



# **Instruction Manual**

VLT® AutomationDrive FC 300





## Safety

## Safety

# **A**WARNING

#### **HIGH VOLTAGE!**

Adjustable frequency drives contain high voltage when connected to AC line power. Installation, start-up, and maintenance should be performed by qualified personnel only. Failure to perform installation, start-up, and maintenance by qualified personnel could result in death or serious injury.

#### **High Voltage**

Adjustable frequency drives are connected to hazardous AC line voltage. Extreme care should be taken to protect against shock. Only trained personnel familiar with electronic equipment should install, start, or maintain this equipment.

# **▲**WARNING

#### **UNINTENDED START!**

When the adjustable frequency drive is connected to AC line power, the motor may start at any time. The adjustable frequency drive, motor, and any driven equipment must be in operational readiness. Failure to be in operational readiness when the adjustable frequency drive is connected to AC line power could result in death, serious injury, equipment, or property damage.

#### **Unintended Start**

When the adjustable frequency drive is connected to AC line power, the motor may be started with an external switch, a serial bus command, an input reference signal, or a cleared fault condition. Use appropriate caution to guard against an unintended start.

# **A**WARNING

#### **DISCHARGE TIME!**

Adjustable frequency drives contain DC link capacitors that can remain charged even when the adjustable frequency drive is not powered. To avoid electrical hazards, disconnect AC line power, any permanent magnet type motors, and any remote DC link power supplies, including battery backups, UPS and DC link connections to other adjustable frequency drives. Wait for the capacitors to fully discharge before performing any service or repair work. The wait time required is listed in the *Discharge Time* table. Failure to wait for the specified period of time after power has been removed to do service or repair could result in death or serious injury.

Voltage (V)	Minimum waiting time (minutes)				
	4	15			
200–240	0.25-3.7 kW	5.5–37 kW			
380-480	0.25-7.5 kW	11–75 kW			
525–600	0.75-7.5 kW	11–75 kW			

High voltage may be present even when the warning LEDs are off!

#### **Discharge Time**

#### **Symbols**

The following symbols are used in this manual.

# **AWARNING**

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

# **ACAUTION**

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.

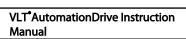
#### **Approvals**



Table 1.2



Safety	VLT AutomationDrive Instruction
Salety	Manual







## Contents

1 Introduction	2-1
1.1 Purpose of the Manual	2-2
1.2 Additional Resources	2-3
1.3 Product Overview	2-3
1.4 Internal Controller Functions	2-3
1.5 Frame Sizes and Power Ratings	2-4
2 Installation	3-1
2.1 Installation Site Checklist	3-1
2.2 Adjustable Frequency Drive and Motor Pre-installation Checklist	3-1
2.3 Mechanical Installation	3-1
2.3.1 Cooling	3-1
2.3.2 Lifting	3-2
2.3.3 Mounting	3-2
2.3.4 Tightening Torques	3-2
2.4 Electrical Installation	3-3
2.4.1 Requirements	3-5
2.4.2 Grounding Requirements	3-5
2.4.2.1 Leakage Current (>3.5 mA)	3-6
2.4.2.2 Grounding Using Shielded Cable	3-6
2.4.3 Motor Connection	3-6
2.4.4 AC Line Power Connection	3-7
2.4.5 Control Wiring	3-7
2.4.5.1 Access	3-7
2.4.5.2 Control Terminal Types	3-8
2.4.5.3 Wiring to Control Terminals	3-9
2.4.5.4 Using Shielded Control Cables	3-9
2.4.5.5 Control Terminal Functions	3-10
2.4.5.6 Jumper Terminals 12 and 27	3-10
2.4.5.7 Terminal 53 and 54 Switches	3-10
2.4.5.8 Terminal 37	3-11
2.4.5.9 Mechanical Brake Control	3-14
2.4.6 Serial Communication	3-14
3 Start-up and Functional Testing	4-1
3.1 Pre-start	4-1
3.1.1 Safety Inspection	4-1
3.2 Applying Power to the Adjustable Frequency Drive	4-3



# VLT AutomationDrive Instruction Manual

Contents

3.3 Basic Operational Programming	4-3
3.4 Automatic Motor Adaptation	4-4
3.5 Check Motor Rotation	4-5
3.6 Check Encoder Rotation	4-5
3.7 Local Control Test	4-6
3.8 System Start-up	4-6
4 User Interface	5-1
4.1 Local Control Panel	5-1
4.1.1 LCP Layout	5-1
4.1.2 Setting LCP Display Values	5-2
4.1.3 Display Menu Keys	5-2
4.1.4 Navigation Keys	5-3
4.1.5 Operation Keys	5-3
4.2 Backup and Copying Parameter Settings	5-3
4.2.1 Uploading Data to the LCP	5-4
4.2.2 Downloading Data from the LCP	5-4
4.3 Restoring Default Settings	5-4
4.3.1 Recommended Initialization	5-4
4.3.2 Manual Initialization	5-4
5 About Adjustable Frequency Drive Programming	6-1
5.1 Introduction	6-1
5.2 Programming Example	6-1
5.3 Control Terminal Programming Examples	6-2
5.4 International/North American Default Parameter Settings	6-3
5.5 Parameter Menu Structure	6-4
5.6 Remote Programming with MCT 10 Set-up Software Set-up Software	6-9
6 Application Examples	7-1
6.1 Introduction	7-1
6.2 Application Examples	7-1
7 Status Messages	8-1
7.1 Status Display	8-1
7.2 Status Message Definitions Table	8-1
8 Warnings and Alarms	9-1
8.1 System Monitoring	9-1
8.2 Warning and Alarm Types	9-1



tents	VLT Automation Drive Instruction Manual	
	8.3 Warning and Alarm Displays	9-1
	8.4 Warning and Alarm Definitions	9-2
9	Basic Troubleshooting	10-1
	9.1 Start Up and Operation	10-1
10	0 Specifications	11-1
	10.1 Power-dependent Specifications	11-1
	10.2 General Technical Data	11-12
	10.3 Fuse Specifications	11-16
	10.3.2 Recommendations	11-16
	10.3.3 CE Compliance	11-17
	10.4 Connection Tightening Torques	11-25
1:	2 Index	12-1



Contents VLT\*AutomationDrive Instruction
Manual



# 1 Introduction

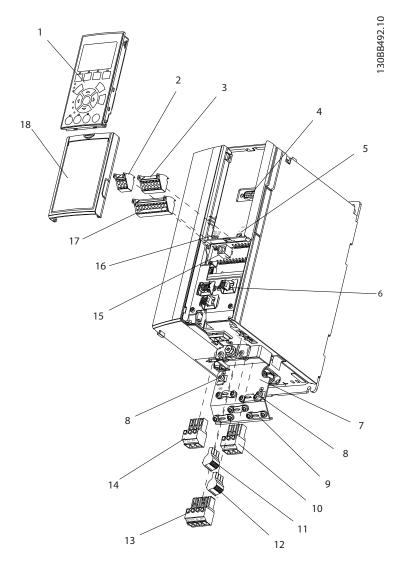


Figure 1.1 Exploded View A1-A3, IP20

1	LCP	10	Motor output terminals 96 (U), 97 (V), 98 (W)
2	RS-485 serial bus connector (+68, -69)	11	Relay 1 (01, 02, 03)
3	Analog I/O connector	12	Relay 2 (04, 05, 06)
4	LCP input plug	13	Brake (-81, +82) and load sharing (-88, +89) terminals
5	Analog switches (A53), (A54)	14	Line power input terminals 91 (L1), 92 (L2), 93 (L3)
6	Cable strain relief/PE ground	15	USB connector
7	Decoupling plate	16	Serial bus terminal switch
8	Grounding clamp (PE)	17	Digital I/O and 24 V power supply
9	Shielded cable grounding clamp and strain relief	18	Control cable cover plate

Table 1.1

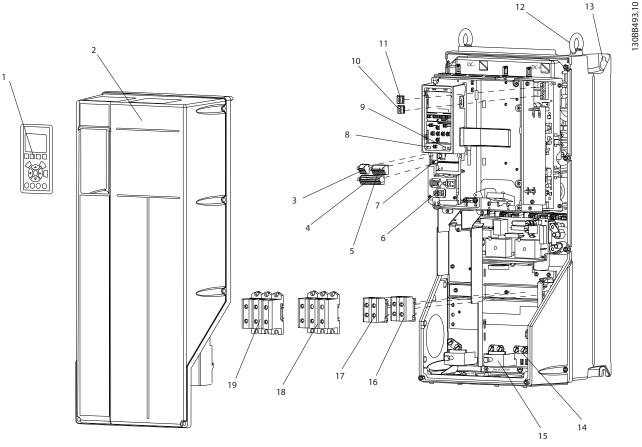


Figure 1.2 Exploded View B and C Sizes, IP55/66

1	LCP	11	Relay 2 (04, 05, 06)
-		11	
2	Cover	12	Lifting ring
3	RS-485 serial bus connector	13	Mounting slot
4	Digital I/O and 24 V power supply	14	Grounding clamp (PE)
5	Analog I/O connector	15	Cable strain relief/PE ground
6	Cable strain relief/PE ground	16	Brake terminal (-81, +82)
7	USB connector	17	Load sharing terminal (DC bus) (-88, +89)
8	Serial bus terminal switch	18	Motor output terminals 96 (U), 97 (V), 98 (W)
9	Analog switches (A53), (A54)	19	Line power input terminals 91 (L1), 92 (L2), 93 (L3)
10	Relay 1 (01, 02, 03)		

Table 1.2

## 1.1 Purpose of the Manual

This manual is intended to provide detailed information for the installation and start-up of the adjustable frequency drive. provides requirements for mechanical and electrical installation, including input, motor, control and serial communications wiring, and control terminal functions. provides detailed procedures for start-up, basic operational programming, and functional testing. The remaining

chapters provide supplementary details. These details include user interface, detailed programming, application examples, start-up troubleshooting, and specifications.

## 1.2 Additional Resources

Other resources are available to understand advanced adjustable frequency drive functions and programming.

- The VLT® Programming Guide provides greater detail on working with parameters and many application examples.
- The VLT® Design Guide is intended to provide detailed capabilities and functionality to design motor control systems.
- Supplementary publications and manuals are available from Danfoss.
   See http://www.danfoss.com/Products/Literature/ Technical+Documentation.htm for listings.
- Optional equipment is available that may change some of the procedures described. Reference the instructions supplied with those options for specific requirements. Contact the local Danfoss supplier or visit the Danfoss website for downloads or additional information.

#### 1.3 Product Overview

An adjustable frequency drive is an electronic motor controller that converts AC line power input into a variable AC waveform output. The frequency and voltage of the output are regulated to control the motor speed or torque. The adjustable frequency drive can vary the speed of the motor in response to system feedback, such as position sensors on a conveyor belt. The adjustable frequency drive can also regulate the motor by responding to remote commands from external controllers.

In addition, the adjustable frequency drive monitors the system and motor status, issues warnings or alarms for fault conditions, starts and stops the motor, optimizes energy efficiency, and offers many more control, monitoring, and efficiency functions. Operation and monitoring functions are available as status indications to an outside control system or serial communication network.

## 1.4 Internal Controller Functions

Figure 1.3 is a block diagram of the adjustable frequency drive's internal components. See *Table 1.3* for their functions.

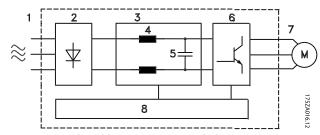


Figure 1.3 Adjustable Frequency Drive Block Diagram

Area	Title	Functions
1	Line power input	Three-phase AC line power supply to the adjustable frequency drive
2	Rectifier	The rectifier bridge converts the AC input to DC current to supply inverter power
3	DC bus	Intermediate DC bus circuit handles the DC current
4	DC reactors	Filter the intermediate DC circuit voltage
		Provide line transient protection
		Reduce RMS current
		Raise the power factor reflected back to the line
		Reduce harmonics on the AC input
5	Capacitor bank	Stores the DC power
		Provides ride-through     protection for short power     losses
6	Inverter	Converts the DC into a controlled PWM AC waveform for a controlled variable output to the motor
7	Output to motor	Regulated three-phase output power to the motor



Area	Title	Functions
8	Control circuitry	Input power, internal processing, output, and motor current are monitored to provide efficient operation and control
		User interface and external commands are monitored and performed
		Status output and control can be provided

Table 1.3 Adjustable Frequency Drive Internal Components

## 1.5 Frame Sizes and Power Ratings

			Frame size [kW]										
[Volts]	A1	A2	A3	A4	<b>A</b> 5	B1	B2	В3	B4	<b>C</b> 1	C2	СЗ	C4
200–240	0.25-1.5	0.25-2.2	3.0-3.7	0.25-2.2	0.25-3.7	5.5-7.5	11	5.5-7.5	11–15	15–22	30–37	18.5–22	30-37
380-480	0.37-1.5	0.37-4.0	5.5-7.5	0.37-4.0	0.37-7.5	11–15	18.5–22	11–15	18.5–30	30–45	55-75	37–45	55-75
525-600	N/A	N/A	0.75-7.5	N/A	0.75-7.5	11–15	18.5–22	11–15	18.5–30	30–45	55-90	37–45	55-90

Table 1.4 Frames Sizes and Power Ratings



## 2 Installation

## 2.1 Installation Site Checklist

- The adjustable frequency drive relies on the ambient air for cooling. Observe the limitations on ambient air temperature for optimal operation
- Ensure that the installation location has sufficient support strength to mount the adjustable frequency drive
- Keep the adjustable frequency drive interior free from dust and dirt. Ensure that the components stay as clean as possible. In construction areas, provide a protective covering. Optional IP54 (NEMA 12) or IP66 (NEMA 4) enclosures may be necessary.
- Keep the manual, drawings, and diagrams accessible for detailed installation and operation instructions. It is important that the manual is available for equipment operators.
- Locate equipment as near to the motor as possible. Keep motor cables as short as possible. Check the motor characteristics for actual tolerances. Do not exceed
  - 300 m (1000 ft) for unshielded motor leads
  - 150 m (500 ft) for shielded cable.

## 2.2 Adjustable Frequency Drive and Motor Pre-installation Checklist

- Compare the model number of unit on the nameplate to what was ordered to verify the proper equipment
- Ensure each of the following are rated for the same voltage:

Line power

Adjustable frequency drive

Motor

 Ensure that the adjustable frequency drive output current rating is equal to or greater than motor full load current for peak motor performance Motor size and adjustable frequency drive power must match for proper overload protection

If adjustable frequency drive rating is less than motor, full motor output cannot be achieved

#### 2.3 Mechanical Installation

## 2.3.1 Cooling

- To provide cooling airflow, mount the unit to a solid flat surface or to the optional backplate (see 2.3.3 Mounting)
- Top and bottom clearance for air cooling must be provided. Generally, 100–225 mm (4–10 in) is required. See Figure 2.1 for clearance requirements
- Improper mounting can result in overheating and reduced performance.
- Derating for temperatures starting between 40°C (104°F) and 50°C (122°F) and elevation 1,000 m (3,300 ft) above sea level must be considered. See the equipment Design Guide for detailed information.

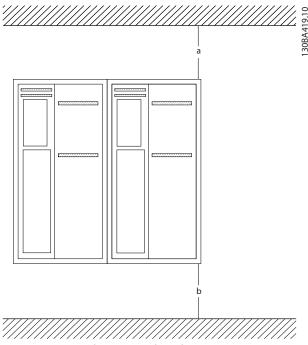


Figure 2.1 Top and Bottom Cooling Clearance

Enclosure	A1-A5	B1-B4	C1, C3	C2, C4
a/b (inch	2 027 [100]	7 074 [200]	7.074 [200]	8.858
[mm])	3.937 [100]	7.874 [200]	7.874 [200]	[225]

Table 2.1 Minimum Airflow Clearance Requirements

## 2.3.2 Lifting

- Check the weight of the unit to determine a safe lifting method
- Ensure that the lifting device is suitable for the task
- If necessary, plan for a hoist, crane, or forklift with the appropriate rating to move the unit
- For lifting, use hoist rings on the unit, when provided

## 2.3.3 Mounting

- Mount the unit vertically
- The adjustable frequency drive allows side by side installation
- Ensure that the strength of the mounting location will support the unit weight
- Mount the unit to a solid flat surface or to the optional backplate to provide cooling airflow (see *Figure 2.2* and *Figure 2.3*).

- Improper mounting can result in overheating and reduced performance.
- Use the slotted mounting holes on the unit for wall mounting, when provided.

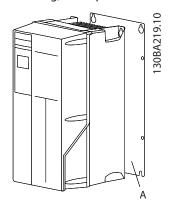


Figure 2.2 Proper Mounting with Backplate

Item A is a backplate properly installed for required airflow to cool the unit.

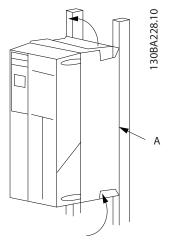


Figure 2.3 Proper Mounting with Railings

## NOTE!

Backplate is needed when mounted on railings.

## 2.3.4 Tightening Torques

See 10.4 Connection Tightening Torques for proper tightening specifications.

## 2.4 Electrical Installation

This section contains detailed instructions for wiring the adjustable frequency drive. The following tasks are described.

- Wiring the motor to the adjustable frequency drive output terminals
- Wiring the AC line power to the adjustable frequency drive input terminals
- Connecting control and serial communication wiring
- After power has been applied, checking input and motor power; programming control terminals for their intended functions

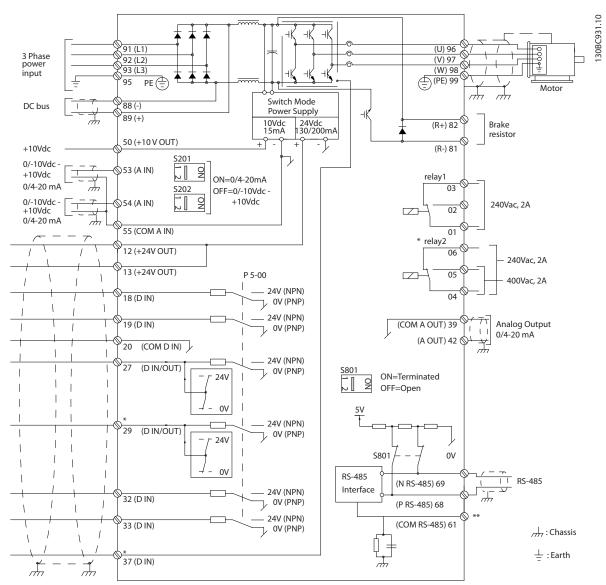


Figure 2.4 Basic Wiring Schematic Drawing

A=Analog, D=Digital

Terminal 37 is used for Safe Stop. For Safe Stop installation instructions, refer to the Design Guide.

- \* Terminal 37 is not included in FC 301 (except frame size A1). Relay 2 and terminal 29 have no function in FC 301.
- \*\* Do not connect cable screen.

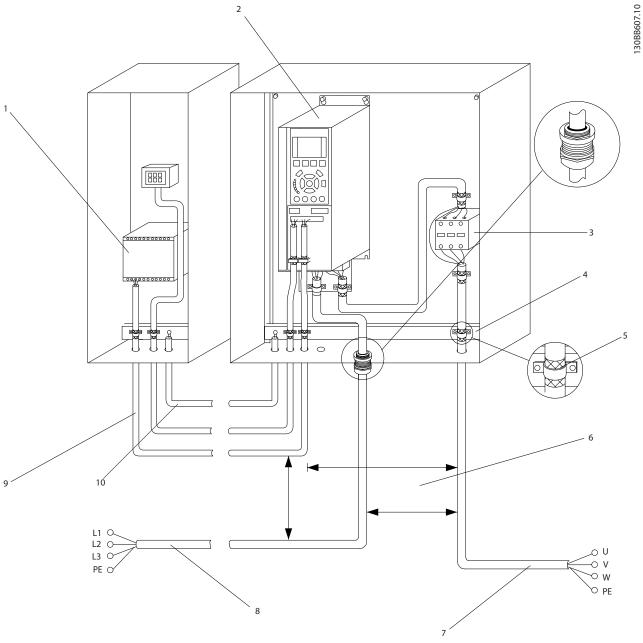


Figure 2.5 Typical Electrical Connection

1	PLC		Min. 200 mm (7.9 in) between control cables, motor and line
			power
2	Adjustable frequency drive	7	Motor, 3-phase and PE
3	Output contactor (Generally not recommended)	8	Line power, 3-phase and reinforced PE
4	Grounding rail (PE)	9	Control wiring
5	Cable insulation (stripped)	10	Equalizing min. 16 mm <sup>2</sup> (0.025 in)

Table 2.2

## 2.4.1 Requirements

# **AWARNING**

## **EQUIPMENT HAZARD!**

Rotating shafts and electrical equipment can be hazardous. All electrical work must conform to national and local electrical codes. It is strongly recommended that installation, start-up, and maintenance be performed only by trained and qualified personnel. Failure to follow these guidelines could result in death or serious injury.

## CAUTION

## WIRING ISOLATION!

Run input power, motor wiring and control wiring in three separate metallic conduits or use separated shielded cable for high frequency noise isolation. Failure to isolate power, motor and control wiring could result in less than optimum adjustable frequency drive and associated equipment performance.

For your safety, comply with the following requirements.

- Electronic controls equipment is connected to hazardous AC line voltage. Extreme care should be taken to protect against electrical hazards when applying power to the unit.
- 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.

## **Overload and Equipment Protection**

- An electronically activated function within the adjustable frequency drive provides overload protection for the motor. The overload calculates the level of increase to activate timing for the trip (controller output stop) function. The higher the current draw, the quicker the trip response. The overload provides Class 20 motor protection. See 8 Warnings and Alarms for details on the trip function.
- Because the motor wiring carries high frequency current, it is important that wiring for line power, motor power, and control is run separately. Use metallic conduit or separated shielded wire.
   Failure to isolate power, motor, and control wiring could result in less than optimum equipment performance.
- All adjustable frequency drives must be provided with short-circuit and overcurrent protection.

Input fusing is required to provide this protection, see *Figure 2.6*. If not factory supplied, fuses must be provided by the installer as part of installation. See maximum fuse ratings in 10.3 Fuse Specifications.

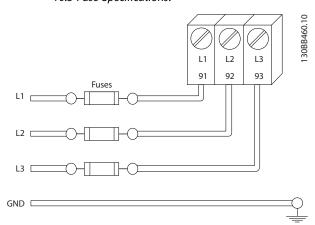


Figure 2.6 Adjustable Frequency Drive Fuses

## Wire Type and Ratings

- All wiring must comply with local and national regulations regarding cross-section and ambient temperature requirements.
- Danfoss recommends that all power connections be made with a minimum 167° F [75°C] rated copper wire.
- See 10.1 Power-dependent Specifications for recommended wire sizes.

## 2.4.2 Grounding Requirements

# **AWARNING**

## **GROUNDING HAZARD!**

For operator safety, it is important to ground the adjustable frequency drive properly in accordance with national and local electrical codes, as well as instructions contained within these instructions. Ground currents are higher than 3.5 mA. Failure to ground the adjustable frequency drive properly could result in death or serious injury.

## NOTE!

It is the responsibility of the user or certified electrical installer to ensure correct grounding of the equipment in accordance with national and local electrical codes and standards.

- 2
- Follow all local and national electrical codes to ground electrical equipment properly.
- Proper protective grounding for equipment with ground currents higher than 3.5 mA must be established, see *Leakage Current* (>3,5 mA)
- A dedicated ground wire is required for input power, motor power and control wiring
- Use the clamps provided on the equipment for proper ground connections
- Do not ground one adjustable frequency drive to another in a "daisy chain" fashion
- Keep the ground wire connections as short as possible
- Use of high-strand wire to reduce electrical noise is recommended
- Follow the motor manufacturer wiring requirements

## 2.4.2.1 Leakage Current (>3.5 mA)

Follow national and local codes regarding protective grounding of equipment with a leakage current > 3.5 mA. Adjustable frequency drive technology implies high frequency switching at high power. This will generate a leakage current in the ground connection. A fault current in the adjustable frequency drive at the output power terminals might contain a DC component which can charge the filter capacitors and cause a transient ground current. The ground leakage current depends on various system configurations including RFI filtering, shielded motor cables, and adjustable frequency drive power.

EN/IEC61800-5-1 (Power Drive System Product Standard) requires special care if the leakage current exceeds 3.5 mA. Grounding must be reinforced in one of the following ways:

- Ground ground wire of at least 0.0155 in<sup>2</sup> [10 mm<sup>2</sup>]
- Two separate ground wires both complying with the dimensioning rules

See EN 60364-5-54 § 543.7 for further information.

#### Using RCDs

Where residual current devices (RCDs), also known as ground leakage circuit breakers (GLCBs), are used, comply with the following:

Use RCDs of type B only which are capable of detecting AC and DC currents

Use RCDs with an inrush delay to prevent faults due to transient ground currents

Dimension RCDs according to the system configuration and environmental considerations

## 2.4.2.2 Grounding Using Shielded Cable

Grounding clamps are provided for motor wiring (see *Figure 2.7*).

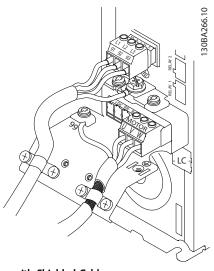


Figure 2.7 Grounding with Shielded Cable

## 2.4.3 Motor Connection

# **A**WARNING

## **INDUCED VOLTAGE!**

Run output 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 motor cables separately could result in death or serious injury.

- For maximum wire sizes, see 10.1 Power-dependent Specifications
- Comply with local and national electrical codes for cable sizes.
- Motor wiring knockouts or access panels are provided at the base of IP21 and higher (NEMA1/12) units
- Do not install power factor correction capacitors between the adjustable frequency drive and the motor
- Do not wire a starting or pole-changing device between the adjustable frequency drive and the motor.

30BB920.10

2

- Connect the 3-phase motor wiring to terminals 96 (U), 97 (V), and 98 (W).
- Ground the cable in accordance with grounding instructions provided.
- Torque terminals in accordance with the information provided in 10.4.1 Connection Tightening Torques
- Follow the motor manufacturer wiring requirements

Figure 2.8 represents line power input, motor, and ground grounding for basic adjustable frequency drives. Actual configurations vary with unit types and optional equipment.

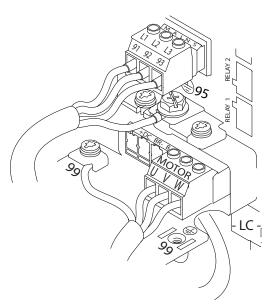


Figure 2.8 Example of Motor, Line Power and Ground Wiring

## 2.4.4 AC Line Power Connection

- Size wiring based upon the input current of the adjustable frequency drive. For maximum wire sizes, see 10.1 Power-dependent Specifications.
- Comply with local and national electrical codes for cable sizes.
- Connect 3-phase AC input power wiring to terminals L1, L2, and L3 (see *Figure 2.8*).
- Depending on the configuration of the equipment, input power will be connected to the line power input terminals or the input disconnect.

- Ground the cable in accordance with grounding instructions provided in 2.4.2 Grounding Requirements
- All adjustable frequency drives may be used with an isolated input source as well as with ground reference power lines. When supplied from an isolated line power source (IT line power or floating delta) or TT/TN-S line power with a grounded leg (grounded delta), set 14-50 RFI 1 to [0] Off. When off, the internal RFI filter capacitors between the chassis and the intermediate circuit are isolated to avoid damage to the intermediate circuit and to reduce ground capacity currents in accordance with IEC 61800-3.

## 2.4.5 Control Wiring

- Isolate control wiring from high power components in the adjustable frequency drive.
- If the adjustable frequency drive is connected to a thermistor, for PELV isolation, optional thermistor control wiring must be reinforced/ double insulated. A 24 V DC supply voltage is recommended.

#### 2.4.5.1 Access

- Remove access cover plate with a screw driver. See *Figure 2.9*.
- Or remove front cover by loosening attaching screws. See *Figure 2.10*.

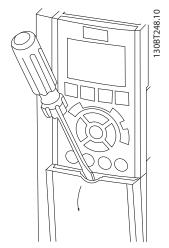


Figure 2.9 Control Wiring Access for A2, A3, B3, B4, C3 and C4 Enclosures

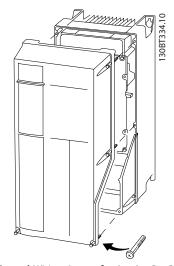


Figure 2.10 Control Wiring Access for A4, A5, B1, B2, C1 and C2 Enclosures

See Table 2.3 before tightening the covers.

-	-	2	2
-	*	2.2	2.2
-	*	2.2	2.2
-	*	2.2	2.2
1	*	2.2	2.2
	- - -	- * - * - *	- * 2.2 - * 2.2 - * 2.2 - * 2.2

<sup>\*</sup> No screws to tighten

Table 2.3 Tightening Torques for Covers (Nm)

## 2.4.5.2 Control Terminal Types

Figure 2.11 and shows the removable adjustable frequency drive connectors. Terminal functions and default settings are summarized in *Table 2.5*.

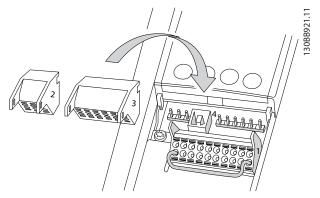


Figure 2.11 Control Terminal Locations

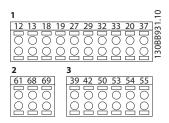


Figure 2.12 Terminal Numbers

- Connector 1 provides four programmable digital inputs terminals, two additional digital terminals programmable as either input or output, a 24 V DC terminal supply voltage, and a common for optional customer supplied 24 V DC voltage. FC 302 and FC 301 (optional in A1 enclosure) also provide a digital input for STO (Safe Torque Off) function.
- Connector 2 terminals (+)68 and (-)69 are for an RS-485 serial communications connection
- Connector 3 provides two analog inputs, one analog output, 10 V DC supply voltage, and commons for the inputs and output
- **Connector 4** is a USB port available for use with the MCT 10 Set-up Software
- Also provided are two Form C relay outputs that are in various locations depending upon the adjustable frequency drive configuration and size
- Some options available for ordering with the unit may provide additional terminals. See the manual provided with the equipment option.

See 10.2 General Technical Data for terminal ratings details.

Terminal description				
		Default		
Terminal	Parameter	setting	Description	
	Digi	ital inputs/outpu	ts	
12, 13	-	+24 V DC	24 V DC supply	
			voltage. Maximum	
			output current is 200	
			mA total (130 mA for	
			FC 301) for all 24 V	
			loads. Usable for	
			digital inputs and	
			external transducers.	
18	5-10	[8] Start		
19	5-11	[10] Reversing		
32	5-14	[0] No	Digital inputs	
		operation	Digital inputs.	
33	5-15	[0] No		
		operation		

<sup>-</sup> Does not exist

Terminal description			
	Default		
Terminal	Parameter	setting	Description
27	5-12	[2] Coast	Selectable for either
		inverse	digital input or
29	5-13	[14] JOG	output. Default setting
			is input.
20	-		Common for digital
			inputs and 0 V
			potential for 24 V
			supply.
37	-	Safe Torque	Safe input. Used for
		Off (STO)	STO.
	Ana	log inputs/outp	uts
39	-		Common for analog
			output
42	6-50	[0] No	Programmable analog
		operation	output. The analog
			signal is 0–20 mA or
			4-20 mA at a
			maximum of 500 $\Omega$
50	-	+10 V DC	10 V DC analog
			supply voltage. 15 mA
			maximum commonly
			used for potenti-
			ometer or thermistor.
53	6-1*	Reference	Analog input.
54	6-2*	Feedback	Selectable for voltage
			or current. Switches
			A53 and A54 select
			mA or V.
55	-		Common for analog
			input

Table 2.4

Terminal description			
		Default	
Terminal	Parameter	setting	Description
	Seri	al communication	on
61	-		Integrated RC-Filter for
			cable screen. ONLY for
			connecting the shield
			when experiencing
			EMC problems.
68 (+)	8-3*		RS-485 Interface. A
69 (-)	8-3*		control card switch is
			provided for
			termination resistance.
Relavs			

Terminal description			
		Default	
Terminal	Parameter	setting	Description
		[0] No	Form C relay output.
01, 02, 03	5-40 [0]	operation	Usable for AC or DC
04, 05, 06	5-40 [1]	[0] No	voltage and resistive
		operation	or inductive loads.

**Table 2.5 Terminal Description** 

## 2.4.5.3 Wiring to Control Terminals

Control terminal connectors can be unplugged from the adjustable frequency drive for ease of installation, as shown in *Figure 2.11*.

- 1. Open the contact by inserting a small screwdriver into the slot above or below the contact, as shown in *Figure 2.13*.
- 2. Insert the bared control wire into the contact.
- 3. Remove the screwdriver to fasten the control wire into the contact.
- 4. Ensure the contact is firmly established and not loose. Loose control wiring can be the source of equipment faults or less than optimal operation.

See 10.1 Power-dependent Specifications for control terminal wiring sizes.

See 6 Application Examples for typical control wiring connections.

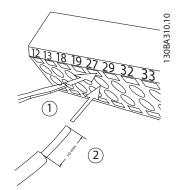


Figure 2.13 Connecting Control Wiring

## 2.4.5.4 Using Shielded Control Cables

## Correct shielding

The preferred method in most cases is to secure control and serial communication cables with shielding clamps provided at both ends to ensure best possible high frequency cable contact.

If the ground potential between the adjustable frequency drive and the PLC is different, electric noise may occur that will disturb the entire system. Solve this problem by fitting



an equalizing cable next to the control cable. Minimum cable cross-section: 0.025 in<sup>2</sup> (16 mm<sup>2)</sup>.

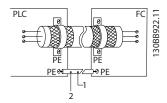


Figure 2.14

#### 50/60 Hz ground loops

With very long control cables, ground loops may occur. To eliminate ground loops, connect one end of the shield-to-ground with a 100 nF capacitor (keeping leads short).

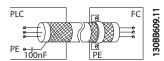


Figure 2.15

#### Avoid EMC noise on serial communication

This terminal is grounded via an internal RC link. Use twisted-pair cables to reduce interference between conductors. The recommended method is shown below:

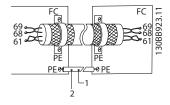


Figure 2.16

Alternatively, the connection to terminal 61 can be omitted:

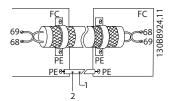


Figure 2.17

## 2.4.5.5 Control Terminal Functions

Adjustable frequency drive functions are commanded by receiving control input signals.

• Each terminal must be programmed for the function it will be supporting in the parameters

- associated with that terminal. See *Table 2.5* for terminals and associated parameters.
- It is important to confirm that the control terminal is programmed for the correct function.
   See 4 User Interface for details on accessing parameters and 5 About Adjustable Frequency
   Drive Programming for details on programming.
- The default terminal programming is intended to initiate adjustable frequency drive functioning in a typical operational mode.

## 2.4.5.6 Jumper Terminals 12 and 27

A jumper wire may be required between terminal 12 (or 13) and terminal 27 for the adjustable frequency drive to operate when using factory default programming values.

- Digital input terminal 27 is designed to receive an 24 V DC external interlock command. In many applications, the user wires an external interlock device to terminal 27
- When no interlock device is used, wire a jumper between control terminal 12 (recommended) or 13 to terminal 27. This provides an internal 24 V signal on terminal 27.
- No signal present prevents the unit from operating.
- When the status line at the bottom of the LCP reads AUTO REMOTE COAST, this indicates that the unit is ready to operate but is missing an input signal on terminal 27.
- When factory installed optional equipment is wired to terminal 27, do not remove that wiring

#### 2.4.5.7 Terminal 53 and 54 Switches

- Analog input terminals 53 and 54 can select either voltage (-10 to 10 V) or current (0/4–20 mA) input signals
- Remove power to the adjustable frequency drive before changing switch positions.
- Set switches A53 and A54 to select the signal type. U selects voltage, I selects current.
- The switches are accessible when the LCP has been removed (see *Figure 2.18*). Note that some option cards available for the unit may cover these switches and must be removed to change switch settings. Always remove power to the unit before removing option cards.

7

- Terminal 53 default is for a speed reference signal in open-loop set in 16-61 Terminal 53 Switch Setting
- Terminal 54 default is for a feedback signal in closed-loop set in 16-63 Terminal 54 Switch Setting

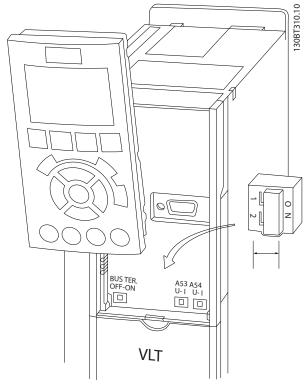


Figure 2.18 Location of Terminals 53 and 54 Switches and Bus Termination Switch

## 2.4.5.8 Terminal 37

## **Terminal 37 Safe Stop Function**

The FC 302 and FC 301 (optional for A1 enclosure) is available with safe stop functionality via control terminal 37. Safe stop disables the control voltage of the power semiconductors of the adjustable frequency drive output stage which in turn prevents generating the voltage required to rotate the motor. When the Safe Stop (T37) is activated, the adjustable frequency drive issues an alarm, trips the unit, and coasts the motor to a stop. Manual restart is required. The safe stop function can be used for stopping the adjustable frequency drive in emergency stop situations. In the normal operating mode when safe stop is not required, use the adjustable frequency drive's regular stop function instead. When automatic restart is used – the requirements according to ISO 12100-2 paragraph 5.3.2.5 must be fulfilled.

#### **Liability Conditions**

It is the responsibility of the user to ensure personnel installing and operating the Safe Stop function:

- Read and understand the safety regulations concerning health and safety/accident prevention
- Understand the generic and safety guidelines given in this description and the extended description in the Design Guide
- Have a good knowledge of the generic and safety standards applicable to the specific application

User is defined as: integrator, operator, servicing, maintenance staff.

#### Standards

Use of safe stop on terminal 37 requires that the user satisfies all provisions for safety including relevant laws, regulations and guidelines. The optional safe stop function complies with the following standards.

EN 954-1: 1996 Category 3

IEC 60204-1: 2005 category 0 - uncontrolled stop

IEC 61508: 1998 SIL2

IEC 61800-5-2: 2007 – safe torque off (STO)

function

IEC 62061: 2005 SIL CL2

ISO 13849-1: 2006 Category 3 PL d

ISO 14118: 2000 (EN 1037) - prevention of

unexpected start-up

The information and instructions of the instruction manual are not sufficient for a proper and safe use of the safe stop functionality. The related information and instructions of the relevant Design Guide must be followed.

#### **Protective Measures**

- Safety engineering systems may only be installed and commissioned by qualified and skilled personnel
- The unit must be installed in an IP54 cabinet or in an equivalent environment
- The cable between terminal 37 and the external safety device must be short circuit protected according to ISO 13849-2 table D.4
- If any external forces influence the motor axis (e.g., suspended loads), additional measures (e.g., a safety holding brake) are required to eliminate hazards.

# Safe Stop Installation and Set-up AWARNING

## SAFE STOP FUNCTION!

The safe stop function does NOT isolate AC line voltage to the adjustable frequency drive or auxiliary circuits. Perform work on electrical parts of the adjustable frequency drive or the motor only after isolating the AC line voltage supply and waiting the length of time specified under Safety in this manual. Failure to isolate the AC line voltage supply from the unit and waiting the time specified could result in death or serious injury.

- It is not recommended to stop the adjustable frequency drive by using the Safe Torque Off function. If a running adjustable frequency drive is stopped by using the function, the unit will trip and stop by coasting. If this is not acceptable, i.e., causes danger, the adjustable frequency drive and machinery must be stopped using the appropriate stopping mode before using this function. Depending on the application, a mechanical brake may be required.
- Concerning synchronous and permanent magnet motor adjustable frequency drives in case of a multiple IGBT power semiconductor failure: In spite of the activation of the Safe torque off function, the adjustable frequency drive system can produce an alignment torque which maximally rotates the motor shaft by 180/p degrees. p denotes the pole pair number.
- This function is suitable for performing mechanical work on the adjustable frequency drive system or affected area of a machine only.
   It does not provide electrical safety. This function should not be used as a control for starting and/or stopping the adjustable frequency drive.

The following requirements have to be meet to perform a safe installation of the adjustable frequency drive:

- 1. Remove the jumper wire between control terminals 37 and 12 or 13. Cutting or breaking the jumper is not sufficient to avoid short-circuiting. (See jumper on *Figure 2.19*.)
- Connect an external Safety monitoring relay via a NO safety function (the instruction for the safety device must be followed) to terminal 37 (safe stop) and either terminal 12 or 13 (24 V DC). The safety monitoring relay must comply with Category 3 (EN 954-1) / PL "d" (ISO 13849-1).

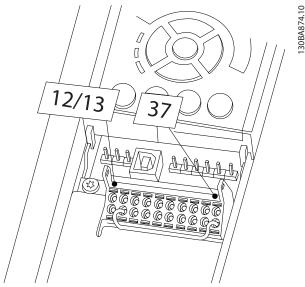


Figure 2.19 Jumper between Terminal 12/13 (24 V) and 37



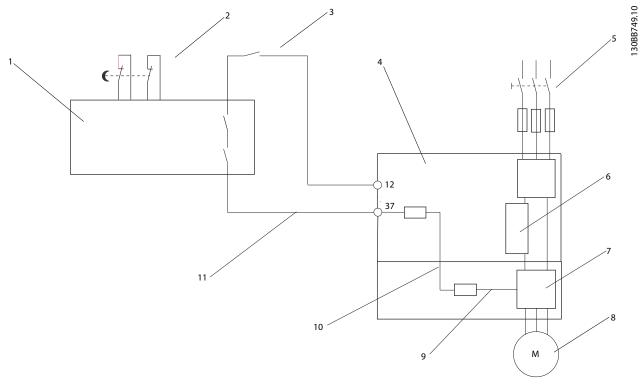


Figure 2.20 Installation to Achieve a Stopping Category 0 (EN 60204-1) with Safety Cat. 3 (EN 954-1) / PL "d" (ISO 13849-1)

1	Safety device Cat. 3 (circuit interrupt device, possibly	7	Inverter
	with release input)		
2	Door contact	8	Motor
3	Contactor (Coast)	9	5 V DC
4	Adjustable frequency drive	10	Safe channel
5	Line power	11	Short-circuit protected cable (if not inside installation cabinet)
6	Control board		

Table 2.6

Installation

## Safe Stop Commissioning Test

After installation and before first operation, perform a commissioning test of the installation making use of safe stop. Also, perform the test after each modification of the installation.

## 2.4.5.9 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 [32] Mechanical brake control in parameter group 5-4\* for applications with an electromechanical 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.

In the vertical movement, the key point is that the load must be held, stopped, controlled (raised, lowered) in a perfectly safe mode during the entire operation. Because the adjustable frequency drive is not a safety device, the crane/lift designer (OEM) must decide on the type and number of safety devices (e.g., speed switch, emergency brakes, etc.) to be used, in order to be able to stop the load in case of emergency or malfunction of the system, according to relevant national crane/lift regulations.

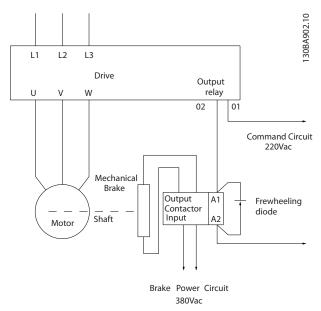


Figure 2.21 Connecting the Mechanical Brake to the Adjustable Frequency Drive

## 2.4.6 Serial Communication

Connect RS-485 serial communication wiring to terminals (+)68 and (-)69.

- A shielded serial communication cable is recommended
- See 2.4.2 Grounding Requirements for proper grounding

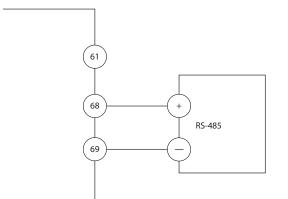


Figure 2.22 Serial Communication Wiring Diagram

# VLT\*AutomationDrive Instruction Manual

For basic serial communication set-up, select the following

- 1. Protocol type in 8-30 Protocol.
- 2. Adjustable frequency drive address in 8-31 Address.
- 3. Baud rate in 8-32 Baud Rate.
- Two communication protocols are internal to the adjustable frequency drive. Follow the motor manufacturer wiring requirements.

Danfoss FC

Modbus RTU

- Functions can be programmed remotely using the protocol software and RS-485 connection or in parameter group 8-\*\* Communications and Options.
- Selecting a specific communication protocol changes various default parameter settings to match that protocol's specifications along with making additional protocol-specific parameters available.
- Option cards which can be installed in the adjustable frequency drive are available to provide additional communication protocols. See the option-card documentation for installation and operation instructions

7



2

## 3

## 3 Start-up and Functional Testing

#### 3.1 Pre-start

## 3.1.1 Safety Inspection

# **▲**WARNING

## **HIGH VOLTAGE!**

If input and output connections have been connected improperly, there is potential for high voltage on these terminals. If power leads for multiple motors are improperly run in same conduit, there is potential for leakage current to charge capacitors within the adjustable frequency drive, even when disconnected from line power input. For initial start-up, make no assumptions about power components. Follow pre-start procedures. Failure to follow pre-start procedures could result in personal injury or damage to equipment.

- Input power to the unit must be OFF and locked out. Do not rely on the adjustable frequency drive disconnect switches for input power isolation.
- Verify that there is no voltage on input terminals L1 (91), L2 (92), and L3 (93), phase-to-phase and phase-to-ground,
- 3. Verify that there is no voltage on output terminals 96 (U), 97 (V), and 98 (W), phase-to-phase and phase-to-ground.
- 4. Confirm continuity of the motor by measuring ohm values on U-V (96-97), V-W (97-98), and W-U (98-96).
- 5. Check for proper grounding of the adjustable frequency drive as well as the motor.
- Inspect the adjustable frequency drive for loose connections on terminals.
- Record the following motor nameplate data: power, voltage, frequency, full load current, and nominal speed. These values are needed to program motor nameplate data later.
- 8. Confirm that the supply voltage matches voltage of adjustable frequency drive and motor.



Before applying power to the unit, inspect the entire installation as detailed in *Table 3.1*. Check mark those items when completed.

Inspect for	Description	Ø
Auxiliary equipment	Look for auxiliary equipment, switches, disconnects, or input fuses/circuit breakers that may reside on the input power side of the adjustable frequency drive or output side to the motor. Ensure that they are ready for full speed operation.	
	Check function and installation of any sensors used for feedback to the adjustable frequency drive.	
	Remove power factor correction caps on motor(s), if present.	
Cable routing	Ensure that input power, motor wiring, and control wiring are separated or in three separate metallic conduits for high frequency noise isolation.	
Control wiring	Check for broken or damaged wires and loose connections.	
	Check that control wiring is isolated from power and motor wiring for noise immunity.	
	Check the voltage source of the signals, if necessary.	
	The use of shielded cable or twisted pair is recommended. Ensure that the shield is terminated correctly.	
Cooling clearance	Measure to make sure that the top and bottom clearance is adequate to ensure proper airflow for cooling.	
EMC considerations	Check for proper installation regarding electromagnetic compatibility.	
Environmental consider-	See equipment label for the maximum ambient operating temperature limits.	
ations	Humidity levels must be 5%–95% non-condensing.	
Fusing and circuit	Check for proper fusing or circuit breakers.	
breakers	Check that all fuses are inserted firmly and in operational condition and that all circuit breakers are in the open position.	
Grounding	The unit requires a ground wire from its chassis to the building's ground.	
	Check for good ground connections that are tight and free of oxidation.	
	Grounding to conduit or mounting the back panel to a metal surface is not a suitable ground.	
Input and output power	Check for loose connections.	
wiring	Check that motor and line power are in separate conduits or separated shielded cables.	
Panel interior	Inspect to ensure that the unit interior is free of dirt, metal chips, moisture, and corrosion.	
Switches	Ensure that all switch and disconnect settings are in the proper positions.	
Vibration	Check that the unit is mounted solidly or that shock mounts are used, as necessary.	
	Check for an unusual amount of vibration.	

Table 3.1 Start-up Check List

# 3

## 3.2 Applying Power to the Adjustable Frequency Drive

# **AWARNING**

#### **HIGH VOLTAGE!**

Adjustable frequency drives contain high voltage when connected to AC line power. Installation, start-up and maintenance should be performed by qualified personnel only. Failure to perform installation, start-up and maintenance by qualified personnel could result in death or serious injury.

# **AWARNING**

## **UNINTENDED START!**

When the adjustable frequency drive is connected to AC line power, the motor may start at any time. The adjustable frequency drive, motor, and any driven equipment must be in operational readiness. Failure to be in operational readiness when the adjustable frequency drive is connected to AC line power could result in death, serious injury, equipment, or property damage.

- Confirm input voltage is balanced within 3%. If not, correct input voltage imbalance before proceeding. Repeat procedure after voltage correction.
- 2. Ensure optional equipment wiring, if present, matches installation application.
- Ensure that all operator devices are in the OFF position. Panel doors closed or cover mounted.
- 4. Apply power to the unit. DO NOT start the adjustable frequency drive at this time. For units with a disconnect switch, turn to the ON position to apply power to the adjustable frequency drive.

#### NOTE!

If the status line at the bottom of the LCP reads AUTO REMOTE COAST, this indicates that the unit is ready to operate but is missing an input signal on terminal 27.

## 3.3 Basic Operational Programming

Adjustable frequency drives require basic operational programming before running for best performance. Basic operational programming requires entering motor nameplate data for the motor being operated and the minimum and maximum motor speeds. The recommended parameter settings are intended for startup and checkout purposes. Application settings may vary. See for detailed instructions on entering data through the LCP.

Enter data with power ON, but before operating the adjustable frequency drive. There are two ways of programming the adjustable frequency drive: either by using the Smart Application Set-up (SAS) or by using the procedure described further down. The SAS is a quick wizard for setting up the most commonly used applications. At first power-up and after a reset, the SAS appears on the LCP. Follow the instructions that appear on the successive screens for setting-up the applications listed. SAS can also be found under the Quick Menu. [Info] can be used throughout the Smart Set-up to see help information for various selections, settings, and messages.

## NOTE!

The start conditions will be ignored while in the wizard.

## NOTE!

If no action is taken after first power-up or reset, the SAS screen will automatically disappear after 10 minutes.

When not using the SAS, enter data in accordance with the following procedure.

- 1. Press [Main Menu] twice on the LCP.
- 2. Use the navigation keys to scroll to parameter group 0-\*\* Operation/Display and press [OK].

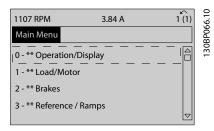


Figure 3.1

 Use navigation keys to scroll to parameter group 0-0\* Basic Settings and press [OK].

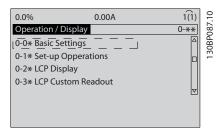


Figure 3.2

4. Use navigation keys to scroll to *0-03 Regional Settings* and press [OK].

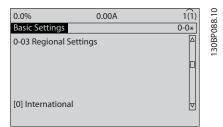


Figure 3.3

- 5. Use navigation keys to select *International* or *North America* as appropriate and press [OK]. (This changes the default settings for a number of basic parameters. See for a complete list.)
- 6. Press [Quick Menu] on the LCP.
- 7. Use the navigation keys to scroll to parameter group *Q2 Quick Setup* and press [OK].

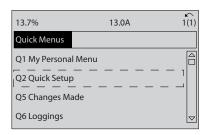


Figure 3.4

8. Select language and press [OK]. Then enter the motor data in 1-20 Motor Power [kW] /1-21 Motor Power [HP] through 1-25 Motor Nominal Speed. The information can be found on the motor nameplate.

1-20 Motor Power [kW] or 1-21 Motor Power [HP]

- 1-22 Motor Voltage
- 1-23 Motor Frequency
- 1-24 Motor Current
- 1-25 Motor Nominal Speed

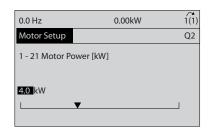


Figure 3.5

- 9. A jumper wire should be in place between control terminals 12 and 27. If this is the case, leave 5-12 Terminal 27 Digital Input at factory default. Otherwise select No Operation. For adjustable frequency drives with an optional Danfoss bypass, no jumper wire is required.
- 10. 3-02 Minimum Reference
- 11. 3-03 Maximum Reference
- 12. 3-41 Ramp 1 Ramp-up Time
- 13. 3-42 Ramp 1 Ramp-down Time
- 14. *3-13 Reference Site*. Linked to Hand/Auto\* Local Remote.

This concludes the quick set-up procedure. Press [Status] to return to the operational display.

## 3.4 Automatic Motor Adaptation

Automatic motor adaptation (AMA) is a test procedure that measures the electrical characteristics of the motor to optimize compatibility between the adjustable frequency drive and the motor.

- The adjustable frequency drive builds a mathematical model of the motor for regulating output motor current. The procedure also tests the input phase balance of electrical power. It compares the motor characteristics with the data entered in parameters 1-20 Motor Power [kW] to 1-25 Motor Nominal Speed.
- It does not cause the motor to run or harm to the motor
- Some motors may be unable to run the complete version of the test. In that case, select *Enable* reduced AMA
- If an output filter is connected to the motor, select *Enable reduced AMA*
- If warnings or alarms occur, see 8 Warnings and
  Alarms
- Run this procedure on a cold motor for best results

3

#### To run AMA

- 1. Press [Main Menu] to access parameters.
- 2. Scroll to parameter group 1-\*\* Load and Motor.
- 3. Press [OK].
- 4. Scroll to parameter group 1-2\* *Motor Data*.
- 5. Press [OK].
- 6. Scroll to 1-29 Automatic Motor Adaptation (AMA).
- 7. Press [OK].
- 8. Select Enable complete AMA.
- 9. Press [OK].
- 10. Follow on-screen instructions.
- 11. The test will run automatically and indicate when it is complete.

## 3.5 Check Motor Rotation

Before running the adjustable frequency drive, check the motor rotation.

- 1. Press [Hand On].
- 2. Press [▶] for positive speed reference.
- 3. Check that the speed displayed is positive.

When 1-06 Clockwise Direction is set to [0] Normal (default clockwise):

- 4a. Verify that the motor turns clockwise.
- 5a. Verify that the LCP direction arrow is clockwise.

When 1-06 Clockwise Direction is set to [1] Inverse (counterclockwise):

- 4b. Verify that the motor turns counter-clockwise.
- 5b. Verify that the LCP direction arrow is counter-clockwise.

## 3.6 Check Encoder Rotation

Check encoder rotation only if encoder feedback is used. Check encoder rotation in default open-loop control.

 Verify that the encoder connection is according to the wiring diagram:

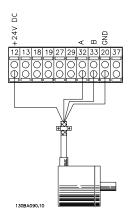


Figure 3.6

## NOTE!

When using an encoder option, refer to the option manual.

- 2. Enter the speed PID feedback source in 7-00 Speed PID Feedback Source.
- 3. Press [Hand On].
- Press [►] for positive speed reference (1-06 Clockwise Direction at [0] Normal).
- 5. Check in *16-57 Feedback [RPM]* that the feedback is positive.

#### NOTE!

If the feedback is negative, the encoder connection is wrong!



#### 3.7 Local Control Test

# **A**CAUTION

#### **MOTOR START!**

Ensure that the motor, system, and any attached equipment are ready for start. It is the responsibility of the user to ensure safe operation under any operational condition. Failure to ensure that the motor, system, and any attached equipment are ready for start could result in personal injury or equipment damage.

#### NOTE!

The Hand on key on the LCP provides a local start command to the adjustable frequency drive. The [Off] key provides the stop function.

When operating in local mode, the up and down arrows on the LCP increase and decrease the speed output of the LCP. The left and right arrow keys move the display cursor in the numeric display.

- 1. Press [Hand On].
- Accelerate the adjustable frequency drive by pressing [\*] to full speed. Moving the cursor left of the decimal point provides quicker input changes.
- 3. Note any acceleration problems.
- Press [Off].
- 5. Note any deceleration problems.

If acceleration problems were encountered

- If warnings or alarms occur, see 8 Warnings and Alarms
- Check that motor data is entered correctly
- Increase the ramp-up time in 3-41 Ramp 1 Rampup Time
- Increase current limit in 4-18 Current Limit
- Increase torque limit in *4-16 Torque Limit Motor Mode*

If deceleration problems were encountered

- If warnings or alarms occur, see 8 Warnings and Alarms
- Check that motor data is entered correctly
- Increase the ramp-down time in 3-42 Ramp 1
  Ramp-down Time
- Enable overvoltage control in 2-17 Over-voltage Control

See 8.4 Warning and Alarm Definitions for resetting the adjustable frequency drive after a trip.

## NOTE!

3.1 Pre-start through 3.7 Local Control Test in this chapter conclude the procedures for applying power to the adjustable frequency drive, basic programming, set-up, and functional testing.

## 3.8 System Start-up

The procedure in this section requires user-wiring and application programming to be completed. 6 Application Examples is intended to help with this task. Other aids to application set-up are listed in 1.2 Additional Resources. The following procedure is recommended after application set-up by the user is completed.

# **ACAUTION**

## **MOTOR START!**

Ensure that the motor, system, and any attached equipment are ready for start. It is the responsibility of the user to ensure safe operation under any operational condition. Failure to ensure that the motor, system, and any attached equipment are ready for start could result in personal injury or equipment damage.

- 1. Press [Auto On].
- 2. Ensure that external control functions are properly wired to the adjustable frequency drive and all programming completed.
- 3. Apply an external run command.
- 4. Adjust the speed reference throughout the speed range.
- 5. Remove the external run command.
- 6. Note any problems.

If warnings or alarms occur, see 8 Warnings and Alarms.



## 4 User Interface

## 4.1 Local Control Panel

The local control panel (LCP) is the combined display and keypad on the front of the unit. The LCP is the user interface to the adjustable frequency drive.

The LCP has several user functions.

- Start, stop, and control speed when in local control
- Display operational data, status, warnings and
  cautions
- Programming adjustable frequency drive functions
- Manually reset the adjustable frequency drive after a fault when auto-reset is inactive

An optional numeric LCP (NLCP) is also available. The NLCP operates in a manner similar to the LCP. See the Programming Guide for details on use of the NLCP.

## NOTE!

The display contrast can be adjusted by pressing [Status] and [A]/[V] key.

## 4.1.1 LCP Layout

The LCP is divided into four functional groups (see *Figure 4.1*).

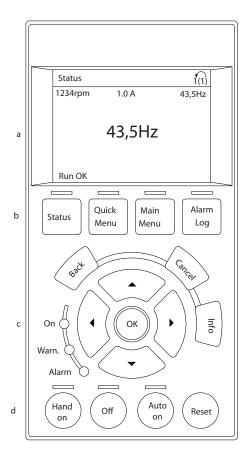


Figure 4.1 LCP

- a. Display area.
- b. Display menu keys for changing the display to show status options, programming, or error message history.
- c. Navigation keys for programming functions, moving the display cursor, and speed control in local operation. Also included are the status indicator lights.
- d. Operational mode keys and reset.



## 4.1.2 Setting LCP Display Values

The display area is activated when the adjustable frequency drive receives power from AC line voltage, a DC bus terminal, or an external 24 V supply.

The information displayed on the LCP can be customized for user application.

- Each display readout has a parameter associated with it.
- Options are selected in main menu 0-2\*.
- The adjustable frequency drive status at the bottom line of the display is generated automatically and is not selectable. See 7 Status Messages for definitions and details.

Display	Parameter number	Default setting
1.1	0-20	Speed [RPM]
1.2	0-21	Motor Current
1.3	0-22	Power [kW]
2	0-23	Frequency
3	0-24	Reference [%]

Table 4.1

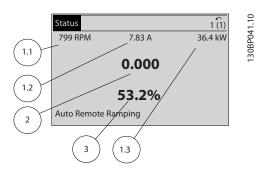


Figure 4.2

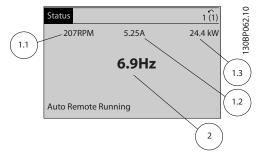


Figure 4.3

## 4.1.3 Display Menu Keys

Menu keys are used for menu access for parameter set-up, toggling through status display modes during normal operation, and viewing fault log data.

Status

Quick Menu Main Menu Alarm Log

m g 130BP045.10

Figure 4.4

Key	Function		
Status	Press to show operational information.  In Auto mode, press and hold to toggle between status readout displays  Press repeatedly to scroll through each status display.		
	<ul> <li>Press and hold [Status] plus [▲] or [▼] to adjust the display brightness</li> <li>The symbol in the upper right corner of the display shows the direction of motor rotation and which set-up is active. This is</li> </ul>		
Quick Menu	not programmable.  Allows access to programming parameters for initial set-up instructions and many detailed application instructions.		
	<ul> <li>Press to access Q2 Quick Setup for sequenced instructions to program the basic frequency controller set up</li> <li>Follow the sequence of parameters as presented for the function setup</li> </ul>		
Main Menu	Allows access to all programming parameters.     Press twice to access top-level index     Press once to return to the last location accessed.     Press and hold to enter a parameter number for direct access to that parameters.		
Alarm Log	Displays a list of current warnings, the last 5 alarms, and the maintenance log.  • For details about the adjustable frequency drive before it entered the alarm mode, select the alarm number using the navigation keys and press [OK].		

Table 4.2



## 4.1.4 Navigation Keys

Navigation keys are used for programming functions and moving the display cursor. The navigation keys also provide speed control in local (hand) operation. Three adjustable frequency drive status indicators are also located in this area.

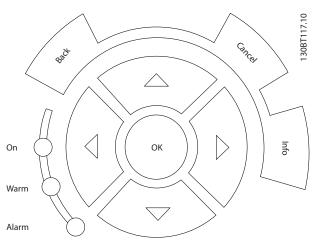


Figure 4.5

Key	Function	
Back	Reverts to the previous step or list in the menu	
	structure.	
Cancel	Cancels the last change or command as long as	
	the display mode has not changed.	
Info	Press for a definition of the function being	
	displayed.	
Navigation	Use the four navigation keys to move between	
Keys	items in the menu.	
ОК	Use to access parameter groups or to enable a	
	choice.	

Table 4.3

Light	Indicator	Function
Green	ON	The ON light activates when the
		adjustable frequency drive receives
		power from AC line voltage, a DC
		bus terminal, or an external 24 V
		supply.
Yellow	WARNING	When warning conditions are met,
		the yellow WARNING light comes
		on and text appears in the display
		area identifying the problem.
Red	ALARM	A fault condition causes the red
		alarm light to flash and an alarm
		text is displayed.

Table 4.4

## 4.1.5 Operation Keys

Operation keys are found at the bottom of the LCP.

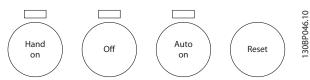


Figure 4.6

Key	Function
Hand On	<ul> <li>Starts the adjustable frequency drive in local control.</li> <li>Use the navigation keys to control adjustable frequency drive speed.</li> <li>An external stop signal by control input or serial communication overrides the local hand on</li> </ul>
Off	Stops the motor but does not remove power to the adjustable frequency drive.
Auto On	Puts the system in remote operational mode.  Responds to an external start command by control terminals or serial communication  Speed reference is from an external source
Reset	Resets the adjustable frequency drive manually after a fault has been cleared.

Table 4.5

## 4.2 Backup and Copying Parameter Settings

Programming data is stored internally in the adjustable frequency drive.

- The data can be uploaded into the LCP memory as a storage backup.
- Once stored in the LCP, the data can be downloaded back into the adjustable frequency drive.
- Data can also be downloaded into other adjustable frequency drives by connecting the LCP into those units and downloading the stored settings. (This is a quick way to program multiple units with the same settings.)
- Initialization of the adjustable frequency drive to restore factory default settings does not change data stored in the LCP memory.



# **A**WARNING

#### **UNINTENDED START!**

When the adjustable frequency drive is connected to AC line power, the motor may start at any time. The adjustable frequency drive, motor, and any driven equipment must be in operational readiness. Failure to be in operational readiness when the adjustable frequency drive is connected to AC line power could result in death, serious injury, or equipment or property damage.

### 4.2.1 Uploading Data to the LCP

- Press [Off] to stop the motor before uploading or downloading data.
- 2. Go to 0-50 LCP Copy.
- 3. Press [OK].
- 4. Select All to LCP.
- 5. Press [OK]. A progress bar shows the uploading process.
- 6. Press [Hand On] or [Auto On] to return to normal operation.

### 4.2.2 Downloading Data from the LCP

- 1. Press [Off] to stop the motor before uploading or downloading data.
- 2. Go to 0-50 LCP Copy.
- Press [OK].
- 4. Select All from LCP.
- 5. Press [OK]. A progress bar shows the downloading process.
- 6. Press [Hand On] or [Auto On] to return to normal operation.

### 4.3 Restoring Default Settings

## CAUTION

Initialization restores the unit to factory default settings. Any programming, motor data, localization, and monitoring records will be lost. Uploading data to the LCP provides a backup before initialization.

Restoring the adjustable frequency drive parameter settings back to default values is done by initialization of the adjustable frequency drive. Initialization can be through 14-22 Operation Mode or manually.

- Initialization using 14-22 Operation Mode does not change adjustable frequency drive data such as operating hours, serial communication selections, personal menu settings, fault log, alarm log, and other monitoring functions
- Using 14-22 Operation Mode is generally recommended.
- Manual initialization erases all motor, programming, localization, and monitoring data and restores factory default settings.

#### 4.3.1 Recommended Initialization

- 1. Press [Main Menu] twice to access parameters.
- 2. Scroll to 14-22 Operation Mode.
- 3. Press [OK].
- 4. Scroll to Initialization.
- Press [OK].
- 6. Remove power to the unit and wait for the display to turn off.
- 7. Apply power to the unit.

Default parameter settings are restored during start-up. This may take slightly longer than normal.

- 8. Alarm 80 is displayed.
- 9. Press [Reset] to return to operation mode.

#### 4.3.2 Manual Initialization

- Remove power to the unit and wait for the display to turn off.
- 2. Press and hold [Status], [Main Menu], and [OK] at the same time and apply power to the unit.

Factory default parameter settings are restored during startup. This may take slightly longer than normal.

Manual initialization does not the following adjustable frequency drive information.

- 15-00 Operating Hours
- 15-03 Power-ups
- 15-04 Over Temps
- 15-05 Over Volts



# 5 About Adjustable Frequency Drive Programming

#### 5.1 Introduction

The adjustable frequency drive is programmed for its application functions using parameters. Parameters are accessed by pressing either [Quick Menu] or [Main Menu] on the LCP. (See *4 User Interface* for details on using the LCP function keys.) Parameters may also be accessed through a PC using the MCT 10 Set-up Software (see *5.6.1 Remote Programming with MCT 10 Set-up Software*).

The quick menu is intended for initial start up (Q2-\*\* Quick Set Up). Data entered in a parameter can change the options available in the parameters following that entry.

The main menu accesses all parameters and allows for advanced adjustable frequency drive applications.

#### 5.2 Programming Example

Here is an example for programming the adjustable frequency drive for a common application in open-loop using the quick menu.

- This procedure programs the adjustable frequency drive to receive a 0–10 V DC analog control signal on input terminal 53
- The adjustable frequency drive will respond by providing 6-60 Hz output to the motor proportional to the input signal (0–10 V DC = 6–60 Hz)

Select the following parameters using the navigation keys to scroll to the titles and press [OK] after each action.

1. 3-15 Reference Resource 1

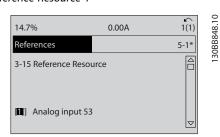


Figure 5.1

2. 3-02 Minimum Reference. Set minimum internal adjustable frequency drive reference to 0 Hz. (This sets the minimum adjustable frequency drive speed at 0 Hz.)

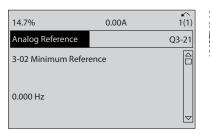


Figure 5.2

3. 3-03 Maximum Reference. Set maximum internal adjustable frequency drive reference to 60 Hz. (This sets the maximum adjustable frequency drive speed at 60 Hz. Note that 50/60 Hz is a regional variation.)

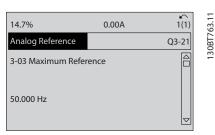


Figure 5.3

4. 6-10 Terminal 53 Low Voltage. Set minimum external voltage reference on Terminal 53 at 0 V. (This sets the minimum input signal at 0 V.)

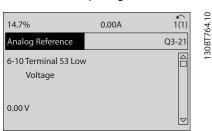


Figure 5.4



5. 6-11 Terminal 53 High Voltage. Set maximum external voltage reference on Terminal 53 at 10 V. (This sets the maximum input signal at 10 V.)

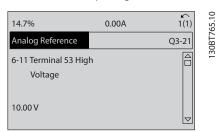


Figure 5.5

 6-14 Terminal 53 Low Ref./Feedb. Value. Set minimum speed reference on Terminal 53 at 6 Hz. (This tells the adjustable frequency drive that the minimum voltage received on Terminal 53 (0 V) equals 6 Hz output.)

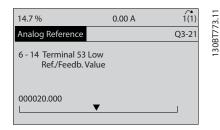


Figure 5.6

7. 6-15 Terminal 53 High Ref./Feedb. Value. Set maximum speed reference on Terminal 53 at 60 Hz. (This tells the adjustable frequency drive that the maximum voltage received on Terminal 53 (10 V) equals 60 Hz output.)

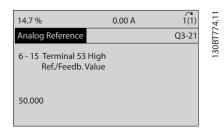


Figure 5.7

With an external device providing a 0–10 V control signal connected to adjustable frequency drive terminal 53, the system is now ready for operation. Note that the scroll bar on the right in the last figure of the display is at the bottom, indicating the procedure is complete.

Figure 5.8 shows the wiring connections used to enable this set-up.

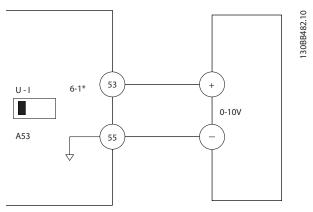


Figure 5.8 Wiring Example for External Device Providing 0–10 V Control Signal (adjustable frequency drive left, external device right)

# 5.3 Control Terminal Programming Examples

Control terminals can be programmed.

- Each terminal has specified functions it is capable of performing.
- Parameters associated with the terminal enable the function.

See *Table 2.5* for control terminal parameter number and default setting. (Default setting can change based on the selection in *0-03 Regional Settings*.)

The following example shows accessing Terminal 18 to see the default setting.

1. Press [Main Menu] twice, scroll to parameter group 5-\*\* *Digital In/Out* and press [OK].

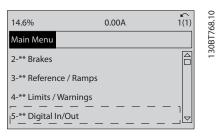


Figure 5.9

\_

 Scroll to parameter group 5-1\* Digital Inputs and press [OK].

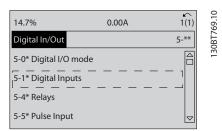


Figure 5.10

3. Scroll to *5-10 Terminal 18 Digital Input*. Press [OK] to access function choices. The default setting *Start* is shown.

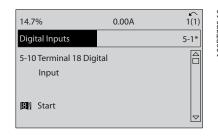


Figure 5.11

# 5.4 International/North American Default Parameter Settings

Setting *0-03 Regional Settings* to [0] *International* or [1] *North America* changes the default settings for some parameters. *Table 5.1* lists those parameters that are effected.

Parameter	International default parameter	North American default parameter	
	value	value	
0-03 Regional	International	North America	
Settings			
1-20 Motor Power	See Note 1	See Note 1	
[kW]			
1-21 Motor Power	See Note 2	See Note 2	
[HP]			
1-22 Motor Voltage	230 V/400 V/575 V	208 V/460 V/575 V	
1-23 Motor	50 Hz	60 Hz	
Frequency			
3-03 Maximum	50 Hz	60 Hz	
Reference			
3-04 Reference	Sum	External/Preset	
Function			

Parameter	International default parameter value	North American default parameter value	
4-13 Motor Speed	1,500 RPM	1,800 RPM	
High Limit [RPM]			
See Note 3 and 5			
4-14 Motor Speed	50 Hz 60 Hz		
High Limit [Hz]			
See Note 4			
4-19 Max Output	132 Hz	120 Hz	
Frequency			
4-53 Warning Speed	1,500 RPM	1,800 RPM	
High			
5-12 Terminal 27	Coast inverse	External interlock	
Digital Input			
5-40 Function Relay	No operation	No alarm	
6-15 Terminal 53	50	60	
High Ref./Feedb.			
Value			
6-50 Terminal 42	No operation	Speed 4-20 mA	
Output			
14-20 Reset Mode	Manual reset	Infinite auto reset	

Table 5.1 International/North American Default Parameter Settings

Note 1: 1-20 Motor Power [kW] is only visible when 0-03 Regional Settings is set to [0] International.

Note 2: 1-21 Motor Power [HP] , is only visible when 0-03 Regional Settings is set to [1] North America.

Note 3: This parameter is only visible when 0-02 Motor Speed Unit is set to [0] RPM.

Note 4: This parameter is only visible when 0-02 Motor Speed Unit is set to [1] Hz.

Note 5: The default value depends on the number of motor poles. For a 4-pole motor, the international default value is 1,500 RPM, and for a 2-pole motor, 3,000 RPM. The corresponding values for North America are 1,800 and 3,600 RPM, respectively.

Changes made to default settings are stored and available for viewing in the quick menu along with any programming entered into parameters.

- 1. Press [Quick Menu].
- 2. Scroll to Q5 Changes Made and press [OK].

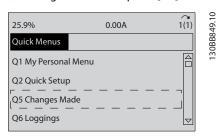


Figure 5.12

3. Select Q5-2 *Since Factory Setting* to view all programming changes or Q5-1 *Last 10 Changes* for the most recent.

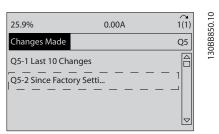


Figure 5.13

#### 5.5 Parameter Menu Structure

Establishing the correct programming for applications often requires setting functions in several related parameters. These parameter settings provide the adjustable frequency drive with system details for the adjustable frequency drive to operate properly. System details may include such things as input and output signal types, programming terminals, minimum and maximum signal ranges, custom displays, automatic restart, and other features.

- See the LCP display to view detailed parameter programming and setting options.
- Press [Info] in any menu location to view additional details for that function.
- Press and hold [Main Menu] to enter a parameter number for direct access to that parameter.
- Details for common application set ups are provided in 6 Application Examples.

STITICLUE	Manual	
140   Moor Construction   145   Stop Adjustments   312   Carlot up/slow down value   141   Moor Construction   142   Moor Date   142   Moor Date   143   Moor Construction   143   Moor Construction   143   Moor Construction   144   Moor Construction   145   Moor Date   144   Moor Power   143   Moor Construction   145   Moor Date   144   Moor Power   145   Moor Power   14	Motor Speed Low Limit [Hz] Motor Speed High Limit [RPM] Motor Speed High Limit [Hz] Torque Limit Generator Mode Torque Limit Generator Mode Torque Limit Generator Mode Torque Limit Factors Torque Limit Factor Source Speed Limit Factor Source Speed Limit Factor Source Speed Limit Factor Source Motor Feedback Loss Function Motor Feedback Loss Timeout Tracking Error Function Tracking Error Ramping Timeout Tracking Error Ramping Timeout Tracking Error Ramping Timeout Tracking Error After Ramping Marning Speed Low Warning Speed Low Warning Speed Low Warning Reference Low Warning Reference Low Warning Reference Low Warning Reference Low Warning Feedback Ligh Warning Feedback Low Warning Feedback Low Warning Feedback Low Warning Feedback Low Warning Reference Low Warning Feedback Low Warning Speed From [RPM] Bypass S	Terminal 32 Digital input Terminal 33 Digital input Terminal X30/2 Digital input Terminal X30/3 Digital input Terminal X30/4 Digital input Terminal X46/1 Digital input Terminal X46/2 Digital input Terminal X46/5 Digital input Terminal X46/5 Digital input Terminal X46/7 Digital input Terminal X46/7 Digital input Terminal X46/1 Digital input Terminal X46/1 Digital input
1-10   Motor Construction   1-86   Stop Adjustments   3-15   Carch in Motor Construction   1-80   Motor Model   1-80   Murdin at Stop   3-15   Reference   1-44   Damping dain   1-80   Murdin at Stop   3-15   Reference   1-44   Damping dain   1-80   Murdin at Stop   3-15   Reference   1-45   Carch Speed Filter Time Const.   1-81   Min Speed for Function at Stop   1-45   Reference   1-16   My Speed Filter Time Const.   1-82   Min Speed for Function at Stop   1-45   Reference   1-16   My Speed Filter Time Const.   1-82   Min Speed for Function at Stop   1-45   Reference   1-15   Motor Power   My   Reference   1-15   Motor Reference   1-15	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	5-14 5-15 5-16 5-17 5-19 5-20 5-21 5-22 5-23
1-10   Motor Construction   1-8   Stop Adjustments   1-11   Motor Model   1-14   Motor Model   1-15   Low Model Model   1-16   Low Model Model   1-16   Low Model Model   1-16   Low Model Mod	Catch up/slow-down value Reference Site Preset Relative Reference Reference Resource 1 Reference Resource 2 Remp 1 Type Ramp 1 Ramp-down Time Ramp 1 S-ramp Ratio at Accel. End Ramp 1 S-ramp Ratio at Decel. End Ramp 2 S-ramp Ratio at Decel. End Ramp 2 Ramp-down Time Ramp 2 S-ramp Ratio at Accel. End Ramp 2 S-ramp Ratio at Accel. Start Ramp 2 S-ramp Ratio at Accel. Start Ramp 3 S-ramp Ratio at Accel. Start Ramp 3 S-ramp Ratio at Accel. End Ramp 4 S-ramp Ratio at Accel. End Cutck Stop Ramp Time Outlet Ramps Jourd Ramp 4 S-ramp Ratio at Accel. End Cutck Stop Ramp Time Outlet Ramp 5 Outlet Ramp 8 Outlet Stop Ramp Time	Utick Supportaining natural protections of protections of the protection of the prot
1-10   Motor Construction   1-8°	3-1-2 3-1-3	3-94 3-90 3-91 3-92 3-93 3-94 3-95 4-10 4-11
1-10 Motor Construction 1-11 Motor Model 1-11 Motor Model 1-11 Motor Model 1-12 Motor Model 1-12 Motor Damping Gain 1-14 Damping Gain 1-17 Voltage Filter Time Const. 1-17 Voltage Filter Time Const. 1-18 Motor Power [kW] 1-21 Motor Power [kW] 1-22 Motor Power [kW] 1-23 Motor Power [kW] 1-24 Motor Current 1-25 Motor Nominal Speed 1-26 Motor Current 1-26 Motor Current 1-27 Motor Motor Data 1-28 Automatic Motor Adaptation (AMA) 1-29 Automatic Motor Adaptation (AMA) 1-31 Motor Motor Data 1-32 Stator Resistance (Ri) 1-33 Stator Resistance (Ri) 1-34 Automatic Motor Magnetizing (Ri) 1-35 Stator Resistance (Ri) 1-36 Automatic Motor Magnetizing (Ri) 1-37 Stator Resistance (Ri) 1-38 Stator Resistance (Ri) 1-39 Motor Poles 1-30 Motor Mogel Offset 1-40 Motor Magnetizing (Ri) 1-30 Motor Mogel Offset 1-40 Motor Magnetizing (Ri) 1-50 Motor Magnetizing (Ri) 1-50 Motor Magnetizing (Ri) 1-51 Motor Magnetizing (Ri) 1-52 Motor Mogel Offset 1-54 Load Indep. Setting 1-54 Load Indep. Setting 1-55 U/f Characteristic - F 1-56 Flystart Test Pulses Frequency 1-57 Voltage reduction in field weakening 1-58 Flystart Test Pulses Frequency 1-59 Flystart Test Pulses Current 1-59 Flystart Test Pulses Frequency 1-60 Depend. Setting 1-75 Start Adjustments 1-76 Motor Magnetizing Time 1-77 Start Adjustments 1-78 Source 1-79 Main mun Inertia 1-79 Start Speed (Ma) 1-71 Start Deley 1-71 Start Deley 1-72 Start Speed (Hz) 1-74 Start Speed (Hz) 1-75 Start Speed (Hz) 1-75 Start Speed (Hz) 1-75 Start Speed (Hz) 1-76 Start Current		
1-10  wer-up (Hand) 1-22  1-15  1-17  1-17  1-18  1-19  1-29  1-29  1-29  1-29  1-29  1-29  1-29  1-29  1-29  1-29  1-29  1-39  1-39  1-39  1-39  1-39  1-39  1-39  1-39  1-47  fined Readout 1-54  1-54  1-54  1-54  1-54  1-54  1-54  1-67  1-69  1-60  1-61  1-71  ation 1-74  djust 1-75		2-27 2-27 2-28 3-28 3-01 3-01 3-04 3-04 3-10 3-10
wer-up (Hand)  / Channel  / Chann	Motor Construction Motor Model Damping Gain Low Speed Filter Time Const. High Speed Filter Time Const. Voltage Filter Time Const. Motor Power [HV] Motor Power [HV] Motor Power [HV] Motor Voltage Motor Cont. Rated Torque Automatic Motor Adaptation (AMA) Adv. Motor Data Stator Resistance (Rs) Rotor Leakage Reactance (X1) Stator Resistance (R6) Adv. Motor Data Stator Resistance (R6) Adv. Motor Data Stator Resistance (R6) Adv. Motor Data Stator Poles Stator Cont. Rated Torque Automatic Motor Adaptation (AMA) Adv. Motor Data Stator Poles Back EMF at 1,000 RPM Motor Poles Back EMF at 1,000 RPM Motor Angle Offset Position Detection Gain Load Indep. Setting Motor Angle Offset Load Indep. Setting Motor Magnetization at Zero Speed Min Speed Normal Magnetizing [Hz] Min Speed Normal Magnetizing [Hz] Model Shift Frequency U/f Characteristic - U U/f Characteristic - I Load Depend. Setting Low Speed Load Compensation High Speed Load Compensation Sip Compensation Time Constant Resonance Dampening Time Constant	Constant Min. Current at Low Speed Load Type Minimum Inertia Start Adjustments PM Start Mode Start Function Flying Start Start Speed [RPM] Start Speed [RPM] Start Speed [RPM] Start Current
Structure  Structure  Ocarition/Display  Out  Basic Settings  Out  Language  Out  Regional Settings  Out  Operating State at Power-up (Hand)  Out  Regional Settings  Out  Regional Settings  Out  Redout Linked Set-ups  Out  Readout Linked Set-ups  Out  Out  No Personal Menu  Out  Out  May Personal Menu  Out  Out  May Personal Menu  Out  Out  Copy/Save  Out  Out  Copy/Save  Out  Out  Out  No Password  Out  Out  Access to Main Menu Wo Password  Out  Out  Out  Motor Control Principle  Out  Out  Out  Out  Motor Control Principle  Out  Out  Out  Out  Out  Out  Out  Ou	1 1 2 2 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1-66 1-67 1-69 1-69 1-70 1-71 1-72 1-74 1-75

VLT Automation Drive Instruction Manual
12-02 Subnet Mask 12-03 Default Gateway 12-04 DHCP Server 12-05 Lease Expires 12-06 Name Servers 12-06 Name Servers 12-07 Domain Name 12-09 Physical Address 12-10 Link Status 12-11 Link Duration 12-12 Auro Negotiation 12-13 Link Speed 12-14 Link Duplex 12-22 Process Data 12-23 Process Data Config Write 12-24 Process Data Config Write 12-25 Process Data Config Write 12-27 Primary Master 12-28 Store Data Values 12-29 Store Always 12-29 Store Always 12-38 Store Data Values 12-39 Warning Parameter 12-31 Net Reference 12-31 Net Reference 12-32 Net Control 12-34 CDP Product Code 12-35 EtherNet/IP 12-34 Modbus TCP 12-36 COS Filter 12-37 COS Inhibit Timer 12-38 GOS Filter 12-39 COS Filter 12-39 COS Filter 12-39 COS Filter 12-39 COS Filter 12-39 Store Always 12-39 COS Filter 12-30 COS Filter 13-30 COS Filter 13-30 COS Filter 13-30 COS Filter 14-30 COS Filter 15-30 COS Filter 15-30 COS Filter 15-30 COS Filter 15-30 COS F
9-28 Process Control 9-44 Fault Message Counter 9-45 Fault Message Counter 9-45 Fault Code 9-46 Fault Situation Counter 9-53 Profibus Warming Word 9-63 Actual Baud Rate 9-64 Device Identification 9-65 Control Word 1 9-68 Status Word 1 9-68 Status Word 1 9-72 Profibus Save Data Values 9-72 Profibus DriveReset 9-73 Do Identification 9-80 Defined Parameters (1) 9-81 Defined Parameters (2) 9-82 Defined Parameters (3) 9-93 Changed Parameters (3) 9-94 Changed Parameters (3) 9-95 Changed Parameters (3) 9-95 Changed Parameters (5) 9-90 Changed Parameters (5) 9-90 Changed Parameters (5) 9-91 Changed Parameters (5) 9-92 Changed Parameters (5) 9-94 Changed Parameters (5) 9-95 Changed Parameters (5) 9-96 Changed Parameters (6) 9-97 Changed Parameters (7) 9-98 Changed Parameters (8) 9-99 Changed Parameters (9) 9-90 Changed Parameters (1) 9-90
Process PID Feed Fwd Ramp-up Process PID Feed Fwd Ramp-down Process PID Ref Filter Time Process PID Ref Filter Time Process PID Ref Filter Time Command Options General Settings Control Word Timeout Timeout Control Word Timeout Function Reset Control Word Timeout Filtering Control Word Filtering Control Word Timeout Filtering Configurable Status Word STW Configurable Status Word CTW FC Port Baud Rate Protocol Protocol Protocol Max Response Delay Max Response Delay Max Response Delay FC MC protocol set Telegram selection PCD read configuration Digital/Bus Coasting Select Outlet Stop Select Outlet Stop Select Outlet Stop Select Start Select Fort Start Se
Terminal X30/8 Max. Scale Terminal X30/8 Bus Control Terminal X30/8 Bus Control Preset Terminal X45/1 Output Terminal X45/1 Min. Scale Terminal X45/1 Min. Scale Terminal X45/1 Min. Scale Terminal X45/1 Bus Control Terminal X45/3 Bus Control Terminal X45/3 Min. Scale Preset Analog Output 4 Preset Terminal X45/3 Min. Scale Terminal X45/3 Min. Scale Terminal X45/3 Min. Scale Terminal X45/3 Output Terminal X45/3 Dutput Terminal X45/3 Dutput Terminal X45/3 Output Terminal X45/3 Dutput
5-60 Terminal 27 Pulse Output Variable 6-65 5-63 Terminal 29 Pulse Output Variable 6-64 5-64 Terminal 29 Pulse Output Variable 6-64 5-65 Terminal 330/6 Pulse Output Wax Freq #27 5-70 Terminal 330/6 Pulse Output Wax Freq #20 5-71 Term 32/33 Pulses per Revolution 6-72 5-73 Term 32/33 Pulses per Revolution 6-72 5-74 Pulse Out #27 Bus Control 6-73 5-75 Pulse Out #27 Bus Control 6-88 5-95 Pulse Out #27 Timeout Preset 6-80 5-95 Pulse Out #27 Timeout Preset 6-80 5-95 Pulse Out #29 Timeout Preset 6-80 5-96 Pulse Out #29 Timeout Preset 6-80 5-97 Pulse Out #30/6 Bus Control 6-81 5-96 Pulse Out #30/6 Bus Control 6-81 5-96 Pulse Out #30/6 Bus Control 6-81 5-97 Pulse Out #30/6 Bus Control 6-81 5-96 Pulse Out #30/6 Bus Control 6-81 5-97 Pulse Out #30/6 Timeout Preset 6-80 5-98 Pulse Out #30/6 Timeout Preset 6-80 6-10 Ire Zero Timeout Function 7-00 6-11 Terminal 53 Low Voltage 7-03 6-11 Terminal 53 Low Voltage 7-05 6-12 Terminal 53 Low Voltage 7-05 6-13 Terminal 53 Low Voltage 7-07 6-15 Terminal 54 Low Current 7-06 6-14 Terminal 54 Low Current 7-06 6-15 Terminal 54 Low Ref./Feedb. Value 7-07 6-16 Terminal 54 Low Ref./Feedb. Value 7-08 6-17 Terminal 54 Low Ref./Feedb. Value 7-08 6-18 Terminal 54 Low Ref./Feedb. Value 7-27 6-21 Terminal 54 Low Ref./Feedb. Value 7-27 6-22 Terminal 54 Low Ref./Feedb. Value 7-28 6-23 Terminal 54 Ligh Ref./Feedb. Value 7-30 6-24 Terminal 54 Ligh Ref./Feedb. Value 7-31 6-25 Terminal 54 Ligh Ref./Feedb. Value 7-31 6-26 Terminal 54 Ligh Ref./Feedb. Value 7-31 6-27 Terminal 54 Light Ref./Feedb. Value 7-31 6-28 Terminal 54 Light Ref./Feedb. Value 7-31 6-29 Terminal 54 Light Ref./Feedb. Value 7-31 6-31 Terminal 54 Light Ref./Feedb. Value 7-31 6-32 Terminal 54 Light Ref./Feedb. Value 7-31 6-33 Terminal 54 Light Ref./Feedb. Value 7-31 6-34 Terminal 54 Light Ref./Feedb. Value 7-31 6-35 Terminal 54 Light Ref./Feedb. Value 7-31 6-36 Terminal 54 Light Ref./Feedb. Value 7-31 6-37 Terminal 54 Light Ref./Feedb. Value 7-31

# VLT AutomationDrive Instruction Manual

About Adjustable Frequency	Manual
17-11 Resolution (PPR) 17-2* Abs. Enc. Interface 17-20 Protocol Selection 17-21 Resolution (Positions/Rev) 17-25 Clock Rate 17-26 Clock Rate 17-26 SSI Data Format 17-37 HIPERFACE Baud rate 17-38 Resolver Interface 17-59 Poles 17-51 Input Voltage 17-51 Input Voltage 17-52 Input Frequency 17-53 Transformation Ratio 17-54 Monitoring and App. 17-69 Resolver Interface 17-64 Monitoring and App. 17-60 Feedback Signal Monitoring 18-8-8 Data Reacoluts 18-8-8 Analog Readouts 18-8-8 Analog Readouts 18-8-8 Analog Readouts	
16-22 Torque [%] 16-25 Torque [Nm] High 16-3* Drive Status 16-30 DC Link Voltage 16-32 Brake Energy /s 16-33 Brake Energy /2 min 16-34 Heatsink Temp. 16-35 Inverter Thermal 16-35 Inv. Max. Current 16-35 Inv. Max. Current 16-38 SL Controller State 16-39 Control Card Temp. 16-40 LCP Bottom Statusline 16-49 Speed Ref. After Ramp [RPM] 16-49 Current Fault Source 16-5 Ref. & Feedb. 16-50 External Reference 16-51 Pulse Reference 16-52 Feedback [Unit] 16-55 Feedback [Unit]	
15-40 FC Type 15-41 Power Section 15-42 Voltage 15-43 Software Version 15-44 Ordered Typecode String 15-45 Actual Typecode String 15-46 Adjustable Frequency Drive Ordering 15-47 Power Card Ordering No. 15-48 LCP ID Num. 15-49 SW ID Control Card 15-50 SW ID Power Card 15-51 Adjustable Frequency Drive Serial 15-53 Power Card Serial Number 15-54 Smart Setup Filename 15-56 Option Mounted 15-60 Option Mounted 15-61 Option Mounted 15-61 Option Mounted	
14-23 Typecode Setting 14-24 Trip Delay at Current Limit 14-25 Trip Delay at Torque Limit 14-26 Trip Delay at Inverter Fault 14-26 Service Code 14-39 Service Code 14-39 Current Lim Ctrl, Proportional Gain 14-31 Current Lim Ctrl, Piter Time 14-31 Current Lim Ctrl, Filter Time 14-32 Current Lim Ctrl, Filter Time 14-33 Current Lim Ctrl, Filter Time 14-44 Energy Optinizing 14-44 A Morimum AEO Frequency 14-42 Minimum AEO Frequency 14-43 Motor Cos Phi 14-55 Environment	Output Filter Capacitance Output Filter Inductance Output Filter Actual Number of Inverter Units Compatibility  VLT Alarm Word  VLT Warning Word  VLT Warning Word  VLT Ext. Status Word  Options  Option Supplied by External 24VDC Option Detection Fault Settings  Fault Level Diva Information Operating Data Operating Hours RWN Counter Power-ups Over Temps Over Temps Over Temps Over Volts Reset Running Hours Counter Reset Running Hours Counter Logging Mode Samples Before Trigger Logging Mode Samples Before Trigger Historic Log: Event Fault Log: Error Code Fault Log: Error Code Fault Log: Time Fault Log: Value Fault Log: Trine Drive Identification
12-51 Configured Station Address 12-89 EtherCAT Status 12-80 Other Ethernet Services 12-80 FTP Server 12-81 HTP Server 12-82 SMTP Service 12-89 Transparent Socket Channel Port 12-96 Cable Diagnostic 12-91 Auto Cross-over 12-92 IGMP Snooping 12-93 Cable Error Length 12-94 Broadcast Storm Protection 12-95 Broadcast Storm Filter 12-95 Broadcast Storm Filter 12-96 Port Config 12-99 Interface Counters 12-99 Media Counters 12-99 Media Counters 12-99 Media Counters 13-06 SLC Settings	Comparators Reset SLC Comparators Comparator Operand Comparator Operand Comparator Operand Comparator Operand Comparator Operand Comparator Operand RS-FIP Operand S RS-FF Operand S SR-FF Operand S SR-FF Operand R Timers SL Controller Timer Logic Rule Boolean 1 Logic Rule Boolean 2 Logic Rule Boolean 2 Logic Rule Boolean 2 Logic Rule Boolean 3 States SL Controller Event S States SL Controller Action Special Functions Inverter Switching Switching Pattern Switc

Popusary by the troops of the	31-01 Bypass Start Time Delay	32-8* Velocity & Accel.	33-53 Terminal X57/4 Digital Input	34-5* Process Data
Proceedings   25.50   Jumps   1952   1954   1952   1954   1952   1954   1952				
Hopes thinking Hours 3.88 Death Velocity Resolution Resolution Regions from the Pages Activated Broad Resolution Hours 3.89 Death Velocity Resolution Reso				
Excitations   23-29 Default Acceleration   23-29 Default Acceleration   23-29 Default Acceleration   23-29 Default Acceleration   23-29 Rect Lot for limited pick   23-29 Terminal XS791 Digital input   24-29 Per Acce down for limited pick   23-29 Terminal XS791 Digital input   24-29 Per Acceleration   23-29 Dec down for limited pick   23-24 Terminal XS91 Digital Dutput   24-29 Per Absolute Feroceco Data Length   23-29 Dec down for limited pick   23-24 Terminal XS91 Digital Output   24-29 Per Absolute Feroceco Clack Generation   23-29 Dec down for limited pick   23-24 Terminal XS92 Digital Output   24-29 Per Absolute Feroceco Clack Generation   23-29 Dec down for limited pick   23-24 Terminal XS92 Digital Output   24-29 Per Absolute Feroceco Clack Generation   23-29 Dec down for limited pick   23-24 Terminal XS92 Digital Output   24-29 Per Absolute Feroceco Clack Generation   23-29 Dec down for limited pick   23-24 Terminal XS92 Digital Output   24-29 Per Clack   23-24 Terminal XS92 Digital Output   24-29 Deceded Clack   23-24 Terminal XS92 Digital Output   23-24 Terminal XS92 Digital Dutput   23-24 Terminal XS92 Digital Dutput   23-24 Terminal XS92				
Heroceter 2.  Heroceter 3.  He			Terminal	
Incremental Resolution 23-29 Decelopment Countried jerk 33-61 Terminal Styl) Toglatal input 34-55 Absolute Protocol and State			Terminal	
Absolute Proceder Clock Generation 32-88 Dec., politorinated jerk 33-63 ferminal XSS91 Digital Output 44-58 Assolute Proceder Clock Generation 32-89 Dec., down for Initiated jerk 33-63 ferminal XSS91 Digital Output 44-63 Assolute Encoder Clock Generation 32-99 Development 33-99 Generation 32-99 Development 33-99 Generation 33-9				
Absolute Protocole Clark Federation   32-29 Dec down for Initited jerk Absolute Resolution   32-29 Development   33-24 Terminal XS92 Deglad Output   34-64 Terminal XS92 Deglad Output   34-65 Terminal XS92 Deglad Output   34-65 Terminal XS93 Deglad Output   34-75 Terminal XS93 Deglad Output   34-75 Terminal XS9 De			Termina	
Station in Encoder Road Rate XS5         3.24 Development         3.24 Heading and the control of th			Terminal	
Absolute brocker bank flex X51 and flex X51 bebug sources and flex X51 bebug source and x52 belong the X51 bebug source and x52 belong the X51 bebug source beat length as 250 beat le				
Absolute Encoder Gock Generation 33-09 Force HOME 33-67 Terminal XS9/5 Digital Output 34-63 Absolute Encoder Gock Generation 33-09 Force HOME 33-67 Terminal XS9/5 Digital Output 34-63 Absolute Encoder Gock Generation 33-09 Force HOME 33-09 Terminal XS9/7 Digital Output 34-70 Absolute Encoder Gock Generation 33-09 Force HOME 33-09 Terminal XS9/7 Digital Output 34-70 Absolute Encoder Cable Length 33-00 Reverse Maker Pape 33-00 Reverse Behavior after Encoder Feature 33-00 Service HOME 33-10 Service Home Motion 33-00 Service HOME 33-10 Service Home Motion 33-00 Service Home Motion 33-10 Service Home Motion Motion 33-10 Service Home Motion Motion Motion Home Motio			Termina	
Absolute Encoder Gock Generation 33-06 Home Motion 33-68 Terminal XS9/6 Digital Output 44-65 Absolute Encoder Gock Generation 33-00 Ferter Motion 33-06 Terminal XS9/6 Digital Output 44-65 Encoder Monitoring 33-00 Relative for Holder Motion 33-00 Fertile Encoder Gock Generation 33-00 Fertile Motion Motion Motion 33-00 Fertile Motion Motion Motion Motion 33-00 Fertile Motion Moti				
Absolute Encoder Gole Generation 3300 Force HOME Broade Monitoring of Cold Generation 3300 Force HOME Broade Monitoring of Cold Generation 3302 Range for Home Motion 1834 Terminal Styly Digital Output 18470 Broade Monitoring 1830 Zenery of Home Motion 1834 Terminal Styly Bolgial Output 18470 Broade Monitoring 1831 Sand Behavior during Home Motion 1834 Parameters 2840 Enc. John Status Monitoring 1831 Sand Behavior after Error Enc. Control 1831 Sand Behavior after Error 2 CAN guard 1831 Sander Salve Most Sand Behavior after Error 2 CAN guard 1831 Sander Monitoring 1834 Behavior after Error 2 CAN guard 1831 Sander Monitoring 1834 Behavior after Error 2 CAN guard 1831 Sander Monitoring 1834 Behavior after Error 2 CAN guard 1831 Sander Monitoring 1834 Behavior after Error 2 CAN guard 1831 Sander Monitoring 1834 Behavior after Error 2 CAN guard 1831 Sander Monitoring 1834 Terminal state at alamm 1835 Sander Monitoring 1834 Monitoring 1834 Behavior after Error 2 CAN guard 1832 Sander Marker Number for Marker Type 1834 Sander Monitoring 1834 Monitoring 1834 Marker Number for Sander Error 2 CAN guard 1832 Sander Marker Type 1834 Monitoring 1834 Monitoring 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Marker Number for Rady Error 2 CAN guard 1834 Ma				
Absolute Encoder Cable Length  Absolute Encoder Monitoring  Absolute Encoder Cable Length  Ab				
Bernoder Montroing 33-03 Ramp for Home Motion and Better Encoder Montroing 33-03 Velocity of Home Motion and Better Bernoder Montroing 33-03 Velocity of Home Motion and Safe Global Planmeers 34-70 Liser Unit Denominator 33-03 Velocity of Home Motion and Safe Most Montroing 33-03 Velocity of Home Motion and Safe Most Montroing 33-03 Particle Montroing 33-03 Particle Most Particle Most Montroing 33-03 Particle Most Montroing 33-03 Particle Most Montroing 33-03 Particle Most Particle Most Most Most Particle Most Montroing 33-03 Particle Most Particle Most Most Most Particle Most Particle Most Most Particle				
Sectional Direction 33.9 Velocity of Home Motion 33-8 Chicke Brancess 34-71 Water Brotzelor Direction 33-9 Velocity of Home Motion 33-9 Activated Program Number 35-70 Encore User Unit Denominator 33-10 Sync Factor Master Control 33-10 Sync Factor Master Sync Encore User Unit Denominator 33-10 Sync Factor Master Sync Encore User Unit Denominator 33-10 Sync Factor Master Sync More Sync Factor Master Encore Control 33-11 Accusacy Window for Position Sync. 33-8 MOS Supplied by External 24 VIC 35-03 Incremental Signal Type 33-14 Relative Slave Velocity Limit Corrected 13-15 Master Native For Sync Associate Resolution 33-15 Master Native For Sync More Sync Sync Sync Sync Sync Sync More Sync Sync Sync Sync Sync Sync Sync Sync			33-70 Terminal X59/8 Digital Output	
User Unit Numerator  33-19 Sync Factor Master  33-10 Sync Factor Master  33-11 Sync Factor Master  33-11 Sync Factor Master  33-12 Position Offset for Synchronization  33-12 Marker Number for Master  33-13 Marker Number for Master  33-14 Master Marker Distance  33-15 Marker Number for Shave  33-16 Marker Number for Shave  33-17 Master Marker Distance  33-18 Marker Number for Shave  33-19 Master Marker Distance  33-10 Marker Marker Distance  33-10 Master Distance  33-10 Master Marker Distance  33-10 Master			33-8* Global Parameters	
Back Unit Numerator         33+1 Synchronization         33-8 Drive State Brauk Monitoring         35-07           Enc2 Control         33-11 Sync Factor Slave         33-82 Drive Status Monitoring         35-03           Enc2 Code ID         33-11 Sync Factor Slave         33-82 Drive Status Monitoring         35-03           Enc2 Code ID         33-11 Sync Factor Slave         33-82 Behavior after Error         35-03           Encode I         33-12 Macken Window for Position Sync.         33-88 Earling Status Mode at alam         35-03           Absolute Recolution         33-14 Marken Number for Slave         33-90 MCO CAN node ID         35-14           Absolute Resolution         33-15 Marken Number for Slave         33-90 MCO CAN node ID         35-15           Absolute Resolution         33-16 Marken Usiner of Marker Distance         33-90 MCO CAN node ID         35-16           Absolute Resolution         33-17 Master Marker Distance         33-90 MCO CAN node ID         35-17           Absolute Recoder Clock Feeneration         33-18 Master Marker Type         33-90 MCO CAN node ID         35-17           Absolute Encoder Clock Generation         33-25 Marker Marker Type         33-90 MCO CAN node ID         35-17           Encoder Termination         33-25 Marker Marker Type         33-90 MCO CAN node ID         33-24 Marker Marker Type         33-90 MCO CAN node ID	32-11 User Unit Denominator			
Enc2 Control         33-10 Sync Factor Master         33-83 Behavior after Enc         35-00           Enc2 Control         33-11 Sync Factor Slave         33-83 Behavior after Enc         35-00           Enc2 Cox Ward         33-12 Position Offset for Synchronization         33-88 Behavior after Enc         35-00           Enc2 CAN guard         33-12 Position Offset for Slave Pelocity         33-88 Behavior after Enc         35-00           Absolute Brooder Data Length         33-15 Marker Number for Master         33-88 Feminal state at alarm         35-05           Absolute Brooder Data Length         33-17 Master Marker Distance         33-90 MCO Port Setting         35-14           Absolute Brooder Clock Generation         33-18 Marker Marker Type         33-90 MCO Port Setting         35-14           Absolute Brooder Clock Generation         33-18 Marker Marker Type         33-90 MCO CAN band rate         35-17           Absolute Brooder Clock Generation         33-25 Slave Marker Tolerance Window         33-90 MCO CAN band rate         35-17           Absolute Brooder Clock Generation         33-25 Slave Marker Tolerance Window         33-90 MCO CAN band rate         35-17           Absolute Brooder Clock Generation         33-25 Slave Marker Tolerance Window         33-90 MCO CAN band rate         35-17           Absolute Brooder Clock Generation         33-25 Slave Marker Tolerance Window	32-12 User Unit Numerator			
Fincz node ID  Salz Position Offices for Synchronization  Salz Relative Slave Heatter Slave Heatter Stave Heatter Slave Heatter Distance Heatter Distanc	32-13 Enc.2 Control			_
Encoder Incremental Signal Type         33-12 Position Offset for Synchronization         33-85 MCO Supplied by External 24 VDC         35-03           Encoder Incremental Signal Type         33-13 Accuracy Window for Position Sync         33-86 McMer Number for Master         33-60 Terminal at alam         35-03           Absolute Recolution         33-15 Marker Number for Master         33-80 Terminal at alam         35-05           Absolute Protocol         33-15 Marker Number for Master         33-80 Terminal at alam         35-05           Absolute Protocol         33-17 Master Marker Distance         33-90 KZB MCO CAN node ID         35-17           Absolute Finceder Clock Generation         33-17 Master Marker Type         33-90 KZB MCO CAN node ID         35-14           Absolute Finceder Clock Generation         33-20 Master Marker Type         33-90 KZB MCO CAN band rate         35-14           Absolute Finceder Clock Generation         33-20 Master Marker Type         33-20 KZB MCO CAN band rate         35-20 KZB MCO CAN band rate         35-20 KZB MCO CAN band rate           Enc. Control         33-22 Master Marker Type Can be allowed to the Allower Type         33-20 KZB MARKER Type Can be allowed to the Allower Type         34-20 KZB MCO CAN band rate         35-20 KZB MCO MCO RASS serial band rate         35-20 KZB MCO MCO RASS	32-14 Enc.2 node ID			•
Encoder         33-13 Accuracy Window for Position Sync         33-85 MICO Supplied by External 24 VDC         35-63           Incremental Signal Type         33-14 Relative Slave Velocity Limit         33-65 Terminal state at alarm         35-60           Absolute Resolution         33-16 Marker Number for Slave         33-80 Terminal state at alarm         35-50           Absolute Resolution         33-16 Marker Number for Slave         33-80 MCD CAN node ID         35-16           Absolute Recoder Oder Requency         33-18 Slave Marker Type         33-90 KG2 MCC CAN node ID         35-18           Absolute Encoder Coder Requency         33-18 Slave Marker Type         33-90 KG2 MCC CAN bad of ID         35-18           Absolute Encoder Coder Requency         33-20 Marker Type         33-90 KG2 MCC CAN bad of ID         35-14           Absolute Encoder Coder Requency         33-20 Marker Type         33-90 KG2 MCC CAN bad of ID         35-14           Absolute Encoder Coder Requency         33-20 Marker Type         33-20 KG2 MCC CAN bad of ID         35-14           Absolute Encoder Coder Requency         33-20 Marker Type         33-20 KG2 MCC CAN bad of ID         35-14           Enc.I Coder Monitoring         33-20 Slave Marker Type         33-20 KG2 MCC CAN bad of Id         35-21           Enc.I Coder Monitoring         33-20 Marker Number for Ready         34-20 PCD Winte to MCC	32-15 Enc.2 CAN quard			•
Incremental Signal Type  33-14 Relative Slave Velocity Limit Absolute Protocol Absolute Resolution 33-16 Marker Number for Master Absolute Resolution 33-16 Marker Number for Slave Absolute Encoder Data Length 33-18 Marker Number for Slave Absolute Encoder Data Length 33-18 Marker Number for Slave Absolute Encoder Clock Generation 33-19 Master Marker Type Encoder Data Length 33-20 Master Marker Type Encoder Monitoring 33-21 Master Marker Type Encoder Monitoring 33-22 Slave Marker Tolerance Window Encoder Termination 33-22 Slave Marker Tolerance Window Encoder Monitoring 33-23 Slave Marker Tolerance Window Encoder Monitoring 33-25 Marker Number for Ready 33-25 K60 MCO RS485 serial band rate 33-25 Marker Number for Ready 33-25 Marker Number for Ready 33-26 Marker Number for Ready 33-27 Marker Number for Ready 33-28 Marker Number for Ready 33-29 Marker Number for Ready 33-30 Marker Slave MCO 302 Lax Will 33-30 Marker Filter Configuration MCO 302 Lax Will 33-30 Marker Filter Configuration MCO 302 Lax Will 33-31 Marker Marker Ordered Marker Order	32-3* Encoder 1			•
Absolute Facebottion   33-15 Marker Number for Master Absolute Protocol   33-16 Marker Number for Stave Absolute Protocol   33-17 Marker Number for Stave Absolute Protocol   33-17 Marker Marker Distance   33-98 MCD Pot Settings   35-18 MCD Pot Settings   35-18 MCD Pot Settings   35-18 MCD CAN node ID   35-18 Master Marker Distance   33-90 MCD CAN node ID   35-18 Master Marker Distance   33-90 MCD CAN node ID   35-18 Master Marker Distance   33-90 MCD CAN node ID   35-18 Master Marker Tolerance Window   33-28 Marker Marker Tolerance Window   33-28 Marker Marker Tolerance Window   33-28 Marker Number for Rault   33-25 Marker Number for Rault   33-26 Med Marker Number for Rault   33-26 Med Marker Marker Stave   33-28 Marker Number for Rault   33-29 Marker Mar				•
Absolute Protocol         33-16 Marker Number for Slave         33-88 Status word at alarm         35-56           Absolute Protocol         33-16 Marker Number for Slave         33-90 XSD MCO CAN node ID         35-14           Absolute Encoder Data Length         33-18 Jas Awarker Type         33-91 XSD MCO CAN node ID         35-14           Absolute Encoder Clock Frequency         33-19 Master Marker Type         33-91 XSD MCO CAN band rate         35-15           Absolute Encoder Clock Generation         33-10 Master Marker Type         33-92 XSD MCO CAN band rate         35-15           Absolute Encoder Clock Generation         33-21 Master Marker Tolerance Window         33-94 XS MCO CAN band rate         35-17           Encoder Monitoring         33-22 Marker Number for Fault         34-04 PCD Wirtle to MCO         35-24           Enc. I control         33-22 Marker Number for Ready         34-02 PCD Wirtle to MCO         35-24           Enc. I control         33-24 Marker Number for Ready         34-03 PCD Wirtle to MCO         35-34           Enc. I control         33-25 Marker Number for Ready         34-02 PCD Wirtle to MCO         35-34           MCO 302 Last Will         33-35 Marker Number for Ready         34-02 PCD Wirtle to MCO         35-34           Source Slave         33-37 Marker Number for Ready         34-03 PCD Wirtle to MCO         35-34				•
Absolute Resolution         33-17 Master Marker Distance         33-9 MCD Not Detailed         35-14 Moster Marker Distance         35-14 Moster Marker Distance         33-9 MCD CAN load rate         35-14 MCD CAN load rate         35-15 MCD CAN load rate         35-17				•
Absolute Encoder Data Length         33-18 Slave Marker Distance         33-90 KZ2 MCO CAN node ID         35-14 Absolute Encoder Code Inception         33-19 Master Marker Type         33-91 KZ2 MCO CAN node ID         35-13 Absolute Encoder Code Inception         33-19 Master Marker Type         33-91 KZ2 MCO CAN band rate         35-14 Master Marker Type         33-91 KZ2 MCO CAN band rate         35-14 Master Marker Type         33-91 KZ2 MCO CAN band rate         35-17 Master Marker Type         33-91 KZ2 MCO CAN band rate         35-17 MCO CAN band rate         35-17 MCO CAN band rate         35-17 MCO MCO RS48S serial band rate         35-17 MCO MCO RS48S serial band rate         35-17 MCO MARKER TYPE         35-18 MA				•
Absolute Encoder Clock Frequency         33-91 Master Marker Type         33-91 XG2 MCD GAN baud rate         35-15 Absolute Encoder Clock Generation         33-92 Slave Marker Type         33-94 XG0 MCD R5485 serial termination         35-16 Master Marker Type         35-16 Master Marker Type         35-10 Marker Type         35-10 Marker Marker Type         35-10 Marker Type         35-20 Marker Type         35-20 Marker Type         35-30 Marker Type				٠.
Absolute Encoder Clock Generation 33-20 Slave Marker Type Absolute Encoder Clock Generation 33-20 Slave Marker Tolenance Window Encoder Monitoring 33-21 Slave Marker Tolenance Window Encoder Termination 33-22 Slave Marker Tolenance Window Encoder Termination 33-23 Slave Bahavior for Marker Sync Enc.! Control Enc.! Control S3-24 Marker Number for Fault Enc.! Control S3-25 Marker Number for Ready S3-25 Marker Number for Ready S3-26 Marker Number for Ready S3-27 Slave Marker Number for Ready S3-28 Marker Number for Ready S3-29 Kelocity Filter Enc.! Control Enc.! Control Enc.! Control S3-26 Marker Number for Ready S3-27 Marker Number for Ready S3-28 Marker Number for Ready S3-29 Filter Time S3-20 Maxer Filter Time S3-20 Maxer Filter Time S3-20 Maxer Filter Time Derivative factor S3-27 Marker Mumber for Marker Filter Mindow Derivative factor S3-28 Marker Mumber for Marker Filter Mindow S3-29 Filter Time for Marker Filter Mindow Derivative factor S3-29 Filter Time for Marker Filter Mindow S3-20 Maximum Marker filter time S3-30 Maximum Marker filter time S3-31 Maxer Mindow S3-32 Marker Mindow S3-32 Marker Mindow S3-32 Marker Mindow S3-32 Maxer Mindow S3-34 Derivative Software End Limit Active S3-34 Derivative Software End Limit Active S4-25 PCD S Read from MCO Sampling Time for PloII Generator S3-34 Maximum Mindow (Limit/Value) S3-35 Maximum Mindow (Deactive Software End Limit Active S4-25 PCD S Read from MCO Sac of the Control Window (Deactive Software End Limit Active S3-37 Mindow (Deactive Software End Limit Active S3-37 Maxer Mindow S3-37 Mindow (Deactive Software End Limit Active S3-47 PCD Read from MCO Sac of the Control Window (Deactive Software End Limit Active S3-37 PCD Read from MCO Sac of the Control Window (Deactive Software End Limit Active S3-37 PCD Read from MCO S3	32-36 Absolute Encoder Clock Frequency			•
Absolute Encoder Cable Length         33-21 Master Marker Tolerance Window         33-35 X60 MCO R5485 serial baud rate         35-77 Microde Monitoring           Encoded Monitoring         33-22 Start Behavior for Marker Sync         34-0 FCD Winte bar.         35-25           Encoder Termination         33-22 Marker Number for Fault         34-0 FCD Winte to MCO         35-25           Enc.1 Control         33-24 Marker Number for Fault         34-0 FCD Winte to MCO         35-25           Enc.1 Control         33-25 Marker Number for Ready         34-0 FCD Winte to MCO         35-27           Enc.1 Control         33-26 Velocity Filter         34-0 FCD Winte to MCO         35-27           Feedback Source         33-26 Marker Filter Time         34-0 FCD Winte to MCO         35-27           MCO 302 Last Will         33-29 Filter Time for Marker Filter         34-0 FCD Winte to MCO         35-37           Source Slave         33-30 Maximum Marker Correction         34-0 FCD Winte to MCO         35-37           PID Controlled         33-3 Slave Maximum Marker Correction         34-0 FCD Winte to MCO         35-37           PID Controlled         33-3 Slave Maximum Marker Correction         34-0 FCD Winte to MCO         35-37           Integral factor         33-3 Slave Maximum Marker filter time         34-0 FCD Winte to MCO         35-37           Integral factor<	32-37 Absolute Encoder Clock Generation			
Encoder Monitoring Barbavior for Marker Johnsow Encoder Termination Barbavior for Marker Johnsow Bender Termination Barbavior for Marker Sync Bender Termination Barbavior for Marker Titler Bender Terminal Marker Number for Ready Barbavior Marker Number for Ready Barbavior Marker Number for Ready Barbavior Marker Number for Ready Barbavior Marker Mumber for Ready Barbavior Marker Filter Time for Marker Filter Marker Marker Filter Barbavior Marker Filter Time for Marker Filter Marker Barbavior Marker Barbavior Marker Barbavior Marker Barbavior Marker Barbavior Marker Marker Filter Marker Barbavior Marker Marker Barbavior Marker Barbavi	32-38 Absolute Encoder Cable Length			
Encoder Termination         33-23         Start Behavior for Marker Sync         34-0°         PCD Write to MCO         35-24           Enc.1 Control         33-24         Marker Number for Ready         34-01         PCD 1 Write to MCO         35-25           Enc.1 Control         33-26         Marker Number for Ready         34-02         PCD 2 Write to MCO         35-27           Feedback Source         33-26         Marker Filter Time         34-04         PCD 4 Write to MCO         35-37           Source Slave         33-27         Orfset Filter Time         34-06         PCD 6 Write to MCO         35-37           Source Slave         33-39         Filter Time for Marker Filter Configuration         34-06         PCD 7 Write to MCO         35-37           Source Slave         33-30         Filter Time for Marker Filter M	32-39 Encoder Monitoring			•
Enc.! Control         33-24 Marker Number for Fault         34-01 PCD 1 Wirte to MCO         35-25           Enc.! Control         33-25 Marker Number for Ready         34-01 PCD 1 Wirte to MCO         35-26           Feedback Source         33-26 Velocity Filter         34-03 PCD 3 Wirte to MCO         35-27           Feedback Source         33-27 Offset Filter Time         34-04 PCD 4 Write to MCO         35-37           Source Slave         33-28 Marker Filter Configuration         34-05 PCD 5 Write to MCO         35-37           MCO 302 Last Will         33-29 Filter Time for Marker Filter         34-05 PCD 5 Write to MCO         35-37           PID Controller         33-31 Synchronization Type         34-07 PCD 7 Write to MCO         35-37           Proportional factor         33-32 Feed Forward Velocity Adaptation         34-09 PCD 9 Write to MCO         35-37           Proportional factor         33-34 Slave Marker filter time         34-10 PCD 10 Write to MCO         35-37           Proportional factor         33-34 Limit Handling         34-21 PCD 1 Read from MCO         35-42           PID Bandwidth         33-44 Ilmit Adaptation         34-23 PCD 2 Read from MCO         35-43           PROSITY Feed-Forward         33-45 Positive Software End Limit Active         34-23 PCD 2 Read from MCO         35-44           Reverse Behavior for Slave <th< td=""><td></td><td></td><td></td><td>•</td></th<>				•
Enc.1 node ID         33-25 Marken Number for Ready         34-02 PCD 2 Write to MCO         35-26           Feedback Source         33-26 Velocity Filter         34-04 PCD 4 Write to MCO         35-27           Feedback Source         33-27 Offset Filter Time         34-05 PCD 5 Write to MCO         35-37           Source Slave         33-28 Marker Filter Configuration         34-05 PCD 5 Write to MCO         35-37           MCO 302 Last Will         33-29 Filter Time for Marker Filter Configuration         34-06 PCD 6 Write to MCO         35-37           PID Control         33-31 Shorthonization Type         34-08 PCD 8 Write to MCO         35-37         35-37           PID Control         33-32 Feed Forward Velocity Adaptation         34-08 PCD 8 Write to MCO         35-37         35-37           PID Control         33-34 Slave Marker filter time         34-08 PCD 8 Write to MCO         35-47         35-47           PID Control         33-34 Slave Marker filter time         34-24 PCD 10 Write to MCO         35-47         35-47           Init Value of Integral Sum         33-34 Slave Marker filter time         34-22 PCD 2 Read from MCO         35-48         35-49           Velocity Feed-Forward         33-34 Negative Software End Limit Active         34-22 PCD 5 Read from MCO         35-48         35-49           Reverse Behavior for Slave         33-44				_
Fench Cab Bound         33-20 Velocity Filter         34-03 PCD 3 Write to MCO         35-27 PCB           Feedback Source         33-20 Offset Filter Time         34-05 PCD 4 Write to MCO         35-27 PCB           Source Slave         33-29 Filter Time for Marker Filter         34-05 PCD 5 Write to MCO         35-35 PCD           MCO 302 Last Will         33-29 Filter Time for Marker Filter         34-06 PCD 6 Write to MCO         35-35 PCD           PID Controller         33-31 Synchronization Type         34-07 PCD 7 Write to MCO         35-35 PCD           Proportional factor         33-32 Feed Forward Velocity Adaptation         34-09 PCD 9 Write to MCO         35-37 PCD           Derivative factor         33-33 Velocity Filter Window         34-10 PCD 9 Write to MCO         35-47 PCD           Integral factor         33-34 Slave Marker filter time         34-27 PCD Read from MCO         35-47 PCD           Limit Value for Integral Sum         33-40 Behavior at End Limit Switch         34-27 PCD Read from MCO         35-48 PCD           Velocity Feed-Forward         33-41 Negative Software End Limit Active         34-27 PCD Read from MCO         35-46 PCD Read from MCO           Acceleration Feed-Forward         33-45 Time in Target Window         34-25 PCD Read from MCO         34-26 PCD Read from MCO           Sampling Time for PID Control         33-45 Time in Target Window         34-26 P				
Feedback Source  33-27 Offset Filter Time Source Slave Maxice Filter Time for Marker Filter Source Slave Maxice Filter Time for Marker Filter Source Master Source Master Source Master By Source Master By Source Master By CO 2012 Last Will By Source Master By CO 2012 Last Will By Source Master Filter Time By Source Master By Source Master By Source Master Filter By Source Master Filter By Source Master Filter By Source Master By Source By Source Master By Source				
Source Slave Marker Filter Configuration MCO 302 Last Will Master MCO 302 Last Will MCO 302 Marker filter time MCO 302 Write to MCO 302 Ag MCO 302 Marker filter time MCO 302 Last Will MCO 302 Read from MCO 30				•
MCO 302 Last Will 33-29 Filter Time for Marker Filter 34-06 PCD 6 Write to MCO 35-35 Source Master 33-39 Filter Time for Marker Correction 34-07 PCD 7 Write to MCO 35-36 PCD 6 Write to MCO 35-37 PCD 6 Write to MCO 35-37 Source Master 33-31 Synchronization Type Proportional factor 33-32 Feed Forward Velocity Adaptation 34-09 PCD 9 Write to MCO 35-47 Integral Factor 33-34 Slave Marker filter time 34-09 PCD 9 Write to MCO 35-42 Integral Factor 33-34 Slave Marker filter time 34-10 PCD 10 Write to MCO 35-42 Integral Factor 33-41 Negative Software End Limit Switch 34-22 PCD Read from MCO 35-45 Acceleration Feed-Forward 33-41 Negative Software End Limit Active 34-25 PCD Read from MCO 33-45 Time in Target Window LimitValue 34-26 PCD 6 Read from MCO Scan Time for PID Control Window (Deactiv.) 33-45 Time in Target Window LimitValue 34-29 PCD 9 Read from MCO Size of the Control Window (Deactiv.) 33-45 Terminal X57/1 Digital Input state Position error filter time 33-51 Terminal X57/3 Digital Input state Position error filter time 33-52 Terminal X57/3 Digital Input state Position error filter time 33-52 Terminal X57/3 Digital Input state Position error filter time 33-53 Ferminal X57/3 Digital Input state Position error filter time 33-54 Terminal X57/3 Digital Input state Position error filter time 33-54 Terminal X57/3 Digital Input state Position error filter time 33-54 Terminal X57/3 Digital Input state Position error filter time 33-51 Terminal X57/3 Digital Input state Position error filter time 33-54 Terminal X57/3 Digital Input state Positive Software End Limit Active Software End Limit				•
Source Master 33-30 Maximum Marker Correction 34-07 PCD 7 Write to MCO 35-36 Proportional factor 33-31 Synchronization Type Eed Forward Velocity Adaptation 34-09 PCD 9 Write to MCO 35-47 Integral factor 33-32 Reed Forward Velocity Filter time 34-10 PCD 10 Write to MCO 35-42 Limit Value for Integral Sum 33-40 Behavior at End Limit Switch 34-22 PCD Read from MCO 35-46 Acceleration Feed-Forward 33-41 Negative Software End Limit Active 34-23 PCD 2 Read from MCO 35-46 Positive Software End Limit Active 34-23 PCD 2 Read from MCO 35-46 Positive Software End Limit Active 34-25 PCD 2 Read from MCO Acceleration Feed-Forward 33-42 Positive Software End Limit Active 34-25 PCD 2 Read from MCO Acceleration For Plot Control 33-45 Time in Target Window LimitValue 34-29 PCD 9 Read from MCO Acceleration For Plot Control Window (Deactiv.) 33-45 Time in Target Window (Activation) 34-29 PCD 9 Read from MCO Activation) 33-45 Time in Target Window (Activation) 33-45 Time in Target Window (Activation) 33-45 Terminal X57/2 Digital Input 34-41 Digital Inputs 33-51 Terminal X57/3 Digital Input 34-41 Digital Inputs				
PID Controller33-31Synchronization Type34-08PCD 8Write to MCO35-37Proportional factor33-32Select Forward Velocity Adaptation34-09PCD 9Write to MCO35-47Integral factor33-34Slave Marker filter time34-27PCD 10Write to MCO35-42Integral factor33-34Slave Marker filter time34-27PCD 1Read from MCO35-44PID Bandwidth33-49Limit Handling34-27PCD 1Read from MCO35-45Velocity Feed-Forward33-41Positive Software End Limit34-22PCD 2Read from MCO35-46Max. Tolerated Position Error33-43Negative Software End Limit Active34-25PCD 5Read from MCO35-46Reverse Behavior for Slave33-44Positive Software End Limit Active34-25PCD 6Read from MCO35-46Sampling Time for PID Control33-45Time in Target Window34-26PCD 7Read from MCO33-46Scan Time for Profile Generator33-45Time in Target Window34-27PCD 7Read from MCOSize of the Control Window33-47Size of Target Window34-29PCD 7Read from MCOSize of the Control Window33-50Terminal X57/2 Digital Input34-40Digital InputsIntegral limit filter time33-51Terminal X57/2 Digital Input34-41Digital InputsPosition error filter time33-52Terminal X57/3 Digital Input34-41Digital Inputs <td></td> <td></td> <td></td> <td></td>				
Proportional factor Proportional factor Proportional factor Derivative factor Derivative factor Derivative factor Derivative factor S3-32 Feed Forward Velocity Filter Window S3-42 Slave Marker filter time S3-42 Slave Marker filter time S3-43 Slave Marker filter time S3-44 Slave Marker filter time S3-45 Slave Marker filter time S3-46 Slave S3-47 FCD Read Parn S3-47 FCD Read from MCO S3-49 Slave S3-40 Slave Marker filter time S3-40 Slave Marker filter time S3-41 Negative Software End Limit S3-42 PCD 2 Read from MCO S3-45 Slave S4-25 PCD 2 Read from MCO S3-45 Slave S4-25 PCD Read from MCO S4-25 PCD Stand from MCO S4-26 PCD Stand from MCO S4-			0	٠.
Derivative factor  13-33 Velocity Filter Window Integral factor Integral factor Integral factor 133-44 Slave Marker filter time 13-45 Limit Handling 13-40 Behavior at End Limit Switch 13-40 Behavior at End Limit Switch 13-40 Behavior at End Limit Switch 13-41 PCD 1 Read from MCO 13-40 Behavior at End Limit Switch 13-41 Rogative Software End Limit 13-42 PCD 2 Read from MCO 13-43 Read from MCO 13-44 Positive Software End Limit Active 13-45 Read from MCO 13-46 Read from MCO 13-47 PCD 1 Read from MCO 13-40 Behavior for Slave 13-44 Positive Software End Limit Active 13-45 Time in Target Window 13-45 FCD 6 Read from MCO 13-46 Franch Integral Window 13-47 PCD 7 Read from MCO 13-46 Franch MCO 13-46 Franch MCO 13-47 PCD 1 Read from MCO 13-46 Franch MCO 13-46 Franch MCO 13-47 PCD 1 Read from MCO 13-46 Franch MCO 13-47 PCD 1 Read from MCO 13-46 Franch MCO 13-47 PCD 1 Read from MCO 13-46 Franch MCO 13-47 PCD 1 Read from MCO 13-46 Franch MCO 13-47 PCD 1 Read from MCO 13-46 Franch MCO 13-47 PCD 1 Read from MCO 13-46 Franch MCO 13-47 PCD 1 Read from MCO 13-46 Franch MCO 13-47 PCD 1 Read from MCO 13-46 Franch MCO 13-47 PCD 1 Read from MCO 13-46 Franch MCO 13-47 PCD 1 Read from MCO 13-46 Franch MCO 13-47 PCD 1 Read from MCO 13-48 Franch MCO 13-49 PCD 1 Read from MCO 13-40 Franch MCO 13-40 Franc				_
Integral factor 33-34 Slave Marker filter time 34-2* PCD Read Par. 35-43 Slave Marker filter time 13-44 Limit Handling 34-2* PCD 1 Read from MCO 35-44 Slave Miles and 13-40 Behavior at End Limit Switch 34-2 PCD 2 Read from MCO 35-45 Slave Software End Limit Switch 34-2 PCD 2 Read from MCO 35-45 Slave Software End Limit Active 34-2 PCD 2 Read from MCO 33-43 Positive Software End Limit Active 34-2 PCD 7 Read from MCO Slave Sampling Time for PID Control 33-45 Time in Target Window Scan Time for PID Control Window (Size of the Control Window (Deactiv.) 33-45 Time in Target Window (Activation) 33-45 Terminal X57/2 Digital Input 134-0 Digital Inputs Software Integral limit filter time 33-51 Terminal X57/3 Digital Input 34-11 Digital Inputs Softputs				_
Limit Value for Integral Sum 35.44 Limit Handling 34-21 PCD I Read from MCO 35-44 Policity Each-Forward 33-41 Negative Software End Limit Active 34-22 PCD 2 Read from MCO 35-46 Acceleration Feed-Forward 33-42 Positive Software End Limit Active 34-25 PCD 3 Read from MCO 35-46 Negative Software End Limit Active 34-25 PCD 5 Read from MCO 34-42 PCD 4 Read from MCO 34-45 PCD 5 Read from MCO 34-45 PCD 6 Read from MCO 34-45 PCD 6 Read from MCO 34-45 PCD 7 Read from MCO 5 Simpling Time for PID Control 33-45 Time in Target Window LimitValue 34-28 PCD 7 Read from MCO 33-45 Time in Target Window Size of the Control Window (Deactiv.) 33-45 Terminal X57/2 Digital Input 34-41 Digital Inputs Position error filter time 33-52 Terminal X57/3 Digital Input 34-41 Digital Inputs				
Velocity Feed-Forward 3-4-40 Behavior at End Limit Switch Velocity Feed-Forward 3-4-40 Behavior at End Limit Switch Software End Limit Active 34-22 PCD 2 Read from MCO 33-40 Positive Software End Limit Active 34-25 PCD 8 Read from MCO Reverse Behavior for Slave 33-43 Negative Software End Limit Active 34-25 PCD 8 Read from MCO Sampling Time for PID Control 33-44 Positive Software End Limit Active 34-25 PCD 8 Read from MCO Sampling Time for PID Control 33-45 Time in Target Window Size of the Control Window (Deactiv.) 33-50 Terminal X57/1 Digital Input 34-41 Digital Inputs Position error filter time 33-52 Terminal X57/3 Digital Input 34-41 Digital Outputs				
Acceleration Feed-Forward Acceleration Feed-Forward Acceleration Feed-Forward Acceleration Feed-Forward As. Tolerated Position Error Base Behavior for Slave Sampling Time for PID Control Size of the Control Window (Deactiv.) 33-57 Terminal X57/2 Digital Input Base Behavior for Slave Size of the Control Window (Deactiv.) 33-50 Terminal X57/2 Digital Input Base Behavior for Slave Behavior for McO Beactiv.) Beline for McO Beactiv.) B	-		PCD 2	
Max. Delated Position Feor Jowana 1934. Positive Software End Limit Active 34-25 Reverse Behavior for Slave 33-44 Positive Software End Limit Active 34-25 Reverse Behavior for Slave 33-45 Time in Target Window 34-27 Scan Time for Profile Generator 33-45 Time in Target Window 34-27 Size of the Control Window (Pactivation) 33-47 Size of Target Window (Pactivation) 33-47 Do Configuration 34-39 Integral limit filter time 33-51 Terminal X57/1 Digital Input 34-40 Position error filter time 33-52 Terminal X57/3 Digital Input 34-40			2 2	
Reverse Behavior for Slave Reverse Behavior for Slave Sampling Time for PID Control Scan Time for Profile Generator Size of the Control Window Size of the Control Window (Deactiv.) Size of the Control Window (Sa.5.7) Size of the Con			7 5	
Sampling Time for PID Control 33-45 Time in Target Window Scan Time for Profile Generator 33-46 Target Window Limit/Alue 34-28 Size of the Control Window (Deactiv.) 33-47 Size of the Control Window (Deactiv.) 33-50 Terminal X57/1 Digital Input 34-30 Position error filter time 33-52 Terminal X57/2 Digital Input 34-41				
Scan Time for Profile Generator 33-47 Size of Target Window Linguistical Size of the Control Window (Deactiv.) 33-5* I/O Configuration Size of the Control Window (Deactiv.) 33-50 Terminal X57/1 Digital Input 14-30 Size of the Control Window (Deactiv.) 33-50 Terminal X57/2 Digital Input 14-4* Size of Size of the Control Window (Deactiv.) 33-50 Terminal X57/2 Digital Input 14-4* Size of Si				
Size of the Control Window 33-47 Size of Terminal X57/1 Digital Input 34-30 Size of the Control Window (Deactiv.) 33-50 Terminal X57/1 Digital Input 34-40 Position error filter time 33-51 Terminal X57/2 Digital Input 34-40 Position error filter time 33-52 Terminal X57/3 Digital Input 34-41				
(Activation)  Size of the Control Window (Deactiv.) 33-50 Terminal X57/1 Digital Input  134-30  Size of the Control Window (Deactiv.) 33-50 Terminal X57/2 Digital Input  34-4  Position error filter time  33-52 Terminal X57/3 Digital Input  34-40		- 0,		
Size of the Control Window (Deactiv.) 33-50 Terminal X57/1 Digital Input Integral limit filter time 33-51 Terminal X57/2 Digital Input 34-40 34-40 33-52 Terminal X57/3 Digital Input 34-41				
Integral limit filter time 33-51 Terminal X57/2 Digital Input 34-40 Position error filter time 33-52 Terminal X57/3 Digital Input 34-41 I		33-50		
Position error filter time 33-52 Terminal X57/3 Digital Input 34-41		33-51	_	

### 5.6 Remote Programming with MCT 10 Setup Software Set-up Software

Danfoss has a software program available for developing, storing, and transferring adjustable frequency driveprogramming. The MCT 10 Set-up Software allows the user to connect a PC to the adjustable frequency drive and perform live programming rather than using the LCP. Additionally, all adjustable frequency drive programming can be done off-line and simply downloaded to the adjustable frequency drive. Or the entire adjustable frequency drive profile can be loaded onto the PC for backup storage or analysis.

The USB connector or RS-485 terminal is available for connecting to the adjustable frequency drive.

MCT 10 Set-up Software is available for free download at www.VLT-software.com. A CD is also available by requesting part number 130B1000. A user's manual provides detailed instructions for operation.



# 6 Application Examples

#### 6.1 Introduction

### NOTE!

A jumper wire may be required between terminal 12 (or 13) and terminal 37 for the adjustable frequency drive to operate when using factory default programming values.

The examples in this section are intended as a quick reference for common applications.

- Parameter settings are the regional default values unless otherwise indicated (selected in 0-03 Regional Settings)
- Parameters associated with the terminals and their settings are shown next to the drawings.
- Where switch settings for analog terminals A53 or A54 are required, these are also shown.

#### 6.2 Application Examples

			Parame	eters
FC		.10	Function	Setting
+24 V	120	30BB929.10		
+24 V	130	30BE	1-29 Automatic	
DIN	180	-	Motor	[1] Enable
DIN	190		Adaptation	complete
сом	200		(AMA)	AMA
DIN	270	_	5-12 Terminal 27	[2]* Coast
DIN	290		Digital Input	inverse
DIN	320		* = Default Value	
DIN	330		Notes/comments: Parameter	
DIN	370		group 1-2* must be set	
+10 V	500		according to mot	
A IN	530			
A IN	540			
сом	550			
A OUT	420			
сом	390			
	7			

Table 6.1 AMA with T27 Connected

FC				Parameters	
D IN	FC		10	Function Setting	
D IN		120	1930.		
D IN	+24 V	130	30BB	1-29 Automatic	
COM 200 D IN 270 D IN 290 D IN 320 D IN 330 D IN 370  Hotel Amale Complete  (AMA) AMA  5-12 Terminal 27 [0] No operation  * = Default Value  Notes/comments: Parameter group 1-2* must be set according to motor  A IN 530 A IN 540 COM 550 A OUT 420	DIN	180	=	Motor	[1] Enable
D IN 270 D IN 290 D IN 320 D IN 330 D IN 370  Hotes/comments: Parameter group 1-2* must be set according to motor  A IN 530 A IN 540 COM 550 A OUT 420	DIN	190		Adaptation	complete
S-12 Terminal 27   10   No     D IN	сом	200		(AMA)	AMA
D IN 320 D IN 330 D IN 370  * = Default Value  Notes/comments: Parameter group 1-2* must be set according to motor  A IN 530 A IN 540 COM 550 A OUT 420	DIN	270		5-12 Terminal 27	[0] No
* = Default Value  Notes/comments: Parameter group 1-2* must be set according to motor  A IN 530 A IN 540 COM 550 A OUT 420	I	1		Digital Input	operation
Notes/comments: Parameter group 1-2* must be set according to motor  A IN 530 A IN 540 COM 550 A OUT 420	I				
#10 V 500 A IN 530 A IN 540 COM 550 A OUT 420	I				
+10 V 500 A IN 530 A IN 540 COM 550 A OUT 420	DIN	370			
A IN 530 A IN 540 COM 550 A OUT 420	l			-	
A IN 540 COM 550 A OUT 420	1			according to mot	OI .
COM 550 A OUT 420	1	530			
A OUT 420	A IN	540			
'-Y	сом	550			
COM 390	A OUT	420			
	сом	390			
		$\vee$			

Table 6.2 AMA without T27 Connected

		_	Parame	eters
FC		.10	Function	Setting
+24 V	120	30BB926.10		
+24 V	130	30BE	6-10 Terminal 53	
D IN	180	-	Low Voltage	0.07 V*
D IN	190		6-11 Terminal 53	10 V*
СОМ	200		High Voltage	
D IN	270		6-14 Terminal 53	0 RPM
D IN	290		Low Ref./Feedb.	
DIN	320		Value	
DIN	330		6-15 Terminal 53	1,500 RPM
DIN	370		High Ref./Feedb.	
  +10 V	500		Value	
AIN	530	+	* = Default Value	
A IN	540		Notes/comments:	
СОМ	550			
A OUT	420	- L - 10V		
СОМ	390	-10 - +10V		
l				
U-I				
A53				

Table 6.3 Analog Speed Reference (Voltage)



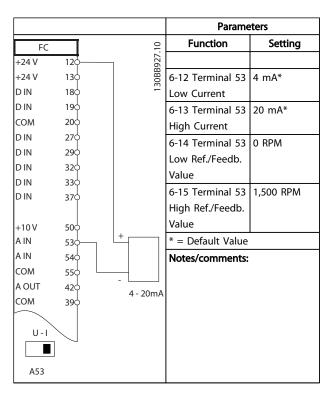


Table 6.4 Analog Speed Reference (Current)

			Parameters		
FC			10	Function	Setting
+24 V	120-		30BB802.10		
+24 V	130		30BE	5-10 Terminal 18	[8] Start*
DIN	180-	<del></del>	-	Digital Input	
DIN	190			5-12 Terminal 27	[0] No
СОМ	200			Digital Input	operation
DIN	27ф			5-19 Terminal 37	[1] Safe Stop
DIN	290			Safe Stop	Alarm
DIN	32ф			* = Default Value	
DIN	33Ф			Notes/comments:	
DIN	37Ф—			If 5-12 Terminal 22	
+10	50Φ			is set to [0] No op	peration, a
A IN	530			jumper wire to te	rminal 27 is
A IN	540			not needed.	
сом	55Q				
A OUT	420				
сом	390				

Table 6.5 Start/Stop Command with Safe Stop

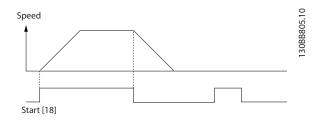


Figure 6.1

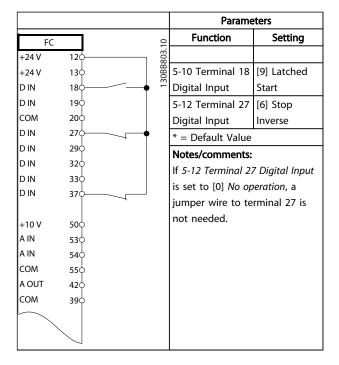


Table 6.6 Pulse Start/Stop

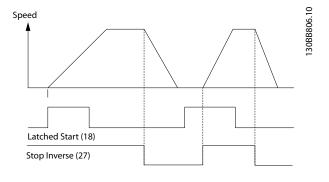


Figure 6.2

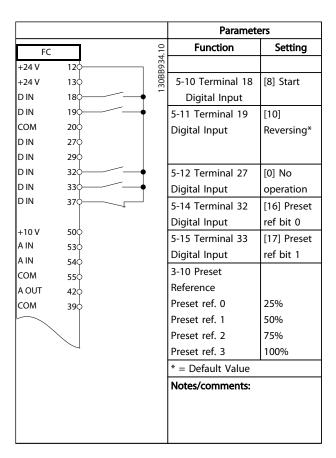


Table 6.7 Start/Stop with Reversing and Four Preset Speeds

			Parame	eters
FC		10	Function	Setting
+24 V	120	 130BB928.10		
+24 V	130	OBB	5-11 Terminal 19	[1] Reset
DIN	180	 13	Digital Input	
DIN	190		* = Default Value	
СОМ	200		Notes/comments:	
DIN	270			
DIN	290			
DIN	320			
DIN	330			
DIN	370			
+10 V	500			
A IN	530			
A IN	540			
СОМ	550			
A OUT	420			
СОМ	390			
	7			

Table 6.8 External Alarm Reset

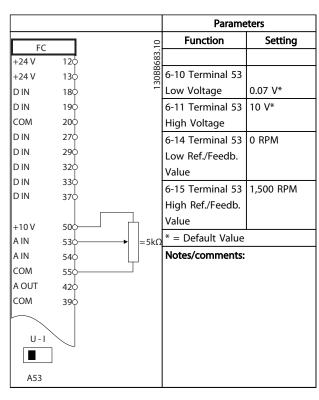


Table 6.9 Speed Reference (using a Manual Potentiometer)

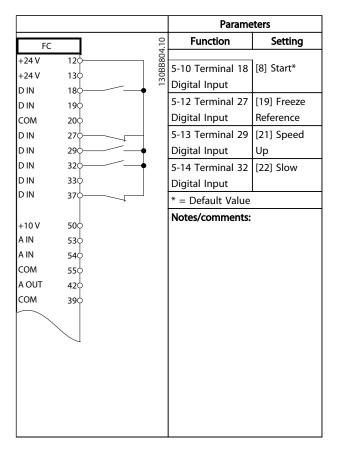


Table 6.10 Speed Up/Down



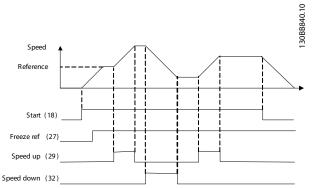


Figure 6.3

			Parameters		
FC 01		Function	Setting		
+24 V	120	30BB685.10			
+24 V	130	08B	8-30 Protocol	FC*	
DIN	180	13	8-31 Address	1*	
DIN	190		8-32 Baud Rate	9600*	
СОМ	200		* = Default Value		
DIN	270		Notes/comments:		
DIN	290		Select protocol, a		
DIN	320		baud rate in the		
DIN	330				
DIN	370		mentioned param	ieters.	
+10 V	<b>50</b> ¢				
A IN	530				
A IN	540				
COM	550				
A OUT	420				
СОМ	390				
	- 010				
≂ -/	- 020				
	- 030				
	- 040				
<sub>2</sub> ./—	- 050				
	- 060	RS-485			
	610	+			
	680				
	690	-			

Table 6.11 RS-485 Network Connection

# **CAUTION**

Thermistors must use reinforced or double insulation to meet PELV insulation requirements.

			Parameters	
FC -		Function	Setting	
+24 V	120	30BB686.1		
+24 V	130	30BB	1-90 Motor	[2]
DIN	180	<del>(1)</del>	Thermal	Thermistor
DIN	190		Protection	trip
СОМ	200		1-93 Thermistor	[1] Analog
DIN	270		Source	input 53
DIN	290		* = Default Value	
DIN	320			
DIN	330		Notes/comments:	
DIN	370		If only a warning	
+10 V	500		1-90 Motor Therm	
A IN	530-		should be set to	
AIN	540		warning.	[1] 111611111501
СОМ	550		warning.	
A OUT	420			
СОМ	390			
U-1				
A53				

**Table 6.12 Motor Thermistor** 



		<b>I</b>	
		Parameters	
FC	9.10	Function	Setting
+24 V	12¢ 8888 13¢ 8980	4-30 Motor	1
+24 V	130	Feedback Loss	
DIN	180	Function	[1] Warning
DIN	190	4-31 Motor	100 RPM
COM	200	Feedback Speed	TOO KEWI
DIN	270	Error	
D IN D IN	29¢ 32¢	=	5 s
DIN	330	4-32 Motor	5.5
DIN	370	Feedback Loss Timeout	
			[2] MCD 102
+10 V	500	7-00 Speed PID	[2] MCB 102
A IN	530	Feedback Source	
A IN	540	17-11 Resolution	1024*
СОМ	550	(PPR)	
A OUT	420	13-00 SL	[1] On
СОМ	390	Controller Mode	F4 03 111
		13-01 Start	[19] Warning
	010	Event	
≅	020	13-02 Stop	[44] Reset
	030	Event	key
<u> </u>	040	13-10 Comparat	[21] Warning
[₂ /—	050	or Operand	no.
L	060	13-11 Comparat	[1] ≈*
		or Operator	
		13-12 Comparat	90
		or Value	
		13-51 SL	[22]
		Controller Event	Comparator 0
		13-52 SL	[32] Set
		Controller Action	digital out A
			low
		5-40 Function	[80] SL digital
		Relay	output A
		* = Default Value	
		Notes/comments:	
		If the limit in the	feedback
		monitor is exceed	led, Warning
		90 will be issued.	The SLC
		monitors Warning	90 and if
		Warning 90 becor	mes TRUE,
		then Relay 1 is tri	ggered.
		External equipme	nt may then
		indicate that servi	ice may be
		required. If the feedback error	
		goes below the limit again	
		within 5 sec then the	
		adjustable frequency drive	
		continues and the	3
		disappears. But Re	•
		be triggered until	[Reset] on
		the LCP.	

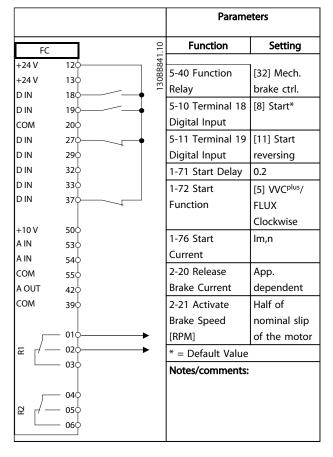


Table 6.14 Mechanical Brake Control

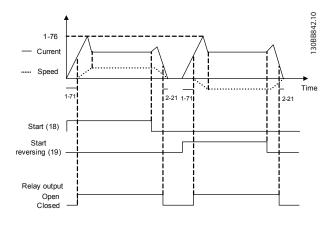


Figure 6.4

Table 6.13 Using SLC to Set a Relay



# 7 Status Messages

### 7.1 Status Display

When the adjustable frequency drive is in status mode, status messages are generated automatically from within the adjustable frequency drive and appear in the bottom line of the display (see *Figure 7.1*.)

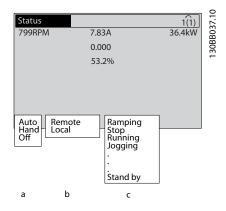


Figure 7.1 Status Display

- a. The first part of the status line indicates where the stop/start command originates.
- b. The second part of the status line indicates where the speed control originates.
- c. The last part of the status line gives the present adjustable frequency drive status. These show the operational mode the adjustable frequency drive is in.

#### NOTE!

In auto/remote mode, the adjustable frequency drive requires external commands to execute functions.

### 7.2 Status Message Definitions Table

The next three tables define the meaning of the status message display words.

	Operation mode
Off	The adjustable frequency drive does not react
	to any control signal until [Auto On] or [Hand
	On] is pressed.
Auto on	The adjustable frequency drive is controlled
	from the control terminals and/or the serial
	communication.
Hand on	The adjustable frequency drive can be
	controlled by the navigation keys on the LCP.
	Stop commands, reset, reversing, DC brake,
	and other signals applied to the control
	terminals can override local control.

Table 7.1

	Reference site	
Remote	The speed reference is given from external	
	signals, serial communication, or internal	
	preset references.	
Local	The adjustable frequency drive uses [Hand On]	
	control or reference values from the LCP.	

Table 7.2

	Operation status	
AC Brake	AC Brake was selected in 2-10 Brake Function.	
	The AC brake over-magnetizes the motor to	
	achieve a controlled slow down.	
AMA finish OK	Automatic motor adaptation (AMA) was	
	carried out successfully.	
AMA ready	AMA is ready to start. Press [Hand On] to start.	
AMA running	AMA process is in progress.	
Braking	The brake chopper is in operation. Generative	
	energy is absorbed by the brake resistor.	
Braking max.	The brake chopper is in operation. The power	
	limit for the brake resistor defined in	
	2-12 Brake Power Limit (kW) is reached.	
Coast	Coast inverse was selected as a function	
	for a digital input (parameter group 5-1*).	
	The corresponding terminal is not	
	connected.	
	Coast activated by serial communication	



	Operation status
Ctrl. Ramp-down	Control Ramp-down was selected in
Cui. namp-down	14-10 Mains Failure.
	The AC line voltage is below the value set in 14-11 Mains Voltage at Mains Fault at line power fault
	The adjustable frequency drive ramps down the motor using a controlled ramp-down.
Current High	The adjustable frequency drive output current is above the limit set in 4-51 Warning Current High.
Current Low	The adjustable frequency drive output current is below the limit set in 4-52 Warning Speed Low
DC Hold	DC hold is selected in 1-80 Function at Stop and a stop command is active. The motor is held by a DC current set in 2-00 DC Hold/Preheat Current.
DC Stop	<ul> <li>The motor is held with a DC current (2-01 DC Brake Current) for a specified time (2-02 DC Braking Time).</li> <li>DC Brake is activated in 2-03 DC Brake Cutin Speed [RPM] and a Stop command is active.</li> <li>DC Brake (inverse) is selected as a function for a digital input (parameter group 5-1*).</li> </ul>
	<ul><li>The corresponding terminal is not active.</li><li>The DC Brake is activated via serial communication.</li></ul>
Feedback high	The sum of all active feedbacks is above the feedback limit set in 4-57 Warning Feedback High.
Feedback low	The sum of all active feedbacks is below the feedback limit set in 4-56 Warning Feedback Low.
Freeze output	<ul> <li>The remote reference is active, which holds the present speed.</li> <li>Freeze output was selected as a function for a digital input (parameter group 5-1*). The corresponding terminal is active. Speed control is only possible via the terminal functions speed up and slow.</li> <li>Hold ramp is activated via serial communication.</li> </ul>
Freeze output request	A freeze output command has been given, but the motor will remain stopped until a run permissive signal is received.

	Operation status
Freeze ref.	Freeze Reference was chosen as a function for
	a digital input (parameter group 5-1*). The
	corresponding terminal is active. The
	adjustable frequency drive saves the actual
	reference. Changing the reference is now only
	possible via terminal functions speed up and
	slow.
Jog request	A jog command has been given, but the
	motor will be stopped until a run permissive
	signal is received via a digital input.
Jogging	The motor is running as programmed in
	3-19 Jog Speed [RPM].
	Jog was selected as function for a digital
	input (parameter group 5-1*). The
	corresponding terminal (e.g., Terminal 29)
	is active.
	The Jog function is activated via the serial
	communication.
	The less formation was calcuted as a
	The Jog function was selected as a  reaction for a monitoring function (a.g. No.)
	reaction for a monitoring function (e.g., No
	signal). The monitoring function is active.
Motor check	In 1-80 Function at Stop, Motor Check was
	selected. A stop command is active. To ensure
	that a motor is connected to the adjustable
	frequency drive, a permanent test current is
	applied to the motor.
Over Voltage	Overvoltage control was activated in 2-17 Over-
Control (OVC)	voltage Control. The connected motor is
	supplying the adjustable frequency drive with
	generative energy. The overvoltage control
	adjusts the V/Hz ratio to run the motor in
	controlled mode and to prevent the
	adjustable frequency drive from tripping.
PowerUnit Off	(For adjustable frequency drives with an
	external 24 V power supply installed only.)
	Line power supply to the adjustable frequency
	drive is removed, but the control card is
	supplied by the external 24 V.
Protection md	Protection mode is active. The unit has
	detected a critical status (an overcurrent or
	overvoltage).
	To avoid tripping, switching frequency is
	reduced to 4 kHz.
	If possible, protection mode ends after
	approximately 10 s.
	Protection mode can be restricted in
	14-26 Trip Delay at Inverter Fault
	, ,

## VLT\*AutomationDrive Instruction Manual

	Operation status
QStop	The motor is decelerating using 3-81 Quick
	Stop Ramp Time.
	Quick stop inverse was chosen as a
	function for a digital input (parameter
	group 5-1*). The corresponding terminal is
	not active.
	The quick stop function was activated via
	serial communication.
Damania a	The makes is a sectional solution of the section of
Ramping	The motor is accelerating/decelerating using
	the active ramp-up/down. The reference, a
Def binb	limit value or a standstill is not yet reached.
Ref. high	The sum of all active references is above the
	reference limit set in 4-55 Warning Reference
D ( )	High.
Ref. low	The sum of all active references is below the
	reference limit set in 4-54 Warning Reference
	Low.
Run on ref.	The adjustable frequency drive is running in
	the reference range. The feedback value
	matches the setpoint value.
Run request	A start command has been given, but the
	motor is stopped until a run permissive signal
	is received via digital input.
Running	The motor is driven by the adjustable
	frequency drive.
Speed high	Motor speed is above the value set in
	4-53 Warning Speed High.
Speed low	Motor speed is below the value set in
	4-52 Warning Speed Low.
Standby	In Auto On mode, the adjustable frequency
	drive will start the motor with a start signal
	from a digital input or serial communication.
Start delay	In 1-71 Start Delay, a delay starting time was
	set. A start command is activated and the
	motor will start after the start delay time
	expires.
Start fwd/rev	Start forward and start reverse were selected
	as functions for two different digital inputs
	(parameter group 5-1*). The motor will start in
	forward or reverse depending on which
	corresponding terminal is activated.
Stop	The adjustable frequency drive has received a
	stop command from the LCP, digital input or
	serial communication.
Trip	An alarm occurred and the motor is stopped.
	Once the cause of the alarm is cleared, the
	adjustable frequency drive can be reset
	manually by pressing [Reset] or remotely by
	control terminals or serial communication.

	Operation status
Trip lock	An alarm occurred and the motor is stopped.
	Once the cause of the alarm is cleared, power
	must be cycled to the adjustable frequency
	drive. The adjustable frequency drive can then
	be reset manually by pressing [Reset] or
	remotely by control terminals or serial
	communication.

Table 7.3

# 8 Warnings and Alarms

#### 8.1 System Monitoring

The adjustable frequency drive monitors the condition of its input power, output, and motor factors as well as other system performance indicators. A warning or alarm may not necessarily indicate a problem internal to the adjustable frequency drive itself. In many cases, it indicates failure conditions from input voltage, motor load or temperature, external signals, or other areas monitored by the adjustable frequency drive's internal logic. Be sure to investigate those areas exterior to the adjustable frequency drive as indicated in the alarm or warning.

#### 8.2 Warning and Alarm Types

#### Warnings

A warning is issued when an alarm condition is impending or when an abnormal operating condition is present and may result in the adjustable frequency drive issuing an alarm. A warning clears by itself when the abnormal condition is removed.

#### Alarms

#### Trip

An alarm is issued when the adjustable frequency drive is tripped, that is, the adjustable frequency drive suspends operation to prevent adjustable frequency drive or system damage. The motor will coast to a stop. The adjustable frequency drive logic will continue to operate and monitor the adjustable frequency drive status. After the fault condition is remedied, the adjustable frequency drive can be reset. It will then be ready to start operation again.

A trip can be reset in any of 4 ways:

- Press [Reset] on the LCP
- Digital reset input command
- Serial communication reset input command
- Auto reset

#### Trip lock

An alarm that causes the adjustable frequency drive to trip-lock requires that input power is cycled. The motor will coast to a stop. The adjustable frequency drive logic will continue to operate and monitor the adjustable frequency drive status. Remove input power to the adjustable frequency drive and correct the cause of the fault, then restore power. This action puts the adjustable frequency drive into a trip condition as described above and may be reset in any of those four ways.

#### 8.3 Warning and Alarm Displays

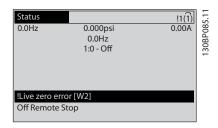


Figure 8.1

An alarm or trip lock alarm will flash on display along with the alarm number.

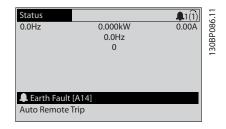


Figure 8.2

In addition to the text and alarm code on the adjustable frequency drive LCP, there are three status indicator lights.

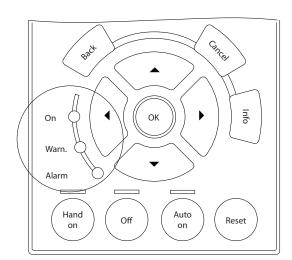


Figure 8.3

30BB467.10



	Warn. LED	Alarm LED
Warning	On	Off
Alarm	Off	On (Flashing)
Trip Lock	On	On (Flashing)

Table 8.1

#### 8.4 Warning and Alarm Definitions

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

#### WARNING 1, 10 Volts low

The control card voltage is 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  $\Omega$ .

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 only appears 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. Broken wiring or faulty device sending the signal can cause this condition.

#### **Troubleshooting**

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

Check that the adjustable frequency 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.

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

#### WARNING 6, DC link voltage low

The intermediate circuit voltage (DC) is lower than the low voltage warning limit. The limit is dependent on the adjustable frequency drive voltage rating. The unit 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 the functions in 2-10 Brake Function

Increase 14-26 Trip Delay at Inverter Fault

If the alarm/warning occurs during a power sag, the solution is to use kinetic backup (14-10 Line Failure)

#### WARNING/ALARM 8, DC undervoltage

If the intermediate circuit voltage (DC link) drops below the under voltage limit, the adjustable frequency drive checks if a 24 V DC backup supply is connected. If no 24 V DC 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 circuit test.

#### WARNING/ALARM 9, Inverter overload

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 issues 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 has run with more than 100% overload for too long.



#### **Troubleshooting**

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

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

Display the Thermal Drive Load on the LCP and monitor the value. When running above the adjustable frequency drive continuous current rating, the counter increases. When running below the adjustable frequency drive continuous current rating, the counter decreases.

#### WARNING/ALARM 10, Motor overload temperature

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

#### **Troubleshooting**

Check for motor overheating.

Check if the motor is mechanically overloaded.

Check that the motor current set in 1-24 Motor Current is correct.

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

If an external fan is in use, check in 1-91 Motor External Fan that it is selected.

Running AMA in 1-29 Automatic Motor Adaptation (AMA) tunes the adjustable frequency drive to the motor more accurately and reduces thermal loading.

#### WARNING/ALARM 11, Motor thermistor over temp

The thermistor might be disconnected. Select whether the adjustable frequency drive gives a warning or an alarm in 1-90 Motor Thermal Protection.

#### Troubleshooting

Check for motor overheating.

Check if the motor is mechanically overloaded.

Check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply) and that the terminal switch for 53 or 54 is set for voltage. Check *1-93 Thermistor Source* selects terminal 53 or 54.

When using digital inputs 18 or 19, check that the thermistor is connected correctly between either terminal 18 or 19 (digital input PNP only) and terminal 50.

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

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

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

#### WARNING/ALARM 12, Torque limit

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

#### **Troubleshooting**

If the motor torque limit is exceeded during ramp-up, extend the ramp-up time.

If the generator torque limit is exceeded during ramp-down, extend the ramp-down time.

If torque limit occurs while running, possibly increase the torque limit. Be sure the system can operate safely at a higher torque.

Check the application for excessive current draw on the motor.

#### WARNING/ALARM 13, Over current

The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts about 1.5 s, then the adjustable frequency drive trips and issues an alarm. This fault may be caused by shock loading or quick acceleration with high inertia loads. It may also appear after kinetic backup if the acceleration during ramp-up is quick. If extended mechanical brake control is selected, trip can be reset externally.

#### **Troubleshooting**

Remove power and check if the motor shaft can be turned

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

Check parameters 1-20 through 1-25 for correct motor data.

#### ALARM 14, Ground fault

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



#### Troubleshooting:

Remove power to the adjustable frequency drive and repair the ground fault.

Check for ground faults in the motor by measuring the resistance to ground of the motor leads and the motor with a megohmmeter.

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 (for each option slot)

#### ALARM 16, Short-circuit

There is short-circuiting in the motor or motor wiring.

Remove power to the adjustable frequency drive and repair 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 then displays 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 a proper installation based on EMC requirements.

#### WARNING/ALARM 22, Hoist mechanical brake

Report value shows 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 protective 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 filters, 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 protective function that checks if the fan is running/mounted. The fan warning can be disabled in *14-53 Fan Monitor* ([0] Disabled).

#### **Troubleshooting**

Check fan resistance.

Check soft charge fuses.

#### WARNING 25, Brake resistor short-circuit

The brake resistor is monitored during operation. If a short circuit occurs, the brake function is disabled and the warning appears. The adjustable frequency drive is still operational but without the brake function. Remove power to 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 mean value over the last 120 s of run time. The calculation is based on the intermediate circuit voltage and the brake resistance value set in 2-16 AC Brake Max. Current. The warning is active when the dissipated braking is higher than 90% of the brake resistance power. If Trip [2] is selected in 2-13 Brake Power Monitoring, the adjustable frequency drive will trip when the dissipated braking energy reaches 100%.

# **AWARNING**

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 a short circuit occurs, the brake function is disabled and a warning is issued. The adjustable frequency drive is still operational but, since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.

Remove power to the adjustable frequency drive and remove the brake resistor.

This alarm/warning could also occur should the brake resistor overheat. Terminals 104 and 106 are available as brake resistors Klixon inputs, see section *Brake Resistor Temperature Switch* in the Design Guide.



#### WARNING/ALARM 28, Brake check failed

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 reset until the temperature falls below a defined heatsink temperature. The trip and reset points are different based on the adjustable frequency drive power size.

#### **Troubleshooting**

Check for the following conditions.

Ambient temperature too high.

Motor cable too long.

Incorrect airflow clearance above and below the adjustable frequency drive

Blocked airflow around the adjustable frequency drive.

Damaged heatsink fan.

Dirty heatsink.

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 sizes, 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.

Remove power from 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.

Remove power from 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.

Remove power from 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 the unit cool to operating temperature.

#### WARNING/ALARM 34, Fieldbus communication fault

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

#### WARNING/ALARM 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 [0] No Function. Check the fuses to the adjustable frequency drive and line power supply to the unit.

#### ALARM 38, Internal fault

When an internal fault occurs, a code number defined in the table below is displayed.

#### **Troubleshooting**

Cycle power

Check that the option is properly installed

Check for loose or missing wiring

It may be necessary to contact your Danfoss supplier or service department. Note the code number for further troubleshooting directions.

No.	Text
0	Serial port cannot be initialized. Contact your
	Danfoss supplier or Danfoss Service Department.
256-258	Power EEPROM data is defective or too old
512	Control board EEPROM data is defective or too old.
513	Communication time out reading EEPROM data
514	Communication time out reading EEPROM data
515	Application oriented control cannot 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)

# VLT AutomationDrive Instruction Manual

	T=
No.	Text
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 oriented control is
	registered. Debug information written in LCP
1792	DSP watchdog is active. Debugging of power part
	data, motor oriented control data not transferred
	correctly.
2049	Power data restarted
2064-2072	H081x: option in slot x has restarted
2080-2088	H082x: option in slot x has issued a power-up wait
2096-2104	H983x: option in slot x has issued a legal power-
	up wait
2304	Could not read any data from 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	Missint lo_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 too small
3072-5122	Parameter value is outside its limits
5123	Option in slot A: Hardware incompatible with
	control board hardware
	-

No.	Text
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 8.2

#### ALARM 39, Heatsink sensor

No feedback from the heatsink temperature sensor.

The signal from the IGBT thermal sensor is not available on the power card. The problem could be on the power card, on the gate drive card, or the ribbon cable between the power card and gate drive card.

**WARNING 40, Overload of digital output terminal 27** Check the load connected to terminal 27 or remove short-circuit connection. Check *5-00 Digital I/O Mode* and *5-01 Terminal 27 Mode*.

**WARNING 41, Overload of digital output terminal 29** Check the load connected to terminal 29 or remove short-circuit connection. Check *5-00 Digital I/O Mode* and *5-02 Terminal 29 Mode*.

# WARNING 42, Overload of digital output on X30/6 or overload of digital output on X30/7

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

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

#### ALARM 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 supplies 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 the 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. Check for a defective control card. If an option card is present, check for an overvoltage condition.

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

WARNING 62, Output frequency at maximum limit

#### ALARM 64, Voltage Limit

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

### WARNING/ALARM 65, Control card over temperature

The cutout temperature of the control card is 176° F [80°C].

#### **Troubleshooting**

- Check that the ambient operating temperature is
- Check for clogged filters.
- Check fan operation.
- Check the control card.

#### WARNING 66, Heatsink temperature low

The adjustable frequency drive is too cold to operate. This warning is based on the temperature sensor in the IGBT module.

Increase the ambient temperature of the unit. Also, a trickle amount of current can be supplied to the adjustable frequency drive whenever the motor is stopped by setting 2-00 DC Hold/Preheat Current at 5% and 1-80 Function at Stop

#### **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. Check that the configuration change is intentional and reset the unit.

## ALARM 68, Safe Stop activated

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

#### ALARM 69, Power card temperature

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

#### **Troubleshooting**

Check the operation of the door fans.

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

Check that the connector plate is properly installed on IP21/IP 54 (NEMA 1/12) adjustable frequency drives.

#### WARNING 49, Speed limit

When the speed is not within the specified range in 4-11 Motor Speed Low Limit [RPM] and 4-13 Motor Speed High Limit [RPM], the adjustable frequency drive shows a warning. When the speed is below the specified limit in 1-86 Trip Speed Low [RPM] (except when starting or stopping), the adjustable frequency drive will trip.

#### ALARM 50, AMA calibration failed

Contact your Danfoss supplier or Danfoss Service Department.

#### ALARM 51, AMA check Unom and Inom

The settings for motor voltage, motor current, and motor power are wrong. Check the settings in parameters 1-20 to

#### 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 operate.

#### ALARM 54, AMA motor too small

The motor is too small for the AMA to operate.

#### ALARM 55, AMA Parameter out of range

The parameter values of the motor are outside of the acceptable range. AMA will not run.

#### 56 ALARM, AMA interrupted by user

The user has interrupted the AMA.

#### ALARM 57, AMA internal fault

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

#### ALARM 58, AMA internal fault

Contact your Danfoss supplier.

#### WARNING 59, Current limit

The current is higher than the value in 4-18 Current Limit. Ensure that Motor data in parameters 1-20 through 1-25 are set correctly. Possibly increase the current limit. Be sure that the system can operate safely at a higher limit.

#### WARNING 60, External interlock

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

#### WARNING/ALARM 61, Tracking error

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



#### ALARM 70, Illegal adjustable frequency drive configuration

The control card and power card are incompatible. Contact your supplier with the type code of the unit from the nameplate and the part numbers of the cards to check compatibility.

#### 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 Bus, Digital I/O, or by pressing [Reset]). Note that if automatic restart is enabled, the motor may start when the fault is cleared.

#### ALARM 72, Dangerous failure

Safe Stop with Trip Lock. Unexpected signal levels on safe stop and digital input from the MCB 112 PTC thermistor card.

#### WARNING 73, Safe stop auto restart

Safe stopped. 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 adjustable frequency drive. Confirm the spare part and its power card are the correct part number.

#### 77 WARNING, 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. Reset the unit to clear the alarm.

#### ALARM 81, CSIV corrupt

CSIV file has syntax errors.

#### ALARM 82, CSIV par. err.

CSIV failed to init a parameter.

#### ALARM 85, Dang fail PB:

Profibus/Profisafe Error.

#### WARNING/ALARM 104, Mixing fan fault

The fan monitor checks that the fan is spinning at power-up or whenever the mixing fan is turned on. If the fan is not operating, then the fault is annunciated. The mixing-fan fault can be configured as a warning or an alarm trip by 14-53 Fan Monitor.

**Troubleshooting** Cycle power to the adjustable frequency drive to determine if the warning/alarm returns.

#### ALARM 243, Brake IGBT

This alarm is only for F Frame adjustable frequency drives. It is equivalent to Alarm 27. The report value in the alarm log indicates which power module generated the alarm:

- 1 = left most inverter module.
- 2 = middle inverter module in F12 or F3 frame sizes.
- 2 = right inverter module in F10 or F11 frame sizes.
- 2 = second adjustable frequency drive from the left inverter module in F14 frame size.
- 3 = right inverter module in F12 or F13 frame sizes.
- 3 = third from the left inverter module in F14 frame size.
- 4 = far right inverter module in F14 frame size.
- 5 = rectifier module.
- 6 = right rectifier module in F14 frame size.

#### ALARM 244, Heatsink temperature

This alarm is only for F Frame adjustable frequency drives. It is equivalent to Alarm 29. The report value in the alarm log indicates which power module generated the alarm.

- 1 = left most inverter module.
- 2 = middle inverter module in F12 or F3 frame
- 2 = right inverter module in F10 or F11 frame sizes.
- 2 = second adjustable frequency drive from the left inverter module in F14 frame size.
- 3 = right inverter module in F12 or F13 frame sizes.
- 3 = third from the left inverter module in F14 frame size.
- 4 = far right inverter module in F14 frame size.
- 5 = rectifier module.
- 6 = right rectifier module in F14 frame size.



#### ALARM 245, Heatsink sensor

This alarm is only for F Frame adjustable frequency drives. It is equivalent to Alarm 39. The report value in the alarm log indicates which power module generated the alarm.

- 1 = left most inverter module.
- 2 = middle inverter module in F12 or F3 frame
- 2 = right inverter module in F10 or F11 frame sizes.
- 2 = second adjustable frequency drive from the left inverter module in F14 frame size.
- 3 = right inverter module in F12 or F13 frame sizes.
- 3 = third from the left inverter module in F14 frame size.
- 4 = far right inverter module in F14 frame size.
- 5 = rectifier module.
- 6 = right rectifier module in F14 frame size.

#### ALARM 246, Power card supply

This alarm is only for F Frame adjustable frequency drive. 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 F12 or F3 frame sizes.
- 2 = right inverter module in F10 or F11 frame sizes.
- 2 = second adjustable frequency drive from the left inverter module in F14 frame size.
- 3 = right inverter module in F12 or F13 frame
- 3 = third from the left inverter module in F14 frame size
- 4 = far right inverter module in F14 frame size.
- 5 = rectifier module.
- 6 = right rectifier module in F14 frame size.

#### ALARM 247, Power card temperature

This alarm is only for F Frame adjustable frequency drive. 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 F12 or F3 frame sizes.
- 2 = right inverter module in F10 or F11 frame sizes.

- 2 = second adjustable frequency drive from the left inverter module in F14 frame size.
- 3 = right inverter module in F12 or F13 frame
- 3 = third from the left inverter module in F14 frame size.
- 4 = far right inverter module in F14 frame size.
- 5 = rectifier module.
- 6 = right rectifier module in F14 frame size.

#### ALARM 248, Illegal power section configuration

This alarm is only for F Frame adjustable frequency drives. It is equivalent to Alarm 79. The report value in the alarm log indicates which power module generated the alarm:

- 1 = left most inverter module.
- 2 = middle inverter module in F12 or F3 frame sizes.
- 2 = right inverter module in F10 or F11 frame sizes.
- 2 = second adjustable frequency drive from the left inverter module in F14 frame size.
- 3 = right inverter module in F12 or F13 frame sizes.
- 3 = third from the left inverter module in F14 frame size.
- 4 = far right inverter module in F14 frame size.
- 5 = rectifier module.
- 6 = right rectifier module in F14 frame size.

#### WARNING 250, New spare part

A component in the adjustable frequency drive has been replaced. Reset the adjustable frequency drive for normal operation.

#### WARNING 251, New type code

The power card or other components have been replaced and the type code changed. Reset to remove the warning and resume normal operation. R



# 9 Basic Troubleshooting

## 9.1 Start Up and Operation

See Alarm Log in Table 4.2.

Symptom	Possible Cause	Test	Solution		
	Missing input power	See Table 3.1.	Check the input power source.		
	Missing or open fuses or circuit	See open fuses and tripped circuit	Follow the recommendations		
	breaker tripped	breaker in this table for possible	provided.		
		causes.			
	No power to the LCP	Check the LCP cable for proper	Replace the faulty LCP or		
		connection or damage.	connection cable.		
	Shortcut on control voltage	Check the 24 V control voltage	Wire the terminals properly.		
Display dark/No function	(terminal 12 or 50) or at control	supply for terminal 12/13 to 20-39			
	terminals	or 10 V supply for terminal 50 to			
		55.			
	Wrong LCP (LCP from VLT® 2800		Use only LCP 101 (P/N 130B1124)		
	or 5000/6000/8000/ FCD or FCM)		or LCP 102 (P/N. 130B1107).		
	Wrong contrast setting		Press [Status] + ▲/▼ to adjust the		
			contrast.		
	Display (LCP) is defective	Test using a different LCP.	Replace the faulty LCP or		
			connection cable.		
	Internal voltage supply fault or		Contact supplier.		
	SMPS is defective				
Intermittent display	Overloaded power supply (SMPS)	To rule out a problem in the	If the display stays lit, then the		
	due to improper control wiring or	control wiring, disconnect all	problem is in the control wiring.		
	a fault within the adjustable	control wiring by removing the	Check the wiring for shorts or		
	frequency drive.	terminal blocks.	incorrect connections. If the display		
			continues to cut out, follow the		
			procedure for display dark.		

# H

# VLT\*AutomationDrive Instruction Manual

Symptom	Possible Cause	Test	Solution			
	Service switch open or missing	Check if the motor is connected	Connect the motor and check the			
	motor connection	and the connection is not	service switch.			
		interrupted (by a service switch or				
		other device).				
	No line power with 24 V DC	If the display is functioning but no	Apply line power to run the unit.			
	option card	output, check that line power is				
		applied to the adjustable frequency				
		drive.				
	LCP Stop	Check if [Off] has been pressed.	Press [Auto On] or [Hand On]			
			(depending on your operation			
			mode) to run the motor.			
Motor not running	Missing start signal (Standby)	Check 5-10 Terminal 18 Digital Input	Apply a valid start signal to start			
		for correct setting for terminal 18	the motor.			
		(use default setting).				
	Motor coast signal active	Check 5-12 Terminal 27 Digital Input	Apply 24 V on terminal 27 or			
	(Coasting)	for correct setting for terminal 27	program this terminal to No			
		(use default setting).	operation.			
	Wrong reference signal source	Check reference signal: Local,	Program correct settings Check			
		remote or bus reference? Preset	3-13 Reference Site Set preset			
		reference active? Terminal	reference active in parameter			
		connection correct? Scaling of	group 3-1* References. Check for			
		terminals correct? Reference signal	correct wiring. Check scaling of			
		available?	terminals. Check reference signal.			
	Motor rotation limit	Check that 4-10 Motor Speed	Program correct settings.			
	<u> </u>	Direction is programmed correctly.				
Motor running in wrong	Active reversing signal	Check if a reversing command is	Deactivate reversing signal.			
direction		programmed for the terminal in				
		parameter group 5-1* Digital inputs.				
	Wrong motor phase connection		See 3.5 Check Motor Rotation in this			
	Fueron and limite and common a	Charles autout limits in 4.12 Mateu	manual.			
	Frequency limits set wrong	Check output limits in4-13 Motor Speed High Limit [RPM], 4-14 Motor	Program correct limits.			
		Speed High Limit [Hz], and 4-19 Max				
Motor is not reaching		Output Frequency				
maximum speed	Reference input signal not scaled	Check reference input signal	Program correct settings.			
maximum specu	correctly	scaling in parameter group 6-*	Trogram correct settings.			
	conceasy	Analog I/O mode and parameter				
		group 3-1* References.				
	Possible incorrect parameter	Check the settings of all motor	Check settings in parameter group			
	settings	parameters, including all motor	1-6* Analog I/O mode. For closed-			
Motor speed unstable		compensation settings. For closed-	loop operation, check settings in			
		loop operation, check PID settings.	parameter group 20-0* Feedback.			
Motor runs rough	Possible over-magnetization	Check for incorrect motor settings	Check motor settings in parameter			
		in all motor parameters.	groups 1-2* Motor data 1-3* Adv			
		·	motor data, and 1-5* Load indep.			
			setting.			
	Possible incorrect settings in the	Check brake parameters. Check	Check parameter group 2-0* DC			
Motor will not brake	brake parameters. Possible too	ramp time settings.	brake and 3-0* Reference limits.			
	short ramp-down times.					



# VLT Automation Drive Instruction Manual

Symptom	Possible Cause	Test	Solution		
	Phase to phase short	Motor or panel has a short phase	Eliminate any shorts detected.		
		to phase. Check motor and panel			
		phase to for shorts.			
	Motor overload	Motor is overloaded for the	Perform start-up test and verify		
		application.	motor current is within specifi-		
Open power fuses or circuit			cations. If motor current is		
breaker trip			exceeding nameplate full load		
			current, motor may run only with		
			reduced load. Review the specifi-		
			cations for the application.		
	Loose connections	Perform pre-startup check for loose	Tighten loose connections.		
		connections.			
	Problem with line power (See	Rotate input power leads into the	If imbalanced leg follows the wire,		
	Alarm 4 Line phase loss	drive one position: A to B, B to C, C	it is a power problem. Check line		
Line power current	description)	to A.	power supply.		
imbalance greater than 3%	Problem with the adjustable	Rotate input power leads into the	If imbalance leg stays on same		
	frequency drive unit	adjustable frequency drive one	input terminal, it is a problem with		
		position: A to B, B to C, C to A.	the unit. Contact supplier.		
	Problem with motor or motor	Rotate output motor leads one	If imbalanced leg follows the wire,		
	wiring	position: U to V, V to W, W to U.	the problem is in the motor or		
Motor current imbalance			motor wiring. Check motor and		
			motor wiring.		
greater than 3%	Problem with adjustable	Rotate output motor leads one	If imbalance leg stays on same		
	frequency drive unit	position: U to V, V to W, W to U.	output terminal, it is a problem		
			with the unit. Contact supplier.		

Table 9.1

**Basic Troubleshooting** 

a



# 10 Specifications

## 10.1 Power-dependent Specifications

FC 301/FC 302	PK25	PK37	PK55	PK75	P1K1	P1K5	P2K2	P3K0	P3K7
	[0.335	[0.496	[0.720 hm	[1 00¢ b.=	[1.475	[2.012	[2.05 hm	[4.023	[4.962
	hp, 0.25	hp, 0.37	[0.738 hp, 0.55 kW]	[1.006 hp, 0.75 kW]	hp, 1.1	hp, 1.5	[2.95 hp, 2.2 kW]	hp, 3.0	hp, 3.7
Typical Shaft Output [hp, kW]	W]	kW]	U.55 KW]	0.75 KW]	kW]	kW]	2.2 KVV]	kW]	kW]
Enclosure IP20/IP21	A2	A2	A2	A2	A2	A2	A2	А3	A3
Enclosure IP20 (FC 301 only)	A1	A1	A1	A1	A1	A1	-	1	-
Enclosure IP55, 66	A4/A5	A4/A5	A4/A5	A4/A5	A4/A5	A4/A5	A4/A5	A5	A5
Output current									
Continuous		2.4	3.5	4.6	6.6	7.5	10.6	12.5	16.7
(3x200-240 V) [A]	1.8								
Intermittent	2.9	3.8	5.6	7.4	10.6	12.0	17.0	20.0	26.7
(3x200-240 V) [A]	2.9	3.0	5.0	7.4	10.6	12.0	17.0	20.0	26.7
Continuous	0.65	0.86	1.26	1.66	2.38	2.70	3.82	4.50	6.00
kVA (208 V AC) [kVA]	0.03			1.00					
Max. input current									
Continuous	1.6	2.2	3.2	4.1	5.9	6.8	9.5	11.3	15.0
(3x200-240 V) [A]	1.0	2.2	3.2	4.1	3.9	0.0	9.5	11.5	13.0
Intermittent	2.6	3.5	5.1	6.6	9.4	10.9	15.2	18.1	24.0
(3x200–240 V) [A]	2.0	3.5	3.1	0.0	7.4	10.5	13.2	10.1	24.0
Additional specifications									
IP20, 21 max. cable cross-section <sup>5)</sup> (line				11	A (12.12.12	))			
power, motor, brake and load sharing)	4,4,4 (12,12,12) (min. 0.2 (24))								
[AWG (mm <sup>2</sup> )] <sup>2)</sup>				(111)	IIII. U.Z (Z <del>-1</del> )	,			
IP55, 66 max. cable cross-section <sup>5)</sup> (line									
power, motor, brake and load sharing)	4,4,4 (12,12,12)								
[AWG (mm <sup>2</sup> )]									
Max. cable cross-section <sup>5)</sup> with disconnect	6,4,4 (10,12,12)								
Estimated power loss	(0.028	(0.039	(0.056 hn	(0.072 hp,	(0.084	(0.110	(0.156	(0.208	(0.248
at rated max. load (HP [W]) 4)	hp, 21	hp, 29	(0.056 hp,	(0.072 np, 54 W)	' l hp. 63	hp, 82	hp, 116	hp, 155	hp, 185
	W)	W)	42 W)	34 W)		W)	W)	W)	W)
Weight, enclosure IP20 (lbs [kg])	10.36	10.36	10.58	10.58	10.0 [4.0]	10.8 [4.9]	10.8	14.6	14.6
	[4.7]	[4.7]	[4.8]	[4.8]	10.8 [4.9]	10.0 [4.9]	[4.9]	[6.6]	[6.6]
A1 (IP20)	2.7	2.7	2.7	2.7	2.7	2.7	-	-	-
A5 (IP55, 66)	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
Efficiency <sup>4)</sup>	0.94	0.94	0.95	0.95	0.96	0.96	0.96	0.96	0.96
0.34–5 hp [0.25–3.7 kW] only available as 1	60% high	overload.	•						-

Table 10.1

Danfoss

Line Power Supply 3x200–240 V AC			1 _	-17-	_	4416	
FC 301/FC 302		K5		7K5		11K	
High/ Normal Load <sup>1)</sup>	НО	NO	НО	NO	НО	NO	
Typical Shaft Output [kW]	[7.376 hp, 5.5 kW]	[10.058 hp, 7.5 kW]	[10.058 hp, 7.5 kW]	[14.751 hp, 11 kW]	[14.751 hp, 11 kW]	[20.115 hp, 15 kW]	
Enclosure IP20	E	33		B3		B4	
Enclosure IP21	E	31		B1		B2	
Enclosure IP55, 66	E	31		B1		B2	
Output current			•				
Continuous (3x200–240 V) [A]	24.2	30.8	30.8	46.2	46.2	59.4	
Intermittent							
(60 s overload) (3x200–240 V) [A]	38.7	33.9	49.3	50.8	73.9	65.3	
Continuous kVA (208 V AC) [kVA]	8.7	11.1	11.1	16.6	16.6	21.4	
Max. input current							
Continuous							
(3x200-240 V) [A]	22	28	28	42	42	54	
Intermittent							
(60 s overload)	35.2	30.8	44.8	46.2	67.2	59.4	
(3x200-240 V) [A]							
Additional specifications							
IP21 max. cable cross-section <sup>5)</sup> (line power, brake, load sharing) [AWG (mm²)] <sup>2)</sup>	16,10, 1	6 (6,8,6)	16,10, 16 (6,8,6)		35,-,- (2,-,-)		
IP21 max. cable cross-section <sup>5)</sup> (motor) [AWG (mm <sup>2</sup> )] <sup>2)</sup>	10,10,	- (8,8,-)	10,10	,- (8,8,-)	35,25,2	25 (2,4,4)	
IP20 max. cable cross-section <sup>5)</sup> (line power, brake, motor and load sharing)	10,10,	- (8,8,-)	10,10	,- (8,8,-)	35,-,- (2,-,-)		
Max. cable cross-section with disconnect [AWG (mm²)] <sup>2)</sup>	16,10,10 (6,8,8)						
Estimated power loss	0.321 hp	0.416 hp [310	0.498 hp	0.689 hp [514	0.621 hp	0.807 hp [602	
at rated max. load (HP [W]) 4)	[239 W]	W]	[371 W]	W]	[463 W]	W]	
Weight, enclosure IP21, IP55, 66 (lbs [kg])	50.7	1 [23]	50.7	1 [23]	59.52 [27]		
Efficiency <sup>4)</sup>	1	964	0	959	0.964		

Table 10.2

Specifications



FC 301/FC 302	P1	5K	P1	8K	P2	2K	P3	OK	P37K	
High/Normal Load <sup>1)</sup>	НО	NO	НО	NO	НО	NO	НО	NO	НО	NO
Typical Shaft Output [kW]	15	18.5	18.5	22	22	30	30	37	37	45
Enclosure IP20	Е	4	C	C3		C3		4	C4	
Enclosure IP21		<u>.</u> 1		1	C	<u> </u>	C	<u>.</u> 1	С	:1
Enclosure IP55, IP66		<u>.</u> 1		1	C	1	C	2	C	2
Output current										
Continuous	50.4	74.0	74.0	00	00	115	115	1.42	1.42	170
(3x200–240 V) [A]	59.4	74.8	74.8	88	88	115	115	143	143	170
Intermittent										
(60 s overload)	89.1	82.3	112	96.8	132	127	173	157	215	187
(3x200–240 V) [A]										
Continuous	21.4	26.9	26.9	31.7	31.7	41.4	41.4	51.5	51.5	61.2
kVA (208 V AC) [kVA]	21.4	20.9	20.9	31.7	31.7	41.4	41.4	31.3	31.3	01.2
Max. input current										
Continuous	54	68	68	80	80	104	104	130	130	154
(3x200–240 V) [A]	34	00	08	80	80	104	104	130	130	134
Intermittent										
(60 s overload)	81	74.8	102	88	120	114	156	143	195	169
(3x200–240 V) [A]										
Additional specifications										
IP20 max. cable cross-section <sup>5)</sup>										
(line power, brake, motor and load	35	(2)	50 (1)		50 (1)		300MCM (150)		300MCM (150)	
sharing)										
IP21, IP55, IP66 max. cable cross-										
section <sup>5)</sup> (line power, motor) [mm <sup>2</sup>	50	(1)	50	(1)	50 (1)		300MCM (150)		300MCM (150)	
(AWG)] <sup>2)</sup>										
IP21, IP55, IP66 max. cable cross-										
section <sup>5)</sup> (brake, load sharing)	50	(1)	50	(1)	50	(1)	95 (	(3/0)	95 (	3/0)
[mm <sup>2</sup> (AWG)] <sup>2)</sup>										
Max cable size with line power					-		05.7	70, 70	185, 15	50, 120
disconnect [mm² (AWG)] 2)			50, 35, 3	5 (1, 2, 2)			-	/0, 2/0)	(350	исм,
							(3/0, 2,		300MC	M, 4/0)
Estimated power loss	0.837	0.988 hp	0.992 hp	1.133 hp	1.172 hp	1.529 hp	1.533 hp	1.814 hp	1.877 hp	2.194 hp
at rated max. load (HP [W]) 4)	hp [624	[737 W]	[740 W]	[845 W]	[874 W]	[1,140	[1,143	[1,353	[1,400	[1,636
	W]	[13/ [1]	[/ <del>T</del> O VV]	[עע כדטן	[U/ + VV]	W]	W]	W]	W]	W]
Weight,	90.2	I [45]	99.21	[45]	00 21 [45]		143.3 [65]		142.2 [65]	
enclosure IP21, 55/66 (lbs [kg])	33.2	[ניד]	99.2	[כד]	99.21 [45]		143.3 [65]		143.3 [65]	
Efficiency <sup>4)</sup>	_	06		07				07		07
	0.	0.96 0.97			0.97		0.97		0.97	

#### Table 10.3

**Specifications** 

For fuse ratings, see 10.3.1 Fuses

- 1) High overload = 160% torque during 60 s. Normal overload = 110% torque during 60 s.
- 2) American Wire Gauge.
- 3) Measured using 16.5 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 ⁴/▼15% (tolerance relates to variety in voltage and cable conditions).



### Specifications VLT\*AutomationDrive Instruction Manual

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 0.04 hp [30 W] to the losses. (Though typically only 0.005 hp [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%).

5) The three values for the max. cable cross-section are for single core, flexible wire and flexible wire with sleeve, respectively.

Line Power Supply 3x380-500 V AC	(FC 302),	3x380-480	V AC (FC	301)						
	PK37	PK55	PK75	P1K1	P1K5	P2K2	РЗКО	P4K0	P5K5	P7K5
	[0.496	[0.738	[1.006 hp,	[1.475	[2.012	[2.95 hp,	[4.023	[5.364	[7.376	[10.058
FC 301/FC 302	hp, 0.37 kW]	hp, 0.55 kW]	0.75	hp, 1.1 kW]	hp, 1.5 kW]	2.2 kW]	hp, 3.0 kW]	hp, 4 kW]	hp, 5.5 kW]	hp, 7.5 kW]
Typical Shaft Output [kW]	KVVJ	KVV	kW]	KVVJ	KVVJ		KVVJ	KVV	KVVJ	KVVJ
Enclosure IP20/IP21	A2	A2	A2	A2	A2	A2	A2	A2	А3	A3
Enclosure IP20 (FC 301 only)	A1	A1	A1	A1	A1					
Enclosure IP55, 66	A4/A5	A4/A5	A4/A5	A4/A5	A4/A5	A4/A5	A4/A5	A4/A5	A5	A5
Output current - High overload 160	% for 1 mi	n.								
	[0.496 hp, 0.37	[0.738 hp, 0.55	[1.006 hp, 0.75	[1.475 hp, 1.1	[2.012 hp, 1.5	[2.95 hp,	[4.023 hp, 3.0	[5.364 hp, 4	[7.376 hp, 5.5	[10.058 hp, 7.5
	kW]	kW]	kW]	kW]	kW]	2.2 kW]	kW]	kW]	kW]	kW]
Continuous		,	,	,	,		,	,	,	
(3x380-440 V) [A]	1.3	1.8	2.4	3	4.1	5.6	7.2	10	13	16
Intermittent (3x380–440 V) [A]	2.1	2.9	3.8	4.8	6.6	9.0	11.5	16	20.8	25.6
Continuous (3x441–500 V) [A]	1.2	1.6	2.1	2.7	3.4	4.8	6.3	8.2	11	14.5
Intermittent (3x441–500 V) [A]	1.9	2.6	3.4	4.3	5.4	7.7	10.1	13.1	17.6	23.2
Continuous kVA (400 V AC) [kVA]	0.9	1.3	1.7	2.1	2.8	3.9	5.0	6.9	9.0	11.0
Continuous kVA (460 V AC) [kVA]	0.9	1.3	1.7	2.4	2.7	3.8	5.0	6.5	8.8	11.6
Max. input current	•	ļ.	!					!	Į.	
Continuous (3x380-440 V) [A]	1.2	1.6	2.2	2.7	3.7	5.0	6.5	9.0	11.7	14.4
Intermittent (3x380–440 V) [A]	1.9	2.6	3.5	4.3	5.9	8.0	10.4	14.4	18.7	23.0
Continuous (3x441–500 V) [A]	1.0	1.4	1.9	2.7	3.1	4.3	5.7	7.4	9.9	13.0
Intermittent (3x441–500 V) [A]	1.6	2.2	3.0	4.3	5.0	6.9	9.1	11.8	15.8	20.8
Additional specifications	l .		l .			ļ				
IP20, 21 max. cable cross-section <sup>5)</sup> (line power, motor, brake and load sharing) [mm² (AWG)] <sup>2)</sup>						12 (4,4,4) 24 (0.2))				
IP55, 66 max. cable cross-section <sup>5)</sup> (line power, motor, brake and load sharing) [AWG (mm²)]					4,4,4 (	12,12,12)				
Max. cable cross-section <sup>5)</sup> with disconnect					6,4,4 (	10,12,12)				
Estimated power loss	(0.047	(0.056	(0.062	(0.078	(0.083	(0.118	(0.156	(0.167	(0.251	(0.342
at rated max. load (hp, W) 4)	hp, 35 W)	hp, 42 W)	hp, 46 W)	hp, 58 W)	hp, 62 W)	hp, 88 W)	hp, 116 W)	hp, 124 W)	hp, 187 W)	hp, 255 W)
Weight,	10.36	10.36	10.58	10.58					14.6	14.6
enclosure IP20 (lb [kg])	[4.7]	[4.7]	[4.8]	[4.8]	10.8 [4.9]	10.8 [4.9]	10.8 [4.9]	10.8 [4.9]	[6.6]	[6.6]
Enclosure IP55, 66	29.76	29.76	29.76	29.76	29.76	29.76	29.76	29.76	31.31	31.31
	[13.5]	[13.5]	[13.5]	[13.5]	[13.5]	[13.5]	[13.5]	[13.5]	[14.2]	[14.2]
Efficiency 4)	0.93	0.95	0.96	0.96	0.97	0.97	0.97	0.97	0.97	0.97
0.5–10 hp [0.37–7.5 kW] only availal	ole as 1609	% high ove	rload.		•		•			

Table 10.4

### 10

## VLT\*AutomationDrive Instruction Manual

Line Power Supply 3x380–500 V AC (FC	302), 3x380–4	80 V AC (FC	301)						
FC 301/FC 302	P1	1K	P1:	5K	P1	18K	P22K		
High/ Normal Load <sup>1)</sup>	НО	NO	НО	NO	НО	NO	НО	NO	
Typical Shaft output [kW]	11	15	15	18.5	18.5	22.0	22.0	30.0	
Enclosure IP20	В	3	B3		B4		В	4	
Enclosure IP21	В	1	В	1	Е	32	В	2	
Enclosure IP55, IP66	В	1	В	1	E	32	В	2	
Output current									
Continuous									
(3x380-440 V) [A]	24	32	32	37.5	37.5	44	44	61	
Intermittent (60 s overload)	20.4	25.2	F4.2	44.2		40.4	70.4	67.4	
(3x380-440 V) [A]	38.4	35.2	51.2	41.3	60	48.4	70.4	67.1	
Continuous	21	27	27	24	24	40	40	F2	
(3x441–500 V) [A]	21	27	27	34	34	40	40	52	
Intermittent (60 s overload)	33.6	29.7	43.2	37.4	54.4	44	64	57.2	
(3x441–500 V) [A]	33.0	29.7	45.2	37.4	34.4	44	04	37.2	
Continuous kVA	16.6	22.2	22.2	26	26	30.5	30.5	42.3	
(400 V AC) [kVA]	10.0	22.2	22.2	20	20	30.3	30.5	42.3	
Continuous kVA		21.5		27.1		31.9		41.4	
(460 V AC) [kVA]		21.5		27.1		31.7		71.7	
Max. input current									
Continuous	22	29	29	34	34	40	40	55	
(3x380-440 V) [A]									
Intermittent (60 s overload)	35.2	31.9	46.4	37.4	54.4	44	64	60.5	
(3x380-440 V) [A]									
Continuous	19	25	25	31	31	36	36	47	
(3x441–500 V) [A]									
Intermittent (60 s overload)	30.4	27.5	40	34.1	49.6	39.6	57.6	51.7	
(3x441–500 V) [A]									
Additional specifications	Ī				ı		I		
IP21, IP55, IP66 max. cable cross-						- 1			
section <sup>5)</sup> (line power, brake, load	16, 10, 16	6 (6, 8, 6)	16, 10, 16	(6, 8, 6)	35,-,-	-(2,-,-)	35,-,-	(2,-,-)	
sharing) [mm² (AWG)] <sup>2)</sup>									
IP21, IP55, IP66 max. cable cross-	10, 10,-	(8, 8,-)	10, 10,-	(8, 8,-)	35, 25, 2	5 (2, 4, 4)	35, 25, 2	5 (2, 4, 4)	
section <sup>5)</sup> (motor) [mm <sup>2</sup> (AWG)] <sup>2)</sup>									
IP20 max. cable cross-section <sup>5)</sup> (line	10, 10,-	(8, 8,-)	10, 10,-	(8, 8,-)	35,-,-	-(2,-,-)	35,-,-	(2,-,-)	
power, brake, motor and load sharing)									
Max. cable cross-section with	16, 10, 10 (6, 8, 8)								
disconnect [AWG (mm²)] 2)	(0.200.1	(0.525.1	(0.500.1	(0.624.1	(0.505.1	(0.704.1	(0.724.1	(0.001.1	
Estimated power loss	(0.390 hp,	(0.526 hp,	(0.508 hp,	(0.624 hp,	(0.595 hp,	(0.704 hp, 525 W)	(0.734 hp,	(0.991 hp,	
at rated max. load (hp,W) 4)	291 W)	392 W)	379 W)	465 W)	444 W)		547 W)	739 W)	
Weight, enclosure IP20 (lbs [kg])	26.46	0 [12]	26.46 [12]		51.81 [23.5]		51.81	[23.5]	
Weight,	50.71	[23]	50.71 [23]		59.52 [27]		59.52 [27]		
enclosure IP21. IP55, 66 (lb [kg])		20							
Efficiency <sup>4)</sup>	L 0.9	0.98		0.98		0.98		0.98	

Table 10.5



Line Power Supply 3x380-500 V AC	(FC 302), 3	x380–480 V	/ AC (FC 30	1)						
FC 301/FC 302	· · · · · · · · · · · · · · · · · · ·	0K	P3	-	P4	15K	P5	5K	P75K	
High/ Normal Load <sup>1)</sup>	НО	NO	НО	NO	НО	NO	НО	NO	НО	NO
Typical Shaft output [kW]	30	37	37	45	45	55	55	75	75	90
Enclosure IP20	B	4	С	3		3		4		4
Enclosure IP21	ļ	:1	C			:3 :1		2		2
Enclosure IP55, IP66	<b>-</b>	:1	C		-	- 1 - 1		2		2
Output current		.1		•		- '				
Continuous										
(3x380–440 V) [A]	61	73	73	90	90	106	106	147	147	177
Intermittent (60 s overload)	91.5	80.3	110	99	135	117	159	162	221	195
(3x380-440 V) [A]										
Continuous	52	65	65	80	80	105	105	130	130	160
(3x441–500 V) [A]										
Intermittent (60 s overload) (3x441–500 V) [A]	78	71.5	97.5	88	120	116	158	143	195	176
Continuous kVA	42.3	50.6	50.6	62.4	62.4	73.4	72.4	102	102	122
(400 V AC) [kVA]	42.3	50.6	50.6	62.4	62.4	73.4	73.4	102	102	123
Continuous kVA		51.8		63.7		83.7		104		128
(460 V AC) [kVA]		31.0		03.7		03.7		104		120
Max. input current										
Continuous (3x380–440 V) [A]	55	66	66	82	82	96	96	133	133	161
Intermittent (60 s overload)										
(3x380-440 V) [A]	82.5	72.6	99	90.2	123	106	144	146	200	177
Continuous	47	50	50	72	70	0.5	0.5	110	110	4.45
(3x441-500 V) [A]	47	59	59	73	73	95	95	118	118	145
Intermittent (60 s overload)	70.5	640	00.5	00.3	110	105	142	120	177	160
(3x441-500 V) [A]	70.5	64.9	88.5	80.3	110	105	143	130	177	160
Additional specifications					•	•	•			
IP20 max. cable cross-section <sup>5)</sup> (line	25	(2)	50 (1)		50 (1)		150 (300 mcm)		150 (300 mcm)	
power and motor)	33	(2)	50 (1)		50 (1)		150 (300 mcm)		150 (300 mcm)	
IP20 max. cable cross-section <sup>5)</sup>	25	(2)	50 (1)		50 (1)		05 (4(0)		05 (4(0)	
(brake and load sharing)	35	(2)	50 (1)		50 (1)		95 (4/0)		95 (4/0)	
IP21, IP55, IP66 max. cable cross-										
section <sup>5)</sup> (line power, motor) [mm <sup>2</sup>	50	(1)	50	(1)	50	(1)	300MC	M (150)	300MC	M (150)
(AWG)] <sup>2)</sup>										
IP21, IP55, IP66 max. cable cross-										
section <sup>5)</sup> (brake, load sharing)	50	(1)	50	(1)	50	(1)	95 (	3/0)	95	(3/0)
[mm <sup>2</sup> (AWG)] <sup>2)</sup>										
Max cable size with line power			50.25	25			05.7	0.70	185, 1	50, 120
disconnect [mm² (AWG)] <sup>2)</sup>			50, 35, (1, 2,					0, 70 /0, 2/0)	l	CM, 300 l, 4/0)
Estimated power loss						1.452	1.371	1.856	1.652	
at rated max. load (HP [W]) 4)	0.764 hp	0.936 hp	0.935 hp	1.130 hp	1.194	hp	hp	hp	hp	1.977 hp
( []	[570 W]	[698 W]	[697 W]	[843 W]	hp [891	[1,083	[1,022	[1,384	[1,232	[1,474
				•	[ W]	W]	W]	W]	W]	W]
Weight,									-	
•	99.21 [45]		99.21 [45]		99.21 [45]		143.3 [65]		143.3 [65]	
enclosure IP21, IP55, IP66 (lbs [kg])	0.98 0.98					0.98		0.99		

Table 10.6

Specifications

### 10

### VLT Automation Drive Instruction Manual

For fuse ratings, see 10.3.1 Fuses

- 1) High overload = 160% torque during 60 s. Normal overload = 110% torque during 60 s.
- 2) American Wire Gauge.
- 3) Measured using 16.5 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 ⁴/▼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 0.04 hp [30 W] to the losses. (Though typical only 0.005 hp [4W] 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%).

5) The three values for the max. cable cross-section are for single core, flexible wire and flexible wire with sleeve, respectively.



FC 302	PK75	P1K1	P1K5	P2K2	P3K0	P4K0	P5K5	P7K5
	[1.006 hp,	[1.475 hp,	[2.012 hp,	[2.95 hp,	[4.023 hp,	[5.364 hp,	[7.376	[10.058
	0.75 kW]	1.1 kW]	1.5 kW]	2.2 kW]	3.0 kW]	4 kW]	hp, 5.5	hp, 7.5
Typical Shaft Output [kW]	0.73 KW]	1.1 KVV]	I.J KWJ	2.2 KVV]	3.0 KW]	4 KVV]	kW]	kW]
Enclosure IP20, 21	А3	А3	A3	А3	A3	А3	А3	А3
Enclosure IP55	A5	A5	A5	A5	A5	A5	A5	A5
Output current								
Continuous	1.8	2.6	2.9	4.1	5.2	6.4	9.5	11.5
(3x525–550 V) [A]	1.0	2.0	2.9	4.1	3.2	0.4	9.5	11.5
Intermittent	2.9	4.2	4.6	6.6	8.3	10.2	15.2	18.4
(3x525–550 V) [A]	2.9	4.2	4.0	0.0	0.5	10.2	13.2	10.4
Continuous	1.7	2.4	2.7	3.9	4.9	6.1	9.0	11.0
(3x551-600 V) [A]	1.7	2.4	2.7	3.9	4.9	0.1	9.0	11.0
Intermittent	2.7	3.8	4.3	6.2	7.8	9.8	14.4	17.6
(3x551–600 V) [A]	2.7	5.0	4.5	0.2	7.0	9.0	14.4	17.0
Continuous kVA (525 V AC) [kVA]	1.7	2.5	2.8	3.9	5.0	6.1	9.0	11.0
Continuous kVA (575 V AC) [kVA]	1.7	2.4	2.7	3.9	4.9	6.1	9.0	11.0
Max. input current								
Continuous	1.7	2.4	2.7	4.1	5.2	5.8	8.6	10.4
(3x525–600 V) [A]	1.7	2.4	2.7	4.1	3.2	5.0	0.0	10.4
Intermittent	2.7	3.8	4.3	6.6	8.3	9.3	13.8	16.6
(3x525–600 V) [A]	2.7	5.0	4.5	0.0	0.5	9.5	13.0	10.0
Additional specifications								
IP20, 21 max. cable cross-section <sup>5)</sup> (line power,				4,4,4 (1	2,12,12)			
motor, brake and load sharing) [mm² (AWG)]²)				(min. 0	).2 (24))			
IP55, 66 max. cable cross-section <sup>5)</sup> (line power,				4 4 4 /1	2 12 12)			
motor, brake and load sharing) [AWG (mm <sup>2</sup> )]				4,4,4 (1	2,12,12)			
Max. cable cross-section <sup>5)</sup> with disconnect				6,4,4 (1	0,12,12)			
Estimated power loss	(0.047 hp,	0.067 hp	0.087 hp	0.123 hp	0.164 hp	0.194 hp	0.261 hp	0.350 hp
at rated max. load (HP [W]) 4)	35 W)	[50 W]	[65 W]	[92 W]	[122W]	[145 W]	[195 W]	[261 W]
Weight,	14.33	14.33	4422 [6 =]	14.33	14.33	14.33	446565	446 [6 7]
Enclosure IP20 (lbs [kg])	[6.5]	[6.5]	14.33 [6.5]	[6.5]	[6.5]	[6.5]	14.6 [6.6] 14.6 [6.6	14.6 [6.6]
Weight,	29.76	29.76	29.76	29.76	29.76	29.76	31.31	31.31
enclosure IP55 (lbs [kg])	[13.5]	[13.5]	[13.5]	[13.5]	[13.5]	[13.5]	[14.2]	[14.2]
Efficiency 4)	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97

Table 10.7

**Specifications** 

Line Power Supply 3x525-600 V AC											
FC 302	P.	I1K	P.	15K	P18	ВК	P2	22K	P30K		
High/ Normal Load <sup>1)</sup>	НО	NO	НО	NO	НО	NO	НО	NO	НО	NO	
Typical Shaft Output [kW]	11	15	15	18.5	18.5	22	22	30	30	37	
Enclosure IP21, IP55, IP66	1	31	E	31	B	2	E	32		:1	
Enclosure IP20		33	E	33	B-	4	Е	34	В	B4	
Output current			Į.				!				
Continuous											
(3x525–550 V) [A]	19	23	23	28	28	36	36	43	43	54	
Intermittent	20	25	27	21	45	40	50	47	65	50	
(3x525–550 V) [A]	30	25	37	31	45	40	58	47	65	59	
Continuous	10	22	22	27	27	24	2.4	41	41	-53	
(3x525-600 V) [A]	18	22	22	27	27	34	34	41	41	52	
Intermittent	29	24	35	30	43	37	54	45	62	57	
(3x525-600 V) [A]	29	24	33	30	43	3/	34	43	02	3/	
Continuous kVA (550 V AC) [kVA]	18.1	21.9	21.9	26.7	26.7	34.3	34.3	41.0	41.0	51.4	
Continuous kVA (575 V AC) [kVA]	17.9	21.9	21.9	26.9	26.9	33.9	33.9	40.8	40.8	51.8	
Max. input current											
Continuous	17.2	20.9	20.9	25.4	25.4	32.7	32.7	39	39	49	
at 550 V [A]	17.2	20.9	20.9	25.4	25.4	32.7	32.7	39	39	49	
Intermittent	28	23	33	28	41	36	52	43	59	54	
at 550 V [A]	20		33	20	7.		32	13		J -	
Continuous	16	20	20	24	24	31	31	37	37	47	
at 575 V [A]	1.0								<i></i>		
Intermittent	26	22	32	27	39	34	50	41	56	52	
at 575 V [A]											
Additional specifications	1		1		1		1				
IP21, IP55, IP66 max. cable cross-	l	_ ,,	16 10 10 (6 0 0)		25 (2 )		25 (2.)				
section <sup>5)</sup> (line power, brake, load	16, 10, 1	0 (6, 8, 8)	16, 10, 10 (6, 8, 8)		35,-,-(2,-,-)		35,-,-(2,-,-)		50,-,- (1,-,-)		
sharing) [mm² (AWG)] ²)											
IP21, IP55, IP66 max. cable cross-	10, 10,	- (8, 8,-)	10, 10,	- (8, 8,-)	35, 25, 25 (2, 4, 4)		35, 25, 25 (2, 4, 4)		50,-,- (1,-,-)		
section <sup>5)</sup> (motor) [mm <sup>2</sup> (AWG)] <sup>2)</sup>											
IP20 max. cable cross-section <sup>5)</sup> (line											
power, brake, motor and load	10 10	- (8, 8,-)	10 10	- (8, 8,-)	25	(2 )	25	-(2,-,-)	25	(2 )	
sharing)	10, 10,	- (0, 0,-)	10, 10,	- (0, 0,-)	35,-,-(2,-,-)		33,-,	-(∠,-,-)	35,-,-(2,-,-)		
Max. cable cross-section with	1			16.	10, 10				50, 3	5, 35	
disconnect [AWG (mm²)] 2)					8, 8)				·	2, 2)	
Estimated power loss	1					0.441				0.939	
at rated max. load (HP [W]) 4)		0.302 hp		0.382 hp		hp [329		0.939 hp		hp [700	
		[225 W]		[285 W]		W]		[700 W]		W]	
Weight,	50.7	1 [22]	F0 7	1 [22]	50.53	[27]	50.5	. [27]	50.53	. [27]	
enclosure IP21 (lbs [kg])	50.7	1 [23]	50.7	1 [23]	59.52 [27]		59.52 [27]		59.52	2 [27]	
Weight,	26.4	6 [12]	26.4	6 [12]	51.81 [23.5]		E1 01 [22 E]		F1 01 [22 F]		
enclosure IP20 (lbs [kg])	20.4	6 [12]	20.4	6 [12]	31.01	[23.3]	51.81 [23.5]		51.81 [23.5]		
Efficiency 4)	0	.98	0	.98	0.9	98	0.	.98	0.	98	

Table 10.8



Line Power Supply 3x525-600 V AC									
FC 302	P3	7K	P4	45K	P5	5K	P7	′5K	
High/Normal Load*	НО	NO	НО	NO	НО	NO	НО	NO	
Typical Shaft Output [kW]	37	45	45	55	55	75	75	90	
Enclosure IP21, IP55, IP66	C1	C1	(	C1	C	2		2	
Enclosure IP20	C3 C3 (		C3	C	<u>.</u> 4	C	[4		
Output current				•					
Continuous	54	65	65	87	87	105	105	137	
(3x525–550 V) [A]	34	03	03	67	67	103	103	137	
Intermittent	81	72	98	96	131	116	158	151	
(3x525–550 V) [A]	01	72	90	90	131	110	136	131	
Continuous	52	62	62	83	83	100	100	131	
(3x525–600 V) [A]	J2	02	02	0.5	05	100	100	131	
Intermittent	78	68	93	91	125	110	150	144	
(3x525–600 V) [A]	70	00	75		123	110	130	'	
Continuous kVA (550 V AC) [kVA]	51.4	61.9	61.9	82.9	82.9	100.0	100.0	130.5	
Continuous kVA (575 V AC) [kVA]	51.8	61.7	61.7	82.7	82.7	99.6	99.6	130.5	
Max. input current									
Continuous	49	59	59	78.9	78.9	95.3	95.3	124.3	
at 550 V [A]	ر۲	37	3,5	70.5	70.5	75.5	75.5	124.5	
Intermittent	74	65	89	87	118	105	143	137	
at 550 V [A]	, ,	03	0,	J 0,		103		137	
Continuous	47	56	56	75	75	91	91	119	
at 575 V [A]				,,,					
Intermittent	70	62	85	83	113	100	137	131	
at 575 V [A]									
Additional specifications									
IP20 max. cable cross-section <sup>5)</sup> (line power		50 (1	)		300MCM (150)				
and motor)									
IP20 max. cable cross-section <sup>5)</sup> (brake and load sharing)		50 (1	)			95 (	(4/0)		
IP21, IP55, IP66 max. cable cross-section <sup>5)</sup>		FO /1	`			150 (20	OMCM)		
(line power, motor) [mm² (AWG)] 2)		50 (1	)			150 (30	OMCM)		
IP21, IP55, IP66 max. cable cross-section <sup>5)</sup>		FO (4	`			0.5	(4.(0)		
(brake, load sharing) [mm <sup>2</sup> (AWG)] <sup>2)</sup>		50 (1	)			95 (	(4/0)		
Max cable size with line power disconnect							185, 1	50, 120	
[mm² (AWG)] <sup>2)</sup>		50, 35,				70, 70		, 300MCM,	
		(1, 2, 1	2)		(3/0, 2	/0, 2/0)	4,	<b>/</b> 0)	
Estimated power loss		1.134 hp		1.475 hp		1.877 hp		2.012 hp	
at rated max. load (HP [W]) 4)		[850 W]		[1,100 W]		[1,400 W]		[1,500 W]	
Weight,	77.16	[25]	77.1	6 [35]	1103	2 [E0]	110 3	2 [50]	
enclosure IP20 (lbs [kg])	77.16	[33]	//.1	6 [35]	110.23 [50]		110.2	3 [50]	
Weight,	00.31	[45]	20.04 5:=3		142.2 [65]		4422 557		
enclosure IP21, IP55 (lbs [kg])	99.21	[45]	99.21 [45]		143.3 [65]		143.3 [65]		
Efficiency <sup>4)</sup>	0.9	98	0	.98	0.	98	0.	98	

Table 10.9

**Specifications** 



#### 10.2 General Technical Data

Line power supply	
Supply Terminals (6-pulse)	L1, L2, L3
Supply Terminals (12-pulse)	L1-1, L2-1, L3-1, L1-2, L2-2, L3-2
Supply voltage	200-240 V ±10%
Supply voltage	FC 301: 380-480 V/FC 302: 380-500 V ±10%
	FC 302: 525-600 V ±10%
Supply voltage	FC 302: 525-690 V ±10%

#### AC line voltage low / line drop-out:

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

Supply frequency	50/60 Hz ±5%
Max. temporary imbalance between line phases	3.0% of rated supply voltage
True Power Factor (λ)	≥ 0.9 nominal at rated load
Displacement Power Factor (cos φ)	near unity (> 0.98)
Switching on input supply L1, L2, L3 (power-ups) ≤ 10 hp [7.5 kW]	maximum 2 times/min.
Switching on input supply L1, L2, L3 (power-ups) 15–100 hp [11–75 kW]	maximum 1 time/min.
Switching on input supply L1, L2, L3 (power-ups) ≥ 125 hp [90 kW]	maximum 1 time/2 min.
Environment according to EN60664-1	overvoltage category lll/pollution degree 2

The unit is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 240/500/600/ 690 V maximum.

Motor output (U, V, W)

Output voltage	0–100% of supply voltage
Output frequency (0.33-10 hp [0.25-75 kW])	FC 301: 0.2-1,000 Hz/FC 302: 0-1,000 Hz
Output frequency (125–1350 hp [90–1,000 kW])	0-800 <sup>1)</sup> Hz
Output frequency in flux mode (FC 302 only)	0–300 Hz
Switching on output	Unlimited
Ramp times	0.01–3600 s.

<sup>1)</sup> Voltage and power dependent

#### Torque characteristics

Starting torque (Constant torque)	maximum 160% for 60 s <sup>1)</sup>
Starting torque	maximum 180% up to 0.5 s <sup>1)</sup>
Overload torque (Constant torque)	maximum 160% for 60 s <sup>1)</sup>
Starting torque (Variable torque)	maximum 110% for 60 s <sup>1)</sup>
Overload torque (Variable torque)	maximum 110% for 60 s

lorque rise time in VVC <sup>pius</sup> (independent of fsw)	10 ms
Torque rise time in FLUX (for 5 kHz fsw)	1 ms

<sup>&</sup>lt;sup>1)</sup> Percentage relates to the nominal torque.

#### Digital inputs

Programmable digital inputs	FC 301: 4 (5) <sup>1)</sup> /FC 302: 4 (6) <sup>1)</sup>
Terminal number	18, 19, 27 <sup>1)</sup> , 29 <sup>1)</sup> , 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

<sup>&</sup>lt;sup>2)</sup> The torque response time depends on application and load but as a general rule, the torque step from 0 to reference is  $4-5 \times 10^{-2}$  torque rise time.



Specifications	VLT*AutomationDrive Instruction Manual	
Voltage level, logic '0' NPN <sup>2)</sup>		> 19 V DC
Voltage level, logic '1' NPN <sup>2)</sup>		< 14 V DC
Maximum voltage on input		28 V DC
Pulse frequency ranges		0–110 kHz
(Duty cycle) Min. pulse width		4.5 ms
Input resistance, R <sub>i</sub>		approx. 4 kΩ
Safe stop Terminal 37 <sup>3, 4)</sup> (Termina	l 37 is fixed PNP logic)	
Voltage level		0-24 V DC
Voltage level, logic'0' PNP		<4 V DC
Voltage level, logic'1' PNP		>20 V DC
Maximum voltage on input		28 V DC
Typical input current at 24 V		50 mA rms
Typical input current at 20 V		60 mA rms
Input capacitance		400 nF

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

#### 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	FC 301: 0 to +10/FC 302: -10 to +10V (scaleable)
Input resistance, R <sub>i</sub>	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 <sub>i</sub>	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	FC 301: 20 Hz/FC 302: 100 Hz

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

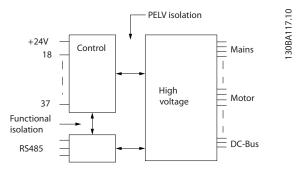


Figure 10.1

<sup>&</sup>lt;sup>1)</sup> Terminals 27 and 29 can also be programmed as output.

<sup>&</sup>lt;sup>2)</sup> Except safe stop input Terminal 37.

<sup>&</sup>lt;sup>3)</sup> See 2.4.5.8 Terminal 37 for further information about terminal 37 and Safe Stop.

<sup>&</sup>lt;sup>4)</sup> When using a contactor with a DC coil inside in combination with Safe Stop, it is important to make a return way for the current from the coil when turning it off. This can be done by using a freewheel diode (or, alternatively, a 30 or 50 V MOV for quicker response time) across the coil. Typical contactors can be bought with this diode.



±50

15 mA

10.5 V ±0.5 V

Specifications	VLT*AutomationDrive Instruction Manual
Pulse/encoder inputs	
Programmable pulse/encoder inputs	2/1
Terminal number pulse/encoder	29 <sup>1)</sup> , 33 <sup>2)</sup> / 32 <sup>3)</sup> , 33 <sup>3</sup>
Max. frequency at terminal 29, 32, 33	110 kHz (push-pull driven
Max. frequency at terminal 29, 32, 33	5 kHz (open collector
Min. frequency at terminal 29, 32, 33	4 H
Voltage level	see 10.2.1 Digital Input
Maximum voltage on input	28 V DC
Input resistance, Ri	approx. 4 kΩ
Pulse input accuracy (0.1–1 kHz)	Max. error: 0.1% of full scale
Encoder input accuracy (1–11 kHz)	Max. error: 0.05% of full scale
voltage terminals.  1) FC 302 only  2) Pulse inputs are 29 and 33  3) Encoder inputs: 32 = A, and 33 = B	
Digital output	
Programmable digital/pulse outputs	2
Terminal number	27, 29 <sup>1</sup>
Voltage level at digital/frequency output	
Max. output current (sink or source)	40 mA
Max. load at frequency output	1 kC
Max. capacitive load at frequency outpu	
Minimum output frequency at frequency	
Maximum output frequency at frequenc	
Accuracy of frequency output	Max. error: 0.1% of full scale
Resolution of frequency outputs  1) Terminal 27 and 29 can also be progra	12 bit
	rom the supply voltage (PELV) and other high-voltage terminals.
Analog output	Tom the supply voltage (1 EEV) and other riight voltage terminals.
Number of programmable analog output	is 1
Terminal number	42
Current range at analog output	0/4–20 mA
Max. load GND - analog output less that	500 Ω
Accuracy on analog output	Max. error: 0.5% of full scale
Resolution on analog output	12 bi
The analog output is galvanically isolated	from the supply voltage (PELV) and other high-voltage terminals.
Control card, 24 V DC output	
	12, 13
Control card, 24 V DC output Terminal number Output voltage	12, 13 24 V +1, -3 V

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

Control card, 10 V DC output

Terminal number

Output voltage

Max. load



Specifications	VLT Automation Drive Instruction
Specifications	Manual

Control card, RS-485 serial communication

Terminal number 68 (P,TX+, RX+), 69 (N,TX-, RX-)
Terminal number 61 Common for terminals 68 and 69

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

Control card, USB serial communication

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

Connection to PC is carried out via a standard host/device USB cable.

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

The USB ground connection is <u>not</u> galvanically isolated from protection ground. Use only an isolated laptop as PC connection to the USB connector on the adjustable frequency drive.

#### Relay outputs

Programmable relay outputs	FC 301all kW: 1/FC 302 all kW: 2
Relay 01 Terminal number	1-3 (break), 1-2 (make)
Max. terminal load (AC-1) <sup>1)</sup> on 1-3 (NC), 1-2 (NO) (Resistive load)	240 V AC, 2A
Max. terminal load (AC-15) <sup>1)</sup> (Inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Max. terminal load (DC-1) <sup>1)</sup> on 1-2 (NO), 1-3 (NC) (Resistive load)	60 V DC, 1A
Max. terminal load (DC-13) <sup>1)</sup> (Inductive load)	24 V DC, 0.1A
Relay 02 (FC 302 only) Terminal number	4-6 (break), 4-5 (make)
Max. terminal load (AC-1) <sup>1)</sup> on 4-5 (NO) (Resistive load) <sup>2)3)</sup> Overvoltage cat. II	400 V AC, 2A
Max. terminal load (AC-15) <sup>1)</sup> on 4-5 (NO) (Inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Max. terminal load (DC-1) <sup>1)</sup> on 4-5 (NO) (Resistive load)	80 V DC, 2A
Max. terminal load (DC-13) <sup>1)</sup> on 4-5 (NO) (Inductive load)	24 V DC, 0.1A
Max. terminal load (AC-1) <sup>1)</sup> on 4-6 (NC) (Resistive load)	240 V AC, 2A
Max. terminal load (AC-15) <sup>1)</sup> on 4-6 (NC) (Inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Max. terminal load (DC-1) <sup>1)</sup> on 4-6 (NC) (Resistive load)	50 V DC, 2A
Max. terminal load (DC-13) <sup>1)</sup> on 4-6 (NC) (Inductive load)	24 V DC, 0.1A
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

<sup>1)</sup> IEC 60947 part 4 and 5

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

Cable lengths and cross sections for control cables<sup>1)</sup>

Max. motor cable length, shielded	FC 301: 164 ft [50 m]/FC 301 (A1): 82	ft [25 m]/ FC 302: 492 ft [150 m]
Max. motor cable length, non-shielded	FC 301: 246 ft [75 m]/FC 301 (A1): 164	ft [50 m]/FC 302: 990 ft [300 m]
Maximum cross-section to control terminals, flex	ible/ rigid wire without cable end sleeves	0.0023 in <sup>2</sup> [1.5 mm <sup>2</sup> ]/16 AWG
Maximum cross-section to control terminals, flex	ible wire with cable end sleeves	0.0016 in <sup>2</sup> [1 mm <sup>2</sup> ]/18 AWG
Maximum cross-section to control terminals, flex	ible wire with cable end sleeves with collar	0.0008 in <sup>2</sup> [0.5 mm <sup>2</sup> ]/20 AWG
Minimum cross-section to control terminals		0.00039 in <sup>2</sup> [0.25 mm <sup>2</sup> ]/24AWG

<sup>&</sup>lt;sup>1)</sup>For power cables, see 10.1 Power-dependent Specifications.

#### Control card performance

Scan interval	FC 301: 5 ms/FC 302: 1 ms	
Control characteristics		
Resolution of output frequency at 0–1,000 Hz	±0.003 Hz	
Repeat accuracy of <i>Precise start/stop</i> (terminals 18, 19)	≤±0.1 ms	
System response time (terminals 18, 19, 27, 29, 32, 33)	≤ 2 ms	
Speed control range (open-loop)	1:100 of synchronous speed	
Speed control range (closed-loop)	1:1,000 of synchronous speed	
Speed accuracy (open-loop)	30–4,000 rpm: error ±8 rpm	

<sup>&</sup>lt;sup>2)</sup> Overvoltage Category II

<sup>3)</sup> UL applications 300V AC2A



EN 61800-3, EN 61000-6-1/2,

Specifications	VLT*AutomationDrive Instruction Manual	
Speed accuracy (closed-loop),	depending on resolution of feedback device	0–6,000 rpm: error ±0.15 rpm
Torque control accuracy (speed		max error ±5% of rated torque
All control characteristics are be	ased on a 4-pole asynchronous motor	
Environment		
Enclosure	IP20	<sup>1)</sup> /Type 1, IP21 <sup>2)</sup> /Type 1, IP55/Type 12, IP66
Vibration test		1.0 g
Max. relative humidity	5%–93% (IEC 721-3-3; Cla	ss 3K3 (non-condensing) during operation
Aggressive environment (IEC 6	0068-2-43) H₂S test	class Kd
Ambient temperature <sup>3)</sup>	Max. 122° F [50°C]	(24-hour average maximum 113° F [45°C])
<sup>1)</sup> Only for ≤ 5 hp [3.7 kW] (200	1–240 V), ≤ 10 hp [7.5 kW] (400–480/500V)	
	.7 kW] (200–240 V), ≤ 10 hp [7.5 kW] (400–480/500V)	
·	mperature, see special conditions in the Design Guide	
Minimum ambient temperature	e during full-scale operation	32° F [0°C]
Minimum ambient temperature	e at reduced performance	14° F [-10°C]
Temperature during storage/tr	ansport	-13° to +149/158° F [-25° to +65/70°C]
Maximum altitude above sea le		2 200 ft [1 000 m]
Derating for high altitude, see s	special conditions in the Design Guide.	
EMC standards, Emission		EN 61800-3, EN 61000-6-3/4, EN 55011

See section on special conditions in the Design Guide.

#### 10.3 Fuse Specifications

EMC standards, Immunity

#### 10.3.1 Fuses

It is recommended to use fuses and/ or circuit breakers on the supply side as protection in case of component breakdown 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.

### **AWARNING**

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.

EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6

#### 10.3.2 Recommendations

### **▲**WARNING

In case of malfunction, not following the recommendation may result in personnel risk and damage to the adjustable frequency drive and other equipment.

The following tables list the recommended rated current. Recommended fuses are of the type gG for small to medium power sizes. For larger powers, aR fuses are recommended. For circuit breakers, Moeller types have been tested to have a recommendation. Other types of circuit breakers may be used provided they limit the energy into the adjustable frequency drive to a level equal to or lower than the Moeller types.

If fuses/circuit breakers according to recommendations are chosen, possible damage to the adjustable frequency drive will mainly be limited to damage inside the unit.

For further information, please see Application Note Fuses and Circuit Breakers, MN90TXYY

### 10.3.3 CE Compliance

Fuses or circuit breakers are mandatory to comply with IEC 60364. Danfoss recommend using a selection of the following.

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.

Enclosure	FC 300 Power	Recommended	Recommended	Recommended circuit	Max. trip level
		fuse size	Max. fuse	breaker	
Size	[kW]			Moeller	[A]
A1	0.25-1.5	gG-10	gG-25	PKZM0-16	16
A2	0.25-2.2	gG-10 (0.25–1.5)	gG-25	PKZM0-25	25
		gG-16 (2.2)			
А3	3.0-3.7	gG-16 (3)	gG-32	PKZM0-25	25
		gG-20 (3.7)			
В3	5.5	gG-25	gG-63	PKZM4-50	50
B4	7.5–15	gG-32 (7.5)	gG-125	NZMB1-A100	100
		gG-50 (11)			
		gG-63 (15)			
C3	18.5–22	gG-80 (18.5)	gG-150 (18.5)	NZMB2-A200	150
		aR-125 (22)	aR-160 (22)		
C4	30–37	aR-160 (30)	aR-200 (30)	NZMB2-A250	250
		aR-200 (37)	aR-250 (37)		
A4	0.25-2.2	gG-10 (0.25-1.5)	gG-32	PKZM0-25	25
		gG-16 (2.2)			
A5	0.25-3.7	gG-10 (0.25–1.5)	gG-32	PKZM0-25	25
		gG-16 (2.2-3)			
		gG-20 (3.7)			
B1	5.5-7.5	gG-25 (5.5)	gG-80	PKZM4-63	63
		gG-32 (7.5)			
B2	11	gG-50	gG-100	NZMB1-A100	100
C1	15–22	gG-63 (15)	gG-160 (15–18.5)	NZMB2-A200	160
		gG-80 (18.5)	aR-160 (22)		
		gG-100 (22)			
C2	30–37	aR-160 (30)	aR-200 (30)	NZMB2-A250	250
		aR-200 (37)	aR-250 (37)		

Table 10.10 200-240 V, Frame Sizes A, B, and C

Enclosure	FC 300 Power	Recommended	Recommended	Recommended circuit	Max. trip level
		fuse size	Max. fuse	breaker	
Size	[kW]			Moeller	[A]
A1	0.37-1.5	gG-10	gG-25	PKZM0-16	16
A2	0.37-4.0	gG-10 (0.37-3)	gG-25	PKZM0-25	25
		gG-16 (4)			
A3	5.5–7.5	gG-16	gG-32	PKZM0-25	25
В3	11–15	gG-40	gG-63	PKZM4-50	50
B4	18.5–30	gG-50 (18.5)	gG-125	NZMB1-A100	100
		gG-63 (22)			
		gG-80 (30)			
C3	37–45	gG-100 (37)	gG-150 (37)	NZMB2-A200	150
		gG-160 (45)	gG-160 (45)		
C4	55-75	aR-200 (55)	aR-250	NZMB2-A250	250
		aR-250 (75)			
A4	0.37-4	gG-10 (0.37-3)	gG-32	PKZM0-25	25
		gG-16 (4)			
A5	0.37-7.5	gG-10 (0.37-3)	gG-32	PKZM0-25	25
		gG-16 (4–7.5)			
B1	11–15	gG-40	gG-80	PKZM4-63	63
B2	18.5–22	gG-50 (18.5)	gG-100	NZMB1-A100	100
		gG-63 (22)			
C1	30–45	gG-80 (30)	gG-160	NZMB2-A200	160
		gG-100 (37)			
		gG-160 (45)			
C2	55-75	aR-200 (55)	aR-250	NZMB2-A250	250
		aR-250 (75)			
		gG-300 (90)	gG-300 (90)		
		gG-350 (110)	gG-350 (110)		
D	90–200	gG-400 (132)	gG-400 (132)	-	-
		gG-500 (160)	gG-500 (160)		
		gG-630 (200)	gG-630 (200)		
Е	250–400	aR-700 (250)	aR-700 (250)		_
<u> </u>	230-400	aR-900 (315–400)	aR-900 (315–400)		<u>-</u>
		aR-1600 (450-500)	aR-1600 (450-500)		
F	450–800	aR-2000 (560-630)	aR-2000 (560-630)	-	-
		aR-2500 (710-800)	aR-2500 (710-800)		

Table 10.11 380–500 V, Frame Sizes A, B, C, D, E, and F



VLT Automation Drive	Instruction
Manual	

Enclosure	FC 300 Power	Recommended	Recommended	Recommended circuit	Max. trip level
		fuse size	Max. fuse	breaker	
Size	[kW]			Moeller	[A]
A2	0-75-4.0	gG-10	gG-25	PKZM0-25	25
А3	5.5-7.5	gG-10 (5.5)	gG-32	PKZM0-25	25
		gG-16 (7.5)			
В3	11–15	gG-25 (11)	gG-63	PKZM4-50	50
		gG-32 (15)			
B4	18.5-30	gG-40 (18.5)	gG-125	NZMB1-A100	100
		gG-50 (22)			
		gG-63 (30)			
C3	37–45	gG-63 (37)	gG-150	NZMB2-A200	150
		gG-100 (45)			
C4	55-75	aR-160 (55)	aR-250	NZMB2-A250	250
		aR-200 (75)			
A5	0.75-7.5	gG-10 (0.75-5.5)	gG-32	PKZM0-25	25
		gG-16 (7.5)			
B1	11–18	gG-25 (11)	gG-80	PKZM4-63	63
		gG-32 (15)			
		gG-40 (18.5)			
B2	22-30	gG-50 (22)	gG-100	NZMB1-A100	100
		gG-63 (30)			
C1	37–55	gG-63 (37)	gG-160 (37–45)	NZMB2-A200	160
		gG-100 (45)	aR-250 (55)		
		aR-160 (55)			
C2	75	aR-200 (75)	aR-250	NZMB2-A250	250

Table 10.12 525-600 V, Frame Sizes A, B, and C

**Specifications** 



#### **Specifications**

Enclosure	FC 300 Power	Recommended	Recommended	Recommended circuit	Max. trip level
		fuse size	Max. fuse	breaker	
Size	[kW]			Moeller	[A]
B2	11	gG-25 (11)	gG-63	-	-
	15	gG-32 (15)			
	18	gG-32 (18)			
	22	gG-40 (22)			
C2	30	gG-63 (30)	gG-80 (30)	-	-
	37	gG-63 (37)	gG-100 (37)		
	45	gG-80 (45)	gG-125 (45)		
	55	gG-100 (55)	gG-160 (55–75)		
	75	gG-125 (75)			
		gG-125 (37)	gG-125 (37)		
		gG-160 (45)	gG-160 (45)		
		gG-200 (55–75)	gG-200 (55–75)		
		aR-250 (90)	aR-250 (90)		
D	37–315	aR-315 (110)	aR-315 (110)	-	-
		aR-350 (132–160)	aR-350 (132–160)		
		aR-400 (200)	aR-400 (200)		
		aR-500 (250)	aR-500 (250)		
		aR-550 (315)	aR-550 (315)		
E	355–560	aR-700 (355–400)	aR-700 (355–400)		
E	333-300	aR-900 (500–560)	aR-900 (500–560)	_	-
		aR-1600 (630–900)	aR-1600 (630–900)		
F	630–1200	aR-2000 (1000)	aR-2000 (1000)		_
'	030-1200	aR-2500 (1200)	aR-2500 (1200)		-

Table 10.13 525–690 V, Frame Sizes B, C, D, E, and F  $\,$ 

#### **UL Compliance**

Fuses or Circuit Breakers must comply with NEC 2009. Danfoss recommends using a selection of the following

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 drive Short Circuit Current Rating (SCCR) is 100,000 Arms.

	Recommended max. fuse							
FC 300 Power	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann		
[kW]	Type RK1 1)	Type J	Type T	Type CC	Type CC	Type CC		
0.25-0.37	KTN-R-05	JKS-05	JJN-05	FNQ-R-5	KTK-R-5	LP-CC-5		
0.55-1.1	KTN-R-10	JKS-10	JJN-10	FNQ-R-10	KTK-R-10	LP-CC-10		
1.5	KTN-R-15	JKS-15	JJN-15	FNQ-R-15	KTK-R-15	LP-CC-15		
2.2	KTN-R-20	JKS-20	JJN-20	FNQ-R-20	KTK-R-20	LP-CC-20		
3.0	KTN-R-25	JKS-25	JJN-25	FNQ-R-25	KTK-R-25	LP-CC-25		
3.7	KTN-R-30	JKS-30	JJN-30	FNQ-R-30	KTK-R-30	LP-CC-30		
5.5	KTN-R-50	KS-50	JJN-50	-	-	-		
7.5	KTN-R-60	JKS-60	JJN-60	-	-	-		
11	KTN-R-80	JKS-80	JJN-80	-	-	-		
15–18.5	KTN-R-125	JKS-125	JJN-125	-	-	-		
22	KTN-R-150	JKS-150	JJN-150	-	-	-		
30	KTN-R-200	JKS-200	JJN-200	-	-	-		
37	KTN-R-250	JKS-250	JJN-250	-	-	-		

Table 10.14 200-240 V, Frame Sizes A, B, and C

	Recommended max. fuse							
FC 300 Power	SIBA	Littel fuse	Ferraz- Shawmut	Ferraz- Shawmut				
[kW]	Type RK1	Type RK1	Type CC	Type RK1 <sup>3)</sup>				
0.25-0.37	5017906-005	KLN-R-05	ATM-R-05	A2K-05-R				
0.55-1.1	5017906-010	KLN-R-10	ATM-R-10	A2K-10-R				
1.5	5017906-016	KLN-R-15	ATM-R-15	A2K-15-R				
2.2	5017906-020	KLN-R-20	ATM-R-20	A2K-20-R				
3.0	5017906-025	KLN-R-25	ATM-R-25	A2K-25-R				
3.7	5012406-032	KLN-R-30	ATM-R-30	A2K-30-R				
5.5	5014006-050	KLN-R-50	-	A2K-50-R				
7.5	5014006-063	KLN-R-60	-	A2K-60-R				
11	5014006-080	KLN-R-80	-	A2K-80-R				
15–18.5	2028220-125	KLN-R-125	-	A2K-125-R				
22	2028220-150	KLN-R-150	-	A2K-150-R				
30	2028220-200	KLN-R-200	-	A2K-200-R				
37	2028220-250	KLN-R-250	-	A2K-250-R				

Table 10.15 200-240 V, Frame Sizes A, B, and C



		Recommended max. fuse		
FC 300 Power	Bussmann	Littel fuse	Ferraz- Shawmut	Ferraz- Shawmut
[kW]	Type JFHR2 <sup>2)</sup>	JFHR2	JFHR2 <sup>4)</sup>	J
0.25-0.37	FWX-5	=	-	HSJ-6
0.55-1.1	FWX-10	=	-	HSJ-10
1.5	FWX-15	=	-	HSJ-15
2.2	FWX-20	-	-	HSJ-20
3.0	FWX-25	-	-	HSJ-25
3.7	FWX-30	-	-	HSJ-30
5.5	FWX-50	-	-	HSJ-50
7.5	FWX-60	-	-	HSJ-60
11	FWX-80	-	-	HSJ-80
15–18.5	FWX-125	-	-	HSJ-125
22	FWX-150	L25S-150	A25X-150	HSJ-150
30	FWX-200	L25S-200	A25X-200	HSJ-200
37	FWX-250	L25S-250	A25X-250	HSJ-250

Table 10.16 200–240 V, Frame Sizes A, B, and C

- 1) KTS fuses from Bussmann may substitute for KTN for 240 V adjustable frequency drives.
- 2) FWH fuses from Bussmann may substitute for FWX for 240 V adjustable frequency drives.
- 3) A6KR fuses from FERRAZ SHAWMUT may substitute for A2KR for 240 V adjustable frequency drives.
- 4) A50X fuses from FERRAZ SHAWMUT may substitute for A25X for 240 V adjustable frequency drives.

	Recommended max. fuse							
FC 300 Power	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann		
[kW]	Type RK1	Type J	Type T	Type CC	Type CC	Type CC		
0.37-1.1	KTS-R-6	JKS-6	JJS-6	FNQ-R-6	KTK-R-6	LP-CC-6		
1.5-2.2	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10		
3	KTS-R-15	JKS-15	JJS-15	FNQ-R-15	KTK-R-15	LP-CC-15		
4	KTS-R-20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20		
5.5	KTS-R-25	JKS-25	JJS-25	FNQ-R-25	KTK-R-25	LP-CC-25		
7.5	KTS-R-30	JKS-30	JJS-30	FNQ-R-30	KTK-R-30	LP-CC-30		
11	KTS-R-40	JKS-40	JJS-40	-	-	-		
15	KTS-R-50	JKS-50	JJS-50	-	-	-		
18	KTS-R-60	JKS-60	JJS-60	-	-	-		
22	KTS-R-80	JKS-80	JJS-80	-	-	-		
30	KTS-R-100	JKS-100	JJS-100	-	-	-		
37	KTS-R-125	JKS-125	JJS-125	-	-	-		
45	KTS-R-150	JKS-150	JJS-150	-	-	-		
55	KTS-R-200	JKS-200	JJS-200	-	-	-		
75	KTS-R-250	JKS-250	JJS-250	-	-	-		

Table 10.17 380–500 V, Frame Sizes A, B, and C  $\,$ 



**Specifications** Manual

		Recommended max. fuse						
FC 302	CIDA	Littel fuse	Ferraz-	Ferraz-				
Power	SIBA	Litter fuse	Shawmut	Shawmut				
[kW]	Type RK1	Type RK1	Type CC	Type RK1				
0.37-1.1	5017906-006	KLS-R-6	ATM-R-6	A6K-6-R				
1.5-2.2	5017906-010	KLS-R-10	ATM-R-10	A6K-10-R				
3	5017906-016	KLS-R-15	ATM-R-15	A6K-15-R				
4	5017906-020	KLS-R-20	ATM-R-20	A6K-20-R				
5.5	5017906-025	KLS-R-25	ATM-R-25	A6K-25-R				
7.5	5012406-032	KLS-R-30	ATM-R-30	A6K-30-R				
11	5014006-040	KLS-R-40	-	A6K-40-R				
15	5014006-050	KLS-R-50	-	A6K-50-R				
18	5014006-063	KLS-R-60	-	A6K-60-R				
22	2028220-100	KLS-R-80	-	A6K-80-R				
30	2028220-125	KLS-R-100	-	A6K-100-R				
37	2028220-125	KLS-R-125	-	A6K-125-R				
45	2028220-160	KLS-R-150	-	A6K-150-R				
55	2028220-200	KLS-R-200	-	A6K-200-R				
75	2028220-250	KLS-R-250	-	A6K-250-R				

Table 10.18 380-500 V, Frame Sizes A, B, and C

	Recommended max. fuse						
FC 302 Power	Bussmann	Ferraz-Shawmut	Ferraz-Shawmut	Littel fuse			
[kW]	JFHR2	J	JFHR2 <sup>1)</sup>	JFHR2			
0.37-1.1	FWH-6	HSJ-6	-	-			
1.5-2.2	FWH-10	HSJ-10	-	-			
3	FWH-15	HSJ-15	-	-			
4	FWH-20	HSJ-20	-	-			
5.5	FWH-25	HSJ-25	-	-			
7.5	FWH-30	HSJ-30	-	-			
11	FWH-40	HSJ-40	-	-			
15	FWH-50	HSJ-50	-	-			
18	FWH-60	HSJ-60	-	-			
22	FWH-80	HSJ-80	-	-			
30	FWH-100	HSJ-100	-	-			
37	FWH-125	HSJ-125	-	-			
45	FWH-150	HSJ-150	-	-			
55	FWH-200	HSJ-200	A50-P-225	L50-S-225			
75	FWH-250	HSJ-250	A50-P-250	L50-S-250			

Table 10.19 380–500 V, Frame Sizes A, B, and C

1) Ferraz-Shawmut A50QS fuses may substitute for A50P fuses.



	Recommended max. fuse							
FC 302 Power	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann	Bussmann		
[kW]	Type RK1	Type J	Type T	Type CC	Type CC	Type CC		
0.75-1.1	KTS-R-5	JKS-5	JJS-6	FNQ-R-5	KTK-R-5	LP-CC-5		
1.5-2.2	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10		
3	KTS-R15	JKS-15	JJS-15	FNQ-R-15	KTK-R-15	LP-CC-15		
4	KTS-R20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20		
5.5	KTS-R-25	JKS-25	JJS-25	FNQ-R-25	KTK-R-25	LP-CC-25		
7.5	KTS-R-30	JKS-30	JJS-30	FNQ-R-30	KTK-R-30	LP-CC-30		
11	KTS-R-35	JKS-35	JJS-35	-	-	-		
15	KTS-R-45	JKS-45	JJS-45	-	-	-		
18	KTS-R-50	JKS-50	JJS-50	-	-	-		
22	KTS-R-60	JKS-60	JJS-60	-	-	-		
30	KTS-R-80	JKS-80	JJS-80	-	-	-		
37	KTS-R-100	JKS-100	JJS-100	-	-	-		
45	KTS-R-125	JKS-125	JJS-125	-	-	-		
55	KTS-R-150	JKS-150	JJS-150	-	-	-		
75	KTS-R-175	JKS-175	JJS-175	-	-	-		

Table 10.20 525–600 V, Frame Sizes A, B, and C

		Recommended max. fuse		
FC 302	CIDA	Line L.	Ferraz-	Ferraz-
Power	SIBA	Littel fuse	Shawmut	Shawmut
[kW]	Type RK1	Type RK1	Type RK1	J
0.75-1.1	5017906-005	KLS-R-005	A6K-5-R	HSJ-6
1.5-2.2	5017906-010	KLS-R-010	A6K-10-R	HSJ-10
3	5017906-016	KLS-R-015	A6K-15-R	HSJ-15
4	5017906-020	KLS-R-020	A6K-20-R	HSJ-20
5.5	5017906-025	KLS-R-025	A6K-25-R	HSJ-25
7.5	5017906-030	KLS-R-030	A6K-30-R	HSJ-30
11	5014006-040	KLS-R-035	A6K-35-R	HSJ-35
15	5014006-050	KLS-R-045	A6K-45-R	HSJ-45
18	5014006-050	KLS-R-050	A6K-50-R	HSJ-50
22	5014006-063	KLS-R-060	A6K-60-R	HSJ-60
30	5014006-080	KLS-R-075	A6K-80-R	HSJ-80
37	5014006-100	KLS-R-100	A6K-100-R	HSJ-100
45	2028220-125	KLS-R-125	A6K-125-R	HSJ-125
55	2028220-150	KLS-R-150	A6K-150-R	HSJ-150
75	2028220-200	KLS-R-175	A6K-175-R	HSJ-175

Table 10.21 525–600 V, Frame Sizes A, B, and C

 $<sup>^{1)}</sup>$  170M fuses shown from Bussmann 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.

	Recommended max. fuse							
FC 302 [kW] Power	Max. prefuse	Bussmann E52273 RK1/JDDZ	Bussmann E4273 J/JDDZ	Bussmann E4273 T/JDDZ	SIBA E180276 RK1/JDDZ	LittelFuse E81895 RK1/JDDZ	Ferraz- Shawmut E163267/E2137 RK1/JDDZ	Ferraz- Shawmut E2137 J/HSJ
11	30 A	KTS-R-30	JKS-30	JKJS-30	5017906-030	KLS-R-030	A6K-30-R	HST-30
15–18.5	45 A	KTS-R-45	JKS-45	JJS-45	5014006-050	KLS-R-045	A6K-45-R	HST-45
22	60 A	KTS-R-60	JKS-60	JJS-60	5014006-063	KLS-R-060	A6K-60-R	HST-60
30	80 A	KTS-R-80	JKS-80	JJS-80	5014006-080	KLS-R-075	A6K-80-R	HST-80
37	90 A	KTS-R-90	JKS-90	JJS-90	5014006-100	KLS-R-090	A6K-90-R	HST-90
45	100 A	KTS-R-100	JKS-100	JJS-100	5014006-100	KLS-R-100	A6K-100-R	HST-100
55	125 A	KTS-R-125	JKS-125	JJS-125	2028220-125	KLS-150	A6K-125-R	HST-125
75	150 A	KTS-R-150	JKS-150	JJS-150	2028220-150	KLS-175	A6K-150-R	HST-150
* UL compli	ance only	525–600 V						

Table 10.22 525-690 V\*, Frame Sizes B and C

### 10.4 Connection Tightening Torques

	Power (kW)			Torque (Nm)					
Enclo- sure	200–240 V	380-480/500 V	525-600 V	Line power	Motor	DC connectio n	Brake	Ground	Relay
A2	0.25-2.2	0.37-4.0		1.8	1.8	1.8	1.8	3	0.6
A3	3.0-3.7	5.5-7.5	0.75–7.5	1.8	1.8	1.8	1.8	3	0.6
A4	0.25-2.2	0.37-4.0		1.8	1.8	1.8	1.8	3	0.6
A5	0.25-3.7	0.37-7.5	0.75–7.5	1.8	1.8	1.8	1.8	3	0.6
B1	5.5–7.5	11–15	11–15	1.8	1.8	1.5	1.5	3	0.6
B2	11	18	18	4.5	4.5	3.7	3.7	3	0.6
		22	22	4.5	4.5	3.7	3.7	3	0.6
В3	5.5–7.5	11–15	11–15	1.8	1.8	1.8	1.8	3	0.6
B4	11–15	18–30	18–30	4.5	4.5	4.5	4.5	3	0.6
C1	15–22	30–45	30–45	10	10	10	10	3	0.6
C2	30–37	55–75	55–75	14/24 <sup>1)</sup>	14/24 <sup>1)</sup>	14	14	3	0.6
C3	18–22	37–45	37–45	10	10	10	10	3	0.6
C4	30–37	55–75	55–75	14/24 <sup>1)</sup>	14/24 <sup>1)</sup>	14	14	3	0.6

Table 10.23 Tightening of Terminals

10

<sup>&</sup>lt;sup>1)</sup> For different cable dimensions x/y, where  $x \le 0.147$  in<sup>2</sup> [95 mm<sup>2</sup> and  $y \ge 0.147$  in<sup>2</sup> [95 mm<sup>2</sup>].

Specifications

VLT\*AutomationDrive Instruction
Manual

Danfoss

10







Index		Control	
		Cables	
_		Card Barfarmana	
A		Card Performance Card, +10 V DC Output	
AC		Card, 410 V DC Output	
Input	1-3, 2-7	Card, RS-485 Serial Communication.	
Line		Card, USB Serial Communication	
Line Power	•	Characteristics	
Line Voltage		Signal	
Waveform	1-3	System	
Adjustable Frequency Drive Block Diagram	1-3	Terminals 2-3, 3	
Alarm Log	4-2	Wire	2-9
Alarms	8-1	Wiring	2-5, 2-6, 2-9, 3-2, 2-7
		Cooling	
AMA	0 2 0 7	Cooling	2-1
AMA	•	Clearance	3-2
With 127 Connected		Copying Parameter Settings	4-3
Without T27 Connected	0-1	., .	
Analog		Current	2.4
Inputs		Limit	
Output		Rating	Z-1, 8-3
Signal	8-2		
Application Examples	6-1	D	
Approvals	0-1	Danfoss FC	2-15
••			2 13
Auto	4.2	DC	1272
Auto Mode		Current	•
On		Link	
	-	Derating	2-1
Automatic Motor Adaptation	3-4, 7-1	Digital	
Auto-reset	4-1	Input	7-3, 2-10
		Inputs	2-8, 7-3, 10-12
_		Output	10-14
В		Disconnect	
Backplate	2-2	Switch	3-3
Basic Operational Programming	3-3	Switches	3-1
Braking		Downloading Data From The LCP	4-4
•	•	Downloading Data From the Ecr	т ¬
Branch Circuit Protection	10-16		
		E	
C		Electrical Noise	2-6
Cable Lengths And Cross–sections	10-15	EMC	3-2
-		Encoder Rotation	
Circuit Breakers	3-2	Encoder Rotation	3-3
Clearance		External	
Clearance		Commands	
Requirements	2-1	Controllers	
Closed-loop	2-11	Interlock	•
Communication Option		Voltage	5- I
Conduit		г	
		F Fault Log	<b>4</b> _2
		<del>-</del>	
		Floating Polts	
		Floating Delta Full Load Current	
		1 411 LVQU CUITIII	

Index

Functional Testing 1-2, 3-6, 3-1	
Fuses	M
Fusing2-5, 3-2	Main Menu 4-2, 5-1, 4-2
	Manual Initialization4-4
G	MCT 10 Set-up Software Set-up Software5-5
Ground	Mechanical Brake Control2-14
Connections	
Loops2-10	<b>Menu</b> Keys4-1, 4-7
Wire 2-6, 3-2	Structure
Grounded Delta2-7	Modbus RTU2-15
Grounding	
Grounding 2-6, 2-7, 3-1, 3-2	<b>Motor</b> Cables2-1, 2-5, 2-6
Using Shielded Cable2-6	Current
	Data3-4, 3-6, 8-3, 8-7, 3-5
Н	Output10-12
I I Hand	Power 2-3, 2-5, 2-6, 8-7
Hand4-3	Protection2-5
On	Rotation
	Speeds
Harmonics 1-3	Status
	g
I	Mounting2-2
IEC 61800-32-7	Multiple
Induced Voltage2-5	Adjustable Frequency Drives2-5, 2-6
_	Motors
Initialization	
Input	N
Current	Navigation Keys 3-3, 5-1, 4-3
Disconnect	Noise Isolation
Power	Noise isolation2-3, 3-2
Signals2-10	
Terminals	0
Voltage	<b>Open-loop</b> 2-11, 5-7
Installation 1-2, 2-1, 2-2, 2-5, 2-9, 2-15, 3-2, 3-3	Operation Keys 4-
Isolated Line Power2-7	Optional Equipment2-7, 2-10, 3-3
	Output
	Current7-2, 8-3
L	Performance (U, V, W)
<b>Leakage Current</b>	Signal5-2
Lifting	Terminals 2-3, 3-7
Line	Overcurrent
Power2-5	Overload Protection2-1, 2-5
Power Supply 10-1, 10-9, 10-10, 10-11	•
Power Supply (L1, L2, L3) 10-12	Overvoltage 3-6, 7-2
Local	
Control 4-1, 4-3, 7-1	Р
Control Panel4-1	PELV2-7, 6-4
Control Test3-6	
Mode	Phase Loss8-2
Operation4-1	Power
Start	Connections2-5
	Factor 1-3, 2-6, 3-2
	Power-dependent 10-7



Index

Pre-start
<b>Programming</b> Programming 1-2, 2-10, 3-6, 4-2, 5-3, 5-4, 5-9, 8-2, 3-3, 4-1, 4-3, 5-1
4-5, 5-1 Example 5-1
Pulse/Encoder Inputs 10-14
Q
Quick       Menu
Ramp-down Time
•
Ramp-up Time
<b>RCD</b>
<b>Reference</b>
<b>Relay Outputs</b>
<b>Remote</b> Commands1-3
Programming5-9
Reference
<b>Reset</b>
RFI Filter2-7
RMS Current1-3
Run         Command
S
Safety Inspection 3-1
<b>Serial Communication</b> 1-3, 2-8, 2-9, 4-3, 7-1, 7-2, 7-3, 8-1, 2-14, 10-15
<b>Setpoint</b>
Setup4-2
Set-up
Shielded         Cable       2-1, 2-5, 3-2         Control Cables       2-9         Wire       2-5
Short Circuit8-4
Smart Application Set-up (SAS)3-3
Specifications 1-2, 2-15, 10-1
Speed Reference
Start Up
Start-up
•
Status         Messages

Stop Command7-2
<b>Supply Voltage</b>
Surroundings
Switching Frequency7-2
<b>Symbols</b>
System         1-3           Feedback         1-3           Monitoring         8-1           Start-up         3-6
Т
Technical Data
Temperature Limits
Terminal         53
Thermistor Thermistor
Tightening Of Terminals
Torque         Characteristics
Transient Protection 1-3
Trip       8-1         Trip       8-1         Function       2-5         Lock       8-1         Troubleshooting       1-2, 9-1
U Uploading Data To The LCP4-4
V Voltage Imbalance
W Warning And Alarm Definitions





#### www.danfoss.com/drives

Danfoss shall not be responsible for any errors in catalogs, brochures or other printed material. Danfoss reserves the right to alter its products at any time without notice, provided that alterations to products already on order shall not require material changes in specifications previously agreed upon by Danfoss and the Purchaser.

All trademarks in this material are property of the respective companies. Danfoss and the Danfoss logotype are trademarks of Danfoss A/S. All rights reserved.

#### **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

