-up select bit 0 [23].
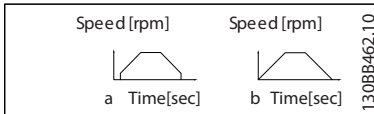
[26]	Precise stop inv.	Sends an inverted stop signal when the precise stop function is activated in *1-83 Precise Stop Function*. Precise stop inverse function is available for terminals 18 or 19.
[27]	Precise start, stop	Use when Precise ramp stop [0] is selected in *1-83 Precise Stop Function*. Precise start, stop is available for terminals 18 and 19. Precise start makes sure that the angle that the rotor turns from standing still to reference is the same for each start (for same ramp time, same setpoint). This is the equivalent to the precise stop where the angle that the rotor turns from reference to standing still is the same for each stop. When using for *1-83 Precise Stop Function* [1] or [2]: The adjustable frequency drive needs a Precise Stop signal before the value of *1-84 Precise Stop Counter Value* is reached. If this is not supplied, the adjustable frequency drive will not stop when the value in *1-84 Precise Stop Counter Value* is reached. Precise start, stop must be triggered by a digital input and is available for terminals 18 and 19.
[28]	Catch up	Increases reference value by percentage (relative) set in *3-12 Catch up/slow Down Value*.
[29]	Slow-down	Reduces reference value by percentage (relative) set in *3-12 Catch up/slow Down Value*.
[30]	Counter input	Precise stop function in *1-83 Precise Stop Function* acts as counter stop or speed compensated counter stop with or without reset. The counter value must be set in *1-84 Precise Stop Counter Value*.
[31]	Pulse edge triggered	Edge-triggered pulse input counts number of pulse flanks per sample time. This gives a higher resolution at high frequencies, but is not as precise at lower frequencies. Use this pulse principle for encoders with very low resolution (e.g., 30 ppr). **Illustration 6.11**
[32]	Pulse time based	Time-based pulse input measures the duration between flanks. This gives a higher resolution at lower frequencies, but is not as precise at higher frequencies. This principle has a cut-off frequency which makes it unsuited for encoders with very low resolutions (e.g., 30 ppr) at low speeds.

a: very low encoder resolution   b: standard encoder resolution

Table 6.8
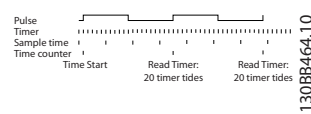
Illustration 6.12

[34]	Ramp bit 0	Enables a choice between one of the four ramps available, according to the table below.
[35]	Ramp bit 1	Same as Ramp bit 0.

Preset ramp bit	1	0
Ramp 1	0	0
Ramp 2	0	1
Ramp 3	1	0
Ramp 4	1	1

Table 6.9

[40]	Latched Precise Start	A latched precise start only requires a pulse of 3ms on T18 or T19. When using for 1-83 [1] or [2]: When the reference is reached, the adjustable frequency drive will internally enable the precise stop signal. This means that the adjustable frequency drive will do the Precise Stop when the counter value of *1-84 Precise Stop Counter Value* is reached.
[41]	Latched Precise Stop inverse	Sends a latched stop signal when the precise stop function is activated in *1-83 Precise Stop Function*. The latched precise stop inverse function is available for terminals 18 or 19.
[51]	External interlock	This function makes it possible to give an external fault to the drive. This fault is treated in the same way as an internally generated alarm.
[55]	DigiPot increase	INCREASE signal to the digital potentiometer function described in parameter group 3-9*.
[56]	DigiPot decrease	DECREASE signal to the digital potentiometer function described in parameter group 3-9*.

6

[57]	DigiPot Clear	Clears the digital potentiometer reference described in parameter group 3-9*.
[60]	Counter A	(Terminal 29 or 33 only) Input for increment counting in the SLC counter.
[61]	Counter A	(Terminal 29 or 33 only) Input for decrement counting in the SLC counter.
[62]	Reset Counter A	Input for reset of counter A.
[63]	Counter B	(Terminal 29 or 33 only) Input for increment counting in the SLC counter.
[64]	Counter B	(Terminal 29 or 33 only) Input for decrement counting in the SLC counter.
[65]	Reset Counter B	Input for reset of counter B.
[70]	Mech. Brake Feedback	Brake feedback for hoisting applications: Set *1-01 Motor Control Principle* to [3] *flux w/ motor feedback*; set *1-72 Start Function* to [6] *Hoist mech brake Ref.*
[71]	Mech. Brake Feedback inv.	Inverted brake feedback for hoisting applications
[72]	PID error inverse	When enabled, it inverts the resulting error from the process PID controller. Available only if "Configuration Mode" is set to "Surface Winder," "Extended PID Speed OL" or "Extended PID Speed CL."
[73]	PID reset I-part	When enabled, resets the I-part of the process PID controller. Equivalent to *7-40 Process PID I-part Reset*. Available only if "Configuration Mode" is set to "Surface Winder," "Extended PID Speed OL" or "Extended PID Speed CL."
[74]	PID enable	When enabled, enables the extended process PID controller. Equivalent to *7-50 Process PID Extended PID*. Available only if "Configuration Mode" is set "Extended PID Speed OL" or "Extended PID Speed CL."
[80]	PTC Card 1	All digital inputs can be set to PTC card 1 [80]. However, only one digital input must be set to this choice.
[91]	Profidrive OFF2	The functionality is the same as the according control word bit of the Profibus/Profinet option.
[92]	Profidrive OFF3	The functionality is the same as the according control word bit of the Profibus/Profinet option.
[98]	Start edge triggered	Edge triggered start command. Keeps the start command alive, even if the input is going back to low; can be used for a start push button.
[100]	Safe Option Reset	

6.1.6 5-3* Digital Outputs

The 2 solid-state digital outputs are common for terminals 27 and 29. Set the I/O function for terminal 27 in *5-01 Terminal 27 Mode*, and set the I/O function for terminal 29 in *5-02 Terminal 29 Mode*.

NOTE
These parameters cannot be adjusted while the motor is running.

[0]	No operation	Default for all digital outputs and relay outputs
[1]	Control ready	The control card is ready. For example, feedback from an adjustable frequency drive where the control is supplied by an external 24 V (MCB 107) and the main power to the unit is not detected.
[2]	Drive ready	The adjustable frequency drive is ready for operation and applies a supply signal on the control board.
[3]	Drive ready / remote control	The adjustable frequency drive is ready for operation and is in [Auto on] mode.
[4]	Enable / no warning	Ready for operation. No start or stop command is been given (start/disable). No warnings are active.
[5]	VLT running	Motor is running and shaft torque is present.
[6]	Running / no warning	Output speed is higher than the speed set in *1-81 Min Speed for Function at Stop [RPM]*. The motor is running and there are no warnings.
[7]	Run in range/no warning	Motor is running within the programmed current and speed ranges set in *4-50 Warning Current Low* to *4-53 Warning Speed High*. There are no warnings.
[8]	Run on reference / no warning	Motor runs at reference speed. No warnings.
[9]	Alarm	An alarm activates the output. There are no warnings.
[10]	Alarm or warning	An alarm or a warning activates the output.
[11]	At torque limit	The torque limit set in *4-16 Torque Limit Motor Mode* or *4-17 Torque Limit Generator Mode* has been exceeded.
[12]	Out of current range	The motor current is outside the range set in *4-18 Current Limit*.
[13]	Below current, low	Motor current is lower than set in *4-50 Warning Current Low*.
[14]	Above current, high	Motor current is higher than set in *4-51 Warning Current High*.
[15]	Out of speed range	Output frequency is outside the frequency ranges set in *4-52 Warning Speed Low* and *4-53 Warning Speed High*.

[16]	Below speed, low	Output speed is lower than the setting in *4-52 Warning Speed Low*.
[17]	Above speed, high	Output speed is higher than the setting in *4-53 Warning Speed High*.
[18]	Out of feedback range	Feedback is outside the range set in *4-56 Warning Feedback Low* and *4-57 Warning Feedback High*.
[19]	Below feedback low	Feedback is below the limit set in *4-56 Warning Feedback Low*.
[20]	Above feedback high	Feedback is above the limit set in *4-57 Warning Feedback High*.
[21]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, the adjustable frequency drive, the brake resistor, or the thermistor.
[22]	Ready, no thermal warning	The adjustable frequency drive is ready for operation and there is no overtemperature warning.
[23]	Remote, ready, no thermal warning	The adjustable frequency drive is ready for operation and is in [Auto on] mode. There is no overtemperature warning.
[24]	Ready, no over/under voltage	The adjustable frequency drive is ready for operation and the AC line voltage is within the specified voltage range (see *General Specifications* section in the Design Guide).
[25]	Reverse	*Reversing. Logic '1'* when CW rotation of the motor. Logic '0' when CCW rotation of the motor. If the motor is not rotating, the output will follow the reference.
[26]	Bus OK	Active communication (no timeout) via the serial communication port.
[27]	Torque limit and stop	Use in performing a coasting stop and in torque limit condition. If the adjustable frequency drive has received a stop signal and is at the torque limit, the signal is Logic '0'.
[28]	Brake, no brake warning	Brake is active and there are no warnings.
[29]	Brake ready, no fault	Brake is ready for operation and there are no faults.
[30]	Brake fault (IGBT)	Output is Logic '1' when the brake IGBT is short-circuited. Use this function to protect the adjustable frequency drive if there is a fault on the brake modules. Use the output/relay to cut out the main voltage from the adjustable frequency drive.
[31]	Relay 123	The relay is activated when Control Word [0] is selected in parameter group 8-**.
[32]	Mechanical brake control	Enables control of an external mechanical brake, see description in the section *Control of Mechanical Brake*, and parameter group 2-2*
[33]	Safe stop activated (FC 302 only)	Indicates that the safe stop on terminal 37 has been activated.

[40]	Out of ref range	Active when the actual speed is outside settings in *4-52 Warning Speed Low* to *4-55 Warning Reference High*.
[41]	Below reference low	Active when actual speed is below speed reference setting.
[42]	Above reference high	Active when actual speed is above speed reference setting
[43]	Extended PID Limit	
[45]	Bus Ctrl	Controls output via bus. The state of the output is set in *5-90 Digital & Relay Bus Control*. The output state is retained in the event of bus timeout.
[46]	Bus Ctrl On at timeout	Controls output via bus. The state of the output is set in *5-90 Digital & Relay Bus Control*. In the event of a bus timeout, the output state is set high (On).
[47]	Bus Ctrl Off at timeout	Controls output via bus. The state of the output is set in *5-90 Digital & Relay Bus Control*. In the event of a bus timeout, the output state is set low (Off).
[51]	MCO controlled	Active when a MCO 302 or MCO 305 is connected. The output is controlled from option.
[55]	Pulse output	
[60]	Comparator 0	See parameter group 13-1*. If Comparator 0 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[61]	Comparator 1	See parameter group 13-1*. If Comparator 1 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[62]	Comparator 2	See parameter group 13-1*. If Comparator 2 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[63]	Comparator 3	See parameter group 13-1*. If Comparator 3 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[64]	Comparator 4	See parameter group 13-1*. If Comparator 4 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[65]	Comparator 5	See parameter group 13-1*. If Comparator 5 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[70]	Logic Rule 0	See parameter group 13-4*. If Logic Rule 0 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[71]	Logic Rule 1	See parameter group 13-4*. If Logic Rule 1 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[72]	Logic Rule 2	See parameter group 13-4*. If Logic Rule 2 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[73]	Logic Rule 3	See parameter group 13-4*. If Logic Rule 3 is evaluated as TRUE, the output will go high. Otherwise, it will be low.

6

[74]	Logic Rule 4	See parameter group 13-4*. If Logic Rule 4 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[75]	Logic Rule 5	See parameter group 13-4*. If Logic Rule 5 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[80]	SL Digital Output A	See *13-52 SL Controller Action*. The output will go high whenever the Smart Logic Action *[38] Set dig. out. A* high is executed. The output will go low whenever the Smart Logic Action *[32] Set dig. out. A* low is executed.
[81]	SL Digital Output B	See *13-52 SL Controller Action*. The input will go high whenever the Smart Logic Action [39] *Set dig. out. A* high is executed. The input will go low whenever the Smart Logic Action [33] *Set dig. out. A low* is executed.
[82]	SL Digital Output C	See *13-52 SL Controller Action*. The input will go high whenever the Smart Logic Action [40] *Set dig. out. A* high is executed. The input will go low whenever the Smart Logic Action [34] *Set dig. out. A low* is executed.
[83]	SL Digital Output D	See *13-52 SL Controller Action*. The input will go high whenever the Smart Logic Action [41] *Set dig. out. A* high is executed. The input will go low whenever the Smart Logic Action [35] *Set dig. out. A low* is executed.
[84]	SL Digital Output E	See *13-52 SL Controller Action*. The input will go high whenever the Smart Logic Action [42] *Set dig. out. A* high is executed. The input will go low whenever the Smart Logic Action [36] *Set dig. out. A low* is executed.
[85]	SL Digital Output F	See *13-52 SL Controller Action*. The input will go high whenever the Smart Logic Action [43] *Set dig. out. A* high is executed. The input will go low whenever the Smart Logic Action [37] *Set dig. out. A low* is executed.
[120]	Local reference active	Output is high when *3-13 Reference Site* = [2] Local or when *3-13 Reference Site* = [0] *Linked to hand auto* at the same time as the LCP is in [Hand on] mode.

Reference site set in *3-13 Reference Site*	Local reference active [120]	Remote reference active [121]
Reference site: Local *3-13 Reference Site* [2]	1	0
Reference site: Remote *3-13 Reference Site* [1]	0	1
Reference site: Linked to Hand/ Auto		
Hand	1	0
Hand -> off	1	0
Auto -> off	0	0
Auto	0	1

Table 6.10

[121]	Remote reference active	Output is high when *3-13 Reference Site* =[1] Remote or [0] Linked to hand/auto while the LCP is in [Auto on] mode. See above.
[122]	No alarm	Output is high when no alarm is present.
[123]	Start command active	Output is high when there is an active Start command (e.g., via digital input bus connection or [Hand on] or [Auto on]), and no Stop or Start command is active.
[124]	Running reverse	Output is high when the adjustable frequency drive is running counter clockwise (the logical product of the status bits 'running' AND 'reverse').
[125]	Drive in hand mode	Output is high when the adjustable frequency drive is in [Hand on] mode (as indicated by the LED light above [Hand on]).
[126]	Drive in auto mode	Output is high when the adjustable frequency drive is in [Hand on] mode (as indicated by the LED light above [Auto on]).
[151]	ATEX ETR cur. alarm	Selectable if *1-90 Motor Thermal Protection* is set to [20] or [21]. If the alarm 164 ATEX ETR cur.lim.alarm is active, the output will be 1.
[152]	ATEX ETR freq. alarm	Selectable if *1-90 Motor Thermal Protection* is set to [20] or [21]. If the alarm 166 ATEX ETR freq.lim.alarm is active, the output will be 1.
[153]	ATEX ETR cur. warning	Selectable if *1-90 Motor Thermal Protection* is set to [20] or [21]. If the alarm 163 ATEX ETR cur.lim.warning is active, the output will be 1.

[154]	ATEX ETR freq. warning	Selectable if *1-90 Motor Thermal Protection* is set to [20] or [21]. If the warning 165 ATEX ETR freq.lim.warning is active, the output will be 1.
[188]	AHF Capacitor Connect	The capacitors will be turned on at 20% (hysteresis of 50% gives an interval of 10%–30%). The capacitors will be disconnected below 10%. The off delay is 10s and will restart if the nominal power goes above 10% during the delay. *5-80 AHF Cap Reconnect Delay* is used to guarantee a minimum off-time for the capacitors.
[189]	External fan control	The internal logics for the internal fan control is transferred to this output to make it possible to control an external fan (relevant for HP duct cooling).

5-40 Function Relay

Array [9]
(Relay 1 [0], Relay 2 [1], Relay 3 [2] (MCB 113), Relay 4 [3] (MCB 113), Relay 5 [4] (MCB 113), Relay 6 [5] (MCB 113), Relay 7 [6] (MCB 105), Relay 8 [7] (MCB 105), Relay 9 [8] (MCB 105))

Option:		Function:
[0] *	No operation	All digital and relay outputs are default set to "No Operation".
[1]	Control ready	The control card is ready. For example, Feedback from a drive where the control is supplied by an external 24 V (MCB 107) and the main power to drive is not detected.
[2]	Drive ready	Drive is ready to operate. Line power and control supplies are OK.
[3]	Drive rdy/rem ctrl	The adjustable frequency drive is ready for operation and is in auto on mode.
[4]	Enable / no warning	Ready for operation. No start or stop commands have been applied (start/ disable). No warnings are active.
[5]	Running	Motor is running, and shaft torque present.
[6]	Running / no warning	Output speed is higher than the speed set in *1-81 Min Speed for Function at Stop [RPM]* Min Speed for Function at Stop [RPM]. The motor is running and no warnings.
[7]	Run in range/no warn	Motor is running within the programmed current and speed ranges set in *4-50 Warning Current Low* and *4-53 Warning Speed High*. No warnings.
[8]	Run on ref/no warn	Motor runs at reference speed. No warnings.

5-40 Function Relay

Array [9]
(Relay 1 [0], Relay 2 [1], Relay 3 [2] (MCB 113), Relay 4 [3] (MCB 113), Relay 5 [4] (MCB 113), Relay 6 [5] (MCB 113), Relay 7 [6] (MCB 105), Relay 8 [7] (MCB 105), Relay 9 [8] (MCB 105))

Option:		Function:
[9]	Alarm	An alarm activates the output. No warnings
[10]	Alarm or warning	An alarm or a warning activates the output.
[11]	At torque limit	The torque limit set in *4-16 Torque Limit Motor Mode* or *4-17 Torque Limit Generator Mode* has been exceeded.
[12]	Out of current range	The motor current is outside the range set in *4-18 Current Limit*.
[13]	Below current, low	Motor current is lower than set in *4-50 Warning Current Low*.
[14]	Above current, high	Motor current is higher than set in *4-51 Warning Current High*.
[15]	Out of speed range	Output speed/frequency is outside the frequency ranges set in *4-52 Warning Speed Low* and *4-53 Warning Speed High*.
[16]	Below speed, low	Output speed is lower than the setting in *4-52 Warning Speed Low*
[17]	Above speed, high	Output speed is higher than the setting in *4-53 Warning Speed High*.
[18]	Out of feedb. range	Feedback is outside the range set in *4-56 Warning Feedback Low* and *4-57 Warning Feedback High*.
[19]	Below feedback, low	Feedback is below the limit set in *4-56 Warning Feedback Low*.
[20]	Above feedback, high	Feedback is above the limit set in *4-57 Warning Feedback High*.
[21]	Thermal warning	Thermal warning turns on when the temperature exceeds the limit either in motor, adjustable frequency drive, brake resistor, or connected thermistor.
[22]	Ready,no thermal W	The adjustable frequency drive is ready for operation and there is no overtemperature warning.
[23]	Remote,ready,no TW	The adjustable frequency drive is ready for operation and is in Auto On mode. There is no overtemperature warning.
[24]	Ready, Voltage OK	The adjustable frequency drive is ready for operation and the AC line voltage is within the specified

6

6

5-40 Function Relay		
Array [9]		
(Relay 1 [0], Relay 2 [1], Relay 3 [2] (MCB 113), Relay 4 [3] (MCB 113), Relay 5 [4] (MCB 113), Relay 6 [5] (MCB 113), Relay 7 [6] (MCB 105), Relay 8 [7] (MCB 105), Relay 9 [8] (MCB 105))		
Option:		Function:
		voltage range (see General Specifications section in Design Guide).
[25]	Reverse	Logic '1' when CW rotation of the motor. Logic '0' when CCW rotation of the motor. If the motor is not rotating, the output will follow the reference.
[26]	Bus OK	Active communication (no timeout) via the serial communication port.
[27]	Torque limit & stop	Use in performing a coasted stop and adjustable frequency drive in torque limit condition. If the adjustable frequency drive has received a stop signal and is at the torque limit, the signal is Logic '0'.
[28]	Brake, no brake war	Brake is active and there are no warnings.
[29]	Brake ready, no fault	Brake is ready for operation and there are no faults.
[30]	Brake fault (IGBT)	Output is Logic '1' when the brake IGBT is short-circuited. Use this function to protect the adjustable frequency drive if there is a fault on the brake module. Use the digital output/relay to cut out the AC line voltage from the adjustable frequency drive.
[31]	Relay 123	Digital output/relay is activated when Control Word [0] is selected in parameter group 8-**.
[32]	Mech brake ctrl	Selection of mechanical brake control. When selected parameters in parameter group 2-2* are active. The output must be reinforced to carry the current for the coil in the brake. Usually solved by connecting an external relay to the selected digital output.
[33]	Safe stop active	(FC 302 only) Indicates that the safe stop on terminal 37 has been activated.
[36]	Control word bit 11	Activate relay 1 by control word from the serial communication bus. No other functional impact in the adjustable frequency drive. Typical application: controlling auxiliary device from the serial communi-

5-40 Function Relay		
Array [9]		
(Relay 1 [0], Relay 2 [1], Relay 3 [2] (MCB 113), Relay 4 [3] (MCB 113), Relay 5 [4] (MCB 113), Relay 6 [5] (MCB 113), Relay 7 [6] (MCB 105), Relay 8 [7] (MCB 105), Relay 9 [8] (MCB 105))		
Option:		Function:
		cation bus. The function is valid when *[0] FC profile* in *8-10 Control Word Profile* is selected.
[37]	Control word bit 12	Activate relay 2 FC 302 only) by control word from serial communication bus. No other functional impact in the adjustable frequency drive. Typical application: controlling auxiliary device from the serial communication bus. The function is valid when *[0] FC profile* in *8-10 Control Word Profile* is selected.
[38]	Motor feedback error	Failure in the speed feedback loop from motor running in closed-loop. The output can eventually be used to prepare switching the adjustable frequency drive in open-loop in the case of an emergency.
[39]	Tracking error	When the difference between calculated speed and actual speed in *4-35 Tracking Error* is larger than selected the digital output/relay is active.
[40]	Out of ref range	Active when the actual speed is outside settings in *4-52 Warning Speed Low* to *4-55 Warning Reference High*.
[41]	Below reference, low	Active when actual speed is below speed reference setting.
[42]	Above ref, high	Active when actual speed is above speed reference setting.
[43]	Extended PID Limit	
[45]	Bus ctrl.	Controls digital output/relay via bus. The state of the output is set in *5-90 Digital & Relay Bus Control*. The output state is retained in the event of bus timeout.
[46]	Bus ctrl, 1 if timeout	Controls output via bus. The state of the output is set in *5-90 Digital & Relay Bus Control*. In the event of a bus timeout, the output state is set high (On).
[47]	Bus ctrl, 0 if timeout	Controls output via bus. The state of the output is set in *5-90 Digital & Relay Bus Control*. In the event of a bus timeout, the output state is set low (Off).

5-40 Function Relay

Array [9]

(Relay 1 [0], Relay 2 [1], Relay 3 [2] (MCB 113), Relay 4 [3] (MCB 113), Relay 5 [4] (MCB 113), Relay 6 [5] (MCB 113), Relay 7 [6] (MCB 105), Relay 8 [7] (MCB 105), Relay 9 [8] (MCB 105))

Option:		Function:
[51]	MCO controlled	Active when a MCO 302 or MCO 305 is connected. The output is controlled from option.
[60]	Comparator 0	See parameter group 13-1* (Smart Logic Control). If Comparator 0 in SLC is TRUE, the output will go high. Otherwise, it will be low.
[61]	Comparator 1	See parameter group 13-1* (Smart Logic Control). If Comparator 1 in SLC is TRUE, the output will go high. Otherwise, it will be low.
[62]	Comparator 2	See parameter group 13-1* (Smart Logic Control). If Comparator 2 in SLC is TRUE, the output will go high. Otherwise, it will be low.
[63]	Comparator 3	See parameter group 13-1* (Smart Logic Control). If Comparator 3 in SLC is TRUE, the output will go high. Otherwise, it will be low.
[64]	Comparator 4	See parameter group 13-1* (Smart Logic Control). If Comparator 4 in SLC is TRUE, the output will go high. Otherwise, it will be low.
[65]	Comparator 5	See parameter group 13-1* (Smart Logic Control). If Comparator 5 in SLC is TRUE, the output will go high. Otherwise, it will be low.
[70]	Logic rule 0	See parameter group 13-4*(Smart Logic Control). If Logic Rule 0 in SLC is TRUE, the output will go high. Otherwise, it will be low.
[71]	Logic rule 1	See parameter group 13-4*(Smart Logic Control). If Logic Rule 1 in SLC is TRUE, the output will go high. Otherwise, it will be low.
[72]	Logic rule 2	See parameter group 13-4*(Smart Logic Control). If Logic Rule 2 in SLC is TRUE, the output will go high. Otherwise, it will be low.
[73]	Logic rule 3	See parameter group 13-4*(Smart Logic Control). If Logic Rule 3 in SLC is TRUE, the output will go high. Otherwise, it will be low.
[74]	Logic rule 4	See parameter group 13-4*(Smart Logic Control). If Logic Rule 4 in SLC

5-40 Function Relay

Array [9]

Option:		Function:
		is TRUE, the output will go high. Otherwise, it will be low.
[75]	Logic rule 5	See parameter group 13-4*(Smart Logic Control). If Logic Rule 5 in SLC is TRUE, the output will go high. Otherwise, it will be low.
[80]	SL digital output A	See *13-52 SL Controller Action*. Output A is low on Smart Logic Action [32]. Output A is high on Smart Logic Action [38].
[81]	SL digital output B	See *13-52 SL Controller Action*. Output B is low on Smart Logic Action [33]. Output B is high on Smart Logic Action [39].
[82]	SL digital output C	See *13-52 SL Controller Action*. Output C is low on Smart Logic Action [34]. Output C is high on Smart Logic Action [40].
[83]	SL digital output D	See *13-52 SL Controller Action*. Output D is low on Smart Logic Action [35]. Output D is high on Smart Logic Action [41]
[84]	SL digital output E	See *13-52 SL Controller Action*. Output E is low on Smart Logic Action [36]. Output E is high on Smart Logic Action [42].
[85]	SL digital output F	See *13-52 SL Controller Action*. Output F is low on Smart Logic Action [37]. Output F is high on Smart Logic Action [43].
[120]	Local ref active	Output is high when *3-13 Reference Site* = [2] Local or when *3-13 Reference Site* = [0] Linked to hand auto at the same time as the LCP is in [Hand on] mode.

6

6

5-40 Function Relay

Array [9]
(Relay 1 [0], Relay 2 [1], Relay 3 [2] (MCB 113), Relay 4 [3] (MCB 113), Relay 5 [4] (MCB 113), Relay 6 [5] (MCB 113), Relay 7 [6] (MCB 105), Relay 8 [7] (MCB 105), Relay 9 [8] (MCB 105))

Option:		Function:		
		Reference site set in *3-13 Reference Site*	Local reference active [120]	Remote reference active [121]
		Reference site: Local *3-13 Reference Site* [2]	1	0
		Reference site: Remote *3-13 Reference Site* [1]	0	1
		Reference site: Linked to Hand/Auto		
		Hand	1	0
		Hand -> off	1	0
		Auto -> off	0	0
		Auto	0	1

Table 6.11

[121]	Remote ref active	Output is high when *3-13 Reference Site* = Remote [1] or Linked to hand/auto [0] while the LCP is in [Auto on] mode. See above.
[122]	No alarm	Output is high when no alarm is present.
[123]	Start command activ	Output is high when the Start command high (i.e., via digital input, bus connection or [Hand on] or [Auto on]), and a Stop has been last command.
[124]	Running reverse	Output is high when the adjustable frequency drive is running counter clockwise (the logical product of the status bits 'running' AND 'reverse').
[125]	Drive in hand mode	Output is high when the adjustable frequency drive is in [Hand on] mode (as indicated by the LED light above [Hand on]).
[126]	Drive in auto mode	Output is high when the adjustable frequency drive is in 'Auto' mode (as indicated by LED on above [Auto on]).
[151]	ATEX ETR cur. alarm	Selectable if *1-90 Motor Thermal Protection* is set to [20] or [21]. If the

5-40 Function Relay

Array [9]
(Relay 1 [0], Relay 2 [1], Relay 3 [2] (MCB 113), Relay 4 [3] (MCB 113), Relay 5 [4] (MCB 113), Relay 6 [5] (MCB 113), Relay 7 [6] (MCB 105), Relay 8 [7] (MCB 105), Relay 9 [8] (MCB 105))

Option:		Function:
		alarm 164 ATEX ETR cur.lim.alarm is active, the output will be 1.
[152]	ATEX ETR freq. alarm	Selectable if *1-90 Motor Thermal Protection* is set to [20] or [21]. If the alarm 166 ATEX ETR freq.lim.alarm is active, the output will be 1.
[153]	ATEX ETR cur. warning	Selectable if *1-90 Motor Thermal Protection* is set to [20] or [21]. If the alarm 163 ATEX ETR cur.lim.warning is active, the output will be 1.
[154]	ATEX ETR freq. warning	Selectable if *1-90 Motor Thermal Protection* is set to [20] or [21]. If the warning 165 ATEX ETR freq.lim.warning is active, the output will be 1.
[188]	AHF Capacitor Connect	
[189]	External Fan Control	The internal logics for the internal fan control is transferred to this output to make it possible to control an external fan (relevant for HP duct cooling).
[192]	RS Flipflop 0	
[193]	RS Flipflop 1	
[194]	RS Flipflop 2	
[195]	RS Flipflop 3	
[196]	RS Flipflop 4	
[197]	RS Flipflop 5	
[198]	RS Flipflop 6	
[199]	RS Flipflop 7	

NOTE

Remember to set switches S201 (A53) and S202 (A54) as specified below when performing a control card test in *14-22 Operation Mode*. Otherwise, the test will fail!

14-22 Operation Mode

Option:		Function:
		Use this parameter to specify normal operation, to perform tests or to initialize all parameters except *15-03 Power Up's*, *15-04 Over Temp's* and *15-05 Over Volt's*. This function is active only when the power is cycled to the adjustable frequency drive. Select *[0] Normal operation* for normal operation of the adjustable frequency drive with the motor in the selected application.

14-22 Operation Mode

Option:		Function:
		Select *[1] Control card test* to test the analog and digital inputs and outputs and the +10 V control voltage. The test requires a test connector with internal connections. Use the following procedure for the control card test:
		1. Select *[1] Control card test*.
		2. Disconnect the line power supply and wait for the light in the display to go out.
		3. Set switches S201 (A53) and S202 (A54) = 'ON' / I.
		4. Insert the test plug (see below).
		5. Connect to the line power supply.
		6. Carry out various tests.
		7. The results are displayed on the LCP, and the adjustable frequency drive moves into an infinite loop.
		8. *14-22 Operation Mode* is automatically set to Normal operation. Carry out a power cycle to start up in normal operation after a control card test.

If the test is OK
LCP readout: Control Card OK.
Disconnect the line power supply and remove the test plug. The green LED on the control card will light up.

If the test fails
LCP readout: Control Card I/O failure.
Replace the adjustable frequency drive or control card. The red LED on the control card is turned on. Test plugs (connect the following terminals to each other): 18 - 27 - 32; 19 - 29 - 33; 42 - 53 - 54

Illustration 6.13

14-22 Operation Mode

Option:		Function:
		Select *Initialization* [2] to reset all parameter values to default settings, except for *15-03 Power Up's*, *15-04 Over Temp's*, and *15-05 Over Volt's*. The adjustable frequency drive will reset during the next power-up. *14-22 Operation Mode* will also revert to the default setting *Normal operation* [0].
[0] *	Normal operation	
[1]	Control card test	
[2]	Initialisation	
[3]	Boot mode	

14-50 RFI Filter

This parameter is only available for FC 302. It is not relevant to FC 301 due to different design and shorter motor cables.

Option:	Function:	
[0]	Off	Select *[0] Off* if the adjustable frequency drive is fed by an isolated line power source (IT line power). If a filter is used, select Off [0] during charging to prevent a high leakage current making the RCD switch. In this mode, the internal RFI filter capacitors between chassis and the line power RFI filter circuit are cut-out to reduce the ground capacity currents.
[1] *	On	Select *[1] On* to ensure that the adjustable frequency drive complies with EMC standards.
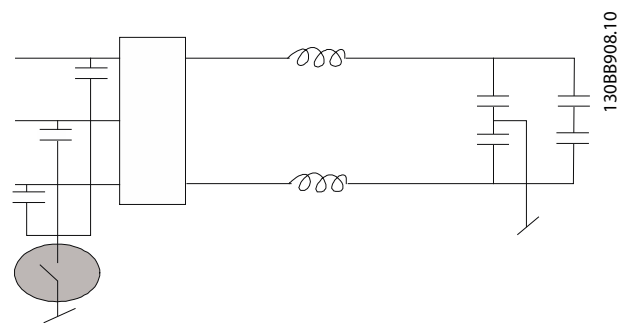
Illustration 6.14

15-43 Software Version

Range:		Function:
0 *	[0 - 0]	View the combined SW version (or 'package version') consisting of power SW and control SW.

6.2 How to Program the Active Filter

The factory settings for the filter part of the Low Harmonic Drive are chosen for optimal operation with a minimum of additional programming. All CT values, as well as frequency, voltage levels and other values directly linked to the drive configuration are pre-set.

It is not recommended to change any other parameters influencing the filter operation. However, the selection of readouts and what information to be displayed on the LCP status lines can be made to fit individual preferences.

To set up the filter, two steps are necessary:
- Change the nominal voltage in *300-10 Active Filter Nominal Voltage*

- Make sure the filter is in auto mode (press [Auto On])

Overview of parameter groups for the filter part

Group	Title	Function
0-**	Operation/Display	Parameters related to the fundamental functions of the filter, function of the LCP buttons and configuration of the LCP display.
5-**	Digital In/Out	Parameter group for configuring the digital inputs and outputs.
8-**	Communication and Options	Parameter group for configuring communications and options.
14-**	Special Functions	Parameter group for configuring special functions.
15-**	Unit Information	Parameter group containing active filter information such as operating data, hardware configuration and software versions.
16-**	Data Readouts	Parameter group for data readouts, such as current references, voltages, control, alarm, warning and status words.
300-**	AF Settings	Parameter group for setting the active filter. Apart from par. 300-10, *Active Filter Nominal Voltage*, it is not recommended to change the settings of this parameter group
301-**	AF Readouts	Parameter group for the filter readouts.

Table 6.12 Parameter groups

A list of all parameters accessible from the filter LCP can be found in the section *Parameter Options - Filter.* A more detailed description of the active filter parameters can be found in the *VLT Active Filter AAF00x Instruction Manual, MG90VXYY*

6.2.1 Using the Low Harmonic Drive in NPN Mode

The default setting for *5-00 Digital I/O Mode* is PNP mode. If NPN mode is desired, it is necessary to change the wiring in the filter part of the Low Harmonic Drive. Before changing the setting in *5-00 Digital I/O Mode* to NPN mode, the wire connected to 24 V (control terminal 12 or 13) must be changed to terminal 20 (ground).

6.3 Parameter Lists - Adjustable Frequency Drive

Changes during operation

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

4-Set-up

'All set-up': the parameters can be set individually in each of the four set-ups, i.e., one single parameter can have four different data values.

'1 set-up': the data value will be the same in all set-ups.

Conversion index

This number refers to a conversion figure used when writing or reading to and from the adjustable frequency drive.

Conv. index	100	67	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6
Conv. factor	1	1/60	1,000,000	100,000	10,000	1,000	100	10	1	0.1	0.01	0.001	0.0001	0.00001	0.000001

Table 6.13

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

Table 6.14

See the adjustable frequency drive *Design Guide* for further information about data types 33, 35 and 54.

Parameters for the adjustable frequency drive are grouped into various parameter groups for easy selection of the correct parameters for optimized operation of the adjustable frequency drive.

0-** Operation and display parameters for basic adjustable frequency drive settings

1-** Load and motor parameters, includes all load and motor related parameters

2-** Brake parameters

3-** References and ramping parameters, includes DigiPot function

4-** Limits/warnings, setting of limits and warning parameters

5-** Digital inputs and outputs, includes relay controls

6-** Analog inputs and outputs

7-** Controls, setting parameters for speed and process controls

8-** Communication and option parameters, setting of FC RS485 and FC USB port parameters.

9-** Profibus parameters

10-** DeviceNet and CAN Fieldbus parameters

12-** Ethernet parameters

13-** Smart Logic Control parameters

14-** Special function parameters

15-** Drive information parameters

16-** Readout parameters

17-** Encoder Option parameters

18-** Data Readouts 2

30-** Special Features

32-** MCO 305 Basic parameters

33-** MCO 305 Advanced parameters

34-** MCO Data Readout parameters

35-** Sensor Input Option

6.3.1 0-** Operation/Display

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	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	[0] RPM	2 set-ups		FALSE	-	Uint8
0-03	Regional Settings	[0] International	2 set-ups		FALSE	-	Uint8
0-04	Operating State at Power-up (Hand)	[1] Forced stop, ref=old	All set-ups		TRUE	-	Uint8
0-09	Performance Monitor	0.0 %	All set-ups		TRUE	-1	Uint16
0-1* Set-up Operations							
0-10	Active Set-up	[1] Set-up 1	1 set-up		TRUE	-	Uint8
0-11	Edit Set-up	[1] Set-up 1	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: Edit Set-ups / Channel	0 N/A	All set-ups		TRUE	0	Int32
0-15	Readout: actual setup	0 N/A	All set-ups		FALSE	0	Uint8
0-2* LCP Display							
0-20	Display Line 1.1 Small	1617	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	1602	All set-ups		TRUE	-	Uint16
0-25	My Personal Menu	App.Dependent	1 set-up		TRUE	0	Uint16
0-3* LCP Custom Readout							
0-30	Unit for User-defined Readout	[0] None	All set-ups		TRUE	-	Uint8
0-31	Min Value of User-defined Readout	0.00 CustomReadoutUnit	All set-ups		TRUE	-2	Int32
0-32	Max Value of User-defined Readout	100.00 CustomRea-doutUnit	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	null	All set-ups		TRUE	-	Uint8
0-41	[Off] Key on LCP	null	All set-ups		TRUE	-	Uint8
0-42	[Auto on] Key on LCP	null	All set-ups		TRUE	-	Uint8
0-43	[Reset] Key on LCP	null	All set-ups		TRUE	-	Uint8
0-44	[Off/Reset] Key on LCP	null	All set-ups		TRUE	-	Uint8
0-45	[Drive Bypass] Key on LCP	null	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	Quick Menu Password	200 N/A	1 set-up		TRUE	0	Int16
0-66	Access to Quick Menu w/o Password	[0] Full access	1 set-up		TRUE	-	Uint8
0-67	Bus Password Access	0 N/A	All set-ups		TRUE	0	Uint16

Table 6.15

6.3.2 1-** Load/Motor

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
1-0* General Settings							
1-00	Configuration Mode	null	All set-ups		TRUE	-	Uint8
1-01	Motor Control Principle	null	All set-ups		FALSE	-	Uint8
1-02	Flux Motor Feedback Source	[1] 24V encoder	All set-ups		FALSE	-	Uint8
1-03	Torque Characteristics	[0] Constant torque	All set-ups	x	TRUE	-	Uint8
1-04	Overload Mode	[0] High torque	All set-ups		FALSE	-	Uint8
1-05	Local Mode Configuration	[2] As mode par 1-00	All set-ups		TRUE	-	Uint8
1-06	Clockwise Direction	[0] Normal	All set-ups		FALSE	-	Uint8
1-1* Motor Selection							
1-10	Motor Construction	[0] Asynchron	All set-ups		FALSE	-	Uint8
1-2* Motor Data							
1-20	Motor Power [kW]	App.Dependent	All set-ups		FALSE	1	Uint32
1-21	Motor Power [HP]	App.Dependent	All set-ups		FALSE	-2	Uint32
1-22	Motor Voltage	App.Dependent	All set-ups		FALSE	0	Uint16
1-23	Motor Frequency	App.Dependent	All set-ups		FALSE	0	Uint16
1-24	Motor Current	App.Dependent	All set-ups		FALSE	-2	Uint32
1-25	Motor Nominal Speed	App.Dependent	All set-ups		FALSE	67	Uint16
1-26	Motor Cont. Rated Torque	App.Dependent	All set-ups		FALSE	-1	Uint32
1-29	Automatic Motor Adaptation (AMA)	[0] Off	All set-ups		FALSE	-	Uint8
1-3* Adv. Motor Data							
1-30	Stator Resistance (Rs)	App.Dependent	All set-ups		FALSE	-4	Uint32
1-31	Rotor Resistance (Rr)	App.Dependent	All set-ups		FALSE	-4	Uint32
1-33	Stator Leakage Reactance (X1)	App.Dependent	All set-ups		FALSE	-4	Uint32
1-34	Rotor Leakage Reactance (X2)	App.Dependent	All set-ups		FALSE	-4	Uint32
1-35	Main Reactance (Xh)	App.Dependent	All set-ups		FALSE	-4	Uint32
1-36	Iron Loss Resistance (Rfe)	App.Dependent	All set-ups		FALSE	-3	Uint32
1-37	d-axis Inductance (Ld)	App.Dependent	All set-ups	x	FALSE	-4	Int32
1-39	Motor Poles	App.Dependent	All set-ups		FALSE	0	Uint8
1-40	Back EMF at 1000 RPM	App.Dependent	All set-ups	x	FALSE	0	Uint16
1-41	Motor Angle Offset	0 N/A	All set-ups		FALSE	0	Int16
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]	App.Dependent	All set-ups		TRUE	67	Uint16
1-52	Min Speed Normal Magnetising [Hz]	App.Dependent	All set-ups		TRUE	-1	Uint16
1-53	Model Shift Frequency	App.Dependent	All set-ups	x	FALSE	-1	Uint16
1-54	Voltage reduction in fieldweakening	0 V	All set-ups		FALSE	0	Uint8
1-55	U/f Characteristic - U	App.Dependent	All set-ups		TRUE	-1	Uint16
1-56	U/f Characteristic - F	App.Dependent	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

Table 6.16

6.3.3 2-** Brakes

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver-sion index	Type
2-0* DC-Brake							
2-00	DC Hold 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]	App.Dependent	All set-ups		TRUE	67	Uint16
2-04	DC Brake Cut In Speed [Hz]	App.Dependent	All set-ups		TRUE	-1	Uint16
2-05	Maximum Reference	MaxReference (P303)	All set-ups		TRUE	-3	Int32
2-1* Brake Energy Funct.							
2-10	Brake Function	null	All set-ups		TRUE	-	Uint8
2-11	Brake Resistor (ohm)	App.Dependent	All set-ups		TRUE	0	Uint16
2-12	Brake Power Limit (kW)	App.Dependent	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	[0] Disabled	All set-ups		TRUE	-	Uint8
2-18	Brake Check Condition	[0] At Power Up	All set-ups		TRUE	-	Uint8
2-19	Over-voltage Gain	100 %	All set-ups		TRUE	0	Uint16
2-2* Mechanical Brake							
2-20	Release Brake Current	ImaxVLT (P1637)	All set-ups		TRUE	-2	Uint32
2-21	Activate Brake Speed [RPM]	App.Dependent	All set-ups		TRUE	67	Uint16
2-22	Activate Brake Speed [Hz]	App.Dependent	All set-ups		TRUE	-1	Uint16
2-23	Activate Brake Delay	0.0 s	All set-ups		TRUE	-1	Uint8
2-24	Stop Delay	0.0 s	All set-ups		TRUE	-1	Uint8
2-25	Brake Release Time	0.20 s	All set-ups		TRUE	-2	Uint16
2-26	Torque Ref	0.00 %	All set-ups		TRUE	-2	Int16
2-27	Torque Ramp Time	0.2 s	All set-ups		TRUE	-1	Uint8
2-28	Gain Boost Factor	1.00 N/A	All set-ups		TRUE	-2	Uint16

Table 6.17

6.3.4 3-** Reference/Ramps

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver- sion index	Type
3-0* Reference Limits							
3-00	Reference Range	null	All set-ups		TRUE	-	Uint8
3-01	Reference/Feedback Unit	null	All set-ups		TRUE	-	Uint8
3-02	Minimum Reference	App.Dependent	All set-ups		TRUE	-3	Int32
3-03	Maximum Reference	App.Dependent	All set-ups		TRUE	-3	Int32
3-04	Reference Function	[0] Sum	All set-ups		TRUE	-	Uint8
3-1* References							
3-10	Preset Reference	0.00 %	All set-ups		TRUE	-2	Int16
3-11	Jog Speed [Hz]	App.Dependent	All set-ups		TRUE	-1	Uint16
3-12	Catch up/slow Down Value	0.00 %	All set-ups		TRUE	-2	Int16
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 Resource 1	null	All set-ups		TRUE	-	Uint8
3-16	Reference Resource 2	null	All set-ups		TRUE	-	Uint8
3-17	Reference Resource 3	null	All set-ups		TRUE	-	Uint8
3-18	Relative Scaling Reference Resource	[0] No function	All set-ups		TRUE	-	Uint8
3-19	Jog Speed [RPM]	App.Dependent	All set-ups		TRUE	67	Uint16
3-4* Ramp 1							
3-40	Ramp 1 Type	[0] Linear	All set-ups		TRUE	-	Uint8
3-41	Ramp 1 Ramp up Time	App.Dependent	All set-ups		TRUE	-2	Uint32
3-42	Ramp 1 Ramp Down Time	App.Dependent	All set-ups		TRUE	-2	Uint32
3-45	Ramp 1 S-ramp Ratio at Accel. Start	50 %	All set-ups		TRUE	0	Uint8
3-46	Ramp 1 S-ramp Ratio at Accel. End	50 %	All set-ups		TRUE	0	Uint8
3-47	Ramp 1 S-ramp Ratio at Decel. Start	50 %	All set-ups		TRUE	0	Uint8
3-48	Ramp 1 S-ramp Ratio at Decel. End	50 %	All set-ups		TRUE	0	Uint8
3-5* Ramp 2							
3-50	Ramp 2 Type	[0] Linear	All set-ups		TRUE	-	Uint8
3-51	Ramp 2 Ramp up Time	App.Dependent	All set-ups		TRUE	-2	Uint32
3-52	Ramp 2 Ramp down Time	App.Dependent	All set-ups		TRUE	-2	Uint32
3-55	Ramp 2 S-ramp Ratio at Accel. Start	50 %	All set-ups		TRUE	0	Uint8
3-56	Ramp 2 S-ramp Ratio at Accel. End	50 %	All set-ups		TRUE	0	Uint8
3-57	Ramp 2 S-ramp Ratio at Decel. Start	50 %	All set-ups		TRUE	0	Uint8
3-58	Ramp 2 S-ramp Ratio at Decel. End	50 %	All set-ups		TRUE	0	Uint8
3-6* Ramp 3							
3-60	Ramp 3 Type	[0] Linear	All set-ups		TRUE	-	Uint8
3-61	Ramp 3 Ramp up Time	App.Dependent	All set-ups		TRUE	-2	Uint32
3-62	Ramp 3 Ramp down Time	App.Dependent	All set-ups		TRUE	-2	Uint32
3-65	Ramp 3 S-ramp Ratio at Accel. Start	50 %	All set-ups		TRUE	0	Uint8
3-66	Ramp 3 S-ramp Ratio at Accel. End	50 %	All set-ups		TRUE	0	Uint8
3-67	Ramp 3 S-ramp Ratio at Decel. Start	50 %	All set-ups		TRUE	0	Uint8
3-68	Ramp 3 S-ramp Ratio at Decel. End	50 %	All set-ups		TRUE	0	Uint8
3-7* Ramp 4							
3-70	Ramp 4 Type	[0] Linear	All set-ups		TRUE	-	Uint8
3-71	Ramp 4 Ramp up Time	App.Dependent	All set-ups		TRUE	-2	Uint32
3-72	Ramp 4 Ramp Down Time	App.Dependent	All set-ups		TRUE	-2	Uint32
3-75	Ramp 4 S-ramp Ratio at Accel. Start	50 %	All set-ups		TRUE	0	Uint8
3-76	Ramp 4 S-ramp Ratio at Accel. End	50 %	All set-ups		TRUE	0	Uint8
3-77	Ramp 4 S-ramp Ratio at Decel. Start	50 %	All set-ups		TRUE	0	Uint8

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver- sion index	Type
3-78	Ramp 4 S-ramp Ratio at Decel. End	50 %	All set-ups		TRUE	0	Uint8

Table 6.18

6.3.5 4-** Limits / Warnings

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver- sion index	Type
4-1* Motor Limits							
4-10	Motor Speed Direction	null	All set-ups		FALSE	-	Uint8
4-11	Motor Speed Low Limit [RPM]	App.Dependent	All set-ups		TRUE	67	Uint16
4-12	Motor Speed Low Limit [Hz]	App.Dependent	All set-ups		TRUE	-1	Uint16
4-13	Motor Speed High Limit [RPM]	App.Dependent	All set-ups		TRUE	67	Uint16
4-14	Motor Speed High Limit [Hz]	App.Dependent	All set-ups		TRUE	-1	Uint16
4-16	Torque Limit Motor Mode	App.Dependent	All set-ups		TRUE	-1	Uint16
4-17	Torque Limit Generator Mode	100.0 %	All set-ups		TRUE	-1	Uint16
4-18	Current Limit	App.Dependent	All set-ups		TRUE	-1	Uint32
4-19	Max Output Frequency	132.0 Hz	All set-ups		FALSE	-1	Uint16
4-2* Limit Factors							
4-20	Torque Limit Factor Source	[0] No function	All set-ups		TRUE	-	Uint8
4-21	Speed Limit Factor Source	[0] No function	All set-ups		TRUE	-	Uint8
4-3* Motor Speed Mon.							
4-30	Motor Feedback Loss Function	[2] Trip	All set-ups		TRUE	-	Uint8
4-31	Motor Feedback Speed Error	300 RPM	All set-ups		TRUE	67	Uint16
4-32	Motor Feedback Loss Timeout	0.05 s	All set-ups		TRUE	-2	Uint16
4-34	Tracking Error Function	null	All set-ups		TRUE	-	Uint8
4-35	Tracking Error	10 RPM	All set-ups		TRUE	67	Uint16
4-36	Tracking Error Timeout	1.00 s	All set-ups		TRUE	-2	Uint16
4-37	Tracking Error Ramping	100 RPM	All set-ups		TRUE	67	Uint16
4-38	Tracking Error Ramping Timeout	1.00 s	All set-ups		TRUE	-2	Uint16
4-39	Tracking Error After Ramping Timeout	5.00 s	All set-ups		TRUE	-2	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 Reference- FeedbackUnit	All set-ups		TRUE	-3	Int32
4-57	Warning Feedback High	999999.999 Reference- FeedbackUnit	All set-ups		TRUE	-3	Int32
4-58	Missing Motor Phase Function	null	All set-ups		TRUE	-	Uint8
4-6* Speed Bypass							
4-60	Bypass Speed From [RPM]	App.Dependent	All set-ups		TRUE	67	Uint16
4-61	Bypass Speed From [Hz]	App.Dependent	All set-ups		TRUE	-1	Uint16
4-62	Bypass Speed To [RPM]	App.Dependent	All set-ups		TRUE	67	Uint16
4-63	Bypass Speed To [Hz]	App.Dependent	All set-ups		TRUE	-1	Uint16

Table 6.19

6.3.6 5-** Digital In/Out

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
5-0* Digital I/O mode							
5-00	Digital I/O Mode	[0] PNP	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	x	TRUE	-	Uint8
5-1* Digital Inputs							
5-10	Terminal 18 Digital Input	null	All set-ups		TRUE	-	Uint8
5-11	Terminal 19 Digital Input	null	All set-ups		TRUE	-	Uint8
5-12	Terminal 27 Digital Input	null	All set-ups		TRUE	-	Uint8
5-13	Terminal 29 Digital Input	null	All set-ups	x	TRUE	-	Uint8
5-14	Terminal 32 Digital Input	null	All set-ups		TRUE	-	Uint8
5-15	Terminal 33 Digital Input	null	All set-ups		TRUE	-	Uint8
5-16	Terminal X30/2 Digital Input	null	All set-ups		TRUE	-	Uint8
5-17	Terminal X30/3 Digital Input	null	All set-ups		TRUE	-	Uint8
5-18	Terminal X30/4 Digital Input	null	All set-ups		TRUE	-	Uint8
5-19	Terminal 37 Safe Stop	[1] Safe Stop Alarm	1 set-up		TRUE	-	Uint8
5-20	Terminal X46/1 Digital Input	[0] No operation	All set-ups		TRUE	-	Uint8
5-21	Terminal X46/3 Digital Input	[0] No operation	All set-ups		TRUE	-	Uint8
5-22	Terminal X46/5 Digital Input	[0] No operation	All set-ups		TRUE	-	Uint8
5-23	Terminal X46/7 Digital Input	[0] No operation	All set-ups		TRUE	-	Uint8
5-24	Terminal X46/9 Digital Input	[0] No operation	All set-ups		TRUE	-	Uint8
5-25	Terminal X46/11 Digital Input	[0] No operation	All set-ups		TRUE	-	Uint8
5-26	Terminal X46/13 Digital Input	[0] No operation	All set-ups		TRUE	-	Uint8
5-3* Digital Outputs							
5-30	Terminal 27 Digital Output	null	All set-ups		TRUE	-	Uint8
5-31	Terminal 29 Digital Output	null	All set-ups	x	TRUE	-	Uint8
5-32	Term X30/6 Digi Out (MCB 101)	null	All set-ups		TRUE	-	Uint8
5-33	Term X30/7 Digi Out (MCB 101)	null	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	x	TRUE	0	Uint32
5-51	Term. 29 High Frequency	100 Hz	All set-ups	x	TRUE	0	Uint32
5-52	Term. 29 Low Ref./Feedb. Value	0.000 ReferenceFeed-backUnit	All set-ups	x	TRUE	-3	Int32
5-53	Term. 29 High Ref./Feedb. Value	App.Dependent	All set-ups	x	TRUE	-3	Int32
5-54	Pulse Filter Time Constant #29	100 ms	All set-ups	x	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 ReferenceFeed-backUnit	All set-ups		TRUE	-3	Int32
5-58	Term. 33 High Ref./Feedb. Value	App.Dependent	All set-ups		TRUE	-3	Int32
5-59	Pulse Filter Time Constant #33	100 ms	All set-ups		FALSE	-3	Uint16

Table 6.20

6.3.7 6-** Analog In/Out

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
6-0* Analog I/O Mode							
6-00	Live Zero Timeout Time	10 s	All set-ups		TRUE	0	Uint8
6-01	Live Zero Timeout Function	[0] Off	All set-ups		TRUE	-	Uint8
6-1* Analog Input 1							
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	0.14 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 ReferenceFeedbackUnit	All set-ups		TRUE	-3	Int32
6-15	Terminal 53 High Ref./Feedb. Value	App.Dependent	All set-ups		TRUE	-3	Int32
6-16	Terminal 53 Filter Time Constant	0.001 s	All set-ups		TRUE	-3	Uint16
6-2* Analog Input 2							
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	0.14 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 ReferenceFeedbackUnit	All set-ups		TRUE	-3	Int32
6-25	Terminal 54 High Ref./Feedb. Value	App.Dependent	All set-ups		TRUE	-3	Int32
6-26	Terminal 54 Filter Time Constant	0.001 s	All set-ups		TRUE	-3	Uint16
6-3* Analog Input 3							
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 ReferenceFeedbackUnit	All set-ups		TRUE	-3	Int32
6-35	Term. X30/11 High Ref./Feedb. Value	App.Dependent	All set-ups		TRUE	-3	Int32
6-36	Term. X30/11 Filter Time Constant	0.001 s	All set-ups		TRUE	-3	Uint16
6-4* Analog Input 4							
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 ReferenceFeedbackUnit	All set-ups		TRUE	-3	Int32
6-45	Term. X30/12 High Ref./Feedb. Value	App.Dependent	All set-ups		TRUE	-3	Int32
6-46	Term. X30/12 Filter Time Constant	0.001 s	All set-ups		TRUE	-3	Uint16
6-5* Analog Output 1							
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	Term 42 Output Bus Ctrl	0.00 %	All set-ups		TRUE	-2	N2
6-54	Terminal 42 Output Timeout Preset	0.00 %	1 set-up		TRUE	-2	Uint16
6-55	Analog Output Filter	[0] Off	1 set-up		TRUE	-	Uint8
6-6* Analog Output 2							
6-60	Terminal X30/8 Output	null	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 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

Table 6.21

6.3.8 7-** Controllers

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver- sion index	Type
7-0* Speed PID Ctrl.							
7-00	Speed PID Feedback Source	null	All set-ups		FALSE	-	Uint8
7-02	Speed PID Proportional Gain	App.Dependent	All set-ups		TRUE	-3	Uint16
7-03	Speed PID Integral Time	App.Dependent	All set-ups		TRUE	-4	Uint32
7-04	Speed PID Differentiation Time	App.Dependent	All set-ups		TRUE	-4	Uint16
7-05	Speed PID Diff. Gain Limit	5.0 N/A	All set-ups		TRUE	-1	Uint16
7-06	Speed PID Lowpass Filter Time	App.Dependent	All set-ups		TRUE	-4	Uint16
7-07	Speed PID Feedback Gear Ratio	1.0000 N/A	All set-ups		FALSE	-4	Uint32
7-08	Speed PID Feed Forward Factor	0 %	All set-ups		FALSE	0	Uint16
7-09	Speed PID Error Correction w/ Ramp	300RPM	All set-ups		TRUE	67	Uint32
7-1* Torque PI Ctrl.							
7-12	Torque PI Proportional Gain	100 %	All set-ups		TRUE	0	Uint16
7-13	Torque PI Integration Time	0.020 s	All set-ups		TRUE	-3	Uint16
7-2* Process Ctrl. Feedb							
7-20	Process CL Feedback 1 Resource	[0] No function	All set-ups		TRUE	-	Uint8
7-22	Process CL Feedback 2 Resource	[0] No function	All set-ups		TRUE	-	Uint8
7-3* Process PID Ctrl.							
7-30	Process PID Normal/ Inverse Control	[0] Normal	All set-ups		TRUE	-	Uint8
7-31	Process PID Anti Windup	[1] On	All set-ups		TRUE	-	Uint8
7-32	Process PID Start Speed	0 RPM	All set-ups		TRUE	67	Uint16
7-33	Process PID Proportional Gain	0.01 N/A	All set-ups		TRUE	-2	Uint16
7-34	Process PID Integral Time	10000.00 s	All set-ups		TRUE	-2	Uint32
7-35	Process PID Differentiation Time	0.00 s	All set-ups		TRUE	-2	Uint16
7-36	Process PID Diff. Gain Limit	5.0 N/A	All set-ups		TRUE	-1	Uint16
7-38	Process PID Feed Forward Factor	0 %	All set-ups		TRUE	0	Uint16
7-39	On Reference Bandwidth	5 %	All set-ups		TRUE	0	Uint8
7-4* Adv. Process PID I							
7-40	Process PID I-part Reset	[0] No	All set-ups		TRUE	-	Uint8
7-41	Process PID Output Neg. Clamp	-100 %	All set-ups		TRUE	0	Int16
7-42	Process PID Output Pos. Clamp	100 %	All set-ups		TRUE	0	Int16
7-43	Process PID Gain Scale at Min. Ref.	100 %	All set-ups		TRUE	0	Int16
7-44	Process PID Gain Scale at Max. Ref.	100 %	All set-ups		TRUE	0	Int16
7-45	Process PID Feed Fwd Resource	[0] No function	All set-ups		TRUE	-	Uint8
7-46	Process PID Feed Fwd Normal/ Inv. Ctrl.	[0] Normal	All set-ups		TRUE	-	Uint8
7-48	PCD Feed Forward	0 N/A	All set-ups	x	TRUE	0	Uint16
7-49	Process PID Output Normal/ Inv. Ctrl.	[0] Normal	All set-ups		TRUE	-	Uint8
7-5* Adv. Process PID II							
7-50	Process PID Extended PID	[1] Enabled	All set-ups		TRUE	-	Uint8
7-51	Process PID Feed Fwd Gain	1.00 N/A	All set-ups		TRUE	-2	Uint16
7-52	Process PID Feed Fwd Ramp up	0.01 s	All set-ups		TRUE	-2	Uint32
7-53	Process PID Feed Fwd Ramp down	0.01 s	All set-ups		TRUE	-2	Uint32
7-56	Process PID Ref. Filter Time	0.001 s	All set-ups		TRUE	-3	Uint16
7-57	Process PID Fb. Filter Time	0.001 s	All set-ups		TRUE	-3	Uint16

Table 6.22

6

6.3.9 8-** Comm. and Options

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver-sion index	Type
8-0* General Settings							
8-01	Control Site	[0] Digital and ctrl.word	All set-ups		TRUE	-	Uint8
8-02	Control Word Source	null	All set-ups		TRUE	-	Uint8
8-03	Control Word Timeout Time	1.0 s	1 set-up		TRUE	-1	Uint32
8-04	Control Word Timeout Function	null	1 set-up		TRUE	-	Uint8
8-05	End-of-Timeout Function	[1] Resume set-up	1 set-up		TRUE	-	Uint8
8-06	Reset Control Word Timeout	[0] Do not reset	All set-ups		TRUE	-	Uint8
8-07	Diagnosis Trigger	[0] Disable	2 set-ups		TRUE	-	Uint8
8-08	Readout Filtering	null	All set-ups		TRUE	-	Uint8
8-1* Ctrl. Word Settings							
8-10	Control Word Profile	[0] FC profile	All set-ups		TRUE	-	Uint8
8-13	Configurable Status Word STW	null	All set-ups		TRUE	-	Uint8
8-14	Configurable Control Word CTW	[1] Profile default	All set-ups		TRUE	-	Uint8
8-3* FC Port Settings							
8-30	Protocol	[0] FC	1 set-up		TRUE	-	Uint8
8-31	Address	1 N/A	1 set-up		TRUE	0	Uint8
8-32	FC Port Baud Rate	null	1 set-up		TRUE	-	Uint8
8-33	Parity / Stop Bits	[0] Even Parity, 1 Stop Bit	1 set-up		TRUE	-	Uint8
8-34	Estimated cycle time	0 ms	2 set-ups		TRUE	-3	Uint32
8-35	Minimum Response Delay	10 ms	All set-ups		TRUE	-3	Uint16
8-36	Max Response Delay	App.Dependent	1 set-up		TRUE	-3	Uint16
8-37	Max Inter-Char Delay	App.Dependent	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
8-41	Parameters for signals	0	All set-ups		FALSE	-	Uint16
8-42	PCD write configuration	App.Dependent	All set-ups		TRUE	-	Uint16
8-43	PCD read configuration	App.Dependent	All set-ups		TRUE	-	Uint16
8-5* Digital/Bus							
8-50	Coasting Select	[3] Logic OR	All set-ups		TRUE	-	Uint8
8-51	Quick Stop 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	[3] Logic OR	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
8-57	Profidrive OFF2 Select	[3] Logic OR	All set-ups		TRUE	-	Uint8
8-58	Profidrive OFF3 Select	[3] Logic OR	All set-ups		TRUE	-	Uint8
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
8-9* Bus Jog							
8-90	Bus Jog 1 Speed	100 RPM	All set-ups		TRUE	67	Uint16
8-91	Bus Jog 2 Speed	App.Dependent	All set-ups		TRUE	67	Uint16

Table 6.23

6.3.10 9-** Profibus

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	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	App.Dependent	1 set-up		TRUE	-	Uint16
9-16	PCD Read Configuration	App.Dependent	2 set-ups		TRUE	-	Uint16
9-18	Node Address	126 N/A	1 set-up		TRUE	0	Uint8
9-22	Telegram Selection	[100] None	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
9-75	DO Identification	0 N/A	All set-ups		TRUE	0	Uint16
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
9-99	Profibus Revision Counter	0 N/A	All set-ups		TRUE	0	Uint16

Table 6.24

6.3.11 10-** CAN Fieldbus

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	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	App.Dependent	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	App.Dependent	All set-ups		TRUE	-	Uint16
10-12	Process Data Config Read	App.Dependent	All 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	App.Dependent	All set-ups		TRUE	0	Uint16
10-33	Store Always	[0] Off	1 set-up		TRUE	-	Uint8
10-34	DeviceNet Product Code	App.Dependent	1 set-up		TRUE	0	Uint16
10-39	Devicenet F Parameters	0 N/A	All set-ups		TRUE	0	Uint32
10-5* CANopen							
10-50	Process Data Config Write.	App.Dependent	2 set-ups		TRUE	-	Uint16
10-51	Process Data Config Read.	App.Dependent	2 set-ups		TRUE	-	Uint16

Table 6.25

6.3.12 12-** Ethernet

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver- sion index	Type
12-0* IP Settings							
12-00	IP Address Assignment	null	2 set-ups		TRUE	-	Uint8
12-01	IP Address	0 N/A	1 set-up		TRUE	0	OctStr[4]
12-02	Subnet Mask	0 N/A	1 set-up		TRUE	0	OctStr[4]
12-03	Default Gateway	0 N/A	1 set-up		TRUE	0	OctStr[4]
12-04	DHCP Server	0 N/A	2 set-ups		TRUE	0	OctStr[4]
12-05	Lease Expires	App.Dependent	All set-ups		TRUE	0	TimD
12-06	Name Servers	0 N/A	1 set-up		TRUE	0	OctStr[4]
12-07	Domain Name	0 N/A	1 set-up		TRUE	0	VisStr[48]
12-08	Host Name	0 N/A	1 set-up		TRUE	0	VisStr[48]
12-09	Physical Address	0 N/A	1 set-up		TRUE	0	VisStr[17]
12-1* Ethernet Link Parameters							
12-10	Link Status	[0] No Link	1 set-up		TRUE	-	Uint8
12-11	Link Duration	App.Dependent	All set-ups		TRUE	0	TimD
12-12	Auto Negotiation	[1] On	2 set-ups		TRUE	-	Uint8
12-13	Link Speed	[0] None	2 set-ups		TRUE	-	Uint8
12-14	Link Duplex	[1] Full Duplex	2 set-ups		TRUE	-	Uint8
12-2* Process Data							
12-20	Control Instance	App.Dependent	1 set-up		TRUE	0	Uint8
12-21	Process Data Config Write	App.Dependent	All set-ups		TRUE	-	Uint16
12-22	Process Data Config Read	App.Dependent	All set-ups		TRUE	-	Uint16
12-23	Process Data Config Write Size	16 N/A	All set-ups		TRUE	0	Uint32
12-24	Process Data Config Read Size	16 N/A	All set-ups		TRUE	0	Uint32
12-27	Primary Master	0 N/A	1 set-up		FALSE	0	
12-28	Store Data Values	[0] Off	All set-ups		TRUE	-	Uint8
12-29	Store Always	[0] Off	1 set-up		TRUE	-	Uint8
12-3* EtherNet/IP							
12-30	Warning Parameter	0 N/A	All set-ups		TRUE	0	Uint16
12-31	Net Reference	[0] Off	2 set-ups		TRUE	-	Uint8
12-32	Net Control	[0] Off	2 set-ups		TRUE	-	Uint8
12-33	CIP Revision	App.Dependent	All set-ups		TRUE	0	Uint16
12-34	CIP Product Code	App.Dependent	1 set-up		TRUE	0	Uint16
12-35	EDS Parameter	0 N/A	All set-ups		TRUE	0	Uint32
12-37	COS Inhibit Timer	0 N/A	All set-ups		TRUE	0	Uint16
12-38	COS Filter	0 N/A	All set-ups		TRUE	0	Uint16
12-4* Modbus TCP							
12-40	Status Parameter	0 N/A	All set-ups		TRUE	0	Uint16
12-41	Slave Message Count	0 N/A	All set-ups		TRUE	0	Uint32
12-42	Slave Exception Message Count	0 N/A	All set-ups		TRUE	0	Uint32
12-5* EtherCAT							
12-50	Configured Station Alias	0 N/A	1 set-up		FALSE	0	Uint16
12-51	Configured Station Address	0 N/A	All set-ups		TRUE	0	Uint16
12-59	EtherCAT Status	0 N/A	All set-ups		TRUE	0	Uint32

Table 6.26

6.3.13 13-** Smart Logic

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	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	App.Dependent	2 set-ups		TRUE	-3	Int32
13-1* RS Flip Flops							
13-15	RS-FF Operand S	null	2 set-ups		TRUE	-	Uint8
13-16	RS-FF Operand R	null	2 set-ups		TRUE	-	Uint8
13-2* Timers							
13-20	SL Controller Timer	App.Dependent	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

Table 6.27

6

6.3.14 14-** Special Functions

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver-sion index	Type
14-0* Inverter Switching							
14-00	Switching Pattern	null	All set-ups		TRUE	-	Uint8
14-01	Switching Frequency	null	All set-ups		TRUE	-	Uint8
14-03	Overmodulation	[1] On	All set-ups		FALSE	-	Uint8
14-04	PWM Random	[0] Off	All set-ups		TRUE	-	Uint8
14-06	Dead Time Compensation	[1] On	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	App.Dependent	All set-ups		TRUE	0	Uint16
14-12	Function at Mains Imbalance	[0] Trip	All set-ups		TRUE	-	Uint8
14-13	Mains Failure Step Factor	1.0 N/A	All set-ups		TRUE	-1	Uint8
14-14	Kin. Backup Time Out	60 s	All set-ups		TRUE	0	Uint8
14-2* Trip Reset							
14-20	Reset Mode	[0] Manual reset	All set-ups		TRUE	-	Uint8
14-21	Automatic Restart Time	App.Dependent	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
14-24	Trip Delay at Current Limit	60 s	All set-ups		TRUE	0	Uint8
14-25	Trip Delay at Torque Limit	60 s	All set-ups		TRUE	0	Uint8
14-26	Trip Delay at Inverter Fault	App.Dependent	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	1.0 ms	All set-ups		TRUE	-4	Uint16
14-35	Stall Protection	[1] Enabled	All set-ups		FALSE	-	Uint8
14-4* Energy Optimising							
14-40	VT Level	66 %	All set-ups		FALSE	0	Uint8
14-41	AEO Minimum Magnetisation	App.Dependent	All set-ups		TRUE	0	Uint8
14-42	Minimum AEO Frequency	10 Hz	All set-ups		TRUE	0	Uint8
14-43	Motor Cosphi	App.Dependent	All set-ups		TRUE	-2	Uint16
14-5* Environment							
14-50	RFI Filter	[1] On	1 set-up	x	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	All set-ups		FALSE	-	Uint8
14-56	Capacitance Output Filter	App.Dependent	All set-ups		FALSE	-7	Uint16
14-57	Inductance Output Filter	App.Dependent	All set-ups		FALSE	-6	Uint16
14-59	Actual Number of Inverter Units	App.Dependent	1 set-up	x	FALSE	0	Uint8

Table 6.28

6.3.15 15-** Drive Information

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
15-0* Operating Data							
15-00	Operating Hours	0 h	All set-ups		FALSE	74	Uint32
15-01	Running Hours	0 h	All set-ups		FALSE	74	Uint32
15-02	kWh Counter	0 kWh	All set-ups		FALSE	75	Uint32
15-03	Power 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
15-1* Data Log Settings							
15-10	Logging Source	0	2 set-ups		TRUE	-	Uint16
15-11	Logging Interval	App.Dependent	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
15-3* Fault Log							
15-30	Fault Log: Error Code	0 N/A	All set-ups		FALSE	0	Uint8
15-31	Fault Log: Value	0 N/A	All set-ups		FALSE	0	Int16
15-32	Fault Log: Time	0 s	All set-ups		FALSE	0	Uint32
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]
15-59	CSIV Filename	App.Dependent	1 set-up		FALSE	0	VisStr[16]

Table 6.29

6.3.16 16-** Data Readouts

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
16-0* General Status							
16-00	Control Word	0 N/A	All set-ups		FALSE	0	V2
16-01	Reference [Unit]	0.000 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	Int16
16-17	Speed [RPM]	0 RPM	All set-ups		FALSE	67	Int32
16-18	Motor Thermal	0 %	All set-ups		FALSE	0	Uint8
16-19	KTY sensor temperature	0 °C	All set-ups		FALSE	100	Int16
16-20	Motor Angle	0 N/A	All set-ups		TRUE	0	Uint16
16-21	Torque [%] High Res.	0.0 %	All set-ups		FALSE	-1	Int16
16-22	Torque [%]	0 %	All set-ups		FALSE	0	Int16
16-25	Torque [Nm] High	0.0 Nm	All set-ups		FALSE	-1	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	App.Dependent	All set-ups		FALSE	-2	Uint32
16-37	Inv. Max. Current	App.Dependent	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
16-41	LCP Bottom Statusline	0 N/A	All set-ups		TRUE	0	VisStr[50]
16-49	Current Fault Source	0 N/A	All set-ups	x	TRUE	0	Uint8
16-5* Ref. & Feedb.							
16-50	External Reference	0.0 N/A	All set-ups		FALSE	-1	Int16
16-51	Pulse Reference	0.0 N/A	All set-ups		FALSE	-1	Int16
16-52	Feedback [Unit]	0.000 ReferenceFeed-backUnit	All set-ups		FALSE	-3	Int32
16-53	Digi Pot Reference	0.00 N/A	All set-ups		FALSE	-2	Int16
16-57	Feedback [RPM]	0 RPM	All set-ups		FALSE	67	Int32

Table 6.30

6.3.17 17-** Motor Feedb.Option

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver-sion index	Type
17-1* Inc. Enc. Interface							
17-10	Signal Type	[1] RS422 (5V TTL)	All set-ups		FALSE	-	Uint8
17-11	Resolution (PPR)	1024 N/A	All set-ups		FALSE	0	Uint16
17-2* Abs. Enc. Interface							
17-20	Protocol Selection	[0] None	All set-ups		FALSE	-	Uint8
17-21	Resolution (Positions/Rev)	App.Dependent	All set-ups		FALSE	0	Uint32
17-24	SSI Data Length	13 N/A	All set-ups		FALSE	0	Uint8
17-25	Clock Rate	App.Dependent	All set-ups		FALSE	3	Uint16
17-26	SSI Data Format	[0] Gray code	All set-ups		FALSE	-	Uint8
17-34	HIPERFACE Baudrate	[4] 9600	All set-ups		FALSE	-	Uint8
17-5* Resolver Interface							
17-50	Poles	2 N/A	1 set-up		FALSE	0	Uint8
17-51	Input Voltage	7.0 V	1 set-up		FALSE	-1	Uint8
17-52	Input Frequency	10.0 kHz	1 set-up		FALSE	2	Uint8
17-53	Transformation Ratio	0.5 N/A	1 set-up		FALSE	-1	Uint8
17-56	Encoder Sim. Resolution	[0] Disabled	1 set-up		FALSE	-	Uint8
17-59	Resolver Interface	[0] Disabled	All set-ups		FALSE	-	Uint8
17-6* Monitoring and App.							
17-60	Feedback Direction	[0] Clockwise	All set-ups		FALSE	-	Uint8
17-61	Feedback Signal Monitoring	[1] Warning	All set-ups		TRUE	-	Uint8

Table 6.31

6.3.18 18-** Data Readouts 2

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver-sion index	Type
18-3* Analog Readouts							
18-36	Analog Input X48/2 [mA]	0.000 N/A	All set-ups		TRUE	-3	Int32
18-37	Temp. Input X48/4	0 N/A	All set-ups		TRUE	0	Int16
18-38	Temp. Input X48/7	0 N/A	All set-ups		TRUE	0	Int16
18-39	Temp. Input X48/10	0 N/A	All set-ups		TRUE	0	Int16
18-6* Inputs & Outputs 2							
18-60	Digital Input 2	0 N/A	All set-ups		FALSE	0	Uint16
18-90 PID Readouts							
18-90	Process PID Error	0.0 %	All set-ups		FALSE	-1	Int16
18-91	Process PID Output	0.0 %	All set-ups		FALSE	-1	Int16
18-92	Process PID Clamped Output	0.0 %	All set-ups		FALSE	-1	Int16
18-93	Process PID Gain Scaled Output	0.0 %	All set-ups		FALSE	-1	Int16

Table 6.32

6.3.19 30-** Special Features

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
30-0* Wobbler							
30-00	Wobble Mode	[0] Abs. Freq., Abs. Time	All set-ups		FALSE	-	Uint8
30-01	Wobble Delta Frequency [Hz]	5.0 Hz	All set-ups		TRUE	-1	Uint8
30-02	Wobble Delta Frequency [%]	25 %	All set-ups		TRUE	0	Uint8
30-03	Wobble Delta Freq. Scaling Resource	[0] No function	All set-ups		TRUE	-	Uint8
30-04	Wobble Jump Frequency [Hz]	0.0 Hz	All set-ups		TRUE	-1	Uint8
30-05	Wobble Jump Frequency [%]	0 %	All set-ups		TRUE	0	Uint8
30-06	Wobble Jump Time	App.Dependent	All set-ups		TRUE	-3	Uint16
30-07	Wobble Sequence Time	10.0 s	All set-ups		TRUE	-1	Uint16
30-08	Wobble Up/ Down Time	5.0 s	All set-ups		TRUE	-1	Uint16
30-09	Wobble Random Function	[0] Off	All set-ups		TRUE	-	Uint8
30-10	Wobble Ratio	1.0 N/A	All set-ups		TRUE	-1	Uint8
30-11	Wobble Random Ratio Max.	10.0 N/A	All set-ups		TRUE	-1	Uint8
30-12	Wobble Random Ratio Min.	0.1 N/A	All set-ups		TRUE	-1	Uint8
30-19	Wobble Delta Freq. Scaled	0.0 Hz	All set-ups		FALSE	-1	Uint16
30-2* Adv. Start Adjust							
30-20	High Starting Torque Time [s]	0.00 s	All set-ups	x	TRUE	-2	Uint8
30-21	High Starting Torque Current [%]	100.0 %	All set-ups	x	TRUE	-1	Uint32
30-22	Locked Rotor Protection	[0] Off	All set-ups	x	TRUE	-	Uint8
30-23	Locked Rotor Detection Time [s]	0.10 s	All set-ups	x	TRUE	-2	Uint8
30-8* Compatibility (I)							
30-80	d-axis Inductance (Ld)	App.Dependent	All set-ups	x	FALSE	-6	Int32
30-81	Brake Resistor (ohm)	App.Dependent	1 set-up		TRUE	-2	Uint32
30-83	Speed PID Proportional Gain	App.Dependent	All set-ups		TRUE	-4	Uint32
30-84	Process PID Proportional Gain	0.100 N/A	All set-ups		TRUE	-3	Uint16

Table 6.33

6.3.20 32-** MCO Basic Settings

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver-sion index	Type
32-0* Encoder 2							
32-00	Incremental Signal Type	[1] RS422 (5V TTL)	2 set-ups		TRUE	-	Uint8
32-01	Incremental Resolution	1024 N/A	2 set-ups		TRUE	0	Uint32
32-02	Absolute Protocol	[0] None	2 set-ups		TRUE	-	Uint8
32-03	Absolute Resolution	8192 N/A	2 set-ups		TRUE	0	Uint32
32-04	Absolute Encoder Baudrate X55	[4] 9600	All set-ups		FALSE	-	Uint8
32-05	Absolute Encoder Data Length	25 N/A	2 set-ups		TRUE	0	Uint8
32-06	Absolute Encoder Clock Frequency	262.000 kHz	2 set-ups		TRUE	0	Uint32
32-07	Absolute Encoder Clock Generation	[1] On	2 set-ups		TRUE	-	Uint8
32-08	Absolute Encoder Cable Length	0 m	2 set-ups		TRUE	0	Uint16
32-09	Encoder Monitoring	[0] Off	2 set-ups		TRUE	-	Uint8
32-10	Rotational Direction	[1] No action	2 set-ups		TRUE	-	Uint8
32-11	User Unit Denominator	1 N/A	2 set-ups		TRUE	0	Uint32
32-12	User Unit Numerator	1 N/A	2 set-ups		TRUE	0	Uint32
32-13	Enc.2 Control	[0] No soft changing	2 set-ups		TRUE	-	Uint8
32-14	Enc.2 node ID	127 N/A	2 set-ups		TRUE	0	Uint8
32-15	Enc.2 CAN guard	null	2 set-ups		TRUE	-	Uint8
32-3* Encoder 1							
32-30	Incremental Signal Type	[1] RS422 (5V TTL)	2 set-ups		TRUE	-	Uint8
32-31	Incremental Resolution	1024 N/A	2 set-ups		TRUE	0	Uint32
32-32	Absolute Protocol	[0] None	2 set-ups		TRUE	-	Uint8
32-33	Absolute Resolution	8192 N/A	2 set-ups		TRUE	0	Uint32
32-35	Absolute Encoder Data Length	25 N/A	2 set-ups		TRUE	0	Uint8
32-36	Absolute Encoder Clock Frequency	262.000 kHz	2 set-ups		TRUE	0	Uint32
32-37	Absolute Encoder Clock Generation	[1] On	2 set-ups		TRUE	-	Uint8
32-38	Absolute Encoder Cable Length	0 m	2 set-ups		TRUE	0	Uint16
32-39	Encoder Monitoring	[0] Off	2 set-ups		TRUE	-	Uint8
32-40	Encoder Termination	[1] On	2 set-ups		TRUE	-	Uint8
32-43	Enc.1 Control	[0] No soft changing	2 set-ups		TRUE	-	Uint8
32-44	Enc.1 node ID	127 N/A	2 set-ups		TRUE	0	Uint8
32-45	Enc.1 CAN guard	null	2 set-ups		TRUE	-	Uint8
32-5* Feedback Source							
32-50	Source Slave	[2] Encoder 2	2 set-ups		TRUE	-	Uint8
32-51	MCO 302 Last Will	[1] Trip	2 set-ups		TRUE	-	Uint8
32-52	Source Master	[1] Encoder 1 X56	2 set-ups		TRUE	-	Uint8

Table 6.34

6.3.21 33-** MCO Adv. Settings

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver- sion index	Type
33-0* Home Motion							
33-00	Force HOME	[0] Home not forced	2 set-ups		TRUE	-	Uint8
33-01	Zero Point Offset from Home Pos.	0 N/A	2 set-ups		TRUE	0	Int32
33-02	Ramp for Home Motion	10 N/A	2 set-ups		TRUE	0	Uint32
33-03	Velocity of Home Motion	10 N/A	2 set-ups		TRUE	0	Int32
33-04	Behaviour during HomeMotion	[0] Revers and index	2 set-ups		TRUE	-	Uint8
33-1* Synchronization							
33-10	Sync Factor Master	1 N/A	2 set-ups		TRUE	0	Int32
33-11	Sync Factor Slave	1 N/A	2 set-ups		TRUE	0	Int32
33-12	Position Offset for Synchronization	0 N/A	2 set-ups		TRUE	0	Int32
33-13	Accuracy Window for Position Sync.	1000 N/A	2 set-ups		TRUE	0	Int32
33-14	Relative Slave Velocity Limit	0 %	2 set-ups		TRUE	0	Uint8
33-15	Marker Number for Master	1 N/A	2 set-ups		TRUE	0	Uint16
33-16	Marker Number for Slave	1 N/A	2 set-ups		TRUE	0	Uint16
33-17	Master Marker Distance	4096 N/A	2 set-ups		TRUE	0	Uint32
33-18	Slave Marker Distance	4096 N/A	2 set-ups		TRUE	0	Uint32
33-19	Master Marker Type	[0] Encoder Z positive	2 set-ups		TRUE	-	Uint8
33-20	Slave Marker Type	[0] Encoder Z positive	2 set-ups		TRUE	-	Uint8
33-21	Master Marker Tolerance Window	0 N/A	2 set-ups		TRUE	0	Uint32
33-22	Slave Marker Tolerance Window	0 N/A	2 set-ups		TRUE	0	Uint32
33-23	Start Behaviour for Marker Sync	[0] Start Function 1	2 set-ups		TRUE	-	Uint16
33-24	Marker Number for Fault	10 N/A	2 set-ups		TRUE	0	Uint16
33-25	Marker Number for Ready	1 N/A	2 set-ups		TRUE	0	Uint16
33-26	Velocity Filter	0 us	2 set-ups		TRUE	-6	Int32
33-27	Offset Filter Time	0 ms	2 set-ups		TRUE	-3	Uint32
33-28	Marker Filter Configuration	[0] Marker filter 1	2 set-ups		TRUE	-	Uint8
33-29	Filter Time for Marker Filter	0 ms	2 set-ups		TRUE	-3	Int32
33-30	Maximum Marker Correction	0 N/A	2 set-ups		TRUE	0	Uint32
33-31	Synchronisation Type	[0] Standard	2 set-ups		TRUE	-	Uint8
33-32	Feed Forward Velocity Adaptation	0 N/A	2 set-ups		TRUE	0	Uint32
33-33	Velocity Filter Window	0 N/A	2 set-ups		TRUE	0	Uint32
33-34	Slave Marker filter time	0 ms	2 set-ups		TRUE	-3	Uint32
33-4* Limit Handling							
33-40	Behaviour at End Limit Switch	[0] Call error handler	2 set-ups		TRUE	-	Uint8
33-41	Negative Software End Limit	-500000 N/A	2 set-ups		TRUE	0	Int32
33-42	Positive Software End Limit	500000 N/A	2 set-ups		TRUE	0	Int32
33-43	Negative Software End Limit Active	[0] Inactive	2 set-ups		TRUE	-	Uint8
33-44	Positive Software End Limit Active	[0] Inactive	2 set-ups		TRUE	-	Uint8
33-45	Time in Target Window	0 ms	2 set-ups		TRUE	-3	Uint8
33-46	Target Window LimitValue	1 N/A	2 set-ups		TRUE	0	Uint16
33-47	Size of Target Window	0 N/A	2 set-ups		TRUE	0	Uint16

Table 6.35

6.3.22 34-** MCO Data Readouts

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver-sion index	Type
34-0* PCD Write Par.							
34-01	PCD 1 Write to MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-02	PCD 2 Write to MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-03	PCD 3 Write to MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-04	PCD 4 Write to MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-05	PCD 5 Write to MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-06	PCD 6 Write to MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-07	PCD 7 Write to MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-08	PCD 8 Write to MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-09	PCD 9 Write to MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-10	PCD 10 Write to MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-2* PCD Read Par.							
34-21	PCD 1 Read from MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-22	PCD 2 Read from MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-23	PCD 3 Read from MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-24	PCD 4 Read from MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-25	PCD 5 Read from MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-26	PCD 6 Read from MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-27	PCD 7 Read from MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-28	PCD 8 Read from MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-29	PCD 9 Read from MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-30	PCD 10 Read from MCO	0 N/A	All set-ups		TRUE	0	Uint16
34-4* Inputs & Outputs							
34-40	Digital Inputs	0 N/A	All set-ups		TRUE	0	Uint16
34-41	Digital Outputs	0 N/A	All set-ups		TRUE	0	Uint16
34-5* Process Data							
34-50	Actual Position	0 N/A	All set-ups		TRUE	0	Int32
34-51	Commanded Position	0 N/A	All set-ups		TRUE	0	Int32
34-52	Actual Master Position	0 N/A	All set-ups		TRUE	0	Int32
34-53	Slave Index Position	0 N/A	All set-ups		TRUE	0	Int32
34-54	Master Index Position	0 N/A	All set-ups		TRUE	0	Int32
34-55	Curve Position	0 N/A	All set-ups		TRUE	0	Int32
34-56	Track Error	0 N/A	All set-ups		TRUE	0	Int32
34-57	Synchronizing Error	0 N/A	All set-ups		TRUE	0	Int32
34-58	Actual Velocity	0 N/A	All set-ups		TRUE	0	Int32
34-59	Actual Master Velocity	0 N/A	All set-ups		TRUE	0	Int32
34-60	Synchronizing Status	0 N/A	All set-ups		TRUE	0	Int32
34-61	Axis Status	0 N/A	All set-ups		TRUE	0	Int32
34-62	Program Status	0 N/A	All set-ups		TRUE	0	Int32
34-64	MCO 302 Status	0 N/A	All set-ups		TRUE	0	Uint16
34-65	MCO 302 Control	0 N/A	All set-ups		TRUE	0	Uint16
34-7* Diagnosis readouts							
34-70	MCO Alarm Word 1	0 N/A	All set-ups		FALSE	0	Uint32
34-71	MCO Alarm Word 2	0 N/A	All set-ups		FALSE	0	Uint32

Table 6.36

6.3.23 35-** Sensor Input Option

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver-sion index	Type
35-0* Temp. Input Mode							
35-00	Term. X48/4 Temp. Unit	[60] °C	All set-ups		TRUE	-	Uint8
35-01	Term. X48/4 Input Type	[0] Not Connected	All set-ups		TRUE	-	Uint8
35-02	Term. X48/7 Temp. Unit	[60] °C	All set-ups		TRUE	-	Uint8
35-03	Term. X48/7 Input Type	[0] Not Connected	All set-ups		TRUE	-	Uint8
35-04	Term. X48/10 Temp. Unit	[60] °C	All set-ups		TRUE	-	Uint8
35-05	Term. X48/10 Input Type	[0] Not Connected	All set-ups		TRUE	-	Uint8
35-06	Temperature Sensor Alarm Function	[5] Stop and trip	All set-ups		TRUE	-	Uint8
35-1* Temp. Input X48/4							
35-14	Term. X48/4 Filter Time Constant	0.001 s	All set-ups		TRUE	-3	Uint16
35-15	Term. X48/4 Temp. Monitor	[0] Disabled	All set-ups		TRUE	-	Uint8
35-16	Term. X48/4 Low Temp. Limit	App.Dependent	All set-ups		TRUE	0	Int16
35-17	Term. X48/4 High Temp. Limit	App.Dependent	All set-ups		TRUE	0	Int16
35-2* Temp. Input X48/7							
35-24	Term. X48/7 Filter Time Constant	0.001 s	All set-ups		TRUE	-3	Uint16
35-25	Term. X48/7 Temp. Monitor	[0] Disabled	All set-ups		TRUE	-	Uint8
35-26	Term. X48/7 Low Temp. Limit	App.Dependent	All set-ups		TRUE	0	Int16
35-27	Term. X48/7 High Temp. Limit	App.Dependent	All set-ups		TRUE	0	Int16
35-3* Temp. Input X48/10							
35-34	Term. X48/10 Filter Time Constant	0.001 s	All set-ups		TRUE	-3	Uint16
35-35	Term. X48/10 Temp. Monitor	[0] Disabled	All set-ups		TRUE	-	Uint8
35-36	Term. X48/10 Low Temp. Limit	App.Dependent	All set-ups		TRUE	0	Int16
35-37	Term. X48/10 High Temp. Limit	App.Dependent	All set-ups		TRUE	0	Int16
35-4* Analog Input X48/2							
35-42	Term. X48/2 Low Current	4.00 mA	All set-ups		TRUE	-5	Int16
35-43	Term. X48/2 High Current	20.00 mA	All set-ups		TRUE	-5	Int16
35-44	Term. X48/2 Low Ref./Feedb. Value	0.000 N/A	All set-ups		TRUE	-3	Int32
35-45	Term. X48/2 High Ref./Feedb. Value	100.000 N/A	All set-ups		TRUE	-3	Int32
35-46	Term. X48/2 Filter Time Constant	0.001 s	All set-ups		TRUE	-3	Uint16

Table 6.37

6.4 Parameter Lists - Active Filter

6.4.1 Operation/Display 0-**

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver- sion index	Type
0-0* Basic Settings							
0-01	Language	[0] English	1 set-up		TRUE	-	Uint8
0-04	Operating State at Power-up (Hand)	[1] Forced stop	All set-ups		TRUE	-	Uint8
0-1* Set-up Operations							
0-10	Active Set-up	[1] Set-up 1	1 set-up		TRUE	-	Uint8
0-11	Edit Set-up	[1] Set-up 1	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: Edit Set-ups / Channel	0 N/A	All set-ups		TRUE	0	Int32
0-2* LCP Display							
0-20	Display Line 1.1 Small	30112	All set-ups		TRUE	-	Uint16
0-21	Display Line 1.2 Small	30110	All set-ups		TRUE	-	Uint16
0-22	Display Line 1.3 Small	30120	All set-ups		TRUE	-	Uint16
0-23	Display Line 2 Large	30100	All set-ups		TRUE	-	Uint16
0-24	Display Line 3 Large	30121	All set-ups		TRUE	-	Uint16
0-25	My Personal Menu	ExpressionLimit	1 set-up		TRUE	0	Uint16
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
0-5* 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	Quick Menu Password	200 N/A	1 set-up		TRUE	0	Int16
0-66	Access to Quick Menu w/o Password	[0] Full access	1 set-up		TRUE	-	Uint8

Table 6.38

6.4.2 Digital In/Out 5-**

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver-sion index	Type
5-0* Digital I/O mode							
5-00	Digital I/O Mode	[0] PNP	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	x	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	[0] No operation	All set-ups		TRUE	-	Uint8
5-13	Terminal 29 Digital Input	[0] No operation	All set-ups		TRUE	-	Uint8
5-14	Terminal 32 Digital Input	[90] AC Contactor	All set-ups		TRUE	-	Uint8
5-15	Terminal 33 Digital Input	[91] DC Contactor	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
5-19	Terminal 37 Safe Stop	[1] Safe Stop Alarm	1 set-up		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	x	TRUE	-	Uint8
5-4* Relays							
5-40	Function Relay	[0] No operation	All set-ups		TRUE	-	Uint8
5-41	On Delay, Relay	0.30 s	All set-ups		TRUE	-2	Uint16
5-42	Off Delay, Relay	0.30 s	All set-ups		TRUE	-2	Uint16

Table 6.39

6.4.3 Comm. and Options 8-**

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver-sion index	Type
8-0* General Settings							
8-01	Control Site	[0] Digital and ctrl.word	All set-ups		TRUE	-	Uint8
8-02	Control Word Source	null	All set-ups		TRUE	-	Uint8
8-03	Control Word Timeout Time	1.0 s	1 set-up		TRUE	-1	Uint32
8-04	Control Word 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 Word Timeout	[0] Do not reset	All set-ups		TRUE	-	Uint8
8-3* FC Port Settings							
8-30	Protocol	[1] FC MC	1 set-up		TRUE	-	Uint8
8-31	Address	2 N/A	1 set-up		TRUE	0	Uint8
8-32	FC Port Baud Rate	[2] 9600 Baud	1 set-up		TRUE	-	Uint8
8-35	Minimum Response Delay	10 ms	All set-ups		TRUE	-3	Uint16
8-36	Max Response Delay	5000 ms	1 set-up		TRUE	-3	Uint16
8-37	Max Inter-Char Delay	25 ms	1 set-up		TRUE	-3	Uint16
8-5* Digital/Bus							
8-53	Start Select	[3] Logic OR	All set-ups		TRUE	-	Uint8
8-55	Set-up Select	[3] Logic OR	All set-ups		TRUE	-	Uint8

Table 6.40

6.4.4 Special Functions 14-**

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conversion index	Type
14-2* Trip Reset							
14-20	Reset Mode	[0] Manual reset	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
14-28	Production Settings	[0] No action	All set-ups		TRUE	-	Uint8
14-29	Service Code	0 N/A	All set-ups		TRUE	0	Int32
14-5* Environment							
14-50	RFI Filter	[1] On	1 set-up		FALSE	-	Uint8
14-53	Fan Monitor	[1] Warning	All set-ups		TRUE	-	Uint8
14-54	Bus Partner	1 N/A	2 set-ups		TRUE	0	Uint16

Table 6.41

6

6.4.5 FC Information 15-**

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	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
15-03	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
15-07	Reset Running Hours Counter	[0] Do not reset	All set-ups		TRUE	-	Uint8
15-1* Data Log Settings							
15-10	Logging Source	0	2 set-ups		TRUE	-	Uint16
15-11	Logging Interval	ExpressionLimit	2 set-ups		TRUE	-3	TimD
15-12	Trigger Event	[0] False	1 set-up		TRUE	-	Uint8
15-13	Logging Mode	[0] Log always	2 set-ups		TRUE	-	Uint8
15-14	Samples Before Trigger	50 N/A	2 set-ups		TRUE	0	Uint8
15-2* Historic Log							
15-20	Historic Log: Event	0 N/A	All set-ups		FALSE	0	Uint8
15-21	Historic Log: Value	0 N/A	All set-ups		FALSE	0	Uint32
15-22	Historic Log: Time	0 ms	All set-ups		FALSE	-3	Uint32
15-3* Fault Log							
15-30	Fault Log: Error Code	0 N/A	All set-ups		FALSE	0	Uint16
15-31	Fault Log: Value	0 N/A	All set-ups		FALSE	0	Int16
15-32	Fault Log: Time	0 s	All set-ups		FALSE	0	Uint32
15-4* Unit 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	Unit 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	Unit 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]
15-6* Option Ident							
15-60	Option Mounted	0 N/A	All set-ups		FALSE	0	VisStr[30]
15-61	Option SW Version	0 N/A	All set-ups		FALSE	0	VisStr[20]
15-62	Option Ordering No	0 N/A	All set-ups		FALSE	0	VisStr[8]
15-63	Option Serial No	0 N/A	All set-ups		FALSE	0	VisStr[18]
15-70	Option in Slot A	0 N/A	All set-ups		FALSE	0	VisStr[30]
15-71	Slot A Option SW Version	0 N/A	All set-ups		FALSE	0	VisStr[20]
15-72	Option in Slot B	0 N/A	All set-ups		FALSE	0	VisStr[30]
15-73	Slot B Option SW Version	0 N/A	All set-ups		FALSE	0	VisStr[20]
15-74	Option in Slot C0	0 N/A	All set-ups		FALSE	0	VisStr[30]
15-75	Slot C0 Option SW Version	0 N/A	All set-ups		FALSE	0	VisStr[20]
15-76	Option in Slot C1	0 N/A	All set-ups		FALSE	0	VisStr[30]
15-77	Slot C1 Option SW Version	0 N/A	All set-ups		FALSE	0	VisStr[20]

Table 6.42

6.4.6 Data Readouts 16-**

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver-sion index	Type
16-0* General Status							
16-00	Control Word	0 N/A	All set-ups		FALSE	0	V2
16-03	Status Word	0 N/A	All set-ups		FALSE	0	V2
16-3* AF Status							
16-30	DC Link Voltage	0 V	All set-ups		FALSE	0	Uint16
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	ExpressionLimit	All set-ups		FALSE	-2	Uint32
16-37	Inv. Max. Current	ExpressionLimit	All set-ups		FALSE	-2	Uint32
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
16-49	Current Fault Source	0 N/A	All set-ups		TRUE	0	Uint8
16-6* Inputs & Outputs							
16-60	Digital Input	0 N/A	All set-ups		FALSE	0	Uint16
16-66	Digital Output [bin]	0 N/A	All set-ups		FALSE	0	Int16
16-71	Relay Output [bin]	0 N/A	All set-ups		FALSE	0	Int16
16-8* Fieldbus & FC Port							
16-80	Fieldbus CTW 1	0 N/A	All set-ups		FALSE	0	V2
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
16-9* 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

Table 6.43

6.4.7 AF Settings 300-**

NOTE

Except for *300-10 Active Filter Nominal Voltage*, it is not recommended to change the settings in this par. group for the Low Harmonic Drive

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver-sion index	Type
300-0* General Settings							
300-00	Harmonic Cancellation Mode	[0] Overall	All set-ups		TRUE	-	Uint8
300-01	Compensation Priority	[0] Harmonics	All set-ups		TRUE	-	Uint8
300-1* Network Settings							
300-10	Active Filter Nominal Voltage	ExpressionLimit	2 set-ups		FALSE	0	Uint32
300-2* CT Settings							
300-20	CT Primary Rating	ExpressionLimit	2 set-ups		FALSE	0	Uint32
300-22	CT Nominal Voltage	342 V	2 set-ups		FALSE	0	Uint32
300-24	CT Sequence	[0] L1, L2, L3	2 set-ups		FALSE	-	Uint8
300-25	CT Polarity	[0] Normal	2 set-ups		FALSE	-	Uint8
300-26	CT Placement	[1] Load Current	2 set-ups		FALSE	-	Uint8
300-29	Start Auto CT Detection	[0] Off	All set-ups		FALSE	-	Uint8
300-3* Compensation							
300-30	Compensation Points	0.0 A	All set-ups		TRUE	-1	Uint32
300-35	Cosphi Reference	0.500 N/A	All set-ups		TRUE	-3	Uint16
300-4* Paralleling							
300-40	Master Follower Selection	[2] Not Paralleled	2 set-ups		FALSE	-	Uint8
300-41	Follower ID	1 N/A	2 set-ups		FALSE	0	Uint32
300-42	Num. of Follower AFs	1 N/A	2 set-ups		FALSE	0	Uint32
300-5* Sleep Mode							
300-50	Enable Sleep Mode	null	2 set-ups		TRUE	-	Uint8
300-51	Sleep Mode Trig Source	[0] Mains current	All set-ups		TRUE	-	Uint8
300-52	Sleep Mode Wake Up Trigger	ExpressionLimit	All set-ups		TRUE	0	Uint32
300-53	Sleep Mode Sleep Trigger	80 %	All set-ups		TRUE	0	Uint32

Table 6.44

6.4.8 AF Readouts 301-**

Par. No. #	Parameter description	Default value	4-set-up	FC 302 only	Change during operation	Conver- sion index	Type
301-0* Output Currents							
301-00	Output Current [A]	0.00 A	All set-ups		TRUE	-2	Int32
301-01	Output Current [%]	0.0 %	All set-ups		TRUE	-1	Int32
301-1* Unit Performance							
301-10	THD of Current [%]	0.0 %	All set-ups		TRUE	-1	Uint16
301-11	Estimated THD of Voltage [%]	0.0 %	All set-ups				Uint16
301-12	Power Factor	0.00 N/A	All set-ups		TRUE	-2	Uint16
301-13	Cosphi	0.00 N/A	All set-ups		TRUE	-2	Int16
301-14	Leftover Currents	0.0 A	All set-ups		TRUE	-1	Uint32
301-2* Mains Status							
301-20	Mains Current [A]	0 A	All set-ups		TRUE	0	Int32
301-21	Mains Frequency	0 Hz	All set-ups		TRUE	0	Uint8
301-22	Fund. Mains Current [A]	0 A	All set-ups		TRUE	0	Int32

Table 6.45

6

7 RS-485 Installation and Set-up

RS-485 is a two-wire bus interface compatible with multi-drop network topology, i.e., nodes can be connected as a bus, or via drop cables from a common trunk line. A total of 32 nodes can be connected to one network segment. Repeaters divide network segments.

NOTE
Each repeater functions as a node within the segment in which it is installed. Each node connected within a given network must have a unique node address across all segments.
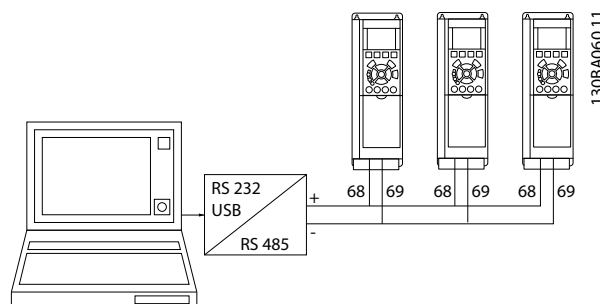
Terminate each segment at both ends using either the termination switch (S801) of the adjustable frequency drives or a biased termination resistor network. Always use shielded twisted pair (STP) cable for bus cabling, and always follow good common installation practice. Low-impedance ground connection of the shield at every node is important, including at high frequencies. Thus, connect a large surface of the shield to ground, for example, with a cable clamp or a conductive cable connector. It may be necessary to apply potential-equalizing cables to maintain the same ground potential throughout the network - particularly in installations with long cables.

To prevent impedance mismatch, always use the same type of cable throughout the entire network. When connecting a motor to the adjustable frequency drives, always use shielded motor cable.

Cable: Shielded twisted pair (STP)
Impedance: 120 Ω
Cable length: Max. 3,400 ft [1,200 m] (including drop lines)
Max. 1,650 ft [500 m] station-to-station

Table 7.1

7.1.1 Network Connection

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

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

Illustration 7.1

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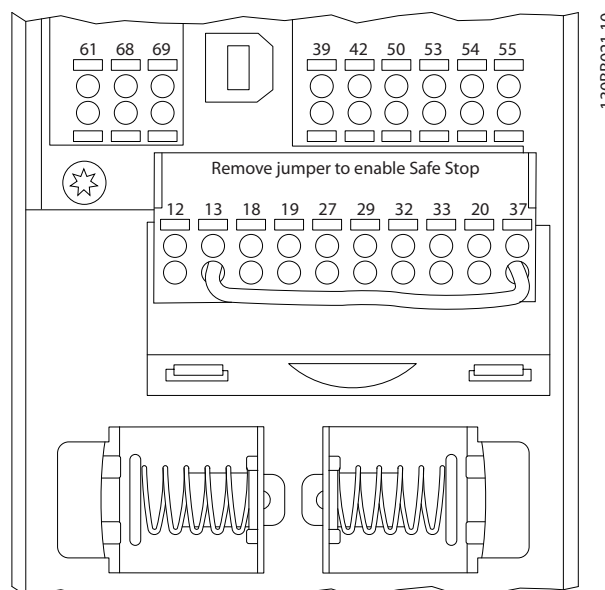

Illustration 7.2 Control Card Terminals

The RS-485 bus must be terminated by a resistor network at both ends. For this purpose, set switch S801 on the control card to "ON".
For more information, see *4.8.2 Switches S201, S202, and S801* .

Communication protocol must be set to *8-30 Protocol*.

7.1.2 EMC Precautions

The following EMC precautions are recommended in order to achieve interference-free operation of the RS-485 network.

Relevant national and local regulations, for example regarding protective ground connection, must be observed. The RS-485 communication cable must be kept away from motor and brake resistor cables to avoid coupling of high frequency noise from one cable to another. Normally a distance of 200 mm (8 inches) is sufficient, but keeping the greatest possible distance between the cables is generally recommended, especially where cables run in parallel over long distances. When crossing is unavoidable, the RS-485 cable must cross motor and brake resistor cables at an angle of 90 degrees.
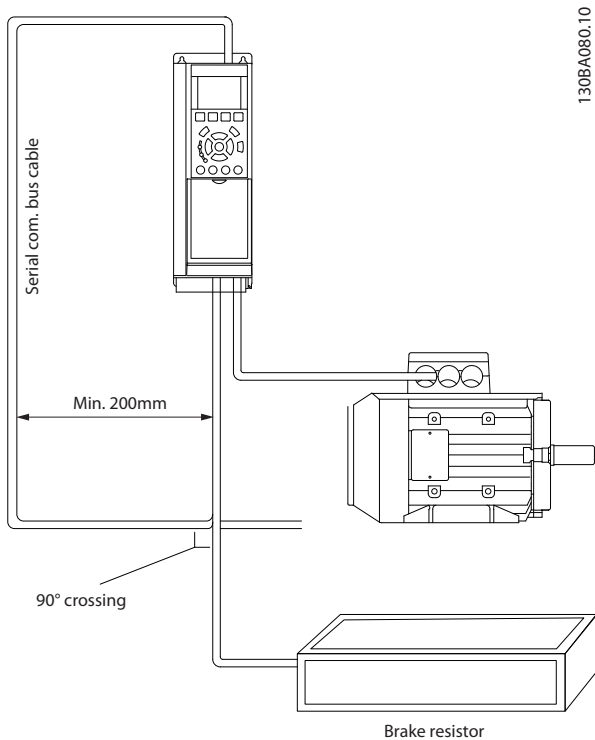
Illustration 7.3

The FC protocol, also referred to as FC bus or Standard bus, is the Danfoss standard serial communication bus. It defines an access technique according to the master-slave principle for communications via a serial bus.
One master and a maximum of 126 slaves can be connected to the bus. The master selects the individual slaves via an address character in the message. A slave itself can never transmit without first being requested to do so, and direct message transfer between the individual slaves is not possible. Communications occur in the half-duplex mode.

The master function cannot be transferred to another node (single-master system).

The physical layer is RS-485, thus utilizing the RS-485 port built into the adjustable frequency drive. The FC protocol supports different message formats:

- A short format of 8 bytes for process data.

- A long format of 16 bytes that also includes a parameter channel.

- A format used for texts.

7.2 Network Configuration

7.2.1 FC 300 Adjustable Frequency Drive Set-up

Set the following parameters to enable the FC protocol for the adjustable frequency drive.

Parameter Number	Setting
8-30 Protocol	FC
8-31 Address	1–126
8-32 FC Port Baud Rate	2400–115200
8-33 Parity / Stop Bits	Even parity, 1 stop bit (default)

Table 7.2

7.3 FC Protocol Message Framing Structure

7.3.1 Content of a Character (byte)

Each character transferred begins with a start bit. Then 8 data bits are transferred, corresponding to a byte. Each character is secured via a parity bit. This bit is set at "1" when it reaches parity. Parity is when there is an equal number of 1s in the 8 data bits and the parity bit in total. A stop bit completes a character, thus consisting of 11 bits in all.
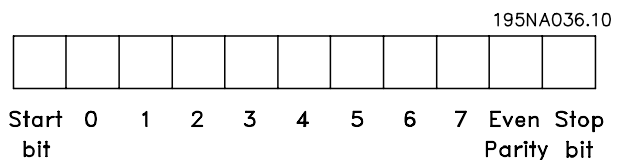

Illustration 7.4

7.3.2 Message Structure

Each message has the following structure:

1. Start character (STX)=02 Hex
2. A byte denoting the message length (LGE)
3. A byte denoting the adjustable frequency drive address (ADR)

A number of data bytes (variable, depending on the type of message) follows.

A data control byte (BCC) completes the message.

Illustration 7.5

7.3.3 Message Length (LGE)

The message length is the number of data bytes plus the address byte ADR and the data control byte BCC.

Data	Length
4 data bytes	LGE = 4 + 1 + 1 = 6 bytes
12 data bytes	LGE = 12 + 1 + 1 = 14 bytes
Messages containing texts	10[1]+n bytes

Table 7.3

[1] The 10 represents the fixed characters, while the "n'" is variable (depending on the length of the text).

7.3.4 Adjustable frequency drive Address (ADR)

Two different address formats are used.
The address range of the adjustable frequency drive is either 1-31 or 1-126.

1. Address format 1-31:

Illustration 7.6

Bit 7 = 0 (address format 1-31 active)

Bit 6 is not used

Bit 5 = 1: Broadcast, address bits (0-4) are not used

Bit 5 = 0: No Broadcast

Bit 0-4 = adjustable frequency drive address 1-31

2. Address format 1-126:

Bit 7 = 1 (address format 1-126 active)

Bit 0-6 = adjustable frequency drive address 1-126

Bit 0-6 = 0 Broadcast

The slave returns the address byte unchanged to the master in the response message.

7.3.5 Data Control Byte (BCC)

The checksum is calculated as an XOR-function. Before the first byte in the message is received, the calculated checksum is 0.

7.3.6 The Data Field

The structure of data blocks depends on the type of message. There are three message types, and the type applies for both control messages (master=>slave) and response messages (slave=>master).

The three types of message are:

Process block (PCD)
The PCD is made up of a data block of 4 bytes (two words) and contains:

-   Control word and reference value (from master to slave)
-   Status word and present output frequency (from slave to master)

Parameter block

The parameter block is used to transfer parameters between master and slave. The data block is made up of 12 bytes (6 words) and also contains the process block.
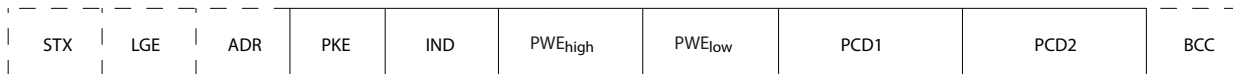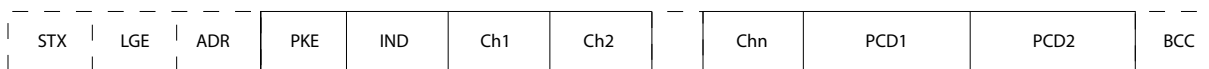

Illustration 7.7

Text block

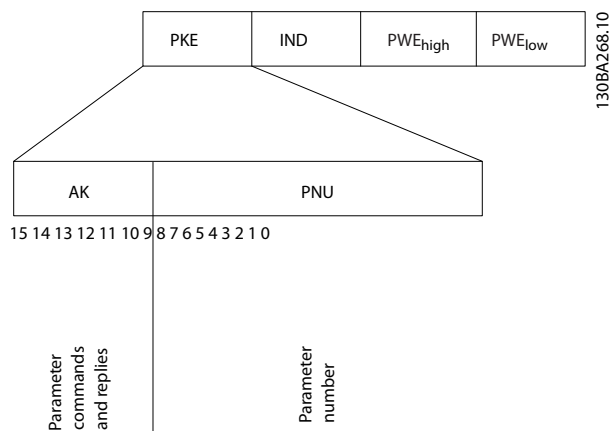The text block is used to read or write texts via the data block.

Illustration 7.8

7.3.7 The PKE Field

The PKE field contains two sub-fields: Parameter command and response AK, and parameter number PNU:

Bits no. 12-15 transfer parameter commands from master to slave and return processed slave responses to the master.

Illustration 7.9

Parameter commands master ⇒ slave				
Bit no.				Parameter command
15	14	13	12	
0	0	0	0	No command
0	0	0	1	Read parameter value
0	0	1	0	Write parameter value in RAM (word)
0	0	1	1	Write parameter value in RAM (double word)
1	1	0	1	Write parameter value in RAM and EEPROM (double word)
1	1	1	0	Write parameter value in RAM and EEPROM (word)
1	1	1	1	Read/write text

Table 7.4

Response slave ⇒master				
Bit no.				**Response**
15	14	13	12	
0	0	0	0	No response
0	0	0	1	Parameter value transferred (word)
0	0	1	0	Parameter value transferred (double word)
0	1	1	1	Command cannot be performed
1	1	1	1	text transferred

Table 7.5

If the command cannot be performed, the slave sends this response:

0111 Command cannot be performed

- and issues the following fault report in the parameter value (PWE):

PWE low (Hex)	Fault Report
0	The parameter number used does not exist
1	There is no write access to the defined parameter
2	Data value exceeds the parameter's limits
3	The sub index used does not exist
4	The parameter is not the array type.
5	The data type does not match the defined parameter
11	Data change in the defined parameter is not possible in the adjustable frequency drive's present mode. Certain parameters can only be changed when the motor is turned off
82	There is no bus access to the defined parameter
83	Data change is not possible because the factory set-up is selected.

Table 7.6

7.3.8 Parameter Number (PNU)

Bits no. 0-11 transfer parameter numbers. The function of the relevant parameter is defined in the parameter description in the *VLT® AutomationDrive Programming Guide, MG33MXYY*.

7.3.9 Index (IND)

The index is used together with the parameter number to read/write-access parameters with an index, e.g., *15-30 Alarm Log: Error Code*. The index consists of 2 bytes, a low byte and a high byte.

Only the low byte is used as an index.

7.3.10 Parameter Value (PWE)

The parameter value block consists of 2 words (4 bytes), and the value depends on the defined command (AK). The master prompts for a parameter value when the PWE block contains no value. To change a parameter value (write), write the new value in the PWE block and send from the master to the slave.

When a slave responds to a parameter request (read command), the present parameter value in the PWE block is transferred and returned to the master. If a parameter contains not a numerical value but several data options, e.g., *0-01 Language* where [0] corresponds to English, and [4] corresponds to Danish, select the data value by entering the value in the PWE block. See Example - Selecting a data value. Serial communication is only capable of reading parameters containing data type 9 (text string).

15-40 FC Type to *15-53 Power Card Serial Number* contain data type 9.
For example, read the unit size and AC line voltage range in *15-40 FC Type*. When a text string is transferred (read), the length of the telegram is variable, and the texts are of different lengths. The message length is defined in the second byte of the message, LGE. When using text transfer the index character indicates whether it is a read or a write command.

To read a text via the PWE block, set the parameter command (AK) to 'F' Hex. The index character high-byte must be "4".

Some parameters contain text that can be written to via the serial bus. To write a text via the PWE block, set the

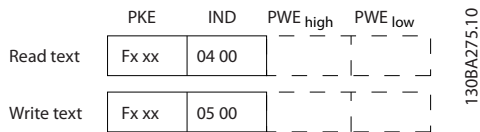parameter command (AK) to 'F' Hex. The index characters high-byte must be "5".

Illustration 7.10

7.3.11 Data Types Supported by FC 300

Unsigned means that there is no operational sign in the message.

Data types	Description
3	Integer 16
4	Integer 32
5	Unsigned 8
6	Unsigned 16
7	Unsigned 32
9	Text string
10	Byte string
13	Time difference
33	Reserved
35	Bit sequence

Table 7.7

7.3.12 Conversion

The various attributes of each parameter are displayed in the section Factory Settings. Parameter values are transferred as whole numbers only. Conversion factors are therefore used to transfer decimals.

4-12 Motor Speed Low Limit [Hz] has a conversion factor of 0.1.
To preset the minimum frequency to 10 Hz, transfer the value 100. A conversion factor of 0.1 means that the value transferred is multiplied by 0.1. The value 100 is thus perceived as 10.0.

Examples:
0s --> conversion index 0
0.00s --> conversion index -2
0ms --> conversion index -3
0.00ms --> conversion index -5

Conversion index	Conversion factor
100	
75	
74	
67	
6	1,000,000
5	100,000
4	10,000
3	1000
2	100
1	10
0	1
-1	0.1
-2	0.01
-3	0.001
-4	0.0001
-5	0.00001
-6	0.000001
-7	0.0000001

Table 7.8 Conversion Table

7.3.13 Process Words (PCD)

The block of process words is divided into two blocks of 16 bits, which always occur in the defined sequence.

PCD 1	PCD 2
Control message (master⇒ slave control word)	Reference value
Control message (slave ⇒ master) status word	Present output frequency

Table 7.9

7.4 Examples

7.4.1 Writing a Parameter Value

Change *4-14 Motor Speed High Limit [Hz]* to 100 Hz. Write the data in EEPROM.

PKE = E19E Hex - Write single word in *4-14 Motor Speed High Limit [Hz]*
IND = 0000 Hex
PWEHIGH = 0000 Hex
PWELOW = 03E8 Hex - Data value 1000, corresponding to 100 Hz, see *7.3.12 Conversion*.

7

The message will look like this:

Illustration 7.11

NOTE
4-14 Motor Speed High Limit [Hz] **is a single word, and the parameter command for write in EEPROM is "E".** *4-14 Motor Speed High Limit [Hz]* **is 19E in hexadecimal.**

The response from the slave to the master will be:

Illustration 7.12

7.4.2 Reading a Parameter Value

Read the value in *3-41 Ramp 1 Ramp Up Time*

PKE = 1155 Hex - Read parameter value in *3-41 Ramp 1 Ramp Up Time*
IND = 0000 Hex
PWEHIGH = 0000 Hex
PWELOW = 0000 Hex

Illustration 7.13

If the value in *3-41 Ramp 1 Ramp Up Time* is 10 s, the response from the slave to the master will be:

Illustration 7.14

3E8 Hex corresponds to 1000 decimal. The conversion index for *3-41 Ramp 1 Ramp Up Time* is -2, i.e., 0.01. *3-41 Ramp 1 Ramp Up Time* is of the type *Unsigned 32*.

7.5 How to Access Parameters

7.5.1 Parameter Handling

The PNU (Parameter Number) is translated from the register address contained in the Modbus read or write message. The parameter number is translated to Modbus as (10 x parameter number) DECIMAL.

7.5.2 Storage of Data

The Coil 65 decimal determines whether data written to the message are stored in EEPROM and RAM (coil 65 = 1) or only in RAM (coil 65 = 0).

7.5.3 IND

The array index is set in Holding Register 9 and used when accessing array parameters.

7.5.4 Text Blocks

Parameters stored as text strings are accessed in the same way as the other parameters. The maximum text block size is 20 characters. If a read request for a parameter is for more characters than the parameter stores, the response is truncated. If the read request for a parameter is for fewer characters than the parameter stores, the response is padded with spaces.

7.5.5 Conversion Factor

The different attributes for each parameter can be seen in the section on factory settings. Since a parameter value can only be transferred as a whole number, a conversion factor must be used to transfer decimals.

7.5.6 Parameter Values

Standard Data Types
Standard data types are int16, int32, uint8, uint16 and uint32. They are stored as 4x registers (40001 – 4FFFF). The parameters are read using function 03HEX "Read Holding Registers." Parameters are written using the function 6HEX "Preset Single Register" for 1 register (16 bits), and the function 10HEX "Preset Multiple Registers" for 2 registers (32 bits). Readable sizes range from 1 register (16 bits) up to 10 registers (20 characters).

Non standard Data Types

Non standard data types are text strings stored as 4x registers (40001–4FFFF). The parameters are read using function 03HEX "Read Holding Registers" and written using function 10HEX "Preset Multiple Registers." Readable sizes range from 1 register (2 characters) up to 10 registers (20 characters).

7

8 General Specifications

Line power supply (L1, L2, L3)

Supply voltage	380–480 V +5%

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

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

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

Motor output (U, V, W)

Output voltage	0–100% of supply voltage
Output frequency	0–800* Hz
Switching on output	Unlimited
Ramp times	1–3600 s

* Voltage and power dependent

Torque characteristics

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

*Percentage relates to the adjustable frequency drive's nominal torque.

Cable lengths and cross-sections

Max. motor cable length, shielded/armored	490 ft [150 m]
Max. motor cable length, non-shielded/unarmored	980 ft [300 m]
Max. cross-section to motor, line power, load sharing and brake *	
Maximum cross-section to control terminals, rigid wire	0.0023 in² [1.5 mm²]/16 AWG (2 x 0.0012 in² [0.75 mm²])
Maximum cross-section to control terminals, flexible cable	0.0016 in² [1 mm²]/18 AWG
Maximum cross-section to control terminals, cable with enclosed core	0.0008 in² [0.5 mm²]/20 AWG
Minimum cross-section to control terminals	0.00039 in² [0.25 mm²]

* See Line Power Supply tables for more information!

Digital inputs

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

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

Analog inputs

Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	Switch S201 and switch S202
Voltage mode	Switch S201/switch S202 = OFF (U)
Voltage level	0 to + 10 V (scaleable)
Input resistance, R_i	approx. 10 kΩ
Max. voltage	± 20 V
Current mode	Switch S201/switch S202 = ON (I)
Current level	0/4 to 20 mA (scaleable)
Input resistance, R_i	approx. 200 Ω
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.
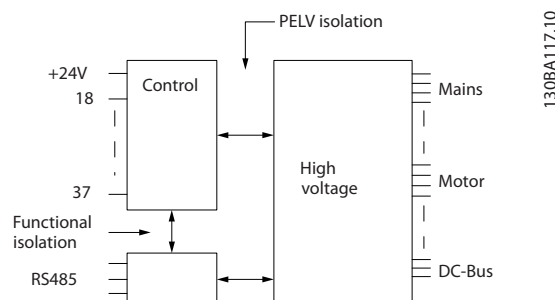
Illustration 8.1

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

1) IEC 60947 parts 4 and 5
The relay contacts are galvanically isolated from the rest of the circuit by reinforced isolation (PELV).
2) Overvoltage Category II
3) UL applications 300 V AC 2 A

Control card, 10 V DC output

Terminal number	50
Output voltage	10.5 V ±0.5 V
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, frame size D and E	IP 21, IP 54 (hybrid)
Enclosure, frame size F	IP 21, IP 54 (hybrid)
Vibration test	0.7 g
Relative humidity	5%–95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43) H$_2$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. 131°F [55°C][1]
- with full output power, typical EFF2 motors	max. 122°F [50°C][1]
- at full continuous FC output current	max. 113°F [45°C][1]

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

Minimum ambient temperature during full-scale operation	32°F [0°C]
Minimum ambient temperature at reduced performance	14°F [-10°C]
Temperature during storage/transport	-15°–+150°/160°F [-25–+65/70°C]
Maximum altitude above sea level without derating	3,300 ft [1,000 m]
Maximum altitude above sea level with derating	3,300 ft [1,000 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
	EN 61800-3, EN 61000-6-1/2,
EMC standards, Immunity	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 ground protection. Use only isolated laptop/PC as connection to the USB connector on the adjustable frequency drive or an isolated USB cable/drive.
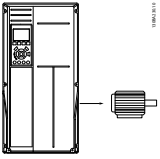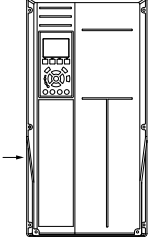
Protection and Features:

- Electronic thermal motor protection against overload.

- Temperature monitoring of the heatsink ensures that the adjustable frequency drive trips if the temperature reaches a predefined level. An overload temperature cannot be reset until the temperature of the heatsink is below the values stated in the tables on the following pages (Guideline - these temperatures may vary for different power sizes, frame sizes, enclosure ratings, etc.).

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

- If a line phase is missing, the adjustable frequency drive trips or issues a warning (depending on the load).

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

- The adjustable frequency drive is protected against ground faults on motor terminals U, V, W.

Line Power Supply 3 x 380–480 VAC							
FC 302		P132		P160		P200	
High/ Normal Load*		HO	NO	HO	NO	HO	NO
	Typical Shaft output at 400 V [kW]	132	160	160	200	200	250
	Typical Shaft output at 460 V [HP]	200	250	250	300	300	350
	Typical Shaft output at 480 V [kW]	218, 160	272, 200	272, 200	340, 250	340, 250	428, 315
	Enclosure IP21	D13		D13		D13	
	Enclosure IP54	D13		D13		D13	
	Output current						
	Continuous (at 400 V) [A]	260	315	315	395	395	480
	Intermittent (60 s overload) (at 400 V) [A]	390	347	473	435	593	528
	Continuous (at 460/480 V) [A]	240	302	302	361	361	443
	Intermittent (60 s overload) (at 460/480 V) [A]	360	332	453	397	542	487
	Continuous KVA (at 400 V) [KVA]	180	218	218	274	274	333
	Continuous KVA (at 460 V) [KVA]	191	241	241	288	288	353
	Continuous KVA (at 480 V) [KVA]	208	262	262	313	313	384
Max. input current							
	Continuous (at 400 V) [A]	251	304	304	381	381	463
	Continuous (at 460/480 V) [A]	231	291	291	348	348	427
	Max. cable size, line power motor, brake and load share [mm² (AWG²))]	2 x 185 (2 x 300 mcm)		2 x 185 (2 x 300 mcm)		2 x 185 (2 x 300 mcm)	
	Max. external electrical fuses [A] 1	400		500		630	
	Estimated motor power loss at 400 V [hp, W] [4]	5.40, 4029		6.88, 5130		7.54, 5621	
	Estimated motor power loss at 460 V [hp, W]	5.3, 3892		6.3, 4646		7.0, 5126	
	Estimated filter losses, 400 V	6.64, 4954		7.66, 5714		8.36, 6234	
	Estimated filter losses, 480 V	7.08, 5279		7.80, 5819		8.96, 6681	
	Weight, enclosure IP21, IP 54 (lb [kg])	837 [380]		837 [380]		895 [406]	
	Efficiency[4]	0.96					
	Output frequency	0–800 Hz					
	Heatsink overtemp. trip	230°F [110°C]		230°F [110°C]		230°F [110°C]	
	Power card ambient trip	140°F [60°C]					
* High overload = 160% torque during 60 s, Normal overload = 110% torque during 60 s							

Table 8.1

Line Power Supply 3 x 380–480 VAC									
FC 302		**P250**		**P315**		**P355**		**P400**	
High/ Normal Load*		HO	NO	HO	NO	HO	NO	HO	NO
	Typical Shaft output at 400 V [kW]	250	315	315	355	355	400	400	450
	Typical Shaft output at 460 V [HP]	350	450	450	500	500	600	550	600
	Typical Shaft output at 480 V [kW]	315	355	355	400	400	500	500	530
	Enclosure IP21	E9		E9		E9		E9	
	Enclosure IP54	E9		E9		E9		E9	
	Output current								
	Continuous (at 400 V) [A]	480	600	600	658	658	745	695	800
	Intermittent (60 s overload) (at 400 V) [A]	720	660	900	724	987	820	1043	880
	Continuous (at 460/480 V) [A]	443	540	540	590	590	678	678	730
	Intermittent (60 s overload) (at 460/480 V) [A]	665	594	810	649	885	746	1017	803
	Continuous KVA (at 400 V) [KVA]	333	416	416	456	456	516	482	554
	Continuous KVA (at 460 V) [KVA]	353	430	430	470	470	540	540	582
	Continuous KVA (at 480 V) [KVA]	384	468	468	511	511	587	587	632
Max. input current									
	Continuous (at 400 V) [A]	472	590	590	647	647	733	684	787
	Continuous (at 460/480 V) [A]	436	531	531	580	580	667	667	718
	Max. cable size, line power, motor and load share [mm^2 (AWG$^{2)}$)]	4x240 (4x500 mcm)		4x240 (4x500 mcm)		4x240 (4x500 mcm)		4x240 (4x500 mcm)	
	Max. cable size, brake [mm^2 (AWG$^{2)}$)	2 x 185 (2 x 350 mcm)		2 x 185 (2 x 350 mcm)		2 x 185 (2 x 350 mcm)		2 x 185 (2 x 350 mcm)	
	Max. external electrical fuses [A] 1	700		900		900		900	
	Estimated motor power loss at 400 V [hp, W] [4)	8.99, 6704		10.01, 7528		11.63, 8671		12.70, 9469	
	Estimated motor power loss at 460 V [hp, W]	7.95, 5930		9.02, 6724		10.49, 7820		11.43, 8527	
	Estimated filter losses, 400 V	8.86, 6607		9.45, 7049		10.36, 7725		11.04, 8234	
	Estimated filter losses, 460 V	8.94, 6670		9.42, 7023		10.32, 7697		10.86, 8099	
	Weight, enclosure IP21, IP 54 (lb [kg])	1314 [596]		1375 [623]		1424 [646]		1424 [646]	
	Efficiency[4)	0.96							
	Output frequency	0–600 Hz							
	Heatsink overtemp. trip	230°F [110°C]							
	Power card ambient trip	154.4°F [68°C]							
* High overload = 160% torque during 60 s, Normal overload = 110% torque during 60 s									

Table 8.2

Line Power Supply 3 x 380–480 V AC									
FC 302			P450		P500		P560		P630
High/ Normal Load*		HO	NO	HO	NO	HO	NO	HO	NO
	Typical Shaft output at 400 V [kW]	450	500	500	560	560	630	630	710
	Typical Shaft output at 460 V [HP]	600	650	650	750	750	900	900	1000
	Typical Shaft output at 480 V [kW]	530	560	560	630	630	710	710	800
	EnclosureIP21, 54	F18		F18		F18		F18	
	Output current								
	Continuous (at 400 V) [A]	800	880	880	990	990	1120	1120	1260
	Intermittent (60 s overload) (at 400 V) [A]	1200	968	1320	1089	1485	1232	1680	1386
	Continuous (at 460/480 V) [A]	730	780	780	890	890	1050	1050	1160
	Intermittent (60 s overload) (at 460/480 V) [A]	1095	858	1170	979	1335	1155	1575	1276
	Continuous KVA (at 400 V) [KVA]	554	610	610	686	686	776	776	873
	Continuous KVA (at 460 V) [KVA]	582	621	621	709	709	837	837	924
	Continuous KVA (at 480 V) [KVA]	632	675	675	771	771	909	909	1005
Max. input current									
	Continuous (at 400 V) [A]	779	857	857	964	964	1090	1090	1227
	Continuous (at 460/480 V) [A]	711	759	759	867	867	1022	1022	1129
	Max. cable size, motor [mm² (AWG²⁾)]	8x150 (8x300 mcm)							
	Max. cable size, line power F1/F2 [mm² (AWG²⁾)]	8x240 (8x500 mcm)							
	Max. cable size, line power F3/F4 [mm² (AWG²⁾)]	8x456 (8x900 mcm)							
	Max. cable size, load sharing [mm² (AWG²⁾)]	4x120 (4x250 mcm)							
	Max. cable size, brake [mm² (AWG²⁾)	4x185 (4x350 mcm)							
	Max. external electrical fuses [A] 1	1600				2000			
	Estimated motor power loss at 400 V [hp, W] ⁴⁾	14.28, 10647		16.55, 12338		17.70, 13201		20.70, 15436	
	Estimated motor power loss at 460 V [hp, W]	12.62, 9414		14.76, 11006		16.57, 12353		18.83, 14041	
	Max. panel options losses	0.54, 400							
	Weight, enclosure IP21, IP 54 (lb [kg]	4429 [2009]							
	Weight drive section (lb [kg])	2213 [1004]							
	Weight filter section (lb [kg])	2215 [1005]							
	Efficiency⁴⁾	0.96							
	Output frequency	0–600 Hz							
	Heatsink overtemp. trip	203°F [95°C]							
	Power card ambient trip	154.4°F [68°C]							
* High overload = 160% torque during 60 s, Normal overload = 110% torque during 60 s									

Table 8.3

1) For type of fuse, see section Fuses.

2) American Wire Gauge.

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

4) The typical power loss is at nominal load conditions and expected to be within +/-15% (tolerance relates to variety in voltage and cable conditions). Values are based on a typical motor efficiency (eff2/eff3 border line). Motors with lower efficiency will also add to the power loss in the adjustable frequency drive and vice-versa. If

the switching frequency is increased compared to the default setting, the power losses may rise significantly. LCP and typical control card power consumptions are included. Further options and customer load may add up to 0.004 hp [30 W] to the losses. (Though typical only 4 W extra for a fully loaded control card, or options for slot A or slot B each).
Although measurements are made with state of the art equipment, some measurement inaccuracy must be allowed for (+/-5%).

8.1 Filter Specifications

Frame size	D	E	F	
Voltage [V]	380–480	380–480	380–480	
Current, RMS [A]	120	210	330	Nominal value
Peak Current [A]	340	595	935	Amplitude value of the current
RMS overload [%]	No Overload			60 s in 10 min
Response time [ms]	< 0.5			
Settling time - reactive current control [ms]	< 40			
Settling time - harmonic current control (filtering) [ms]	< 20			
Overshoot - reactive current control [%]	< 20			
Overshoot - harmonic current control [%]	< 10			

Table 8.4 Power Ranges (LHD with AF)

8

9 Troubleshooting

9.1 Alarms and Warnings - Adjustable Frequency Drive (right LCP)

9.1.1 Warnings/Alarm Messages

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

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

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

This may be done in three ways:
1. By using the [Reset] key on the LCP.
2. Via a digital input with the "Reset" function.
3. Via serial communication/optional serial communication bus.

NOTE
After a manual reset using the [Reset] key on the LCP, the [Auto On] key 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 9.1*).

Alarms that are trip-locked offer additional protection, meaning that the line power supply must be switched off before the alarm can be reset. After being switched back on, the adjustable frequency drive is no longer blocked and may be reset as described above, once the cause has been rectified.

Alarms that are not trip-locked can also be reset using the automatic reset function in *14-20 Reset Mode*

NOTE
Automatic wake-up is possible!

If a warning and alarm are marked against a code in the table on the following page, this means that either a warning occurs before an alarm, or that you can specify whether it is a warning or an alarm that is to be displayed for a given fault.

This is possible, for instance, in *1-90 Motor Thermal Protection*. After an alarm or trip, the motor carries on coasting, and the alarm and warning flash. Once the problem has been rectified, only the alarm continues flashing until the adjustable frequency drive is reset.

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
1	10 Volts low	X			
2	Live zero error	(X)	(X)		6-01 Live Zero Timeout Function
3	No motor	(X)			1-80 Function at Stop
4	Mains phase loss	(X)	(X)	(X)	14-12 Function at Mains Imbalance
5	DC link voltage high	X			
6	DC link voltage low	X			
7	DC over-voltage	X	X		
8	DC undervoltage	X	X		
9	Inverter overloaded	X	X		
10	Motor ETR overtemperature	(X)	(X)		1-90 Motor Thermal Protection
11	Motor thermistor overtemperature	(X)	(X)		1-90 Motor Thermal Protection
12	Torque limit	X	X		
13	Overcurrent	X	X	X	
14	Ground Fault	X	X	X	
15	Hardware mismatch		X	X	

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
16	Short-circuit		X	X	
17	Control word timeout	(X)	(X)		8-04 Control Word Timeout Function
20	Temp. Input Error				
21	Param Error				
22	Hoist Mech. Brake	(X)	(X)		Parameter group 2-2*
23	Internal Fans	X			
24	External Fans	X			
25	Brake resistor short-circuited	X			
26	Brake resistor power limit	(X)	(X)		2-13 Brake Power Monitoring
27	Brake chopper short-circuited	X	X		
28	Brake check	(X)	(X)		2-15 Brake Check
29	Heatsink temp	X	X	X	
30	Motor phase U missing	(X)	(X)	(X)	4-58 Missing Motor Phase Function
31	Motor phase V missing	(X)	(X)	(X)	4-58 Missing Motor Phase Function
32	Motor phase W missing	(X)	(X)	(X)	4-58 Missing Motor Phase Function
33	Inrush fault		X	X	
34	Fieldbus communication fault	X	X		
35	Option Fault				
36	Mains failure	X	X		
37	Phase imbalance		X		
38	Internal Fault		X	X	
39	Heatsink sensor		X	X	
40	Overload of Digital Output Terminal 27	(X)			5-00 Digital I/O Mode, 5-01 Terminal 27 Mode
41	Overload of Digital Output Terminal 29	(X)			5-00 Digital I/O Mode, 5-02 Terminal 29 Mode
42	Ovrld X30/6-7	(X)			
43	Ext. Supply (option)				
45	Earth Fault 2	X	X	X	
46	Pwr. card supply		X	X	
47	24 V supply low	X	X	X	
48	1.8 V supply low		X	X	
49	Speed limit	X			
50	AMA calibration failed		X		
51	AMA check U_{nom} and I_{nom}		X		
52	AMA low I_{nom}		X		
53	AMA motor too big		X		
54	AMA motor too small		X		
55	AMA parameter out of range		X		
56	AMA interrupted by user		X		
57	AMA timeout		X		
58	AMA internal fault	X	X		
59	Current limit	X			
60	External Interlock	X	X		
61	Feedback Error	(X)	(X)		4-30 Motor Feedback Loss Function
62	Output Frequency at Maximum Limit	X			

9

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
63	Mechanical Brake Low		(X)		2-20 Release Brake Current
64	Voltage Limit	X			
65	Control Board Overtemperature	X	X	X	
66	Heat sink Temperature Low	X			
67	Option Configuration has Changed		X		
68	Safe Stop	(X)	(X)[1]		5-19 Terminal 37 Safe Stop
69	Pwr. Card Temp		X	X	
70	Illegal FC configuration			X	
71	PTC 1 Safe Stop				
72	Dangerous failure				
73	Safe Stop Auto Restart	(X)	(X)		5-19 Terminal 37 Safe Stop
74	PTC Thermistor			X	
75	Illegal Profile Sel.		X		
76	Power Unit Setup	X			
77	Reduced power mode	X			14-59 Actual Number of Inverter Units
78	Tracking Error	(X)	(X)		4-34 Tracking Error Function
79	Illegal PS config		X	X	
80	Drive Initialized to Default Value		X		
81	CSIV corrupt		X		
82	CSIV parameter error		X		
83	Illegal Option Combination			X	
84	No Safety Option		X		
88	Option Detection			X	
89	Mechanical Brake Sliding	X			
90	Feedback Monitor	(X)	(X)		17-61 Feedback Signal Monitoring
91	Analog input 54 wrong settings			X	S202
163	ATEX ETR cur.lim.warning	X			
164	ATEX ETR cur.lim.alarm		X		
165	ATEX ETR freq.lim.warning	X			
166	ATEX ETR freq.lim.alarm		X		
243	Brake IGBT	X	X	X	
244	Heatsink temp	X	X	X	
245	Heatsink sensor		X	X	
246	Pwr.card supply			X	
247	Pwr.card temp		X	X	
248	Illegal PS config			X	
249	Rect. low temp.	X			
250	New spare parts			X	
251	New Type Code		X	X	

Table 9.1 Alarm/Warning code list

(X) Dependent on parameter

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

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

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

Table 9.2

Bit	Hex	Dec	Alarm Word	Alarm Word 2	Warning Word	Warning Word 2	Extended Status Word
Alarm Word Extended Status Word							
0	00000001	1	Brake Check (A28)	ServiceTrip, Read/Write	Brake Check (W28)	reserved	Ramping
1	00000002	2	Heatsink temp. (A29)	ServiceTrip, (reserved)	Heatsink temp. (W29)	reserved	AMA Running
2	00000004	4	Ground Fault (A14)	ServiceTrip, Typecode/Sparepart	Ground Fault (W14)	reserved	Start CW/CCW NOT start_possible start_possible is active, when the DI selections [12] OR [13] are active and the requested direction matches the reference sign.
3	00000008	8	Ctrl.Card Temp (A65)	ServiceTrip, (reserved)	Ctrl.Card Temp (W65)	reserved	Slow-down slow-down command active, e.g., via CTW bit 11 or DI
4	00000010	16	Ctrl. Word TO (A17)	ServiceTrip, (reserved)	Ctrl. Word TO (W17)		Catch Up catch up command active, e.g., via CTW bit 12 or DI
5	00000020	32	Overcurrent (A13)	reserved	Overcurrent (W13)	reserved	Feedback High feedback > 4-57
6	00000040	64	Torque Limit (A12)	reserved	Torque Limit (W12)	reserved	Feedback Low feedback < 4-56
7	00000080	128	Motor Th Over (A11)	reserved	Motor Th Over (W11)	reserved	Output Current High current > 4-51
8	00000100	256	Motor ETR Over (A10)	reserved	Motor ETR Over (W10)	reserved	Output Current Low current < 4-50
9	00000200	512	Inverter Overld. (A9)	reserved	Inverter Overld (W9)	reserved	Output Freq High speed > 4-53
10	00000400	1024	DC under volt (A8)	reserved	DC under volt (W8)		Output Freq Low speed < 4-52
11	00000800	2048	DC overvoltage (A7)	reserved	DC overvoltage (W7)		Brake Check OK brake test NOT ok
12	00001000	4096	Short Circuit (A16)	reserved	DC Voltage Low (W6)	reserved	Braking Max BrakePower > BrakePowerLimit (2-12)
13	00002000	8192	Inrush Fault (A33)	reserved	DC Voltage High (W5)		Braking
14	00004000	16384	Mains ph. Loss (A4)	reserved	Mains ph. Loss (W4)		Out of Speed Range
15	00008000	32768	AMA Not OK	reserved	No Motor (W3)		OVC Active
16	00010000	65536	Live Zero Error (A2)	reserved	Live Zero Error (W2)		AC Brake

9

Bit	Hex	Dec	Alarm Word	Alarm Word 2	Warning Word	Warning Word 2	Extended Status Word
17	00020000	131072	Internal Fault (A38)	KTY error	10 V Low (W1)	KTY Warn	Password Timelock number of allowed password trials exceeded - timelock active
18	00040000	262144	Brake Overload (A26)	Fans error	Brake Overload (W26)	Fans Warn	Password Protection 0-61 = ALL_NO_ACCESS OR BUS_NO_ACCESS OR BUS_READONLY
19	00080000	524288	U phase Loss (A30)	ECB error	Brake Resistor (W25)	ECB Warn	Reference High reference > 4-55
20	00100000	1048576	V phase Loss (A31)	reserved	Brake IGBT (W27)	reserved	Reference Low reference < 4-54
21	00200000	2097152	W phase Loss (A32)	reserved	Speed Limit (W49)	reserved	Local Reference reference site = REMOTE -> auto on pressed & active
22	00400000	4194304	Fieldbus Fault (A34)	reserved	Fieldbus Fault (W34)	reserved	Protection Mode
23	00800000	8388608	24 V Supply Low (A47)	reserved	24V Supply Low (W47)	reserved	Unused
24	01000000	16777216	Mains Failure (A36)	reserved	Mains Failure (W36)	reserved	Unused
25	02000000	33554432	1.8V Supply Low (A48)	reserved	Current Limit (W59)	reserved	Unused
26	04000000	67108864	Brake Resistor (A25)	reserved	Low Temp (W66)	reserved	Unused
27	08000000	134217728	Brake IGBT (A27)	reserved	Voltage Limit (W64)	reserved	Unused
28	10000000	268435456	Option Change (A67)	reserved	Encoder loss (W90)	reserved	Unused
29	20000000	536870912	Drive Initialized (A80)	Feedback Fault (A61, A90)	Feedback Fault (W61, W90)		Unused
30	40000000	1073741824	Safe Stop (A68)	PTC 1 Safe Stop (A71)	Safe Stop (W68)	PTC 1 Safe Stop (W71)	Unused
31	80000000	2147483648	Mech. brake low (A63)	Dangerous Failure (A72)	Extended Status Word		Unused

Table 9.3 Description of Alarm Word, Warning Word and Extended Status Word

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

9.1.2 Warnings/Alarm Messages - Adjustable Frequency Drives

WARNING 1, 10 volts low

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

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

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

WARNING/ALARM 2, Live zero error

This warning or alarm will only appear if programmed by the user in *6-01 Live Zero Timeout Function*. The signal on one of the analog inputs is less than 50% of the minimum value programmed for that input. This condition can be caused by broken wiring or faulty device sending the signal.

Troubleshooting:

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

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

Perform Input Terminal Signal Test.

WARNING/ALARM 3, No motor

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

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

WARNING/ALARM 4, Mains phase loss

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

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

WARNING 5, DC link voltage high

The intermediate circuit voltage (DC) is higher than the high voltage warning limit. The limit is dependent on the drive voltage rating. The adjustable frequency drive is still active.

WARNING 6, DC link voltage low

The intermediate circuit voltage (DC) is lower than the low voltage warning limit. The limit is dependent on the drive voltage rating. The adjustable frequency drive is still active.

WARNING/ALARM 7, DC overvoltage

If the intermediate circuit voltage exceeds the limit, the adjustable frequency drive trips after a time.

Troubleshooting:

Connect a brake resistor

Extend the ramp time

Change the ramp type

Activate functions in *2-10 Brake Function*

Increase *14-26 Trip Delay at Inverter Fault*

WARNING/ALARM 8, DC under voltage

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

Troubleshooting:

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

Perform Input voltage test

Perform soft charge and rectifier circuit test

WARNING/ALARM 9, Inverter overloaded

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

Troubleshooting:

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

Compare 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.

WARNING/ALARM 10, Motor overload temperature

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

9

Troubleshooting:

Check if the motor is overheating.

If the motor is mechanically overloaded

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

Motor data in *1-20 Motor Power [kW]* through *1-25 Motor Nominal Speed* are set correctly.

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

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

WARNING/ALARM 11, Motor thermistor overtemp

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

Troubleshooting:

Check if the motor is overheating.

Check if the motor is mechanically overloaded.

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

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

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

If using a KTY sensor, check the programming of *1-95 KTY Sensor Type*, *1-96 KTY Thermistor Resource*, and *1-97 KTY Threshold level* match sensor wiring.

WARNING/ALARM 12, Torque limit

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

WARNING/ALARM 13, Overcurrent

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

Troubleshooting:

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

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

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

Incorrect motor data in *1-20 Motor Power [kW]* through *1-25 Motor Nominal Speed*.

ALARM 14, Ground fault

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

Troubleshooting:

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

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

Perform current sensor test.

ALARM 15, Hardware mismatch

A fitted option is not operational with the present control board hardware or software.

Record the value of the following parameters and contact your Danfoss supplier:

15-40 FC Type

15-41 Power Section

15-42 Voltage

15-43 Software Version

15-45 Actual Typecode String

15-49 SW ID Control Card

15-50 SW ID Power Card

15-60 Option Mounted

15-61 Option SW Version

ALARM 16, Short-circuit

There is short-circuiting in the motor or on the motor terminals.
Turn off the adjustable frequency drive and remove the short-circuit.

WARNING/ALARM 17, Control word timeout

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

Troubleshooting:

Check connections on the serial communication cable.

Increase *8-03 Control Word Timeout Time*

Check the operation of the communication equipment.

Verify proper installation based on EMC requirements.

WARNING 22, Hoist Mech. Brake:
Report value will show what kind it is.
0 = The torque ref. was not reached before timeout.
1 = There was no brake feedback before timeout.

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

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

 Troubleshooting:

Check fan resistance.

Check soft charge fuses.

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

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

 Troubleshooting:

Check fan resistance.

Check soft charge fuses.

WARNING 25, Brake resistor short-circuit
The brake resistor is monitored during operation. If it short-circuits, the brake function is disconnected and the warning appears. The adjustable frequency drive still works, but without the brake function. Turn off the adjustable frequency drive and replace the brake resistor (see *2-15 Brake Check*).

WARNING/ALARM 26, Brake resistor power limit
The power transmitted to the brake resistor is calculated: as a percentage, as a mean value over the last 120 seconds, on the basis of the resistance value of the brake resistor, and the intermediate circuit voltage. The warning is active when the dissipated braking energy is higher than 90%. If *Trip* [2] has been selected in *2-13 Brake Power Monitoring*, the adjustable frequency drive cuts out and issues this alarm, when the dissipated braking energy is higher than 100%.

⚠CAUTION

There is a risk of substantial power being transmitted to the brake resistor if the brake transistor is short-circuited.

WARNING/ALARM 27, Brake chopper fault
The brake transistor is monitored during operation and if it short-circuits, the brake function disconnects and issues a warning. The adjustable frequency drive is still able to run, but since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.

Turn off the adjustable frequency drive and remove the brake resistor.
This alarm/ warning could also occur should the brake resistor overheat. Terminal 104 to 106 are available as brake resistor. Klixon inputs, see section Brake Resistor Temperature Switch.

WARNING/ALARM 28, Brake check failed
Brake resistor fault: the brake resistor is not connected or not working.
Check *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 adjustable frequency drive power size.

 Troubleshooting:

Ambient temperature too high.

Too long motor cable.

Incorrect clearance above and below the adjustable frequency drive.

Dirty heatsink.

Blocked air flow around the adjustable frequency drive.

Damaged heatsink fan.

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

 Troubleshooting:

Check fan resistance.

Check soft charge fuses.

IGBT thermal sensor.

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

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

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

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

9

WARNING/ALARM 34, Fieldbus communication fault

The serial communication bus on the communication option card is not working.

WARNING/ALARM 36, Mains failure

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

ALARM 38, Internal fault

It may be necessary to contact your Danfoss supplier. Some typical alarm messages:

0	Serial port cannot be initialized. Serious hardware failure
256-258	Power EEPROM data is defect or too old
512	Control board EEPROM data is defect or too old
513	Communication time out reading EEPROM data
514	Communication time out reading EEPROM data
515	Application Orientated Control cannot recognize the EEPROM data
516	Cannot write to the EEPROM because a write command is on progress
517	Write command is under timeout
518	Failure in the EEPROM
519	Missing or invalid barcode data in EEPROM
783	Parameter value outside of min/max limits
1024-1279	A CAN message that has to be sent, couldn't be sent
1281	Digital Signal Processor flash timeout
1282	Power micro software version mismatch
1283	Power EEPROM data version mismatch
1284	Cannot read Digital Signal Processor software version
1299	Option SW in slot A is too old
1300	Option SW in slot B is too old
1301	Option SW in slot C0 is too old
1302	Option SW in slot C1 is too old
1315	Option SW in slot A is not supported (not allowed)
1316	Option SW in slot B is not supported (not allowed)
1317	Option SW in slot C0 is not supported (not allowed)
1318	Option SW in slot C1 is not supported (not allowed)
1379	Option A did not respond when calculating Platform Version.
1380	Option B did not respond when calculating Platform Version.
1381	Option C0 did not respond when calculating Platform Version.
1382	Option C1 did not respond when calculating Platform Version.
1536	An exception in the Application Orientated Control is registered. Debug information written in LCP
1792	DSP watchdog is active. Debugging of power part data Motor Orientated Control data not transferred correctly

2049	Power data restarted
2064-2072	H081x: option in slot x has restarted
2080-2088	H082x: option in slot x has issued a power-up wait
2096-2104	H083x: option in slot x has issued a legal power-up wait
2304	Could not read any data from power EEPROM
2305	Missing SW version from power unit
2314	Missing power unit data from power unit
2315	Missing SW version from power unit
2316	Missing io_statepage from power unit
2324	Power card configuration is determined to be incorrect at power-up
2325	A power card has stopped communicating while main power is applied
2326	Power card configuration is determined to be incorrect after the delay for power cards to register
2327	Too many power card locations have been registered as present
2330	Power size information between the power cards does not match
2561	No communication from DSP to ATACD
2562	No communication from ATACD to DSP (state running)
2816	Stack overflow Control board module
2817	Scheduler slow tasks
2818	Fast tasks
2819	Parameter thread
2820	LCP Stack overflow
2821	Serial port overflow
2822	USB port overflow
2836	cfListMempool to small
3072-5122	Parameter value is outside its limits
5123	Option in slot A: Hardware incompatible with control board hardware
5124	Option in slot B: Hardware incompatible with control board hardware
5125	Option in slot C0: Hardware incompatible with control board hardware
5126	Option in slot C1: Hardware incompatible with control board hardware
5376-6231	Out of memory

Table 9.4

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.

9

WARNING 40, Overload of Digital Output Terminal 27

Check the load connected to terminal 27 or remove short-circuit connection. Check *5-00 Digital I/O Mode* and *5-01 Terminal 27 Mode*.

WARNING 41, Overload of Digital Output Terminal 29

Check the load connected to terminal 29 or remove short-circuit connection. Check *5-00 Digital I/O Mode* and *5-02 Terminal 29 Mode*.

WARNING 42, Overload of Digital Output on X30/6 or Overload of Digital Output on X30/7

For X30/6, check the load connected to X30/6 or remove short-circuit connection. Check *5-32 Term X30/6 Digi Out (MCB 101)*.

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

ALARM 46, Power card supply

The supply on the power card is out of range.

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

WARNING 47, 24 V supply low

The 24 V DC is measured on the control card. The external 24 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

The speed is not within the specified range in *4-11 Motor Speed Low Limit [RPM]* and *4-13 Motor Speed High Limit [RPM]*.

ALARM 50, 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 resistances Rs and Rr are increased. In most cases, however, this is not critical.

ALARM 58, AMA internal fault

Contact your Danfoss supplier.

WARNING 59, Current limit

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

WARNING 60, External interlock

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

WARNING 61, Tracking error

An error has been detected between the calculated motor speed and the speed measurement from the feedback device. The function for Warning/Alarm/Disable is set in *4-30 Motor Feedback Loss Function*, error setting in *4-31 Motor Feedback Speed Error*, and the allowed error time in *4-32 Motor Feedback Loss Timeout*. During a commissioning procedure the function may be effective.

WARNING 62, Output frequency at maximum limit

The output frequency is higher than the value set in *4-19 Max Output Frequency*

WARNING 64, Voltage limit

The load and speed combination demands a motor voltage higher than the actual DC link voltage.

WARNING/ALARM/TRIP 65, Control card overtemperature

Control card overtemperature: The cut-out temperature of the control card is 176°F [80°C].

WARNING 66, Heatsink temperature low

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

Troubleshooting:

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

ALARM 67, Option module configuration has changed

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

ALARM 68, Safe stop activated

Safe stop has been activated. To resume normal operation, apply 24 V DC to terminal 37, then send a reset signal (via Bus, Digital I/O, or by pressing [Reset]. See *5-19 Terminal 37 Safe Stop*.

ALARM 69, Power card temperature

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

9

Troubleshooting:

Check the operation of the door fans.

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

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

ALARM 70, Illegal FC Configuration
Actual combination of control board and power board is illegal.

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

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

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

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

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

WARNING 77, Reduced power mode:
This warning indicates that the adjustable frequency 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 adjustable frequency 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.

WARNING 81, CSIV corrupt:
CSIV file has syntax errors.

WARNING 82, CSIV parameter error:
CSIV parameter error.

WARNING 85, Dang fail PB:
Profibus/Profisafe Error.

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 243, Brake IGBT
This alarm is only for F Frame sizes. 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 frame sizes F2 or F4.

2 = right inverter module in frame sizes F1 or F3.

3 = right inverter module in frame sizes F2 or F4.

5 = rectifier module.

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

2 = right inverter module in frame sizes F1 or F3.

3 = right inverter module in frame sizes F2 or F4.

5 = rectifier module.

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

2 = right inverter module in frame sizes F1 or F3.

3 = right inverter module in frame sizes F2 or F4.

5 = rectifier module.

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

2 = right inverter module in frame sizes F1 or F3.

3 = right inverter module in frame sizes F2 or F4.

5 = rectifier module.

ALARM 247, Power card temperature

This alarm is only for F Frame. 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 frame sizes F2 or F4.
>
> 2 = right inverter module in frame sizes F1 or F3.
>
> 3 = right inverter module in frame sizes F2 or F4.
>
> 5 = rectifier module.

ALARM 248, Illegal power section configuration

This alarm is only for F Frame. 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 frame sizes F2 or F4.
>
> 2 = right inverter module in frame sizes F1 or F3.
>
> 3 = right inverter module in frame sizes F2 or F4.
>
> 5 = rectifier module.

ALARM 250, New spare part

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

ALARM 251, New type code

The adjustable frequency drive has a new type code.

9.2 Alarms and Warnings - Filter (left LCP)

NOTE

This sections covers warnings and alarms on the filter side LCP. For warning and alarms for the adjustable frequency drive, please see previous section.

A warning or an alarm is signaled by the relevant LED on the front of the filter 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 unit may still be continued. Warning messages may be critical, but are not necessarily so.

In the event of an alarm, the unit 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] key on the LCP control panel.

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

3. Via serial communication/optional serial communication bus.

4. By resetting automatically using the [Auto Reset] function. See *14-20 Reset Mode* in the*VLT®Active Filter AAF 00x Instruction Manual, MG90VXYY*.

NOTE

After a manual reset using the [Reset] key on the LCP, the [Auto On] or [Hand On] key must be pressed to restart the unit.

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

Alarms that are trip-locked offer additional protection, means that the line power supply must be switched off before the alarm can be reset. After being switched back on, the unit is no longer blocked and may be reset as described above once the cause has been rectified.

Alarms that are not trip-locked can also be reset using the automatic reset function in *14-20 Reset Mode* (Warning: automatic wake-up is possible!)

If a warning and alarm is marked against a code in the table on the following page, this means that either a warning occurs before an alarm, or it can be specified whether it is a warning or an alarm that is to be displayed for a given fault.

9

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
1	10 Volts low	X			
2	Live zero error	(X)	(X)		6-01
4	Mains phase loss		X		
5	DC link voltage high	X			
6	DC link voltage low	X			
7	DC over voltage	X	X		
8	DC undervoltage	X	X		
13	Over current	X	X	X	
14	Ground fault	X	X	X	
15	Hardware mismatch		X	X	
16	Short-circuit		X	X	
17	Control word timeout	(X)	(X)		8-04
23	Internal Fan Fault	X			
24	External Fan Fault	X			14-53
29	Heatsink temp	X	X	X	
33	Inrush fault		X	X	
34	Fieldbus fault	X	X		
35	Option fault	X	X		
38	Internal fault				
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	
65	Control Board Overtemperature	X	X	X	
66	Heat sink Temperature Low	X			
67	Option Configuration has Changed		X		
68	Safe Stop Activated		X[1]		
69	Pwr. Card Temp		X	X	
70	Illegal FC configuration			X	
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		
244	Heatsink temp	X	X	X	
245	Heatsink sensor		X	X	
246	Pwr.card supply		X	X	
247	Pwr.card temp		X	X	
248	Illegal PS config		X	X	
250	New spare part			X	
251	New Type Code		X	X	
300	Line Power Cont. fault			X	
301	SC Cont. Fault			X	
302	Cap. Overcurrent	X	X		
303	Cap. Ground Fault	X	X		
304	DC overcurrent	X	X		
305	Mains Freq. Limit		X		
306	Compensation Limit	X			

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
308	Resistor temp	X		X	
309	Mains Earth Fault	X	X		
311	Switch Freq. Limit		X		
312	CT Range		X		
314	Auto CT Interrupt		X		
315	Auto CT Error		X		
316	CT Location Error		X		
317	CT Polarity Error		X		
318	CT Ratio Error		X		

Table 9.5 Alarm/Warning code list

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

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

Table 9.6

9

9

Alarm Word and Extended Status Word					
Bit	Hex	Dec	Alarm Word	Warning Word	Extended Status Word
0	00000001	1	Mains Cont. Fault	Reserved	Reserved
1	00000002	2	Heatsink Temp	Heatsink Temp	Auto CT Running
2	00000004	4	Ground Fault	Ground Fault	Reserved
3	00000008	8	Ctrl.Card Temp	Ctrl.Card Temp	Reserved
4	00000010	16	Ctrl. Word TO	Ctrl. Word TO	Reserved
5	00000020	32	Overcurrent	Overcurrent	Reserved
6	00000040	64	SC Cont. Fault	Reserved	Reserved
7	00000080	128	Cap. Overcurrent	Cap. Overcurrent	Reserved
8	00000100	256	Cap. Ground Fault	Cap. Ground Fault	Reserved
9	00000200	512	Inverter Overld.	Inverter Overld.	Reserved
10	00000400	1024	DC under volt	DC under volt	Reserved
11	00000800	2048	DC overvolt	DC overvolt	Reserved
12	00001000	4096	Short-circuit	DC Voltage Low	Reserved
13	00002000	8192	Inrush fault	DC Voltage High	Reserved
14	00004000	16384	Mains ph. Loss	Mains ph. Loss	Reserved
15	00008000	32768	Auto CT Error	Reserved	Reserved
16	00010000	65536	Reserved	Reserved	Reserved
17	00020000	131072	Internal Fault	10V low	Password Time Lock
18	00040000	262144	DC overcurrent	DC overcurrent	Password Protection
19	00080000	524288	Resistor temp	Resistor temp	Reserved
20	00100000	1048576	Mains Earth Fault	Mains Earth Fault	Reserved
21	00200000	2097152	Switch Freq. Limit	Reserved	Reserved
22	00400000	4194304	Fieldbus fault	Fieldbus fault	Reserved
23	00800000	8388608	24 V Supply Low	24V Supply Low	Reserved
24	01000000	16777216	CT Range	Reserved	Reserved
25	02000000	33554432	1.8 V supply low	Reserved	Reserved
26	04000000	67108864	Reserved	Low Temp	Reserved
27	08000000	134217728	Auto CT Interrupt	Reserved	Reserved
28	10000000	268435456	Option Change	Reserved	Reserved
29	20000000	536870912	Unit Initialized	Unit Initialized	Reserved
30	40000000	1073741824	Safe Stop	Safe Stop	Reserved
31	80000000	2147483648	Mains Freq. Limit	Extended Status Word	Reserved

Table 9.7 Description of Alarm Word, Warning Word and Extended Status Word

The alarm words, warning words and extended status words can be read out via serial bus or optional serial communication bus for diagnosis. See also *16-90 Alarm Word*, *16-92 Warning Word* and *16-94 Ext. Status Word*. "Reserved" means that the bit is not guaranteed to be any particular value. Reserved bits should not be used for any purpose.

9.2.1 Fault Messages - Active Filter

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.

WARNING/ALARM 2, Live zero error
The signal on terminal 53 or 54 is less than 50% of the value set in par. 6-10, 6-12, 6-20 or 6-22 respectively.

WARNING/ALARM 4, Mains phase loss
A phase is missing on the supply side, or the line voltage imbalance is too high.

WARNING 5, DC link voltage high
The intermediate circuit voltage (DC) is higher than the high voltage warning limit. The unit is still active.

WARNING 6, DC link voltage low
The intermediate circuit voltage (DC) is below the undervoltage limit of the control system. The unit is still active.

WARNING/ALARM 7, DC overvoltage
If the intermediate circuit voltage exceeds the limit, the unit trips.

WARNING/ALARM 8, DC under voltage
If the intermediate circuit voltage (DC) drops below the under voltage limit, the filter checks if a 24 V backup supply is connected. If not, the unit trips. Make sure the AC line voltage matches the nameplate specification.

WARNING/ALARM 13, Overcurrent
the unit current limit has been exceeded.

ALARM 14, Ground fault
The sum current of the IGBT CTs does not equal zero. Check if the resistance of any phase to ground has a low value. Make sure to check both before and after line power contactor. Also make sure IGBT current transducers, connection cables, and connectors are ok.

ALARM 15, Incomp. Hardware
A mounted option is not handled by the present control card SW/HW.

ALARM 16, Short-circuit
There is a short-circuit in the output. Turn off the unit and correct the error.

WARNING/ALARM 17, Control word timeout
There is no communication to the unit.
The warning will only be active when *8-04 Control Word Timeout Function* is NOT set to *OFF*.
Possible correction: Increase *8-03 Control Word Timeout Time*. Change *8-04 Control Word Timeout Function*

WARNING 23, Internal fan fault
Internal fans have failed due to defect hardware or fans not mounted.

WARNING 24, External fan fault
External fans have failed due to defect hardware or fans not mounted.

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.

ALARM 33, Inrush fault
Check whether a 24 Volt external DC supply has been connected.

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

WARNING/ALARM 35, Option Fault:
Contact your Danfoss supplier.

ALARM 38, Internal fault
Contact your Danfoss supplier.

ALARM 39, Heatsink sensor
No feedback from the heatsink temperature sensor.

WARNING 40, Overload of Digital Output Terminal 27
Check the load connected to terminal 27 or remove short-circuit connection.

WARNING 41, Overload of Digital Output Terminal 29
Check the load connected to terminal 29 or remove short-circuit connection.

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.

For X30/7, check the load connected to X30/7 or remove short-circuit connection.

WARNING 43, Ext. Supply (option)
The external 24 V DC supply voltage on the option is not valid.

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

WARNING 47, 24 V supply low
Contact your Danfoss supplier.

WARNING 48, 1.8 V supply low
Contact your Danfoss supplier.

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

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

Troubleshooting:

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

9

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 [Reset]. See *5-19 Terminal 37 Safe Stop*.

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

ALARM 70, Illegal FC Configuration
Actual combination of control board and power board is illegal.

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

WARNING 77, Reduced power mode:
This warning indicates that the adjustable frequency 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 adjustable frequency 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, Unit initialized to default value
Parameter settings are initialized to default settings after a manual reset.

ALARM 244, Heatsink temperature
Report value indicates source of alarm (from left):
1-4 Inverter
5-8 Rectifier

ALARM 245, Heatsink sensor
No feedback from the heatsink sensor. Report value indicates source of alarm (from left):
1-4 Inverter
5-8 Rectifier

ALARM 246, Power card supply
The supply on the power card is out of range. Report value indicates source of alarm (from left):
1-4 Inverter
5-8 Rectifier

ALARM 247, Power card temperature
Power card overtemperature. Report value indicates source of alarm (from left):
1-4 Inverter
5-8 Rectifier

ALARM 248, Illegal power section configuration
Power size configuration fault on the power card. Report value indicates source of alarm (from left):
1-4 Inverter

5-8 Rectifier

ALARM 249, Rect. low temp.
The temperature of the rectifier heatsink is too low. This could indicate that the temperature sensor is defective.

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

ALARM 251, New type code
The filter has a new type code.

ALARM 300, Mains Cont. Fault
The feedback from the line power contactor did not match the expected value within the allowed time frame. Contact your Danfoss supplier.

ALARM 301, SC Cont. Fault
The feedback from the soft charge contactor did not match the expected value within the allowed time frame. Contact your Danfoss supplier.

ALARM 302, Cap. Overcurrent
Excessive current was detected through the AC capacitors. Contact your Danfoss supplier.

ALARM 303, Cap. Ground Fault
A ground fault was detected through the AC capacitor currents. Contact your Danfoss supplier.

ALARM 304, DC Overcurrent
Excessive current through the DC link capacitor bank was detected. Contact your Danfoss supplier.

ALARM 305, Line Power Freq. Limit
The line power frequency was outside the limits. Verify that the line power frequency is within product specification.

ALARM 306, Compensation Limit
The needed compensation current exceeds unit capability. Unit is running at full compensation.

ALARM 308, Resistor temp
Excessive resistor heatsink temperature detected.

ALARM 309, Mains Earth Fault
A ground fault was detected in the line power currents. Check the line power for shorts and leakage current.

ALARM 310, RTDC Buffer Full
Contact your Danfoss supplier.

ALARM 311, Switch. Freq. Limit
The average switching frequency of the unit exceeded the limit. Verify that *300-10 Active Filter Nominal Voltage* and *300-22 CT Nominal Voltage* are set correctly. If so, contact your Danfoss supplier.

ALARM 312, CT Range
Current transformer measurement limitation was detected. Verify that the CTs used are an appropriate ratio.

9

ALARM 314, Auto CT Interrupt

Auto CT detection was interrupted by the user.

ALARM 315, Auto CT Error

An error was detected while performing auto CT detection.

Contact your Danfoss supplier.

ALARM 316, CT Location Error

The Auto CT function could not determine the correct locations of the CTs.

ALARM 317, CT Polarity Error

The Auto CT function could not determine the correct polarity of the CTs.

ALARM 318, CT Ratio Error

The Auto CT function could not determine the correct primary rating of the CTs.

9

Index

www.danfoss.com/drives

Danfoss Drives

4401 N. Bell School Rd.
Loves Park IL 61111 USA
Phone: 1-800-432-6367
1-815-639-8600
Fax: 1-815-639-8000
www.danfossdrives.com

Danfoss Drives

8800 W. Bradley Rd.
Milwaukee, WI 53224 USA
Phone: 1-800-621-8806
1-414-355-8800
Fax: 1-414-355-6117
www.danfossdrives.com