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Contents

# **1** How to Read the Instruction Manual

# 1.1.1 Copyright, Limitation of Liability and Revision Rights

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

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# 1.1.2 Symbols

Symbols used in this manual:



**NOTE!** Indicates something to be noted by the reader.



Indicates a general warning.



Indicates a high-voltage warning.

★ Indicates default setting

# 1.1.3 Available Literature for VLT HVAC Drive

- Instruction ManualMG.11.Ax.yy provides the necessary information for getting the adjustable frequency drivedrive up and running.
- Instruction Manual VLT HVAC Drive High Power, MG.11.Fx.yy
- Design Guide MG.11.Bx.yy contains all the technical information about the adjustable frequency drivedrive and customer design and applications.
- Programming Guide MG.11.Cx.yy provides information on how to program and includes complete parameter descriptions.
- Mounting Instruction, Analog I/O Option MCB109, MI.38.Bx.yy
- Application Note, Temperature Derating Guide, MN.11.Ax.yy
- PC-based Configuration Tool MCT 10DCT 10, MG.10.Ax.yy enables the user to configure the adjustable frequency drivedrive from a Windows<sup>™</sup> based PC environment.
- Danfoss VLT<sup>®</sup> Energy Box software at *www.danfoss.com/BusinessAreas/DrivesSolutions* www.geelectrical.com/driveswww.trane.com/vfd, then choose PC Software Download
- VLT<sup>®</sup> VLT HVAC Drive Drive Applications, MG.11.Tx.yy
- Instruction ManualVLT HVAC Drive Profibus, MG.33.Cx.yy.
- Instruction ManualVLT HVAC Drive Device Net, MG.33.Dx.yy
- Instruction Manual VLT HVAC Drive BACnet, MG.11.Dx.yy
- Instruction ManualVLT HVAC Drive LonWorks, MG.11.Ex.yy
- Instruction ManualVLT HVAC Drive Metasys, MG.11.Gx.yy
- Instruction Manual VLT HVAC Drive FLN, MG.11.Zx.yy
- Output Filter Design Guide, MG.90.Nx.yy
- Brake Resistor Design Guide, MG.90.Ox.yy

#### x = Revision number

yy = Language code

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

# 1.1.4 Abbreviations and Standards

a     Acceleration     m/s <sup>2</sup> ft/s <sup>2</sup> AWG     American wire gauge     ft/s <sup>2</sup> Auto Tune     Automatic Motor Tuning     ft       °C     Celsius     ft       I     Current     A mp       Joule     Energy     J = N+m       °F     Fahrenheit     ft-lb, Btu       °F     Fahrenheit     ft/s <sup>2</sup> FC     Adjustable Frequency Drive     Hz       f     Frequency     Hz       kHz     Kilohertz     KHz       LCP     Local Control Panel     KHz       mA     Milliampere     in-lbs       min     Milliscond     in-lbs       MCT     Motor Type Dependent     in-lbs       MMN     Nominal motor current     in-lbs       ft <sub>N,N</sub> Nominal motor requency     Pa       MMN     Nominal motor voltage     par.       PAL     Pressure     Pa = N/m <sup>2</sup> PSCal     Pressure     Pa = N/m <sup>2</sup> MAN     Revolutions Per Minute     Stize Related       T     Temperature     C       F     F     F       MAN     Size Related     T       Tum     Torque limit     T       U     Voltage     V	Abbreviations:	Terms:	SI units:	I-P units:
AWGAmerican wire gaugeAuto TuneAutomatic Motor Tuning`CCelsiusICurrent Motor TuningJouleEnergyJouleEnergy'FFahrenheitFCAdjustable Frequency DrivefFrequencyHzHzHzKHzKHzKilohertzKHzKilohertzMAMilliamperemaxMilliampereminMinuteMCTMotor Type DependentMTYPEMotor Type DependentMMTNominal motor currentIMANNominal motor requencyMANNominal motor requencyMANParameterPANParameterPELVPressurePARAPressureMattPowerWattPowerMattPressureRPMRevolutions Per MinuteSRSize RelatedTTemperatureCFInwRated Inverter Output CurrentRPMRevolutions Per MinuteSRSize RelatedTTemperatureCFInwTorque limitUVoltageVV	а	Acceleration	m/s <sup>2</sup>	ft/s <sup>2</sup>
Auto TuneAutomatic Motor Tuning °CCelsiusICurrentAAmpIumCurrent limitAAmpJouleEnergyJ = N•mft-lb, Btu°FFahrenheitFtFtfFrequency DriveHzHzKHzKilohertzkHzkHzLCPLocal Control PanelKHzkHzmAMilliampereMilliampereIn-lbsMSMilliamperein-lbsin-lbsMMTNotron Control ToolIn-lbsIn-lbsMMNNominal motor Currentin-lbsin-lbsMMNNominal motor requencyFFPRNNNominal motor voltagepar.ParameterPELVProtective Extra Low VoltageVWBascalPressurePa = N/m2psi, psf, ft of waterINNRevolutions Per MinuteSRSize RelatedTTemperatureCFtTimess, hrTumTorque limitUVV VoltageVV	AWG	American wire gauge		
°C     Celsius       I     Current     A     Amp       ILiM     Current limit     Janual     Amp       Joule     Energy     J = N•m     ft-lb, Btu       °F     Fahrenheit     FC     Adjustable Frequency Drive       f     Frequency     Hz     Hz       kHz     Kilohertz     kHz     kHz       LCP     Local Control Panel     Kilohertz     Kilohertz       mA     Milliampere     Ft     Ft       ms     Millisecond     Ft     Ft       MCT     Motor Topo     Ft     Ft       MMT     Motor Type Dependent     Ft     Ft       Nm     Newton meters     in-lbs       IMN     Nominal motor reurent     Ft       MMN     Nominal motor rourent     Ft       MMN     Nominal motor voltage     Ft       par.     Parameter     Ft       PELV     Pressure     Pa = N/m2     psi, psf, ft of water       Inv     Rated Inverter Output Current     Ft     Ft       RPM     Revolutions Per Minute     Ft     Ft       SR     Size Related     Ft     Ft       T     Temperature     C     Ft       T     Temperature     C	Auto Tune	Automatic Motor Tuning		
ICurrentAAmpI_LMCurrent limitJouleEnergyJ = N*mft-lb, Btu*FFahrenheit*FCAdjustable Frequency DriveHzHzfFrequencyHzKHzKHzkHzKilohertzkHzkHzkHzLCPLocal Control PanelmAMilliamperemSMillisecondMCTMotor Type DependentMCTMotor Type DependentMMNominal motor currentMMNominal motor requercyPMNNominal motor voltagepar.ParameterPRLVPressureWBtu/hr, hpPascalPressureVWRPMRevolutions Per MinuteSRSize RelatedTTemperatureCFtTimess, hrTumTorque limitVVoltageVV	°C	Celsius		
ILIMCurrent limitJouleEnergyJ = N-mft-lb, Btu"FFahrenheitFCAdjustable Frequency DriveHzHzfFrequencyHzKlzLCPLocal Control PanelKHzKHzLCPLocal Control PanelmAMillisecondminMinuteMCTMotion Control ToolMTTMotion Control ToolMMNNewton metersin-lbsImmNewton metersin-lbsImmNominal motor frequencyMMNNominal motor ortragePM,NNominal motor voltagePELVPrescurePa = N/m²PascalPressurePa = N/m²PascalPressureCRPMRevolutions Per MinuteSRSize RelatedTTemperatureCTTimesSh Sr, hrTumVVVV	I	Current	А	Amp
JouleEnergyJ = N•mft-lb, Btu°FFahrenheitFahrenheitFdFCAdjustable Frequency DriveHzHzfFrequencyHzkHzLCPLocal Control PanelKHzkHzmAMilliampereImage: State S	ILIM	Current limit		
${}^{P}$ Fahrenheit $FC$ Adjustable Frequency DriveHzHz $f$ FrequencyHzkHzkHzKilohertzkHzkHzLCPLocal Control PanelmAMillisecondminMinuteMCTMotion Control ToolM-TYPEMotor Type Dependentin-lbsMMNewton metersin-lbsIM,NNominal motor currentMM,NNominal motor frequencyPM,NNominal motor voltagepar.ParameterPELVProtective Extra Low VoltageVattPowerWBu/hr, hpPascalPressureRPMRevolutions Per MinuteSRSize RelatedTTemperatureCFtTimeSRSize RelatedTTorque limitUVoltageVV	Joule	Energy	J = N•m	ft-lb, Btu
FCAdjustable Frequency DrivefFrequencyHzHzkHzKilohertzkHzkHzLCPLocal Control PanelKHzkHzmAMilliampereKHzKHzmsMillisecondKHzKHzMCTMotion Control ToolKHzKHzMCTMotor Type DependentKHzKHzMMTPYPEMotor Type DependentKHzKHzMMTNominal motor currentKHzKHzMMNNominal motor frequencyKHzKHzMMNNominal motor powerKHzKHzMANNominal motor voltageKHzKHzPELVProtective Extra Low VoltageFa = N/m2psi, psf, ft of waterMAHReventKated Inverter Output CurrentKHzKHzRPMRevolutions Per MinuteSRSize RelatedFaTTemperatureCFFtTimess, hrTumTLIMTorque limitVVK	°F	Fahrenheit		
fFrequencyHzHzKHzKlohertzKHzKHzKHzLCPLocal Control PanelKHzKHzmAMilliampereKHzKHzmsMillisecondKHzKHzminMinuteKHzKHzMCTMotion Control ToolKHzKHzMMTNotion Control ToolKHzKHzMMTNotion Control ToolKHzKHzMMTNominal motor currentKHzKHzMMNominal motor currentKHzKHzMMNNominal motor powerKHzKHzMANNominal motor voltageKHzKHzMANParameterKHzKHzPAscalPressurePa = N/m²psi, psf, ft of waterINVRated Inverter Output CurrentKHzKHzRPMRevolutions Per MinuteKHzKHzSRSize RelatedKHzKHzTTemperatureCFTTimess, hrUVoltageVV	FC	Adjustable Frequency Drive		
kHzKilohertzkHzkHzkHzLCPLocal Control PanelmAMilliamperemsMillisecondminMinuteMCTMotion Control ToolM-TYPEMotor Type DependentImmNewton metersin-TYPEMotor Grupe Dependentfm,nNominal motor currentfm,NNominal motor powerUM,NNominal motor powerUM,NNominal motor voltagepar.ParameterPELVProtective Extra Low VoltageWattPowerWBtu/hr, hpPascalPressurePASCALSize RelatedTTemperatureCFtTimeSRSize RelatedTTimeTTorque limitUVoltageVV	f	Frequency	Hz	Hz
LCPLocal Control PanelmAMilliamperemsMilliaecondminMinuteMCTMotion Control ToolMCTMotion Control ToolMMTNewton metersImmaNaminal motor currentMMNominal motor frequencyMMNNominal motor powerMMNNominal motor voltageMathProtective Extra Low VoltagePELVProtective Extra Low VoltagePARAPressurePascalPressure Valtade Inverter Output CurrentImmaRevolutions Per MinuteSRSize RelatedTTemperatureCFtTimeMTorque limitUVoltageVV	kHz	Kilohertz	kHz	kHz
mAMillisecondmisMillisecondminMinuteMCTMotion Control ToolMTYPEMotor Type DependentMnNewton metersImage: Name of the second s	LCP	Local Control Panel		
msMillisecondMinuteMinuteMCTMotor Control ToolM-TYPEMotor Type DependentNmNewton metersin-lbsIM,NNominal motor currentfM,NNominal motor frequencyPM,NNominal motor routagepar.ParameterPELVProtective Extra Low VoltagePAscalPressurePascalPressureRPMRevolutions Per MinuteSRSize RelatedTTemperatureCFtTimeSs, hrUVoltageVVoltageVVVoltageVVoltage	mA	Milliampere		
minMinuteMCTMotion Control ToolM-TYPEMotor Type DependentNmNewton metersin-lbsIM,NNominal motor currentM,NNominal motor frequencyPM,NNominal motor powerUM,NNominal motor voltagepar.ParameterPELVProtective Extra Low VoltagePSLQPressurePascalPressureINVRated Inverter Output CurrentINVRated Inverter Output CurrentRPMRevolutions Per MinuteSRSize RelatedTTemperatureCTTimesJUVoltageVVV	ms	Millisecond		
MCTMotion Control ToolM-TYPEMotor Type DependentNmNewton metersIM,NNominal motor currentIM,NNominal motor frequencyPM,NNominal motor powerUM,NNominal motor voltagepar.ParameterPELVProtective Extra Low VoltageWattPowerWBtu/hr, hpPascalPressureINNRated Inverter Output CurrentRPMRevolutions Per MinuteSRSize RelatedTTemperatureCFtTimeSs, hrTLIMTorque limitUVoltageVVVVoltage	min	Minute		
M-TYPEMotor Type DependentNmNewton metersin-lbsIM,NNominal motor currentin-lbsfm,NNominal motor frequencyin-lbsPM,NNominal motor frequencyin-lbsUM,NNominal motor frequencyin-lbsDM,NNominal motor frequencyin-lbsPM,NNominal motor frequencyin-lbsUM,NNominal motor frequencyin-lbsDM,NNominal motor frequencyin-lbsPM,NNominal motor frequencyin-lbsUM,NNominal motor frequencyin-lbsParameterin-lbsin-lbsParameterParameterPELVProtective Extra Low VoltageWWattPowerWBtu/hr, hpPascalPressurePa = N/m²psi, psf, ft of waterINVRated Inverter Output CurrentinterestinginterestingRPMRevolutions Per MinuteinterestinginterestingSRSize RelatedinterestinginterestingTTemperatureCFtTimess, hrUVoltageVV	MCT	Motion Control Tool		
NmNewton metersin-lbsImage: Image:	M-TYPE	Motor Type Dependent		
ImmNominal motor currentfm,NNominal motor frequencyPM,NNominal motor powerUM,NNominal motor voltagepar.ParameterPELVProtective Extra Low VoltageWattPowerWPascalPressurePa = N/m²INVRated Inverter Output CurrentRPMRevolutions Per MinuteSRSize RelatedTTemperatureCTTimesLIMTorque limitUVoltageVVV	Nm	Newton meters		in-lbs
fm,NNominal motor frequencyPM,NNominal motor powerUM,NNominal motor voltagepar.ParameterPELVProtective Extra Low VoltageWattPowerWPascalPressurePa = N/m²INVRated Inverter Output CurrentRPMRevolutions Per MinuteSRSize RelatedTTemperatureCTTimesLIMTorque limitUVoltageVVV	Im,N	Nominal motor current		
PM_NNominal motor powerUM_NNominal motor voltagepar.ParameterPELVProtective Extra Low VoltageWattPowerWPascalPressurePa = N/m²INVRated Inverter Output CurrentRPMRevolutions Per MinuteSRSize RelatedTTemperatureCTTimestTimey, hrUVoltageVVV	fм,N	Nominal motor frequency		
UM,NNominal motor voltagepar.ParameterPELVProtective Extra Low VoltageWattPowerWPascalPressurePa = N/m²INVRated Inverter Output CurrentRPMRevolutions Per MinuteSRSize RelatedTTemperatureCTTimestTimey, hrUVoltageVVV	P <sub>M,N</sub>	Nominal motor power		
par.ParameterPELVProtective Extra Low VoltageWattPowerWBascalPressurePa = N/m²PascalPressurePa = N/m²INVRated Inverter Output CurrentRPMRevolutions Per MinuteSRSize RelatedTTemperatureCTTimestTimesUVoltageV	U <sub>M,N</sub>	Nominal motor voltage		
PELVProtective Extra Low VoltageWattPowerWBtu/hr, hpPascalPressurePa = N/m²psi, psf, ft of waterImvRated Inverter Output CurrentRPMRevolutions Per MinuteRPMRevolutions Per MinuteSRSize RelatedTTemperatureCFtTimess, hrTLIMTorque limitUVoltageVV	par.	Parameter		
WattPowerWBtu/hr, hpPascalPressurePa = N/m²psi, psf, ft of waterInvRated Inverter Output CurrentPa = N/m²psi, psf, ft of waterRPMRevolutions Per MinuteVVSRSize RelatedCFTTemperatureCFtTimess, hrTLIMTorque limitVV	PELV	Protective Extra Low Voltage		
PascalPressurePa = N/m²psi, psf, ft of waterInvvRated Inverter Output CurrentRPMRevolutions Per MinuteSRSize RelatedTTemperatureCFtTimess, hrTLIMTorque limitUVoltageVV	Watt	Power	W	Btu/hr, hp
IINV     Rated Inverter Output Current       RPM     Revolutions Per Minute       SR     Size Related       T     Temperature     C       t     Time     s       TLIM     Torque limit       U     Voltage     V	Pascal	Pressure	$Pa = N/m^2$	psi, psf, ft of water
RPM     Revolutions Per Minute       SR     Size Related       T     Temperature     C       t     Time     s     s, hr       TLIM     Torque limit     V     V	IINV	Rated Inverter Output Current		
SRSize RelatedTTemperatureCFtTimess, hrTLIMTorque limitVV	RPM	Revolutions Per Minute		
T         Temperature         C         F           t         Time         s         s, hr           TLIM         Torque limit         V         V	SR	Size Related		
t         Time         s         s, hr           TLIM         Torque limit         V         V           U         Voltage         V         V	Т	Temperature	С	F
TLIM         Torque limit           U         Voltage         V         V	t	Time	S	s, hr
U Voltage V V	Тым	Torque limit		
	U	Voltage	V	V

Table 1.1: Abbreviation and standards table.

1 How to Read the Instruction Manual

# 2 Safety

# 2.1.1 High Voltage Warning



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

# 2.1.2 Safety Instructions

NOTE!



Prior to using functions directly or indirectly influencing personal safety (e.g., **Safe Stop**, **Fire Mode** or other functions either forcing the motor to stop or attempting to keep it functioning), a thorough **risk analysis** and **system test** must be carried out. The system tests **must** include testing failure modes regarding the control signaling (analog and digital signals and serial communication.



# Before using fire mode, contact Danfoss

- Make sure the adjustable frequency drive is properly grounded.
- Do not remove AC line input connections, motor connections or other power connections while the adjustable frequency drive is connected to line power.
- Protect users against supply voltage.
- Protect the motor against overloading according to national and local regulations.
- The ground leakage current exceeds 3.5 mA.
- The [OFF] key is not a safety switch. It does not disconnect the adjustable frequency drive from line power.

2

# 2.1.3 General Warning



# Warning:

Touching the electrical parts may be fatal - even after the equipment has been disconnected from line power. Also make sure that other voltage inputs have been disconnected, (linkage of DC intermediate circuit), as well as the motor connection for kinetic backup.

Before touching any potentially live parts of the adjustable frequency drive, wait at least as follows: Be aware that there may be high voltage on the DC link even when the control card LEDs are turned off. A red LED is mounted on a circuit board inside the drive to indicate the DC bus voltage. The red LED will stay lit until the DC link is 50 VDC or lower.



#### Leakage Current

The ground leakage current from the adjustable frequency drive exceeds 3.5 mA. According to IEC 61800-5-1, a reinforced protective ground connection must be ensured by means of: a min. 0.015 in<sup>2</sup> [10 mm<sup>2</sup>] Cu or 0.025 in<sup>2</sup> [16 mm<sup>2</sup>] Al PE wire or an additional PE wire - with the same cable cross-section as the line power wiring - must be terminated separately.

#### **Residual Current Device**

This product can cause DC current in the protective conductor. Where a residual current device (RCD) is used for extra protection, only an RCD of Type B (time delayed) shall be used on the supply side of this product. See also RCD Application Note MN.90.GX.02. Protective grounding of the adjustable frequency drive and the use of RCDs must always follow national and local regulations.

## 2.1.4 Before Commencing Repair Work

- 1. Disconnect the adjustable frequency drive from line power.
- 2. Disconnect DC bus terminals 88 and 89
- 3. Wait at least the time mentioned above in the section General Warning.
- 4. Remove motor cable

# 2.1.5 Special Conditions

#### **Electrical ratings:**

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

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

- Single phase applications.
- High temperature applications that require derating of the electrical ratings.
- Marine applications with more severe environmental conditions.

Other applications might also affect the electrical ratings.

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

#### Installation requirements:

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

- Fuses and circuit breakers for overcurrent and short-circuit protection
- Selection of power cables (line power, motor, brake, load sharing and relay)
- Grid configuration (grounded delta transformer leg, IT,TN, etc.)
- Safety of low-voltage ports (PELV conditions).

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

## 2.1.6 Installation at High Altitudes (PELV)

Installation at high altitude: 380–480 V: At altitudes above 9842 ft [3 km], please contact Danfoss regarding PELV. 525–690 V: At altitudes above 6,600 feet [2 km], please contact Danfoss regarding PELV.

#### 2.1.7 Avoid unintended start

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

- Disconnect the adjustable frequency drive from line power whenever personal safety considerations make it necessary to avoid an unintended start.
- To avoid unintended start, always activate the [OFF] key before changing parameters.
- Unless terminal 37 is turned off, an electronic fault, temporary overload, a fault in the line power supply, or lost motor connection may cause a stopped motor to start.

## 2.1.8 Safe Stop of the Adjustable Frequency Drive

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

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

Prüf- und Zertifizieru im BG-PRÜFZERT	ngsstelle	Berufsgenossenschaftliches Institut für Arbeitsschutz Hauptverband der gewerblichen
<u>Translation</u> In any case, the German original shall prevail.	Type Test Certificate	Berutsgenossenschaften 05 06004
Name and address of the holder of the certificate: (customer)	Danfoss Drives A/S, Ulnaes 1 DK-6300 Graasten, Dänemark	No. of certificate
Name and address of the manufacturer:	Danfoss Drives A/S, Ulnaes 1 DK-6300 Graasten, Dänemark	
Ref. of customer:	Ref. of Test and Certification Body: Apf/Köh VE-Nr. 2003 23220	Date of Issue: 13.04.2005
Product designation:	Frequency converter with integrated safety function	ons
Туре:	VLT® Automation Drive FC 302	
Intended purpose:	Implementation of safety function "Safe Stop"	
Testing based on:	EN 954-1, 1997-03, DKE AK 226.03, 1998-06, EN ISO 13849-2; 2003-12, EN 61800-3, 2001-02, EN 61800-5-1, 2003-09,	
Test certificate:	No.: 2003 23220 from 13.04.2005	
Remarks:	The presented types of the frequency converter Fo down in the test bases. With correct wiring a category 3 according to DIt function.	C 302 meet the requirements laid NEN 954-1 is reached for the safety
The type tested complies wi	th the provisions laid down in the directive 98/37/EC (Machine	איץ).
Further conditions are laid	down in the Rules of Procedure for Testing and Certification of	April 2004.
PZBIOE 01.05	Reinert) Postal adress: Office: 33754 Sankt Augustin 53757 Sankt Augustin	n officer A JUJA R. Apfeld) Phone: 0 22 41/2 31-02 Fax: 0 22 41/2 31-22 34 130BA491

This certificate also covers FC 102 and FC 202!

## 2.1.9 IT Line Power



# IT line power

Do not connect adjustable frequency drives with RFI filters to line power supplies with a voltage between phase and ground of more than 440 V for 400 V drives and 760 V for 690 V drives.

For 400 VT IT line power and delta ground (grounded leg), AC line voltage may exceed 440 V between phase and ground. For 690 VT IT line power and delta ground (grounded leg), AC line voltage may exceed 760 V between phase and ground.

Par. 14-50 RFI 1 can be used to disconnect the internal RFI capacitors from the RFI filter to ground.

2 Safety

2

# 2.1.10 Software Version and Approvals: VLT HVAC Drive



# 2.1.11 Disposal Instructions



Equipment containing electrical components may not be disposed of together with domestic waste. It must be separately collected with electrical and electronic waste according to local and currently valid legislation. 2 Safety

# **3** Mechanical Installation

# 3.1 How to Get Started

# 3.1.1 About How to Install

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

# 3.1.2 How to Get Started

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



Read the safety instructions before installing the unit.

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

#### Mechanical Installation

Mechanical mounting

#### **Electrical Installation**

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

#### **Quick Setup**

- Local Control Panel, LCP
- Automatic Motor Adaptation, AMA
- Programming

Frame size is depending on enclosure type, power range and AC line voltage



Figure 3.1: Diagram showing basic installation including line power, motor, start/stop key, and potentiometer for speed adjustment.

# 3.2 Pre-installation

# 3.2.1 Planning the Installation Site



## NOTE!

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

Select the best possible operation site by considering the following (see details on the following pages and in the respective Design Guides):

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

# 3.2.2 Receiving the Adjustable Frequency Drive

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

## 3.2.3 Transportation and Unpacking

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



#### NOTE!

The card box cover contains a drilling master for the mounting holes in the D frames. For the E size, please refer to section *Mechanical Dimensions* later in this chapter.

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# 3.2.4 Lifting

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





The lifting bar must be able to handle the weight of the adjustable frequency drive. See *Mechanical Dimensions* for the weight of the different frame sizes. Maximum diameter for bar is 1 in [2.5 cm]. The angle from the top of the drive to the lifting cable should be  $60^{\circ}$  C or greater.







# NOTE!

Note the plinth is provided in the same packaging as the adjustable frequency drive but is not attached to frame sizes F1-F4 during shipment. The plinth is required to allow airflow to the drive to provide proper cooling. The F frames should be positioned on top of the plinth in the final installation location. The angle from the top of the drive to the lifting cable should be  $60^{\circ}$  C or greater. In addition to the drawings above, a spreader bar is an acceptable way to lift the F Frame.



3



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1320 [52.0]

3

27 [1.0]

13 0.5

\* Please note airflow directions



3



Mechanical dimensions, Frame size D									
Frame S	ize			D1		D2	D3	D4	
		150–175 hp [1 (380 60–225 hp [45 (525	10–132 kW] at 400 V ⊢480 V) −160 kW] at 690 V ⊢690 V)	225–350 hp [160–250 kW] at 400 V (380–480 V) 275–550 hp [200–400 kW] at 690 V (525–690 V)		225–350 hp [160–250 kW] at 400 V (380–480 V) 275–550 hp [200–400 kW] at 690 V (525–690 V) 275–650 hp [200–400 kW] at 690 V (525–690 V) 275–690 V) 275–550 hp [200–400 kW] at 690 V		150-175 hp [110-132 kW] at 400 V (380-480 V) 60-225 hp [45-160 kW] at 690 V	225-350 hp [160-250 kW] at 400 V (380-480 V) 275-550 hp [200-400 kW] at 690 V
TD			21	E4	21	E4	(525–690 V)	(525-690 V)	
IP NEMA			Type 1	Type 12	Type 1	Type 12	Chassis	Chassis	
Ship- ping di- men- sions	Height		25.59 in [650 mm]	25.59 in [650 mm]	25.59 in [650 mm]	25.59 in [650 mm]	25.59 in [650 mm]	25.59 in [650 mm]	
	Width		68.11 in [1730 mm]	68.11 in [1730 mm]	68.11 in [1730 mm]	68.11 in [1730 mm]	48.03 in [1220 mm]	58.66 in [1490 mm]	
	Depth		22.44 in [570 mm]	22.44 in [570 mm]	22.44 in [570 mm]	22.44 in [570 mm]	22.44 in [570 mm]	22.44 in [570 mm]	
Drive dimen- sions	Height		47.6 in [1209 mm]	47.6 in [1209 mm]	62.56 in [1589 mm]	62.56 in [1589 mm]	41.18 in [1046 mm]	52.24 in [1327 mm]	
	Width		16.54 in [420 mm]	16.54 in [420 mm]	16.54 in [420 mm]	16.54 in [420 mm]	16.06 in [408 mm]	16.06 in [408 mm]	
	Depth		14.96 in [380 mm]	14.96 in [380 mm]	14.96 in [380 mm]	14.96 in [380 mm]	14.76 in [375 mm]	14.76 in [375 mm]	
	Max weight		229.3 lbs [104 kg]	229.3 lbs [104 kg]	332.9 in [151 kg]	332.9 in [151 kg]	200.62 lbs [91 kg]	304.24 lbs [138 kg]	

Mecha	Mechanical dimensions, frame size E and F								
Frame Size E1			E2	F1	F2	F3	F4		
		450-600 HP	450-600 HP	675–950 HP	1075–1350 HP	675–950 HP	1075–1350 HP		
		[315–450 kW]	[315–450 kW] at	[500–710 kW]	[800–1000 kW]	[500–710 kW] at	[800–1000 kW]		
		at 400 V	400 V	at 400 V	at 400 V	400 V	at 400 V		
		(380–480 V)	(380–480 V)	(380–480 V)	(380–480 V)	(380–480 V)	(380–480 V)		
		600-850 HP	1000-850 HP	950–1200 HP	1350-1600 HP	950–1200 HP	1350–1875 hp		
		[450–630 kW]	[450–630 kW] at	[710–900 kW]	[1000-1200	[710–900 kW] at	[1000–1400 kW]		
		at 690 V	690 V	at 690 V	kW] at 690 V	690 V	at 690 V		
		(525-690 V)	(525-690 V)	(525-690 V)	(525-690 V)	(525-690 V)	(525-690 V)		
IP		21, 54	00	21, 54	21, 54	21, 54	21, 54		
NEMA		Type 1/ Type 12	Chassis	Type 1/ Type 12					
Shipping di- mensions	Height	31.65 in [840 mm]	32.72 in [831 mm]	91.5 in [2324 mm]	91.5 in [2324 mm]	91.5 in [2324 mm]	91.5 in [2324 mm]		
	ما حاله (/ ۸	0C E in [2107 mm]	67.13 in [1705	61.77 in [1569	77.24 in [1962	05 in [2150 mm]	100.75 in [2559		
	Width	80.5 IN [2197 ININ]	mm]	mm]	mm]	85 IN [2159 MM]	mm]		
	Donth	28 08 in [736 mm]	28 08 in [736 mm]	44.49 in [1130	44.49 in [1130	44.49 in [1130	44.49 in [1130		
	Deptil	20.90 III [7.50 IIIII]	20.90 III [750 IIIII]	mm]	mm]	mm]	mm]		
Drive dimen- sions	Height	78.74 in [2000 mm]	60.91 in [1547 mm]	2204	2204	2204	2204		
	Width	23.62 in [600 mm]	23 in [585 mm]	1400	1800	2000	2400		
	Depth	18.45 in [494 mm]	19.61 in [498 mm]	606	606	606	606		
	Max weight	690 lbs [313 kg]	611 lbs [277 kg]	1004	1246	1299	1541		

# 3.2.6 Rated Power

Frame s	ize	D1	D2	D3	D4	
	130Aa f.		1386417.10		tores to	
Enclosure	IP	21/54	21/54	00	00	
protection	NEMA	Type 1/ Type 12	Type 1/ Type 12	Chassis	Chassis	
		150–175 HP [110–132 kW] at	200–350 HP [150–250 kW] at	150–175 HP [110–132 kW] at	200–350 HP [150–250 kW] at	
Normal over	beo	400 V	400 V	400 V	400 V	
rated power	- 110%	(380–480 V)	(380–480 V)	(380–480 V)	(380–480 V)	
overload tor	110 /0	60–250 HP [45–160 kW] at	300–550 HP [200–400 kW] at	60–250 HP [45–160 kW] at	300–550 HP [200–400 kW] at	
overidad tort	luc	690 V	690 V	690 V	690 V	
		(525–690 V)	(525–690 V)	(525–690 V)	(525–690 V)	
l						



# 5

## NOTE!

The F frames have four different sizes, F1, F2, F3 and F4 The F1 and F2 consist of an inverter cabinet on the right and rectifier cabinet on the left. The F3 and F4 have an additional options cabinet left of the rectifier cabinet. The F3 is an F1 with an additional options cabinet. The F4 is an F2 with an additional options cabinet.

# 3.3 Mechanical Installation

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

# 3.3.1 Tools Needed

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

- Drill with 0.39 or 0.47 in [10 or 12 mm] drill.
- Tape measure
- Wrench with relevant metric sockets (0.28-0.67 in (7-17 mm))
- Extensions to wrench
- Sheet metal punch for conduits or cable connectors in IP 21/Nema 1 and IP 54 units
- Lifting bar to lift the unit (rod or tube max. Ø1 in [25 mm], able to lift minimum 880 lbs [400 kg].
- Crane or other lifting aid to place the adjustable frequency drive in position
- A Torx T50 tool is needed to install the E1 in IP21 and IP54 enclosure types.

# 3.3.2 General Considerations

#### Space

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





# 3 Mechanical Installation





#### Wire access

Ensure that proper cable access is present including the necessary bending allowance. As the IP00 enclosure is open to the bottom cables must be fixed to the back panel of the enclosure where the adjustable frequency drive is mounted, i.e., by using cable clamps.



#### NOTE!

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

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# 3.3.3 Terminal Locations - Frame size D





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



All D frames are available with standard input terminals or disconnect switch. All terminal dimensions can be found in the following table.

# 3 Mechanical Installation

	<u>IP 21 (NEMA 1) / IP 54 (NEMA 12)</u>			/ Chassis
	Frame size D1	Frame size D2	Frame size D3	Frame size D4
A	277 (10.9)	379 (14.9)	119 (4.7)	122 (4.8)
В	227 (8.9)	326 (12.8)	68 (2.7)	68 (2.7)
С	173 (6.8)	273 (10.8)	15 (0.6)	16 (0.6)
D	179 (7.0)	279 (11.0)	20.7 (0.8)	22 (0.8)
E	370 (14.6)	370 (14.6)	363 (14.3)	363 (14.3)
F	300 (11.8)	300 (11.8)	293 (11.5)	293 (11.5)
G	222 (8.7)	226 (8.9)	215 (8.4)	218 (8.6)
н	139 (5.4)	142 (5.6)	131 (5.2)	135 (5.3)
I	55 (2.2)	59 (2.3)	48 (1.9)	51 (2.0)
J	354 (13.9)	361 (14.2)	347 (13.6)	354 (13.9)
К	284 (11.2)	277 (10.9)	277 (10.9)	270 (10.6)
L	334 (13.1)	334 (13.1)	326 (12.8)	326 (12.8)
Μ	250 (9.8)	250 (9.8)	243 (9.6)	243 (9.6)
Ν	167 (6.6)	167 (6.6)	159 (6.3)	159 (6.3)
0	261 (10.3)	260 (10.3)	261 (10.3)	261 (10.3)
Р	170 (6.7)	169 (6.7)	170 (6.7)	170 (6.7)
Q	120 (4.7)	120 (4.7)	120 (4.7)	120 (4.7)
R	256 (10.1)	350 (13.8)	98 (3.8)	93 (3.7)
S	308 (12.1)	332 (13.0)	301 (11.8)	324 (12.8)
Т	252 (9.9)	262 (10.3)	245 (9.6)	255 (10.0)
U	196 (7.7)	192 (7.6)	189 (7.4)	185 (7.3)
V	260 (10.2)	273 (10.7)	260 (10.2)	273 (10.7)

Table 3.1: Cable positions as shown in the drawings above. Dimensions in mm (inches).

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## 3.3.4 Terminal Locations - Frame size E

#### **Terminal Locations - E1**

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



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size	"						
	IP54/IP21 UL AND NEMA1/NEMA12						
	350/450 hp [250/315 kW] (400 V) AND						
E1	500/600-675/850 hp [355/450-500/630 KW]	381 (15.0)	253 (9.9)	253 (9.9)	431 (17.0)	562 (22.1)	N/A
	(690 V)						
	450/500-550/600 hp [315/355-400/450 kW]	371 (14.6)	371 (14.6)	341 (13 4)	431 (17.0)	431 (17 0)	455 (17.0)
	(400 V)	571 (14.0)	571 (14.0)	541 (15.4)	101 (17.0)	17.0)	-55 (17.9)

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#### Terminal locations - Frame size E2

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



3



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

Each terminal allows for the use of up to 4 cables with cable lugs or the use of standard box lug. Ground is connected to relevant termination point in the drive.



Frame Unit type Dimension for disconnect ter size					minal		
	IPOO/CHASSIS	А	В	С	D	E	F
	350/450 hp [250/315 kW] (400 V) AND						
E2	500/600-675/850 hp [355/450-500/630 KW]	381 (15.0)	245 (9.6)	334 (13.1)	423 (16.7)	256 (10.1)	N/A
LZ	(690 V)						
	450/500-550/600 hp [315/355-400/450 kW]	383 (15-1)	244 (9.6)	334 (13-1)	424 (16 7)	109 (4 3)	149 (5.8)
	(400 V)	505 (15.1)	244 (0.0)	554 (15.1)	424 (10.7)	105 (4.5)	145 (5.0)

# 3.3.5 Terminal Locations - Frame size F



The F framesUnit Sizes 5 have four different sizes, F1, F2, F3 and F461, 62, 63 and 64. The F1 and F261 and 62 consist of an inverter cabinet on the right and rectifier cabinet on the left. The F3 and F463 and 64 have an additional options cabinet left of the rectifier cabinet. The F363 is an F161 with an additional options cabinet. The F464 is an F262 with an additional options cabinet.

#### Terminal locations - Frame size F1 and F3

NOTE!



1) Earth ground bar

2) Motor terminals

3) Brake terminals

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1) Earth ground bar


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#### Terminal locations - Rectifier (F1, F2, F3 and F4)

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## 3 Mechanical Installation

#### Terminal locations - Options Cabinet (F3 and F4)



#### Terminal locations - Options Cabinet with circuit breaker/ molded case switch (F3 and F4)



Power size	2	3	4	5
675 hp [500 kW] (480 V), 950– 1075 hp [710–800 kW] (690 V)	34.9	86.9	122.2	174.2
750–1350 hp [560–1000 kW] (480 V), 1200–1875 hp [900– 1400 kW] (690 V)	46.3	98.3	119.0	171.0

Table 3.2: Dimension for terminal

## 3.3.6 Cooling and Airflow

#### Cooling

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

#### Duct cooling

A dedicated option has been developed to optimize installation of IP00/chassis adjustable frequency drives in Rittal TS8 enclosures utilizing the fan of the adjustable frequency drive for forced air cooling of the backchannel. The air out the top of the enclosure could but ducted outside a facility so the heat losses from the backchannel are not dissipated within the control room reducing air-conditioning requirements of the facility. Please see *Installation of Duct Cooling Kit in Rittal enclosures*, for further information.

#### **Back cooling**

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



## NOTE!

A door fan is required on the enclosure to remove the heat losses not contained in the backchannel of the drive and any additional losses generated from other components installed inside the enclosure. The total required air flow must be calculated so that the appropriate fans can be selected. Some enclosure manufacturers offer software for performing the calculations (i.e., Rittal Therm software). If the VLT is the only heat generating component in the enclosure, the minimum airflow required at an ambient temperature of  $113^{\circ}F$  [45°C] for the D3 and D4 drives is 391 m<sup>3</sup>/h (230 cfm). The minimum airflow required at an ambient temperature of  $113^{\circ}F$  [45°C] for the E2 drive is 782 m<sup>3</sup>/h (460 cfm).

#### Airflow

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

Enclosure protection	Frame size	Door fan(s) / Top fan airflow	Heatsink fan(s)				
IP21 / NEMA 1	D1 and D2	170 m <sup>3</sup> /h (100 cfm)	765 m <sup>3</sup> /h (450 cfm)				
IP54 / NEMA 12	E1 P315T5, P450T7, P500T7	340 m <sup>3</sup> /h (200 cfm)	1105 m <sup>3</sup> /h (650 cfm)				
	E1 P355-P450T5, P560-P630T7	340 m <sup>3</sup> /h (200 cfm)	1445 m <sup>3</sup> /h (850 cfm)				
IP21 / NEMA 1	F1, F2, F3 and F4	700 m <sup>3</sup> /h (412 cfm)*	985 m <sup>3</sup> /h (580 cfm)*				
IP54 / NEMA 12	F1, F2, F3 and F4	525 m <sup>3</sup> /h (309 cfm)*	985 m <sup>3</sup> /h (580 cfm)*				
IP00 / Chassis	D3 and D4	255 m <sup>3</sup> /h (150 cfm)	765 m <sup>3</sup> /h (450 cfm)				
	E2 P315T5, P450T7, P500T7	255 m <sup>3</sup> /h (150 cfm)	1105 m <sup>3</sup> /h (650 cfm)				
	E2 P355-P450T5, P560-P630T7	255 m <sup>3</sup> /h (150 cfm)	1445 m <sup>3</sup> /h (850 cfm)				
* Airflow per fan. Frame size F contain multiple fans.							

Table 3.3: Heatsink Air Flow

n	NOTE!	
A	The fan	runs for the following reasons:
$\infty$	1.	AMAAuto tune
•	2.	DC Hold
	3.	Pre-Mag
	4.	DC Brake
	5.	60% of nominal current is exceeded
	6.	Specific heatsink temperature exceeded (power size dependent)
	7.	Specific Power Card ambient temperature exceeded (power size-dependent)
	8.	Specific Control Card ambient temperature exceeded
	Once th	e fan is started, it will run for a minimum of 10 minutes.

#### **External ducts**

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



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## 3.3.7 Installation on the wall - IP21 (NEMA 1) and IP54 (NEMA 12) Units

This only applies to frame sizes D1 and D2. Thought must be given to where the unit should be installed.

#### Take the relevant points into consideration before you select the final installation site:

- Clearance space for cooling
- Clearance for opening the door
- Cable entry clearance from the bottom

Mark the mounting holes carefully using the mounting template on the wall, and drill the holes as indicated. Ensure proper distance to the floor and the ceiling for cooling. A minimum of 8.9 in [225 mm] below the adjustable frequency drive is needed. Mount the bolts at the bottom and lift the adjustable frequency drive up on the bolts. Tilt the adjustable frequency drive against the wall and mount the upper bolts. Tighten all four bolts to secure the adjustable frequency drive against the wall.



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

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



## NOTE!

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



Figure 3.35: Example of proper installation of the connector plate.

## 3 Mechanical Installation





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The bottom plate of the E1 can be mounted from either inside or outside of the enclosure, allowing flexibility in the installation process, i.e., if mounted from the bottom the connectors and cables can be mounted before the adjustable frequency drive is placed on the pedestal.

## 3.3.9 IP21 Drip Shield Installation (Frame size D1 and D2)

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

- Remove the two front screws.
- Insert the drip shield and replace the screws.
- Torque the screws to 5.6 Nm (50 in-lbs).



# 3.4 Field Installation of Options

## 3.4.1 Installation of Duct Cooling Kit in Rittal Enclosures

This section deals with the installation of IP00 / chassis enclosed adjustable frequency drives with duct work cooling kits in Rittal enclosures. In addition to the enclosure an 8 in [200 mm] base/plinth is required.



#### The minimum enclosure dimension is:

NOTE!

- D3 and D4 frame: Depth 19.7 in [500 mm] and width 23.6 in [600 mm].
- E2 frame: Depth 23.6 in [600 mm] and width 31.5 in [800 mm].

The maximum depth and width are as required for the installation. When using multiple adjustable frequency drives in one enclosure it is recommended that each drive is mounted on its own back panel and supported along the mid-section of the panel. These duct work kits do not support the "in frame" mounting of the panel (see Rittal TS8 catalog for details). The duct work cooling kits listed in the table below are suitable for use only with IP 00 / Chassis adjustable frequency drives in Rittal TS8 IP 20 and UL and NEMA 1 and IP 54 and UL and NEMA 12 enclosures.



For the E2 frames, it is important to mount the plate at the absolute rear of the Rittal enclosure due to the weight of the adjustable frequency drive.



## NOTE!

A door fan is required on the enclosure to remove the heat losses not contained in the backchannel of the drive and any additional losses generated from other components installed inside the enclosure. The total required air flow must be calculated so that the appropriate fans can be selected. Some enclosure manufacturers offer software for performing the calculations (i.e., Rittal Therm software). If the VLT is the only heat generating component in the enclosure, the minimum airflow required at an ambient temperature of  $113^{\circ}F$  [45°C] for the D3 and D4 drives is 391 m<sup>3</sup>/h (230 cfm). The minimum airflow required at an ambient temperature of  $113^{\circ}F$  [45°C] for the E2 drive is 782 m<sup>3</sup>/h (460 cfm).

## Ordering Information

Rittal TS-8 Enclosure	Frame D3 Kit Part No.	Frame D4Kit Part No.	Frame E2 Part No.
70.87 in [1800 mm]	176F1824	176F1823	Not possible
78.74 in [2000 mm]	176F1826	176F1825	176F1850
86.62 in [2200 mm]			176F0299



## NOTE!

Please see the Duct Kit Instruction Manual, 175R5640, for further information

#### External ducts

If additional duct work is added externally to the Rittal cabinet, the pressure drop in the ducting must be calculated. Please see the section *Cooling and Airflow* for further information.

## 3.4.2 Installation of Top-only Duct Cooling Kit

This description is for the installation of the top section only of the backchannel cooling kits available for frame sizes D3, D4 and E2. In addition to the enclosure, an 8 in [200 mm] vented pedestal is required.

The minimum enclosure depth is 19.7 in [500 mm] (23.6 in [600 mm] for E2 frame) and the minimum enclosure width is 23.6 in [600 mm] (31.5 in [800 mm] for E2 frame). The maximum depth and width are as required for the installation. When using multiple adjustable frequency drives in one enclosure mount each drive on its own back panel and support along the mid-section of the panel. The back-channel cooling kits are very similar in construction for all frames. The D3 and D4 kits do not support "in frame" mounting of the adjustable frequency drives. The E2 kit is mounted "in frame" for additional support of the adjustable frequency drive.

Using these kits as described removes 85% of the losses via the backchannel using the drive's main heatsink fan. The remaining 15% must be removed via the door of the enclosure.



NOTE!

Please see the Top-Only Back Channel Cooling Kit Instruction, 175R1107, for further information.

**Ordering information** Frame size D3 and D4: 176F1775 Frame size E2: 176F1776

## 3.4.3 Installation of Top and Bottom Covers for Rittal Enclosures

The top and bottom covers, installed onto IP00 adjustable frequency drives, direct the heatsink cooling air in and out the back of the adjustable frequency drive. The kits are applicable to IP00 drive frames D3, D4 and E2. These kits are designed and tested to be used with IP00/Chassis drives in Rittal TS8 enclosures.

#### Notes:

- If external duct work is added to the exhaust path of the drive, additional back pressure will be created that will reduce the cooling of the drive. The drive must be derated to accommodate the reduced cooling. First, the pressure drop must be calculated, then refer to the derating tables located earlier in this section.
- 2. A door fan is required on the enclosure to remove the heat losses not contained in the backchannel of the drive and any additional losses generated from other components installed inside the enclosure. The total required air flow must be calculated so that the appropriate fans can be selected. Some enclosure manufacturers offer software for performing the calculations (i.e., Rittal Therm software). If the adjustable frequency drive is the only heat generating component in the enclosure, the minimum airflow required at an ambient temperature of 113°F [45°C] for the D3 and D4 frame drives is 391 m<sup>3</sup>/h (230 cfm). The minimum airflow required at an ambient temperature of 113°F [45°C] for the E2 frame drive is 782 m<sup>3</sup>/h (460 cfm).



## NOTE!

Please see the instruction for Top and Bottom Covers - Rittal Enclosure, 177R0076, for further information.

#### Ordering information

Frame size D3: 176F1781 Frame size D4: 176F1782 Frame size E2: 176F1783

## 3.4.4 Installation of Top and Bottom Covers

Top and bottom covers can be installed on frame sizes D3, D4 and E2. These kits are designed to be used to direct the backchannel airflow in and out the back of the drive as opposed to in the bottom and out the top of the drive (when the drives are being mounted directly on a wall or inside a welded enclosure).

#### Notes:

- If external duct work is added to the exhaust path of the drive, additional back pressure will be created that will reduce the cooling of the drive. The drive must be derated to accommodate the reduced cooling. First, the pressure drop must be calculated, then refer to the derating tables located earlier in this section.
- 2. A door fan is required on the enclosure to remove the heat losses not contained in the backchannel of the drive and any additional losses generated from other components installed inside the enclosure. The total required air flow must be calculated so that the appropriate fans can be selected. Some enclosure manufacturers offer software for performing the calculations (i.e., Rittal Therm software). If the adjustable frequency drive is the only heat generating component in the enclosure, the minimum airflow required at an ambient temperature of 113°F [45°C] for the D3 and D4 frame drives is 391 m<sup>3</sup>/h (230 cfm). The minimum airflow required at an ambient temperature of 113°F [45°C] for the E2 frame drive is 782 m<sup>3</sup>/h (460 cfm).



#### NOTE!

Please see the Top and Bottom Covers Only Instruction, 175R1106, for further information.

Ordering information Frame size D3 and D4: 176F1862 Frame size E2: 176F1861 3

## 3 Mechanical Installation



## 3.4.5 Outside Installation/ NEMA 3R Kit for Rittal Enclosures



This section is for the installation of NEMA 3R kits available for the adjustable frequency drive frames D3, D4 and E2. These kits are designed and tested to be used with IP00/ Chassis versions of these frames in Rittal TS8 NEMA 3R or NEMA 4 enclosures. The NEMA-3R enclosure is an outdoor enclosure that provides a degree of protection against rain and ice. The NEMA-4 enclosure is an outdoor enclosure that provides a greater degree of protection against weather and hosed water.

The minimum enclosure depth is 19.7 in [500 mm] 23.6 in [600 mm] for E2 frame) and the kit is designed for a 23.6 in [600 mm] 31.5 in [800 mm] for E2 frame) wide enclosure. Other enclosure widths are possible, however additional Rittal hardware is required. The maximum depth and width are as required for the installation.



## NOTE!

The current rating of drives in D3 and D4 frames are de-rated by 3%, when adding the NEMA 3R kit. Drives in E2 frames require no derating.

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#### NOTE!

A door fan is required on the enclosure to remove the heat losses not contained in the backchannel of the drive and any additional losses generated from other components installed inside the enclosure. The total required air flow must be calculated so that the appropriate fans can be selected. Some enclosure manufacturers offer software for performing the calculations (i.e., Rittal Therm software). If the VLT is the only heat generating component in the enclosure, the minimum airflow required at an ambient temperature of  $113^{\circ}F$  [45°C] for the D3 and D4 drives is 391 m<sup>3</sup>/h (230 cfm). The minimum airflow required at an ambient temperature of  $113^{\circ}F$  [45°C] for the E2 drive is 782 m<sup>3</sup>/h (460 cfm).

#### Ordering information

Frame size D3: 176F4600 Frame size D4: 176F4601 Frame size E2: 176F1852



## NOTE!

Please see the instructions 175R5922 for further information.

3 Mechanical Installation

## 3.4.6 Outside Installation / NEMA 3R Kit of Industrial Enclosures

The kits are available for the frame sizes D3, D4 and E2. These kits are designed and tested to be used with IP00/Chassis drives in welded box construction enclosures with an environmental rating of NEMA-3R or NEMA-4. The NEMA-3R enclosure is a dust-tight, rain-tight, ice-resistant, outdoor enclosure. The NEMA-4 enclosure is a dust-tight and water-tight enclosure.

This kit has been tested and complies with UL environmental rating Type-3R.

Note: The current rating of D3 and D4 frame drives are de-rated by 3% when installed in a NEMA-3R enclosure. E2 frame drives require no de-rating when installed in a NEMA-3R enclosure.



NOTE!

Please see the instruction for Outside Installation /NEMA 3R kit of industrial enclosures, 175R1068, for further information.

#### **Ordering information**

Frame size D3: 176F0296 Frame size D4: 176F0295 Frame size E2: 176F0298

## 3.4.7 Installation of IP00 to IP20 Kits

The kits can be installed on frame sizes D3, D4, and E2 (IP00).



Please see the instruction for Installation of IP20 Kits, 175R1108, for further information.

Ordering information Frame size D3/D4: 176F1779 Frame size E2: 176FXXXX

NOTE!

NOTE!

#### 3.4.8 Installation of IP00s D3, D4, & E2 Cable Clamp Bracket

The motor cable clamp brackets can be installed on frame sizes D3 and D4 (IP00).



Please see the instruction for Cable Clamp Bracket Kit, 175R1109, for further information.

Ordering information Frame size D3: 176F1774 Frame size D4: 176F1746 Frame size E2: 176F1745



## 3.4.9 Installation on Pedestal

This section describes the installation of a pedestal unit available for the adjustable frequency drives frames D1 and D2. This is an 8 in [200 mm] high pedestal that allows these frames to be floor mounted. The front of the pedestal has openings for input air to the power components.

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The adjustable frequency drive connector plate must be installed to provide adequate cooling air to the control components of the adjustable frequency drive via the door fan and to maintain the IP21/NEMA 1 or IP54/NEMA 12 degrees of enclosure protections.



There is one pedestal that fits both frames D1 and D2. Its ordering number is 176F1827. The pedestal is standard for E1 frame.





#### NOTE!

Please see the Pedestal Kit Instruction Manual, 175R5642, for further information.

## 3.4.10 Installation of Line Power Shield for Adjustable Frequency Drives

This section is for the installation of a line power shield for the adjustable frequency drive series with D1, D2 and E1 frames. It is not possible to install in the IP00/ Chassis versions as these have included as standard a metal cover. These shields satisfy VBG-4 requirements.

#### Ordering numbers:

Frames D1 and D2 : 176F0799 Frame E1: 176F1851

NOTE!



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

## 3.4.11 F Frame USB Extension Kit

A USB extension cable can be installed into the door of F frame VLT adjustable frequency drives.

#### Ordering number:

176F1784



**NOTE!** For further information, please see the Instruction Sheet, *177R0091* 

## 3.4.12 Installation of Input Plate Options

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



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## NOTE!

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

	380–480 V 380–500 V	Fuses	Disconnect Fuses	RFI	RFI Fuses	RFI Disconnect Fuses
D1	All D1 power sizes	176F8442	176F8450	176F8444	176F8448	176F8446
D2	All D2 power sizes	176F8443	176F8441	176F8445	176F8449	176F8447
E1	FC 102/: 450 hp [315 kW] FC 302: 350 hp [250 kW]	176F0253	176F0255	176F0257	176F0258	176F0260
	FC 102/ : 500–600 hp [355–450 kW] FC 302: 450–550 hp [315–400 kW]	176F0254	176F0256	176F0257	176F0259	176F0262
	525–690 V	Fuses	Disconnect Fuses	RFI	RFI Fuses	RFI Disconnect Fuses
D1	FC 102/ : 60–125 hp [45–90 kW]	175L8829	175L8828	175L8777	NA	NA

						Fuses
D1	FC 102/ : 60–125 hp [45–90 kW] FC 302: 50–100 hp [37– 75 kW]	175L8829	175L8828	175L8777	NA	NA
	FC 102/ : 150–225 hp [110–160 kW] FC 302: 125–175 hp [90– 132 kW]	175L8442	175L8445	175L8777	NA	NA
D2	All D2power sizes	175L8827	175L8826	175L8825	NA	NA
E1	FC 102/ : 600–675 hp [450–500 kW] FC 302: 500–550 hp [355–400 kW]	176F0253	176F0255	NA	NA	NA
	FC 102/ : 750–850 hp [560–630 kW] FC 302: 675–750 hp [500–560 kW]	176F0254	176F0258	NA	NA	NA



#### NOTE!

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

## 3.4.13 Installation of D or E Load Share Option

The load share option can be installed on frame sizes D1, D2, D3, D4, E1 and E2.



Please see the Load Share Terminal Kit Instructions, 175R5637 (D frames) or 177R1114 (E frames), for further information.

#### Ordering information

Frame size D1/D3: 176F8456 Frame size D2/D4: 176F8455 Frame size E1/E2: 176F1843

NOTE!

# 3.5 Frame size F Panel Options

#### **Space Heaters and Thermostat**

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

#### **Cabinet Light with Power Outlet**

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

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

#### **Transformer Tap Set-up**

If the Cabinet Light & Outlet and/or the Space Heaters & Thermostat are installed Transformer T1 requires it taps to be set to the proper input voltage. A 380–480/500 V380–480 V drive will initially be set to the 525 V tap and a 525–690 V drive will be set to the 690 V tap to insure no overvoltage of secondary equipment occurs if the tap is not changed prior to power being applied. See the table below to set the proper tap at terminal T1 located in the rectifier cabinet. For location in the drive, see figure of rectifier in the *Power Connections* section.

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

#### NAMUR Terminals

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

#### **RCD (Residual Current Device)**

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

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

## 3 Mechanical Installation

- Fault memory
- TEST / RESET button

#### Insulation Resistance Monitor (IRM)

Monitors the insulation resistance in ungrounded systems (IT systems in IEC terminology) between the system phase conductors and ground. There is an ohmic pre-warning and a main alarm setpoint for the insulation level. Associated with each setpoint is an SPDT alarm relay for external use. Note: only one insulation resistance monitor can be connected to each ungrounded (IT) system.

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

#### IEC Emergency Stop with Pilz Safety Relay

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

#### Manual Motor Starters

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

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

#### 30 Ampere, Fuse-protected Terminals

- 3-phase power matching incoming AC line voltage for powering auxiliary customer equipment
- Not available if two manual motor starters are selected
- Terminals are off when the incoming power to the drive is off
- Power for the fused protected terminals will be provided from the load side of any supplied contactor, circuit breaker, or disconnect switch.

#### 24 VDC Power Supply

- 5 amp, 120 W, 24 VDC
- Protected against output overcurrent, overload, short circuits, and overtemperature
- For powering customer-supplied accessory devices such as sensors, PLC I/O, contactors, temperature probes, LEDs, and/or other electronic hardware
- Diagnostics include a dry DC-ok contact, a green DC-ok LED, and a red overload LED

#### External Temperature Monitoring

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

#### Universal inputs (8)

Signal types:

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

Additional features:

- One universal output, configurable for analog voltage or analog current
- Two output relays (N.O.)
- Dual-line LC display and LED diagnostics



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- Sensor lead wire break, short-circuit, and incorrect polarity detection
- Interface set-up software

#### Dedicated thermistor inputs (2)

Features:

- Each module is capable of monitoring up to six thermistors in a series
- Fault diagnostics for wire breakage or short-circuits of sensor leads
- ATEX/UL/CSA certification
- A third thermistor input can be provided by the PTC thermistor option card MCB 112, if necessary.

3 Mechanical Installation



# **4 Electrical Installation**

# 4.1 Electrical Installation

## 4.1.1 Power Connections

NOTE!

**Cabling and Fusing** 



#### Cables General

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

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

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

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





#### NOTE!

To comply with EMC emission specifications, shielded/armored cables are recommended. If an unshielded/unarmored cable is used, see section *Power and Control Wiring for Unshielded Cables.* For more information, see *EMC Test Results* in the Design Guide.

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

#### Shielding of cables:

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

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

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

#### Cable-length and cross-section:

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

## Switching frequency:

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

Term. no.	96	97	98	99	
	U	V	W	PE <sup>1)</sup>	Motor voltage 0–100% of AC line voltage.
					3 wires out of motor
-	U1	V1	W1	DC1)	Delta-connected
	W2	U2	V2	PE*/	6 wires out of motor
	U1	V1	W1	PE <sup>1)</sup>	Star-connected U2, V2, W2
					U2, V2 and W2 to be interconnected separately.

1)Protected Ground Connection

4

## 

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





88

89



96

Τ1

97 98

T2 T3

## 4 Electrical Installation





 $\mathsf{MG.11}.\mathsf{F3.22}$  -  $\mathsf{VLT}^{\textcircled{R}}$  is a registered Danfoss trademark

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## 4 Electrical Installation



176FA259.10

Figure 4.9: Position of ground terminals IP00, frame sizes E



V<sub>Earth Terminals</sub>

## **4** Electrical Installation

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- R S T L1 L2 L3
- 10) 30 Amp Fuse Protected Power fuses



## 4 Electrical Installation







## 4.1.2 Power and Control Wiring for Unshielded Cables

#### Induced Voltage!

 $\triangle$ 

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



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

Because the power wiring carries high frequency electrical pulses, it is important that input power and motor power are run in separate conduit. If the incoming power wiring is run in the same conduit as the motor wiring, these pulses can couple electrical noise back onto the building power grid. Control wiring should always be isolated from the high voltage power wiring.

When shielded/armored cable is not used, at least three separate conduits must be connected to the panel option (see figure below).

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



## 4.1.3 Grounding

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

- Safety grounding: Please note that the adjustable frequency drive has a high leakage current and must be grounded appropriately for safety reasons. Always follow local safety regulations.
- High-frequency grounding: Keep the ground wire connections as short as possible.

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

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

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

## 4.1.4 Extra Protection (RCD)

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

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

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

See also the section Special Conditions in the Design Guide.

## 4.1.5 RFI Switch

#### Line power supply isolated from ground

If the adjustable frequency drive is supplied from an isolated line power source (IT line power, floating delta and grounded delta) or TT/TN-S line power with grounded leg, the RFI switch is recommended to be turned off (OFF)<sup>1</sup>) via par. 14-50 *RFI 1*. For further reference, see IEC 364-3. In case optimum EMC performance is needed, parallel motors are connected or the motor cable length is above 82 ft [25 m],, it is recommended to set par. 14-50 *RFI 1* to [ON].

 $^{1)}$  Not available for 525–600/690 V adjustable frequency drives in frame sizes D, E and F.

In OFF, the internal RFI capacities (filter capacitors) between the chassis and the intermediate circuit are cut off to avoid damage to the intermediate circuit and to reduce the ground capacity currents (according to IEC 61800-3).

Please also refer to the application note VLT on IT line power, MN.90.CX.02. It is important to use isolation monitors that are capable for use together with power electronics (IEC 61557-8).

## 4 Electrical Installation



## 4.1.6 Torque

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



Frame size	Terminal	Torque	Bolt size
D1, D2, D3 and D4	Line power	10  Nm (169  in   lbc)	M10
	Motor	19 1011 (108 111-105)	MIO
	Load sharing	$0 \in Nm(94 in lbc)$	MQ
	Brake	9.5 IIII (04 III - 105)	010
E1 and E2	Line power		
	Motor	19 NM (168 in-lbs)	M10
	Load sharing		
	Brake	9.5 Nm (84 in-lbs)	M8
F1, F2, F3 and F4	Line power	10  Nm (169  in lbc)	M10
	Motor	19 1011 (108 111-105)	MIU
	Load sharing	19 Nm (168 in-lbs)	M10
	Brake	9.5 Nm (84 in-lbs)	M8
	Regen	19 Nm (168 in-lbs)	M10

Table 4.1: Torque for terminals

## 4.1.7 Shielded Cables

It is important that shielded and armored cables are connected properly to ensure high EMC immunity and low emissions.

#### Connection can be made using either cable connectors or clamps:

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

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



The direction of rotation can be changed by switching two phases in the motor cable or by changing the setting of par. 4-10 *Motor Speed Direction*. Motor rotation check can be performed using par. 1-28 *Motor Rotation Check* and following the steps shown in the display.

#### F frame Requirements

**F1/F3 requirements:** Motor phase cable quantities must be multiples of 2, resulting in 2, 4, 6, or 8 (1 cable is not allowed) to obtain equal amount of wires attached to both inverter module terminals. The cables are required to be equal length within 10% between the inverter module terminals and the first common point of a phase. The recommended common point is the motor terminals.

**F2/F4 requirements:** Motor phase cable quantities must be multiples of 3, resulting in 3, 6, 9, or 12 (1 or 2 cables are not allowed) to obtain equal amount of wires attached to each inverter module terminal. The wires are required to be equal length within 10% between the inverter module terminals and the first common point of a phase. The recommended common point is the motor terminals.

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



#### NOTE!

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

### 4.1.9 Brake Cable Drives with Factory Installed Brake Chopper Option

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

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

Terminal No.	Function
81, 82	Brake resistor terminals

The connection cable to the brake resistor must be shielded. Connect the shield by means of cable clamps to the conductive backplate at the adjustable frequency drive and to the metal cabinet of the brake resistor.

Size the brake cable cross-section to match the brake torque. See also *Brake Instructions, MI.90.Fx.yy* and *MI.50.Sx.yy* for further information regarding safe installation.



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

#### **F** Frame Requirements

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

### 4.1.10 Brake Resistor Temperature Switch

### Frame size D-E-F

Torque: 0.5–0.6 Nm (5 in-lbs) Screw size: M3

This input can be used to monitor the temperature of an externally connected brake resistor. If the input between 104 and 106 is established, the adjustable frequency drive will trip on warning / alarm 27, "Brake IGBT". If the connection is closed between 104 and 105, the adjustable frequency drive will trip on warning/alarm 27, "Brake IGBT".

A KLIXON switch must be installed that is 'normally closed'. If this function is not used, 106 and 104 must be short-circuited together. Normally closed: 104-106 (factory-installed jumper)

Normally open: 104-105





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### 4.1.11 Load Sharing

Terminal No.	Function
88, 89	Load sharing

The connection cable must be shielded and the max. length from the adjustable frequency drive to the DC bar is limited to 82 ft [25 m]. Load sharing enables the linking of the DC intermediate circuits of several adjustable frequency drives.



Please note that voltages up to 1099 V DC may occur on the terminals. Load sharing calls for extra equipment and safety considerations. For further information, see load sharing Instructions MI.50.NX.YY.



### 4.1.12 Shielding against Electrical Noise

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

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



### 4.1.13 AC line input connections

The line power supply must be connected to terminals 91, 92 and 93. Ground is connected to the terminal to the right of terminal 93.

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



### NOTE! Check the

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

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

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

### 4.1.14 External Fan Supply

#### Frame size D-E-F

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

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

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

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### 4.1.15 Fuses

#### Branch circuit protection:

In order to protect the installation against electrical and fire hazard, all branch circuits in an installation, switch gear, machines, etc., must be shortcircuited and overcurrent protected according to national/international regulations.

#### Short-circuit protection:

The adjustable frequency drive must be protected against short-circuit to avoid electrical or fire hazard. Danfoss recommends using the fuses mentioned below to protect service personnel and equipment in case of an internal failure in the drive. The adjustable frequency drive provides full short-circuit protection in case of a short-circuit on the motor output.

#### **Overcurrent protection**

Provide overload protection to avoid fire hazard due to overheating of the cables in the installation. The adjustable frequency drive is equipped with internal overcurrent protection that can be used for upstream overload protection (UL applications excluded). See par. 4-18 *Current Limit*. Moreover, fuses or circuit breakers can be used to provide the overcurrent protection in the installation. Overcurrent protection must always be carried out according to national regulations.

### Non-UL compliance

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

P110 - P250	380–480 V	type gG
P315 - P450	380–480 V	type gR

### **UL Compliance**

### 380-480 V, frame sizes D, E and F

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

Size/ Type	Bussmann E1958 JFHR2**	Bussmann E4273 T/JDDZ**	SIBA E180276 JFHR2	LittelFuse E71611 JFHR2**	Ferraz- Shawmut E60314 JFHR2**	Bussmann E4274 H/JDDZ**	Bussmann E125085 JFHR2*	Internal Option Bussmann
P110	FWH- 300	JJS- 300	2061032.315	L50S-300	A50-P300	NOS- 300	170M3017	170M3018
P132	FWH- 350	JJS- 350	2061032.35	L50S-350	A50-P350	NOS- 350	170M3018	170M3018
P160	FWH- 400	JJS- 400	2061032.40	L50S-400	A50-P400	NOS- 400	170M4012	170M4016
P200	FWH- 500	JJS- 500	2061032.50	L50S-500	A50-P500	NOS- 500	170M4014	170M4016
P250	FWH- 600	JJS- 600	2062032.63	L50S-600	A50-P600	NOS- 600	170M4016	170M4016

Table 4.2: Frame size D, Line fuses, 380-480 V

Size/Type	Bussmann PN*	Rating	Ferraz	Siba
P315	170M4017	700 A, 700 V	6.9URD31D08A0700	20 610 32.700
P355	170M6013	900 A, 700 V	6.9URD33D08A0900	20 630 32.900
P400	170M6013	900 A, 700 V	6.9URD33D08A0900	20 630 32.900
P450	170M6013	900 A, 700 V	6.9URD33D08A0900	20 630 32.900

Table 4.3: Frame size E, Line fuses, 380-480 V

Size/Type	Bussmann PN*	Rating	Siba	Internal Bussmann Option
P500	170M7081	1600 A, 700 V	20 695 32.1600	170M7082
P560	170M7081	1600 A, 700 V	20 695 32.1600	170M7082
P630	170M7082	2000 A, 700 V	20 695 32.2000	170M7082
P710	170M7082	2000 A, 700 V	20 695 32.2000	170M7082
P800	170M7083	2500 A, 700 V	20 695 32.2500	170M7083
P1M0	170M7083	2500 A, 700 V	20 695 32.2500	170M7083

Table 4.4: Frame size F, Line fuses, 380-480 V

### 4 Electrical Installation



Bussmann PN*	Rating	Siba	
170M8611	1100 A, 1000 V	20 781 32.1000	
170M8611	1100 A, 1000 V	20 781 32.1000	
170M6467	1400 A, 700 V	20 681 32.1400	
170M6467	1400 A, 700 V	20 681 32.1400	
170M8611	1100 A, 1000 V	20 781 32.1000	
170M6467	1400 A, 700 V	20 681 32.1400	
	Bussmann PN* 170M8611 170M8611 170M6467 170M6467 170M8611 170M6467	Bussmann PN* Rating   170M8611 1100 A, 1000 V   170M8611 1100 A, 1000 V   170M6467 1400 A, 700 V   170M6467 1400 A, 700 V   170M8611 1100 A, 1000 V   170M6467 1400 A, 700 V   170M8611 1100 A, 1000 V   170M6467 1400 A, 700 V	Bussmann PN* Rating Siba   170M8611 1100 A, 1000 V 20 781 32.1000   170M8611 1100 A, 1000 V 20 781 32.1000   170M6467 1400 A, 700 V 20 681 32.1400   170M6467 1400 A, 700 V 20 681 32.1400   170M6467 1400 A, 700 V 20 681 32.1400   170M8611 1100 A, 1000 V 20 781 32.1000   170M6467 1400 A, 700 V 20 681 32.1400

Table 4.5: Frame size F, Inverter module DC Link Fuses, 380-480 V

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

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

#### 525–690 V, frame sizes D, E and F

Size/Type	Bussmann E125085 JFHR2	Amps	SIBA E180276 JFHR2	Ferraz-Shawmut E76491 JFHR2	Internal Option Bussmann
P45K	170M3013	125	2061032.125	6.6URD30D08A0125	170M3015
P55K	170M3014	160	2061032.16	6.6URD30D08A0160	170M3015
P75K	170M3015	200	2061032.2	6.6URD30D08A0200	170M3015
P90K	170M3015	200	2061032.2	6.6URD30D08A0200	170M3015
P110	170M3016	250	2061032.25	6.6URD30D08A0250	170M3018
P132	170M3017	315	2061032.315	6.6URD30D08A0315	170M3018
P160	170M3018	350	2061032.35	6.6URD30D08A0350	170M3018
P200	170M4011	350	2061032.35	6.6URD30D08A0350	170M5011
P250	170M4012	400	2061032.4	6.6URD30D08A0400	170M5011
P315	170M4014	500	2061032.5	6.6URD30D08A0500	170M5011
P400	170M5011	550	2062032.55	6.6URD32D08A550	170M5011

Table 4.6: Frame size D, E and F 525-690 V

Size/Type	Bussmann PN*	Rating	Ferraz	Siba
P450	170M4017	700 A, 700 V	6.9URD31D08A0700	20 610 32.700
P500	170M4017	700 A, 700 V	6.9URD31D08A0700	20 610 32.700
P560	170M6013	900 A, 700 V	6.9URD33D08A0900	20 630 32.900
P630	170M6013	900 A, 700 V	6.9URD33D08A0900	20 630 32.900

Table 4.7: Frame size E, 525-690 V

Size/Type	Bussmann PN*	Rating	Siba	Internal Bussmann Option
P710	170M7081	1600 A, 700 V	20 695 32.1600	170M7082
P800	170M7081	1600 A, 700 V	20 695 32.1600	170M7082
P900	170M7081	1600 A, 700 V	20 695 32.1600	170M7082
P1M0	170M7081	1600 A, 700 V	20 695 32.1600	170M7082
P1M2	170M7082	2000 A, 700 V	20 695 32.2000	170M7082
P1M4	170M7083	2500 A, 700 V	20 695 32.2500	170M7083

Table 4.8: Frame size F, Line fuses, 525-690 V

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

Table 4.9: Frame size F, Inverter module DC Link Fuses, 525–690 V

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

Suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 500/600/690 Volts maximum when protected by the above fuses.

### Supplementary fuses

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

Table 4.10: SMPS Fuse

Size/Type	Bussmann PN*	LittelFuse	Rating
P110-P315, 380-480 V	KTK-4		4 A, 600 V
P45K-P500, 525-690 V	KTK-4		4 A, 600 V
P355-P1M0, 380-480 V		KLK-15	15A, 600 V
P560-P1M4, 525-690 V		KLK-15	15A, 600 V

Table 4.11: Fan Fuses

Size/Type		Bussmann PN*	Rating	Alternative Fuses
P500-P1M0, 380–480 V	2.5–4.0 A	LPJ-6 SP or SPI	6 A, 600 V	Any listed Class J Dual Ele- ment, Time Delay, 6 A
P710-P1M4, 525-690 V		LPJ-10 SP or SPI	10 A, 600 V	Any listed Class J Dual Ele- ment, Time Delay, 10 A
P500-P1M0, 380-480 V	4.0–6.3 A	LPJ-10 SP or SPI	10 A, 600 V	Any listed Class J Dual Ele- ment, Time Delay, 10 A
P710-P1M4, 525-690 V		LPJ-15 SP or SPI	15 A, 600 V	Any listed Class J Dual Ele- ment, Time Delay, 15 A
P500-P1M0, 380-480 V	6.3–10 A	LPJ-15 SP or SPI	15 A, 600 V	Any listed Class J Dual Ele- ment, Time Delay, 15 A
P710-P1M4, 525 <del>-</del> 690 V		LPJ-20 SP or SPI	20 A, 600 V	Any listed Class J Dual Ele- ment, Time Delay, 20 A
P500-P1M0, 380-480 V	10–16 A	LPJ-25 SP or SPI	25 A, 600 V	Any listed Class J Dual Ele- ment, Time Delay, 25 A
P710-P1M4, 525-690 V		LPJ-20 SP or SPI	20 A, 600 V	Any listed Class J Dual Ele- ment, Time Delay, 20 A

Table 4.12: Manual Motor Controller Fuses

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

Table 4.13: 30 A Fuse Protected Terminal Fuse

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

Table 4.14: Control Transformer Fuse

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

Table 4.15: NAMUR Fuse

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

Table 4.16: Safety Relay Coil Fuse with PILS Relay

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### 4.1.16 Line Power Disconnectors - Frame Size D, E and F

D1/D3 P110-P132 380-480 V & P110-P160 525-690 V ABB OETL-NF200A or OT200U12-91   D2/D4 P160-P250 380-480 V & P200-P400 525-690 V ABB OETL-NF400A or OT400U12-91   E1/E2 P315 380-480 V & P450-P630 525-690 V ABB OETL-NF600A   E1/E2 P355-P450 380-480 V ABB OETL-NF800A   F3 P500 380-480 V & P710-P800 525-690 V Merlin Gerin NPJF36000S12AAYP	Frame size	Power & Voltage	Туре
D2/D4 P160-P250 380-480 V & P200-P400 525-690 V ABB OETL-NF400A or OT400U12-91   E1/E2 P315 380-480 V & P450-P630 525-690 V ABB OETL-NF600A   E1/E2 P355-P450 380-480 V ABB OETL-NF800A   F3 P500 380-480 V & P710-P800 525-690 V Merlin Gerin NPJF36000S12AAYP	D1/D3	P110-P132 380-480 V & P110-P160 525-690 V	ABB OETL-NF200A or OT200U12-91
E1/E2 P315 380-480 V & P450-P630 525-690 V ABB OETL-NF600A   E1/E2 P355-P450 380-480 V ABB OETL-NF800A   F3 P500 380-480 V & P710-P800 525-690 V Merlin Gerin NPJF36000S12AAYP   F3 P500 380-480 V & P700-F800 525-690 V Merlin Gerin NPJF36000S12AAYP	D2/D4	P160-P250 380-480 V & P200-P400 525-690 V	ABB OETL-NF400A or OT400U12-91
E1/E2 P355-P450 380-480 V ABB OETL-NF800A   F3 P500 380-480 V & P710-P800 525-690 V Merlin Gerin NPJF36000S12AAYP   F3 P500 710 380 480 V & P710-P800 525-690 V Merlin Gerin NPJF36000S12AAYP	E1/E2	P315 380-480 V & P450-P630 525-690 V	ABB OETL-NF600A
F3 P500 380–480 V & P710-P800 525–690 V Merlin Gerin NPJF36000S12AAYP   F3 P560 P310 380 480 V & P000 F35 600 V Merlin Gerin NPJF36000S12AAYP	E1/E2	P355-P450 380-480 V	ABB OETL-NF800A
E2 DECO D710 200 400 V 9 D000 E2E 600 V Mortin Covin NDV26000C2044VD	F3	P500 380-480 V & P710-P800 525-690 V	Merlin Gerin NPJF36000S12AAYP
rs P300-7710 300-460 V & P300 323-030 V Meriin Gerin NRK30000520AATP	F3	P560-P710 380-480 V & P900 525-690 V	Merlin Gerin NRK36000S20AAYP
F4 P800-P1M0 380-480 V & P1M0-P1M4 525-690 V Merlin Gerin NRK36000S20AAYP	F4	P800-P1M0 380-480 V & P1M0-P1M4 525-690 V	Merlin Gerin NRK36000S20AAYP

### 4.1.17 F Frame circuit breakers

Frame size	Power & Voltage	Туре
F3	P500 380-480 V & P710-P800 525-690 V	Merlin Gerin NPJF36120U31AABSCYP
F3	P560-P710 380-480 V & P900 525-690 V	Merlin Gerin NRJF36200U31AABSCYP
F4	P800 380-480 V & P1M0-P1M4 525-690 V	Merlin Gerin NRJF36200U31AABSCYP
F4	P1M0 380-480 V	Merlin Gerin NRJF36250U31AABSCYP

### 4.1.18 F Frame Line Power Contactors

Frame size	Power & Voltage	Туре
F3	P500-P560 380-480 V & P710-P900 525-690 V	Eaton XTCE650N22A
F3	P 630-P710 380-480 V	Eaton XTCEC14P22B
F4	P800-P1M0 380-480 V & P1M0-P1M4 525-690 V	Eaton XTCEC14P22B

### 4.1.19 Motor Insulation

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

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

### 4.1.20 Motor Bearing Currents

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

### Standard Mitigation Strategies:

- 1. Use an insulated bearing
- 2. Apply rigorous installation procedures

Ensure the motor and load motor are aligned

Strictly follow the EMC Installation guideline

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

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

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

- 3. Apply conductive lubrication
- 4. Try to ensure the line voltage is balanced to ground. This can be difficult for IT, TT, TN-CS or Grounded leg systems
- 5. Use an insulated bearing as recommended by the motor manufacturer (note: Motors from reputable manufacturers will typically have these fitted as standard in motors of this size)

If found to be necessary and after consultation with Danfoss:

- 6. Lower the IGBT switching frequency
- 7. Modify the inverter waveform, 60° AVM vs. SFAVM
- 8. Install a shaft grounding system or use an isolating coupling between motor and load
- 9. Use minimum speed settings, if possible.
- 10. Use a dU/dt or sinus filter

### 4.1.21 Control Cable Routing

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

### Serial communication bus connection

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





D4, E1 and E2 use the same path.

Control card wiring path for the D3. Control card wiring for the D1, D2, Control card wiring path for the F1/F3. Control card wiring for the F2/F4 use the same path.

In the Chassis (IP00) and NEMA 1 units it is also possible to connect the serial communication bus from the top of the unit as shown in the following pictures. On the NEMA 1 unit, a cover plate must be removed. Kit number for serial communication bus top connection: 176F1742



Figure 4.17: Top connection for serial communication bus.



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

	N.	
STILL ST	130BB256.10	

No.	Function
35 (-), 36 (+)	24 V external DC supply

24 VDC external supply can be used as low-voltage supply to the control card and any option cards installed. This enables full operation of the LCP (including parameter setting) without connection to line power. Please note that a warning of low voltage will be given when 24 V DC has been connected; however, there will be no tripping.



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

## 4.1.22 Access to Control Terminals

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



### 4.1.23 Electrical Installation, Control Terminals

### To connect the cable to the terminal:

- 1. Strip insulation by about 0.34–0.39 in [9–10 mm]
- 2. Insert a screwdriver<sup>1)</sup> in the square hole.
- 3. Insert the cable in the adjacent circular hole.
- 4. Remove the screwdriver. The cable is now mounted in the terminal.

### To remove the cable from the terminal:

- 1. Insert a screwdriver<sup>1)</sup> in the square hole.
- 2. Pull out the cable.
- $^{1)}$  Max. 0.015 x 0.1 in. [0.4 x 2.5 mm]





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## 4.2 Connection Examples

### 4.2.1 Start/Stop

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

Terminal 37 = Safe stop



### 4.2.2 Pulse Start/Stop

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

Terminal 37 = Safe stop



### Terminals 29/32 = Speed up/down:

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

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

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

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

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

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### 4.2.4 Potentiometer Reference

### Voltage reference via a potentiometer:

Reference Source 1 = [1] *Analog input 53* (default) Terminal 53, Low Voltage = 0 Volt Terminal 53, High Voltage = 10 Volt

Terminal 53, Low Ref./Feedback = 0 RPM Terminal 53, High Ref./Feedback = 1,500 RPM

Switch S201 = OFF (U)



4 Electrical Installation

## 4.3 Electrical Installation - additional

### 4.3.1 Electrical Installation, Control Cables



adjustable frequency drive Design Guide. See also sections Safe Stop and Safe Stop Installation.

supply cables.

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

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

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### 4 Electrical Installation



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

### Input polarity of control terminals







### NOTE!

To comply with EMC emission specifications, shielded/armored cables are recommended. If an unshielded/unarmored cable is used, see section *Power and Control Wiring for Unshielded Cables.* For more information, see *EMC Test Results* in the Design Guide.



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

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### 4.3.2 Switches S201, S202, and S801

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

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

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

### Default setting:

S201 (A53) = OFF (voltage input)

S202 (A54) = OFF (voltage input)

S801 (Bus termination) = OFF



#### NOTE!

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



## 4.4 Final Set-up and Test

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

#### Step 1. Locate the motor nameplate

NOTE!



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

	THREE PHA	SE INDUCT	ION MC	TOR	
	MOD MCV 315E	Nr. 135189 12 0	4	IL/IN 6.5	
	kW 400	PRIMARY		SF 1.15	
	HP 536	V 690 A 410.6	CONN Y	COSF 0.85 40	
	mm 1481	V A	CONN	AMB 40 °C	
	Hz 50	V A	CONN	ALT 1000 m	
	DESIGN N	SECONDAR	1	RISE 80 °C	
	DUTY S1	V A	CONN	ENCLOSURE IP23	
-	INSUL   EFFICIENC	r % 95.8% 100% §	95.8% 75%	WEIGHT 1.83 ton	
	Δc	AUTION			
				130BA767.10	

**Step 2. Enter the motor nameplate data in this parameter list.** To access this list, first press the [QUICK MENU] key, then select "Q2 Quick Set-up".

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

#### Step 3. Activate the Automatic Motor Adaptation (AMA)

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

- 1. Connect terminal 37 to terminal 12 (if terminal 37 is available).
- 2. Connect terminal 27 to terminal 12 or set par. 5-12 Terminal 27 Digital Input to 'No function' (par. 5-12 Terminal 27 Digital Input [0])
- 3. Activate the AMA par. 1-29 Automatic Motor Adaptation (AMA).
- 4. Choose between complete or reduced AMA. If a sine-wave filter is mounted, run only the reduced AMA, or remove the sine-wave filter during the AMA procedure.
- 5. Press the [OK] key. The display shows "Press [Hand on] to start".
- 6. Press the [Hand on] key. A progress bar indicates if the AMA is in progress.

### Stop the AMA during operation

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

### Successful AMA

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

#### Unsuccessful AMA

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



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

### Step 4. Set speed limit and ramp time

NOTE!

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

Table 4.17: Set up the desired limits for speed and ramp time.

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

Par. 3-41 *Ramp 1 Ramp-up Time* Par. 3-42 *Ramp 1 Ramp-down Time* 

MG.11.F3.22 -  $\text{VLT}^{\circledast}$  is a registered Danfoss trademark

## 4.5 Additional Connections

### 4.5.1 Mechanical Brake Control

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

- Control the brake using any relay output or digital output (terminal 27 or 29).
- Keep the output closed (voltage-free) as long as the adjustable frequency drive is unable to 'support' the motor, such as when the load is too heavy, for example.
- Select Mechanical brake control [32] in par. 5-4\* for applications with an electro-mechanical brake.
- The brake is released when the motor current exceeds the preset value in par. 2-20 Release Brake Current.
- The brake is engaged when the output frequency is less than the frequency set in par. 2-21 *Activate Brake Speed [RPM]* or par. 2-22 *Activate Brake Speed [Hz]*, and only if the adjustable frequency drive carries out a stop command.

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

### 4.5.2 Parallel Connection of Motors

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



### NOTE!

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



### NOTE!

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

### NOTE!

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



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

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### 4.5.3 Motor Thermal Protection

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

For thermal motor protection, it is also possible to use the MCB 112 PTC thermistor card option. This card provides an ATEX certificate to protect motors in explosion hazard areas, Zone 1/21 and Zone 2/22. Please refer to the *Design Guide* for further information.

4 Electrical Installation

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## 5 How to Operate the Adjustable Frequency Drive

### 5.1.1 Three Ways of Operating

### The adjustable frequency drive can be operated in three ways:

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

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

### 5.1.2 How to Operate the GraphicalLCP (GLCP)

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

The GLCP is divided into four functional groups:

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

### Graphical display:

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

### **Display lines:**

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



Drive

The display is divided into 3 sections:

The top section (a) shows the status when in status mode or up to 2 variables when not in status mode and in case of an alarm/warning.

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

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

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

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

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

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

5.25 A; 15.2 A 105 A.

### Status display I:

This readout state is standard after startup or initialization. Use [INFO] to obtain information about the value/measurement linked to the displayed operating variables (1.1, 1.2, 1.3, 2, and 3).

See the operating variables shown in the display in this figure. 1.1, 1.2 and 1.3 are shown in small size. 2 and 3 are shown in medium size.



#### Status display II:

See the operating variables (1.1, 1.2, 1.3, and 2) shown in the display in this figure.

In the example, Speed, Motor current, Motor power and Frequency are selected as variables in the first and second lines.

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



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#### Status display III:

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

Status 1(1) 835RPM 2.09A 0.97kW 835RPM 2.09A 0.97kW 80000 State: 0 of 0 (off) When: -Do: -Auto Remote Running

#### **Display Contrast Adjustment**

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



### LEDs:

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

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



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#### Menu keys

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



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#### [Status]

indicates the status of the adjustable frequency drive and/or the motor. Three different readouts can be chosen by pressing the [Status] key: 5 line readouts, 4 line readouts or Smart Logic Control.

Use [Status] for selecting the mode of display or for changing back to display mode from either the quick menu mode, main menu mode or alarm mode. Also use the [Status] key to toggle single or double readout mode.

#### [Ouick Menu]

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

#### The [Quick Menu] consists of:

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

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

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

#### [Main Menu]

is used for programming all parameters. The main menu parameters can be accessed immediately unless a password has been created via par. 0-60 Main Menu Password, par. 0-61 Access to Main Menu w/o Password, par. 0-65 Personal Menu Password or par. 0-66 Access to Personal Menu w/o Password. For the majority of VLT HVAC Drive applications, it is not necessary to access the Main Menu parameters but instead the Quick Menu, Quick Set-up and Function Set-up provide the simplest and quickest access to parameters that are typically required.

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

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

#### [Alarm Log]

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

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

#### [Back]

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

#### [Cancel]

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

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#### [Info]

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





#### [Hand On]

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

- [Hand On] [Off] [Auto on] •
- Reset •
- Coasting stop inverse •
- Reversing
- Set-up select lsb Set-up select msb •
- Stop command from serial communication •
- Quick stop ٠
- DC brake

5

Drive





### NOTE!

NOTE!

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

### [Off]

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

#### [Auto on]

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



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

### [Reset]

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

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

### 5.1.3 RS-485 Bus Connection

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

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



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

#### **Bus termination**

The RS-485 bus must be terminated by a resistor network at both ends. If the drive is the first or the last device in the RS-485 loop, set the switch S801 on the control card to ON.

For more information, see the paragraph Switches S201, S202, and S801.

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### 5.1.4 How to connect a PC to the adjustable frequency drive

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



### NOTE!

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



### 5.1.5 PC software tools

### PC-based Configuration Tool MCT 10

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

#### MCT 10 set-up software

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

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

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

Drive



### Save adjustable frequency drive settings:

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

All parameters are now stored on the PC.

#### Load adjustable frequency drive settings:

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

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

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

### The MCT 10 Set-up software modules

The following modules are included in the software package:

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

#### Ordering number:

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

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

### 5.1.6 Tips and Tricks

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

Table 5.1: Tips and tricks

### 5.1.7 Quick Transfer of Parameter Settings When Using GLCP

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



Stop the motor before performing any of these operations,.

#### Data storage in LCP:

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

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

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

#### Data transfer from LCP to adjustable frequency drive:

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

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

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### 5.1.8 Initialization to Default Settings

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

#### Recommended initialization (via par. 14-22 Operation Mode)

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

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

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

#### Manual initialization



### NOTE!

NOTE!

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

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

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

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

3. Release the keys after 5 s

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

This parameter initializes all except:

Par. 15-00 Operating Hours

Par. 15-03 Power-ups

Par. 15-04 Over Temps Par. 15-05 Over Volts

# 6 How to Program

### 6.1.1 Parameter Set-up

Group	Title	Function
0-	Operation and Display	Parameters used to program the fundamental functions of the adjustable frequency drive and the LCP
		including: selection of language; selection of which variables are displayed at each position in the display
		(e.g., static duct pressure or condenser water return temperature can be displayed with the setpoint in
		small digits in the top row and feedback in large digits in the center of the display); enabling/disabling
		of the LCP keys/buttons; passwords for the LCP; upload and download of commissioned parameters to/
		from the LCP and setting the built-in clock.
1-	Load / Motor	Parameters used to configure the adjustable frequency drive for the specific application and motor in-
		cluding: open or closed-loop operation; type of application such as compressor, fan or centrifugal pump;
		motor nameplate data; auto-tuning of the drive to the motor for optimum performance; flying start
		(typically used for fan applications) and motor thermal protection.
2-	Brakes	Parameters used to configure braking functions of the adjustable frequency drive which although not
		common in many HVAC applications, can be useful on special fan applications. Parameters including: DC
		braking; dynamic/resistor braking and overvoltage control (which provides automatic adjustment of the
		deceleration rate (auto-ramping) to avoid tripping when decelerating large inertia fans)
3-	Reference / Ramps	Parameters used to program the minimum and maximum reference limits of speed (RPM/Hz) in open-
		loop or in actual units when operating in closed-loop); digital/preset references; jog speed; definition of
		the source of each reference (e.g., which analog input the reference signal is connected to); ramp-up
		and ramp-down times and digital potentiometer settings.
4-	Limits / Warnings	Parameters used to program limits and warnings of operation including: allowable motor direction; min-
		imum and maximum motor speeds (e.g., in pump applications, it is typical to program a minimum speed
		to approx 30-40% to ensure pump seals are adequately lubricated at all times, avoid cavitation and
		ensure adequate head is produced at all times to create flow); torque and current limits to protect the
		pump, fan or compressor driven by the motor; warnings for low/high current, speed, reference, and
		feedback; missing motor phase protection; speed bypass frequencies including semi-automatic set-up
		of these frequencies (e.g., to avoid resonance conditions on cooling tower and other fans).
5-	Digital In / Out	Parameters used to program the functions of all digital inputs, digital outputs, relay outputs, pulse inputs
		and pulse outputs for terminals on the control card and all option cards.
6-	Analog In / Out	Parameters used to program the functions associated with all analog inputs and analog outputs for the
		terminals on the control card and General Purpose I/O option (MCB101) (note: NOT Analog I/O option
		MCB109, see parameter group 26-00) including: analog input live zero timeout function (which, for ex-
		ample, can be used to command a cooling tower fan to operate at full speed if the condenser water
		return sensor fails); scaling of the analog input signals (for example, to match the analog input to the
		mA and pressure range of a static duct pressure sensor); filter time constant to filter out electrical noise
		on the analog signal which can sometimes occur when long cables are installed; function and scaling of
		the analog outputs (for example, to provide an analog output representing motor current or kW to an
		analog input of a DDC controller) and to configure the analog outputs to be controlled by the BMS via a
		high level interface (HLI) (e.g., to control a chilled water valve) including ability to define a default value
		of these outputs in the event of the HLI failing.
8-	Communication and Options	Parameters used for configuring and monitoring functions associated with the serial communications /
		high level interface to the adjustable frequency drive
9-	Profibus	Parameters only applicable when a Profibus option is installed.
10-	CAN Fieldbus	Parameters only applicable when a DeviceNet option is installed.
11-	LonWorks	Parameters only applicable when a Lonworks option is installed.

Table 6.1: Parameter Groups

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

6

6

22-	Application Functions	Parameters used to monitor, protect and control pumps, fans and compressors including: no flow de- tection and protection of pumps (including auto-setup of this function); dry pump protection; end of curve detection and protection of pumps; sleep mode (especially useful for cooling tower and booster pump sets); broken belt detection (typically used for fan applications to detect no air flow instead of using a $\Delta p$ switch installed across the fan); short cycle protection of compressors and pump flow com- pensation of setpoint (especially useful for secondary chilled water pump applications where the $\Delta p$ sensor has been installed close to the pump and not across the furthest most significant load(s) in the system; using this function can compensate for the sensor installation and help to realize the maximum energy savings).
23-	Time-based Functions	Time based parameters including: those used to initiate daily or weekly actions based on the built-in real time clock (e.g., change of setpoint for night set back mode or start/stop of the pump/fan/compressor start/stop of a external equipment); preventative maintenance functions which can be based on running or operating hour time intervals or on specific dates and times; energy log (especially useful in retrofit applications or where information of the actual historical load (kW) on the pump/fan/compressor is of interest); trending (especially useful in retrofit or other applications where there is an interest to log operating power, current, frequency or speed of the pump/fan/compressor for analysis and a payback counter.
24-	Application Functions 2	Parameters used to set up fire mode and/or to control a bypass contactor/starter if designed into the system.
25-	CascadePack Controller	Parameters used to configure and monitor the built-in pump cascadepack controller (typically used for pump booster sets).
26-	Analog I/O Option MCB 109	Parameters used to configure the analog I/O option (MCB109) including: definition of the analog input types (e.g., voltage, Pt1000 or Ni1000) and scaling and definition of the analog output functions and scaling.

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

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

### 6.1.2 Quick Menu mode

### Parameter data

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

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

### Example of changing parameter data

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

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

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

### Select [My Personal Menu] to display personal parameters:

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

### Select [Changes Made] to get information about:

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

#### Select [Loggings]:

to get information about the display line readouts. The information is shown as graphs.

Only display parameters selected in par. 0-20 *Display Line 1.1 Small* and par. 0-24 *Display Line 3 Large* can be viewed. It is possible to store up to 120 samples in the memory for later reference.

### **Quick Setup**

#### Efficient Parameter Set-up for VLT HVAC Drive Applications:

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

Assume you want to set the ramp-down time to 100 seconds!

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

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

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



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

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

Table 6.2: Quick Setup parameters

NOTE!

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

\*\* Par. 5-40 *Function Relay*, is an array, where one may choose between Relay1 [0] or Relay2 [1]. Standard setting is Relay1 [0] with the default choice Alarm [9].

See the parameter description in the section Commonly Used Parameters.

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

x=version number



#### y=language

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

0-01 Language			
Option	:	Function:	
		Defines the language to be used in the display. The adjustable frequency drive can be delivered with 4 different language packages. English and German are included in all packages. English cannot be erased or manipulated.	
[0] *	English	Part of Language packages 1 - 4	
[1]	Deutsch	Part of Language packages 1 - 4	
[2]	Francais	Part of Language package 1	
[3]	Dansk	Part of Language package 1	
[4]	Spanish	Part of Language package 1	
[5]	Italiano	Part of Language package 1	

	Svenska	Part of Language package 1
[7]	Nederlands	Part of Language package 1
	Chinese	Part of Language package 2
	Suomi	Part of Language package 1
	English US	Part of Language package 4
	Greek	Part of Language package 4
	Bras.port	Part of Language package 4
	Slovenian	Part of Language package 3
	Korean	Part of Language package 2
	Japanese	Part of Language package 2
	Turkish	Part of Language package 4
	Trad.Chinese	Part of Language package 2
	Bulgarian	Part of Language package 3
	Srpski	Part of Language package 3
	Romanian	Part of Language package 3
	Magyar	Part of Language package 3
	Czech	Part of Language package 3
	Polski	Part of Language package 4
	Russian	Part of Language package 3
	Thai	Part of Language package 2
	Bahasa Indonesia	Part of Language package 2
1-20 M	lotor Power [kW]	
Range:		Function:
4.00 kW*	[0.09 - 3000.00 kW]	
1-21 M	lotor Power [HP]	
Range:		Function:
4.00 hp*	[0.09 - 3000.00 hp]	Enter the nominal motor power in HP according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit. This parameter cannot be adjusted while the motor is running. Depending on the choices made in par. 0-03 <i>Regional Settings</i> , either par. 1-20 <i>Motor Power [kW]</i> or par. 1-21 <i>Motor Power [HP]</i> is made invisible.
1-22 M	lotor Voltage	
Range:		Function:
400. V*	[10 1000. V]	Enter the nominal motor voltage according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit. This parameter cannot be adjusted while the motor is running.

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1-23 Mo	otor Frequency	
Range:		Function:
50. Hz*	[20 - 1000 Hz]	Select the motor frequency value from the motor nameplate data.For 87 Hz operation with 230/400 V motors, set the nameplate data for 230 V/50 Hz. Adapt par. 4-13 <i>Motor Speed High Limit [RPM]</i> and par. 3-03 <i>Maximum Reference</i> to the 87 Hz application.
5	<b>NOTE!</b> This parameter cannot be adjuste	ed while the motor is running.
1-24 Mo	otor Current	
Range:		Function:
7.20 A*	[0.10 - 10000.00 A]	Enter the nominal motor current value from the motor nameplate data. This data is used for cal- culating motor torque, motor thermal protection, etc.
65	<b>NOTE!</b> This parameter cannot be adjuste	ed while the motor is running.
1 35 M	ter Neminal Creed	
I-25 MG	otor Nominal Speed	Function
tange:	[100 60000 DDM]	Function:
1420. KPM	[100 - 00000 KPM]	lating automatic motor compensations.
5	<b>NOTE!</b> This parameter cannot be adjuste	ed while the motor is running.
1-28 M	otor Rotation Check	
Option:		Function:
		Following installation and connection of the motor, this function allows the correct motor rotation direction to be verified. Enabling this function overrides any bus commands or digital inputs, except External Interlock and Safe Stop (if included).

[0] *	OFF	Motor Rotation Check is not active.
[1]	Enabled	Motor Rotation Check is enabled. Once enabled, display shows:
		"Please Note! Motor may run in wrong direction".

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



Line power must be removed before disconnecting motor phase cables.

3-41 Ra	amp 1 Ramp-up Time	
Range:		Function:
10.00 s*	[1.00 - 3600.00 s]	
3-42 Ra	amp 1 Ramp-down Time	
Range:		Function:
20.00 s*	[1.00 - 3600.00 s]	
4-14 M	otor Speed High Limit [Hz	2]
Range:		Function:
50/60.0 Hz*	[par. 4-12 - par. 4-19 Hz]	Enter the maximum limit for motor speed. The Motor Speed High Limit can be set to correspond to the manufacturer's recommended maximum of the motor shaft. The Motor Speed High Limit must exceed the in par. 4-12 <i>Motor Speed Low Limit [Hz]</i> . Only par. 4-11 <i>Motor Speed Low Limit [RPM]</i> or par. 4-12 <i>Motor Speed Low Limit [Hz]</i> will be displayed, depending on other parameters in the main menu, and depending on default settings dependant on global location.



NOTE!

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

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

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



## NOTE!

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



## NOTE!

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

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4-11 Mo	4-11 Motor Speed Low Limit [RPM]			
Range:		Function:		
0 RPM*	[0 - par. 4-13 RPM]	Enter the minimum limit for motor speed. The Motor Speed Low Limit can be set to correspond to the manufacturer's recommended minimum motor speed. The Motor Speed Low Limit must not exceed the setting in par. 4-13 <i>Motor Speed High Limit [RPM]</i> .		
3-11 Jo	g Speed [Hz]			
Range:		Function:		
10.0 Hz*	[0.0 - par. 4-14 Hz]	The jog speed is a fixed output speed at which the adjustable frequency drive is running when the jog function is activated. See also par, 3-80 <i>log Ramp Time</i> .		

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## 6.1.3 Function Set-ups

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

#### How to access Function set-up - example



## 6 How to Program



## Function Set-ups parameters

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

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

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

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

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

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

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



This parameter cannot be changed when the motor is running.



## NOTE!

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

1-03 Torque Characteristics		
Option:		Function:
[0] *	Compressor torque	<i>Compressor</i> [0]: For speed control of screw and scroll compressors. Provides a voltage which is optimized for a constant torque load characteristic of the motor in the entire range down to 10 Hz.
[1]	Variable torque	<i>Variable Torque</i> [1]: For speed control of centrifugal pumps and fans. Also to be used when con- trolling more than one motor from the same adjustable frequency drive (e.g., multiple condenser fans or cooling tower fans). Provides a voltage which is optimized for a squared torque load char- acteristic of the motor.
[2]	Auto Energy Optim. CT	<i>Auto Energy Optimization Compressor</i> [2]: For optimum energy-efficient speed control of screw and scroll compressors. Provides a voltage that is optimized for a constant torque load characteristic of the motor in the entire range down to 15 Hz. In addition, the AEO feature will adapt the voltage exactly to the current load situation, thereby reducing energy consumption and audible noise from the motor. To obtain optimal performance, the motor power factor cos phi must be set correctly. This value is set in par. 14-43 <i>Motor Cos-Phi.</i> The parameter has a default value which is automatically adjusted when the motor data is programmed. These settings will typically ensure optimum motor voltage but if the motor power factor cos phi requires tuning, an AMA function can be carried out using par. 1-29 <i>Automatic Motor Adaptation (AMA).</i> It is very rarely necessary to adjust the motor power factor parameter manually.
[3] *	Auto Energy Optim. VT	<i>Auto Energy Optimization VT</i> [3]: For optimum energy efficient speed control of centrifugal pumps and fans. Provides a voltage which is optimized for a squared torque load characteristic of the motor but in addition the AEO feature will adapt the voltage exactly to the current load situation, thereby reducing energy consumption and audible noise from the motor. To obtain optimal performance, the motor power factor cos phi must be set correctly. This value is set in par. 14-43 <i>Motor Cos-</i> <i>Phi.</i> The parameter has a default value and is automatically adjusted when the motor data is pro- grammed. These settings will typically ensure optimum motor voltage but if the motor power factor cos phi requires tuning, an AMA function can be carried out using par. 1-29 <i>Automatic Motor Adap-</i> <i>tation (AMA).</i> It is very rarely necessary to adjust the motor power factor parameter manually.

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

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

NOTE:

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



## NOTE!

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



## NOTE!

Avoid generating external torque during AMA.



### NOTE!

If one of the settings in par. 1-2\* Motor Data is changed, par. 1-30 *Stator Resistance (Rs)* to par. 1-39 *Motor Poles*, the advanced motor parameters, will return to the default setting.

This parameter cannot be adjusted while the motor is running.



## NOTE!

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

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

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

1-/3 F	lying Start	
Option	:	Function:
		This function makes it possible to catch a motor that is spinning freely due to a line drop-out.
		<ul> <li>When par. 1-73 <i>Flying Start</i> is enabled, par. 1-71 <i>Start Delay</i> has no function.</li> <li>Search direction for flying start is linked to the setting in par. 4-10 <i>Motor Speed Direction.</i></li> <li><i>Clockwise</i> [0]: Flying start search in clockwise direction. If not successful, a DC brake is carried out.</li> <li><i>Both Directions</i> [2]: The flying start will first make a search in the direction determined by the last reference (direction). If unable to find the speed, it will search in the other direction. If not successful, a DC brake will be activated in the time set in par. 2-02 <i>DC Braking Time</i>. Start will then take place from 0 Hz.</li> </ul>
[0] *	Disabled	Select <i>Disable</i> [0] if this function is not required
[1]	Enabled	Select <i>Enable</i> [1] to enable the adjustable frequency drive to "catch" and control a spinning motor.
1-80 F	unction at Stop	
Option	:	Function:
		Select the adjustable frequency drive function after a stop command or after the speed is ramped down to the settings in par. 1-81 <i>Min Speed for Function at Stop [RPM]</i> .
[0] *	Coast	Leaves motor in free mode.
[1]	DC Hold/Motor Preheat	Energizes motor with a DC holding current (see par. 2-00 DC Hold/Preheat Current).
1-90 N	otor Thermal Protection	
Option	:	Function:
		<ul> <li>I he adjustable frequency drive determines the motor temperature for motor protection in two different ways:</li> <li>Via a thermistor sensor connected to one of the analog or digital inputs (par. 1-93 <i>Thermistor Source</i>).</li> <li>Via calculation (ETR = Electronic Thermal Relay) of the thermal load, based on the actual load and time. The calculated thermal load is compared with the rated motor current I<sub>M,N</sub> and the rated motor frequency f<sub>M,N</sub>. The calculations estimate the need for a lower load at lower speed due to less cooling from the fan incorporated in the motor.</li> </ul>
[0]	No protection	If the motor is continuously overloaded and no warning or trip of adjustable frequency drive is wanted.
[1]	Thermistor warning	Activates a warning when the connected thermistor in the motor reacts in the event of motor over- temperature.
[2]	Thermistor trip	Stops (trips) the adjustable frequency drive when the connected thermistor in the motor reacts in the event of motor overtemperature.
[3]	ETR warning 1	
[4] *	ETR trip 1	
[5]	ETR warning 2	
[6]	ETR trip 2	
[7]	ETR warning 3	
[8]	ETR trip 3	
[9]	ETR warning 4	
[10]	ETR trip 4	

## 6 How to Program

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





# 5

#### NOTE!

Danfoss recommends using 24 VDC as thermistor supply voltage.

1-93 T	hermistor Source	
Option:		Function:
		Select the input to which the thermistor (PTC sensor) should be connected. An analog input option [1] or [2] cannot be selected if the analog input is already in use as a reference source (selected in par. 3-15 <i>Reference 1 Source</i> , par. 3-16 <i>Reference 2 Source</i> or par. 3-17 <i>Reference 3 Source</i> ). When using MCB112, choice [0] <i>None</i> must always be selected.
[0] *	None	
[1]	Analog input 53	
[2]	Analog input 54	
[3]	Digital input 18	
[4]	Digital input 19	
[5]	Digital input 32	
[6]	Digital input 33	



## NOTE!

This parameter cannot be adjusted while the motor is running.



## NOTE!

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

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



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

2-10 Brake Function		
Option	1	Function:
[0] *	Off	No brake resistor installed.
[1]	Resistor brake	Brake resistor incorporated in the system, for dissipation of surplus braking energy as heat. Con- necting a brake resistor allows a higher DC link voltage during braking (generating operation). The resistor brake function is only active in adjustable frequency drives with an integral dynamic brake.
[2]	AC brake	AC Brake will only work in Compressor Torque mode in par. 1-03 Torque Characteristics.
2-17 0	2-17 Over-voltage Control	
Option:		Function:
		Overvoltage control (OVC) reduces the risk of the adjustable frequency drive tripping due to over- voltage on the DC link caused by generative power from the load.
[0]	Disabled	No OVC required.
[2] *	Enabled	Activates OVC.
5	<b>NOTE!</b> The ramp time is automatically a	djusted to avoid tripping of the adjustable frequency drive.

## 3-02 Minimum Reference

Range:	Function:
0.000 Ref- [-999999.999 - par. 3-03 Referen-	Enter the Minimum Reference. The Minimum Reference is the lowest value obtainable by adding all
erenceFeed-ceFeedbackUnit]	references together. The Minimum Reference value and unit matches the configuration choice made $% \left( {{{\rm{A}}_{\rm{B}}}} \right)$
backUnit*	in par. 1-00 Configuration Mode and par. 20-12 Reference/Feedback Unit, respectively.
	NOTE! This parameter is used in open-loop only.

## 3-03 Maximum Reference

Range:	Function:	
50.000 Ref- [par. 3-02 - 999999.999 Referen- erenceFeed-ceFeedbackUnit] backUnit*	Enter the maximum acceptable value for the remote reference. The Maximum Reference value and unit matches the configuration choice made in par. 1-00 <i>Configuration Mode</i> and par. 20-12 <i>Reference/Feedback Unit</i> , respectively.	
	NOTE! If operating with par. 1-00 <i>Configuration Mode</i> set for Closed-loop [3], par. 20-14 <i>Maximum Reference/Feedb.</i> must be used.	

#### **3-10 Preset Reference**

#### Array [8]



## 3-15 Reference 1 Source

**Option:** 

#### Function:

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

This parameter cannot be adjusted while the motor is running.

[0]	No function
[1] *	Analog input 53
[2]	Analog input 54
[7]	Pulse input 29
[8]	Pulse input 33
[20]	Digital pot.meter
[21]	Analog input X30/11
[22]	Analog input X30/12
[23]	Analog Input X42/1
[24]	Analog Input X42/3
[25]	Analog Input X42/5
[30]	Ext. Closed-loop 1

[31] Ext. Closed-loop 2

[32] Ext. Closed-loop 3

3-16 R	3-16 Reference 2 Source			
Option:		Function:		
		Select the reference input to be used for the second reference signal. par. 3-15 <i>Reference 1 Source</i> , par. 3-16 <i>Reference 2 Source</i> and par. 3-17 <i>Reference 3 Source</i> define up to three different reference signals. The sum of these reference signals defines the actual reference. This parameter cannot be adjusted while the motor is running.		
[0]	No function			
[0]	Angle a jacent 52			
[1]	Analog input 53			
[2]	Analog input 54			
[7]	Pulse input 29			
[8]	Pulse input 33			
[20] *	Digital pot.meter			
[21]	Analog input X30/11			
[22]	Analog input X30/12			
[23]	Analog Input X42/1			
[24]	Analog Input X42/3			
[25]	Analog Input X42/5			
[30]	Ext. Closed-loop 1			
[31]	Ext. Closed-loop 2			
[32]	Ext. Closed-loop 3			
4-10 M	4-10 Motor Speed Direction			
<b>Option:</b>		Function:		
		Selects the motor speed direction required.		
		Use this parameter to prevent unwanted reversing.		
[0]	Clockwise	Only operation in a clockwise direction will be allowed.		
[ <b>7</b> ] *	Poth directions	Operation in both a clockwice and anti-clockwice direction will be allowed		



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

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

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

If a different value is needed in par. 4-53 *Warning Speed High*, it must be set after programming of par. 4-13 *Motor Speed High Limit* [*RPM*]!

4-56 W	arning Feedback Low		
Range:		Function:	
-9999999.99 9 Proc essCtrlU- nit*	9 [-999999.999 - par. 4-57 Proc- - essCtrlUnit]	Enter the lower feedback limit. When the feedback falls below this limit, the display reads Feedb Low. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.	
4-57 W	arning Feedback High		
Range:		Function:	
999999.999 ProcessCtr- IUnit*	9 [par. 4-56 - 999999.999 ProcessCtr- · IUnit]	Enter the upper feedback limit. When the feedback exceeds this limit, the display reads Feedb High. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.	
4-64 S	emi-Auto Bypass Set-up		
Option:		Function:	
[0] *	OFF	No function	
[1]	Enabled	Starts the semi-automatic bypass set-up and continue with the procedure described above.	
5-01 Te	erminal 27 Mode		
Option:		Function:	
[0] *	Input	Defines terminal 27 as a digital input.	
[1]	Output	Defines terminal 27 as a digital output.	
Please note that this parameter cannot be adjusted while the motor is running.			
5-02 Te	erminal 29 Mode		
Option:		Function:	
[0] *	Input	Defines terminal 29 as a digital input.	

Output

[1]

This parameter cannot be adjusted while the motor is running.

6

Defines terminal 29 as a digital output.

## 6.1.4 5-1\* Digital Inputs

Parameters for configuring the input functions for the input terminals.

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

Digital input function	Select	Terminal
No operation	[0]	All *terminal 19, 32, 33
Reset	[1]	All
Coast inverse	[2]	27
Coast and reset inverse	[3]	All
DC brake inverse	[5]	All
Stop inverse	[6]	All
External interlock	[7]	All
Start	[8]	All *terminal 18
Latched start	[9]	All
Reversing	[10]	All
Start reversing	[11]	All
Joq	[14]	All *terminal 29
Preset reference on	[15]	All
Preset ref bit 0	[16]	All
Preset ref bit 1	[17]	All
Preset ref bit 2	[18]	All
Freeze reference	[19]	All
Freeze output	[20]	All
Speed up	[21]	All
Slow	[22]	All
Set-up select bit 0	[23]	All
Set-up select bit 1	[24]	All
Pulse input	[32]	terminal 29, 33
Ramp bit 0	[34]	All
Mains failure inverse	[36]	All
Fire mode	[37]	All
Run Permissive	[57]	All
Hand start	[53]	All
Auto-start	[54]	All
DigiPot Increase	[55]	All
DigiPot Decrease	[56]	All
DigiPot Clear	[57]	All
Counter A (un)	[60]	29 33
Counter A (down)	[61]	29,33
Reset Counter A	[62]	ΔII
Counter B (up)	[63]	29.33
Counter B (down)	[64]	29, 33
Peset Counter B	[65]	۵IJ
Sleen Mode	[65]	
Reset Maintenance Word	[78]	
Load Bump Start	[10]	
	[120]	
	[121]	
	[130]	
	[13]	
Pump 5 Intenock	[132]	All

	erminal 27 Digital Input	
Same optio	ons and functions as par. 5-1*, except	for <i>Pulse input</i> .
Option:		Function:
[0] *	No operation	
5-13 T	erminal 29 Digital Input	
Same optio	ons and functions as par. 5-1*.	
Option:		Function:
[14] *	Jog	
5-14 T	erminal 32 Digital Input	
Same optic	ons and functions as par. 5-1*, except	for Pulse input.
Option:		Function:
[0] *	No operation	
E 4E T		
Same ontic	eminal 55 Digital Input	Tonute
Ontion	nis and functions as part 5-1. Digital I	
[0] *	No operation	
[*]		
5-40 F	unction Relay	
Array [8]	1] Delay 2 [1]	
Option MC	B 105: Relay 7 [6], Relay 8 [7] and Re	av 9 [8]).
Select opti	ons to define the function of the relay	S.
Select opti The selecti	ons to define the function of the relay on of each mechanical relay is realized	s. d in an array parameter.
Select option The selection <b>Option</b> :	ons to define the function of the relays on of each mechanical relay is realized	d in an array parameter. Function:
Select option The selection <b>Option:</b> [0] *	ons to define the function of the relay on of each mechanical relay is realized No operation	s. d in an array parameter. Function:
Select opti The selecti <b>Option:</b> [0] * [1]	ons to define the function of the relays on of each mechanical relay is realized No operation Control ready	s. d in an array parameter. Function:
Select opti The selecti <b>Option:</b> [0] * [1] [2]	No operation Control ready Drive ready	s. d in an array parameter. Function:
Select opti The selecti <b>Option:</b> [0] * [1] [2] [3]	No operation Control ready Drive ready Drive rdy/rem ctrl	s. d in an array parameter. Function:
Select opti The selecti <b>Option:</b> [0] * [1] [2] [3] [4]	No operation Control ready Drive ready Drive rdy/rem ctrl Stand-by / no warning	s. d in an array parameter. Function:
Select opti The selecti <b>Option:</b> [0] * [1] [2] [3] [4] [5] *	No operation Control ready Drive ready Drive ready Drive rdy/rem ctrl Stand-by / no warning Running	S. d in an array parameter. Function: Default setting for relay 2.
Select opti The selecti Option: [0] * [1] [2] [3] [4] [5] * [6]	No operation Control ready Drive ready Drive ready Drive rdy/rem ctrl Stand-by / no warning Running Running / no warning	s. d in an array parameter. Function: Default setting for relay 2.
Select opti The selecti Option: [0] * [1] [2] [3] [4] [5] * [6] [8]	No operation Control ready Drive ready Drive ready Drive rdy/rem ctrl Stand-by / no warning Running Running / no warning	S. d in an array parameter. Function: Default setting for relay 2.
Select opti The selecti Option: [0] * [1] [2] [3] [4] [5] * [6] [8] [9] *	No operation Control ready Drive ready Drive ready Drive rdy/rem ctrl Stand-by / no warning Running Running / no warning Run on ref/no warn Alarm	S. d in an array parameter. Function: Default setting for relay 2. Default setting for relay 1.
Select opti The selecti Option: [0] * [1] [2] [3] [4] [5] * [6] [8] [9] * [10]	No operation Control ready Drive ready Drive ready Drive redy/rem ctrl Stand-by / no warning Running Running / no warning Run on ref/no warn Alarm Alarm or warning	S. d in an array parameter. Function: Default setting for relay 2. Default setting for relay 1.
Select opti The selecti Option: [0] * [1] [2] [3] [4] [5] * [6] [8] [9] * [10] [11]	No operation Control ready Drive ready Drive ready Drive rdy/rem ctrl Stand-by / no warning Running Running / no warning Run on ref/no warn Alarm Alarm or warning At torque limit	S. d in an array parameter. Function: Default setting for relay 2. Default setting for relay 1.
Select opti The selecti <b>Option:</b> [0] * [1] [2] [3] [4] [5] * [6] [8] [9] * [10] [11] [12]	No operation Control ready Drive ready Drive ready Drive ready Drive ready Running Running Run on ref/no warning Alarm Alarm At torque limit Out of current range	S. d in an array parameter. Function: Default setting for relay 2. Default setting for relay 1.
Select opti The selecti Option: [0] * [1] [2] [3] [4] [5] * [6] [6] [8] [9] * [10] [11] [12] [13]	No operation Control ready Drive ready Drive ready Drive ready Drive rdy/rem ctrl Stand-by / no warning Running Running / no warning Run on ref/no warn Alarm Alarm Alarm or warning At torque limit Out of current range Below current, low	s. d in an array parameter. Function: Default setting for relay 2. Default setting for relay 1.
Select opti The selecti Option: [0] * [1] [2] [3] [4] [5] * [6] [8] [9] * [10] [11] [12] [12] [13] [14]	No operation Control ready Drive ready Drive ready Drive rdy/rem ctrl Stand-by / no warning Running Running / no warning Runn on ref/no warn Alarm Alarm or warning At torque limit Out of current range Below current, low Above current, high	S. d in an array parameter. Function: Default setting for relay 2. Default setting for relay 1.
Select opti The selecti Option: [0] * [1] [2] [3] [4] [5] * [6] [6] [8] [9] * [10] [11] [12] [13] [14] [15]	No operation Control ready Drive ready Drive ready Drive ready Drive ready Control ready Drive ready Drive ready Running Running Running Running / no warning Run on ref/no warn Alarm Alarm Alarm Out of current range Below current, low Above current, high Out of speed range	s. d in an array parameter. Function: Default setting for relay 2. Default setting for relay 1.
Select opti The selecti <b>Option:</b> [0] * [1] [2] [3] [4] [5] * [6] [8] [9] * [10] [11] [12] [12] [13] [14] [15] [16]	ons to define the function of the relays on of each mechanical relay is realized No operation Control ready Drive ready Drive ready Drive rdy/rem ctrl Stand-by / no warning Running Running / no warning Run on ref/no warn Alarm Alarm Alarm or warning At torque limit Out of current range Below current, high Out of speed range Below speed, low	s. d in an array parameter. Function: Default setting for relay 2. Default setting for relay 1.
Select opti The selecti (0) * (1) (2) (3) (4) (5) * (6) (8) (9) * (10) (11) (12) (11) (12) (13) (14) (15) (14) (15) (16) (17)	No operation Control ready Drive ready Drive ready Drive ready Drive ready Control ready Drive ready Drive ready Running Running Running Running / no warning Run on ref/no warn Alarm Alarm Alarm Alarm or warning At torque limit Out of current range Below current, low Above current, high Out of speed range Below speed, low Above speed, high	S. d in an array parameter. Function: Default setting for relay 2. Default setting for relay 1.

## 6 How to Program



[20]	Above feedback, high
[21]	Thermal warning
[25]	Reverse
[26]	Bus OK
[27]	Torque limit stop
[28]	Brake: No Brake War
[29]	Brake ready, no fault
[30]	Brake fault (IGBT)
[35]	External Interlock
[36]	Control word bit 11
[37]	Control word bit 12
[40]	Out of ref range
[41]	Below reference, low
[42]	Above ref, high
[45]	Bus ctrl.
[46]	Bus ctrl, 1 if timeout
[47]	Bus ctrl, 0 if timeout
[60]	Comparator 0
[61]	Comparator 1
[62]	Comparator 2
[63]	Comparator 3
[64]	Comparator 4
[65]	Comparator 5
[70]	Logic rule 0
[71]	Logic rule 1
[72]	Logic rule 2
[73]	Logic rule 3
[74]	Logic rule 4
[75]	Logic rule 5
[80]	SL digital output A
[81]	SL digital output B
[82]	SL digital output C
[83]	SL digital output D
[84]	SL digital output E
[85]	SL digital output F
[160]	No alarm
[161]	Running reverse
[165]	Local ref active
[166]	Remote ref active
[167]	Start cmd. active
[168]	Hand mode
[169]	Auto mode
[180]	Clock Fault

[181]	Prev. Maintenance	
[190]	No-Flow	
[191]	Dry Pump	
[192]	End Of Curve	
[193]	Sleep Mode	
[194]	Broken Belt	
[195]	Bypass Valve Control	
[196]	Fire Mode Active	
[197]	Fire Mode Was Active	
[198]	Bypass Mode Active	
[211]	Cascade Pump 1	
[212]	Cascade Pump 2	
[213]	Cascade Pump 3	
6-00 L	ive Zero Timeout Time	
Range:	l	Function:
10 s*	[1 - 99 s]	Enter the Live Zero Timeout time period. Live Zero Timeout Time is active for analog inputs, i.e., terminal 53 or terminal 54, used as reference or feedback sources. If the reference signal value associated with the selected current input falls below 50% of the value set in par. 6-10 <i>Terminal 53 Low Voltage</i> , par. 6-12 <i>Terminal 53 Low Current</i> , par. 6-20 <i>Terminal 54 Low Voltage</i> or par. 6-22 <i>Terminal 54 Low Current</i> for a time period longer than the time set in par. 6-00 <i>Live Zero Timeout Time</i> , the function selected in par. 6-01 <i>Live Zero Timeout Function</i> will be activated.
6-01 L	ive Zero Timeout Function	
6-01 L Option	ive Zero Timeout Function	Function:
6-01 L Option	ive Zero Timeout Function	<b>Function:</b> Select the timeout function. The function set in par. 6-01 <i>Live Zero Timeout Function</i> will be activated if the input signal on terminal 53 or 54 is below 50% of the value in par. 6-10 <i>Terminal 53 Low Voltage</i> , par. 6-12 <i>Terminal 53 Low Current</i> , par. 6-20 <i>Terminal 54 Low Voltage</i> or par. 6-22 <i>Terminal 54 Low Current</i> for a time period defined in par. 6-00 <i>Live Zero Timeout Time</i> . If several timeouts occur simultaneously, the adjustable frequency drive prioritizes the timeout functions as follows:
6-01 L Option	ive Zero Timeout Function	Function:         Select the timeout function. The function set in par. 6-01 Live Zero Timeout Function will be activated if the input signal on terminal 53 or 54 is below 50% of the value in par. 6-10 Terminal 53 Low Voltage, par. 6-12 Terminal 53 Low Current, par. 6-20 Terminal 54 Low Voltage or par. 6-22 Terminal 54 Low Current for a time period defined in par. 6-00 Live Zero Timeout Time. If several timeouts occur simultaneously, the adjustable frequency drive prioritizes the timeout functions as follows:         1.       Par. 6-01 Live Zero Timeout Function
6-01 L Option	ive Zero Timeout Function	<ul> <li>Function:</li> <li>Select the timeout function. The function set in par. 6-01 <i>Live Zero Timeout Function</i> will be activated if the input signal on terminal 53 or 54 is below 50% of the value in par. 6-10 <i>Terminal 53 Low Voltage</i>, par. 6-12 <i>Terminal 53 Low Current</i>, par. 6-20 <i>Terminal 54 Low Voltage</i> or par. 6-22 <i>Terminal 54 Low Current</i> for a time period defined in par. 6-00 <i>Live Zero Timeout Time</i>. If several timeouts occur simultaneously, the adjustable frequency drive prioritizes the timeout functions as follows:</li> <li>Par. 6-01 <i>Live Zero Timeout Function</i></li> <li>Par. 8-04 <i>Control Timeout Function</i></li> </ul>
6-01 L Option	ive Zero Timeout Function	<ul> <li>Function:</li> <li>Select the timeout function. The function set in par. 6-01 <i>Live Zero Timeout Function</i> will be activated if the input signal on terminal 53 or 54 is below 50% of the value in par. 6-10 <i>Terminal 53 Low Voltage</i>, par. 6-12 <i>Terminal 53 Low Current</i>, par. 6-20 <i>Terminal 54 Low Voltage</i> or par. 6-22 <i>Terminal 54 Low Current</i> for a time period defined in par. 6-00 <i>Live Zero Timeout Time</i>. If several timeouts occur simultaneously, the adjustable frequency drive prioritizes the timeout functions as follows: <ol> <li>Par. 6-01 <i>Live Zero Timeout Function</i></li> <li>Par. 8-04 <i>Control Timeout Function</i></li> </ol> </li> <li>The output frequency of the adjustable frequency drive can be: <ol> <li>[1] frozen at the present value</li> </ol> </li> </ul>
6-01 L Option	ive Zero Timeout Function	<ul> <li>Function:</li> <li>Select the timeout function. The function set in par. 6-01 <i>Live Zero Timeout Function</i> will be activated if the input signal on terminal 53 or 54 is below 50% of the value in par. 6-10 <i>Terminal 53 Low Voltage</i>, par. 6-12 <i>Terminal 53 Low Current</i>, par. 6-20 <i>Terminal 54 Low Voltage</i> or par. 6-22 <i>Terminal 54 Low Current</i> for a time period defined in par. 6-00 <i>Live Zero Timeout Time</i>. If several timeouts occur simultaneously, the adjustable frequency drive prioritizes the timeout functions as follows: <ol> <li>Par. 6-01 <i>Live Zero Timeout Function</i></li> <li>Par. 8-04 <i>Control Timeout Function</i></li> </ol> </li> <li>The output frequency of the adjustable frequency drive can be: <ol> <li>[1] frozen at the present value</li> <li>[2] overruled to stop</li> </ol> </li> </ul>
6-01 L Option	ive Zero Timeout Function	<ul> <li>Function:</li> <li>Select the timeout function. The function set in par. 6-01 <i>Live Zero Timeout Function</i> will be activated if the input signal on terminal 53 or 54 is below 50% of the value in par. 6-10 <i>Terminal 53 Low Voltage</i>, par. 6-12 <i>Terminal 53 Low Current</i>, par. 6-20 <i>Terminal 54 Low Voltage</i> or par. 6-22 <i>Terminal 54 Low Current</i> for a time period defined in par. 6-00 <i>Live Zero Timeout Time</i>. If several timeouts occur simultaneously, the adjustable frequency drive prioritizes the timeout functions as follows: <ol> <li>Par. 6-01 <i>Live Zero Timeout Function</i></li> <li>Par. 8-04 <i>Control Timeout Function</i></li> <li>If requency of the adjustable frequency drive can be: <ol> <li>[1] frozen at the present value</li> <li>[2] overruled to stop</li> <li>[3] overruled to jog speed</li> </ol> </li> </ol></li></ul>
6-01 L Option	ive Zero Timeout Function	<ul> <li>Function:</li> <li>Select the timeout function. The function set in par. 6-01 <i>Live Zero Timeout Function</i> will be activated if the input signal on terminal 53 or 54 is below 50% of the value in par. 6-10 <i>Terminal 53 Low Voltage</i>, par. 6-12 <i>Terminal 53 Low Current</i>, par. 6-20 <i>Terminal 54 Low Voltage</i> or par. 6-22 <i>Terminal 54 Low Current</i> for a time period defined in par. 6-00 <i>Live Zero Timeout Time</i>. If several timeouts occur simultaneously, the adjustable frequency drive prioritizes the timeout functions as follows: <ol> <li>Par. 6-01 <i>Live Zero Timeout Function</i></li> <li>Par. 8-04 <i>Control Timeout Function</i></li> </ol> </li> <li>The output frequency of the adjustable frequency drive can be: <ol> <li>[1] frozen at the present value</li> <li>[2] overruled to stop</li> <li>[3] overruled to jog speed</li> <li>[4] overruled to max. speed</li> </ol> </li> </ul>
6-01 L Option	ive Zero Timeout Function	<ul> <li>Function:</li> <li>Select the timeout function. The function set in par. 6-01 <i>Live Zero Timeout Function</i> will be activated if the input signal on terminal 53 or 54 is below 50% of the value in par. 6-10 <i>Terminal 53 Low Voltage</i>, par. 6-12 <i>Terminal 53 Low Current</i>, par. 6-20 <i>Terminal 54 Low Voltage</i> or par. 6-22 <i>Terminal 54 Low Current</i> for a time period defined in par. 6-00 <i>Live Zero Timeout Time</i>. If several timeouts occur simultaneously, the adjustable frequency drive prioritizes the timeout functions as follows:</li> <li>1. Par. 6-01 <i>Live Zero Timeout Function</i></li> <li>2. Par. 8-04 <i>Control Timeout Function</i></li> <li>1. [1] frozen at the present value</li> <li>[2] overruled to stop</li> <li>[3] overruled to max. speed</li> <li>[4] overruled to max. speed</li> <li>[5] overruled to stop with subsequent trip</li> </ul>
6-01 L Option	ive Zero Timeout Function	<ul> <li>Function:</li> <li>Select the timeout function. The function set in par. 6-01 <i>Live Zero Timeout Function</i> will be activated if the input signal on terminal 53 or 54 is below 50% of the value in par. 6-10 <i>Terminal 53 Low Voltage</i>, par. 6-12 <i>Terminal 53 Low Current</i>, par. 6-20 <i>Terminal 54 Low Voltage</i> or par. 6-22 <i>Terminal 54 Low Current</i> for a time period defined in par. 6-00 <i>Live Zero Timeout Time</i>. If several timeouts occur simultaneously, the adjustable frequency drive prioritizes the timeout functions as follows: <ol> <li>Par. 6-01 <i>Live Zero Timeout Function</i></li> <li>Par. 8-04 <i>Control Timeout Function</i></li> </ol> </li> <li>The output frequency of the adjustable frequency drive can be: <ol> <li>[1] frozen at the present value</li> <li>[2] overruled to stop</li> <li>[3] overruled to max. speed</li> <li>[5] overruled to stop with subsequent trip</li> </ol> </li> </ul>
6-01 L Option	ive Zero Timeout Function	<ul> <li>Function:</li> <li>Select the timeout function. The function set in par. 6-01 <i>Live Zero Timeout Function</i> will be activated if the input signal on terminal 53 or 54 is below 50% of the value in par. 6-10 <i>Terminal 53 Low Voltage</i>, par. 6-12 <i>Terminal 53 Low Current</i>, par. 6-20 <i>Terminal 54 Low Voltage</i> or par. 6-22 <i>Terminal 54 Low Current</i> for a time period defined in par. 6-00 <i>Live Zero Timeout Time</i>. If several timeouts occur simultaneously, the adjustable frequency drive prioritizes the timeout functions as follows: <ol> <li>Par. 6-01 <i>Live Zero Timeout Function</i></li> <li>Par. 8-04 <i>Control Timeout Function</i></li> </ol> </li> <li>The output frequency of the adjustable frequency drive can be: <ol> <li>[1] frozen at the present value</li> <li>[2] overruled to stop</li> <li>[3] overruled to max. speed</li> <li>[5] overruled to stop with subsequent trip</li> </ol> </li> </ul>
6-01 L Option	ive Zero Timeout Function  Off Freeze output Stop	<ul> <li>Function:</li> <li>Select the timeout function. The function set in par. 6-01 <i>Live Zero Timeout Function</i> will be activated if the input signal on terminal 53 or 54 is below 50% of the value in par. 6-10 <i>Terminal 53 Low Voltage</i>, par. 6-12 <i>Terminal 53 Low Current</i>, par. 6-20 <i>Terminal 54 Low Voltage</i> or par. 6-22 <i>Terminal 54 Low Current</i> for a time period defined in par. 6-00 <i>Live Zero Timeout Time</i>. If several timeouts occur simultaneously, the adjustable frequency drive prioritizes the timeout functions as follows: <ol> <li>Par. 6-01 <i>Live Zero Timeout Function</i></li> <li>Par. 8-04 <i>Control Timeout Function</i></li> <li>Par. 8-04 <i>Control Timeout Function</i></li> <li>[1] frozen at the present value</li> <li>[2] overruled to stop</li> <li>[3] overruled to max. speed</li> <li>[5] overruled to stop with subsequent trip</li> </ol> </li> </ul>
6-01 L Option	ive Zero Timeout Function  Off Freeze output Stop Jogging	<ul> <li>Function:</li> <li>Select the timeout function. The function set in par. 6-01 <i>Live Zero Timeout Function</i> will be activated if the input signal on terminal 53 or 54 is below 50% of the value in par. 6-10 <i>Terminal 53 Low Voltage</i>, par. 6-12 <i>Terminal 53 Low Current</i>, par. 6-20 <i>Terminal 54 Low Voltage</i> or par. 6-22 <i>Terminal 54 Low Current</i> for a time period defined in par. 6-00 <i>Live Zero Timeout Time</i>. If several timeouts occur simultaneously, the adjustable frequency drive prioritizes the timeout functions as follows:</li> <li>1. Par. 6-01 <i>Live Zero Timeout Function</i></li> <li>2. Par. 8-04 <i>Control Timeout Function</i></li> <li>The output frequency of the adjustable frequency drive can be:</li> <li>[1] frozen at the present value</li> <li>[2] overruled to stop</li> <li>[3] overruled to jog speed</li> <li>[4] overruled to max. speed</li> <li>[5] overruled to stop with subsequent trip</li> </ul>
6-01 L Option	ive Zero Timeout Function  Off Freeze output Stop Jogging Max. speed	<ul> <li>Function:</li> <li>Select the timeout function. The function set in par. 6-01 <i>Live Zero Timeout Function</i> will be activated if the input signal on terminal 53 or 54 is below 50% of the value in par. 6-10 <i>Terminal 53 Low Voltage</i>, par. 6-12 <i>Terminal 53 Low Current</i>, par. 6-20 <i>Terminal 54 Low Voltage</i> or par. 6-22 <i>Terminal 54 Low Current</i> for a time period defined in par. 6-00 <i>Live Zero Timeout Time</i>. If several timeouts occur simultaneously, the adjustable frequency drive prioritizes the timeout functions as follows:</li> <li>1. Par. 6-01 <i>Live Zero Timeout Function</i></li> <li>2. Par. 8-04 <i>Control Timeout Function</i></li> <li>The output frequency of the adjustable frequency drive can be:</li> <li>[1] frozen at the present value</li> <li>[2] overruled to stop</li> <li>[3] overruled to jog speed</li> <li>[4] overruled to max. speed</li> <li>[5] overruled to stop with subsequent trip</li> </ul>

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Range:		Function:
0.07 V*	[0.00 - par. 6-11 V]	Enter the low voltage value. This analog input scaling value should correspond to the low reference/ feedback value set in par. 6-14 <i>Terminal 53 Low Ref./Feedb. Value</i> .
6-11 Te	rminal 53 High Voltage	
Range:		Function:
10.00 V*	[par. 6-10 - 10.00 V]	Enter the high voltage value. This analog input scaling value should correspond to the high reference/feedback value set in par. 6-15 <i>Terminal 53 High Ref./Feedb. Value</i> .
6-14 Te	rminal 53 Low Ref./Feed	o. Value
Range:		Function:
0.000 N/A*	[-999999.999 - 999999.999 N/A]	Enter the analog input scaling value that corresponds to the low voltage/low current set in par. 6-10 <i>Terminal 53 Low Voltage</i> and par. 6-12 <i>Terminal 53 Low Current</i> .
6-15 Te	rminal 53 High Ref./Feed	b. Value
Range:		Function:
50.000 N/ A*	[-999999.999 - 999999.999 N/A]	Enter the analog input scaling value that corresponds to the high voltage/high current value set in par. 6-11 <i>Terminal 53 High Voltage</i> and par. 6-13 <i>Terminal 53 High Current</i> .
6-16 Te	rminal 53 Filter Time Con	stant
Range:		Function:
0.001 s*	[0.001 - 10.000 s]	Enter the time constant. This is a first-order digital low pass filter time constant for suppressing electrical noise in terminal 53. A high time constant value improves dampening but also increases the time delay through the filter. This parameter cannot be adjusted while the motor is running.
6-17 Te	rminal 53 Live Zero	
Option:		Function:
		This parameter makes it possible to disable the Live Zero monitoring. For example, this is to be used if the analog outputs are used as part of a de-central I/O system (e.g., when not used as part of any adjustable frequency drive related control functions, but for feeding a building management system with data).
[0]	Disabled	
[1] *	Enabled	

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6-20 T	erminal 54 Low Voltage				
Range:		Function:			
0.07 V*	[0.00 - par. 6-21 V]	Enter the low voltage value. This analog input scaling value should correspond to the low reference/			
		feedback value, set in par. 6-24 Terminal 54 Low Ref./Feedb. Value.			
6-21 T	erminal 54 High Voltage				
Range:		Function:			
10.00 V*	[par. 6-20 - 10.00 V]	Enter the high voltage value. This analog input scaling value should correspond to the high refer-			
		ence/feedback value set in par. 6-25 Terminal 54 High Ref./Feedb. Value.			
6-24 T	erminal 54 Low Ref./Feed	b. Value			
Range:		Function:			
0.000 N/A*	[-999999.999 - 999999.999 N/A]	Enter the analog input scaling value that corresponds to the low voltage/low current value set in			
		par. 6-20 Terminal 54 Low Voltage and par. 6-22 Terminal 54 Low Current.			
6-25 T	erminal 54 High Ref./Feed	b. Value			
Range:		Function:			
100.000 N	/ [-999999.999 - 999999.999 N/A]	Enter the analog input scaling value that corresponds to the high voltage/high current value set in			
A*		par. 6-21 Terminal 54 High Voltage and par. 6-23 Terminal 54 High Current.			
6-26 T	erminal 54 Filter Time Con	stant			
Range:		Function:			
0.001 s*	[0.001 - 10.000 s]	Enter the time constant. This is a first-order digital low pass filter time constant for suppressing			
		electrical noise in terminal 54. A high time constant value improves dampening but also increases			
		the time delay through the filter.			
6-27 T	erminal 54 Live Zero				
Option:		Function:			
		This parameter makes it possible to disable the Live Zero monitoring. For example, this to be used			
		If the analog outputs are used as part of a de-central I/O system (e.g., when used not as part of any adjustable frequency drive related control functions, but for feeding a building management			
		system with data).			
[0]	Disabled				
[1] *	Enabled				
6-50 T	6-50 Terminal 42 Output				
Option:		Function:			
		Select the function of Terminal 42 as an analog current output. A motor current of 20 mA corre-			
		sponds to I <sub>max</sub> .			
[0] *	No operation				
[100]	Output frequency	: 0–100 Hz, (0–20 mA)			
[101]	Reference	: Minimum reference - Maximum reference, (0–20 mA)			
[102]	Feedback	: -200% to +200% of par. 20-14 Maximum Reference/Feedb., (0-20 mA)			
[103]	Motor current	: 0 - Inverter Max. Current (par. 16-37 <i>Inv. Max. Current</i> ), (0–20 mA)			
[104]	Torque rel to limit	: 0 - Torque limit (par. 4-16 Torque Limit Motor Mode), (0-20 mA)			
[104]	Torque rel to limit	: 0 - Torque limit (par. 4-16 <i>Torque Limit Motor Mode</i> ), (0–20 mA)			

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

#### NOTE!

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

6-51 Te	rminal 42 Output Min Sca	ale
Range:		Function:
0.00 %*	[0.00 - 200.00 %]	
6-52 Te	rminal 42 Output Max Sc	ale
6-52 Te Range:	rminal 42 Output Max Sc	ale Function:
6-52 Te Range: 100.00 %*	rminal 42 Output Max Sc [0.00 - 200.00 %]	ale Function:

EXAMPLE 1:

Variable value= OUTPUT FREQUENCY, range = 0-100 Hz

Range needed for output = 0-50 Hz

Output signal 0 or 4 mA is needed at 0 Hz (0% of range) - set par. 6-51 *Terminal 42 Output Min Scale* to 0% Output signal 20 mA is needed at 50 Hz (50% of range) - set par. 6-52 *Terminal 42 Output Max Scale* to 50%



#### EXAMPLE 2:

Variable= FEEDBACK, range= -200% to +200%

Range needed for output= 0-100%

Output signal 0 or 4 mA is needed at 0% (50% of range) - set par. 6-51 *Terminal 42 Output Min Scale* to 50% Output signal 20 mA is needed at 100% (75% of range) - set par. 6-52 *Terminal 42 Output Max Scale* to 75%



#### EXAMPLE 3:

Variable value= REFERENCE, range= Min ref - Max ref

Range needed for output= Min ref (0%) - Max ref (100%), 0-10 mA

Output signal 0 or 4 mA is needed at Min ref - set par. 6-51 Terminal 42 Output Min Scale to 0%

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



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

[11] 10.0 kHz [12] 12.0 kHz [13] 14.0 kHz [14] 16.0 kHz

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

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[102] Bus feedback 3

NOTE!



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

20-01 Feedback 1 Conversion		
Option:		Function:
		This parameter allows a conversion function to be applied to Feedback 1.
[0] *	Linear	<i>Linear</i> [0] has no effect on the feedback.
[1]	Square root	Square root [1] is commonly used when a pressure sensor is used to provide flow feedback (( flow $\propto \sqrt{pressure}$ )).
[2]	Pressure to temperature	Pressure to temperature [2] is used in compressor applications to provide temperature feedback using a pressure sensor. The temperature of the refrigerant is calculated using the following formula: $Temperature = \frac{A2}{(In(Pe+1) - A1)} - A3$ , where A1, A2 and A3 are refrigerant-specific constants. The refrigerant must be selected in par. 20-30 <i>Refrigerant</i> . Par. 20-21 <i>Setpoint 1</i> through par. 20-23 <i>Setpoint 3</i> allow the values of A1, A2 and A3 to be entered for a refrigerant that is not listed in par. 20-30 <i>Refrigerant</i> .

20-03 Feedback 2 Source		
Option:		Function:
		See par. 20-00 <i>Feedback 1 Source</i> for details.
[0] *	No function	
[1]	Analog input 53	
[2]	Analog input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog Input X42/1	
[10]	Analog Input X42/3	
[11]	Analog Input X42/5	
[100]	Bus feedback 1	
[101]	Bus feedback 2	
[102]	Bus feedback 3	
20-04 Feedback 2 Conversion		
Option:		Function:
		See par. 20-01 Feedback 1 Conversion for details.
[0] *	Linear	
[1]	Square root	

[2] Pressure to temperature

20-06	Feedback 3 Source	
Option:		Function:
		See par. 20-00 Feedback 1 Source for details.
20-07	Feedback 3 Conversion	
Option:		Function:
		See par. 20-01 Feedback 1 Conversion for details.
[0] *	Linear	
[1]	Square root	
[2]	Pressure to temperature	
20-20	Feedback Function	
<b>Option:</b>		Function:
		This parameter determines how the three possible feedbacks will be used to control the output frequency of the adjustable frequency drive.
[0]	Sum	Sum [0] sets up the PID Controller to use the sum of Feedback 1, Feedback 2 and Feedback 3 as the feedback.
		NOTE!           Any unused feedbacks must be set to No Function in par. 20-00 Feedback 1           Source, par. 20-03 Feedback 2 Source, or par. 20-06 Feedback 3 Source.
		The sum of Setpoint 1 and any other references that are enabled (see par. group 3-1*) will be used as the PID Controller's setpoint reference.
[1]	Difference	<i>Difference</i> [1] sets up the PID controller to use the difference between Feedback 1 and Feedback 2 as the feedback. Feedback 3 will not be used with this selection. Only Setpoint 1 will be used. The sum of Setpoint 1 and any other references that are enabled (see par. group 3-1*) will be used as the PID controller's setpoint reference.
[2]	Average	<i>Average</i> [2] sets up the PID Controller to use the average of Feedback 1, Feedback 2 and Feedback 3 as the feedback.
		NOTE! Any unused feedbacks must be set to <i>No Function</i> in par. 20-00 <i>Feedback 1</i> <i>Source</i> , par. 20-03 <i>Feedback 2 Source</i> , or par. 20-06 <i>Feedback 3 Source</i> . The sum of Setpoint 1 and any other references that are enabled (see par. group 3-1*) will be used as the PID Controller's setpoint reference.
[3] *	Minimum	<i>Minimum</i> [3] sets up the PID controller to compare Feedback 1, Feedback 2 and Feedback 3 and use the lowest value as the feedback.
		NOTE!         Any unused feedbacks must be set to No Function in par. 20-00 Feedback 1         Source, par. 20-03 Feedback 2 Source, or par. 20-06 Feedback 3 Source. Only setpoint 1 will be used. The sum of Setpoint 1 and any other references that are enabled (see par. group 3-1*) will be used as the PID controller's setpoint reference.
[4]	Maximum	<i>Maximum</i> [4] sets up the PID controller to compare Feedback 1, Feedback 2 and Feedback 3 and use the highest value as the feedback.



Any unused feedbacks must be set to *No Function* in par. 20-00 *Feedback 1 Source*, par. 20-03 *Feedback 2 Source*, or par. 20-06 *Feedback 3 Source*.

Only Setpoint 1 will be used. The sum of Setpoint 1 and any other references that are enabled (see par. group 3-1\*) will be used as the PID controller's setpoint reference.

*Multi-setpoint minimum* [5] sets up the PID Controller to calculate the difference between Feedback 1 and Setpoint 1, Feedback 2 and Setpoint 2, and Feedback 3 and Setpoint 3. It will use the feedback/setpoint pair in which the feedback is the farthest below its corresponding setpoint reference. If all feedback signals are above their corresponding setpoints, the PID Controller will use the feedback/setpoint pair in which the difference between the feedback and setpoint is the least.



#### NOTE!

If only two feedback signals are used, the feedback that is not to be used must be set to *No Function* in par. 20-00 *Feedback 1 Source*, par. 20-03 *Feedback 2 Source* or par. 20-06 *Feedback 3 Source*. Note that each setpoint reference will be the sum of its respective parameter value (par. 20-21 *Setpoint 1*, par. 20-22 *Setpoint 2* and par. 20-23 *Setpoint 3*) and any other references that are enabled (see par. group 3-1\*).

[6] Multi Setpoint Max

Multi Setpoint Min

[5]

*Multi-setpoint maximum* [6] sets up the PID Controller to calculate the difference between Feedback 1 and Setpoint 1, Feedback 2 and Setpoint 2, and Feedback 3 and Setpoint 3. It will use the feedback/setpoint pair in which the feedback is farthest above its corresponding setpoint reference. If all feedback signals are below their corresponding setpoints, the PID Controller will use the feedback/setpoint pair in which the difference between the feedback and the setpoint reference is the least.



#### NOTE!

If only two feedback signals are used, the feedback that is not to be used must be set to *No Function* in par. 20-00 *Feedback 1 Source*, par. 20-03 *Feedback 2 Source* or par. 20-06 *Feedback 3 Source*. Note that each setpoint reference will be the sum of its respective parameter value (par. 20-21 *Setpoint 1*, par. 20-22 *Setpoint 2* and par. 20-23 *Setpoint 3*) and any other references that are enabled (see par. group 3-1\*).



#### NOTE!

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

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

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

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

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

#### Example 1: Multi-zone, single setpoint

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



#### Example 2: Multi-zone, multi setpoint

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

Range:

#### Function:

0.000 Proc- [-999999.999 - 999999.999 Proc- essCtrlU- essCtrlUnit]	- Setpoint 1 is used in closed-loop mode to enter a setpoint reference that is used by the adjustable frequency drive's PID controller. See the description of par. 20-20 <i>Feedback Function</i> .
nit*	NOTE! Setpoint reference entered here is added to any other references that are enabled (see par. group 3-1*).

#### 20-22 Setpoint 2

Range:	Function:
0.000 Proc- [-999999.999 - 999999.999 Proc-	Setpoint 2 is used in closed-loop mode to enter a setpoint reference that may be used by the ad-
essCtrlU- essCtrlUnit] nit*	justable frequency drive's PID controller. See the description of <i>Feedback Function</i> , par. 20-20 <i>Feedback Function</i> .



#### NOTE!

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

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

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

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

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

NOTE!



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

20-94 PID Integral Time			
Range:	Function:		
20.00 s* [0.01 - 10000.00 s]	Over time, the integrator accumulates a contribution to the output from the PID controller as long as there is a deviation between the reference/setpoint and feedback signals. The contribution is proportional to the size of the deviation. This ensures that the deviation (error) approaches zero. Quick response on any deviation is obtained when the integral time is set to a low value. Setting it too low, however, may cause the control to become unstable. The value set is the time needed for the integrator to add the same contribution as the proportional part for a certain deviation. If the value is set to 10,000, the controller will act as a pure proportional controller with a P-band based on the value set in par. 20-93 <i>PID Proportional Gain.</i> When no deviation is present, the output from the proportional controller will be 0.		
22-21 Low Power Detecti	on		

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

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

## 22-23 No-Flow Function

Common actions for Low Power Detection and Low Speed Detection (Individual selections not possible).

<b>Option:</b>		Function:
[0] *	OFF	
[1]	Sleep Mode	The drive will enter sleep mode and stop when a No Flow condition is detected. See parameter group 22-4* for programming options for sleep mode.
[2]	Warning	The drive will continue to run, but activate a No-Flow Warning [W92]. A drive digital output or a serial communication bus can communicate a warning to other equipment.
[3]	Alarm	The drive will stop running and activate a No-Flow Alarm [A 92]. A drive digital output or a serial communication bus can communicate an alarm to other equipment.



## NOTE!

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



#### NOTE!

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

22-24 No-Flow Delay			
Range:		Function:	
10 s*	[1 - 600 s]	Set the time. Low Power/Low Speed must remain detected to activate signal for actions. If detection disappears before the timer runs out, the timer will be reset.	
22-26 D	Pry Pump Function		
Select desired action for dry pump operation.			
Option:		Function:	

Option:		Function:
[0] *	OFF	
[1]	Warning	The drive will continue to run, but activate a dry pump warning [W93]. A drive digital output or a serial communication bus can communicate a warning to other equipment.
[2]	Alarm	The drive will stop running and activate a dry pump alarm [A93]. A drive digital output or a serial communication bus can communicate an alarm to other equipment



## NOTE!

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



6-38

#### NOTE!

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



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

22-40 I	Minimum Run Time	
Range:		Function:
10 s*	[0 - 600 s]	Set the desired minimum running time for the motor after a start command (digital input or bus)
		before entering sleep mode.
22-41	Minimum Sleep Time	
Range:		Function:
10 s*	[0 - 600 s]	Set the desired minimum time for staying in sleep mode. This will override any wake-up conditions.
22-42	Wake-up Speed [RPM]	
Range:		Function:
0 RPM*	[par. 4-11 - par. 4-13 RPM]	To be used if par. 0-02 <i>Motor Speed Unit</i> has been set for RPM (parameter not visible if Hz selected).
		Only to be used if par. 1-00 <i>Configuration Mode</i> is set for open-loop and speed reference is applied by an external controller
		Set the reference speed at which sleep mode should be canceled.
22-60	Broken Belt Function	
Selects the	action to be performed if the broken	belt condition is detected.
Option:		Function:
[0] *	OFF	
[1]	Warning	The drive will continue to run, but activate a Broken Belt Warning [W95]. A drive digital output or a serial communication bus can communicate a warning to other equipment.
[2]	Trip	The drive will stop running and activate a Broken Belt alarm [A 95]. A drive digital output or a serial
n	NOTE	
A	Do not set par. 14-20 Reset Mode	to [13] Infinite auto reset when par. 22-60 <i>Broken Belt Function</i> is set to [2] Trip. Doing so will cause
<b>S</b>	the drive to continuously cycle be	tween running and stopping when a broken belt condition is detected.
. በ	NOTE!	
A A	If the drive is equipped with a cor	stant speed bypass with an automatic bypass function that starts the bypass if the drive experiences
$\langle \mathcal{O} \rangle$	a persistent alarm condition, be su	are to disable the bypass' automatic bypass function, if [2] Trip is selected as the broken belt function.

22-61 Broken Belt Torque			
Range:		Function:	
10 %*	[0 - 100 %]	Sets the broken belt torque as a percentage of the rated motor torque.	
22-62 B	roken Belt Delay		
22-62 B Range:	roken Belt Delay	Function:	



22-75 Short Cycle Protection			
Option:		Function:	
[0] *	Disabled	Timer set in par. 22-76 Interval between Starts is disabled.	
[1]	Enabled	Timer set in par. 22-76 Interval between Starts is enabled.	
22-76	Interval between Starts		
Range:		Function:	
par. 22-7 s*	77 [par. 22-77 - 3600 s]	Sets the time desired as minimum time between two starts. Any normal start command (Start/Jog/ Freeze) will be disregarded until the timer has expired.	
22-77	Minimum Run Time		
Range:		Function:	
0 s*	[0 - par. 22-76 s]	Sets the time desired as minimum run time after a normal start command (Start/Jog/Freeze). Any normal stop command will be disregarded until the set time has expired. The timer will start counting following a normal start command (Start/Jog/Freeze).	
		The timer will be overridden by a Coast (Inverse) or an External Interlock command.	
65	<b>NOTE!</b> Does not work in cascade mode.		
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#### 6.1.5 Main Menu Mode

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

1452RPM 4.79A 📆	
0-** Operation/Display	
2-** Brakes 3-** Reference / Ramps	
Figure 6.9: Display example.	

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

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

### 6.1.6 Parameter Selection

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

Group no.Parameter group:0Operation/Display1Load/Motor2Brakes3References/Ramps4Limits/Warnings5Digital In/Out6Analog In/Out8Comm. and Options9Profibus10CAN Fieldbus11LonWorks13Smart Logic14Special Functions15Drive Information16Data Readouts 2
0       Operation/Display         1       Load/Motor         2       Brakes         3       References/Ramps         4       Limits/Warnings         5       Digital In/Out         6       Analog In/Out         8       Comm. and Options         9       Profibus         10       CAN Fieldbus         11       LonWorks         13       Smart Logic         14       Special Functions         15       Drive Information         16       Data Readouts         18       Data Readouts
1Load/Motor2Brakes3References/Ramps4Limits/Warnings5Digital In/Out6Analog In/Out8Comm. and Options9Profibus10CAN Fieldbus11LonWorks13Smart Logic14Special Functions15Drive Information16Data Readouts 2
2     Brakes       3     References/Ramps       4     Limits/Warnings       5     Digital In/Out       6     Analog In/Out       8     Comm. and Options       9     Profibus       10     CAN Fieldbus       11     LonWorks       13     Smart Logic       14     Special Functions       15     Drive Information       16     Data Readouts 2
3       References/Ramps         4       Limits/Warnings         5       Digital In/Out         6       Analog In/Out         8       Comm. and Options         9       Profibus         10       CAN Fieldbus         11       LonWorks         13       Smart Logic         14       Special Functions         15       Drive Information         16       Data Readouts         18       Data Readouts
4     Limits/Warnings       5     Digital In/Out       6     Analog In/Out       8     Comm. and Options       9     Profibus       10     CAN Fieldbus       11     LonWorks       13     Smart Logic       14     Special Functions       15     Drive Information       16     Data Readouts       18     Data Que douts
5Digital In/Out6Analog In/Out8Comm. and Options9Profibus10CAN Fieldbus11LonWorks13Smart Logic14Special Functions15Drive Information16Data Readouts18Data Readouts
6     Analog In/Out       8     Comm. and Options       9     Profibus       10     CAN Fieldbus       11     LonWorks       13     Smart Logic       14     Special Functions       15     Drive Information       16     Data Readouts 2
8     Comm. and Options       9     Profibus       10     CAN Fieldbus       11     LonWorks       13     Smart Logic       14     Special Functions       15     Drive Information       16     Data Readouts       18     Data Readouts
9     Profibus       10     CAN Fieldbus       11     LonWorks       13     Smart Logic       14     Special Functions       15     Drive Information       16     Data Readouts       18     Data Readouts
10CAN Fieldbus11LonWorks13Smart Logic14Special Functions15Drive Information16Data Readouts18Data Readouts 2
11     LonWorks       13     Smart Logic       14     Special Functions       15     Drive Information       16     Data Readouts       18     Data Readouts
13     Smart Logic       14     Special Functions       15     Drive Information       16     Data Readouts       18     Data Readouts
14     Special Functions       15     Drive Information       16     Data Readouts       18     Data Readouts 2
15 Drive Information 16 Data Readouts 18 Data Readouts 2
16 Data Readouts
18 Data Readouts 2
20 Drive Closed-loop
21 Ext. Closed-loop
22 Application Functions
23 Time-based Functions
24 Fire Mode
25 Cascade Controller
26 Analog I/O Option MCB 109

Table 6.3: Parameter groups.

After selecting a parameter group, choose a parameter by means of the navigation keys.

The middle section on the GLCP display shows the parameter number and name, as well as the selected parameter value.



#### 6.1.7 Changing Data

- 1. Press the [Quick Menu] or [Main Menu] key.
- 2. Use [▲] and [▼] keys to find parameter group to edit.
- 3. Press the [OK] key.
- 4. Use [▲] and [▼] keys to find parameter to edit.
- 5. Press the [OK] key.
- 6. Use the [▲] and [▼] keys to select the correct parameter setting. Or, to move to digits within a number, use the keys. The cursor indicates the digit selected to be changed. The [▲] key increases the value, the [▼] key decreases the value.
- 7. Press the [Cancel] key to disregard the change, or press the [OK] key to accept the change and enter the new setting.

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#### 6.1.8 Changing a text value

If the selected parameter is a text value, it can be changed by using the up/down navigation keys.

The up key increases the value, and the down key decreases the value. Place the cursor on the value to be saved and press [OK].



#### 6.1.9 Changing a group of numeric data values

If the chosen parameter represents a numeric data value, change the chosen data value by means of the [ $\neg$ ] and [ $\vdash$ ] navigation keys as well as the up/down [ $\blacktriangle$ ] [ $\checkmark$ ] navigation keys. Use the  $\neg$ ] and [ $\vdash$ ] navigation keys to move the cursor horizontally.

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

1428RPM 3.76A (ft) Load-Depend. Settg. 1-6* 1-60 Low Speed Load Compensation 100%	
Figure 6.12: Display example.	
1177RPM       3.81A       100       100         Load-Depend. Settg.       1-6*       1-6*       100         1-60 Low Speed Load       Compensation       100       100       100         160 %       The set of th	

#### 6.1.10 Changing of data value, Step-by-Step

Certain parameters can be changed step-by-step or by an infinite number of variables. This applies to par. 1-20 *Motor Power [kW]*, par. 1-22 *Motor Voltage* and par. 1-23 *Motor Frequency*.

The parameters are changed both as a group of numeric data values, and as numeric data values using an infinite number of variables.

#### 6.1.11 Readout and programming of indexed parameters

Parameters are indexed when placed in a rolling stack.

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

#### Use par. 3-10 Preset Reference as another example:

Choose the parameter, press [OK], and use the up/down navigation keys to scroll through the indexed values. To change the parameter value, select the indexed value and press [OK]. Change the value by using the up/down keys. Press [OK] to accept the new setting. Press [Cancel] to abort. Press [Back] to leave the parameter.

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# 6.2 Parameter lists

#### 6.2.1 Main Menu Structure

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

The vast majority of VLT HVAC Drive applications can be programmed using the Quick Menu button and selecting the parameters under Quick Set-up and Function Set-ups.

Descriptions and default settings of parameters may be found under the section Parameter Lists at the back of this manual.

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

# 6.2.2 0-\*\* Operation and Display

Par. No. #	Parameter description	Default value	4-set-up	Change dur- ing operation	Conver- sion index	Туре
0-0* I	Basic Settings					
0-01	Language	[0] English	1 set-up	TRUE	-	Uint8
0-02	Motor Speed Unit	[1] Hz	2 set-ups	FALSE	-	Uint8
0-03	Regional Settings	[0] International	2 set-ups	FALSE	-	Uint8
0-04	Operating State at Power-up	[0] Resume	All set-ups	TRUE	-	Uint8
0-05	Local Mode Unit	[0] As Motor Speed Unit	2 set-ups	FALSE	-	Uint8
0-1* 9	Set-up Operations					
0-10	Active Set-up	[1] Set-up 1	1 set-up	TRUE	-	Uint8
0-11	Programming Set-up	[9] Active Set-up	All set-ups	TRUE	-	Uint8
0-12	This Set-up Linked to	[0] Not linked	All set-ups	FALSE	-	Uint8
0-13	Readout: Linked Set-uns	0 N/A	All set-ups	FALSE	0	Uint16
0-14	Readout: Prog. Set-ups / Channel	0 N/A	All set-ups	TRUE	0	Int32
0-2*1	CP Display	UNIA	All Sec ups	INCL	0	11102
0-20	Display Line 1.1 Small	1602	All cot-upc	TDUE	-	Llint16
0-20	Display Line 1.1 Small	1614	All set ups	TRUE		Uint16
0.22	Display Line 1.2 Small	1610	All set-ups	TDUE	-	Unit16
0.22	Display Line 2. Jargo	1612	All set-ups	TRUL	-	Unit16
0-23	Display Line 2 Large	1015	All set-ups	TDUE	-	Ullint16
0.24	My Dersonal Many	1502 EveressionLimit	All set-ups	TRUE	-	Ullint16
0-25	My Personal Menu	ExpressionLimit	1 set-up	IRUE	0	UINTIG
0-3*1	LCP Cust. Readout	F 17 6/				
0-30	Custom Readout Unit	[1] %	All set-ups	TRUE	-	Uint8
0-31	Custom Readout Min Value	ExpressionLimit	All set-ups	TRUE	-2	Int32
0-32	Custom Readout Max Value	100.00 CustomReadoutUnit	All set-ups	TRUE	-2	Int32
						VisStr[2
0-37	Display Text 1	0 N/A	1 set-up	TRUE	0	5]
						VisStr[2
0-38	Display Text 2	0 N/A	1 set-up	TRUE	0	5]
						VisStr[2
0-39	Display Text 3	0 N/A	1 set-up	TRUE	0	5]
0-4* I	LCP Keypad					
0-40	[Hand on] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-41	[Off] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-42	[Auto on] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-43	[Reset] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-44	[Off/Reset] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-45	[Drive Bypass] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-5* (	Copy/Save					
0-50	LCP Copy	[0] No copy	All set-ups	FALSE	-	Uint8
0-51	Set-up Copy	0 No copy	All set-ups	FALSE	-	Uint8
0-6* I	Password					
0-60	Main Menu Password	100 N/A	1 set-up	TRUF	0	Int16
0-61	Access to Main Menu w/o Password	[0] Full access	1 set-up	TRUE	-	Llint8
0-65	Personal Menu Password	200 N/A	1 set-up	TRUE	0	Int16
0-66	Access to Personal Menu w/o Password	[0] Full access	1 set-up	TRUE	-	Llint8
0-7* (	Clock Settings		1 Set up	INCL		01110
0-7 0	clock Settings					TimeOf-
0-70	Date and Time	ExpressionLimit	All set-ups	TRUE	0	Dav
0-70	Date and Time	LXPIESSIONLINIC	All set-ups	TDUE	0	Day Llipt9
0.72	Time Format	null	1 set-up	TRUL	-	Ulinto
0-72	DCT/Cummertime		1 set-up	TDUE	-	UllintQ
0-74	DS1/Summerume		1 set-up	TRUE	-	UINt8
0.70	DCT/C	E anno 1 in 11	4	TDUE	0	TimeOr-
0-76	DST/Summertime Start	ExpressionLimit	1 set-up	IRUE	0	Day
						TimeOf-
0-77	DST/Summertime End	ExpressionLimit	1 set-up	TRUE	0	Day
0-79	Clock Fault	null	1 set-up	TRUE	-	Uint8
0-81	Working Days	null	1 set-up	TRUE	-	Uint8
						TimeOf-
0-82	Additional Working Days	ExpressionLimit	1 set-up	TRUE	0	Day
						TimeOf-
0-83	Additional Non-Working Days	ExpressionLimit	1 set-up	TRUE	0	Day
						VisStr[2
0-89	Date and Time Readout	0 N/A	All set-ups	TRUE	0	5]

#### 6.2.3 1-\*\* Load / Motor

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

#### 6.2.4 2-\*\* Brakes

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

### 6.2.5 3-\*\* Reference / Ramps

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

## 6.2.6 4-\*\* Limits / Warnings

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

#### 6.2.7 5-\*\* Digital In / Out

Par. No. #	Parameter description	Default value	4-set-up	Change dur- ing operation	Conver- sion index	Туре
5-0* C	Digital I/O mode					
5-00	Digital I/O Mode	[0] PNP - Active at 24 V	All set-ups	FALSE	-	Uint8
5-01	Terminal 27 Mode	[0] Input	All set-ups	TRUE	-	Uint8
5-02	Terminal 29 Mode	[0] Input	All set-ups	TRUE	-	Uint8
5-1* [	Digital Inputs					
5-10	Terminal 18 Digital Input	[8] Start	All set-ups	TRUE	-	Uint8
5-11	Terminal 19 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-12	Terminal 27 Digital Input	null	All set-ups	TRUE	-	Uint8
5-13	Terminal 29 Digital Input	[14] Jog	All set-ups	TRUE	-	Uint8
5-14	Terminal 32 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-15	Terminal 33 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-16	Terminal X30/2 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-17	Terminal X30/3 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-18	Terminal X30/4 Digital Input	[0] No operation	All set-ups	TRUE	-	Uint8
5-3* C	Digital Outputs					
5-30	Terminal 27 Digital Output	[0] No operation	All set-ups	TRUE	-	Uint8
5-31	Terminal 29 digital Output	[0] No operation	All set-ups	TRUE	-	Uint8
5-32	Term X30/6 Digi Out (MCB 101)	[0] No operation	All set-ups	TRUE	-	Uint8
5-33	Term X30/7 Digi Out (MCB 101)	[0] No operation	All set-ups	TRUE	-	Uint8
5-4* F	Relays					
5-40	Function Relay	null	All set-ups	TRUE	-	Uint8
5-41	On Delay, Relay	0.01 s	All set-ups	TRUE	-2	Uint16
5-42	Off Delay, Relay	0.01 s	All set-ups	TRUE	-2	Uint16
5-5* F	Pulse Input					
5-50	Term. 29 Low Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-51	Term. 29 High Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-52	Term, 29 Low Ref./Feedb. Value	0.000 N/A	All set-ups	TRUE	-3	Int32
5-53	Term, 29 High Ref./Feedb, Value	100.000 N/A	All set-ups	TRUE	-3	Int32
5-54	Pulse Filter Time Constant #29	100 ms	All set-ups	FALSE	-3	Uint16
5-55	Term, 33 Low Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-56	Term, 33 High Frequency	100 Hz	All set-ups	TRUE	0	Uint32
5-57	Term, 33 Low Ref./Feedb, Value	0.000 N/A	All set-ups	TRUE	-3	Int32
5-58	Term, 33 High Ref./Feedb, Value	100.000 N/A	All set-ups	TRUE	-3	Int32
5-59	Pulse Filter Time Constant #33	100 ms	All set-ups	FALSE	-3	Uint16
5-6* F	Pulse Output					
5-60	Terminal 27 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
5-62	Pulse Output Max Freg #27	5000 Hz	All set-ups	TRUE	0	Uint32
5-63	Terminal 29 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
5-65	Pulse Output Max Freq #29	5000 Hz	All set-ups	TRUE	0	Uint32
5-66	Terminal X30/6 Pulse Output Variable	[0] No operation	All set-ups	TRUE	-	Uint8
5-68	Pulse Output Max Freg #X30/6	5000 Hz	All set-ups	TRUE	0	Uint32
5-9* E	Bus Controlled			-	-	
5-90	Digital & Relay Bus Control	0 N/A	All set-ups	TRUF	0	Uint32
5-93	Pulse Out #27 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
5-94	Pulse Out #27 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
5-95	Pulse Out #29 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
5-96	Pulse Out #29 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
5-97	Pulse Out #X30/6 Bus Control	0.00 %	All set-ups	TRUE	-2	N2
5-98	Pulse Out #X30/6 Timeout Preset	0.00 %	1 set-up	TRUE	-2	Uint16
			p	=		,

## 6.2.8 6-\*\* Analog In / Out

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

### 6.2.9 8-\*\* Communication and Options

Par.	Parameter description	Default value	4-set-up	Change dur-	Conver-	Туре
8-0* 0	Conoral Sottings			ing operation	SIGITITUEX	
8-01	Control Site	pull	All cet-unc	TRUE	_	L lint8
8-02	Control Source	null		TRUE		LlintQ
8-02	Control Timeout Time	Expression imit	1 set-ups	TDUE	_1	Llint32
8-04	Control Timeout Function		1 set-up	TRUE	-1	LlintQ
8-05	End-of-Timeout Function	[1] Pecume cet-up	1 set-up	TDUE	-	Llint8
8-06	Poset Control Timeout	[1] Resume set-up		TRUE	-	Ulint®
0-00	Diagnosis Triggor	[0] Do Hot Teset	All Set-ups	TRUE		Unito
9-1* (			z set-ups	TRUL		UIILO
<b>0-1</b> <sup>+</sup> (	Control Profile	[0] EC profile	All cot upc	EALCE		L lint9
0 12	Configurable Status Word STW	[0] FC profile	All set-ups	TDUE	-	Ulint9
0-15	Configurable Status Word STW		All Set-ups	IRUL	-	UIILO
0-3* F	Destacel	البيم	1 cot up	TDUE		Llin+0
8-30	Address	null Expression limit	1 set-up	TRUE	-	UINt8
0-31	Address Baud Data	ExpressionLinit	1 set-up	TRUE	U	Ullinto
8-32	Bauu Rate	nuii	1 set-up	TRUE	-	UINt8
8-33	Parity / Stop Bits	nuii	1 set-up	TRUE	-	UINt8
8-35	Minimum Response Delay	ExpressionLimit	1 set-up	TRUE	-3	UINT16
8-30	Maximum Response Delay	ExpressionLimit	1 set-up	TRUE	-3	UINT16
8-3/		ExpressionLimit	1 set-up	TRUE	-5	UINTIO
8-4* F		[1] Chan doubt tale surgers 1	2	TDUE		11:+0
8-40	lelegram selection	[1] Standard telegram 1	2 set-ups	IRUE	-	Uint8
8-5* L	Digital/Bus					
8-50	Coasting Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-52	DC Brake Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-53	Start Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-54	Reverse Select	null	All set-ups	TRUE	-	Uint8
8-55	Set-up Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-56	Preset Reference Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-7* E	BACnet					
8-70	BACnet Device Instance	1 N/A	1 set-up	TRUE	0	Uint32
8-72	MS/TP Max Masters	127 N/A	1 set-up	TRUE	0	Uint8
8-73	MS/TP Max Info Frames	1 N/A	1 set-up	TRUE	0	Uint16
8-74	"I-Am" Service	[0] Send at power-up	1 set-up	TRUE	-	Uint8
						VisStr[2
8-75	Initialization Password	ExpressionLimit	1 set-up	TRUE	0	0
8-8* F	C Port Diagnostics					
8-80	Bus Message Count	0 N/A	All set-ups	TRUE	0	Uint32
8-81	Bus Error Count	0 N/A	All set-ups	TRUE	0	Uint32
8-82	Slave Messages Rcvd	0 N/A	All set-ups	TRUE	0	Uint32
8-83	Slave Error Count	0 N/A	All set-ups	TRUE	0	Uint32
8-84	Slave Messages Sent	0 N/A	All set-ups	TRUE	0	Uint32
8-85	Slave Timeout Errors	0 N/A	All set-ups	TRUE	0	Uint32
8-89	Diagnostics Count	0 N/A	1 set-up	TRUE	0	Int32
8-9* E	Bus Jog				-	
8-90	Bus Jog 1 Speed	100 RPM	All set-ups	TRUE	67	Uint16
8-91	Bus Jog 2 Speed	200 RPM	All set-ups	TRUE	67	Uint16
8-94	Bus Feedback 1	0 N/A	1 set-up	TRUE	0	N2
8-95	Bus Feedback 2	0 N/A	1 set-up	TRUE	0	N2
8-96	Bus Feedback 3	0 N/A	1 set-up	TRUE	0	N2

### 6.2.10 9-\*\* Profibus

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

### 6.2.11 10-\*\* CAN Fieldbus

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

#### 6.2.12 11-\*\* LonWorks

Par. No. #	Parameter description	Default value	4-set-up	Change dur- ing operation	Conver- sion index	Туре
11-0*	LonWorks ID					
						OctStr[6
11-00	Neuron ID	0 N/A	All set-ups	TRUE	0	]
11-1*	LON Functions					
11-10	Drive Profile	[0] VSD profile	All set-ups	TRUE	-	Uint8
11-15	LON Warning Word	0 N/A	All set-ups	TRUE	0	Uint16
11-17	XIE Revision	0 N/A	All set-uns	TRUF	0	VisStr[5
		0 11/11	7 in Sec ups	INCE	Ū	VisStr[5
11-18	LonWorks Revision	0 N/A	All set-ups	TRUE	0	]
11-2*	LON Param. Access					
11-21	Store Data Values	[0] Off	All set-ups	TRUE	-	Uint8

#### 6.2.13 13-\*\* Smart Logic Controller

Par. No. #	Parameter description	Default value	4-set-up	Change dur- ing operation	Conver- sion index	Туре
13-0*	SLC Settings					
13-00	SL Controller Mode	null	2 set-ups	TRUE	-	Uint8
13-01	Start Event	null	2 set-ups	TRUE	-	Uint8
13-02	Stop Event	null	2 set-ups	TRUE	-	Uint8
13-03	Reset SLC	[0] Do not reset SLC	All set-ups	TRUE	-	Uint8
13-1*	Comparators					
13-10	Comparator Operand	null	2 set-ups	TRUE	-	Uint8
13-11	Comparator Operator	null	2 set-ups	TRUE	-	Uint8
13-12	Comparator Value	ExpressionLimit	2 set-ups	TRUE	-3	Int32
13-2*	Timers					
13-20	SL Controller Timer	ExpressionLimit	1 set-up	TRUE	-3	TimD
13-4*	Logic Rules					
13-40	Logic Rule Boolean 1	null	2 set-ups	TRUE	-	Uint8
13-41	Logic Rule Operator 1	null	2 set-ups	TRUE	-	Uint8
13-42	Logic Rule Boolean 2	null	2 set-ups	TRUE	-	Uint8
13-43	Logic Rule Operator 2	null	2 set-ups	TRUE	-	Uint8
13-44	Logic Rule Boolean 3	null	2 set-ups	TRUE	-	Uint8
13-5*	States					
13-51	SL Controller Event	null	2 set-ups	TRUE	-	Uint8
13-52	SL Controller Action	null	2 set-ups	TRUE	-	Uint8

### 6.2.14 14-\*\* Special Functions

14-0* Inverter Switching14-00Switching PrequencynullAll set-upsTRUE-Uint814-03Switching FrequencynullAll set-upsTRUE-Uint814-04PWM Random[1] OnAll set-upsFALSE-Uint814-04PWM Random[0] OffAll set-upsFALSE-Uint814-10Mains Failure[0] No functionAll set-upsFALSE-Uint814-11Mains Voltage at Mains FaultExpressionLimitAll set-upsTRUE0Uint1614-12Function at Mains Imbalance[0] TripAll set-upsTRUE0Uint1614-24Reset Functions10 sAll set-upsTRUE-Uint814-22Operation Mode[0] Normal operationAll set-upsTRUE0Uint1614-23Trip Delay at Torque Limit60 sAll set-upsTRUE-Uint814-24Trip Delay at Torque Limit60 sAll set-upsTRUE0Uint814-25Trip Delay at Torque Limit60 sAll set-upsTRUE0Uint814-28Peroduction Settings[0] No actionAll set-upsTRUE0Uint814-29Service Code0 N/AAll set-upsTRUE0Uint814-24Trip Delay at Torque LimitComerce0N/AAll set-upsTRUE014-25Trip Delay at Torque LimitComerce0N/A </th <th>Par. No. #</th> <th>Parameter description</th> <th>Default value</th> <th>4-set-up</th> <th>Change dur- ing operation</th> <th>Conver- sion index</th> <th>Туре</th>	Par. No. #	Parameter description	Default value	4-set-up	Change dur- ing operation	Conver- sion index	Туре
14-00Switching PatternnullAll set-upsTRUE-Uint814-01Switching FrequencynullAll set-upsTRUE-Uint814-04PWM Random[0] OffAll set-upsFALSE-Uint814-04PWM Random[0] OffAll set-upsFALSE-Uint814-14Mains Failure[0] No functionAll set-upsFALSE-Uint814-14Mains Failure[0] No functionAll set-upsTRUE0Uint1614-12Function at Mains Imbalance[0] TripAll set-upsTRUE-Uint814-20Reset ModenullAll set-upsTRUE0Uint1614-22Reset Mode[0] Normal operationAll set-upsTRUE0Uint1614-23Automatic Restart Time10 sAll set-upsTRUE0Uint1614-24Automatic Restart Time10 sAll set-upsTRUE0Uint1614-25Trip Delay at Torque Limit60 sAll set-upsTRUE0Uint814-28Production Settings[0] No actionAll set-upsTRUE0Uint814-32Service Code0 N/AAll set-upsTRUE0Uint814-34Automatic ChUint8Uint26Uint8Uint814-28Service Code0 N/AAll set-upsTRUE0Uint814-28Current Lim Cott, Proportional Gain100 %All se	14-0*	Inverter Switching					
14-01Switching FrequencynullAll set-upsTRUE-Uint814-03Overmodulation[1] OnAll set-upsFALSE-Uint814-04PWM Random[0] OffAll set-upsTRUE-Uint814-10Mains Failure[0] No functionAll set-upsFALSE-Uint814-11Mains Voltage at Mains FaultExpressionLimitAll set-upsTRUE0Uint1614-12Function at Mains Imbalance[0] TripAll set-upsTRUE0Uint1614-24Reset Functions-Uint8-Uint814-22Operation Mode[0] Normal operationAll set-upsTRUE-Uint814-23Trip Delay at Torque Limit60 sAll set-upsTRUE-Uint814-24Attornatic Restart Time[0] No actionAll set-upsTRUE0Uint1614-25Trip Delay at Torque Limit60 sAll set-upsTRUE0Uint814-28Production Settings[0] No actionAll set-upsTRUE0Uint814-29Service Code0 N/AAll set-upsTRUE0Uint814-24Trip Delay at Torque Limit60 sAll set-upsTRUE0Uint814-25Trip Delay at Torque Limit60 sAll set-upsTRUE0Uint814-26Trip Delay at Torque Limit60 sAll set-upsTRUE0Uint814-28Production	14-00	Switching Pattern	null	All set-ups	TRUE	-	Uint8
14-03       Overmodulation       [1] On       All set-ups       FALSE       -       Uint8         14-04       PWM Random       [0] Off       All set-ups       TRUE       -       Uint8         14-14       Mains Failure       [0] No function       All set-ups       FALSE       -       Uint8         14-11       Mains Failure       [0] No function       All set-ups       TRUE       0       Uint16         14-12       Function at Mains Imbalance       [0] Trip       All set-ups       TRUE       0       Uint16         14-20       Reset Mode       null       All set-ups       TRUE       0       Uint8         14-21       Automatic Restart Time       10 s       All set-ups       TRUE       0       Uint8         14-22       Automatic Restart Time       10 s       All set-ups       TRUE       0       Uint8         14-23       Typecode Setting       null       2 set-ups       TRUE       0       Uint8         14-24       Automatic Restart Time       60 s       All set-ups       TRUE       0       Uint8         14-25       Trip Delay at Inverter Fault       ExpressionLimit       All set-ups       TRUE       0       Uint8         14-	14-01	Switching Frequency	null	All set-ups	TRUE	-	Uint8
14-04PWM Random[0] OffAll set-upsTRUE-Uint814-14Mains Falure[0] No functionAll set-upsFALSE-Uint814-10Mains Falure[0] No functionAll set-upsTRUE0Uint1614-12Function at Mains Imbalance[0] TripAll set-upsTRUE-Uint814-24Reset FunctionsnullAll set-upsTRUE-Uint814-20Reset ModenullAll set-upsTRUE0Uint1614-21Automatic Restart Time10 sAll set-upsTRUE-Uint814-23Typecode Settingnull2 set-upsFALSE-Uint814-25Trip Delay at Torque Limit60 sAll set-upsTRUE0Uint814-26Trip Delay at Torque Limit60 sAll set-upsTRUE0Uint814-28Production Settings[0] No actionAll set-upsTRUE0Uint814-29Service Code0 N/AAll set-upsTRUE0Uint814-30Current Lim Cont, Proportional Gain100 %All set-upsFALSE-3Uint1614-34Current Lim Cont, Filter Time26.0 msAll set-upsFALSE0Uint1614-34All set-upsTRUE0Uint814-44All set-upsTRUE0Uint814-34All set-upsTRUE000%All set-upsTRUE0Uint16 <t< td=""><td>14-03</td><td>Overmodulation</td><td>[1] On</td><td>All set-ups</td><td>FALSE</td><td>-</td><td>Uint8</td></t<>	14-03	Overmodulation	[1] On	All set-ups	FALSE	-	Uint8
14-1* Mains On/Off         14-10       Mains Failure       [0] No function       All set-ups       FALSE       -       Uint8         14-11       Mains Imbalance       [0] Trip       All set-ups       TRUE       0       Uint18         14-2*       Function at Mains Imbalance       [0] Trip       All set-ups       TRUE       -       Uint8         14-2*       Reset Functions       Iterups       TRUE       -       Uint8         14-20       Reset Mode       null       All set-ups       TRUE       -       Uint8         14-21       Automatic Restart Time       10 s       All set-ups       TRUE       -       Uint8         14-21       Automatic Restart Time       10 s       All set-ups       TRUE       -       Uint8         14-22       Typecode Setting       null       2 set-ups       FALSE       -       Uint8         14-25       Trip Delay at Inverter Fault       ExpressionLimit       All set-ups       TRUE       0       Uint8         14-29       Production Settings       [0] No action       All set-ups       TRUE       0       Uint8         14-29       Service Code       0 N/A       All set-ups       TRUE       0       Uint16	14-04	PWM Random	[0] Off	All set-ups	TRUE	-	Uint8
14-10Mains Failure[0] No functionAll set-upsFALSE-Uint814-11Mains Voltage at Mains FaultExpressionLimitAll set-upsTRUE0Uint1614-22Function at Mains Imbalance[0] TripAll set-upsTRUE-Uint814-20Reset FunctionsUint16-Uint1614-21Automatic Restart Time10 sAll set-upsTRUE0Uint1614-22Operation Mode[0] Normal operationAll set-upsTRUE0Uint1614-23Typecode Settingnull2 set-upsFALSE-Uint814-24Trip Delay at Torque Limit60 sAll set-upsTRUE0Uint814-25Trip Delay at Torque Limit60 sAll set-upsTRUE0Uint814-26Trip Delay at Inverter FaultExpressionLimitAll set-upsTRUE0Uint814-29Service Code0 N/AAll set-upsTRUE0Uint814-30Current Lim Cort, Proportional Gain100 %All set-upsFALSE0Uint1614-31Current Lim Cort, Proportional Gain100 %All set-upsTRUE0Uint1614-32Current Lim Cort, Proportional Gain100 %All set-upsFALSE0Uint1614-32Current Lim Cort, Proportional Gain100 %All set-upsTRUE0Uint1614-33Current Lim Cort, Proportional Gain100 %All	14-1*	Mains On/Off					
14-11Mains Voltage at Mains FaultExpressionLimitAll set-upsTRUE0Uint1614-12Function at Mains Imbalance[0] TripAll set-upsTRUE-Uint814-27Reset Functions10 sAll set-upsTRUE-Uint814-28Reset ModenullAll set-upsTRUE0Uint1614-29Argention Mode[0] Normal operationAll set-upsTRUE-Uint814-20Reset Modenull2 set-upsFALSE-Uint814-22ArgenationAll set-upsTRUE0Uint814-25Trip Delay at Inverter FaultExpressionLimitAll set-upsTRUE0Uint814-26Trip Delay at Inverter FaultExpressionLimitAll set-upsTRUE0Uint814-29Service Code0 N/AAll set-upsTRUE0Uint814-29Service Code0 N/AAll set-upsTRUE0Uint814-30Current Lim Cont, Proportional Gain100 %All set-upsFALSE0Uint1614-31Current Lim Cont, Integration Time0.020 sAll set-upsFALSE0Uint1614-44Motor Cos-PhiExpressionLimitAll set-upsTRUE0Uint814-44VT Level66 %All set-upsTRUE0Uint814-44Motor Cos-PhiExpressionLimitAll set-upsTRUE0Uint8 <tr< tr="">14-44Motor</tr<>	14-10	Mains Failure	[0] No function	All set-ups	FALSE	-	Uint8
14-12       Function at Mains Imbalance       [0] Trip       All set-ups       TRUE       -       Uint8         14-20       Reset Mode       null       All set-ups       TRUE       -       Uint8         14-20       Reset Mode       10 s       All set-ups       TRUE       0       Uint16         14-20       Reset Mode       [0] Normal operation       All set-ups       TRUE       0       Uint16         14-21       Automatic Restart Time       10 s       All set-ups       TRUE       0       Uint8         14-21       Automatic Restart Time       10 s       All set-ups       TRUE       0       Uint8         14-23       Trip Delay at Torque Limit       60 s       All set-ups       TRUE       0       Uint8         14-26       Trip Delay at Inverter Fault       ExpressionLimit       All set-ups       TRUE       0       Uint8         14-28       Production Settings       [0] No action       All set-ups       TRUE       0       Uint3         14-29       Service Code       0 N/A       All set-ups       FALSE       0       Uint16         14-32       Current Lim Contr, Integration Time       0.020 s       All set-ups       FALSE       0       Uint16	14-11	Mains Voltage at Mains Fault	ExpressionLimit	All set-ups	TRUE	0	Uint16
14-2* Reset Functions14-20Reset ModenullAll set-upsTRUE-Uint1614-21Automatic Restart Time10 sAll set-upsTRUE0Uint1614-22Operation Mode[0] Normal operationAll set-upsTRUE-Uint814-23Typecode Settingnull2 set-upsFALSE-Uint814-25Trip Delay at Inverter FaultExpressionLimitAll set-upsTRUE0Uint814-26Trip Delay at Inverter FaultExpressionLimitAll set-upsTRUE0Uint814-28Production Settings[0] No actionAll set-upsTRUE0Uint814-29Service Code0 N/AAll set-upsTRUE0Uint3214-34Current Lim Cort, Integration Time0.020 sAll set-upsFALSE0Uint1614-32Current Lim Cort, Integration Time0.202 sAll set-upsTRUE-Uint814-43Current Lim Cort, Integration Time0.202 sAll set-upsTRUE-Uint814-44Herry OptimizingUint814-44Uint1614-44Harrey OptimizingUint814-4214-44All set-upsTRUE0Uint814-4214-44Uint814-44All set-upsTRUE0Uint814-4214-44Uint814-44Motor Cos-PhiExpressionLimitAll set-ups<	14-12	Function at Mains Imbalance	[0] Trip	All set-ups	TRUE	-	Uint8
14-20Reset ModenullAll set-upsTRUE-Uint814-21Automatic Restart Time10 sAll set-upsTRUE0Uint1614-22Automatic Restart Time10 sAll set-upsTRUE0Uint1614-22Typecode Settingnull2 set-upsFALSE-Uint814-23Typecode Settingnull2 set-upsFALSE-Uint814-25Trip Delay at Torque Limit60 sAll set-upsTRUE0Uint814-26Trip Delay at Torque LimitExpressionLimitAll set-upsTRUE0Uint814-28Production Settings[0] No actionAll set-upsTRUE0Uint814-29Service Code0 N/AAll set-upsTRUE0Int3214-34Current Lim Cont, Proportional Gain100 %All set-upsFALSE0Uint1614-31Current Lim Cont, Integration Time0.202 sAll set-upsFALSE-3Uint1614-32Current Lim Cont, Integration Time0.602 sAll set-upsTRUE-4Uint1614-34ExpressionLimitAll set-upsTRUE0Uint814-44Uint1614-44ExpressionLimitAll set-upsTRUE0Uint814-44Uint1614-44All Set-upsTRUE0Uint814-44Uint1614-42Uint1614-42Uint1614-42Minimum AEO Frequency10 HzAll set-ups<	14-2*	Reset Functions					
14-21Automatic Restart Time10 sAll set-upsTRUE0Uint1614-22Operation Mode[0] Normal operationAll set-upsTRUE-Uint814-23Typecode Settingnull2 set-upsFALSE-Uint814-25Trip Delay at Torque Limit60 sAll set-upsTRUE0Uint814-26Trip Delay at Inverter FaultExpressionLimitAll set-upsTRUE0Uint814-28Production Settings[0] No actionAll set-upsTRUE0Uint814-29Service Code0 N/AAll set-upsTRUE0Uint814-29Service Code0 N/AAll set-upsTRUE0Uint614-31Current Lim Contr, Integration Time0.020 sAll set-upsFALSE-3Uint1614-32Current Lim Contr, Integration Time0.020 sAll set-upsTRUE-4Uint1614-44Kengy Optimizing	14-20	Reset Mode	null	All set-ups	TRUE	-	Uint8
14-22Operation Mode[0] Normal operationAll set-upsTRUE-Uint814-23Typecode Settingnull2 set-upsFALSE-Uint814-25Trip Delay at Inverter FaultExpressionLimitAll set-upsTRUE0Uint814-26Trip Delay at Inverter FaultExpressionLimitAll set-upsTRUE0Uint814-28Production Settings[0] No actionAll set-upsTRUE0Uint814-29Service Code0 N/AAll set-upsTRUE0Int3214-34Current Limit Ctrl.1100 %All set-upsFALSE0Uint1614-31Current Lim Cont, Integration Time0.020 sAll set-upsFALSE-3Uint1614-32Current Lim Cont, Integration Time0.020 sAll set-upsFALSE-3Uint1614-32Current Lim Cont, Integration Time0.020 sAll set-upsFALSE0Uint814-40VT Level66 %All set-upsTRUE0Uint814-41AEO Minimum MagnetizationExpressionLimitAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE-Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE-Uint814-43RFI 1[1] On1 set-upsTRUE <td>14-21</td> <td>Automatic Restart Time</td> <td>10 s</td> <td>All set-ups</td> <td>TRUE</td> <td>0</td> <td>Uint16</td>	14-21	Automatic Restart Time	10 s	All set-ups	TRUE	0	Uint16
14-23Typecode Settingnull2 set-upsFALSE-Uint814-25Trip Delay at Torque Limit60 sAll set-upsTRUE0Uint814-26Trip Delay at Torque LimitExpressionLimitAll set-upsTRUE0Uint814-26Trip Delay at Inverter FaultExpressionLimitAll set-upsTRUE-Uint814-28Production Settings[0] No actionAll set-upsTRUE-Uint814-29Service Code0 N/AAll set-upsTRUE0Uint3214-37Current Lim Cont, Proportional Gain100 %All set-upsFALSE0Uint1614-31Current Lim Cont, Integration Time0.020 sAll set-upsFALSE-3Uint1614-32Current Lim Cort, Integration Time0.020 sAll set-upsTRUE-4Uint1614-44Energy Optimizing4Uint16-4Uint1614-44AEO Minimum MagnetizationExpressionLimitAll set-upsTRUE0Uint814-44Motor Cos-PhiExpressionLimitAll set-upsTRUE-2Uint1614-52Fan Control[0] AutoAll set-upsTRUE-2Uint1814-54Amotor Cos-PhiExpressionLimitAll set-upsTRUE-2Uint1814-55Output Filter[1] On1 set-upFALSE-Uint814-54Fan Control[1] WarningAll set-upsTRUE <td< td=""><td>14-22</td><td>Operation Mode</td><td>[0] Normal operation</td><td>All set-ups</td><td>TRUE</td><td>-</td><td>Uint8</td></td<>	14-22	Operation Mode	[0] Normal operation	All set-ups	TRUE	-	Uint8
14-25Trip Delay at Torque Limit60 sAll set-upsTRUE0Uint814-26Trip Delay at Inverter FaultExpressionLimitAll set-upsTRUE0Uint814-28Production Settings[0] No actionAll set-upsTRUE-Uint814-29Service Code0 N/AAll set-upsTRUE0Uint1614-30Current Limit CtrlUint6-14-30Current Lim Contr, Integration Time0.020 sAll set-upsFALSE0Uint1614-31Current Lim Contr, Integration Time0.020 sAll set-upsFALSE-3Uint1614-32Current Lim Contr, Integration Time0.66 %All set-upsTRUE-4Uint1614-44Energy OptimizingUint8-4Uint814-44Haco Minimum MagnetizationExpressionLimitAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE0Uint814-44Motor Cos-PhiExpressionLimitAll set-upsTRUE-2Uint1614-52Fan Control[0] AutoAll set-upsTRUE-Uint814-53Fan Monitor[1] WarningAll set-upsTRUE-Uint814-54AutoAll set-upsTRUE-Uint814-55Output Filter10Uint814-55Output Filter[0] AutoAll set-upsTRUE	14-23	Typecode Setting	null	2 set-ups	FALSE	-	Uint8
14-26Trip Delay at Inverter FaultExpressionLimitAll set-upsTRUE0Uint814-28Production Settings[0] No actionAll set-upsTRUE-Uint814-29Service Code0 N/AAll set-upsTRUE0Int3214-30Current Limit Ctrl.14-30Current Lim Cont, Proportional Gain100 %All set-upsFALSE0Uint1614-31Current Lim Cont, Integration Time0.020 sAll set-upsFALSE-3Uint1614-32Current Lim Ctrl, Filter Time26.0 msAll set-upsFALSE-3Uint1614-32Current Lim Ctrl, Filter Time26.0 msAll set-upsFALSE0Uint814-44Mengu potizingTRUE-4Uint1614 <td>14-25</td> <td>Trip Delay at Torque Limit</td> <td>60 s</td> <td>All set-ups</td> <td>TRUE</td> <td>0</td> <td>Uint8</td>	14-25	Trip Delay at Torque Limit	60 s	All set-ups	TRUE	0	Uint8
14-28Production Settings[0] No actionAll set-upsTRUE-Uint814-29Service Code0 N/AAll set-upsTRUE0Int3214-3*Current Limit Ctrl.14-30Current Lim Contr, Proportional Gain100 %All set-upsFALSE0Uint1614-31Current Lim Contr, Integration Time0.020 sAll set-upsFALSE-3Uint1614-32Current Lim Contr, Integration Time0.020 sAll set-upsTRUE-4Uint1614-42Energy OptimizingTRUE-4Uint16-4Uint814-40VT Level66 %All set-upsFALSE0Uint814-41AEO Minimum MagnetizationExpressionLimitAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE-2Uint1614-50RFI 1[1] On1 set-upFALSE-Uint814-52Fan Control[0] AutoAll set-upsTRUE-Uint814-53Fan Control[0] No Filter1 set-upFALSE-Uint814-54Fan Control[0] No Filter1 set-upFALSE-Uint814-55Output Filter[0] No Filter1 set-upFALSE-Uint814-54Auto Derate[0] No Filter1 set-upFALSE0Uint8 <td>14-26</td> <td>Trip Delay at Inverter Fault</td> <td>ExpressionLimit</td> <td>All set-ups</td> <td>TRUE</td> <td>0</td> <td>Uint8</td>	14-26	Trip Delay at Inverter Fault	ExpressionLimit	All set-ups	TRUE	0	Uint8
14-29Service Code0 N/AAll set-upsTRUE0Int3214-3* Current Limit Ctrl.14-30Current Lim Cont, Proportional Gain100 %All set-upsFALSE0Uint1614-31Current Lim Contr, Integration Time0.020 sAll set-upsFALSE-3Uint1614-32Current Lim Contr, Integration Time26.0 msAll set-upsTRUE-4Uint1614-4* Energy Optimizing14-4*Energy Optimizing-4Uint16-4Uint1814-40VT Level66 %All set-upsTRUE0Uint814-40Minimum MagnetizationExpressionLimitAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE-2Uint1614-55Fan Control[0] AutoAll set-upsTRUE-Uint814-50RFI 1[1] On1 set-upFALSE-Uint814-50RFI 1[1] On1 set-upFALSE-Uint814-55Output Filter[0] NuoAll set-upsTRUE-Uint814-55Output Filter[0] No Filter1 set-upFALSE-Uint814-59Actual Number of Inverter UnitsExpressionLimit1 set-upFALSE0Uint814-59Actual Number of Inverter UnitsExpressionLimit1 set-upFALSE <td>14-28</td> <td>Production Settings</td> <td>[0] No action</td> <td>All set-ups</td> <td>TRUE</td> <td>-</td> <td>Uint8</td>	14-28	Production Settings	[0] No action	All set-ups	TRUE	-	Uint8
14-3* Current Limit Ctrl.14-30Current Lim Cont, Proportional Gain100 %All set-upsFALSE0Uint1614-31Current Lim Contr, Integration Time0.020 sAll set-upsFALSE-3Uint1614-32Current Lim Ctrl, Filter Time26.0 msAll set-upsTRUE-4Uint1614-42Energy Optimizing14-44Energy Optimizing14-44Level66 %All set-upsFALSE0Uint814-41AEO Minimum MagnetizationExpressionLimitAll set-upsTRUE0Uint814-42Minimum AEO Frequency10 HzAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE-2Uint1614-54EnvironmentII On1 set-upTRUE-2Uint1814-55Fan Control[0] AutoAll set-upsTRUE-Uint814-55Fan Control[0] AutoAll set-upsTRUE-Uint814-55Fan Monitor[1] WarningAll set-upsTRUE-Uint814-55Output Filter[0] No Filter1 set-upFALSE-Uint814-54Auto Derate[0] No Filter1 set-upFALSE-Uint814-55Output Filter[0] No Filter1 set-upFALSE-Uint814-54Auto Derate[0] TripAll set-upsTRUE-Uint8 <tr< tr="">14-64Auto De</tr<>	14-29	Service Code	0 N/A	All set-ups	TRUE	0	Int32
14-30Current Lim Cont, Proportional Gain100 %All set-upsFALSE0Uint1614-31Current Lim Contr, Integration Time0.020 sAll set-upsFALSE-3Uint1614-32Current Lim Ctrl, Filter Time26.0 msAll set-upsTRUE-4Uint1614-4*Energy OptimizingTRUE-4Uint1614-44Energy Optimizing14-44All set-upsTRUE0Uint814-40VT Level66 %All set-upsTRUE0Uint814-42Minimum MagnetizationExpressionLimitAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE-2Uint1614-54EnvironmentII] On1 set-upFALSE-Uint814-55Fan Control[0] AutoAll set-upsTRUE-Uint814-55Fan Monitor[1] WarningAll set-upsTRUE-Uint814-55Output Filter[0] No Filter1 set-upFALSE-Uint814-59Actual Number of Inverter UnitsExpressionLimit1 set-upFALSE-Uint814-59Actual Number of Inverter UnitsExpressionLimit1 set-upFALSE-Uint814-54*Auto DerateI[0] TripAll set-upsTRUE-Uint814-64*Auto D	14-3*	Current Limit Ctrl.					
14-31Current Lim Contr, Integration Time0.020 sAll set-upsFALSE-3Uint1614-32Current Lim Ctrl, Filter Time26.0 msAll set-upsTRUE-4Uint1614-4*Energy Optimizing-4Uint16-4Uint1614-40VT Level66 %All set-upsFALSE0Uint814-41AEO Minimum MagnetizationExpressionLimitAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE-2Uint1614-54FenvironmentII10 n1 set-upFALSE-Uint814-55RFI 1[1] On1 set-upFALSE-Uint814-55Fan Control[0] AutoAll set-upsTRUE-Uint814-55Output Filter[0] No Filter1 set-upFALSE-Uint814-59Actual Number of Inverter UnitsExpressionLimit1 set-upFALSE-Uint814-64*Auto DerateI[0] TripAll set-upsTRUE-Uint814-64*Function at Inverter Overload[0] TripAll set-upsTRUE-Uint814-62Inv. Overload Derate Current95 %All set-upsTRUE0Uint16	14-30	Current Lim Cont, Proportional Gain	100 %	All set-ups	FALSE	0	Uint16
14-32Current Lim Ctrl, Filter Time26.0 msAll set-upsTRUE-4Uint1614-4*Energy Optimizing14-40VT Level66 %All set-upsFALSE0Uint814-41AEO Minimum MagnetizationExpressionLimitAll set-upsTRUE0Uint814-42Minimum AEO Frequency10 HzAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE-2Uint1614-5*Environment11 On1 set-upFALSE-Uint814-50RFI 1[1] On1 set-upsTRUE-Uint814-52Fan Control[0] AutoAll set-upsTRUE-Uint814-53Fan Monitor[1] WarningAll set-upsTRUE-Uint814-55Output Filter[0] No Filter1 set-upFALSE-Uint814-54Auto Derate[0] No Filter1 set-upFALSE-Uint814-54Auto Derate[0] TripAll set-upsTRUE-Uint814-64Function at Inverter Overload[0] TripAll set-upsTRUE-Uint814-62Inv. Overload Derate Current95 %All set-upsTRUE0Uint16	14-31	Current Lim Contr, Integration Time	0.020 s	All set-ups	FALSE	-3	Uint16
14-4* Energy Optimizing14-40VT Level66 %All set-upsFALSE0Uint814-41AEO Minimum MagnetizationExpressionLimitAll set-upsTRUE0Uint814-42Minimum AEO Frequency10 HzAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE-2Uint1614-54EnvironmentI10 N1 set-upFALSE-Uint814-52Fan Control[0] AutoAll set-upsTRUE-Uint814-53Fan Monitor[1] WarningAll set-upsTRUE-Uint814-55Output Filter[0] No Filter1 set-upFALSE-Uint814-59Actual Number of Inverter UnitsExpressionLimit1 set-upFALSE-Uint814-54Auto DerateI10 No Filter1 set-upFALSE-Uint814-64Auto Derate[0] TripAll set-upsTRUE-Uint814-61Function at Inverter Overload[0] TripAll set-upsTRUE-Uint814-62Inv. Overload Derate Current95 %All set-upsTRUE0Uint16	14-32	Current Lim Ctrl, Filter Time	26.0 ms	All set-ups	TRUE	-4	Uint16
14-40VT Level66 %All set-upsFALSE0Uint814-41AEO Minimum MagnetizationExpressionLimitAll set-upsTRUE0Uint814-42Minimum AEO Frequency10 HzAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE-2Uint1614-54EnvironmentIIIn1 set-upFALSE-Uint814-52Fan Control[0] AutoAll set-upsTRUE-Uint814-53Fan Monitor[1] WarningAll set-upsTRUE-Uint814-55Output Filter[0] No Filter1 set-upFALSE-Uint814-59Actual Number of Inverter UnitsExpressionLimit1 set-upFALSE-Uint814-60Function at Overtemperature[0] TripAll set-upsTRUE-Uint814-61Function at Inverter Overload[0] TripAll set-upsTRUE-Uint814-62Inv. Overload Derate Current95 %All set-upsTRUE0Uint16	14-4*	Energy Optimizing					
14-41AEO Minimum MagnetizationExpressionLimitAll set-upsTRUE0Uint814-42Minimum AEO Frequency10 HzAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE-2Uint1614-5*EnvironmentIII On1 set-upFALSE-Uint814-50RFI 1[1] On1 set-upFALSE-Uint814-52Fan Control[0] AutoAll set-upsTRUE-Uint814-53Fan Monitor[1] WarningAll set-upsTRUE-Uint814-55Output Filter[0] No Filter1 set-upFALSE-Uint814-59Actual Number of Inverter UnitsExpressionLimit1 set-upFALSE-Uint814-64*Auto DerateII set-upFALSE0Uint814-61Function at Overtemperature[0] TripAll set-upsTRUE-Uint814-62Inv. Overload Derate Current95 %All set-upsTRUE0Uint16	14-40	VT Level	66 %	All set-ups	FALSE	0	Uint8
14-42Minimum AEO Frequency10 HzAll set-upsTRUE0Uint814-43Motor Cos-PhiExpressionLimitAll set-upsTRUE-2Uint1614-5*EnvironmentImage: Control set-up	14-41	AEO Minimum Magnetization	ExpressionLimit	All set-ups	TRUE	0	Uint8
14-43Motor Cos-PhiExpressionLimitAll set-upsTRUE-2Uint1614-5*Environment14-50RFI 1[1] On1 set-upFALSE-Uint814-52Fan Control[0] AutoAll set-upsTRUE-Uint814-53Fan Monitor[1] WarningAll set-upsTRUE-Uint814-55Output Filter[0] No Filter1 set-upFALSE-Uint814-59Actual Number of Inverter UnitsExpressionLimit1 set-upFALSE-Uint814-6*Auto Derate14-60Function at Overtemperature[0] TripAll set-upsTRUEUint814-61Function at Inverter Overload[0] TripAll set-upsTRUE-Uint814-62Inv. Overload Derate Current95 %All set-upsTRUE0Uint16	14-42	Minimum AEO Frequency	10 Hz	All set-ups	TRUE	0	Uint8
14-5* Environment14-50RFI 1[1] On1 set-upFALSE-Uint814-52Fan Control[0] AutoAll set-upsTRUE-Uint814-53Fan Monitor[1] WarningAll set-upsTRUE-Uint814-54Fan Monitor[1] No Filter1 set-upFALSE-Uint814-55Output Filter[0] No Filter1 set-upFALSE-Uint814-59Actual Number of Inverter UnitsExpressionLimit1 set-upFALSE0Uint814-64Auto DerateImage: State of the set of the se	14-43	Motor Cos-Phi	ExpressionLimit	All set-ups	TRUE	-2	Uint16
14-50RFI 1[1] On1 set-upFALSE-Uint814-52Fan Control[0] AutoAll set-upsTRUE-Uint814-53Fan Monitor[1] WarningAll set-upsTRUE-Uint814-55Output Filter[0] No Filter1 set-upFALSE-Uint814-59Actual Number of Inverter UnitsExpressionLimit1 set-upFALSE-Uint814-64Auto DerateUint8-Uint814-61Function at Overtemperature[0] TripAll set-upsTRUE-Uint814-62Inv. Overload Derate Current95 %All set-upsTRUE0Uint16	14-5*	Environment					
14-52Fan Control[0] AutoAll set-upsTRUE-Uint814-53Fan Monitor[1] WarningAll set-upsTRUE-Uint814-55Output Filter[0] No Filter1 set-upFALSE-Uint814-59Actual Number of Inverter UnitsExpressionLimit1 set-upFALSE0Uint814-64Auto DerateUint8-Uint814-61Function at Overtemperature[0] TripAll set-upsTRUE-Uint814-62Inv. Overload Derate Current95 %All set-upsTRUE0Uint16	14-50	RFI 1	[1] On	1 set-up	FALSE	-	Uint8
14-53Fan Monitor[1] WarningAll set-upsTRUE-Uint814-55Output Filter[0] No Filter1 set-upFALSE-Uint814-59Actual Number of Inverter UnitsExpressionLimit1 set-upFALSE0Uint814-6*Auto Derate-Uint8-Uint814-61Function at Overtemperature[0] TripAll set-upsTRUE-Uint814-62Inv. Overload Derate Current95 %All set-upsTRUE0Uint16	14-52	Fan Control	[0] Auto	All set-ups	TRUE	-	Uint8
14-55Output Filter[0] No Filter1 set-upFALSE-Uint814-59Actual Number of Inverter UnitsExpressionLimit1 set-upFALSE0Uint814-6*Auto DerateUint8-Uint814-60Function at Overtemperature[0] TripAll set-upsTRUE-Uint814-61Function at Inverter Overload[0] TripAll set-upsTRUE-Uint814-62Inv. Overload Derate Current95 %All set-upsTRUE0Uint16	14-53	Fan Monitor	[1] Warning	All set-ups	TRUE	-	Uint8
14-59Actual Number of Inverter UnitsExpressionLimit1 set-upFALSE0Uint814-6*Auto Derate14-60Function at Overtemperature[0] TripAll set-upsTRUE-Uint814-61Function at Inverter Overload[0] TripAll set-upsTRUE-Uint814-62Inv. Overload Derate Current95 %All set-upsTRUE0Uint16	14-55	Output Filter	[0] No Filter	1 set-up	FALSE	-	Uint8
14-6* Auto Derate14-60Function at Overtemperature[0] TripAll set-upsTRUE-Uint814-61Function at Inverter Overload[0] TripAll set-upsTRUE-Uint814-62Inv. Overload Derate Current95 %All set-upsTRUE0Uint16	14-59	Actual Number of Inverter Units	ExpressionLimit	1 set-up	FALSE	0	Uint8
14-60Function at Overtemperature[0] TripAll set-upsTRUE-Uint814-61Function at Inverter Overload[0] TripAll set-upsTRUE-Uint814-62Inv. Overload Derate Current95 %All set-upsTRUE0Uint16	14-6*	Auto Derate					
14-61Function at Inverter Overload[0] TripAll set-upsTRUE-Uint814-62Inv. Overload Derate Current95 %All set-upsTRUE0Uint16	14-60	Function at Overtemperature	[0] Trip	All set-ups	TRUE	-	Uint8
14-62Inv. Overload Derate Current95 %All set-upsTRUE0Uint16	14-61	Function at Inverter Overload	[0] Trip	All set-ups	TRUE	-	Uint8
	14-62	Inv. Overload Derate Current	95 %	All set-ups	TRUE	0	Uint16

#### 6.2.15 15-\*\* FC Information

Par. No. #	Parameter description	Default value	4-set-up	Change dur- ing operation	Conver- sion in- dex	Туре
15-0*	Operating Data					
15-00	Operating Hours	0 h	All set-ups	FALSE	74	Uint32
15-01	Running Hours	0 h	All set-ups	FALSE	74	Uint32
15-02	kWh Counter	0 kWh	All set-ups	FALSE	75	Uint32
15-03	Power-ups	0 N/A	All set-ups	FALSE	0	Uint32
15-04	Over Temps	0 N/A	All set-ups	FALSE	0	Uint16
15-05	Over Volts	0 N/A	All set-ups	FALSE	0	Uint16
15-06	Reset kWh Counter	[0] Do not reset	All set-ups	TRUE	-	Uint8
15-07	Reset Running Hours Counter	[0] Do not reset	All set-ups	TRUE	-	Uint8
15-08	Number of Starts	0 N/A	All set-ups	FALSE	0	Uint32
15-1*	Data Log Settings		2 +	TDUE		
15-10	Logging Source	U	2 set-ups	TRUE	-	UINT16
15-11	Logging Interval	ExpressionLimit	2 set-ups	TRUE	-3	1 ImD
15-12	Ingger Event	[U] FALSE	1 set-up	TRUE	-	UINt8
15-13	Logging Mode		2 set-ups	TRUE	-	UINt8
15-14		50 N/A	z set-ups	TRUE	0	UIILO
15-20	Historic Log: Event	0 N/A	All cet-upc	EALSE	0	Llint8
15-20	Historic Log: Value			FALSE	0	Llint32
15-21	Historic Log: Time	0 N/A		EALSE	_3	Unt32
15-22	Historic Log: Date and Time	Expression limit	All set-ups	FALSE	0	TimeOfDay
15-3*	Alarm Log	ExpressionEnnit	All Set ups	TALSE	0	Timeorbay
15-30	Alarm Log: Error Code	0 N/A	All set-ups	FAI SE	0	Llint8
15-31	Alarm Log: Value	0 N/A	All set-ups	FALSE	0	Int16
15-32	Alarm Log: Time	0 s	All set-ups	FALSE	0	Llint32
15-33	Alarm Log: Date and Time	ExpressionLimit	All set-ups	FALSE	0	TimeOfDay
15-4*	Drive Identification				-	
15-40	FC Type	0 N/A	All set-ups	FALSE	0	VisStr[6]
15-41	Power Section	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-42	Voltage	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-43	Software Version	0 N/A	All set-ups	FALSE	0	VisStr[5]
15-44	Ordered Typecode String	0 N/A	All set-ups	FALSE	0	VisStr[40]
15-45	Actual Typecode String	0 N/A	All set-ups	FALSE	0	VisStr[40]
15-46	Adj Freq Dr Ordering No.	0 N/A	All set-ups	FALSE	0	VisStr[8]
15-47	Power Card Ordering No.	0 N/A	All set-ups	FALSE	0	VisStr[8]
15-48	LCP ID Num.	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-49	SW ID Control Card	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-50	SW ID Power Card	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-51	Adj Freq Dr Serial No.	0 N/A	All set-ups	FALSE	0	VisStr[10]
15-53	Power Card Serial Number	0 N/A	All set-ups	FALSE	0	VisStr[19]
15-6*	Option Ident	0.11/1				
15-60	Option Mounted	0 N/A	All set-ups	FALSE	0	VisStr[30]
15-61	Option Svv version	0 N/A	All set-ups	FALSE	0	VISSTr[20]
15-62	Option Ordering No	0 N/A	All set-ups	FALSE	0	VISSTr[8]
15-63	Option Serial No	0 N/A	All set-ups	FALSE	0	VISSTr[18]
15-70	Option In Slot A	0 N/A	All set-ups	FALSE	0	VISStr[30]
15-/1	Slot A Option SW Version	0 N/A	All set-ups	FALSE	0	VISStr[20]
15-72	Clet B Option SW/ Version	0 N/A	All set-ups	FALSE	0	VISSU[30]
15-73	Option in Slot CO		All set-ups	FALSE	0	VisStr[20]
15-75	Slot CO Ontion SW Version			FALSE	0	VicStr[20]
15-76	Ontion in Slot C1			FALSE	0	VisStr[20]
15-77	Slot C1 Ontion SW Version	0 N/A	All set-ups	FALSE	0	VisStr[20]
15-9*	Parameter Info					1.000[20]
15-92	Defined Parameters	0 N/A	All set-ups	FALSE	0	Uint16
15-93	Modified Parameters	0 N/A	All set-ups	FALSE	Õ	Uint16
15-98	Drive Identification	0 N/A	All set-ups	FALSE	0	VisStr[40]
15-99	Parameter Metadata	0 N/A	All set-ups	FALSE	0	Uint16

### 6.2.16 16-\*\* Data Readouts

Par. No. #	Parameter description	Default value	4-set-up	Change dur- ing operation	Conver- sion index	Туре
16-0*	General Status					
16-00	Control Word	0 N/A	All set-ups	FALSE	0	V2
16-01	Reference [Unit]	0.000 ReferenceFeedbackUnit	All set-ups	FALSE	-3	Int32
16-02	Reference %	0.0 %	All set-ups	FALSE	-1	Int16
16-03	Status Word	0 N/A	All set-ups	FALSE	0	V2
16-05	Main Actual Value [%]	0.00 %	All set-ups	FALSE	-2	N2
16-09	Custom Readout	0.00 CustomReadoutUnit	All set-ups	FALSE	-2	Int32
16 10		0.00 kW		EALCE	1	Int22
16-11	Power [hp]	0.00 kW	All set-ups	FALSE	-2	Int32
16-12	Motor voltage	0.00 Np	All set-ups	FALSE	-2	Llint16
16-13	Frequency	0.0 V	All set-ups	FALSE	-1	Uint16
16-14	Motor Current	0.00 A	All set-ups	FALSE	-2	Int32
16-15	Frequency [%]	0.00 %	All set-ups	FALSE	-2	N2
16-16	Torque [Nm]	0.0 Nm	All set-ups	FALSE	-1	Int32
16-17	Speed [RPM]	0 RPM	All set-ups	FALSE	67	Int32
16-18	Motor Thermal	0 %	All set-ups	FALSE	0	Uint8
16-22	Torque [%]	0 %	All set-ups	FALSE	0	Int16
16-26	Power Filtered [kW]	0.000 kW	All set-ups	FALSE	0	Int32
16-27	Power Filtered [hp]	0.000 hp	All set-ups	FALSE	-3	Int32
16-3*	Drive Status					
16-30	DC Link Voltage	0 0	All set-ups	FALSE	0	Uint16
16 22	Brake Energy /S Brake Energy /2 min		All set-ups	FALSE	0	UINU32
16 24	Blake Ellergy /2 IIIII		All set-ups	FALSE	100	UIIIL52
16-35	Inverter Thermal	0 %	All set-ups	FALSE	100	Unito
16-36	Inventer merinar	Expression limit	All set-uns	FALSE	-2	Llint32
16-37	Inv. Max. Current	ExpressionLimit	All set-ups	FALSE	-2	Uint32
16-38	SL Controller State	0 N/A	All set-ups	FALSE	0	Uint8
16-39	Control Card Temp.	0 °C	All set-ups	FALSE	100	Uint8
16-40	Logging Buffer Full	[0] No	All set-ups	TRUE	-	Uint8
16-49	Current Fault Source	0 N/A	All set-ups	TRUE	0	Uint8
16-5*	Ref. & Feedb.					
16-50	External Reference	0.0 N/A	All set-ups	FALSE	-1	Int16
16-52	Feedback [Unit]	0.000 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
16-53	Digi Pot Reference	0.00 N/A	All set-ups	FALSE	-2	Int16
16-54	Feedback 1 [Unit]	0.000 ProcessCtrlUnit	All set-ups	FALSE	-3	Int32
16-55	Feedback 2 [Unit]	0.000 ProcessCtrIUnit	All set-ups	FALSE	-3	Int32
16-50	Feedback 3 [Unit]		All set-ups	FALSE	-3	Int32
16-56	PID Output [%]	0.0 %	All set-ups	IRUE	-1	111(10
16 60	Digital Input	0 N/A	All cot upc	EALCE	0	Llint16
16-61	Terminal 53 Switch Setting	[0] Current	All set-ups	FALSE	-	Unit10
16-62	Analog Input 53		All set-ups	FALSE	-3	Int32
16-63	Terminal 54 Switch Setting	[0] Current	All set-ups	FALSE	-	Uint8
16-64	Analog Input 54	0.000 N/A	All set-ups	FALSE	-3	Int32
16-65	Analog Output 42 [mA]	0.000 N/A	All set-ups	FALSE	-3	Int16
16-66	Digital Output [bin]	0 N/A	All set-ups	FALSE	0	Int16
16-67	Pulse Input #29 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
16-68	Pulse Input #33 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
16-69	Pulse Output #27 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
16-70	Pulse Output #29 [Hz]	0 N/A	All set-ups	FALSE	0	Int32
16-71		U N/A	All set-ups	FALSE	0	Int16
16 72	Counter B		All set-ups		0	Int32
16 75	Applog In V30/11		All set-ups	EALCE	_2	Int22
16-76	Analog In X30/11 Analog In X30/12	0.000 N/A		FALSE	-3	Int32
16-77	Analog Out X30/8 [mA]	0.000 N/A	All set-ups	FALSE	-3	Int16
16-8*	Fieldbus & FC Port		7 in Sec ups	TALOE	5	Incro
16-80	Fieldbus CTW 1	0 N/A	All set-ups	FALSE	0	V2
16-82	Fieldbus REF 1	0 N/A	All set-ups	FALSE	0	N2
16-84	Comm. Option Status	0 N/A	All set-ups	FALSE	0	V2
16-85	FC Port CTW 1	0 N/A	All set-ups	FALSE	0	V2
16-86	FC Port REF 1	0 N/A	All set-ups	FALSE	0	N2
16-9*	Diagnosis Readouts					
16-90	Alarm Word	0 N/A	All set-ups	FALSE	0	Uint32
16-91	Alarm word 2	0 N/A	All set-ups	FALSE	0	Uint32
16-92	Warning Word	0 N/A	All set-ups	FALSE	0	Uint32
16-93	Warning word 2	0 N/A	All set-ups	FALSE	0	Uint32
16-94	Ext. Status Word	0 N/A	All set-ups	FALSE	0	Uint32
16-95	Ext. Status Word 2	U N/A	All set-ups	FALSE	0	UINt32
10-90	maintenance word	U N/A	All set-ups	FALSE	U	UINT32

### 6.2.17 18-\*\* Info & Readouts

Par. No. #	Parameter description	Default value	4-set-up	Change dur- ing operation	Conver- sion index	Туре
18-0*	Maintenance Log					
18-00	Maintenance Log: Item	0 N/A	All set-ups	FALSE	0	Uint8
18-01	Maintenance Log: Action	0 N/A	All set-ups	FALSE	0	Uint8
18-02	Maintenance Log: Time	0 s	All set-ups	FALSE	0	Uint32
						TimeOf-
18-03	Maintenance Log: Date and Time	ExpressionLimit	All set-ups	FALSE	0	Day
18-1*	Fire Mode Log					
18-10	Fire Mode Log: Event	0 N/A	All set-ups	FALSE	0	Uint8
18-11	Fire Mode Log: Time	0 s	All set-ups	FALSE	0	Uint32
						TimeOf-
18-12	Fire Mode Log: Date and Time	ExpressionLimit	All set-ups	FALSE	0	Day
18-3*	Inputs & Outputs					
18-30	Analog Input X42/1	0.000 N/A	All set-ups	FALSE	-3	Int32
18-31	Analog Input X42/3	0.000 N/A	All set-ups	FALSE	-3	Int32
18-32	Analog Input X42/5	0.000 N/A	All set-ups	FALSE	-3	Int32
18-33	Analog Out X42/7 [V]	0.000 N/A	All set-ups	FALSE	-3	Int16
18-34	Analog Out X42/9 [V]	0.000 N/A	All set-ups	FALSE	-3	Int16
18-35	Analog Out X42/11 [V]	0.000 N/A	All set-ups	FALSE	-3	Int16
18-5*	Ref. & Feedb.					
18-50	Sensorless Readout [unit]	0.000 SensorlessUnit	All set-ups	FALSE	-3	Int32

#### 6.2.18 20-\*\* FC Closed-loop

Par. No. #	Parameter description	Default value	4-set-up	Change dur- ing operation	Conver- sion index	Туре
20-0*	Feedback					
20-00	Feedback 1 Source	[2] Analog input 54	All set-ups	TRUE	-	Uint8
20-01	Feedback 1 Conversion	[0] Linear	All set-ups	FALSE	-	Uint8
20-02	Feedback 1 Source Unit	null	All set-ups	TRUE	-	Uint8
20-03	Feedback 2 Source	[0] No function	All set-ups	TRUE	-	Uint8
20-04	Feedback 2 Conversion	[0] Linear	All set-ups	FALSE	-	Uint8
20-05	Feedback 2 Source Unit	null	All set-ups	TRUE	-	Uint8
20-06	Feedback 3 Source	[0] No function	All set-ups	TRUE	-	Uint8
20-07	Feedback 3 Conversion	[0] Linear	All set-ups	FALSE	-	Uint8
20-08	Feedback 3 Source Unit	null	All set-ups	TRUE	-	Uint8
20-12	Reference/Feedback Unit	null	All set-ups	TRUE	-	Uint8
20-13	Minimum Reference/Feedb.	0.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
20-14	Maximum Reference/Feedb.	100.000 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
20-2*	Feedback/Setpoint	1001000 11000000000000				1.1602
20-20	Feedback Function	[3] Minimum	All set-ups	TRUE	-	Uint8
20-21	Setpoint 1	0 000 ProcessCtrll Init	All set-ups	TRUE	-3	Int32
20-21	Setpoint 2	0.000 ProcessCtrill Init	All set-ups	TRUE	-3	Int32
20-22	Setpoint 3	0.000 ProcessCtrill Init	All set-ups	TRUE	-3	Int32
20-3*	Feedb Adv Conv	0.000 1100005001101110	7 in Sec ups	INCE	5	Incor
20-30	Refrigerant	[0] P22		TRUE	-	Llint8
20-30	Licer-defined Refrigerant A1	10 0000 N/A		TRUE	-4	Llint32
20 31	User-defined Refrigerant A2	-2250 00 N/A		TDUE	-2	Int32
20-32	User-defined Refrigerant A3	2230.00 N/A	All set-ups	TRUE	-2	Llint32
20-33	Ean 1 Area [m2]	0.500 m/A	All set-ups	TRUE	-3	Unt32
20 34	Fan 1 Area [in2]	750 in2	All set-ups	TDUE	0	Llint32
20-35	Fan 2 Area $[m2]$	0 500 m2	All set-ups	TRUE	-3	Unt32
20-30	Fan 2 Area [in2]	7E0 in2	All set-ups	TRUE	-5	Uint32
20-37	Air Donsity Easter [0/]	100.04	All set-ups	TDUE	0	UIIIL32
20-30	All Density Factor [70]	100 %	All set-ups	TRUL	0	UIILSZ
20-0*	Sensorless Concerless	pull	All cot upo	TDUE		Llint0
20-00	Sensoness onic	nuii	All set-ups	TRUE	-	
20 60	Concerlage Information	0.11/4	All cot upo	TDUE	0	
20-09		U N/A	All set-ups	TRUE	0	2]
20-7*	Classification		2	TDUE		11:
20-70	Closed-loop Type		2 set-ups	TRUE	-	UINt8
20-71	PID Performance		2 set-ups	TRUE	-	UINt8
20-72	PID Output Change	U.10 N/A	2 set-ups	TRUE	-2	UINELO
20-73	Minimum Feedback Level	-999999.000 ProcessCtriUnit	2 set-ups	TRUE	-3	Int32
20-74	Maximum Feedback Level	999999.000 ProcessCtriUnit	2 set-ups	TRUE	-3	Int32
20-79	PID Autotuning		All set-ups	TRUE	-	UINT8
20-8*	PID Basic Settings	FOI Nerroel	All and success	TRUE		115-10
20-81	PID Normal/ Inverse Control		All set-ups	TRUE	-	Uint8
20-82	PID Start Speed [RPM]	ExpressionLimit	All set-ups	TRUE	6/	Uint16
20-83	PID Start Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
20-84	On Reference Bandwidth	5 %	All set-ups	TRUE	0	Uint8
20-9*	PID Controller					
20-91	PID Anti Windup	[1] On	All set-ups	TRUE	-	Uint8
20-93	PID Proportional Gain	0.50 N/A	All set-ups	TRUE	-2	Uint16
20-94	PID Integral Time	20.00 s	All set-ups	TRUE	-2	Uint32
20-95	PID Differentiation Time	0.00 s	All set-ups	TRUE	-2	Uint16
20-96	PID Diff. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16

#### 6.2.19 21-\*\* Ext. Closed-loop

Par.	Parameter description	Default value	4-set-up	Change dur-	Conver-	Туре
No. #				ing operation	sion index	
21-0*	Ext. CL Autotuning	[0] A.t.	2	TDUE		1510
21-00	Closed-loop Type		2 set-ups	TRUE	-	UINt8
21-01	PID Performance		2 set-ups	TRUE	-	UINt8
21-02	Minimum Feedback Level		2 set-ups	TRUE	-2	Unit10
21-03	Maximum Feedback Level	999999.000 N/A	2 set-ups	TRUE	-3	Int32
21-04	PID Autotuning	[0] Disabled	All set-ups	TRUE	-5	Llint8
21-05	Fyt CL 1 Ref /Fb		All Set ups	TROL		Onto
21-10	Ext 1 Ref /Feedback   Init	[1] %	All set-uns	TRUF	_	L lint8
21-10	Ext. 1 Minimum Reference	0.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
21-12	Ext. 1 Maximum Reference	100.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
21-13	Ext. 1 Reference Source	[0] No function	All set-ups	TRUE	-	Uint8
21-14	Ext. 1 Feedback Source	[0] No function	All set-ups	TRUE	-	Uint8
21-15	Ext. 1 Setpoint	0.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
21-17	Ext. 1 Reference [Unit]	0.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
21-18	Ext. 1 Feedback [Unit]	0.000 ExtPID1Unit	All set-ups	TRUE	-3	Int32
21-19	Ext. 1 Output [%]	0 %	All set-ups	TRUE	0	Int32
21-2*	Ext. CL 1 PID			-		
21-20	Ext. 1 Normal/Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
21-21	Ext. 1 Proportional Gain	0.01 N/A	All set-ups	TRUE	-2	Uint16
21-22	Ext. 1 Integral Time	10000.00 s	All set-ups	TRUE	-2	Uint32
21-23	Ext. 1 Differentation Time	0.00 s	All set-ups	TRUE	-2	Uint16
21-24	Ext. 1 Dif. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16
21-3*	Ext. CL 2 Ref./Fb.					
21-30	Ext. 2 Ref./Feedback Unit	[1] %	All set-ups	TRUE	-	Uint8
21-31	Ext. 2 Minimum Reference	0.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
21-32	Ext. 2 Maximum Reference	100.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
21-33	Ext. 2 Reference Source	[0] No function	All set-ups	TRUE	-	Uint8
21-34	Ext. 2 Feedback Source	[0] No function	All set-ups	TRUE	-	Uint8
21-35	Ext. 2 Setpoint	0.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
21-37	Ext. 2 Reference [Unit]	0.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
21-38	Ext. 2 Feedback [Unit]	0.000 ExtPID2Unit	All set-ups	TRUE	-3	Int32
21-39	Ext. 2 Output [%]	0 %	All set-ups	TRUE	0	Int32
21-4*	Ext. CL 2 PID					
21-40	Ext. 2 Normal/Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
21-41	Ext. 2 Proportional Gain	0.01 N/A	All set-ups	TRUE	-2	Uint16
21-42	Ext. 2 Integral Time	10000.00 s	All set-ups	TRUE	-2	Uint32
21-43	Ext. 2 Differentation Time	0.00 s	All set-ups	TRUE	-2	Uint16
21-44	Ext. 2 Dif. Gain Limit	5.0 N/A	All set-ups	TRUE	-1	Uint16
21-5*	Ext. CL 3 Ref./Fb.	543.07		TOUL		11: 10
21-50	Ext. 3 Ref./Feedback Unit	[1] %	All set-ups	TRUE	-	Uint8
21-51	Ext. 3 Minimum Reference	0.000 ExtPID3Unit	All set-ups	TRUE	-3	Int32
21-52	Ext. 3 Maximum Reference	100.000 EXTPID30nit	All set-ups	TRUE	-3	Int32
21-53	Ext. 3 Reference Source	[U] No function	All set-ups	TRUE	-	UINt8
21-54	Ext. 3 Feedback Source		All set-ups	TRUE	-	UIIIto
21-55	Ext. 3 Setpoint	0.000 ExtPID3UNIt	All set-ups	TRUE	-3	Int32
21-57	Ext. 3 Reference [Unit]	0.000 EXIPIDSUIII	All set-ups	TRUE	-5	Int22
21-50	Ext. 3 Feedback [Unit]	0.000 EXPIDSON	All set-ups	TRUE	-5	Int22
21-59		0 70	All set-ups	IRUL	0	1111.52
21-0*	Ext. 3 Normal/Inverse Control	[0] Normal	All cet-upc	TDUE	_	l lint Q
21-00	Ext. 3 Proportional Cain			TDUE	-7	Unito
21-01	Ext. 3 Integral Time	10000 00 s		TRUE	-2	Llint32
21-02	Ext. 3 Differentation Time	0.00 s		TRUE	-2	Llint16
21-64	Ext 3 Dif Gain Limit	5 0 N/A	All set-uns	TRUE	-1	Uint16
2101			All Set ups	INCL	1	Onitio

## 6.2.20 22-\*\* Application Functions

Par. No. #	Parameter description	Default value	4-set-up	Change dur-	Conver- sion index	Туре
22-0*	Miscellaneous			ing operation		
22-00	External Interlock Delay	0 s	All set-ups	TRUE	0	Uint16
22-01	Power Filter Time	0.50 s	2 set-ups	TRUE	-2	Uint16
22-2*	No-Flow Detection					
22-20	Low Power Auto Set-up	[0] OFF	All set-ups	FALSE	-	Uint8
22-21	Low Power Detection	[0] Disabled	All set-ups	TRUE	-	Uint8
22-22	Low Speed Detection	[0] Disabled	All set-ups	TRUE	-	Uint8
22-23	No-Flow Function	[0] OFF	All set-ups	TRUE	-	Uint8
22-24	No-Flow Delay	10 s	All set-ups	TRUE	0	Uint16
22-26	Dry Pump Function	[0] OFF	All set-ups	TRUE	-	Uint8
22-27	Dry Pump Delay	10 s	All set-ups	TRUE	0	Uint16
22-3*	No-Flow Power Tuning					
22-30	No-Flow Power	0.00 kW	All set-ups	TRUE	1	Uint32
22-31	Power Correction Factor	100 %	All set-ups	TRUE	0	Uint16
22-32	Low Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
22-33	Low Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
22-34	Low Speed Power [kW]	ExpressionLimit	All set-ups	TRUE	1	Uint32
22-35	Low Speed Power [HP]	ExpressionLimit	All set-ups	TRUE	-2	Uint32
22-36	High Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
22-37	High Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
22-38	High Speed Power [kW]	ExpressionLimit	All set-ups	TRUE	1	Uint32
22-39	High Speed Power [HP]	ExpressionLimit	All set-ups	TRUE	-2	Uint32
22-4*	Sleep Mode					
22-40	Minimum Run Time	10 s	All set-ups	TRUE	0	Uint16
22-41	Minimum Sleep Time	10 s	All set-ups	TRUE	0	Uint16
22-42	Wake-up Speed [RPM]	ExpressionLimit	All set-ups	TRUE	67	Uint16
22-43	Wake-up Speed [Hz]	ExpressionLimit	All set-ups	TRUE	-1	Uint16
22-44	Wake-up Ref./FB Difference	10 %	All set-ups	TRUE	0	Int8
22-45	Setpoint Boost	0 %	All set-ups	TRUE	0	Int8
22-46	Maximum Boost Time	60 s	All set-ups	TRUE	0	Uint16
22-5*	End of Curve		7 al occ apo		<u> </u>	011110
22-50	End of Curve Function	[0] OFF	All set-ups	TRUE	-	Uint8
22-50	End of Curve Delay	10 s	All set-ups	TRUE	0	Uint16
22-6*	Broken Belt Detection	10.5	741 562 495	INCE	Ū	Onicio
22-60	Broken Belt Function	[0] OFF	All cot-unc	TRUE	_	L lint8
22-61	Broken Belt Torque	10 %		TRUE	0	Llint8
22-62	Broken Belt Delay	10 %	All set-ups	TRUE	0	Llint16
22 02	Short Cycle Protection	10.5	An Sec ups	INCL	0	011110
22-75	Short Cycle Protection	[0] Disabled	All cot-unc	TRUE	-	Llint8
22 / J	Shore Cycle Trotection	start to start min on time	All Set ups	INCL		Onito
22-76	Interval between Starts		All cot-upc	TDUE	0	Llint16
22-70	Minimum Pun Time	(F2277)	All set-ups	TRUE	0	Unit16
22-77	Minimum Run Time Override	[0] Disabled		EALCE	0	Unit10
22-70	Minimum Run Time Override Value		All set-ups	TDUE	-3	Unito Int22
22-79	Flow Componention	0.000 FIOCESSCITIONIC	All Set-ups	TRUL	-5	IIIUZ
22-0	Flow Compensation	[0] Disabled		TDUE		L lint9
22-00	Flow Compensation		All set-ups	TRUL	-	UlintQ
22-01	Work Point Calculation	[0] Disabled	All set-ups	TRUE	0	Ulint
22-02	Speed at No Flow [DDM]	EvpressionLimit	All set-ups	TDUE	67	Ulint16
22-03	Speed at No-Flow [H7]	ExpressionLimit	All set-ups	TRUE	-1	Unit10
22-04	Speed at NO-FIOW [II2]	ExpressionLimit	All set-ups	TRUE	-1	UIII(10
22-00	Speed at Design Point [H=]	ExpressionLimit	All set-ups	TRUE	1	Unit10
22-86	Speeu at Design Point [HZ]		All set-ups	TRUE	-1	UITILID Int22
22-8/	Pressure at Dated Creed		All set-ups	TRUE	-3	10032
22-88	Flow at Design Deint	999999.999 N/A	All set-ups	TRUE	-3	Int32
22-89	Flow at Design Point		All set-ups	TRUE	-3	Int32
22-90	riow at kated Speed	0.000 N/A	All set-ups	TRUE	-3	Int32

#### 6.2.21 23-\*\* Time-based Funtions

Par. No. #	Parameter description	Default value	4-set-up	Change dur- ing operation	Conver- sion index	Туре
23-0*	Timed Actions					
						TimeOf-
						DayWo-
23-00	ON Time	ExpressionLimit	2 set-ups	TRUE	0	Date
23-01	ON Action	[0] DISABLED	2 set-ups	TRUE	-	Uint8
						TimeOf-
						DayWo-
23-02	OFF Time	ExpressionLimit	2 set-ups	TRUE	0	Date
23-03	OFF Action	[0] DISABLED	2 set-ups	TRUE	-	Uint8
23-04	Occurrence	[0] All days	2 set-ups	TRUE	-	Uint8
23-1*	Maintenance					
23-10	Maintenance Item	[1] Motor bearings	1 set-up	TRUE	-	Uint8
23-11	Maintenance Action	[1] Lubricate	1 set-up	TRUE	-	Uint8
23-12	Maintenance Time Base	[0] Disabled	1 set-up	TRUE	-	Uint8
23-13	Maintenance Time Interval	1 h	1 set-up	TRUE	74	Uint32
						TimeOf-
23-14	Maintenance Date and Time	ExpressionLimit	1 set-up	TRUE	0	Dav
23-1*	Maintenance Reset				-	_ = = ,
23-15	Reset Maintenance Word	[0] Do not reset	All set-ups	TRUE	-	Uint8
		[0]				VisStr[2
23-16	Maintenance Text	0 N/A	1 set-up	TRUF	0	01
23-5*	Energy Log	•••,••			-	
23-50	Energy Log Resolution	[5] Last 24 Hours	2 set-uns	TRUF	-	Uint8
23 30			2 500 495	INCL		TimeOf-
23-51	Period Start	Expressionl imit	2 set-uns	TRUF	0	Dav
23-53	Energy Log	0 N/A	All set-ups	TRUE	0	Llint32
23-54	Reset Energy Log	[0] Do not reset	All set-ups	TRUE	-	Uint8
23-6*	Trending		7 in Sec ups	INCE		Onico
23-60	Trend Variable	[0] Power [kW]	2 set-uns	TRUE	-	Llint8
23-61	Continuous Bin Data		All set-uns	TRUE	0	Llint32
23-62	Timed Bin Data	0 N/A	All set-ups	TRUE	0	Llint32
25 02		0 10/11	7 in Sec ups	INCE	Ū	TimeOf-
23-63	Timed Period Start	Expression limit	2 set-uns	TRUF	0	Day
25 05		ExpressionEnnic	2 301 405	INCL	0	TimeOf-
23-64	Timed Period Stop	Expression limit	2 set-uns	TRUE	0	Dav
23-65	Minimum Bin Value	ExpressionLimit	2 set-ups	TRUE	0	Llint8
23-66	Reset Continuous Bin Data	[0] Do not reset	All set-ups	TRUE	-	Llint8
23-67	Reset Timed Bin Data	[0] Do not reset	All set-ups	TRUE	_	Llint8
23-8*	Payback Counter		All Set ups	INCL		Onto
23-80	Power Deference Factor	100.%	2 cot-upc	TDUF	0	L lint Q
23-00	Energy Cost	1 00 N/A	2 set-ups	TRUE	-2	Llint32
23-01			2 set-ups	TDUE	-2	Ullint22
23-02	Energy Savings		2 set-ups	TDUE	75	Int32
23-03	Cost Savings			TDUE	/5	Int32
23-04	COSt Savings	U N/A	All set-ups	IKUL	0	IIIUSZ

# 6.2.22 24-\*\* Application Functions 2

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

#### 6.2.23 25-\*\* Cascade Controller

Par.	Parameter description	Default value	4-set-up	Change dur-	Conver-	Туре
25-0*	System Settings			ing operation	SIGITITUEX	
25-00	Cascade Controller	[0] Disabled	2 set-ups	FALSE	-	Uint8
25-02	Motor Start	[0] Direct on Line	2 set-ups	FALSE	-	Uint8
25-04	Pump Cycling	[0] Disabled	All set-ups	TRUE	-	Uint8
25-05	Fixed Lead Pump	[1] Yes	2 set-ups	FALSE	-	Uint8
25-06	Number Of Pumps	2 N/A	2 set-ups	FALSE	0	Uint8
25-2*	Bandwidth Settings	· ·	· · ·			
25-20	Staging Bandwidth	10 %	All set-ups	TRUE	0	Uint8
25-21	Override Bandwidth	100 %	All set-ups	TRUE	0	Uint8
		casco_staging_bandwidth				
25-22	Fixed Speed Bandwidth	(P2520)	All set-ups	TRUE	0	Uint8
25-23	SBW Staging Delay	15 s	All set-ups	TRUE	0	Uint16
25-24	SBW De-staging Delay	15 s	All set-ups	TRUE	0	Uint16
25-25	OBW Time	10 s	All set-ups	TRUE	0	Uint16
25-26	Destage At No-Flow	[0] Disabled	All set-ups	TRUE	-	Uint8
25-27	Stage Function	[1] Enabled	All set-ups	TRUE	-	Uint8
25-28	Stage Function Time	15 s	All set-ups	TRUE	0	Uint16
25-29	Destage Function	[1] Enabled	All set-ups	TRUE	-	Uint8
25-30	Destage Function Time	15 s	All set-ups	TRUE	0	Uint16
25-4*	Staging Settings					
25-40	Ramp-down Delay	10.0 s	All set-ups	TRUE	-1	Uint16
25-41	Ramp-up Delay	2.0 s	All set-ups	TRUE	-1	Uint16
25-42	Staging Threshold	ExpressionLimit	All set-ups	TRUE	0	Uint8
25-43	De-staging Threshold	ExpressionLimit	All set-ups	TRUE	0	Uint8
25-44	Staging Speed [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
25-45	Staging Speed [Hz]	0.0 Hz	All set-ups	TRUE	-1	Uint16
25-46	De-staging Speed [RPM]	0 RPM	All set-ups	TRUE	67	Uint16
25-47	De-staging Speed [Hz]	0.0 Hz	All set-ups	TRUE	-1	Uint16
25-5*	Alternation Settings					
25-50	Lead Pump Alternation	[0] OFF	All set-ups	TRUF	-	Uint8
25-51	Alternation Event	[0] External	All set-ups	TRUE	-	Uint8
25-52	Alternation Time Interval	24 h	All set-ups	TRUE	74	Uint16
						VisStr[7
25-53	Alternation Timer Value	0 N/A	All set-ups	TRUE	0	1
					-	TimeOf-
						DavWo-
25-54	Alternation Predefined Time	ExpressionI imit	All set-ups	TRUF	0	Date
25-55	Alternate if Load < 50%	[1] Enabled	All set-ups	TRUE	-	Uint8
25-56	Staging Mode at Alternation	[0] Slow	All set-ups	TRUE	-	Uint8
25-58	Run Next Pump Delay	01s	All set-ups	TRUE	-1	Uint16
25-59	Run-on Line Delay	0.5 s	All set-ups	TRUE	-1	Uint16
25-8*	Status	0.00			-	0
	otatuo					VicStr[2
25-80	Cascade Status	0 N/A	All set-ups	TRUF	0	51
25 00		0 N/A	All Set ups	INCL	0	VisStr[2
25-81	Pump Status	0 N/A	All cot-unc	TRUE	0	51
25-82	Lead Pump	0 N/A	All set-ups	TRUE	0	Llint8
23-02		0 N/A	All Set-ups	IKUL	0	VicStr[4
25-82	Relay Status	0 N/A	All set-ups	TRUE	0	1550[4
25-03	Pump ON Time			TRUE	74	Llint32
25-85	Relay ON Time	0 h		TRUE	74	Llint32
25-86	Reset Relay Counters	[0] Do not reset		TRUE	-	Llint
25-00	Service		All Set-ups	INUL		Onto
25-9	Dump Interlock	[0] Off	All cot unc	TDUE		L lint Q
25-90	Manual Alternation		All set-ups		0	LlintQ
23-91			All set-ups	INUL	U	Unito

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

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

# 7 General Specifications

#### Line power supply (L1, L2, L3):

Supply voltage	380–480 V	±10%
Supply voltage	525–690 V	±10%

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

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

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

The unit is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical Amperes, 480/690 V maximum.

Motor output (U, V, W):	
Output voltage	0–100% of supply voltage
Output frequency	0–800* Hz
Switching on output	Unlimited
Ramp times	1–3600 sec.
* Voltage and power dependent	
Torque characteristics:	
Starting torque (Constant torque)	maximum 110% for 1 min.*
Starting torque	maximum 135% up to 0.5 sec.*
Overload torque (Constant torque)	maximum 110% for 1 min.*
*Percentage relates to the nominal torque of the adjustable frequency drive.	
Cable lengths and cross-sections:	
Max. motor cable length, shielded/armored	492 ft [150 m]
Max. motor cable length, unshielded/unarmored	984 ft [300 m]
Max. cross-section to motor, line power, load sharing and brake *	
Maximum cross-section to control terminals, rigid wire	0.0023 in <sup>2</sup> [1.5 mm <sup>2</sup> ]/16 AWG (2 x 0.00112 <sup>2</sup> in [0.75 mm <sup>2</sup> ])
Maximum cross-section to control terminals, flexible cable	0.0016 in <sup>2</sup> [1 mm <sup>2</sup> ]/18 AWG
Maximum cross-section to control terminals, cable with enclosed core	0.0008 in <sup>2</sup> [0.5 mm <sup>2</sup> ]/20 AWG
Minimum cross-section to control terminals	0.039 in <sup>2</sup> [0.25 mm <sup>2</sup> ]

\* See Line Power Supply tables for more information!

# 7 General Specifications

4 (6)
18, 19, 27 <sup>1)</sup> , 29 <sup>1)</sup> , 32, 33
PNP or NPN
0–24 V DC
< 5 V DC
> 10 V DC
> 19 V DC
< 14 V DC
28 V DC
approx. 4 kG

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

Analog inputs:	
Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	Switch S201 and switch S202
Voltage mode	Switch S201/switch S202 = OFF (U)
Voltage level	: 0-+10 V (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	: 200 Hz

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



Pulse inputs:	
Programmable pulse inputs	2
Terminal number pulse	29, 33
Max. frequency at terminal, 29, 33	110 kHz (push-pull driven)
Max. frequency at terminal, 29, 33	5 kHz (open collector)
Min. frequency at terminal 29, 33	4 Hz
Voltage level	see section on Digital input
Maximum voltage on input	28 V DC
Input resistance, Ri	approx. 4 kΩ

7

Pulse input accuracy (0.1–1 kHz)	Max. error: 0.1% of full scale
Analog output:	
Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	0/4–20 mA
Max. resistor load to common at analog output	500 Ω
Accuracy on analog output	Max. error: 0.8% of full scale
Resolution on analog output	8 bit

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

Control card, RS-485 serial communication:

Terminal number 6	58 (P,TX+, RX+), 69 (N,TX-, RX-)
Terminal number 61	Common for terminals 68 and 69

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

## 7 General Specifications

12, 13 : 200 mA

#### Digital output:

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

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

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

Control card, 24 V DC output:
Terminal number
Max. load

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

Relay outputs:	
Programmable relay outputs	2
Relay 01 Terminal number	1-3 (break), 1-2 (make)
Max. terminal load (AC-1) <sup>1)</sup> on 1-3 (NC), 1-2 (NO) (Resistive load)	240 V AC, 2 A
Max. terminal load (AC-15) <sup>1)</sup> (Inductive load @ $\cos \phi$ 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 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>	400 V AC, 2 A
Max. terminal load (AC-15) <sup>1)</sup> on 4-5 (NO) (Inductive load @ $\cos \varphi$ 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, 2 A
Max. terminal load (DC-13) <sup>1)</sup> on 4-5 (NO) (Inductive load)	24 V DC, 0.1 A
Max. terminal load (AC-1) <sup>1)</sup> on 4-6 (NC) (Resistive load)	240 V AC, 2 A
Max. terminal load (AC-15) <sup>1)</sup> on 4-6 (NC) (Inductive load @ $\cos \phi$ 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, 2 A
Max. terminal load (DC-13) <sup>1)</sup> on 4-6 (NC) (Inductive load)	24 V DC, 0.1 A
Min. terminal load on 1-3 (NC), 1-2 (NO), 4-6 (NC), 4-5 (NO)	24 V DC 10 mA, 24 V AC 20 mA
Environment according to EN 60664-1	overvoltage category III/pollution degree 2

1) IEC 60947 t 4 and 5

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

2) Overvoltage Category II

3) UL applications 300 V AC 2 A

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

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

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

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

7-4

sure, frame size D and E IP 00, IP 21, IP 54 sure, frame size F IP 21, IP 54 tion test 0.7 c ive humidity 5%–95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation essive environment (IEC 60068-2-43) H <sub>2</sub> S test class kD method according to IEC 60068-2-43 H <sub>2</sub> S (10 days) ent temperature (at 60 AVM switching mode) i derating max. 131°F [55°C] <sup>1</sup> .
sure, frame size F IP 21, IP 52 tion test 0.7 c ve humidity 5%–95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation essive environment (IEC 60068-2-43) H <sub>2</sub> S test class kC method according to IEC 60068-2-43 H <sub>2</sub> S (10 days) ent temperature (at 60 AVM switching mode) i derating max. 131°F [55°C] <sup>1</sup> i full output power, typical EFF2 motors max. 122°F [50°C] <sup>1</sup>
tion test 0.7 c ive humidity 5%–95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation issive environment (IEC 60068-2-43) H <sub>2</sub> S test class kE method according to IEC 60068-2-43 H2S (10 days) ent temperature (at 60 AVM switching mode) i derating max. 131°F [55°C] <sup>1</sup> i full output power, typical EFF2 motors max. 122°F [50°C] <sup>1</sup>
ive humidity 5%–95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation essive environment (IEC 60068-2-43) H <sub>2</sub> S test class kE method according to IEC 60068-2-43 H2S (10 days) ent temperature (at 60 AVM switching mode) e derating max. 131°F [55°C] <sup>1</sup> . i full output power, typical EFF2 motors max. 122°F [50°C] <sup>1</sup> .
essive environment (IEC 60068-2-43) H <sub>2</sub> S test class kE method according to IEC 60068-2-43 H <sub>2</sub> S (10 days) ent temperature (at 60 AVM switching mode) in derating max. 131°F [55°C] <sup>1</sup> . in full output power, typical EFF2 motors max. 122°F [50°C] <sup>1</sup> .
method according to IEC 60068-2-43 H2S (10 days) ent temperature (at 60 AVM switching mode) I derating max. 131°F [55°C] <sup>1</sup> I full output power, typical EFF2 motors max. 122°F [50°C] <sup>1</sup>
ent temperature (at 60 AVM switching mode) 1 derating max. 131°F [55°C] <sup>1</sup> . 1 full output power, typical EFF2 motors max. 122°F [50°C] <sup>1</sup> .
n derating max. 131°F [55°C] <sup>1</sup> ا full output power, typical EFF2 motors max. 122°F [50°C] <sup>1</sup> .
I full output power, typical EFF2 motors max. 122°F [50°C] <sup>1</sup>
ıll continuous FC output current max. 113°F [45°C] <sup>1</sup>
or more information on derating see the Design Guide, section on Special Conditions.
num ambient temperature during full-scale operation 32°F [0°C]
num ambient temperature at reduced performance 14°F [- 10 °C]
verature during storage/transport -13°-+149°/158°F [-25°-+65°/70°C]
num altitude above sea level without derating 3280 ft [1000 m]
num altitude above sea level with derating 9842 ft [3000 m]
ating for high altitude, see section on special conditions.
standards, Emission EN 61800-3, EN 61000-6-3/4, EN 55011, IEC 61800-3
EN 61800-3, EN 61000-6-1/2,
standards, Immunity EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6
section on special conditions!
ol card performance:
interval : 5 ms
ol card, USB serial communication:
standard 1.1 (Full speed)
olug USB type B "device" plug

The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. The USB connection is <u>not</u> galvanically isolated from protection ground. Use only isolated laptop/PC as connection to the USB connector on the adjustable frequency drive or an isolated USB cable/drive.

#### Protection and Features:

- Electronic thermal motor protection against overload.
- Temperature monitoring of the heatsink ensures that the adjustable frequency drive trips if the temperature reaches a predefined level. An overload temperature cannot be reset until the temperature of the heatsink is below the values stated in the tables on the following pages (guideline these temperatures may vary for different power sizes, frame sizes, enclosure ratings, etc.).
- The adjustable frequency drive is protected against short-circuits on motor terminals U, V, W.
- If a line phase is missing, the adjustable frequency drive trips or issues a warning (depending on the load).
- Monitoring of the intermediate circuit voltage ensures that the adjustable frequency drive trips if the intermediate circuit voltage is too low or too high.
- The adjustable frequency drive is protected against ground faults on motor terminals U, V, W.

# 7 General Specifications

Line Power Supply 3 x 380–480 V AC						
		P110	P132	P160	P200	P250
	Typical Shaft output at 400 V [kW]	110	132	160	200	250
	Typical Shaft output at 460 V [HP]	150	200	250	300	350
	Enclosure IP21	D1	D1	D2	D2	D2
	Enclosure IP54	D1	D1	D2	D2	D2
	Enclosure IP00	D3	D3	D4	D4	D4
	Output current				1	
	Continuous (at 400 V) [A]	212	260	315	395	480
	Intermittent (60 sec overload) (at 400 V) [A]	233	286	347	435	528
	Continuous (at 460/ 480 V) [A]	190	240	302	361	443
	Intermittent (60 sec overload) (at 460/480 V) [A]	209	264	332	397	487
	Continuous KVA (at 400 V) [KVA]	147	180	218	274	333
	Continuous KVA (at 460 V) [KVA]	151	191	241	288	353
Max. input current						
	Continuous	204	251	304	381	463
	Continuous (at 460/ 480 V) [A]	183	231	291	348	427
	Max. cable size, line power motor, brake and load share [mm <sup>2</sup> (AWG <sup>2)</sup> )]	2 x 70 (2 x 2/0)	2 x 70 (2 x 2/0)	2 x 150 (2 x 300 mcm)	2 x 150 (2 x 300 mcm)	2 x 150 (2 x 300 mcm)
	Max. external pre- fuses [A] <sup>1</sup>	300	350	400	500	630
	Estimated power loss at rated max. load [W] <sup>4)</sup> , 400 V	3234	3782	4213	5119	5893
	Estimated power loss at rated max. load [W] <sup>4)</sup> , 460 V	2947	3665	4063	4652	5634
	Weight, enclosure IP21, IP 54 [kg]	96	104	125	136	151
	Weight, enclosure IP00 [kg]	82	91	112	123	138
	Efficiency <sup>4)</sup> Output frequency			0.98 0–800 Hz		
	Heatsink overtemp. trip	194°F [90°C]	230°F [110°C]	230°F [110°C]	230°F [110°C]	230°F [110°C]
	Power card ambient trip			140°F [60°C]		

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Line Power Supply 3 >	380–480 V AC							
		P315	P355	P400	P450			
	Typical Shaft output at 400 V [kW]	315	355	400	450			
	Typical Shaft output at 460 V [HP]	450	500	600	600			
	Enclosure IP21	E1	E1	E1	E1			
	Enclosure IP54	E1	E1	E1	E1			
	Enclosure IP00	E2	E2	E2	E2			
	Output current		1					
	Continuous (at 400 V) [A]	600	658	745	800			
	Intermittent (60 sec over- load) (at 400 V) [A]	660	724	820	880			
	Continuous (at 460/ 480 V) [A]	540	590	678	730			
	Intermittent (60 sec over- load) (at 460/480 V) [A]	594	649	746	803			
	Continuous KVA (at 400 V) [KVA]	416	456	516	554			
	Continuous KVA (at 460 V) [KVA]	430	470	540	582			
Max. input current								
	Continuous (at 400 V) [A]	590	647	733	787			
	Continuous (at 460/ 480 V) [A]	531	580	667	718			
	Max. cable size, line pow- er, motor and load share [mm <sup>2</sup> (AWG <sup>2)</sup> )]	4x240 (4x500 mcm)	4x240 (4x500 mcm)	4x240 (4x500 mcm)	4x240 (4x500 mcm)			
	Max. cable size, brake [mm <sup>2</sup> (AWG <sup>2)</sup> )	2 x 185 (2 x 350 mcm)						
	Max. external pre-fuses [A] <sup>1</sup>	700	900	900	900			
	Estimated power loss at rated max. load [W] <sup>4)</sup> , 400 V	6790	7701	8879	9670			
	Estimated power loss at rated max. load [W] <sup>4)</sup> , 460 V	6082	6953	8089	8803			
	Weight, enclosure IP21, IP 54 [kg]	263	270	272	313			
	Weight, enclosure IP00 [kg]	221	234	236	277			
	Efficiency <sup>4)</sup>		0.98					
	Output frequency		0–600	Hz				
	Heatsink overtemp. trip		230°F [11	l0°C]				
	Power card ambient trip		154.4°F [68°C]					

Line Power Supply 3 x 380–480 V AC							
		P500	P560	P630	P710	P800	P1M0
	Typical Shaft output at 400 V [kW]	500	560	630	710	800	1000
	Typical Shaft output at 460 V [HP]	650	750	900	1000	1200	1350
	Enclosure IP21, 54 without/ with op- tions cabinet	F1/F3	F1/F3	F1/F3	F1/F3	F2/F4	F2/F4
	Output current Continuous (at 400 V) [A]	880	990	1120	1260	1460	1720
	Intermittent (60 sec overload) (at 400 V) [A]	968	1089	1232	1386	1606	1892
	Continuous (at 460/ 480 V) [A]	780	890	1050	1160	1380	1530
	Intermittent (60 sec overload) (at 460/480 V) [A]	858	979	1155	1276	1518	1683
	Continuous KVA (at 400 V) [KVA]	610	686	776	873	1012	1192
	Continuous KVA (at 460 V) [KVA]	621	709	837	924	1100	1219
Max. input curre	Continuous (at 400 V) [A]	857	964	1090	1227	1422	1675
	Continuous (at 460/480 V) [A]	759	867	1022	1129	1344	1490
	Max. cable size,mo- tor [mm <sup>2</sup> (AWG <sup>2)</sup> )]		12x (12x30)	12x150 (12x300 mcm)			
→	Max. cable size, line power F1/F2 [mm <sup>2</sup> (AWG <sup>2)</sup> )]	8x240 (8x500 mcm)					
	Max. cable size, line power F3/F4 [mm <sup>2</sup> (AWG <sup>2)</sup> )]	8x456 (8x900 mcm)					
	Max. cable size, load sharing [mm2 (AWG <sup>2)</sup> )]			4x12 (4x250)	20 mcm)		
	Max. cable size,		4x18	35		6x1	185
	brake [mm <sup>2</sup> (AWG <sup>2</sup> ) Max. external pre-	16	(4x350) 00	mcm) 20	00	(6x350	0 mcm) 00
	Est. power loss at rated max. load [W] <sup>4)</sup> , 400 V, F1 & F2	10647	12338	13201	15436	18084	20358
	Est. power loss at rated max. load [W] <sup>4)</sup> , 460 V, F1 & F2	9414	11006	12353	14041	17137	17752
	Max. added losses of A1 RFI, Circuit Breaker or Discon- nect, & Contactor, F3 & F4	963	1054	1093	1230	2280	2541
	Max Panel Options Losses			400	)		
	Weight, enclosure IP21, IP 54 [kg]	1004/ 1299	1004/ 1299	1004/ 1299	1004/ 1299	1246/ 1541	1246/ 1541
	Weight Rectifier Module [kg]	102	102	102	102	136	136
	Weight Inverter Module [kg]	102	102	102	136	102	102
	Efficiency <sup>4)</sup>			0.98	3		
	Heatsink overtemp.			0–600 203°F [9	HZ 95°C]		
	Power card ambient trip		154.4°F [68°C]				

Line Power Supp	oly 3 x 525–690 VAC					
		P45K	P55K	P75K	P90K	P110
	Typical Shaft output at 550 V [kW]	37	45	55	75	90
	Typical Shaft output at 575 V [HP]	50	60	75	100	125
	Typical Shaft output at 690 V [kW]	45	55	75	90	110
	Enclosure IP21	D1	D1	D1	D1	D1
	Enclosure IP54	D1	D1	D1	D1	D1
<b>0</b>	Enclosure IP00	D2	D2	D2	D2	D2
Output current	Continuous					
	(at 3 x 525–550 V) [A]	56	76	90	113	137
	overload) (at 550 V) [A]	62	84	99	124	151
	Continuous (at 3 x 551–690 V) [A]	54	73	86	108	131
	Intermittent (60 sec overload) (at 575/690 V) [A]	59	80	95	119	144
	Continuous KVA (at 550 V) [KVA]	53	72	86	108	131
	Continuous KVA (at 575 V) [KVA]	54	73	86	108	130
	Continuous KVA (at 690 V) [KVA]	65	87	103	129	157
Max. input curre	ent					
	Continuous (at 550 V) [A]	60	77	89	110	130
	Continuous (at 575 V) [A]	58	74	85	106	124
→	Continuous (at 690 V) [A]	58	77	87	109	128
	Max. cable size, line power, motor, load share and brake [mm <sup>2</sup> (AWG)]			2x70 (2x2/0)		
	Max. external pre-fuses [A] <sup>1</sup>	125	160	200	200	250
	Estimated power loss at rated max. load [W] <sup>4)</sup> , 600 V	1398	1645	1827	2157	2533
	Estimated power loss at rated max. load [W] <sup>4)</sup> , 690 V	1458	1717	1913	2262	2662
	Weight, enclosure IP21, IP 54 [kg]			96		
	Weight, enclosure IP00 [ka]			82		
	Efficiency <sup>4)</sup>	0.97	0.97	0.98	0.98	0.98
	Output frequency		•	0–600 Hz		
	Heatsink overtemp. trip			185°F [85°C]		
	Power card ambient trip			140°F [60°C]		

# 7 General Specifications

Line Power Supply 3 x 525–690 VAC						
		P132	P160	P200	P250	
	Typical Shaft output at 550 V [kW]	110	132	160	200	
	Typical Shaft output at 575 V [HP]	150	200	250	300	
	Typical Shaft output at 690 V [kW]	132	160	200	250	
	Enclosure IP21	D1	D1	D2	D2	
	Enclosure IP54	D1	D1	D2	D2	
	Enclosure IP00	D3	D3	D4	D4	
	Output current					
	Continuous (at 550 V) [A]	162	201	253	303	
	Intermittent (60 sec over- load) (at 550 V) [A]	178	221	278	333	
	Continuous (at 575/690 V) [A]	155	192	242	290	
	Intermittent (60 sec over- load) (at 575/690 V) [A]	171	211	266	319	
	Continuous KVA (at 550 V) [KVA]	154	191	241	289	
	Continuous KVA (at 575 V) [KVA]	154	191	241	289	
	Continuous KVA (at 690 V) [KVA]	185	229	289	347	
Max. input current						
	Continuous (at 550 V) [A]	158	198	245	299	
	Continuous (at 575 V) [A]	151	189	234	286	
	Continuous (at 690 V) [A]	155	197	240	296	
	Max. cable size, line power motor, load share and brake [mm <sup>2</sup> (AWG)]	2 x 70 (2 x 2/0)	2 x 70 (2 x 2/0)	2 x 150 (2 x 300 mcm)	2 x 150 (2 x 300 mcm)	
	Max. external pre-fuses [A]	315	350	350	400	
	Estimated power loss at rated max. load [W] <sup>4)</sup> , 600 V	2963	3430	4051	4867	
	Estimated power loss at rated max. load [W] <sup>4)</sup> , 690 V	3430	3612	4292	5156	
	Weight, Enclosure IP21, IP 54 [kg]	96	104	125	136	
	Weight, Enclosure IP00 [kg]	82	91	112	123	
	Efficiency <sup>4)</sup> Output frequency Heatsink overtemp. trip Power card ambient trip	194°F [90°C]	0.98 0–600 230°F [110°C] 140°F [6	Hz 230°F [110°C] 0°C]	230°F [110°C]	

Line Power Supply 3 x 52	25–690 V AC			
		P315	P400	P450
	Typical Shaft output at 550 V [kW]	250	315	355
	Typical Shaft output at 575 V [HP]	350	400	450
	Typical Shaft output at 690 V [kW]	315	400	450
	Enclosure IP21	D2	D2	E1
	Enclosure IP54	D2	D2	E1
	Enclosure IP00	D4	D4	E2
	Output current			
<b>1</b>	Continuous (at 550 V) [A]	360	418	470
	Intermittent (60 sec overload) (at 550 V) [A]	396	460	517
	Continuous (at 575/690 V) [A]	344	400	450
	Intermittent (60 sec overload) (at 575/690 V) [A]	378	440	495
	Continuous KVA (at 550 V) [KVA]	343	398	448
	Continuous KVA (at 575 V) [KVA]	343	398	448
	Continuous KVA (at 690 V) [KVA]	411	478	538
Max. input current			1	
	Continuous (at 550 V) [A]	355	408	453
→	Continuous (at 575 V) [A]	339	390	434
	Continuous (at 690 V) [A]	352	400	434
	Max. cable size, line power, mo- tor and load share [mm <sup>2</sup> (AWG)]	2 x 150 (2 x 300 mcm)	2 x 150 (2 x 300 mcm)	4 x 240 (4 x 500 mcm)
	Max. cable size, brake [mm <sup>2</sup>	2 x 150	2 x 150	2 x 185
	(AWG)]	(2 x 300 mcm)	(2 x 300 mcm)	(2 x 350 mcm)
	Max. external pre-fuses [A] <sup>1</sup>	500	550	700
	Estimated power loss at rated max. load [W] <sup>4)</sup> , 600 V	5493	5852	6132
	Estimated power loss at rated max. load [W] <sup>4)</sup> , 690 V	5821	6149	6440
	Weight, enclosure IP21, IP 54 [kg]	151	165	263
	Weight, enclosure IP00 [kg]	138	151	221
	Efficiency <sup>4)</sup>		0.98	
	Output frequency	0–600 Hz	0–500 Hz	0–500 Hz
	Heatsink overtemp. trip	230°F [110°C]	230°F [110°C]	230°F [110°C]
	Power card ambient trip	140°F [60°C]	140°F [60°C]	154.4°F [68°C]

Line Power Supply 3 x 525–690 VAC							
		P500	P560	P630			
	Typical Shaft output at 550 V [kW]	400	450	500			
	Typical Shaft output at 575 V [HP]	500	600	650			
	Typical Shaft output at 690 V [kW]	500	560	630			
	Enclosure IP21	E1 F1	E1	E1			
	Enclosure ID00	E1 E2	E1 E2	E1 E2			
	Output current	L2	LZ	LZ			
	Continuous						
	(at 550 V) [A]	523	596	630			
	Intermittent (60 sec overload) (at 550 V) [A]	575	656	693			
	(at 575/690 V) [A]	500	570	630			
	Intermittent (60 sec overload) (at 575/690 V) [A]	550	627	693			
	Continuous KVA (at 550 V) [KVA]	498	568	600			
	Continuous KVA (at 575 V) [KVA]	498	568	627			
	Continuous KVA (at 690 V) [KVA]	598	681	753			
Max. input current							
	Continuous (at 550 V) [A]	504	574	607			
	Continuous (at 575 V) [A]	482	549	607			
	Continuous (at 690 V) [A]	482	549	607			
	Max. cable size, line power, mo- tor and load share [mm <sup>2</sup> (AWG)]	4x240 (4x500 mcm)	4x240 (4x500 mcm)	4x240 (4x500 mcm)			
	Max. cable size, brake [mm <sup>2</sup> (AWG)]	2 x 185 (2 x 350 mcm)	2 x 185 (2 x 350 mcm)	2 x 185 (2 x 350 mcm)			
	Max. external pre-fuses [A] *	700	900	900			
	at rated max. load [W] <sup>4)</sup> , 600 V	6903	8343	9244			
	Estimated power loss at rated max. load [W] <sup>4</sup> , 690 V	7249	8727	9673			
	Weight, enclosure IP21, IP 54 [kg]	263	272	313			
	Weight, enclosure IP00 [kg]	221	236	277			
	Efficiency <sup>4)</sup>		0.98				
	Output frequency		0–500 Hz				
	Heatsink overtemp. trip		230°F [110°C]				
	Power card ambient trip		154.4°F [68°C]				
Line Power Supp	ply 3 x 525–690 VAC	P710	P800	P900	P1M0	P1M2	P1M4
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	Typical Shaft output	560	670	750	850	1000	1100
	at 550 V [kW]	500	0/0	750	050	1000	1100
	at 575 V [HP]	750	950	1050	1150	1350	1550
	Typical Shaft output at 690 V [kW]	710	800	900	1000	1200	1400
	Enclosure IP21, 54 without/ with options	F1/ F3	F1/ F3	F1/ F3	F2/ F4	F2/ F4	F2/F4
	Output current						
	Continuous (at 550 V) [A]	763	889	988	1108	1317	1479
	Intermittent (60 s overload, at 550 V) [A]	839	978	1087	1219	1449	1627
	Continuous (at 575/690 V) [A]	730	850	945	1060	1260	1415
	Intermittent (60 s overload, at 575/690 V) [A]	803	935	1040	1166	1386	1557
	Continuous KVA (at 550 V) [KVA]	727	847	941	1056	1255	1409
	Continuous KVA (at 575 V) [KVA]	727	847	941	1056	1255	1409
	Continuous KVA (at 690 V) [KVA]	872	1016	1129	1267	1506	1691
Max. input curre	ent						
	Continuous (at 550 V) [A]	743	866	962	1079	1282	1440
	(at 575 V) [A]	711	828	920	1032	1227	1378
	(at 690 V) [A]	711	828	920	1032	1227	1378
	Max. cable size,mo- tor [mm <sup>2</sup> (AWG <sup>2)</sup> )]		8x150 (8x300 mcm)			12x150 (12x300 mcm)	
	Max. cable size, line power F1/F2 [mm <sup>2</sup> (AWG <sup>2)</sup> )]		, ,	8x24 (8x500 r	ł0 ncm)		
	Max. cable size, line power F3/F4 [mm <sup>2</sup> (AWG <sup>2)</sup> )]			8x45 8x900 r	i6 ncm		
	Max. cable size, load sharing [mm2 (AWG <sup>2)</sup> )]			4x12 (4x250 r	:0 ncm)		
	Max. cable size, brake [mm <sup>2</sup> (AWG <sup>2</sup> ))		4x185 (4x350 mcm)			6x185 (6x350 mcm)	
	Max. external pre-		(1,0500 mem)	00		2000	2500
	Est. power loss at rated max. load	10771	12272	13835	15592	18281	20825
	Est. power loss at rated max. load	11315	12903	14533	16375	19207	21857
	Max. added losses of Circuit Breaker or Disconnect & Contac-	427	532	615	665	863	1044
	tor, F3 & F4 Max Panel Options Losses			400	)		
	Weight,enclo-	1004/ 1299	1004/ 1299	1004/ 1299	1246/ 1541	1246/ 1541	1280/1575
	Weight, Rectifier Module [kg]	102	102	102	136	136	136
	Weight, Inverter Module [kg]	102	102	136	102	102	136
	Efficiency <sup>4)</sup>			0.98	3 H7		
	Heatsink overtemp.			0-300 2020E F	5°C1		
	trip Power card amb. trip			154.4°F	[68°C]		

### 7 General Specifications

1) For type of fuse, see the section Fuses.

2) American Wire Gauge.

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

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

Although measurements are made with state of the art equipment, some measurement inaccuracy must be allowed for (+/-5%).

### 8 Warnings and Alarms

### 8.1.1 Alarms and Warnings

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

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

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

#### This may be done in four ways:

NOTE!

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



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

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



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

Alarms that are not trip-locked can also be reset using the automatic reset function in par. 14-20 *Reset Mode* (Warning: automatic wake-up is possible!)

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

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

### 8 Warnings and Alarms



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

Table 8.1: Alarm/Warning code list

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

Table 8.2: Alarm/Warning code list

(X) Dependent on parameter

1) Cannot be auto reset via par. 14-20 Reset Mode

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

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

Table 8.3: LED Indication

Danhoss	VLT	HVAC	Drive	High	Power	Instruction	Man-
Jungen							ual

Bit	Hex	Dec	Alarm Word	Warning Word	Extended Status Word
)	0000001	1	Brake Check	Brake Check	Ramping
1	0000002	2	Pwr. Card Temp	Pwr. Card Temp	AMA Running
2	0000004	4	Ground Fault	Ground Fault	Start CW/CCW
3	0000008	8	Ctrl.Card Temp	Ctrl.Card Temp	Slow Down
1	0000010	16	Ctrl. Word TO	Ctrl. Word TO	Catch Up
5	0000020	32	Overcurrent	Overcurrent	Feedback High
5	0000040	64	Torque Limit	Torque Limit	Feedback Low
7	0000080	128	Motor Th Over	Motor Th Over	Output Current High
3	00000100	256	Motor ETR Over	Motor ETR Over	Output Current Low
Ð	00000200	512	Inverter Overld.	Inverter Overld.	Output Freq High
10	00000400	1024	DC undervolt	DC undervolt	Output Freq Low
11	00000800	2048	DC overvolt	DC overvolt	Brake Check OK
12	00001000	4096	Short Circuit	DC Voltage Low	Braking Max
13	00002000	8192	Inrush Fault	DC Voltage High	Braking
14	00004000	16384	Mains ph. Loss	Mains ph. Loss	Out of Speed Range
15	0008000	32768	AMA Not OK	No Motor	OVC Active
16	00010000	65536	Live Zero Error	Live Zero Error	
17	00020000	131072	Internal Fault	10V low	
18	00040000	262144	Brake Overload	Brake Overload	
19	00080000	524288	U phase Loss	Brake Resistor	
20	00100000	1048576	V phase Loss	Brake IGBT	
21	00200000	2097152	W phase Loss	Speed Limit	
22	00400000	4194304	Fieldbus Fault	Fieldbus Fault	
23	0080000	8388608	24 V Supply Low	24V Supply Low	
24	01000000	16777216	Mains Failure	Mains Failure	
25	02000000	33554432	1.8 V Supply Low	Current Limit	
26	04000000	67108864	Brake Resistor	Low Temp	
27	08000000	134217728	Brake IGBT	Voltage Limit	
28	1000000	268435456	Option Change	Unused	
29	2000000	536870912	Drive Initialized	Unused	
30	4000000	1073741824	Safe Stop	Unused	

Table 8.4: Description of Alarm Word, Warning Word and Extended Status Word

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

### 8.1.2 Fault Messages

#### WARNING 1, 10 volts low

The control card voltage is below 10 V from terminal 50. Remove some of the load from terminal 50, as the 10 V supply is over-loaded. 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 will only appear if programmed by the user in par. 6-01 *Live Zero Timeout Function*. The signal on one of the analog inputs is less than 50% of the minimum value programmed for that input. This condition can be caused by broken wiring or faulty device sending the signal.

#### Troubleshooting:

Check connections on all the analog input terminals. Control card terminals 53 and 54 for signals, terminal 55 common. MCB 1010PCGPIO terminals 11 and 12 for signals, terminal 10 common. MCB 1090PCAIO terminals 1, 3, 5 for signals, terminals 2, 4, 6 common).

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

Perform Input Terminal Signal Test.

#### WARNING/ALARM 3, No motor

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

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

**WARNING/ALARM 4, Mains phase loss** A phase is missing on the supply side, or the 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 par. 14-12 *Function at Mains Imbalance*.

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

#### WARNING 5, DC link voltage high

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

#### WARNING 6, DC link voltage low

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

#### WARNING/ALARM 7, DC overvoltage

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

#### Troubleshooting:

Connect a brake resistor

Extend the ramp time

Change the ramp type

Activate functions in par. 2-10 Brake Function

Increase par. 14-26 Trip Delay at Inverter Fault

#### WARNING/ALARM 8, DC undervoltage

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

#### Troubleshooting:

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

Perform Input voltage test

Perform soft charge and rectifier circuit test

#### WARNING/ALARM 9, Inverter overloaded

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

The fault is that the adjustable frequency drive is overloaded by more than 100% for too long.

#### Troubleshooting:

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

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

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

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

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

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

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#### Troubleshooting:

Check if the motor is overheating.

If the motor is mechanically overloaded

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

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

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

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

#### WARNING/ALARM 11, Motor thermistor overtemp

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

#### Troubleshooting:

Check if the motor is overheating.

Check if the motor is mechanically overloaded.

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

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

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

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

#### Troubleshooting:

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

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

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

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

#### ALARM 14, Earth (ground) fault

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

#### Troubleshooting:

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

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

Perform current sensor test.



#### ALARM 15, Hardware mismatch

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

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

Par. 15-40 FC Type

Par. 15-41 *Power Section* Par. 15-42 *Voltage* 

Par. 15-43 Software Version

Par. 15-45 Actual Typecode String

- Par. 15-49 SW ID Control Card
- Par. 15-50 SW ID Power Card
- Par. 15-60 Option Mounted
- Par. 15-61 Option SW Version

#### ALARM 16, Short circuit

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

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

#### WARNING/ALARM 17, Control word timeout

There is no communication to the adjustable frequency drive.

The warning will only be active when par. 8-04 *Control Timeout Function* is NOT set to OFF.

If par. 8-04 *Control Timeout Function* is set to *Stop* and *Trip*, a warning appears and the adjustable frequency drive ramps down until it trips, while giving an alarm.

#### Troubleshooting:

Check connections on the serial communication cable.

Increase par. 8-03 Control Timeout Time

Check the operation of the communication equipment.

Verify proper installation based on EMC requirements.

#### WARNING 23, Internal fan fault

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

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

#### Troubleshooting:

Check fan resistance.

Check soft charge fuses.

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#### WARNING 24, External fan fault

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

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

#### Troubleshooting:

Check fan resistance.

Check soft charge fuses.

#### WARNING 25, Brake resistor short circuit

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

#### WARNING/ALARM 26, Brake resistor power limit

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

#### WARNING/ALARM 27, Brake chopper fault

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

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

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

Brake resistor fault: the brake resistor is not connected or not working. Check par. 2-15 *Brake Check*.

#### ALARM 29, Heatsink temp

The maximum temperature of the heatsink has been exceeded. The temperature fault will not be reset until the temperature falls below a defined heatsink temperature. The trip and reset point are different based on the drive power size.

#### Troubleshooting:

Ambient temperature too high.

Too long motor cable.

Incorrect clearance above and below the drive.

Dirty heatsink.

Blocked air flow around the drive.

Damaged heatsink fan.

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

#### Troubleshooting:

Check fan resistance.

- Check soft charge fuses.
- IGBT thermal sensor.

#### ALARM 30, Motor phase U missing

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

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

#### ALARM 31, Motor phase V missing

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

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

#### ALARM 32, Motor phase W missing

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

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

#### ALARM 33, Inrush fault

Too many power-ups have occurred within a short time period. Let unit cool to operating temperature.

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

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

#### WARNING/ALARM 35, Out of frequency range:

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

#### WARNING/ALARM 36, Mains failure

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

#### ALARM 38, Internal fault

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

0	Serial port cannot be initialized. Serious hardware fail- ure
256-258	Power EEPROM data is defect or too old
512	Control board EEPROM data is defect or too old
513	Communication time out reading EEPROM data
514	Communication time out reading EEPROM data
515	Application Orientated Control cannot recognize the EEPROM data
516	Cannot write to the EEPROM because a write command is on progress
517	Write command is under timeout
518	Failure in the EEPROM
519	Missing or invalid Barcode data in EEPROM
/83	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 LI is too old
1316	Option SW in slot B is not supported (not allowed)
1317	Option SW in slot C0 is not supported (not allowed)
1318	Option SW in slot C1 is not supported (not allowed)
1379	Option A did not respond when calculating Platform Version.
1380	Option B did not respond when calculating Platform Version.
1381	Option C0 did not respond when calculating Platform Version.
1382	Option C1 did not respond when calculating Platform Version.
1536	An exception in the Application Orientated Control is registered. Debug information written in LCP
1792	DSP watchdog is active. Debugging of power part data motor orientated control data not transferred correctly
2049	Power data restarted
2064-2072	H081x: option in slot x has restarted
2080-2088	H082x: option in slot x has issued a power-up wait
2090-2104	wait
2304	Could not read any data from power EEPROM
2305	Missing power unit data from power unit
2315	Missing SW version from power unit
2316	Missing io_statepage from power unit
2324	Power card configuration is determined to be incorrect
2330	at power-up 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
201/	Scheudier Siuw Lasks
2819	Parameter thread
2820	LCP Stack overflow
2821	Serial port overflow
2822	USB port overflow
2836	cfListMempool to small
3072-5122	Parameter value is outside its limits
5123	Option in slot A: Hardware incompatible with Control board hardware
5124	Option in slot B: Hardware incompatible with Control board hardware
5125	Option in slot C0: Hardware incompatible with Control board hardware
5126	Option in slot C1: Hardware incompatible with Control board hardware
5376-6231	Out of memory

#### ALARM 39, Heatsink sensor

No feedback from the heatsink temperature sensor.

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

#### WARNING 40, Overload of Digital Output Terminal 27

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

#### WARNING 41, Overload of Digital Output Terminal 29

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

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

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

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

#### ALARM 46, Power card supply

The supply on the power card is out of range.

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

#### WARNING 47, 24 V supply low

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

#### WARNING 48, 1.8 V supply low

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

#### WARNING 49, Speed limit

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

#### ALARM 50, AMA calibration failed

Contact your Danfoss supplier.

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

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

#### ALARM 52, AMA low Inom

The motor current is too low. Check the settings.

#### ALARM 53, AMA big motor

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

#### ALARM 54, AMA small motor

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

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

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

#### ALARM 56, AMA interrupted by user

The AMA has been interrupted by the user.

#### ALARM 57, AMA timeout

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

#### ALARM 58, AMA internal fault

Contact your Danfoss supplier.

#### WARNING 59, Current limit

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

#### WARNING 60, External interlock

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

#### WARNING 61, Tracking error

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

#### WARNING 62, Output frequency at maximum limit

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

#### WARNING 64, Voltage limit

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

#### WARNING/ALARM/TRIP 65, Control card overtemperature

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

#### WARNING 66, Heatsink temperature low

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

#### Troubleshooting:

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

#### ALARM 67, Option module configuration has changed

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

#### ALARM 68, Safe stop activated

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

#### ALARM 69, Power card temperature

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

#### Troubleshooting:

Check the operation of the door fans.

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

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

#### ALARM 70, Illegal FC Configuration

The current control board and power board combination is illegal.

#### WARNING/ALARM 71, PTC 1 safe stop

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

#### ALARM 72, Dangerous failure

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

#### WARNING 73, Safe stop auto restart

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

#### Warning 76, Power Unit Setup

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

#### Troubleshooting:

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

#### WARNING 77, Reduced power mode:

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

#### ALARM 79, Illegal power section configuration

The scaling card is the incorrect part number or not installed. Also MK102 connector on the power card could not be installed.

#### ALARM 80, Drive initialized to default value

Parameter settings are initialized to default settings after a manual reset.

#### ALARM 91, Analog input 54 wrong settings

Switch S202 has to be set in position OFF (voltage input) when a KTY sensor is connected to analog input terminal 54.

#### ALARM 92, No flow

A no-load situation has been detected in the system. See parameter group 22-2.

### 8 Warnings and Alarms

#### ALARM 93, Dry pump

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

#### ALARM 94, End of curve

Feedback stays lower than the setpoint which may indicate leakage in the pipe system. See parameter group 22-5.

#### ALARM 95, Broken belt

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

#### ALARM 96, Start delayed

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

#### WARNING 97, Stop delayed

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

#### WARNING 98, Clock fault

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

#### WARNING 201, Fire Mode was Active

Fire mode has been active.

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#### WARNING 202, Fire Mode Limits Exceeded

Fire mode has suppressed one or more warranty voiding alarms.

#### WARNING 203, Missing Motor

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

#### WARNING 204, Locked Rotor

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

#### ALARM 243, Brake IGBT

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

#### 1 = left most inverter module.

- 2 = middle inverter module in F2 or F4 drive.
- 2 = right inverter module in F1 or F3 drive.
- 3 = right inverter module in F2 or F4 drive.
- 5 = rectifier module.

#### ALARM 244, Heatsink temperature

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

#### 1 = left most inverter module.

- 2 = middle inverter module in F2 or F4 drive
- 2 = right inverter module in F1 or F3 drive.
- 3 = right inverter module in F2 or F4 drive.
- 5 = rectifier module.



#### ALARM 245, Heatsink sensor

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

- 1 = left most inverter module.
- 2 = middle inverter module in F2 or F4 drive.
- 2 = right inverter module in F1 or F3 drive.
- 3 = right inverter module in F2 or F4 drive.
- 5 = rectifier module.

#### ALARM 246, Power card supply

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

- 1 =left most inverter module.
- 2 = middle inverter module in F2 or F4 drive.
- 2 = right inverter module in F1 or F3 drive.
- 3 = right inverter module in F2 or F4 drive.
- 5 = rectifier module.

#### ALARM 247, Power card temperature

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

- 1 =left most inverter module.
- 2 = middle inverter module in F2 or F4 drive.
- 2 = right inverter module in F1 or F3 drive.
- 3 = right inverter module in F2 or F4 drive.
- 5 = rectifier module.

#### ALARM 248, Illegal power section configuration

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

- 2 = middle inverter module in F2 or F4 drive.
- 2 = right inverter module in F1 or F3 drive.
- 3 = right inverter module in F2 or F4 drive.
- 5 = rectifier module.

#### ALARM 250, New spare part

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

#### ALARM 251, New type code

The adjustable frequency drive has a new type code.

1 =left most inverter module.

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