MAKING MODERN LIVING POSSIBLE

Programming Guide

VLT® DriveMotor FCP 106 and FCM 106

www.danfoss.com/drives

THE REAL DRIVE

⚠WARNING

RISK OF OVERHEATING AND/OR FIRE

Changing the setting *[4] ETR trip 1* in *1-90 Motor Thermal Protection* to 1 of the settings listed below may result in overheating and/or cause fire.

- ***[0] No operation*.**
- ***[1] Thermistor warning*.**
- ***[2] Thermistor trip*.**
- ***[3] ETR warning 1*.**

If the setting in *1-90 Motor Thermal Protection* is changed, the *VLT® DriveMotor FCM 106* system is no longer thermally protected under the approval of XDNZ.

Contents

1 Introduction

1.1 Purpose of the Manual

The Programming Guide provides information required for commissioning and programming the frequency converter, including complete parameter descriptions.

1.2 Additional Resources

Literature available:

- *VLT® DriveMotor FCP 106 and FCM 106 Operating Instructions,* for information required to install and commission the frequency converter.
- *VLT® DriveMotor FCP 106 and FCM 106 Design Guide,* provides information required for integration of the frequency converter into a diversity of applications.
- *VLT® DriveMotor FCP 106 and FCM 106 Programming Guide*, for how to program the unit, including complete parameter descriptions.
- *VLT® LCP Instruction*, for operation of the local control panel (LCP).
- *VLT® LOP Instruction*, for operation of the local operation pad (LOP).
- *Modbus RTU Operating Instructions*, *VLT® DriveMotor FCP 106 and FCM 106 BACnet Operating Instructions* and *VLT® DriveMotor FCP 106 and FCM 106 Metasys Operating Instructions*, for information required for controlling, monitoring, and programming the frequency converter.
- *PC-based Configuration Tool MCT 10,* enables configuration of the frequency converter from a Windows™ based PC environment.
- *Danfoss VLT® Energy Box* software, for energy calculation in HVAC applications.

Technical literature and approvals are available online at *www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.*

Danfoss VLT® Energy Box software is available at *www.danfoss.com/BusinessAreas/DrivesSolutions*, PC software download area.

1.3 Document and Software Version

This manual is regularly reviewed and updated. All suggestions for improvement are welcome. *Table 1.1* shows the document version and the corresponding software version.
In the frequency converter, read the software version in *parameter 15-43 Software Version*.

Edition	Remarks	Software version
MG03N1xx	New document	1.00

Table 1.1 Document and Software Version

1.4 Copyright

1.5 Symbols, Abbreviations and Definitions

The following symbols are used in this manual.

⚠WARNING

Indicates a potentially hazardous situation which could result in death or serious injury.

1

⚠CAUTION

Indicates a potentially hazardous situation which could result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTICE

Indicates important information, including situations that may result in damage to equipment or property.

Conventions

Numbered lists indicate procedures.

Bullet lists indicate other information and description of illustrations.

Italicised text indicates

- cross reference
- link
- footnote
- parameter name, parameter group name, parameter option

60° AVM	60° Asynchronous Vector Modulation
A	Ampere/AMP
AC	Alternating current
AD	Air discharge
AI	Analog Input
AMA	Automatic Motor Adaptation
AWG	American wire gauge
°C	Degrees Celsius
CD	Contant discharge
CM	Common mode
CT	Constand Torque
DC	Direct current
DI	Digital Input
DM	Differential mode
D-TYPE	Drive Dependent
EMC	Electro Magnetic Compatibility
ETR	Electronic Thermal Relay
f_{JOG}	Motor frequency when jog function is activated
f_M	Motor frequency
f_{MAX}	The maximum output frequency the frequency converter applies on its output
f_{MIN}	The minimum motor frequency from frequency converter
$f_{M,N}$	Nominal motor frequency
FC	Frequency converter
g	Gram
Hiperface®	Hiperface® is a registered trademark by Stegmann
hp	Horsepower
HTL	HTL encoder (10-30 V) pulses - High-voltage Transistor Logic
Hz	Hertz
I_{INV}	Rated Inverter Output Current
I_{LIM}	Current limit
$I_{M,N}$	Nominal motor current
$I_{VLT,MAX}$	The maximum output current
$I_{VLT,N}$	The rated output current supplied by the frequency converter
kHz	Kilohertz
LCP	Local Control Panel
lsb	Least significant bit
m	Meter
mA	Milliampere
MCM	Mille Circular Mil
MCT	Motion Control Tool
mH	Millihenry Inductance
min	Minute
ms	Millisecond
msb	Most significant bit
η_{VLT}	Efficiency of the frequency converter defined as ratio between power output and power input
nF	Nanofarad
NLCP	Numerical Local Control Panel
Nm	Newton Meters
n_s	Synchronous Motor Speed
On-line/Off-line Parameters	Changes to on-line parameters are activated immediately after the data value is changed.
$P_{br,cont.}$	Rated power of the brake resistor (average power during continuous braking)
PCB	Printed Circuit Board
PCD	Process Data
PELV	Protective Extra Low Voltage
P_m	Frequency converter nominal output power as HO
$P_{M,N}$	Nominal motor power
PM motor	Permanent Magnet motor
Process PID	The PID regulator maintains the desired speed, pressure, temperature, etc.
$R_{br,nom}$	The nominal resistor value that ensures a brake power on motor shaft of 150/160% for 1 minute
RCD	Residual Current Device
Regen	Regenerative terminals
R_{min}	Minimum permissible brake resistor value by frequency converter
RMS	Root Mean Square
RPM	Revolutions Per Minute
R_{rec}	Resistor value and resistance of the brake resistor
s	Second
SFAVM	Stator Flux oriented Asynchronous Vector Modulation
STW	Status Word
SMPS	Switch Mode Power Supply

THD	Total Harmonic Distortion
T_{LIM}	Torque limit
TTL	TTL encoder (5 V) pulses - Transistor Transistor Logic
$U_{M,N}$	Nominal motor voltage
V	Volts

VT	Variable Torque
VVC^{plus}	Voltage Vector Control

Table 1.2 Abbreviations

1.6 Electrical Overview

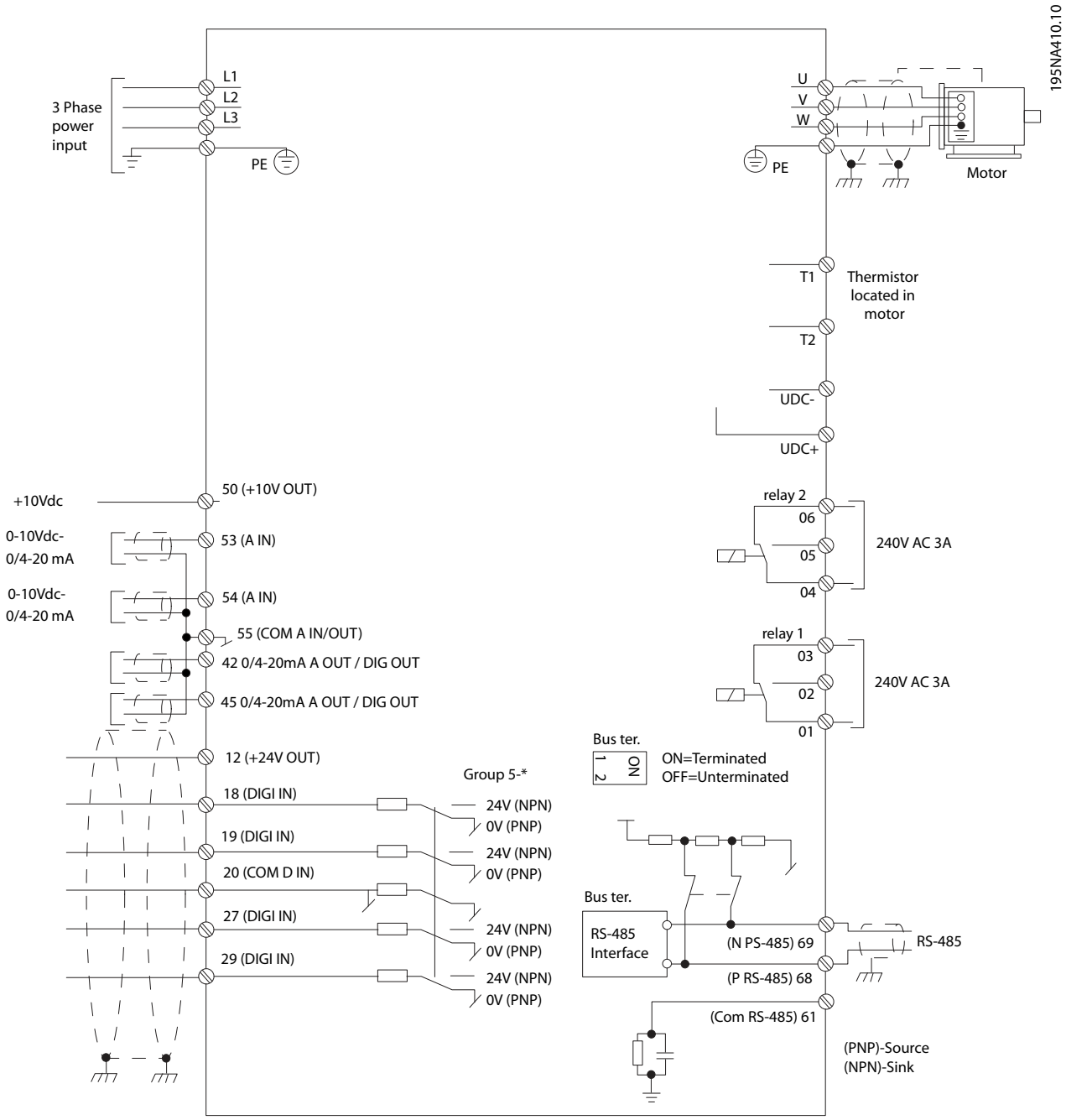


Illustration 1.1 Electrical Overview

1

2 Programming

2.1 Programming with MCT 10 Setup Software

The frequency converter can be programmed from a PC via RS-485 COM port by using the MCT 10 Set-up Software. This software can either be ordered using code number 130B1000 or downloaded from *www.danfoss.com/BusinessAreas/DrivesSolutions/softwaredownload*.

2.2 Local Control Panel (LCP)

The LCP is divided into 4 functional sections.

A. Alphanumeric display

B. Menu selection

C. Navigation keys and indicator lights (LEDs)

D. Operation keys and indicator lights (LEDs)

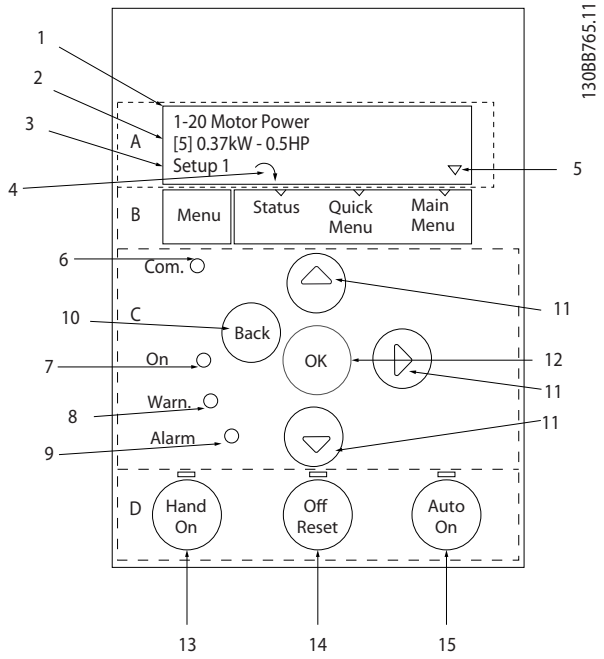


Illustration 2.1 Local Control Panel (LCP)

A. Alphanumeric display
The LCD-display is back-lit with 2 alphanumeric lines. All data is displayed on the LCP.

Information can be read from the display.

1	Parameter number and name.
2	Parameter value.
3	Set-up number shows the active set-up and the edit set-up. If the same set-up acts as both active and edit set-up, only that set-up number is shown (factory setting). When active and edit set-up differ, both numbers are shown in the display (Set-up 12). The number flashing, indicates the edit set-up.
4	Motor direction is shown to the bottom left of the display – indicated by a small arrow pointing either clockwise or counterclockwise.

B. Menu key
Use the [Menu] key to select between status, quick menu or main menu.

5	The triangle indicates if the LCP is in status, quick menu or main menu.

C. Navigation keys and indicator lights (LEDs)

6	Com LED: Flashes when bus communication is communicating.
7	Green LED/On: Control section is working.
8	Yellow LED/Warn.: Indicates a warning.
9	Flashing Red LED/Alarm: Indicates an alarm.
10	[Back]: For moving to the previous step or layer in the navigation structure
11	[▲] [▼] [►]: For maneuvering between parameter groups, parameters and within parameters. Can also be used for setting local reference.
12	[OK]: For selecting a parameter and for accepting changes to parameter settings

D. Operation keys and indicator lights (LEDs)

13	[Hand On]: Starts the motor and enables control of the frequency converter via the LCP. ***NOTICE*** **Terminal 27 Digital Input (*parameter 5-12 Terminal 27 Digital Input*) has coast inverse as default setting. This means that [Hand On] does not start the motor if there is no 24 V to terminal 27. Connect terminal 12 to terminal 27.**
14	[Off/Reset]: Stops the motor (Off). If in alarm mode the alarm is reset.
15	[Auto On]: Frequency converter is controlled either via control terminals or serial communication.

2

2.3 LCP Menus

2.3.1 Status Menu

In the Status menu, the selection options are:

- Motor Frequency [Hz], *parameter 16-13 Frequency*
- Motor Current [A], *parameter 16-14 Motor current*
- Motor Speed Reference in Percentage [%], *parameter 16-02 Reference [%]*
- Feedback, *parameter 16-52 Feedback[Unit]*
- Motor Power [kW] (if *parameter 0-03 Regional Settings* is set to *[1] North America*, Motor Power is shown in the unit of hp instead of kW), *parameter 16-10 Power [kW]* for kW, *parameter 16-11 Power [hp]* for hp
- Custom Readout *parameter 16-09 Custom Readout*

2.3.2 Quick Menu

Use the Quick Menu to programme the most common functions. The Quick Menu consists of:

- Wizard for open loop applications, see *chapter 2.3.4 Start-up Wizard for Open Loop Applications*
- Closed loop set-up wizard, see *chapter 2.3.5 Set-up Wizard for Closed Loop Applications*
- Motor set-up, see *chapter 2.3.6 Quick Menu Motor Set-up*
- Changes made

2.3.3 Main Menu

Main Menu is used for access to and programming of all parameters. The Main Menu parameters can be accessed readily unless a password has been created via *parameter 0-60 Main Menu Password*.
For the majority of applications it is not necessary to access the Main Menu parameters. Instead the Quick Menu provides the simplest and quickest access to the parameters which are typically required.

2.3.4 Start-up Wizard for Open Loop Applications

The start-up wizard guides the installer through the set-up of the frequency converter in a clear and structured manner to set up an open loop application. An open loop application does not utilise a feedback signal from the process.

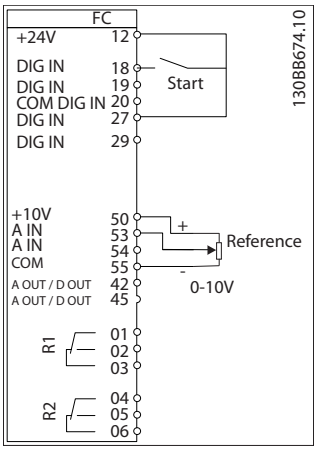


Illustration 2.2 Principle Wiring for Open Loop Start-up Wizard

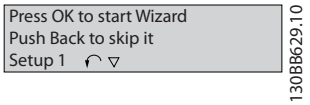


Illustration 2.3 Wizard Start View

The wizard start view appears after power up, and remains until a parameter setting is changed. Access to the wizard is always available later, via the quick menu. Press [OK] to start the wizard. Press [Back] to return to the status screen.

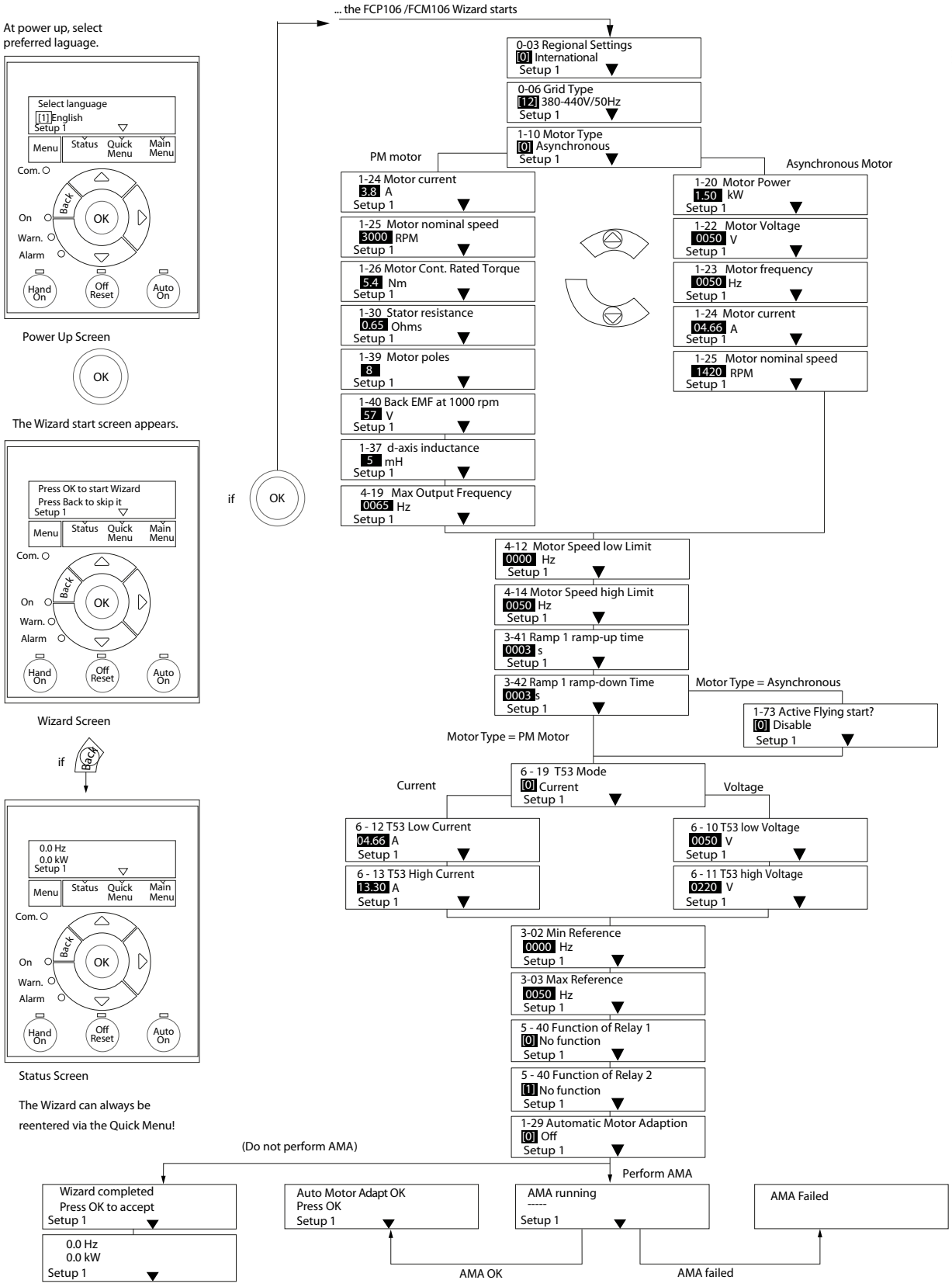


Illustration 2.4 Start-up Wizard for Open Loop Applications

2.3.5 Set-up Wizard for Closed Loop Applications

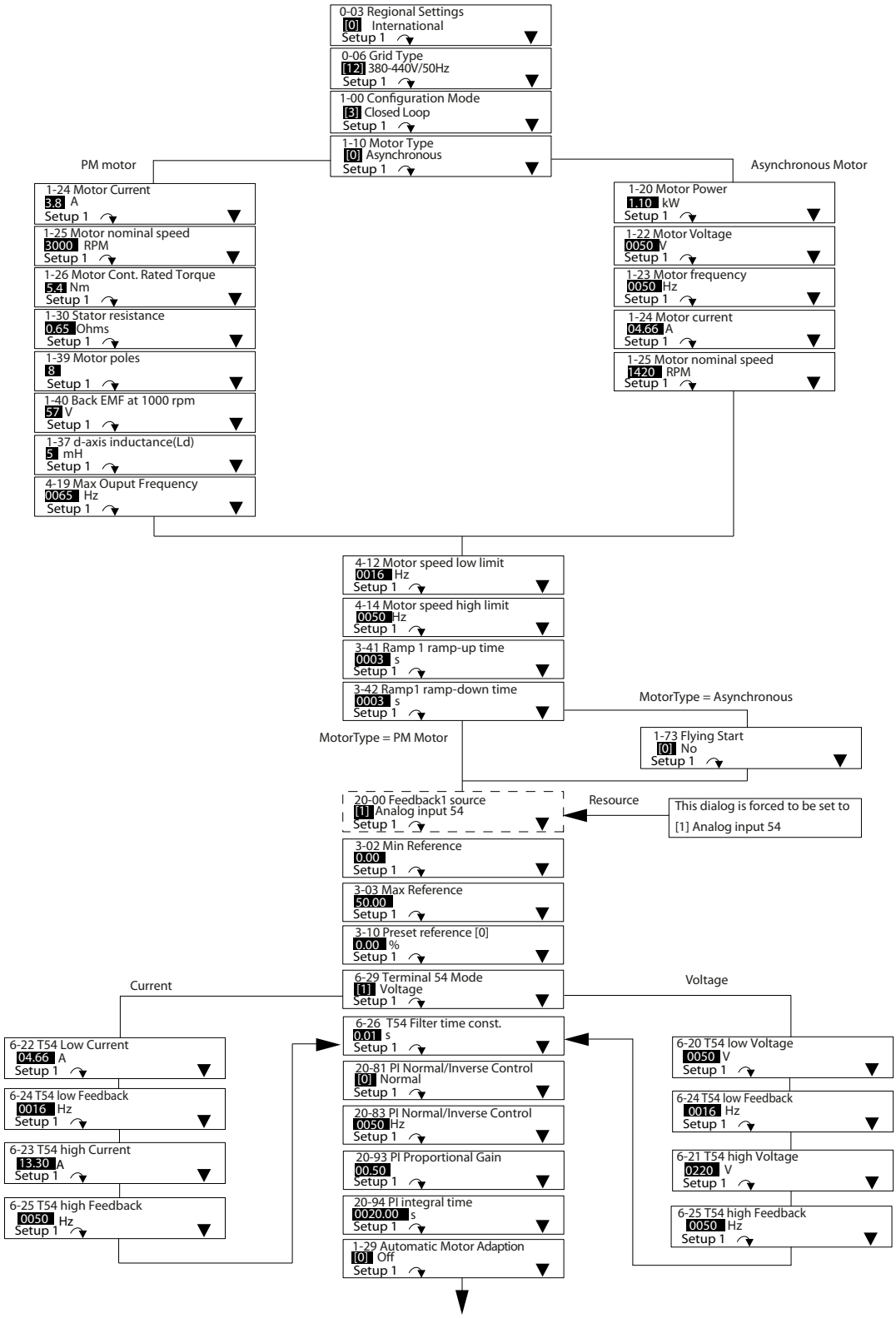


Illustration 2.5 Closed Loop Set-up Wizard

2.3.6 Quick Menu Motor Set-up

The Quick Menu Motor Set-up guides the installer through setting of the required motor parameters.

NOTICE

MOTOR OVERLOAD PROTECTION

Thermal protection of the motor is recommended. Especially when running at low speed, the cooling from the integrated motor fan is often not sufficient.

- **Use PTC or Klixon, see *VLT® DriveMotor FCP 106 and FCM 106 Operating Instructions* , or**
- **Enable motor thermal protection by setting *1-90 Motor Thermal Protection* to *[4] ETR trip 1*.**

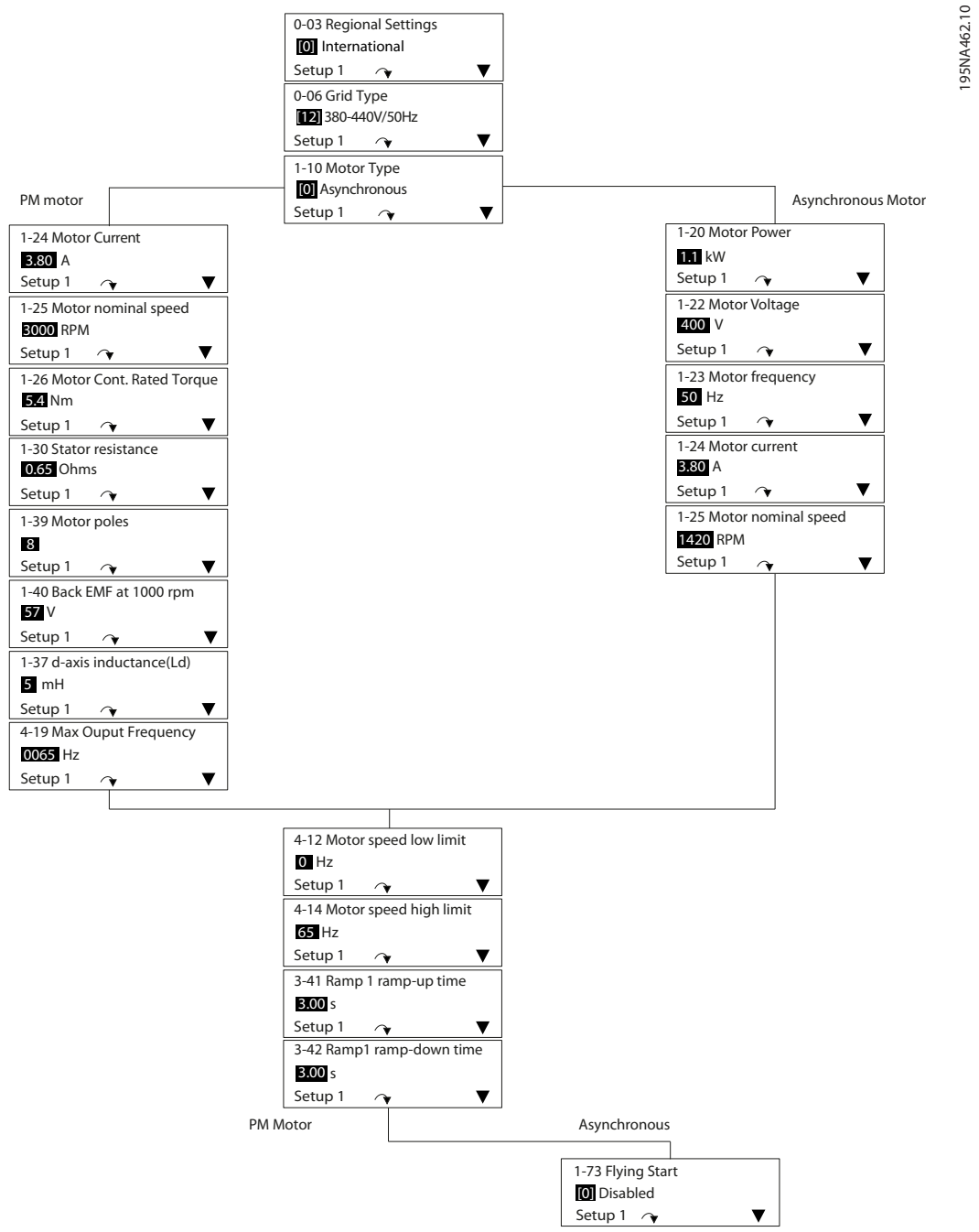


Illustration 2.6 Quick Menu Motor Set-up

2

2.4 Programming Parameters

Procedure:

1. Press [Menu] until the arrow in the display indicates the desired menu: “Quick Menu” or “Main Menu”.
2. Press [▲] [▼] to browse through the parameter groups.
3. Press [OK] to select a parameter group.
4. Press [▲] [▼] to browse through the parameters in the specific group.
5. Press [OK] to select the parameter.
6. Press [▲] [▼] [►] to change the parameter value.
7. Press [OK] to save the new setting. Press [Back] to abort
8. Press [Back] to return to the previous menu.

2.5 Back-up and Copying Parameter Settings

NOTICE

Stop the motor before backing-up or copying parameter settings.

Data storage in LCP
Once the set-up of a frequency converter is complete, store the data in the LCP. Alternatively, use a PC with MCT 10 Setup Software tool to perform the same back-up.

1. Go to *parameter 0-50 LCP Copy*
2. Press [OK]
3. Select *[1] All to LCP*
4. Press [OK]

Data transfer from LCP to frequency converter
Connect the LCP to another frequency converter and copy the parameter settings to this frequency converter as well.

1. Go to *parameter 0-50 LCP Copy*
2. Press [OK]
3. Select *[2] All from LCP*
4. Press [OK]

2.6 Restoring Default Settings

Select initialisation mode according to the requirement for retaining parameter settings.

Recommended initialisation (via *parameter 14-22 Operation Mode*).
Use this method to perform initialisation without resetting communication settings.

1. Select *parameter 14-22 Operation Mode*.
2. Press [OK].
3. Select *Initialisation* and Press [OK].
4. Cut off the mains supply and wait until the display turns off.
5. Reconnect the mains supply
6. The frequency converter is now reset, with the exception of the following parameters:

   8-30 Protocol

   parameter 8-31 Address

   parameter 8-32 Baud Rate

   parameter 8-33 Parity / Stop Bits

   parameter 8-35 Minimum Response Delay

   parameter 8-36 Maximum Response Delay

   parameter 8-70 BACnet Device Instance

   parameter 8-72 MS/TP Max Masters

   parameter 8-73 MS/TP Max Info Frames

   parameter 8-74 "I am" Service

   parameter 8-75 Intialisation Password

   parameter 15-00 Operating hours to *parameter 15-05 Over Volt's*

   parameter 15-03 Power Up's

   parameter 15-04 Over Temp's

   parameter 15-05 Over Volt's

   parameter 15-30 Alarm Log: Error Code

   15-4 Drive identification parameters*

   parameter 1-06 Clockwise Direction

2-finger initialisation
Use this method to perform initialisation, including reset of communication settings.

1. Power off the frequency converter.
2. Press [OK] and [Menu] simultaneously.
3. Power up the frequency converter while still pressing the keys above for 10 s.
4. The frequency converter is now reset, with the exception of the following parameters:

   parameter 15-00 Operating hours

   parameter 15-03 Power Up's

   parameter 15-04 Over Temp's

   parameter 15-05 Over Volt's

   15-4 Drive identification parameters*

The alarm AL80 appears as confirmation that parameters are initialised. Press [Reset].

3 RS-485 Installation and Set-up

3.1 RS-485

3.1.1 Overview

3

RS-485 is a 2-wire bus interface compatible with multi-drop network topology, that is, nodes can be connected as a bus, or via drop cables from a common trunk line. A total of 32 nodes can be connected to one network segment.
Repeaters divide network segments, see *Illustration 3.1*.

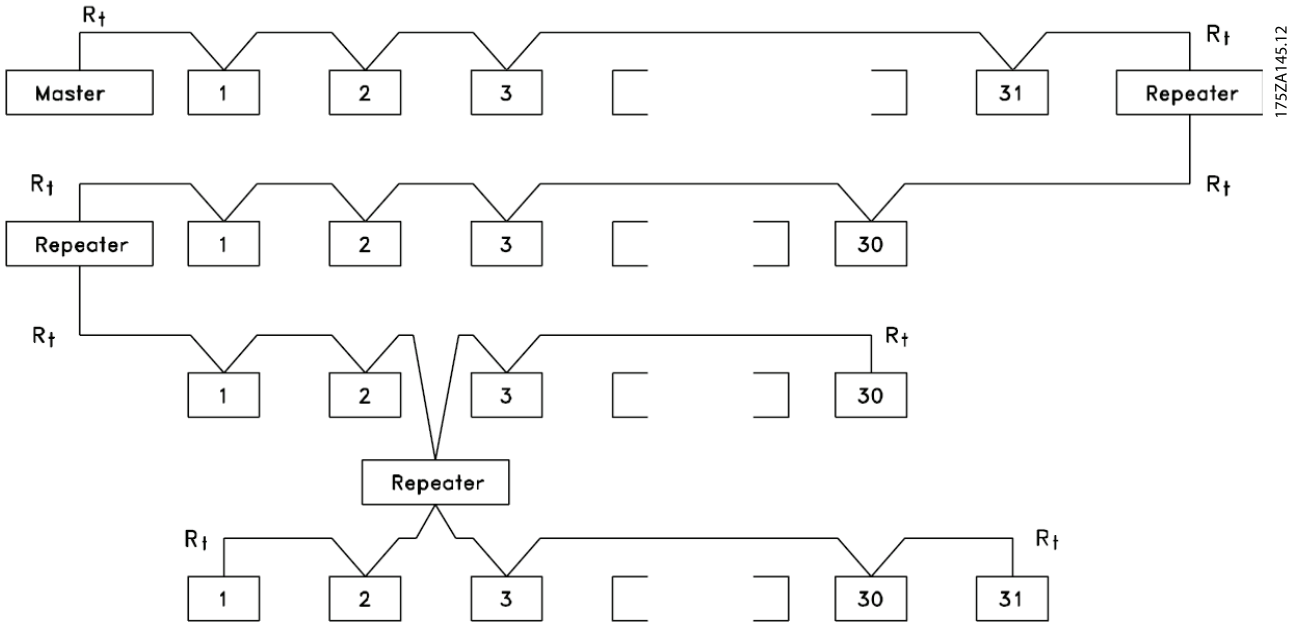


Illustration 3.1 RS-485 Bus Interface

NOTICE

Each repeater functions as a node within the segment in which it is installed. Each node connected within a given network must have a unique node address across all segments.

Terminate each segment at both ends, using either the termination switch (S801) of the frequency converters or a biased termination resistor network. Always use screened twisted pair (STP) cable for bus cabling, and follow good common installation practice, according to *Illustration 3.2*.

Low-impedance ground connection of the screen at every node is important, including at high frequencies. Thus, connect a large surface of the screen to ground, for example with a cable clamp or a conductive cable gland. It may be necessary to apply potential-equalising cables to maintain the same earth potential throughout the network - particularly in installations with long cables.

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

Cable	Screened twisted pair (STP)
Impedance [Ω]	120
Cable length [m]	Max. 1200 (including drop lines) Max. 500 station-to-station

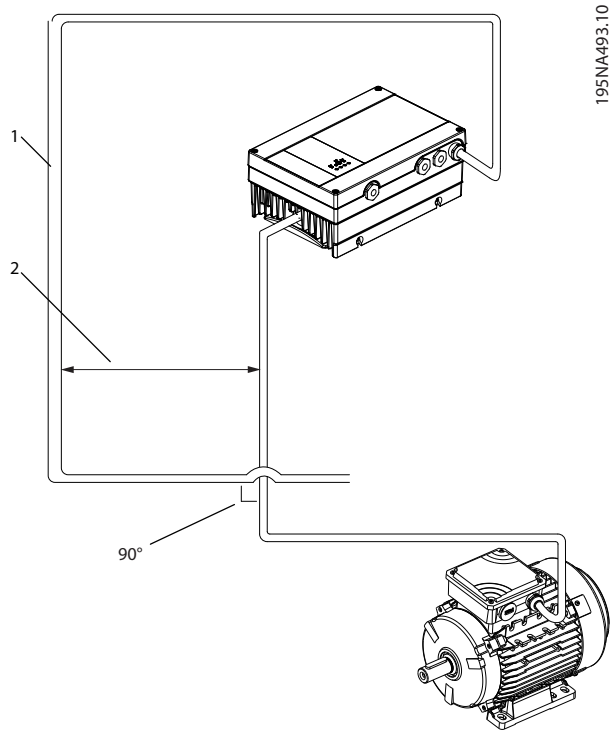
Table 3.1 Cable Specifications

3.1.2 EMC Precautions

To achieve interference-free operation of the RS-485 network, Danfoss recommends the following EMC precautions.

NOTICE

Observe relevant national and local regulations, for example regarding protective earth connection. To avoid coupling of high-frequency noise between the cables, the RS-485 communication cable must be kept away from motor and brake resistor cables. Normally, a distance of 200 mm (8 inches) is sufficient. Maintain the greatest possible distance between the cables, especially where cables run in parallel over long distances. When crossing is unavoidable, the RS-485 cable must cross motor and brake resistor cables at an angle of 90°.



1	Fieldbus cable
2	Minimum 200 mm distance

Illustration 3.2 Minimum Distance between Communication and Power Cables

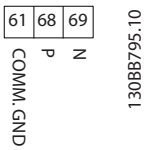
3.1.3 Network Connection

Connect the frequency converter to the RS-485 network as follows (see also *Illustration 3.3*):

1. Connect signal wires to terminal 68 (P+) and terminal 69 (N-) on the main control board of the frequency converter.
2. Connect the cable screen to the cable clamps.
3. Terminal 61 is normally not used. However when there is a large potential difference between frequency converters, connect the screen of the RS-485 cable to terminal 61. Terminal 61 has an RC filter to eliminate current noise on the cable.

NOTICE

Screened, twisted-pair cables are recommended to reduce noise between conductors.

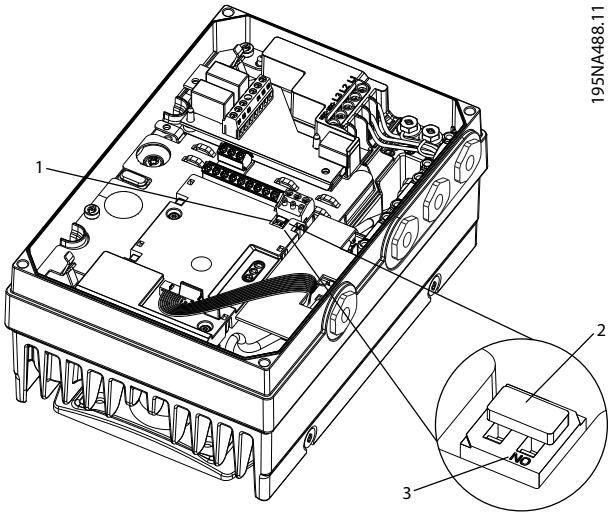


COMM. GND	Communication ground
P	(P+) Positive
N	(N-) Negative

Illustration 3.3 Network Connection

4. Set the control card DIP switch to ON to terminate the RS-485 bus, and activate RS-485. For position of DIP switch, see *Illustration 3.4*. The factory setting for the DIP switch is OFF.

3



1	DIP switch
2	DIP switch set to factory setting, OFF position
3	DIP switch ON position

Illustration 3.4 DIP Switch set to Factory Setting

3.1.4 Frequency Converter Parameter Settings for Modbus Communication

Define the RS-485 Communication Set-up

Parameter	Function
8-30 Protocol	Select the application protocol to run on the RS-485 interface
parameter 8-31 Address	Set the node address. ***NOTICE*** **The address range depends on the protocol selected in *8-30 Protocol***
parameter 8-32 Baud Rate	Set the baud rate. ***NOTICE*** **The default baud rate depends on the protocol selected in *8-30 Protocol***
parameter 8-33 Parity / Stop Bits	Set the parity and number of stop bits. ***NOTICE*** **The default selection depends on the protocol selected in *8-30 Protocol***
parameter 8-35 Minimum Response Delay	Specify a minimum delay time between receiving a request and transmitting a response. This function is for overcoming modem turnaround delays.
parameter 8-36 Maximum Response Delay	Specify a maximum delay time between transmitting a request and receiving a response.
8-37 Maximum Inter-char delay	If transmission is interrupted, specify a maximum delay time between two received bytes to ensure time-out. ***NOTICE*** **The default selection depends on the protocol selected in *8-30 Protocol***

Table 3.2 Modbus Communication Parameter Settings

3.2 FC Protocol Overview

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

The physical layer is RS-485, thus utilising the RS-485 port built into the frequency converter. The FC protocol supports different telegram formats:

- A short format of 8 bytes for process data
- A long format of 16 bytes that also includes a parameter channel
- A format used for texts

3.2.1 FC with Modbus RTU

The FC protocol provides access to the control word and bus reference of the frequency converter.

The control word allows the Modbus master to control several important functions of the frequency converter.

- Start
- Stop of the frequency converter in various ways:
  - Coast stop
  - Quick stop
  - DC Brake stop
  - Normal (ramp) stop

- Reset after a fault trip
- Run at various preset speeds
- Run in reverse
- Change of the active set-up
- Control of the 2 relays built into the frequency converter

The bus reference is commonly used for speed control. It is also possible to access the parameters, read their values, and where possible, write values to them. This permits a range of control options, including controlling the setpoint of the frequency converter when its internal PI controller is used.

3.3 Network Configuration

3.3.1 Frequency Converter Set-up

Set the following parameters to enable the FC protocol for the frequency converter.

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

Table 3.3 Network Configuration Parameters

3.4 FC Protocol Message Framing Structure

3.4.1 Content of a Character (byte)

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

Illustration 3.5 Content of a Character

3.4.2 Telegram Structure

Each telegram has the following structure:

1. Start character (STX)=02 hex
2. A byte denoting the telegram length (LGE)
3. A byte denoting the frequency converter address (ADR)

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

A data control byte (BCC) completes the telegram.

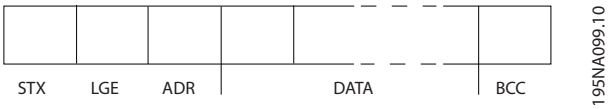


Illustration 3.6 Telegram Structure

3.4.3 Telegram Length (LGE)

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

4 data bytes	LGE=4+1+1=6 bytes
12 data bytes	LGE=12+1+1=14 bytes
Telegramscontaining texts	10[1)]+n bytes

Table 3.4 Length of Telegrams

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

3.4.4 Frequency Converter Address (ADR)

Address format 1-126

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

Bit 0-6=frequency converter address 1-126

Bit 0-6=0 Broadcast

The follower returns the address byte unchanged to the master in the response telegram.

3.4.5 Data Control Byte (BCC)

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

3.4.6 The Data Field

The structure of data blocks depends on the type of telegram. There are 3 telegram types, and the type applies for both control telegrams (master⇒follower) and response telegrams (follower⇒master).

3

The 3 types of telegram are:

Process block (PCD)
The PCD is made up of a data block of 4 bytes (2 words) and contains:

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

Illustration 3.7 Process Block

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

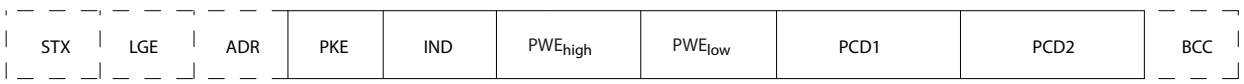


Illustration 3.8 Parameter Block

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

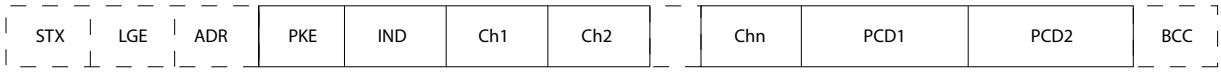


Illustration 3.9 Text Block

3.4.7 The PKE Field

The PKE field contains 2 subfields: Parameter command and response (AK) and Parameter number (PNU):

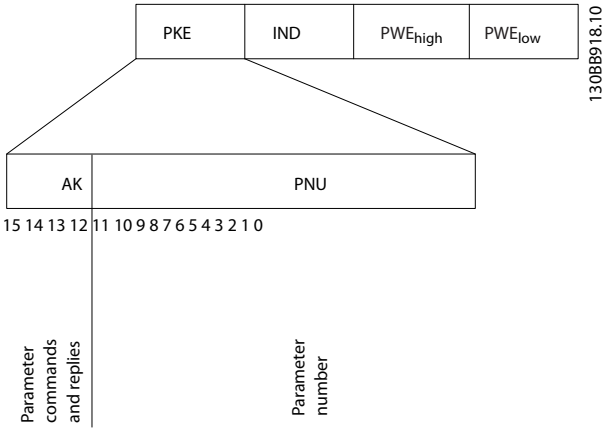


Illustration 3.10 PKE Field

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

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

Table 3.5 Parameter Commands

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

Table 3.6 Response

If the command cannot be performed, the follower sends this response:
0111 Command cannot be performed
- and issues the following fault report in the parameter value:

Error code	+ Specification
0	Illegal Parameter Number
2	Upper or lower limit exceeded
3	Subindex corrupted
4	No Array
5	Wrong Data Type
6	Not used
7	Not used
17	Not while Running
18	Other error
23	Parameter database is busy
100	
>100	
130	No bus access for this parameter
132	No LCP access
255	No error

Table 3.7 Follower Report

3.4.8 Parameter Number (PNU)

Bits no. 0-11 transfer parameter numbers. The function of the relevant parameter is defined in the parameter description in .

3.4.9 Index (IND)

The index is used with the parameter number to read/write-access parameters with an index, for example, *parameter 15-30 Alarm Log: Error Code*. The index consists of 2 bytes; a low byte, and a high byte. Index (IND)

Only the low byte is used as an index.

3.4.10 Parameter Value (PWE)

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

When a follower responds to a parameter request (read command), the present parameter value in the PWE block is transferred and returned to the master. If a parameter contains several data options, e.g.
parameter 0-01 Language, select the data value by entering the value in the PWE block. Serial communication is only capable of reading parameters containing data type 9 (text string).

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

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

3.4.11 Data Types Supported by the Frequency Converter

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

Data types	Description
3	Integer 16
4	Integer 32
5	Unsigned 8
6	Unsigned 16
7	Unsigned 32
9	Text string

Table 3.8 Data Types

3.4.12 Conversion

The various attributes of each parameter are displayed in the chapter *Parameter Lists* in the *Programming Guide*. Parameter values are transferred as whole numbers only. Conversion factors are therefore used to transfer decimals.

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

Conversion index	Conversion factor
74	3600
2	100
1	10
0	1
-1	0.1
-2	0.01
-3	0.001
-4	0.0001
-5	0.00001

Table 3.9 Conversion

3.4.13 Process Words (PCD)

The block of process words is divided into 2 blocks of 16 bits, which always occur in the defined sequence.

PCD 1	PCD 2
Control telegram (master⇒follower control word)	Reference-value
Control telegram (follower⇒master) status word	Present output frequency

Table 3.10 Process Words (PCD)

3.5 Examples

3.5.1 Writing a Parameter Value

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

PKE=E19E hex - Write single word in *parameter 4-14 Motor Speed High Limit [Hz]*:

IND=0000 hex

PWEHIGH=0000 hex

PWELOW=03E8 hex

Data value 1000, corresponding to 100 Hz, see *chapter 3.4.12 Conversion*.

The telegram looks like this:

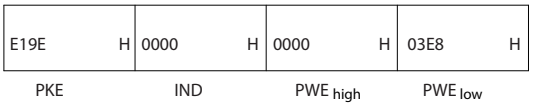


Illustration 3.11 Telegram

NOTICE

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

The response from the follower to the master is:

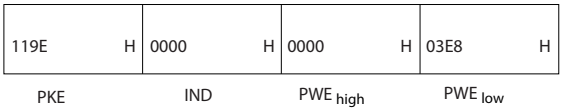


Illustration 3.12 Response from Master

3.5.2 Reading a Parameter Value

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

PKE=1155 hex - Read parameter value in *parameter 3-41 Ramp 1 Ramp Up Time*
IND=0000 hex
PWE_{HIGH}=0000 hex
PWE_{LOW}=0000 hex

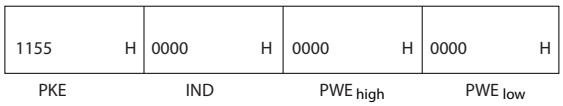


Illustration 3.13 Telegram

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

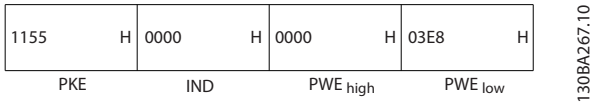


Illustration 3.14 Response

3E8 hex corresponds to 1000 decimal. The conversion index for *parameter 3-41 Ramp 1 Ramp Up Time* is -2, that is, 0.01.
Parameter 3-41 Ramp 1 Ramp Up Time is of the type *Unsigned 32*.

3.6 Modbus RTU Overview

3.6.1 Assumptions

Danfoss assumes that the installed controller supports the interfaces in this document, and strictly observes all requirements and limitations stipulated in the controller and frequency converter.

3.6.2 What the User Should Already Know

The built-in Modbus RTU (Remote Terminal Unit) is designed to communicate with any controller that supports the interfaces defined in this document. It is assumed that the user has full knowledge of the capabilities and limitations of the controller.

3.6.3 Modbus RTU Overview

Regardless of the type of physical communication networks, the Modbus RTU Overview describes the process a controller uses to request access to another device. This process includes how the Modbus RTU responds to requests from another device, and how errors are detected and reported. It also establishes a common format for the layout and contents of message fields.
During communications over a Modbus RTU network, the protocol determines:

- How each controller learns its device address
- Recognises a message addressed to it
- Determines which actions to take
- Extracts any data or other information contained in the message

If a reply is required, the controller constructs the reply message and sends it.
Controllers communicate using a master-follower technique in which only the master can initiate transactions (called queries). Followers respond by supplying the requested data to the master, or by taking the action requested in the query.
The master can address individual followers, or initiate a broadcast message to all followers. Followers return a response to queries that are addressed to them individually. No responses are returned to broadcast queries from the master. The Modbus RTU protocol establishes the format for the master's query by providing the device (or broadcast) address, a function code defining the requested action, any data to be sent, and an error-checking field. The follower's response message is also constructed using Modbus protocol. It contains fields confirming the action taken, any data to be returned, and an error-checking field. If an error occurs in receipt of the message, or if the follower is unable to perform the

requested action, the follower constructs an error message, and send it in response, or a time-out occurs.

3.6.4 Frequency Converter with Modbus RTU

3

The frequency converter communicates in Modbus RTU format over the built-in RS-485 interface. Modbus RTU provides access to the control word and bus reference of the frequency converter.

The control word allows the modbus master to control several important functions of the frequency converter:

- Start
- Stop of the frequency converter in various ways:
  - Coast stop
  - Quick stop
  - DC Brake stop
  - Normal (ramp) stop
- Reset after a fault trip
- Run at a variety of preset speeds
- Run in reverse
- Change the active set-up
- Control the frequency converter's built-in relay

The bus reference is commonly used for speed control. It is also possible to access the parameters, read their values, and where possible, write values to them. This permits a range of control options, including controlling the setpoint of the frequency converter when its internal PI controller is used.

3.7 Network Configuration

To enable Modbus RTU on the frequency converter, set the following parameters:

Parameter	Setting
8-30 Protocol	Modbus RTU
Parameter 8-31 Address	1-247
Parameter 8-32 Baud Rate	2400-115200
Parameter 8-33 Parity / Stop Bits	Even parity, 1 stop bit (default)

Table 3.11 Network Configuration

3.8 Modbus RTU Message Framing Structure

3.8.1 Frequency Converter with Modbus RTU

The controllers are set up to communicate on the Modbus network using RTU (Remote Terminal Unit) mode, with each byte in a message containing 2 4-bit hexadecimal characters. The format for each byte is shown in *Table 3.12*.

Start bit	Data byte								Stop/ parity	Stop

Table 3.12 Format for Each Byte

Coding System	8-bit binary, hexadecimal 0-9, A-F. 2 hexadecimal characters contained in each 8-bit field of the message
Bits Per Byte	1 start bit 8 data bits, least significant bit sent first 1 bit for even/odd parity; no bit for no parity 1 stop bit if parity is used; 2 bits if no parity
Error Check Field	Cyclical Redundancy Check (CRC)

3.8.2 Modbus RTU Message Structure

The transmitting device places a Modbus RTU message into a frame with a known beginning and ending point. This allows receiving devices to begin at the start of the message, read the address portion, determine which device is addressed (or all devices, if the message is broadcast), and to recognise when the message is completed. Partial messages are detected and errors set as a result. Characters for transmission must be in hexadecimal 00 to FF format in each field. The frequency converter continuously monitors the network bus, also during 'silent' intervals. When the first field (the address field) is received, each frequency converter or device decodes it to determine which device is being addressed. Modbus RTU messages addressed to zero are broadcast messages. No response is permitted for broadcast messages. A typical message frame is shown in *Table 3.13*.

Start	Address	Function	Data	CRC check	End
T1-T2-T3-T4	8 bits	8 bits	N x 8 bits	16 bits	T1-T2-T3-T4

Table 3.13 Typical Modbus RTU Message Structure

3.8.3 Start/Stop Field

Messages start with a silent period of at least 3.5 character intervals. This is implemented as a multiple of character intervals at the selected network baud rate (shown as Start T1-T2-T3-T4). The first field to be transmitted is the device address. Following the last transmitted character, a similar period of at least 3.5 character intervals marks the end of the message. A new message can begin after this period. The entire message frame must be transmitted as a continuous stream. If a silent period of more than 1.5 character intervals occurs before completion of the frame, the receiving device flushes the incomplete message and assumes that the next byte is the address field of a new message. Similarly, if a new message begins before 3.5 character intervals after a previous message, the receiving device considers it a continuation of the previous message. This causes a time-out (no response from the follower), since the value in the final CRC field is not valid for the combined messages.

3.8.4 Address Field

The address field of a message frame contains 8 bits. Valid follower device addresses are in the range of 0-247 decimal. The individual follower devices are assigned addresses in the range of 1-247. (0 is reserved for broadcast mode, which all followers recognise.) A master addresses a follower by placing the follower address in the address field of the message. When the follower sends its response, it places its own address in this address field to let the master know which follower is responding.

3.8.5 Function Field

The function field of a message frame contains 8 bits. Valid codes are in the range of 1-FF. Function fields are used to send messages between master and follower. When a message is sent from a master to a follower device, the function code field tells the follower what kind of action to perform. When the follower responds to the master, it uses the function code field to indicate either a normal (error-free) response, or that some kind of error occurred (called an exception response). For a normal response, the follower simply echoes the original function code. For an exception response, the follower returns a code that is equivalent to the original function code with its most significant bit set to logic 1. In addition, the follower places a unique code into the data field of the response message. This tells the master what kind of error occurred, or the reason for the exception. Also refer to and *chapter 3.8.13 Modbus Exception Codes*

3.8.6 Data Field

The data field is constructed using sets of 2 hexadecimal digits, in the range of 00 to FF hexadecimal. These are made up of one RTU character. The data field of messages sent from a master to follower device contains additional information which the follower must use to take the action defined by the function code. This can include items such as coil or register addresses, the quantity of items to be handled, and the count of actual data bytes in the field.

3.8.7 CRC Check Field

Messages include an error-checking field, operating based on a Cyclical Redundancy Check (CRC) method. The CRC field checks the contents of the entire message. It is applied regardless of any parity check method used for the individual characters of the message. The CRC value is calculated by the transmitting device, which appends the CRC as the last field in the message. The receiving device recalculates a CRC during receipt of the message and compares the calculated value to the actual value received in the CRC field. If the 2 values are unequal, a bus time-out results. The error-checking field contains a 16-bit binary value implemented as 2 8-bit bytes. When this is done, the low-order byte of the field is appended first, followed by the high-order byte. The CRC high-order byte is the last byte sent in the message.

3.8.8 Coil Register Addressing

For coil register addressing, refer to *Modbus RTU Operating Instructions*.

3.8.9 Access via PCD write/read

The advantage of using the PCD write/read configuration is that the controller can write or read more data in one telegram. Up to 63 registers can be read or written to via the Function code Read Holding register or Write Multiple Registers in one telegram. The structure is also flexible so that only two registers can be written to and 10 registers can be read from the controller.

The PCD write list is data send from the controller to the like Control word, Reference and application dependent data like Minimum reference and Ramp times.

NOTICE

The Control word and Reference is always sent in the list from the controller to the .

The PCD write list is setup in *8-42 PCD Write Configuration*.

3

The PCD read list is data send from the to the controller like Status word, Main Actual Value and application dependent data like Running Hours, Motor current and Alarm word.

NOTICE

The Status word and Main Actual Value is always sent in the list from the to the Controller.

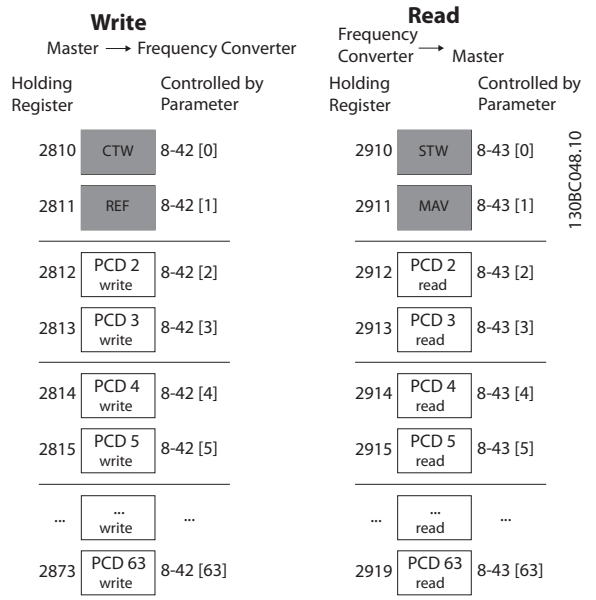


Illustration 3.15

NOTICE

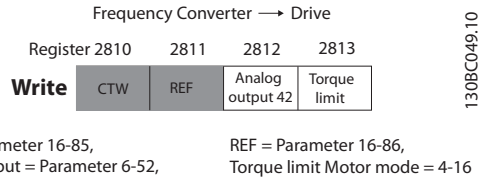
The boxes marked in grey are not changeable, they are the default values.

NOTICE

32 bit parameters must be mapped inside the 32 bit boundaries, (PCD2 & PCD3 or PCD4 & PCD5 etc.) where the parameter number is mapped twice to*8-42 PCD Write Configuration* or *8-43 PCD Read Configuration*.

3.8.10 Mapping the Holding Registers to Drive Parameters

Example:
The PLC sends control word, reference, set the analog output 42 and set the torque limit

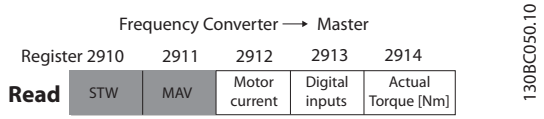


CTW = Parameter 16-85,
Analog output = Parameter 6-52,

REF = Parameter 16-86,
Torque limit Motor mode = 4-16

Illustration 3.16

Example:
The sends status word, main actual value, actual motor current, digital inputs and torque [Nm]



STW = Parameter 16-03,
Motor Current = Parameter 16-14,
Actual Torque [Nm]

MAV = Parameter 16-05,
Digital Inputs = Parameter 16-60

Illustration 3.17

Example, continued
The input and output data of the Modbus RTU has to be mapped to the Parameter of the . This is done in *8-42 PCD Write Configuration* and *8-43 PCD Read Configuration*.

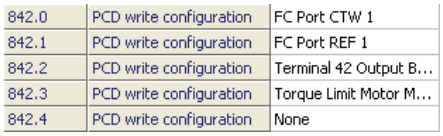


Illustration 3.18

NOTICE

Grey lines are fixed, red are user selectable.

Following parameters has to be set up in the :

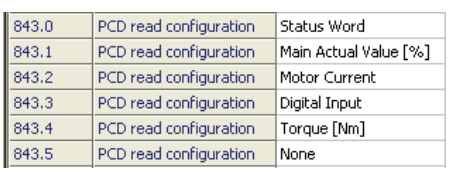


Illustration 3.19

NOTICE

The motor current in *16-14 Motor current* is 32 bit. This mapping is only mapping the lower 16 bit, so the maximum motor current readout is 327 Amps.

For higher Amp readout, user 32 bit readout.

Mapping a 32 bit parameter as 16 bit always accesses the 16 lower bits.

3.8.11 How to Control the Frequency Converter

This section describes codes which can be used in the function and data fields of a Modbus RTU message.

3.8.12 Function Codes Supported by Modbus RTU

Modbus RTU supports use of the following function codes in the function field of a message.

Function	Function code
Read coils	1 Hex
Read holding registers	3 Hex
Write single coil	5 Hex
Write single register	6 Hex
Write multiple coils	F Hex
Write multiple registers	10 Hex
Get comm. event counter	B Hex
Report follower ID	11 Hex
Read write multiple registers	17 Hex

Table 3.14 Function Codes

Function	Function Code	Sub-function code	Sub-function
Diagnostics	8	1	Restart communication
		2	Return diagnostic register
		10	Clear counters and diagnostic register
		11	Return bus message count
		12	Return bus communi-cation error count
		13	Return follower error count
		14	Return follower message count

Table 3.15 Function Codes

3.8.13 Modbus Exception Codes

For a full explanation of the structure of an exception code response, refer to *chapter 3.8.5 Function Field*.

Code	Name	Meaning
1	Illegal function	The function code received in the query is not an allowable action for the server (or follower). This may be because the function code is only applicable to newer devices, and was not implemented in the unit selected. It could also indicate that the server (or follower) is in the wrong state to process a request of this type, for example because it is not configured and is being asked to return register values.
2	Illegal data address	The data address received in the query is not an allowable address for the server (or follower). More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, a request with offset 96 and length 4 would succeed, a request with offset 96 and length 5 generates exception 02.
3	Illegal data value	A value contained in the query data field is not an allowable value for server (or follower). This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It specifically does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the Modbus protocol is unaware of the significance of any particular value of any particular register.
4	Follower device failure	An unrecoverable error occurred while the server (or follower) was attempting to perform the requested action.

Table 3.16 Modbus Exception Codes

3.9 How to Access Parameters

3.9.1 Parameter Handling

The PNU (Parameter Number) is translated from the register address contained in the Modbus read or write message. The parameter number is translated to Modbus as (10 x parameter number) DECIMAL. Example: Reading *3-12 Catch up/slow Down Value* (16bit): The holding register 3120 holds the parameters value. A value of 1352 (Decimal), means that the parameter is set to 12.52%

Reading *3-14 Preset Relative Reference* (32bit): The holding registers 3410 & 3411 holds the parameters value. A value of 11300 (Decimal), means that the parameter is set to 1113.00.

For information on the parameters, size and converting index, consult the product relevant programming guide.

3.9.2 Storage of Data

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

3.9.3 IND (Index)

Some parameters in the frequency converter are array parameters e.g. *3-10 Preset Reference*. Since the Modbus does not support arrays in the holding registers, the frequency converter has reserved the holding register 9 as pointer to the array. Before reading or writing an array parameter, set the holding register 9. Setting holding register to the value of 2 causes all following read/write to array parameters to be to the index 2. See also .

3.9.4 Text Blocks

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

3.9.5 Conversion Factor

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

3.9.6 Parameter Values

Standard data types
Standard data types are int 16, int 32, uint 8, uint 16 and uint 32. They are stored as 4x registers (40001–4FFFF). The parameters are read using function 03hex "Read Holding Registers." Parameters are written using the function 6hex "Preset Single Register" for 1 register (16 bits), and the function 10 hex "Preset Multiple Registers" for 2 registers (32 bits). Readable sizes range from 1 register (16 bits) up to 10 registers (20 characters).

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

3.10 Examples

The following examples illustrate various Modbus RTU commands.

3.10.1 Read Holding Registers (03 hex)

Description
This function reads the contents of holding registers in the follower.

Query
The query message specifies the starting register and quantity of registers to be read. Register addresses start at zero, that is, registers 1-4 are addressed as 0-3.

Example: Read *parameter 3-03 Maximum Reference*, register 03030.

Field Name	Example (hex)
Follower Address	01
Function	03 (read holding registers)
Starting Address HI	0B (Register address 3029)
Starting Address LO	D5 (Register address 3029)
No. of Points HI	00
No. of Points LO	02 - (*parameter 3-03 Maximum Reference* is 32 bits long, i.e. 2 registers)
Error Check (CRC)	-

Table 3.17 Query

Response
The register data in the response message are packed as 2 bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high-order bits and the second contains the low-order bits.

Example: hex 000088B8=35.000=35 Hz.

Field Name	Example (hex)
Follower Address	01
Function	03
Byte Count	04
Data HI (Register 3030)	00
Data LO (Register 3030)	16
Data HI (Register 3031)	E3
Data LO (Register 3031)	60
Error Check (CRC)	-

Table 3.18 Response

3.10.2 Preset Single Register (06 hex)

Description
This function presets a value into a single holding register.

Query
The query message specifies the register reference to be preset. Register addresses start at zero, that is, register 1 is addressed as 0.

Example: Write to *parameter 1-00 Configuration Mode*, register 1000.

Field Name	Example (hex)
Follower Address	01
Function	06
Register Address HI	03 (Register address 999)
Register Address LO	E7 (Register address 999)
Preset Data HI	00
Preset Data LO	01
Error Check (CRC)	-

Table 3.19 Query

Response
The normal response is an echo of the query, returned after the register contents have been passed.

Field Name	Example (hex)
Follower Address	01
Function	06
Register Address HI	03
Register Address LO	E7
Preset Data HI	00
Preset Data LO	01
Error Check (CRC)	-

Table 3.20 Response

3.10.3 Preset Multiple Registers (10 hex)

Description
This function presets values into a sequence of holding registers.

Query
The query message specifies the register references to be preset. Register addresses start at zero, that is, register 1 is addressed as 0. Example of a request to preset 2 registers (set *1-24 Motor Current* to 738 (7.38 A)):

Field Name	Example (hex)
Follower Address	01
Function	10
Starting Address HI	04
Starting Address LO	07
No. of Registers HI	00
No. of registers LO	02
Byte Count	04
Write Data HI (Register 4: 1049)	00
Write Data LO (Register 4: 1049)	00
Write Data HI (Register 4: 1050)	02
Write Data LO (Register 4: 1050)	E2
Error Check (CRC)	-

Table 3.21 Query

Response
The normal response returns the follower address, function code, starting address, and quantity of registers preset.

Field Name	Example (hex)
Follower Address	01
Function	10
Starting Address HI	04
Starting Address LO	19
No. of Registers HI	00
No. of registers LO	02
Error Check (CRC)	-

Table 3.22 Response

3.10.4 Read/Write Multiple registers (17 HEX)

Description
This function code performs a combination of one read operation and one write operation in a single MODBUS transaction. The write operation is performed before the read.

Query
The query message specifies the starting address and number of holding registers to be read as well as the starting address, number of holding registers, and the data to be written. Holding registers are addressed starting at zero.
Example of a request to set *1-24 Motor Current* to 738 (7.38 A) and read *parameter 3-03 Maximum Reference* which has value 50000 (50,000 Hz):

3

Field Name	Example (HEX)
Follower Address	01
Function	17
Read Starting Address HI	0B (Register address 3029)
Read Starting Address LO	D5 (Register address 3029)
Quantity to Read HI	00
Quantity to Read LO	02 (*parameter 3-03 Maximum Reference* is 32 bits long, that is, 2 registers)
Write Starting Address HI	04 (Register address 1239)
Write Starting address LO	D7 (Register address 1239)
Quantity to Write HI	00
Quantity to Write LO	02
Write Byte Count	04
Write Registers Value HI	00
Write Registers Value LO	00
Write Registers Value HI	02
Write Registers Value LO	0E
Error Check (CRC)	-

Table 3.23 Query

Response
The normal response contains the data from the group of registers that were read. The byte count field specifies the quantity of bytes to follow in the read data field.

Field Name	Example (HEX)
Follower Address	01
Function	17
Byte Count	04
Read Registers Value HI	00
Read Registers Value LO	00
Read Registers Value HI	C3
Read Registers Value LO	50
CRC	-

Table 3.24 Response

3.11 FC Control Profile

3.11.1 Control Word According to FC Profile (8-10 Protocol = FC profile)

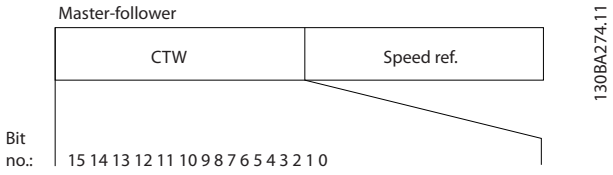


Illustration 3.20 Control Word According to FC Profile

Bit	Bit value=0	Bit value=1
00	Reference value	external selection lsb
01	Reference value	external selection msb
02	DC brake	Ramp
03	Coasting	No coasting
04	Quick stop	Ramp
05	Hold output frequency	use ramp
06	Ramp stop	Start
07	No function	Reset
08	No function	Jog
09	Ramp 1	Ramp 2
10	Data invalid	Data valid
11	Relay 01 open	Relay 01 active
12	Relay 02 open	Relay 02 active
13	Parameter set-up	selection lsb
15	No function	Reverse

Table 3.25 Control Word According to FC Profile

Explanation of the control bits

Bits 00/01
Bits 00 and 01 are used to select between the 4 reference values, which are pre-programmed in *parameter 3-10 Preset Reference* according to the *Table 3.26*.

Programmed ref. value	Parameter	Bit 01	Bit 00
1	*Parameter 3-10 Preset Reference* [0]	0	0
2	*Parameter 3-10 Preset Reference* [1]	0	1
3	*Parameter 3-10 Preset Reference* [2]	1	0
4	*Parameter 3-10 Preset Reference* [3]	1	1

Table 3.26 Control Bits

NOTICE

Make a selection in *parameter 8-56 Preset Reference Select* to define how Bit 00/01 gates with the corresponding function on the digital inputs.

Bit 02, DC brake
Bit 02='0' leads to DC braking and stop. Set braking current and duration in *parameter 2-01 DC Brake Current* and *parameter 2-02 DC Braking Time*.
Bit 02='1' leads to ramping.

Bit 03, Coasting
Bit 03='0': The frequency converter immediately "lets go" of the motor, (the output transistors are "shut off") and it coasts to a standstill.
Bit 03='1': The frequency converter starts the motor if the other starting conditions are met.

Make a selection in *parameter 8-50 Coasting Select* to define how Bit 03 gates with the corresponding function on a digital input.

Bit 04, Quick stop
Bit 04='0': Makes the motor speed ramp down to stop (set in *parameter 3-81 Quick Stop Ramp Time*).

Bit 05, Hold output frequency
Bit 05='0': The present output frequency (in Hz) freezes. Change the frozen output frequency only with the digital inputs (*parameter 5-10 Terminal 18 Digital Input* to *parameter 5-13 Terminal 29 Digital Input*) programmed to *Speed up=21* and *Slow down=22*.

NOTICE

If Freeze output is active, the frequency converter can only be stopped by the following:

- **Bit 03 Coasting stop**
- **Bit 02 DC braking**
- **Digital input (*parameter 5-10 Terminal 18 Digital Input* to *parameter 5-13 Terminal 29 Digital Input*) programmed to *DC braking=5*, *Coasting stop=2*, or *Reset and coasting stop=3*.**

Bit 06, Ramp stop/start
Bit 06='0': Causes a stop and makes the motor speed ramp down to stop via the selected ramp down parameter. Bit 06='1': Permits the Frequency converter to start the motor, if the other starting conditions are met.

Make a selection in *parameter 8-53 Start Select* to define how Bit 06 Ramp stop/start gates with the corresponding function on a digital input.

Bit 07, Reset
Bit 07='0': No reset.
Bit 07='1': Resets a trip. Reset is activated on the signal's leading edge, that is, when changing from logic '0' to logic '1'.

Bit 08, Jog
Bit 08='1': The output frequency is determined by *parameter 3-11 Jog Speed [Hz]*.

Bit 09, Selection of ramp 1/2
Bit 09="0": Ramp 1 is active (*parameter 3-41 Ramp 1 Ramp Up Time* to *parameter 3-42 Ramp 1 Ramp Down Time*).
Bit 09="1": Ramp 2 (*parameter 3-51 Ramp 2 Ramp Up Time* to *parameter 3-52 Ramp 2 Ramp Down Time*) is active.

Bit 10, Data not valid/Data valid
Tell the frequency converter whether to use or ignore the control word.
Bit 10='0': The control word is ignored.
Bit 10='1': The control word is used. This function is relevant because the telegram always contains the control word, regardless of the telegram type. Turn off the control word if not wanting to use it when updating or reading parameters.

Bit 11, Relay 01
Bit 11="0": Relay not activated.
Bit 11="1": Relay 01 activated provided that *Control word bit 11=36* is chosen in *parameter 5-40 Function Relay*.

Bit 12, Relay 02
Bit 12="0": Relay 02 is not activated.
Bit 12="1": Relay 02 is activated provided that *Control word bit 12=37* is chosen in *parameter 5-40 Function Relay*.

Bit 13, Selection of set-up
Use bit 13 to select from the 2 menu set-ups according to *Table 3.27*.

Set-up	Bit 13
1	0
2	1

The function is only possible when *Multi Set-Ups=9* is selected in *parameter 0-10 Active Set-up*.

Make a selection in *parameter 8-55 Set-up Select* to define how Bit 13 gates with the corresponding function on the digital inputs.

Bit 15 Reverse
Bit 15='0': No reversing.
Bit 15='1': Reversing. In the default setting, reversing is set to digital in *parameter 8-54 Reversing Select*. Bit 15 causes reversing only when Serial communication, Logic or Logic and is selected.

3.11.2 Status Word According to FC Profile (STW) (*8-30 Protocol* = FC profile)

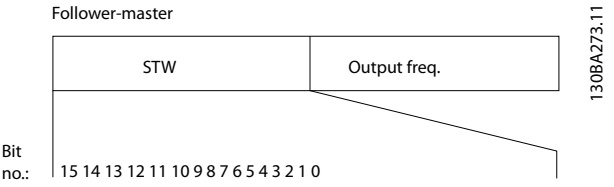


Illustration 3.21 Status Word

3

Bit	Bit=0	Bit=1
00	Control not ready	Control ready
01	Drive not ready	Drive ready
02	Coasting	Enable
03	No error	Trip
04	No error	Error (no trip)
05	Reserved	-
06	No error	Triplock
07	No warning	Warning
08	Speed ≠ reference	Speed=reference
09	Local operation	Bus control
10	Out of frequency limit	Frequency limit OK
11	No operation	In operation
12	Drive OK	Stopped, auto start
13	Voltage OK	Voltage exceeded
14	Torque OK	Torque exceeded
15	Timer OK	Timer exceeded

Table 3.27 Status Word According to FC Profile

Explanation of the status bits

Bit 00, Control not ready/ready
Bit 00='0': The frequency converter trips.
Bit 00='1': The frequency converter controls are ready but the power component does not necessarily receive any power supply (in case of external 24 V supply to controls).

Bit 01, Drive ready
Bit 01='0': The frequency converter is not ready.

Bit 01='1': The frequency converter is ready for operation but the coasting command is active via the digital inputs or via serial communication.

Bit 02, Coasting stop
Bit 02='0': The frequency converter releases the motor.
Bit 02='1': The frequency converter starts the motor with a start command.

Bit 03, No error/trip
Bit 03='0' : The frequency converter is not in fault mode.
Bit 03='1': The frequency converter trips. To re-establish operation, press [Reset].

Bit 04, No error/error (no trip)
Bit 04='0': The frequency converter is not in fault mode.
Bit 04='1': The frequency converter shows an error but does not trip.

Bit 05, Not used
Bit 05 is not used in the status word.

Bit 06, No error / triplock
Bit 06='0': The frequency converter is not in fault mode. Bit 06="1": The frequency converter is tripped and locked.

Bit 07, No warning/warning
Bit 07='0': There are no warnings.
Bit 07='1': A warning has occurred.

Bit 08, Speed≠ reference/speed=reference
Bit 08='0': The motor is running but the present speed is different from the preset speed reference. It might for example, be the case when the speed ramps up/down during start/stop.
Bit 08='1': The motor speed matches the preset speed reference.

Bit 09, Local operation/bus control
Bit 09='0': [Off/Reset] is activate on the control unit or *Local control* in *3-13 Reference Site* is selected. It is not possible to control the frequency converter via serial communication.
Bit 09='1' It is possible to control the frequency converter via the fieldbus/serial communication.

Bit 10, Out of frequency limit
Bit 10='0': The output frequency has reached the value in *parameter 4-12 Motor Speed Low Limit [Hz]* or *parameter 4-14 Motor Speed High Limit [Hz]*.
Bit 10="1": The output frequency is within the defined limits.

Bit 11, No operation/in operation
Bit 11='0': The motor is not running.
Bit 11='1': The coasting has a start signal or the output frequency is greater than 0 Hz.

Bit 12, Drive OK/stopped, autostart
Bit 12='0': There is no temporary over temperature on the inverter.
Bit 12='1': The inverter stops because of over temperature but the unit does not trip and resumes operation once the over temperature stops.

Bit 13, Voltage OK/limit exceeded
Bit 13='0': There are no voltage warnings.
Bit 13='1': The DC voltage in the frequency converter's intermediate circuit is too low or too high.

Bit 14, Torque OK/limit exceeded
Bit 14='0': The motor current is lower than the torque limit selected in *parameter 4-18 Current Limit*.
Bit 14='1': The torque limit in *parameter 4-18 Current Limit* is exceeded.

Bit 15, Timer OK/limit exceeded
Bit 15='0': The timers for motor thermal protection and thermal protection are not exceeded 100%.
Bit 15='1': One of the timers exceeds 100%.

3.11.3 Bus Speed Reference Value

Speed reference value is transmitted to the frequency converter in a relative value in %. The value is transmitted in the form of a 16-bit word; in integers (0-32767) the value 16384 (4000 Hex) corresponds to 100%. Negative figures are formatted by means of 2's complement. The Actual Output frequency (MAV) is scaled in the same way as the bus reference.

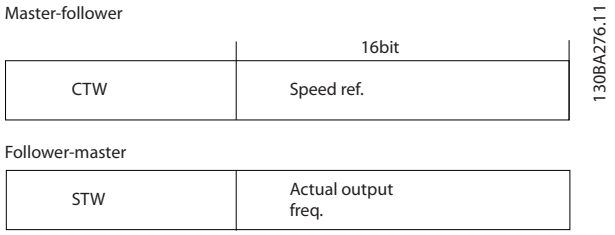


Illustration 3.22 Actual Output Frequency (MAV)

The reference and MAV are scaled as follows:

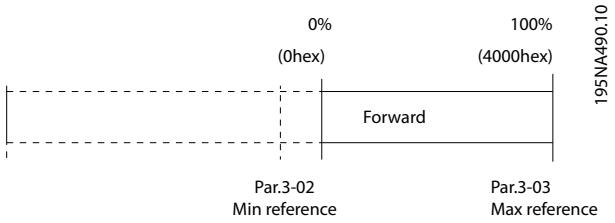


Illustration 3.23 Reference

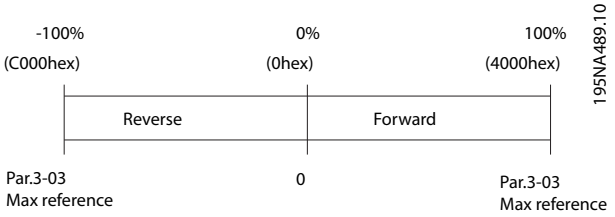


Illustration 3.24 MAV when Par.*parameter 1-00 Configuration Mode* is set to *[0] Open Loop*

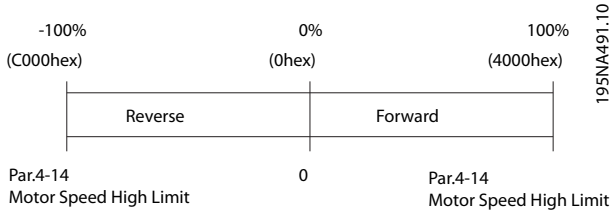


Illustration 3.25 MAV when Par. *parameter 1-00 Configuration Mode* is set to *[3] Closed Loop*

4 Parameters

4.1 Main Menu - Operation and Display - Group 0

Parameters related to the fundamental functions of the frequency converter, function of the LCP keys and configuration of the LCP display.

4

4.1.1 0-0* Basic Settings

0-01 Language		
Option:		**Function:**
		Defines the language to be used in the display.
[0] *	English	
[1]	Deutsch	
[2]	Francais	
[3]	Dansk	
[4]	Spanish	
[5]	Italiano	
[28]	Bras.port	
[255]	No Text	

0-03 Regional Settings		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.** To meet the needs for different default settings in different parts of the world, *parameter 0-03 Regional Settings* is implemented in the frequency converter. The selected setting influences the default setting of the motor nominal frequency.
[0]	International	Sets default value of *parameter 1-23 Motor Frequency* [50 Hz].
[1]	North America	Sets the default value of *parameter 1-23 Motor Frequency* to 60 Hz.

0-04 Operating State at Power-up		
Option:		**Function:**
		Select the operating mode upon reconnection of the frequency converter to mains voltage after power down when operating in Hand (local) mode.
[0] *	Resume	Resumes operation of the frequency converter maintaining the same local reference and the same start/stop condition (applied by [Hand On]/[Off] on the LCP or Hand Start via a digital input as before the frequency converter was powered down.
[1]	Forced stop, ref=old	Uses saved reference [1] to stop the frequency converter but at the same time retain the local speed reference in memory before powering down. After mains voltage is reconnected and after receiving a start command (pressing [Hand On] key or using her Hand Start command via a digital input) the frequency converter restarts and operates at the retained speed reference.

0-06 GridType		
Option:		**Function:**
		Select the grid type of the supply voltage/frequency. ***NOTICE*** **Not all choices are supported in all power sizes.** IT grid is a supply mains, where there are no connections to ground. Adjust the position of the RFI switch to match the grid type (refer to*VLT® DriveMotor FCP 106 and FCM 106 Operating Instructions*) Delta is a supply mains where the secondary part of the transformer is delta connected and one phase is connected to ground.
[10]	380-440V/ 50Hz/IT-grid	
[11]	380-440V/50Hz/ Delta	
[12]	380-440V/50Hz	
[20]	440-480V/ 50Hz/IT-grid	
[21]	440-480V/50Hz/ Delta	
[22]	440-480V/50Hz	
[110]	380-440V/ 60Hz/IT-grid	
[111]	380-440V/60Hz/ Delta	
[112]	380-440V/60Hz	
[120]	440-480V/ 60Hz/IT-grid	
[121]	440-480V/60Hz/ Delta	

0-06 GridType		
Option:		**Function:**
[122]	440-480V/60Hz	

0-07 Auto DC Braking		
Option:		**Function:**
		Protective function against overvoltage at coast. ***NOTICE*** **Can cause PWM when coasted.**
[0]	Off	Function is not active.
[1] *	On	Function is active.

4.1.2 0-1* Define and Set Up Operations

A complete set of all parameters controlling the frequency converter is called a set-up. The frequency converter contains 2 set-ups: Set-up1 and Set-up2. Furthermore, a fixed set of factory settings can be copied into one or more set-ups.

Some of the advantages of having more than one set-up in the frequency converter are:

- Run motor in one set-up (Active Set-up) while updating parameters in another set-up (Edit Set-up)
- Connect various motors (one at a time) to frequency converter. Motor data for various motors can be placed in different set-ups.
- Rapidly change settings of frequency converter and/or motor while motor is running e.g. Ramp time or preset references) via bus or digital inputs.

The Active Set-up can be set as Multi Set-up, where the active set-up is selected via input on a digital input terminal and/or via the bus control word.

Use *parameter 0-51 Set-up Copy* to copy a set-up to the other set-ups. To avoid conflicting settings of the same parameter within 2 different set-ups, link the set-ups together using *parameter 0-12 Link Setups*. Stop the frequency converter before switching between set-ups where parameters marked 'not changeable during operation' have different values.
Parameters which are 'not changeable during operation' are marked FALSE in *chapter 6 Parameter Lists*.

0-10 Active Set-up		
Option:		**Function:**
		Select the set-up in which the frequency converter is to operate.
[1] *	Set-up 1	Set-up 1 is active.
[2]	Set-up 2	Set-up 2 is active.
[9]	Multi Set-up	Is used for remote selection of set-ups using digital inputs and the serial communication port. This set-up uses the settings from *parameter 0-12 Link Setups*.

0-11 Programming Set-up		
Option:		**Function:**
		The number of the set-up being edited is displayed in the LCP, flashing.
[1]	Set-up 1	Edit *Set-up 1*
[2]	Set-up 2	Edit *Set-up 2*
[9] *	Active Set-up	Edit parameters in the set-up selected via digital I/Os

0-12 Link Setups		
Option:		**Function:**
		If the set-ups are not linked, a change between them is not possible while the motor is running.
[0]	Not linked	When selecting a different setup for operation, the set-up change does not occur until the motor is coasted
[20] *	Linked	Copies "not changeable during operation" parameters from one set-up to the other. It is possible to switch set-up while the motor is running.

4.1.3 0-3* LCP Custom Readout and Display Text

It is possible to customise the display elements for various purposes.

Custom Readout
The calculated value to be displayed is based on settings in *parameter 0-30 Custom Readout Unit*, *parameter 0-31 Custom Readout Min Value* (linear only), *parameter 0-32 Custom Readout Max Value*, *parameter 4-14 Motor Speed High Limit [Hz]* and actual speed.

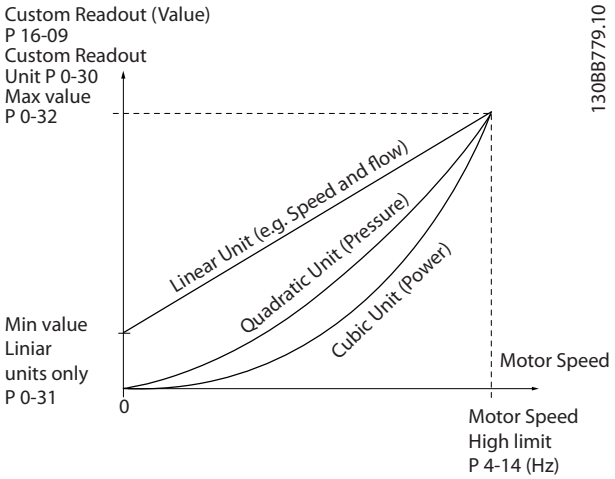


Illustration 4.1 Custom Readout

The relation depends on the type of unit selected in *parameter 0-30 Custom Readout Unit*:

Unit Type	Speed Relation
Dimensionless	Linear
Speed	
Flow, volume	
Flow, mass	
Velocity	
Length	
Temperature	
Pressure	Quadratic
Power	Cubic

Table 4.1 Relation

0-30 Custom Readout Unit

Option:		Function:
		Program a value to be shown in the display of the LCP. The value has a linear, squared or cubed relation to speed. This relation depends on the unit selected (see table above). The actual calculated value can be read in *parameter 16-09 Custom Readout*.
[0]	None	
[1] *	%	
[5]	PPM	
[10]	l/Min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m3/s	
[24]	m3/min	
[25]	m3/h	

0-30 Custom Readout Unit

Option:		Function:
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	Degree Celsius	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m Wg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[127]	ft3/h	
[140]	ft/s	
[141]	ft/min	
[160]	Degree Fahr	
[170]	psi	
[171]	lb/in2	
[172]	in WG	
[173]	ft WG	
[180]	hp	

0-31 Custom Readout Min Value

Range:		Function:
0 CustomReadoutUnit*	[0 - 999999.99 CustomReadoutUnit]	This parameter allows the choice of the min. value of the custom defined readout (occurs at zero speed). It is only possible to select a value different to 0 when selecting a linear unit in *parameter 0-30 Custom Readout Unit*. For Quadratic and Cubic units the minimum value is 0.

0-32 Custom Readout Max Value

Range:		Function:
100 CustomReadoutUnit*	[0.0 - 999999.99 CustomReadoutUnit]	This parameter sets the max value to be shown when the speed of the motor has reached the set value for *parameter 4-14 Motor Speed High Limit [Hz]*.

0-37 Display Text 1		
Range:	**Function:**	
	[0 - 0]	In this parameter it is possible to write an individual text string to be read via serial communication. Only used when running BACnet.

0-38 Display Text 2		
Range:	**Function:**	
	[0 - 0]	In this parameter it is possible to write an individual text string to be read via serial communication. Only used when running BACnet.

0-39 Display Text 3		
Range:	**Function:**	
	[0 - 0]	In this parameter it is possible to write an individual text string to be read via serial communication. Only used when running BACnet.

4.1.4 0-4* LCP

Enable, disable and password protect individual keys on the LCP.

0-40 [Hand on] Key on LCP		
Option:		**Function:**
[0]	Disabled	Select *[0] Disabled* to avoid accidental start of the frequency converter in Hand Mode.
[1] *	Enabled	[Hand On] is enabled.

0-42 [Auto on] Key on LCP		
Option:		**Function:**
[0]	Disabled	Select *[0] Disabled* to avoid accidental start of the frequency converter from LCP.
[1] *	Enabled	[Auto On] is enabled.

0-44 [Off/Reset] Key on LCP		
Option:		**Function:**
[0]	Disabled	
[1] *	Enabled	
[7]	Enable Reset Only	

4.1.5 0-5* Copy/Save

Copy parameter settings between set-ups and to/from the LCP.

0-50 LCP Copy		
Option:		**Function:**
[0] *	No copy	
[1]	All to LCP	Copies all parameters in all set-ups from the frequency converter memory to the LCP memory. For service purposes it is recommended to copy all parameters to the LCP after commissioning.
[2]	All from LCP	Copies all parameters in all set-ups from the LCP memory to the frequency converter memory.
[3]	Size indep. from LCP	Copies only the parameters that are independent of the motor size. The latter selection can be used to programme several frequency converters with the same function without disturbing motor data which are already set.

0-51 Set-up Copy		
Option:		**Function:**
[0] *	No copy	No function
[1]	Copy from setup 1	Copy from setup 1 to setup 2.
[2]	Copy from setup 2	Copy from setup 2 to setup 1.
[9]	Copy from Factory setup	Copy factory setting to programming setup (selected in *parameter 0-11 Programming Set-up*).

4.1.6 0-6* Password

0-60 Main Menu Password		
Range:		**Function:**
0*	[0 - 999]	Define the password for access to the Main Menu via the [Main Menu] key. Setting value to 0 disables the password-function.

4.2 Main Menu - Load and Motor - Group 1

Parameters related to the motor nameplate load compensations and application load type.

4.2.1 1-0* General Settings

4

1-00 Configuration Mode

Option:		Function:
[0] *	Open Loop	***NOTICE*** **This parameter cannot be adjusted when motor is running.** ***NOTICE*** **When set for Closed Loop, the commands Reversing and Start Reversing do not reverse the direction of the motor.** Motor speed is determined by applying a speed reference or by setting desired speed when in Hand Mode. Open Loop is also used if the frequency converter is part of a closed loop control system based on an external PI controller providing a speed reference signal as output.
[3]	Closed Loop	Motor Speed is determined by a reference from the built-in PI controller varying the motor speed as of a closed loop control process (e.g. constant pressure or flow). The PI controller must be configured in parameter group *20-** Drive Closed Loop*.

1-01 Motor Control Principle

Option:		Function:
[0]	U/f	Is used for parallel connected motors and/or special motor applications. The U/f settings are set in *1-55 U/f Characteristic - U* and *1-56 U/f Characteristic - F*. ***NOTICE*** **When running U/f control slip and load compensations are not included.**
[1] *	VVC+	Normal running mode, including slip- and load compensations. ***NOTICE*** **When 1-10 = [1] PM, only VVC^{plus} option is available.**

1-03 Torque Characteristics

Option:		Function:
[1] *	Variable Torque	For speed control of centrifugal pumps and fans. Also to be used when controlling more than one motor from the same frequency converter (e.g. multiple condenser fans or cooling tower fans). Provides a voltage which is optimised for a squared torque load characteristic of the motor.
[3]	Auto Energy Optim.	For optimum energy efficient speed control of centrifugal pumps and fans. Provides a voltage which is optimised for a squared torque load characteristic of the motor but in addition the AEO feature adapts the voltage exactly to the current load situation, thereby reducing energy consumption and audible noise from the motor.

1-06 Clockwise Direction

Option:		Function:
		NOTICE **This parameter cannot be adjusted while the motor is running.** This parameter defines the term "Clockwise" corresponding to the LCP direction arrow. Used for easy change of direction of shaft rotation without swapping motor wires.
[0] *	Normal	Motor shaft turns in clockwise direction when frequency converter is connected U→U; V→V, and W→W to motor.
[1]	Inverse	Motor shaft turns in counter-clockwise direction when frequency converter is connected U→U; V→V, and W→W to motor.

1-08 Motor Control Bandwidth

Option:		Function:
[0]	High	High dynamic response.
[1]	Medium	Optimized for smooth steady-state operation.
[3]	Adaptive 1	Optimized for smooth steady-state operation, with additional active damping.

4.2.2 1-10 - 1-12 Motor Selection

NOTICE

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

The following parameters are active ('x') depending on the setting of *1-10 Motor Construction*

1-10 Motor Construction	[0] Asynchron	[1] PM Motor non salient
1-00 Configuration Mode	x	x
1-03 Torque Characteristics	x	
1-06 Clockwise Direction	x	x
1-14 Damping Gain		x
1-15 Low Speed Filter Time Const.		x
1-16 High Speed Filter Time Const.		x
1-17 Voltage filter time const.		x
1-20 Motor Power [kW]	x	
1-22 Motor Voltage	x	
1-23 Motor Frequency	x	x
1-24 Motor Current	x	x
1-25 Motor Nominal Speed	x	x
parameter 1-26 Motor Cont. Rated Torque		x
parameter 1-29 Automatic Motor Adaption (AMA)	x	x
1-30 Stator Resistance (Rs)	x	x
1-33 Stator Leakage Reactance (X1)	x	
1-35 Main Reactance (Xh)	x	
1-37 d-axis Inductance (Ld)		x
1-39 Motor Poles	x	x
1-40 Back EMF at 1000 RPM		x
1-52 Min Speed Normal Magnetising [Hz]	x	
1-60 Low Speed Load Compensation	x	
1-61 High Speed Load Compensation	x	
1-62 Slip Compensation	x	
1-63 Slip Compensation Time Constant	x	
1-64 Resonance Dampening	x	
1-65 Resonance Dampening Time Constant	x	
1-66 Min. Current at Low Speed		x
1-71 Start Delay	x	x
1-72 Start Function	x	x
1-73 Flying Start	x	x
1-80 Function at Stop	x	x
1-82 Min Speed for Function at Stop [Hz]	x	x
parameter 1-90 Motor Thermal Protection	x	x
2-00 DC Hold Current	x	
2-01 DC Brake Current	x	
2-02 DC Braking Time	x	
2-04 DC Brake Cut In Speed [Hz]	x	
2-06 Parking Current		x
parameter 2-07 Parking Time		x
2-10 Brake Function	x	x
2-16 AC brake Max. Current	x	
2-17 Over-voltage Control	x	x
4-10 Motor Speed Direction	x	x
4-12 Motor Speed Low Limit [Hz]	x	x
4-14 Motor Speed High Limit [Hz]	x	x
4-18 Current Limit	x	x
4-19 Max Output Frequency	x	x
4-58 Missing Motor Phase Function	x	x
14-40 VT Level	x	
14-41 AEO Minimum Magnetisation	x	
parameter 30-22 Locked Rotor Detection		x
parameter 30-23 Locked Rotor Detection Time [s]		x

Table 4.2 Parameters Activated by Setting of*1-10 Motor Construction*

1-10 Motor Construction

Select the motor construction type. Other parameters will be changed when changing motor type selection

Option:		Function:
[0] *	Asynchron	For asynchronous motors.
[1]	PM, non salient SPM	For permanent magnet (PM) motors with surface mounted (non salient) magnets. Refer to parameters 1-14 to 1-17 for optimising the motor operation

NOTICE

Motor construction can either be asynchronous or permanent magnet (PM) motor, non-salient SPM.

1-11 Motor Selection

Option:		Function:
[0]	Default Motor Selection	Automatically sets the manufacturer's settings for the selected motor. Setting the parameter value might change these parameters. Other parameters will also change, when changing motor type selection

1-12 Motor ID

Range:		Function:
Default Motor *	[0 - 0]	Displays motor name according to the selected motor in par.1-11 Motor Selection

4.2.3 1-14 to 1-17 VVC^{plus} PM

The default control parameters for VVC^{plus} PM motor control core are optimised for HVAC applications and inertia load in range of 50>Jl/Jm>5, were Jl is load inertia from the application and jm is machine inertia.
For low inertia applications Jl/Jm<5 it is recommended that *1-17 Voltage filter time const.* is increased with a factor of 5-10 and in some cases *1-14 Damping Gain* should also be reduced to improve performance and stability.
For high inertia applications Jl/Jm>50 it is recommended that *1-15 Low Speed Filter Time Const.*, *1-16 High Speed Filter Time Const.* and*1-14 Damping Gain* are increased to improve performance and stability.
For high load at low speed [<30% of rated speed] it is recommended that *1-17 Voltage filter time const.* is increased due to nonlinearity in the inverter at low speed.

1-14 Damping Gain		
Range:		**Function:**
120 %*	[0 - 250 %]	The parameter stabilises the PM motor to ensure smooth and stable operation. The value of damping gain controls the dynamic performance of the PM motor. Low damping gain results in high dynamic performance and a high value results in a low dynamic performance. The dynamic performance is related to the motor data and load type. If the damping gain is too high or low, the control becomes unstable.

1-15 Low Speed Filter Time Const		
Range:		**Function:**
Size related*	[0.01 - 20 s]	High pass-filter damping time constant determines the response time to load steps. Obtain quick control through a short damping time constant. However, if this value is too short, the control gets unstable. This time constant is used below 10% rated speed.

1-16 High Speed Filter Time Const		
Range:		**Function:**
Size related*	[0.01 - 20 s]	High pass-filter damping time constant determines the response time to load steps. Obtain quick control through a short damping time constant. However, if this value is too short, the control gets unstable. This time constant is used above 10% rated speed.

1-17 Voltage filter time const		
Range:		**Function:**
Size related*	[0.01 - 1 s]	Machine Supply Voltage Filter Time constant is used for reducing the influence of high frequency ripples and system resonances in the calculation of machine supply voltage. Without this filter, the ripples in the currents can distort the calculated voltage and affects the stability of the system.

4.2.4 1-2* Motor Data

This parameter group comprises input data from the nameplate on the connected motor.

NOTICE

Changing the value of these parameters affects the setting of other parameters.

1-20 Motor Power		
Enter the nominal motor power in kW/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.		
Option:		**Function:**
[3]	0.18 kW - 0.25 hp	
[4]	0.25 kW - 0.33 hp	
[5]	0.37 kW - 0.5 hp	
[6]	0.55 kW - 0.75 hp	
[7]	0.75 kW - 1 hp	
[8]	1.1 kW - 1 hp	
[9]	1.5 kW - 2 hp	
[10]	2.2 kW - 3 hp	
[11]	3 kW - 4 hp	
[12]	3.7 kW - 5 hp	
[13]	4 kW - 5.4 hp	
[14]	5.5 kW - 7.5 hp	
[15]	7.5 kW - 10 hp	
[16]	11 kW - 15 hp	
[17]	15 kW - 20 hp	
[18]	18.5 kW - 25 hp	
[19]	22 kW - 30 hp	
[20]	30 kW - 40 hp	

1-22 Motor Voltage		
Range:		**Function:**
Size related*	[50.0 - 1000.0 V]	Enter the nominal motor voltage according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit.

1-23 Motor Frequency		
Range:		**Function:**
Size related*	[20 - 400 Hz]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** 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 *parameter 4-14 Motor Speed High Limit [Hz]* and *parameter 3-03 Maximum Reference* to the 87 Hz application.

1-24 Motor Current		
Range:		**Function:**
Size related*	[0.01 - 26.0 A]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the nominal motor current value from the motor nameplate data. This data is used for calculating motor torque, motor thermal protection etc.

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

1-26 Motor Cont. Rated Torque		
Range:		**Function:**
Size related*	[0.1 - 10000 Nm]	***NOTICE*** **Changing this parameter affects settings of other parameters.** This parameter is available only when *1-10 Motor Construction* is set to *[1] PM, non-salient SPM*.

1-29 Automatic Motor Adaption (AMA)		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.** The AMA function optimises dynamic motor performance by automatically optimising the advanced motor *parameter 1-30 Stator Resistance (Rs)* to *parameter 1-35 Main Reactance (Xh)* while the motor is stationary.
[0] *	Off	No function
[1]	Enable Complete AMA	Performs AMA of the stator resistance R_S, the stator leakage reactance X_1 and the main reactance X_h. ***NOTICE*** **Terminal 27 Digital Input (*parameter 5-12 Terminal 27 Digital Input*) has coast inverse as default setting. This means that AMA cannot be performed if there is no 24 V to terminal 27.**
[2]	Enable Reduced AMA	Performs a reduced AMA of the stator resistance R_s in the system only. Select this option if an LC filter is used between the frequency converter and the motor.

NOTICE

When *1-10 Motor Construction* is set to *[1] PM, non-salient SPM*, the only option available is *[1] Enable Complete AMA*.

Activate the AMA function by pressing [Hand On] after selecting [1] or [2]. After a normal sequence, the display reads: "Press [OK] to finish AMA". After pressing [OK], the frequency converter is ready for operation.

NOTICE

- **For the best adaptation of the frequency converter, run AMA on a cold motor**
- **AMA cannot be performed while the motor is running**
- **AMA can not be performed on a motor with a bigger power rating than the frequency converter, e.g. when a 5.5 kW motor is connected to a 4 kW frequency converter.**

NOTICE

Avoid generating external torque during AMA.

NOTICE

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

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NOTICE

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

1-30 Stator Resistance (Rs)		
Range:		**Function:**
Size related*	[0.0 - 99.99 Ohm]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Set the stator resistance value. Enter the value from a motor data sheet or perform an AMA on a cold motor.

1-33 Stator Leakage Reactance (X1)		
Range:		**Function:**
Size related*	[0.0 - 999.9 Ohm]	Set stator leakage reactance of motor.

1-35 Main Reactance (Xh)		
Range:		**Function:**
Size related*	[0.0 - 999.9 Ohm]	Set the main reactance of the motor using one of these methods: 1. Run an AMA on a cold motor. The frequency converter measures the value from the motor. 2. Enter the X_h value manually. Obtain the value from the motor supplier. 3. Use the X_h default setting. The frequency converter establishes the setting on the basis of the motor name plate data.

1-37 d-axis Inductance (Ld)		
Range:		**Function:**
Size related*	[0.000 - 0.000 mH]	***NOTICE*** **This parameter is only active when *1-10 Motor Construction* has the value PM, non-salient SPM [1] (Permanent Magnet Motor).** Enter the value of the d-axis inductance. Obtain the value from the PM motor data sheet.

Stator resistance and d-axis Inductance values are normally, for asynchronous motors, described in technical specifications as between line and common (starpoint). For PM motors they are typically described in technical specifications as between Line-Line. PM motors are typically built for star connection.

1-30 Stator Resistance (Rs) (Line to common)	This parameter gives stator winding resistance (R_s) Similar to Asynchronous Motor Stator resistance. The Stator resistance is defined for line to common measurement. That means for line-line data, where stator resistance is measured between any 2 lines, divide by 2.
parameter 1-37 d-axis Inductance (Ld) (Line to common)	This parameter gives direct axis inductance of the PM motor. The d-axis inductance is defined for phase to common measurement. That means for line-line data, where stator resistance is measured between any 2 lines, divide by 2.
1-40 Back EMF at 1000 RPM RMS (Line to Line Value)	This parameter gives back EMF across stator terminal of PM Motor at 1000 RPM mechanical speed specifically. It is defined between line to line and expressed in RMS Value

Table 4.3 Parameters related to PM Motors

NOTICE

Motor manufacturers provide values for Stator resistance (*1-30 Stator Resistance (Rs)*) and d-axis Inductance (*parameter 1-37 d-axis Inductance (Ld)*) in technical specifications as between line and common (starpoint) or between Line-Line. There is no general standard. The different setups of Stator Winding Resistance and Induction are shown in *Illustration 4.2*. Danfoss inverters always require the line to common value. The back EMF of PM motor is defined as `Induced EMF developed across any of two phases of stator winding of free running Motor'. Danfoss inverters always require the Line to Line RMS value measured at 1000 rpm, mechanical speed of rotation. This is shown in *Illustration 4.3*)

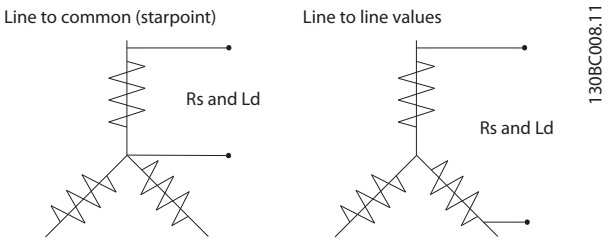

Illustration 4.2 Motor parameters are provided in different formats. Danfoss frequency converters always require the line to common value.

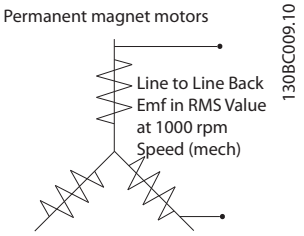

Illustration 4.3 Machine parameter definitions of Back EMF of permanent magnet motors

1-39 Motor Poles

Range:		Function:
4*	[2 - 100]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the number of motor poles. The motor pole value is always an even number, because it refers to the total number of poles, not pairs of poles.

1-40 Back EMF at 1000 RPM

Range:		Function:
Size related*	[10 - 9000 V]	Line-Line RMS back EMF voltage at 1000 RPM

1-50 Motor Magnetisation at Zero Speed

Range:		Function:
100 %*	[0 - 300.0 %]	Use this parameter along with *parameter 1-52 Min Speed Normal Magnetising [Hz]* to obtain a different thermal load on the motor when running at low speed. Enter a value which is a percentage of the rated magnetising current. If the setting is too low, the torque on the motor shaft may be reduced.

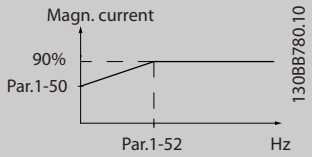

Illustration 4.4 Motor Magnetisation

1-52 Min Speed Normal Magnetising [Hz]

Range:		Function:
0 Hz*	[0 - 10.0 Hz]	Set the required frequency for normal magnetising current. Use this parameter along with *parameter 1-50 Motor Magnetisation at Zero Speed*. See *Illustration 4.4*.

1-55 U/f Characteristic - U

Range:		Function:
Size related*	[0 - 999 V]	Enter voltage at each frequency point to manually form a U/f characteristic matching motor. Frequency points are defined in *parameter 1-56 U/f Characteristic - F*.

1-56 U/f Characteristic - F

Range:		Function:
Size related*	[0 - 400.0 Hz]	Enter frequency points to manually form a U/f characteristic matching motor. Voltage at each point is defined in *parameter 1-55 U/f Characteristic - U*. Make a U/f characteristic based on 6 definable voltages and frequencies, see *Illustration 4.5*. Simplify U/f characteristics by merging 2 or more points (voltages and frequencies), respectively, are set equal.

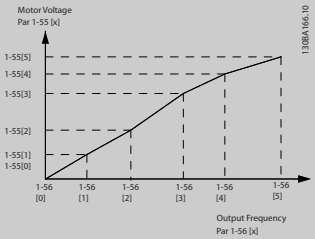

Illustration 4.5 U/f Characteristic

1-62 Slip Compensation

Range:		Function:
0 %*	[-400 - 399.0 %]	Enter the % value for slip compensation to compensate for tolerances in the value of $n_{M,N}$. Slip compensation is calculated automatically, i.e. on the basis of the rated motor speed $n_{M,N}$.

1-63 Slip Compensation Time Constant

Range:		Function:
0.1 s*	[0.05 - 5.00 s]	Enter the slip compensation reaction speed. A high value results in slow reaction, and a low value results in quick reaction. If low-frequency resonance problems arise, use a longer time setting.

1-64 Resonance Dampening

Range:		Function:
100 %*	[0 - 500 %]	Enter the resonance dampening value. Set *1-64 Resonance Dampening* and *1-65 Resonance Dampening Time Constant* to help eliminate high-frequency resonance problems. To reduce resonance oscillation,

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1-64 Resonance Dampening		
Range:		**Function:**
		increase the value of *1-64 Resonance Dampening*.

1-65 Resonance Dampening Time Constant		
Range:		**Function:**
0.005 s*	[0.001 - 0.05 s]	Set *1-64 Resonance Dampening* and *1-65 Resonance Dampening Time Constant* to help eliminate high-frequency resonance problems. Enter the time constant that provides the best dampening.

1-66 Min. Current at Low Speed		
Range:		**Function:**
50 %*	[0 - 120 %]	Applies to PM motors only. Increasing the minimum current improves motor torque at low speed, but also reduces efficiency.

1-71 Start Delay		
Range:		**Function:**
0 s*	[0 - 10 s]	This parameter enables a delay of the starting time. The frequency converter begins with the start function selected in *parameter 1-72 Start Function*. Set the start delay time until acceleration is to begin.

1-72 Start Function		
Option:		**Function:**
[0]	DC Hold/ delay time	Motor is energised with *parameter 2-00 DC Hold/Motor Preheat Current* during start delay time.
[2] *	Coast/delay time	Inverter is coasted during start delay time (inverter off).

1-73 Flying Start		
Option:		**Function:**
		This function makes it possible to catch a motor which is spinning freely due to a mains drop-out. Flying start searches in clockwise direction only. If not successful, a DC brake is activated. If PM motor is selected, Parking is carried out if the speed is below 2.5-5%, in the time set in *parameter 2-07 Parking Time*.
[0]	Disabled	Select *[0] Disabled* if this function is not required
[1]	Enabled	

The flying start function used for PM motors is based on an initial speed estimation. The speed is always estimated as the first thing after an active start signal is given.

If the speed estimate comes out below 2.5%-5% of nominal speed, the parking function is engaged (see *2-06 Parking Current* and *parameter 2-07 Parking Time*). Otherwise, the frequency converter catches the motor at that speed and resumes normal operation.

Current limitations of the flying start principle used for PM motors:

- The speed range is up to 100% Nominal Speed or the field weakening speed (which ever is lowest).
- For high inertia applications (that is, where the load inertia is more than 30 times larger than the motor inertia).

1-80 Function at Stop		
Option:		**Function:**
		Select the drive function after a stop command or after the speed is ramped down to the settings in *1-82 Min Speed for Function at Stop [Hz]*. Function at Stop. Available selections depend on *1-10 Motor Construction*: [0] Asynchron: [0] coast [1] DC-hold [1] PM non salient: [0] coast
[0] *	Coast	Leaves motor in free mode.
[1]	DC hold / Motor Preheat	Energises motor with a DC holding current (see *parameter 2-00 DC Hold/Motor Preheat Current*).

1-82 Min Speed for Function at Stop [Hz]		
Range:		**Function:**
0 Hz*	[0 - 20 Hz]	Set the output frequency at which to activate *parameter 1-80 Function at Stop*.

1-90 Motor Thermal Protection		
Option:		**Function:**
		Using ETR (Electronic Thermal Relay), the motor temperature is calculated based on frequency, current and time. Danfoss recommends using the ETR function, if a thermistor is not present. The functionality is the same for asynchronous motors and PM motors. ***NOTICE*** **ETR calculation is based on motor data from group *1-2* Motor Data*.**
[0]	No protection	Disables temperature monitoring.

1-90 Motor Thermal Protection		
Option:		**Function:**
[1]	Thermistor warning	A thermistor gives a warning if upper limit of motor temperature range is exceeded,
[2]	Thermistor trip	A thermistor gives an alarm and makes the frequency converter trip if upper limit of motor temperature range is exceeded.
[3]	ETR warning 1	If calculated upper limit of motor temperature range is exceeded, a warning occurs.
[4]	ETR trip 1	If 90% of calculated upper limit of motor temperature range is exceeded, an alarm occurs and frequency converter trips.

4.3 Main Menu - Brakes - Group 2

2-00 DC Hold/Motor Preheat Current		
Range:		**Function:**
50 %*	[0 - 160 %]	Set holding current as a percentage of the rated motor current IM,N *1-24 Motor Current*. *parameter 2-00 DC Hold/Motor Preheat Current* holds the motor function (holding torque) or pre-heats the motor. This parameter is active if DC hold is selected in *parameter 1-72 Start Function* [0] or *parameter 1-80 Function at Stop* [1].

NOTICE

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

2-01 DC Brake Current		
Range:		**Function:**
50 %*	[0 - 150 %]	Set current as % of rated motor current, *1-24 Motor Current*. DC brake current is applied on stop command, when speed is below the limit set in *parameter 2-04 DC Brake Cut In Speed*; when the DC Brake Inverse function is active; or via the serial port. See *parameter 2-02 DC Braking Time* for duration.

NOTICE

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

2-02 DC Braking Time		
Range:		**Function:**
10 s*	[0 - 60 s]	Set the duration of the DC braking current set in *parameter 2-01 DC Brake Current*, once activated.

2-04 DC Brake Cut In Speed		
Range:		**Function:**
0 Hz*	[0 - 400 Hz]	This parameter is for setting the DC brake cut in speed at which the DC braking current *parameter 2-01 DC Brake Current* is to be active, in connection with a stop command.

NOTICE

2-01, 2-02 and 2-04 have no effect when *1-10 Motor Construction = [1] PM, non salient SPM*.

2-06 Parking Current		
Range:		**Function:**
100 %*	[0 - 150 %]	Set current as percentage of rated motor current, *1-24 Motor Current*. Active in connection with *parameter 1-73 Flying Start*. The parking current is active during the time period set in *parameter 2-07 Parking Time*. ***NOTICE*** ***2-06 Parking Current* is only active when PM motor construction is selected in *parameter 1-10 Motor Construction***

2-07 Parking Time		
Range:		**Function:**
3 s*	[0.1 - 60 s]	Set the duration of the parking current time set in *2-06 Parking Current*. Active in connection with *parameter 1-73 Flying Start*. ***NOTICE*** ***parameter 2-07 Parking Time* is only active when PM motor construction is selected in *parameter 1-10 Motor Construction***

4.3.1 2-1* Brake Energy Function

Parameter group for selecting dynamic braking parameters.

2-10 Brake Function		
Option:		**Function:**
[0] *	Off	No brake resistor installed.
[2]	AC brake	AC brake is active.

2-16 AC Brake, Max current		
Range:		**Function:**
100 %*	[0 - 150 %]	Enter the maximum permissible current when using AC brake to avoid overheating of motor windings.

2-17 Over-voltage Control		
Option:		**Function:**
		Select whether to enable OVC, which reduces the risk of drive trip due to over voltage on the DC link caused by generative power from load.
[0]	Disabled	No OVC required.
[2] *	Enabled	Activates OVC.

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NOTICE

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

4.3.2 2-2* Mechanical Brake

Parameters for setting the speed and current of the mechanical brake.

2-20 Release Brake Current		
Range:		**Function:**
0 A*	[0 - 100 A]	Set the motor current for release of the mechanical brake, when a start condition is present. The upper limit is specified in *16-37 Inv. Max. Current*.

2-22 Activate Brake Speed [Hz]		
Range:		**Function:**
0 Hz*	[0 - 400 Hz]	Set the motor frequency for activation of the mechanical brake, when a stop condition is present.

4.4 Main Menu - Reference/Ramps - Group 3

4.4.1 3-0* Reference Limits

Parameters for setting the reference unit, limits and ranges.

Also see parameter group *20-0* Feedback* for information on settings in closed loop.

3-02 Minimum Reference		
Range:		**Function:**
0 ReferenceFeedbackUnit*	[-4999.0 - 4999 ReferenceFeedbackUnit]	The Minimum Reference is the lowest value obtainable by summing all references.

3-03 Maximum Reference		
Range:		**Function:**
Size related*	[-4999.0 - 4999 ReferenceFeedbackUnit]	The maximum reference is the highest value obtainable by summing all references. The maximum reference unit matches the choice of configuration in *parameter 1-00 Configuration Mode*.

4.4.2 3-1* References

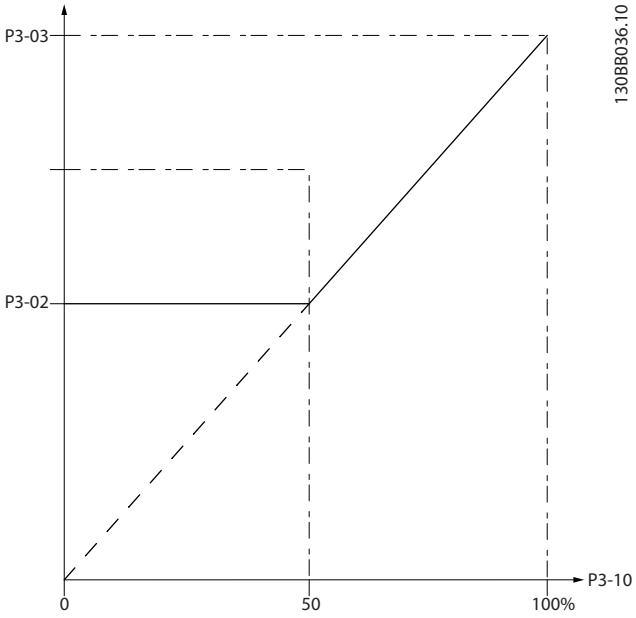
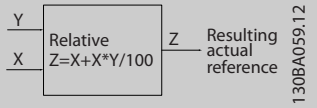


Illustration 4.6 References

3-10 Preset Reference		
Range:		**Function:**
0 %*	[-100 - 100 %]	Enter up to 8 different preset references (0-7) in this parameter, using array programming. Select Preset Reference bit 0/1/2 [16] , [17] or [18] for the corresponding digital inputs in parameter group *5-1* Digital Inputs*, for selecting dedicated references. See also *Table 4.5*

3-11 Jog Speed [Hz]		
Range:		**Function:**
5 Hz*	[0 - 400.0 Hz]	The jog speed is a fixed output speed at which the frequency converter is running when the jog function is activated. See also *parameter 3-80 Jog Ramp Time*.

3-14 Preset Relative Reference		
Range:		**Function:**
0 %*	[-100 - 100 %]	Define fixed value in % to be added to variable value defined in *3-18 Relative Scaling Reference Resource*, *Relative Scaling Reference Source*. The sum of fixed and variable values (labelled Y in *Illustration 4.7*) is multiplied with actual reference (labelled X in *Illustration 4.7*). This product is added to actual reference $X + X \times \frac{Y}{100}$

3-14 Preset Relative Reference		
Range:		**Function:**
		
		Illustration 4.7 Preset Relative Reference

3-15 Reference 1 Source		
Option:		**Function:**
		Select the input to be used for the first reference signal. *parameter 3-15 Reference 1 Source*, *parameter 3-16 Reference 2 Source* and *parameter 3-17 Reference 3 Source* define up to three different reference signals. The sum of these reference signals defines the actual reference.
[0]	No function	
[1] *	Analog in 53	
[2]	Analog in 54	
[7]	Pulse input 29	
[11]	Local bus reference	

3-16 Reference 2 Source		
Option:		**Function:**
		Select the input to be used for the second reference signal. *parameter 3-15 Reference 1 Source*, *parameter 3-16 Reference 2 Source* and *parameter 3-17 Reference 3 Source* define up to three different reference signals. The sum of these reference signals defines the actual reference. See also *1-93 Thermistor Source*.
[0]	No function	
[1]	Analog in 53	
[2] *	Analog in 54	
[7]	Pulse input 29	
[11]	Local bus reference	

3-17 Reference 3 Source		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.** Select the reference input to be used for the third reference signal. *parameter 3-15 Reference 1 Source*, *parameter 3-16 Reference 2 Source* and *parameter 3-17 Reference 3 Source* define up to 3 different reference signals. The sum of

3-17 Reference 3 Source		
Option:		**Function:**
		these reference signals defines the actual reference. The option *[1] PM* is not accessible, if *parameter 3-17 Reference 3 Source = [1] PM.*
[0]	No function	
[1]	Analog in 53	
[2]	Analog in 54	
[7]	Pulse input 29	
[11] *	Local bus reference	

4.4.3 3-4* Ramp 1

Configure the ramp parameter, ramping times, for each of the 2 ramps (parameter group *3-4* Ramp 1* and parameter group *3-5* Ramp 2*).

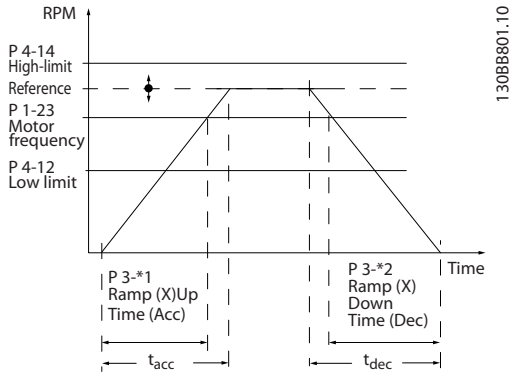


Illustration 4.8 Ramps

3-41 Ramp 1 Ramp Up Time		
Range:		**Function:**
Size related*	[0.05 - 3600 s]	Enter acceleration time from 0 Hz to *parameter 1-23 Motor Frequency* if Asynchronous motor is selected. Enter acceleration time from 0 RPM, to *parameter 1-25 Motor Nominal Speed* if PM motor is selected. Select a ramp-up time such that the output current does not exceed the current limit in *parameter 4-18 Current Limit* during ramping. See ramp down time in *3-42 Ramp 1 Ramp Down Time*.

3-42 Ramp 1 Ramp Down Time		
Range:		**Function:**
Size related*	[0.05 - 3600 s]	Enter deceleration time from *parameter 1-23 Motor Frequency* to 0 Hz if Asynchronous motor is selected. Enter deceleration time from *parameter 1-25 Motor Nominal Speed* to 0 RPM if PM motor is selected. Select a ramp-up time such that the output current does not exceed the current limit in *parameter 4-18 Current Limit* Current Limit during ramping. See ramp-up time in *3-41 Ramp 1 Ramp Up Time*.

4.4.4 3-5* Ramp 2

Selecting ramp parameters, see parameter group *3-4* Ramp 1*.

3-51 Ramp 2 Ramp Up Time		
Range:		**Function:**
Size related*	[0.05 - 3600 s]	Enter acceleration time from 0 Hz to *parameter 1-23 Motor Frequency* if asynchronous motor is selected. Enter acceleration time from 0 RPM to *parameter 1-25 Motor Nominal Speed* if PM motor is selected. Select a ramp-down time such that the output current does not exceed the current limit in *parameter 4-18 Current Limit* during ramping. See ramp-down time in *parameter 3-52 Ramp 2 Ramp Down Time*.

3-52 Ramp 2 Ramp Down Time		
Range:		**Function:**
Size related*	[0.05 - 3600 s]	Enter deceleration time from *parameter 1-23 Motor Frequency* to 0 Hz if asynchronous motor is selected. Enter deceleration time from *parameter 1-25 Motor Nominal Speed* to 0 RPM if PM motor is selected. Select a ramp-down time such that the output current does not exceed the current limit in *parameter 4-18 Current Limit* during ramping. See ramp-up time in *parameter 3-51 Ramp 2 Ramp Up Time*.

4.4.5 3-8* Other Ramps

3-80 Jog Ramp Time		
Range:		**Function:**
Size related*	[0.05 - 3600 s]	Enter the jog ramp time, i.e. the acceleration/deceleration time between 0 Hz to *parameter 1-23 Motor Frequency*. Ensure that the resultant output current required for the given jog ramp time does not exceed the current limit in *parameter 4-18 Current Limit*. The jog ramp time starts upon activation of a jog signal via the control panel, a selected

3-80 Jog Ramp Time		
Range:		**Function:**
		digital input, or the serial communication port.

3-81 Quick Stop Ramp Time		
Range:		**Function:**
Size related*	[0.05 - 3600 s]	Enter the quick stop ramp time from the *parameter 1-23 Motor Frequency* to 0 Hz. During ramping, no over-voltage may arise in the inverter, nor may the generated current exceed the limit in *parameter 4-18 Current Limit* is activated by means of a signal on a selected digital input or via the serial communication port.

4.5 Main Menu - Limits/Warnings - Group 4

4.5.1 4-1* Motor Limits

Define current and speed limits for the motor, and the reaction of the frequency converter when the limits are exceeded.

4-10 Motor Speed Direction		
Option:		**Function:**
[0]	Clockwise	Only operation in clockwise direction is allowed.
[2] *	Both directions	Operation in both clockwise and anti-clockwise direction are allowed.

NOTICE

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

4-12 Motor Speed Low Limit [Hz]		
Range:		**Function:**
0 Hz*	[0 - 400.0 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 *parameter 4-14 Motor Speed High Limit [Hz]*.

4-14 Motor Speed High Limit [Hz]		
Range:		**Function:**
65 Hz*	[0.1 - 400.0 Hz]	Enter the maximum limit for motor speed.*parameter 4-14 Motor Speed High Limit [Hz]* can be set to match the manufacturer's recommended max. motor speed. The Motor Speed High Limit must exceed the value in *parameter 4-12 Motor Speed Low Limit [Hz]*.

NOTICE

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

NOTICE

Motor Speed High Limit cannot be set higher than *parameter 4-19 Max Output Frequency*.

4-18 Current Limit		
Range:		**Function:**
110 %*	[0 - 300 %]	Enter the current limit for motor and generator operation (in % of rated motor current. If the value is higher than maximum rated output from frequency converter, current is still limited to the frequency converters maximum output current). If a setting in *parameter 1-00 Configuration Mode* to *parameter 1-25 Motor Nominal Speed* is changed, *parameter 4-18 Current Limit* is not automatically reset to the default setting.

4-19 Max Output Frequency		
Range:		**Function:**
Size related*	[0.0 - 400 Hz]	Enter the max. output frequency value. *parameter 4-19 Max Output Frequency* specifies the absolute limit on the frequency converter output frequency for improved safety in applications where accidental over-speeding must be avoided. This absolute limit applies to all configurations and is independent of the setting in *parameter 1-00 Configuration Mode*.

4.5.2 4-4* Adjustable Warnings 2

4-40 Warning Frequency Low		
Range:		**Function:**
0.00 Hz*	[0.0 Hz- Depend on the value of *4-41 Warning Frequency High*]	Use this parameter to set a lower limit for the frequency range. When the motor speed drops below this limit, the display reads SPEED LOW. Warning bit 10 is set in *16-94 Ext. Status Word*. Output Relay can be configured to indicate this warning. LCP warning light does not light when this parameter set limit is reached.

4-41 Warning Frequency High		
Range:		**Function:**
400.0 Hz*	[Depend on the value of *4-40 Warning Frequency Low* -400.0 Hz]	Use this parameter to set a higher limit for the frequency range. When the motor speed exceeds this limit, the display reads SPEED HIGH. Warning bit 9 is set in *16-94 Ext.*

4-41 Warning Frequency High		
Range:		**Function:**
		Status Word. Output Relay can be configured to indicate this warning. LCP warning light does not light when this parameter set limit is reached.

4

4.5.3 4-5* Adj. Warnings

Define adjustable warning limits for current. Warnings are shown on the display, programmed output or serial bus.

4-50 Warning Current Low		
Range:		**Function:**
0 A*	[0 - 194.0 A]	Enter the I_{LOW} value. When the motor current falls below this limit, a bit in the statusword is set. This value can also be programmed to produce a signal on the digital output or the relay output.

4-51 Warning Current High		
Range:		**Function:**
Size related*	[0.0 - 194.0 A]	Enter the I_{HIGH} value. When the motor current exceeds this limit, a bit in the statusword is set. This value can also be programmed to produce a signal on the digital output or the relay output.

4-54 Warning Reference Low		
Range:		**Function:**
-4999 *	[-4999 - 4999]	Enter the lower reference limit. When the actual reference falls below this limit, the display reads Ref_{LOW}. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-55 Warning Reference High		
Range:		**Function:**
4999.000*	[Depend on the value of *4-54 Warning Reference Low*- 4999.000]	Use this parameter to set a higher limit for the reference range. When the actual reference exceeds this limit, the display reads Reference High. Warning bit 19 is set in *16-94 Ext. Status Word*. Output Relay can be configured to indicate this warning. LCP warning light does not light when this parameter set limit is reached.

4-56 Warning Feedback Low		
Range:		**Function:**
-4999.000*	[-4999.000- Depend on the value of *4-57*	Use this parameter to set a lower limit for the feedback range.

4-56 Warning Feedback Low		
Range:		**Function:**
	Warning Feedback High]	When the feedback falls below this limit, the display reads Feedback Low. Warning bit 6 is set in *16-94 Ext. Status Word*. Output Relay can be configured to indicate this warning. LCP warning light does not light when this parameter set limit is reached.

4-57 Warning Feedback High		
Range:		**Function:**
4999.000*	[Depend on the value of *4-56 Warning Feedback Low* -4999.000]	Use this parameter to set a higher limit for the feedback range. When the feedback exceeds this limit, the display reads Feedback High. Warning bit 5 is set in *16-94 Ext. Status Word*. Output Relay can be configured to indicate this warning. LCP warning light does not light when this parameter set limit is reached.

4-58 Missing Motor Phase Function		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running. Missing Motor Phase Function is always disabled with PM.** Select On, to display an alarm in the event of a missing motor phase. Select Off, for no missing motor phase alarm. However the On setting is strongly recommended to avoid motor damage.
[0]	Off	No alarm is displayed if a missing motor phase occurs.
[1] *	On	An alarm is displayed if a missing motor phase occurs.

4.5.4 4-6* Speed Bypass

Define the Speed Bypass areas for the ramps. Some systems call for avoiding certain output frequencies or speeds, due to resonance problems in the system. 3 frequency ranges can be avoided.

4-61 Bypass Speed From [Hz]		
Range:		**Function:**
0 Hz*	[0 - 500 Hz]	Some systems call for avoiding certain output speeds due to resonance problems in the system. Enter the lower limits of the speeds to be avoided.

4-63 Bypass Speed To [Hz]		
Range:		**Function:**
0 Hz*	[0 - 500 Hz]	Some systems call for avoiding certain output speeds due to resonance problems in the system. Enter the upper limits of the speeds to be avoided.

4.5.5 Semi-Automatic Bypass Speed Set-up

Use the Semi-Automatic Bypass Speed Set-up to facilitate the programming of the frequencies to be skipped due to resonances in the system.

Procedure:

1. Stop the motor.

NOTICE

Smaller frequency converters have a ramp time of 3 seconds which can make it difficult to set the bypass speeds. Adjust the ramp times in *parameter 3-41 Ramp 1 Ramp Up Time* and *parameter 3-42 Ramp 1 Ramp Down Time*.

2. Select *[1] Enabled* in *parameter 4-64 Semi-Auto Bypass Set-up*.
3. Press [Hand On] to start the search for frequency bands causing resonances. The motor ramps up according to the ramp set.

NOTICE

Terminal 27 Digital Input *parameter 5-12 Terminal 27 Digital Input* has coast inverse as default setting. This means that [Hand On] does not start the motor if there is no 24 V to terminal 27, so connect terminal 12 to terminal 27.

4. When sweeping through a resonance band, press [OK] on the LCP when leaving the band. The actual frequency is stored as the first element in *4-63 Bypass Speed To [Hz]* (array). Repeat this for each resonance band identified at the ramp-up (maximum of 3 can be adjusted).
5. When maximum speed has been reached, the motor automatically begins to ramp down. Repeat the above procedure when speed is leaving the resonance bands during the deceleration. The actual frequencies registered when pressing [OK] are stored in *4-61 Bypass Speed From [Hz]*.
6. When the motor has ramped down to stop, press [OK]. The *parameter 4-64 Semi-Auto Bypass Set-up* automatically resets to Off. The frequency converter stays in *Hand On* mode until [Off] or [Auto On] is pressed.

If the frequencies for a certain resonance band are not registered in the right order (frequency values stored in *4-63 Bypass Speed To [Hz]* are higher than those in *4-61 Bypass Speed From [Hz]*) or if they do not have the same numbers of registrations for the *4-61 Bypass Speed From [Hz]* and *4-63 Bypass Speed To [Hz]*, all registrations are canceled and the following message is displayed: *Collected speed areas overlapping or not completely determined. Press [Cancel] to abort*.

4-64 Semi-Auto Bypass Set-up		
Option:		**Function:**
[0] *	Off	
[1]	Enable	

4.6 Main Menu - Digital In/Out - Group 5

4.6.1 5-0* Digital I/O Mode

Parameters for configuring the input and output using NPN and PNP.

NOTICE

These parameters cannot be adjusted while the motor is running.

5-00 Digital Input Mode		
Option:		**Function:**
		Set NPN or PNP mode for digital inputs 18,19 and 27. Digital Input Mode
[0] *	PNP	Action on positive directional pulses (0). PNP systems are pulled down to GND.
[1]	NPN	Action on negative directional pulses (1). NPN systems are pulled up to +24 V, internally in the frequency converter.

4.6.2 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 frequency converter. All digital inputs can be set to the following functions:

Digital input function	Description
[0] No operation	No reaction to signals transmitted to terminal.
[1] Reset	Resets frequency converter after a TRIP/ ALARM. Trip locked alarms can be reset.
[2] Coast inverse	Leaves motor in free mode. Logic '0' ⇒ coasting stop.
[3] Coast and reset inverse	Reset and coasting stop inverted input (NC). Leaves motor in free mode and resets the frequency converter. Logic '0' ⇒ coasting stop and reset.
[4] Quick Stop inverse	Inverted input (NC). Generates a stop in accordance with the quick-stop ramp time set in *parameter 3-81 Quick Stop Ramp Time*. After ramping down, shaft is in free mode.
[5] DC-brake inverse	Inverted input for DC braking (NC). Stops motor by energising it with DC current for a certain time period, see *parameter 2-01 DC Brake Current*. Function is only active when value in *parameter 2-02 DC Braking Time* is different from 0. This selection is not possible when *1-10 Motor Construction* is set to *[1] PM non salient SPM*.
[6] Stop inverse	Stop inverted function. Generates stop function when selected terminal goes from logical level "1" to "0" (not latched). Stop is performed according to selected ramp time.
[7] External Interlock	Same function as Coasting stop, inverse, but External Interlock generates the alarm message 'external fault' on the display when the terminal which is programmed for Coast Inverse is logic '0'. The alarm message is also active via digital outputs and relay outputs, if programmed for External Interlock. The alarm can be reset using a digital input, fieldbus, or the [Reset] key if the cause for the External Interlock has been removed.
*[8] Start	Select start for a start/stop command. Logic '1' = start, logic '0' = stop. (Default Digital input 18)
[9] Latched start	Motor starts, if a pulse is applied for min. 2 ms. Motor stops when Stop inverse is activated.
[10] Reversing	Change direction of motor shaft rotation. Reversing signal only changes direction of rotation; it does not activate start function. Select *[2] Both directions* in *parameter 4-10 Motor Speed Direction*. 0 = normal, 1 = reversing.
[11] Start reversing	Use for start/stop and for reversing at the same time. Signals on *[8] start* are not allowed at the same time. 0 = stop, 1 = start reversing.
[14] Jog	Used for activating jog speed. See *parameter 3-11 Jog Speed [Hz]*. (Default Digital input 29)
[16] Preset ref bit 0	Enables a selection between one of the 8 preset references according to *Table 4.5*.
[17] Preset ref bit 1	Enables a selection between one of the 8 preset references according to *Table 4.5*.
[18] Preset ref bit 2	Enables a selection between one of the 8 preset references according to *Table 4.5*.

Digital input function	Description
[19] Freeze reference	Freeze actual reference. The frozen reference is now the point of enable/ condition for Speed up and Speed down to be used. If Speed up/down is used, speed change always follows ramp 2 (*parameter 3-51 Ramp 2 Ramp Up Time* and *parameter 3-52 Ramp 2 Ramp Down Time*) in the range *parameter 3-02 Minimum Reference* - *parameter 3-03 Maximum Reference*.
[20] Freeze output	Freezes actual reference. The frozen reference is now the point of enable/ condition for Speed up and Speed down to be used. If Speed up/down is used, the speed change always follows ramp 2
[21] Speed up	For digital control of the up/down speed is desired (motor potentiometer). Activate this function by selecting either Freeze reference or Freeze output. When Speed up is activated for less than 400 ms, the resulting reference is increased by 0.1%. If Speed up is activated for more than 400 ms, the resulting reference ramps according to Ramp 1 in *parameter 3-41 Ramp 1 Ramp Up Time*.
[22] Speed down	Same as *[21] Speed up*, but reference decreases.
[23] Set-up select bit 0	Selects one of the 2 set-ups. Set *parameter 0-10 Active Set-up* to Multi Set-up.
[32] Pulse Input	Select Pulse input when using a pulse sequence as either reference or feedback. Scaling is done in parameter group *5-5* Pulse Input*. Available only for Terminal 29
[34] Ramp bit 0	Select which ramp to use. Logic "0" selects ramp 1 while logic "1" selects ramp 2.
[37] Fire mode	A signal applied puts the frequency converter into Fire Mode and all other commands are disregarded. See *24-0* Fire Mode*.

Digital input function	Description
[52] Run permissive	The input terminal, for which the Run permissive has been programmed must be logic "1" before a start command can be accepted. Run permissive has a logic 'AND' function related to the terminal which is programmed for *[8] Start*, *[14] Jog* or *[20] Freeze Output*, which means that to start running the motor, both conditions must be fulfilled. If Run permissive is programmed on multiple terminals, Run permissive needs only be logic '1' on one of the terminals for the function to be carried out. The digital output signal for Run Request (*[8] Start*, *[14] Jog* or *[20] Freeze Output*) programmed in paramter group *5-3* Digital Outputs*, or paramter group *5-4* Relays*, is not affected by Run Permissive. ***NOTICE*** **If no Run permissive signal is applied but either Run, Jog or Freeze commands is activated, the status line in the display shows either Run Requested, Jog Requested or Freeze Requested.**
[53] Hand Start	A signal applied puts the frequency converter into Hand mode as if [Hand On] has been pressed and a normal stop command is overridden. If disconnecting the signal, the motor stops. To make any other start commands valid, another digital input must be assigned to *Auto Start* and a signal applied to this. The [Hand On] and [Auto On] keys have no impact. The [Off] key overrides *Hand Start* and *Auto Start*. Press either [Hand On] or [Auto On] to make *Hand Start* and *Auto Start* active again. If no signal on neither *Hand Start* nor *Auto Start*, the motor stops regardless of any normal Start command applied. If signal applied to both *Hand Start* and *Auto Start*, the function is *Auto Start*.
[54] Auto start	A signal applied puts the frequency converter into Auto mode as if [Auto On] has been pressed. See also *[53] Hand Start*.
[60] Counter A (up)	Input for increment counting in the SLC counter.
[61] Counter A (down)	Input for decrement counting in the SLC counter.
[62] Reset Counter A	Input for reset of counter A.

Digital input function	Description
[63] Counter B (up)	Input for increment counting in the SLC counter.
[64] Counter B (down)	Input for decrement counting in the SLC counter.
[65] Reset Counter B	Input for reset of counter B

Table 4.4 Digital Input Functions

Selected preset ref.:	Preset ref. bit 2	Preset ref. bit 1	Preset ref. bit 0
Preset reference 0	0	0	0
Preset reference 1	0	0	1
Preset reference 2	0	1	0
Preset reference 3	0	1	1
Preset reference 4	1	0	0
Preset reference 5	1	0	1
Preset reference 6	1	1	0
Preset reference 7	1	1	1

Table 4.5 Selected Preset Reference

5-10 Terminal 18 Digital Input

Parameter for configuring the input function on input terminal 18. Refer to *Table 4.4* for setting options.

Option:		Function:
[0]	No operation	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inverse	
[4]	Quick stop inverse	
[5]	DC-brake inverse	
[6]	Stop inverse	
[7]	External Interlock	
[8] *	Start	
[9]	Latched start	
[10]	Reversing	
[11]	Start reversing	
[14]	Jog	
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	
[19]	Freeze reference	
[20]	Freeze output	
[21]	Speed up	

5-10 Terminal 18 Digital Input

Parameter for configuring the input function on input terminal 18. Refer to *Table 4.4* for setting options.

Option:		Function:
[22]	Speed down	
[23]	Set-up select bit 0	
[34]	Ramp bit 0	
[37]	Fire Mode	
[52]	Run permissive	
[53]	Hand start	
[54]	Auto start	
[60]	Counter A (up)	
[61]	Counter A (down)	
[62]	Reset Counter A	
[63]	Counter B (up)	
[64]	Counter B (down)	
[65]	Reset Counter B	

5-11 Terminal 19 Digital Input

Parameter for configuring the input function on input terminal 19.

Option:		Function:
[0] *	No operation	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inverse	
[4]	Quick stop inverse	
[5]	DC-brake inverse	
[6]	Stop inverse	
[7]	External Interlock	
[8]	Start	
[9]	Latched start	
[10]	Reversing	
[11]	Start reversing	
[14]	Jog	
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	
[19]	Freeze reference	
[20]	Freeze output	
[21]	Speed up	
[22]	Speed down	
[23]	Set-up select bit 0	
[34]	Ramp bit 0	
[37]	Fire Mode	
[52]	Run permissive	
[53]	Hand start	
[54]	Auto start	
[60]	Counter A (up)	
[61]	Counter A (down)	
[62]	Reset Counter A	
[63]	Counter B (up)	
[64]	Counter B (down)	
[65]	Reset Counter B	

5-12 Terminal 27 Digital Input		
Parameter for configuring the input function on input terminal 27.		
Option:		**Function:**
[0]	No operation	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inverse	
[4]	Quick stop inverse	
[5]	DC-brake inverse	
[6]	Stop inverse	
[7]	External Interlock	
[8]	Start	
[9]	Latched start	
[10]	Reversing	
[11]	Start reversing	
[14]	Jog	
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	
[19]	Freeze reference	
[20]	Freeze output	
[21]	Speed up	
[22]	Speed down	
[23]	Set-up select bit 0	
[34]	Ramp bit 0	
[37]	Fire Mode	
[52]	Run permissive	
[53]	Hand start	
[54]	Auto start	
[60]	Counter A (up)	
[61]	Counter A (down)	
[62]	Reset Counter A	
[63]	Counter B (up)	
[64]	Counter B (down)	
[65]	Reset Counter B	

5-13 Terminal 29 Digital Input		
Parameter for configuring the input function on input terminal 29.		
Option:		**Function:**
[0]	No operation	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inverse	
[4]	Quick stop inverse	
[5]	DC-brake inverse	
[6]	Stop inverse	
[7]	External Interlock	
[8]	Start	
[9]	Latched start	
[10]	Reversing	
[11]	Start reversing	
[14] *	Jog	

5-13 Terminal 29 Digital Input		
Parameter for configuring the input function on input terminal 29.		
Option:		**Function:**
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	
[19]	Freeze reference	
[20]	Freeze output	
[21]	Speed up	
[22]	Speed down	
[23]	Set-up select bit 0	
[32]	Pulse input	
[34]	Ramp bit 0	
[37]	Fire Mode	
[52]	Run permissive	
[53]	Hand start	
[54]	Auto start	
[60]	Counter A (up)	
[61]	Counter A (down)	
[62]	Reset Counter A	
[63]	Counter B (up)	
[64]	Counter B (down)	
[65]	Reset Counter B	

4.6.3 5-3* Digital Outputs

Parameters for configuring the output functions for the output terminals.

5-34 On Delay, Digital Output		
Range:		**Function:**
0.01 s*	[0 - 600 s]	

5-35 Off Delay, Digital Output		
Range:		**Function:**
0.01 s*	[0 - 600 s]	

4.6.4 5-4* Relays

Parameters for configuring the timing and the output functions for the relays.

4

5-40 Function Relay

Array (Relay 1 [0], Relay 2 [1])

Select options to define the function of the relays.

The selection of each mechanical relay is realised in an array parameter.

Default values for *5-40 Function Relay*:

When *0-03 Regional Settings* is set to *[0] International*, the default value of Relay1 is 'Alarm', and default value of Relay2 is 'Drive Running'.

When *0-03 Regional Settings* is set to *[1] North America*, the default value of Relay1 is 'No Alarm', and default value of Relay2 is 'Drive Running'.

Option:		Function:
[0]	No operation	Default for both relays
[1]	Control Ready	Control board receives supply voltage.
[2]	Drive ready	Frequency converter is ready for operation and applies supply signal on control board.
[3]	Drive ready/ remote control	Frequency converter is ready for operation in Auto On-mode.
[4]	Standby / no warning	Frequency converter is ready for operation. No start or stop command is given. No warnings are present.
[5]	Drive running	Motor is running.
[6]	Running / no warning	Motor runs, and no warning are present.
[7]	Run in range/no warning	Motor runs within programmed current ranges, see *parameter 4-50 Warning Current Low* and *parameter 4-51 Warning Current High*. No warnings are present.
[8]	Run on ref/no warning	Motor runs at reference speed and with no warnings.
[9]	Alarm	An alarm activates output.
[10]	Alarm or warning	An alarm or warning activates output.
[12]	Out of current range	Motor current is outside range set in *parameter 4-50 Warning Current Low* and *parameter 4-51 Warning Current High*.
[13]	Below current, low	Motor current is lower than set in *parameter 4-50 Warning Current Low*.
[14]	Above current, high	Motor current is higher than set in *parameter 4-51 Warning Current High*.
[16]	Below speed, low	
[17]	Above speed, high	
[19]	Below feedback, low	
[20]	Above feedback, high	

5-40 Function Relay

Array (Relay 1 [0], Relay 2 [1])

Select options to define the function of the relays.

The selection of each mechanical relay is realised in an array parameter.

Default values for *5-40 Function Relay*:

When *0-03 Regional Settings* is set to *[0] International*, the default value of Relay1 is 'Alarm', and default value of Relay2 is 'Drive Running'.

When *0-03 Regional Settings* is set to *[1] North America*, the default value of Relay1 is 'No Alarm', and default value of Relay2 is 'Drive Running'.

Option:		Function:
[21]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in motor, frequency converter or thermistor.
[22]	Ready, no thermal warning	Frequency converter is ready for operation and no over-temperature warning is present.
[23]	Remote, ready, no thermal warning	Frequency converter is ready for operation in Auto mode, and no over-temperature warning is present.
[24]	Ready, Voltage OK	Frequency converter is ready for operation and mains voltage is within specified voltage range.
[25]	Reverse	Motor runs/is ready to run clockwise when logic = 0 and counter clockwise when logic = 1. Output changes as soon as reversing signal is applied.
[26]	Bus OK	Active communication (no time-out) via serial communication port.
[35]	External Interlock	See digital input.
[36]	Control word bit 11	Bit 11 in control word controls relay.
[37]	Control word bit 12	Bit 12 in control word controls relay.
[41]	Below reference, low	
[42]	Above ref, high	
[45]	Bus Control	
[60]	Comparator 0	See parameter group 13-1*. If Comparator 0 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[61]	Comparator 1	See parameter group 13-1*. If Comparator 2 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[62]	Comparator 2	See parameter group 13-1*. If Comparator 2 is evaluated as TRUE, the output goes high. Otherwise, it is low.

5-40 Function Relay

Array (Relay 1 [0], Relay 2 [1])

Select options to define the function of the relays.

The selection of each mechanical relay is realised in an array parameter.

Default values for *5-40 Function Relay*:

When *0-03 Regional Settings* is set to *[0] International*, the default value of Relay1 is 'Alarm', and default value of Relay2 is 'Drive Running'.

When *0-03 Regional Settings* is set to *[1] North America*, the default value of Relay1 is 'No Alarm', and default value of Relay2 is 'Drive Running'.

Option:		Function:
[63]	Comparator 3	See parameter group 13-1*. If Comparator 3 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[64]	Comparator 4	See parameter group 13-1*. If Comparator 4 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[65]	Comparator 5	See parameter group 13-1*. If Comparator 5 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[70]	Logic rule 0	See parameter group 13-4*. If Logic Rule 0 is evaluated as TRUE, the output will go high. Otherwise, it will be low.
[71]	Logic rule 1	See parameter group 13-4*. If Logic Rule 1 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[72]	Logic rule 2	See parameter group 13-4*. If Logic Rule 2 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[73]	Logic rule 3	See parameter group 13-4*. If Logic Rule 3 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[74]	Logic rule 4	See parameter group 13-4*. If Logic Rule 4 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[75]	Logic rule 5	See parameter group 13-4*. If Logic Rule 5 is evaluated as TRUE, the output goes high. Otherwise, it is low.
[80]	SL digital output A	See *parameter 13-52 SL Controller Action*. The input will go high whenever the Smart Logic Action *[38] Set dig. out. A high* is executed. The input goes low whenever the Smart Logic *[32] Action Set dig. out.* A low is executed.
[81]	SL digital output B	See *parameter 13-52 SL Controller Action*. The input goes high whenever the Smart Logic Action *[39] Set dig. out. B high* is executed. The input goes low whenever the Smart Logic *[33] Action Set dig. out. B low* is executed.

5-40 Function Relay

Array (Relay 1 [0], Relay 2 [1])

Select options to define the function of the relays.

The selection of each mechanical relay is realised in an array parameter.

Default values for *5-40 Function Relay*:

When *0-03 Regional Settings* is set to *[0] International*, the default value of Relay1 is 'Alarm', and default value of Relay2 is 'Drive Running'.

When *0-03 Regional Settings* is set to *[1] North America*, the default value of Relay1 is 'No Alarm', and default value of Relay2 is 'Drive Running'.

Option:		Function:
[82]	SL digital output C	See *parameter 13-52 SL Controller Action*. The input goes high whenever the Smart Logic Action *[40] Set dig. out. C high* is executed. The input goes low whenever the Smart Logic *[34] Action Set dig. out. C low* is executed.
[83]	SL digital output D	See *parameter 13-52 SL Controller Action*. The input goes high whenever the Smart Logic *[41] Action Set dig. out. D* high is executed. The input goes low whenever the Smart Logic *[35] Action Set dig. out. D low* is executed.
[160]	No alarm	The output is high when no alarm is present.
[161]	Running reverse	The output is high when the frequency converter is running counter clockwise (the logical product of the status bits 'running' AND 'reverse').
[165]	Local ref. active	The output is high when *3-13 Reference Site = [2] Local* or when *3-13 Reference Site = [0] Linked to hand auto* at the same time as the LCP is in [Hand on] mode.
[166]	Remote ref. active	The output is high when *3-13 Reference Site [1] or Linked to hand/auto [0]* while the LCP is in [Auto on] mode.
[167]	Start command activ	The output is high when there is an active Start command (i.e. via digital input bus connection or [Hand on] or [Auto on], and no Stop command is active.
[168]	Drive in hand mode	The output is high when the frequency converter is in Hand on mode (as indicated by the LED light above [Hand on].
[169]	Drive in auto mode	The output is high when the frequency converter is in Hand on mode (as indicated by the LED light above [Auto on].

4

5-40 Function Relay

Array (Relay 1 [0], Relay 2 [1])

Select options to define the function of the relays.

The selection of each mechanical relay is realised in an array parameter.

Default values for *5-40 Function Relay*:

When *0-03 Regional Settings* is set to *[0] International*, the default value of Relay1 is 'Alarm', and default value of Relay2 is 'Drive Running'.

When *0-03 Regional Settings* is set to *[1] North America*, the default value of Relay1 is 'No Alarm', and default value of Relay2 is 'Drive Running'.

Option:		Function:
[193]	Sleep Mode	The frequency converter/system has turned into sleep mode. See parameter group *22-4* - Sleep Mode*.
[194]	Broken Belt Function	A Broken Belt condition has been detected. This function must be enabled in *parameter 22-60 Broken Belt Function*.
[196]	Fire Mode	The frequency converter is operating in Fire Mode. See parameter group *24-0* Fire Mode*.
[198]	Drive Bypass	To be used as signal for activating an external electromechanical bypass switching the motor direct on line. See *24-1* Drive Bypass*.

5-41 On Delay, Relay

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

Range:		Function:
0.01 s*	[0.01 - 600 s]	Enter the delay of the relay cut-in time. The relay will only cut in if the condition in *5-40 Function Relay* is uninterrupted during the specified time. Select one of the available mechanical relays in an array function. See *5-40 Function Relay*.

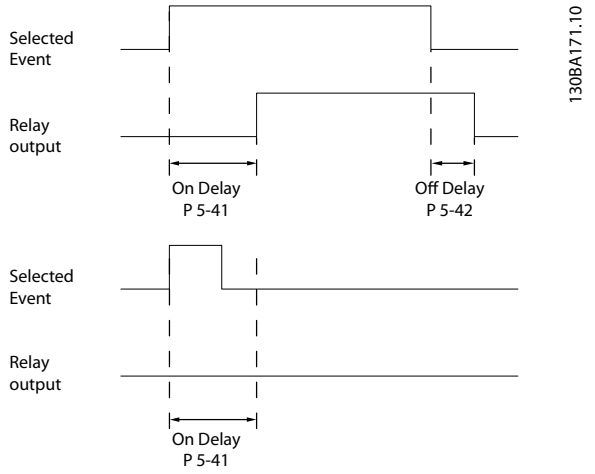


Illustration 4.9 On Delay, Relay

5-42 Off Delay, Relay

Array[2]: Relay1[0], Relay2[1]

Range:		Function:
0.01 s*	[0.01 - 600 s]	Enter the delay of the relay cut-out time. Select one of the available mechanical relays in an array function. See *5-40 Function Relay*.

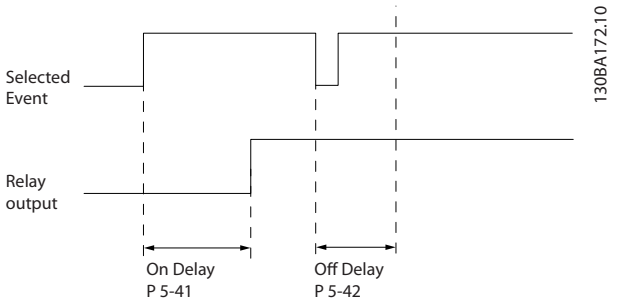


Illustration 4.10 Off Delay, Relay

If the selected Event condition changes before the on- or off delay timer expires, the relay output is unaffected.

4.6.5 5-5* Pulse Input

The pulse input parameters are used to define an appropriate window for the impulse reference area by configuring the scaling and filter settings for the pulse inputs. Input terminal 29 acts as frequency reference inputs. Set terminal 29 (*5-13 Terminal 29 Digital Input* to *[32] Pulse input*.

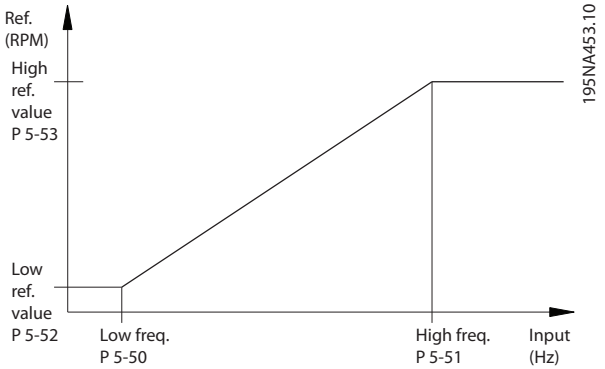


Illustration 4.11 Pulse Input

5-50 Term. 29 Low Frequency

Range:		Function:
4 Hz*	[4 - 31999 Hz]	Enter the low frequency limit corresponding to the low motor shaft speed (i.e. low reference value) in *5-52 Term. 29 Low Ref./Feedb. Value*. Refer to *Illustration 4.11*.

5-51 Term. 29 High Frequency		
Range:		**Function:**
32000 Hz*	[5 - 32000 Hz]	Enter the high frequency limit corresponding to the high motor shaft speed (i.e. high reference value) in *5-53 Term. 29 High Ref./Feedb. Value*.

5-52 Term. 29 Low Ref./Feedb. Value		
Range:		**Function:**
0 *	[-4999 - 4999]	Enter the low reference value limit for the motor shaft speed [RPM]. This is also the lowest feedback value, see also *5-13 Terminal 29 Digital Input* = [32] Pulse Input).

5-53 Term. 29 High Ref./Feedb. Value		
Range:		**Function:**
50 *	[-4999 - 4999]	Enter the high reference value [RPM] for the motor shaft speed and the high feedback value, see also *5-13 Terminal 29 Digital Input* = [32] Pulse Input).

4.6.6 5-9* Bus Controlled

This parameter group selects digital and relay outputs via a fieldbus setting.

5-90 Digital & Relay Bus Control		
Range:		**Function:**
0*	[0 - 0xFFFFFFFF]	This parameter holds the state of the digital outputs and relays that is controlled by bus. A logical '1' indicates that the output is high or active. A logical '0' indicates that the output is low or inactive.

Bit 0-3	Reserved
Bit 4	Relay 1 output terminal
Bit 5	Relay 2 output terminal
Bit 6-23	Reserved
Bit 24	Terminal 42 Digital Output
Bit 25	Terminal 45 Digital Output
Bit 26-31	Reserved

Table 4.6 Bit Functions

4.7 Main Menu - Analog In/Out - Group 6

Parameter group for setting up the analog I/O configuration and the digital output. The frequency converter is equipped with 2 analog inputs: Terminal 53 and 54. The analog inputs can freely be allocated to either voltage (0-10 V) or current input (0/4-20 mA)

4.7.1 6-0* Analog I/O Mode

6-00 Live Zero Timeout Time		
Range:		**Function:**
10 s*	[1 - 99 s]	Enter the time-out time.

6-01 Live Zero Timeout Function		
Option:		**Function:**
		Select the time-out function. The function set in *parameter 6-01 Live Zero Timeout Function* is activated, if the input signal on terminal 53 or 54 is below 50% of the value in *parameter 6-10 Terminal 53 Low Voltage*, *parameter 6-12 Terminal 53 Low Current*, *parameter 6-20 Terminal 54 Low Voltage* or *parameter 6-22 Terminal 54 Low Current* for a time period defined in *parameter 6-00 Live Zero Timeout Time*.
[0] *	Off	
[1]	Freeze output	
[2]	Stop	
[3]	Jogging	
[4]	Max. speed	
[5]	Stop and trip	

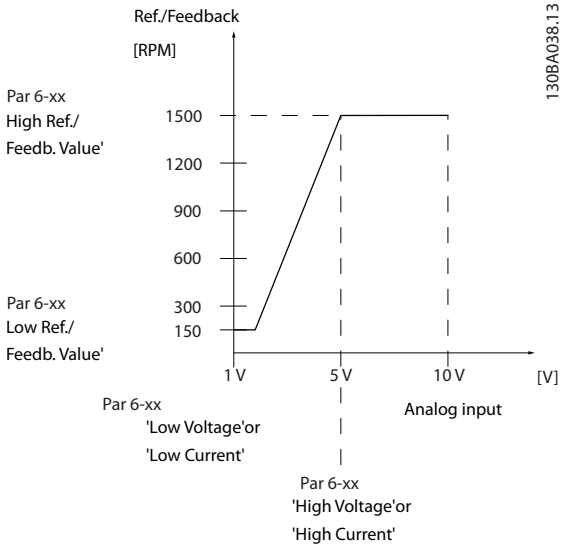


Illustration 4.12 Live Zero Timeout Function

4.7.2 6-1* Analog Input 53

Parameters for configuring the scaling and limits for analog input 53 (terminal 53).

4

6-10 Terminal 53 Low Voltage		
Range:		**Function:**
0.07 V*	[0 - 10 V]	Enter the voltage (V) that corresponds to *parameter 6-14 Terminal 53 Low Ref./Feedb. Value*. The value must be set at >1 V to activate *parameter 6-01 Live Zero Timeout Function*.

6-11 Terminal 53 High Voltage		
Range:		**Function:**
10 V*	[0 - 10 V]	Enter the voltage (V) that corresponds to the high reference value (set in *6-15 Terminal 53 High Ref./Feedb. Value*).

6-12 Terminal 53 Low Current		
Range:		**Function:**
4 mA*	[0 - 20 mA]	Enter the low current value. This reference signal should correspond to the low reference/ feedback value, set in *parameter 6-14 Terminal 53 Low Ref./Feedb. Value*. The value must be set at >2 mA to activate the Live Zero Time-out Function in *parameter 6-01 Live Zero Timeout Function*.

6-13 Terminal 53 High Current		
Range:		**Function:**
20 mA*	[0 - 20 mA]	Enter the high current value corresponding to the high reference/feedback set in *parameter 6-15 Terminal 53 High Ref./Feedb. Value*.

6-14 Terminal 53 Low Ref./Feedb. Value		
Range:		**Function:**
0*	[-4999 - 4999]	Enter the reference or feedback value that corresponds to the voltage or current set in *parameter 6-10 Terminal 53 Low Voltage* to *parameter 6-12 Terminal 53 Low Current*.

6-15 Terminal 53 High Ref./Feedb. Value		
Range:		**Function:**
Size related*	[-4999 - 4999]	Enter the reference or feedback value that corresponds to the voltage or current set in *parameter 6-11 Terminal 53 High Voltage* to *parameter 6-13 Terminal 53 High Current*.

6-16 Terminal 53 Filter Time Constant		
Range:		**Function:**
0.01 s*	[0.01 - 10 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.

6-19 Terminal 53 mode		
Option:		**Function:**
		Select if terminal 53 is used for current- or voltage input.
[0]	Current mode	
[1] *	Voltage mode	

4.7.3 6-2* Analog Input 54

Parameters for configuring the scaling and limits for analog input 54 (terminal 54).

6-20 Terminal 54 Low Voltage		
Range:		**Function:**
0.07 V*	[0 - 10 V]	Enter the voltage (V) that corresponds to the low reference value (set in *parameter 6-24 Terminal 54 Low Ref./Feedb. Value*). The value must be set at >1 V to activate *parameter 6-01 Live Zero Timeout Function*.

6-21 Terminal 54 High Voltage		
Range:		**Function:**
10 V*	[0 - 10 V]	Enter the voltage (V) that corresponds to the high reference value (set in *parameter 6-25 Terminal 54 High Ref./Feedb. Value*).

6-22 Terminal 54 Low Current		
Range:		**Function:**
4 mA*	[0 - 20 mA]	Enter the low current value. This reference signal should correspond to the low reference/ feedback value, set in *parameter 6-24 Terminal 54 Low Ref./Feedb. Value*. The value must be set at >2 mA to activate the Live Zero Timeout Function in *parameter 6-01 Live Zero Timeout Function*.

6-23 Terminal 54 High Current		
Range:		**Function:**
20 mA* 20.00 mA*	[0 - 20 mA] [par. 6-22-20.00 mA]	Enter the high current value corresponding to the high reference/feedback value set in *parameter 6-25 Terminal 54 High Ref./ Feedb. Value*.

6-24 Terminal 54 Low Ref./Feedb. Value		
Range:		**Function:**
0*	[-4999 - 4999]	Enter the reference or feedback value that corresponds to the voltage or current set in *parameter 6-21 Terminal 54 High Voltage/ parameter 6-22 Terminal 54 Low Current*.

6-25 Terminal 54 High Ref./Feedb. Value		
Range:		**Function:**
Size related*	[-4999 - 4999]	Enter the reference or feedback value that corresponds to the voltage or current set in *parameter 6-21 Terminal 54 High Voltage/ parameter 6-23 Terminal 54 High Current*.

6-26 Terminal 54 Filter Time Constant		
Range:		**Function:**
0.01 s*	[0.01 - 10 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.

6-29 Terminal 54 mode		
Option:		**Function:**
		Select if terminal 54 is used for current- or voltage input.
[0]	Current mode	
[1] *	Voltage mode	

4.7.4 6-7* Analog/Digital Output 45

Parameters for configuring the scaling and limits for analog/digital output Terminal 45. Analog outputs are current outputs: 0/4-20 mA. Resolution on analog output is 12 bit. Analog output terminals can also be setup as digital output.

6-70 Terminal 45 Mode		
Option:		**Function:**
		Set terminal 45 to act as analog output or as digital output.
[0] *	0-20 mA	
[1]	4-20 mA	
[2]	Digital Output	

6-71 Terminal 45 Analog Output		
Option:		**Function:**
		Select the function of Terminal 45 as an analog current output. See also *parameter 6-70 Terminal 45 Mode*.
[0] *	No operation	

6-71 Terminal 45 Analog Output		
Option:		**Function:**
[100]	Output frequency	0-400 Hz
[101]	Reference	$Min_{Ref.}$ - $Max_{Ref.}$
[102]	Feedback	Min_{FB} - Max_{FB}
[103]	Motor Current	0-I_{max}
[106]	Power	0-P_{nom}
[139]	Bus Control	0-100%

6-72 Terminal 45 Digital Output		
Option:		**Function:**
		Select the function of Terminal 45 as a digital current output. See also *parameter 6-70 Terminal 45 Mode*. See *parameter 5-40 Function Relay* for description of the choices.
[0]	No operation	
[1]	Control Ready	
[2]	Drive ready	
[3]	Drive ready/remote control	
[4]	Standby / no warning	
[5]	Drive running	
[6]	Running / no warning	
[7]	Run in range/no warning	
[8]	Run on ref/no warning	
[9]	Alarm	
[10]	Alarm or warning	
[12]	Out of current range	
[13]	Below current, low	
[14]	Above current, high	
[16]	Below speed, low	
[17]	Above speed, high	
[19]	Below feedback, low	
[20]	Above feedback, high	
[21]	Thermal warning	
[22]	Ready, no thermal warning	
[23]	Remote, ready, no thermal warning	
[24]	Ready, Voltage OK	
[25]	Reverse	
[26]	Bus OK	
[32]	Mech brake ctrl	
[35]	External Interlock	
[36]	Control word bit 11	
[37]	Control word bit 12	
[41]	Below reference, low	
[42]	Above ref, high	
[45]	Bus Control	
[60]	Comparator 0	

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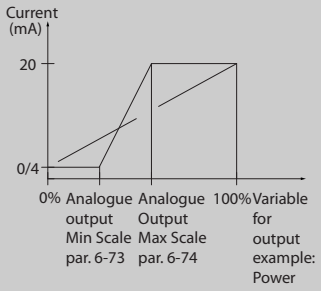
6-72 Terminal 45 Digital Output		
Option:		**Function:**
[61]	Comparator 1	
[62]	Comparator 2	
[63]	Comparator 3	
[64]	Comparator 4	
[65]	Comparator 5	
[70]	Logic rule 0	
[71]	Logic rule 1	
[72]	Logic rule 2	
[73]	Logic rule 3	
[74]	Logic rule 4	
[75]	Logic rule 5	
[80]	SL digital output A	
[81]	SL digital output B	
[82]	SL digital output C	
[83]	SL digital output D	
[160]	No alarm	
[161]	Running reverse	
[165]	Local ref. active	
[166]	Remote ref. active	
[167]	Start command activ	
[168]	Drive in hand mode	
[169]	Drive in auto mode	
[193]	Sleep Mode	
[194]	Broken Belt Function	
[196]	Fire Mode	
[198]	Drive Bypass	

6-73 Terminal 45 Output Min Scale		
Range:		**Function:**
0 %*	[0 - 200 %]	Scale for the minimum output (0 or 4 mA) of the analog signal at Terminal 45. Set the value to be the percentage of the full range of the variable selected in *parameter 6-71 Terminal 45 Analog Output*.
0.0%*	[0.0-200.0%]	

6-74 Terminal 45 Output Max Scale		
Range:		**Function:**
100 %*	[0 - 200 %]	Scale for the maximum output (20 mA) of the analog signal at Terminal 45. Set the value to be the percentage of the full range of the variable selected in *parameter 6-71 Terminal 45 Analog Output*.

6-74 Terminal 45 Output Max Scale		
Range:		**Function:**
		 **Illustration 4.13 Output Max Scale**
100.0%*	[0.0-200.0%]	

6-76 Terminal 45 Output Bus Control		
Range:		**Function:**
0*	[0 - 16384]	

4.7.5 6-9* Analog/Digital Output 42

Parameters for configuring the limits for analog/digital output Terminal 42. Analog outputs are current outputs: 0/4-20 mA. Resolution on analog outputs is 12 bit. Analog output terminals can also be set-up as digital output.

6-90 Terminal 42 Mode		
Option:		**Function:**
		Set Terminal 42 to act as analog output or as digital output.
[0] *	0-20 mA	
[1]	4-20 mA	
[2]	Digital Output	

6-91 Terminal 42 Analog Output		
Option:		**Function:**
		Select the function of Terminal 42 as an analog current output. See also *6-90 Terminal 42 Mode*.
[0] *	No operation	
[100]	Output frequency	0-100 Hz
[101]	Reference	$Min_{Ref.}$ - $Max_{Ref.}$
[102]	Feedback	Min_{FB} - Max_{FB}
[103]	Motor Current	0-I_{max}
[106]	Power	0-P_{nom}
[139]	Bus Control	0-100%

6-92 Terminal 42 Digital Output		
Option:		**Function:**
		Select the function of Terminal 42 as an analog current output. See also *6-90 Terminal 42 Mode*. See *parameter 5-40 Function Relay* for description of the choices.
[0]	No operation	
[1]	Control Ready	
[2]	Drive ready	
[3]	Drive ready/remote control	
[4]	Standby / no warning	
[5]	Drive running	
[6]	Running / no warning	
[7]	Run in range/no warning	
[8]	Run on ref/no warning	
[9]	Alarm	
[10]	Alarm or warning	
[12]	Out of current range	
[13]	Below current, low	
[14]	Above current, high	
[16]	Below speed, low	
[17]	Above speed, high	
[19]	Below feedback, low	
[20]	Above feedback, high	
[21]	Thermal warning	
[22]	Ready, no thermal warning	
[23]	Remote, ready, no thermal warning	
[24]	Ready, Voltage OK	
[25]	Reverse	
[26]	Bus OK	
[32]	Mech brake ctrl	
[35]	External Interlock	
[36]	Control word bit 11	
[37]	Control word bit 12	
[41]	Below reference, low	
[42]	Above ref, high	
[45]	Bus Control	
[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	

6-92 Terminal 42 Digital Output		
Option:		**Function:**
[81]	SL digital output B	
[82]	SL digital output C	
[83]	SL digital output D	
[160]	No alarm	
[161]	Running reverse	
[165]	Local ref. active	
[166]	Remote ref. active	
[167]	Start command activ	
[168]	Drive in hand mode	
[169]	Drive in auto mode	
[193]	Sleep Mode	
[194]	Broken Belt Function	
[196]	Fire Mode	
[198]	Drive Bypass	

6-93 Terminal 42 Output Min Scale		
Range:		**Function:**
0 %*	[0 - 200 %]	Scale for the minimum output (0 or 4 mA) of the analog signal at Terminal 42. Set the value to be the percentage of the full range of the variable selected in *6-91 Terminal 42 Analog Output*.

6-94 Terminal 42 Output Max Scale		
Range:		**Function:**
100 %*	[0 - 200 %]	Scale for the maximum output (20 mA) of the scaling at Terminal 42. Set the value to be the percentage of the full range of the variable selected in *6-91 Terminal 42 Analog Output*.

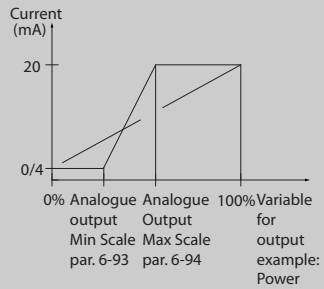


Illustration 4.14 Output Max Scale

6-96 Terminal 42 Output Bus Control		
Range:		**Function:**
0*	[0 - 16384]	

6-98 Drive Type		
Range:		**Function:**
0 *	[0 - 0]	

4.8 Main Menu - Communications and Options - Group 8

4.8.1 8-0* General Settings

8-01 Control Site		
Option:		**Function:**
		Select *[0] Digital and ctrl.word* for using digital input and control word. Select *[1] Digital* only to use digital inputs only. Select *[2] Control word only* to use control word only. This parameter overrules settings in *parameter 8-50 Coasting Select* to *parameter 8-56 Preset Reference Select*.
[0] *	Digital and ctrl.word	Control by using both digital input and control word.
[1]	Digital only	Control by using digital inputs only.
[2]	Controlword only	Control by using control word only.

8-02 Control Source		
Option:		**Function:**
		NOTICE **This parameter cannot be adjusted while the motor is running.** Select the source of the control word.
[0]	None	
[1] *	FC Port	

8-03 Control Timeout Time		
Range:		**Function:**
1 s*	[0.1 - 6500 s]	Enter the maximum time expected to pass between the reception of 2 consecutive telegrams. If this time is exceeded, it indicates that the serial communication has stopped. The function selected in *parameter 8-04 Control Timeout Function Control Time-out Function* is carried out.

8-04 Control Timeout Function		
Option:		**Function:**
		Select the timeout function. The time-out function is activated when the control word fails to be updated within the time period specified in *parameter 8-03 Control Timeout Time*.
[0] *	Off	

4.8.2 8-3* FC Port Settings

8-30 Protocol		
Option:		**Function:**
		Select the protocol for the integrated RS-485 port. Change of settings in may change the baud rate.
[0]	FC	Communication according to the FC Protocol.
[2]	Modbus RTU	Communication according to the Modbus RTU protocol.
[3]	Metasys N2	Communication protocol. The N2 software protocol is designed to accommodate the unique properties each device may have.
[5]	BACNet	

8-31 Address		
Range:		**Function:**
1*	[0.0 - 247]	Enter the address for the RS-485 port. Valid range: 1-126 for FC-bus OR 1-247 for Modbus.

8-32 Baud Rate		
Option:		**Function:**
		Select the baud rate for the RS-485 port Default refers to the FC Protocol. Changing Protocol in *8-30 Protocol* may change the Baud Rate. Changing Protocol in *8-30 Protocol* may change the Baud Rate.
[0]	2400 Baud	
[1]	4800 Baud	
[2]	9600 Baud	Default setting for • Modbus RTU • BACnet • Metasys N2
[3]	19200 Baud	
[4]	38400 Baud	
[5]	57600 Baud	
[6]	76800 Baud	
[7]	115200 Baud	

8-33 Parity / Stop Bits		
Option:		**Function:**
		Parity and stop bits for the protocol using the FC Port. For some of the protocols, not all options are available. Default refers to the FC Protocol. Changing Protocol in *8-30 Protocol* may change the Baud Rate.
[0]	Even Parity, 1 Stop Bit	
[1]	Odd Parity, 1 Stop Bit	

8-33 Parity / Stop Bits		
Option:		**Function:**
[2]	No Parity, 1 Stop Bit	
[3]	No Parity, 2 Stop Bits	

8-35 Minimum Response Delay		
Range:		**Function:**
0.01 s*	[0.0010 - 0.5 s]	Specify the minimum delay time between receiving a request and transmitting a response. This is used for overcoming modem turnaround delays.

8-36 Maximum Response Delay		
Range:		**Function:**
Size related*	[0.1 - 10.0 s]	Specify the maximum permissible delay time between receiving a request and transmitting the response. If this time is exceeded, no response is returned.

4.8.3 8-4* MC Protocol Set

8-42 PCD Write Configuration		
Different parameters can be assigned to PCD 3 to 10 of the PPOs. The number of PCDs depends on the PPO type. The values in PCD 3 to 10 are written to the selected parameters as data values.		
Option:		**Function:**
[0]	None	
[1]	[302] Minimum Reference	
[2]	[303] Maximum Reference	
[3]	[341] Ramp 1 Ramp up time	
[4]	[342] Ramp 1 Ramp down time	
[5]	[351] Ramp 2 Ramp up time	
[6]	[352] Ramp 2 Ramp down time	
[7]	[380] Jog Ramp Time	
[8]	[381] Quick Stop Time	
[9]	[412] Motor Speed Low Limit [Hz]	
[10]	[414] Motor Speed High Limit [Hz]	
[11]	[590] Digital & Relay Bus Control	
[12]	[676] Terminal45 Output Bus Control	
[13]	[696] Terminal 42 Output Bus Control	
[14]	[894] Bus Feedback 1	
[15]	FC Port CTW	
[16]	FC Port REF	

8-43 PCD Read Configuration		
Different parameters can be assigned to PCD 3 to 10 of the PPOs. The number of PCDs depends on the PPO type. PCD 3 to 10 will hold the real-time data value of the selected parameters.		
Option:		**Function:**
[0]	None	
[1]	[1500] Operation Hours	
[2]	[1501] Running Hours	
[3]	[1502] kWh Counter	
[4]	[1600] Control Word	
[5]	[1601] Reference [Unit]	
[6]	[1602] Reference %	
[7]	[1603] Status Word	
[8]	[1605] Main Actual Value [%]	
[9]	[1609] Custom Readout	
[10]	[1610] Power [kW]	
[11]	[1611] Power [hp]	
[12]	[1612] Motor Voltage	
[13]	[1613] Frequency	
[14]	[1614] Motor Current	
[15]	[1615] Frequency [%]	
[16]	[1618] Motor Thermal	
[17]	[1630] DC Link Voltage	
[18]	[1634] Heatsink Temp.	
[19]	[1635] Inverter Thermal	
[20]	[1638] SL Controller State	
[21]	[1650] External Reference	
[22]	[1652] Feedback [Unit]	
[23]	[1660] Digital Input 18,19,27,33	
[24]	[1661] Terminal 53 Switch Setting	
[25]	[1662] Analog Input 53(V)	
[26]	[1663] Terminal 54 Switch Setting	
[27]	[1664] Analog Input 54	
[28]	[1665] Analog Output 42 [mA]	
[29]	[1671] Relay Output [bin]	
[30]	[1672] Counter A	
[31]	[1673] Counter B	
[32]	[1690] Alarm Word	
[33]	[1692] Warning Word	
[34]	[1694] Ext. Status Word	

4.8.4 8-5* Digital/Bus

Parameters for configuring the control word Digital/Bus merging.

8-50 Coasting Select		
Option:		**Function:**
		Select control of the coasting function via the terminals (digital input) and/or via the bus.

4

8-50 Coasting Select

Option:		Function:
		NOTICE **This parameter is active only when *parameter 8-01 Control Site* is set to *[0] Digital and control word*.**
[0]	Digital input	Activates coast via a digital input.
[1]	Bus	Activates coast via the serial communication port.
[2]	Logic AND	Activates coast via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates coast via the serial communication port OR via one of the digital inputs.

8-51 Quick Stop Select

Option:		Function:
		Select control of the Quick Stop function via the terminals (digital input) and/or via the bus. ***NOTICE*** **This parameter is active only when *parameter 8-01 Control Site* is set to *[0] Digital and control word*.**
[0]	Digital input	Activates Quick Stop via a digital input.
[1]	Bus	Activates Quick Stop via the serial communication port.
[2]	Logic AND	Activates Quick Stop via the serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates Quick Stop via the serial communication port OR via one of the digital inputs.

8-52 DC Brake Select

Option:		Function:
		Select control of the DC brake via the terminals (digital input). ***NOTICE*** **This parameter is active only when *parameter 8-01 Control Site* is set to *[0] Digital and control word*.**
[0]	Digital input	Activates DC brake via a digital input.
[1]	Bus	Activates DC brake via the serial communication port.

8-52 DC Brake Select

Option:		Function:
[2]	Logic AND	Activates DC brake via the serial communication port, AND additionally via one of the digital inputs.
[3]	Logic OR	Activates DC brake via the serial communication port OR via one of the digital inputs.

8-53 Start Select

Option:		Function:
		Select control of the frequency converter start function via the terminals (digital input). ***NOTICE*** **This parameter is active only when *parameter 8-01 Control Site* is set to *[0] Digital and control word*.**
[0]	Digital input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port.
[2]	Logic AND	Activates Start command via the serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates Start command via the serial communication port OR via one of the digital inputs.

8-54 Reversing Select

Option:		Function:
		Select control of the frequency converter reverse function via the terminals (digital input) and/or via the serial communication port. ***NOTICE*** **This parameter is active only when *parameter 8-01 Control Site* is set to *[0] Digital and control word*.**
[0] *	Digital input	Activates Reverse command via a digital input.
[1]	Bus	Activates Reverse command via the serial communication port.
[2]	Logic AND	Activates Reverse command via the serial communication port, AND additionally via one of the digital inputs.
[3]	Logic OR	Activates Reverse command via the serial communication port OR via one of the digital inputs.

8-55 Set-up Select		
Option:		**Function:**
		Select control of the frequency converter set-up selection via the terminals (digital input) and/or via the serial communication port. ***NOTICE*** **This parameter is active only when *parameter 8-01 Control Site* is set to *[0] Digital and control word*.**
[0]	Digital input	Activates the set-up selection via a digital input.
[1]	Bus	Activates the set-up selection via the serial communication port.
[2]	Logic AND	Activates the set-up selection via the serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activate the set-up selection via the serial communication port OR via one of the digital inputs.

8-56 Preset Reference Select		
Option:		**Function:**
		Select control of the frequency converter Preset Reference selection via the terminals (digital input) and/or via the serial communication port.
[0]	Digital input	Activates Preset Reference selection via a digital input.
[1]	Bus	Activates Preset Reference selection via the serial communication port.
[2]	Logic AND	Activates Preset Reference selection via the serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates the Preset Reference selection via the serial communication port OR via one of the digital inputs.

4.8.5 8-7* BACnet

8-70 BACnet Device Instance		
Range:		**Function:**
1*	[0 - 4194303]	Enter a unique ID number for the BACnet device.

8-72 MS/TP Max Masters		
Range:		**Function:**
127*	[0 - 127]	Define the address of the master which holds the highest address in this network. Decreasing this value optimises polling for the token.

8-73 MS/TP Max Info Frames		
Range:		**Function:**
1*	[1 - 65534]	Define how many info/data frames the device is allowed to send while holding the token.

8-74 "I am" Service		
Option:		**Function:**
[0] *	Send at power-up	Select when the device should send the "I-Am" service message only at power-up.
[1]	Continuously	Select when the device should send the "I-Am" service message continuously with an interval of approx. 1 min.

8-75 Intialisation Password		
Range:		**Function:**
admin*	[1 - 1]	Enter the password needed for execution of Drive Re-initialisation.

8-79 Protocol Firmware version		
Range:		**Function:**
Size related*	[0 - 65535]	Read the supported protocol version. Index 5 is for BACNet.

4.8.6 8-8* FC Port Diagnostics

These parameters are used for monitoring the Bus communication via the FC Port.

8-80 Bus Message Count		
Range:		**Function:**
0*	[0 - 65536]	This parameter shows the number of valid telegrams detected on the bus.

8-81 Bus Error Count		
Range:		**Function:**
0*	[0 - 65536]	This parameter shows the number of telegrams with faults (e.g. CRC fault), detected on the bus.

8-82 Slave Messages Rcvd		
Range:		**Function:**
0*	[0 - 65536]	This parameter shows the number of valid telegrams addressed to the follower, sent by the frequency converter.

8-83 Slave Error Count		
Range:		**Function:**
0*	[0 - 65536]	This parameter shows the number of error telegrams, which could not be executed by the frequency converter.

8-84 Slave Messages Sent		
Range:		**Function:**
0*	[0 - 65536]	This parameter shows the number of messages sent from the follower.

8-85 Slave Timeout Errors		
Range:		**Function:**
0*	[0 - 65536]	This parameter shows the number of follower timeout errors.

8-88 Reset FC port Diagnostics		
Option:		**Function:**
[0] *	Do not reset	
[1]	Reset counter	

4.8.7 8-9* Bus Feedback

8-94 Bus Feedback 1		
Range:		**Function:**
0*	[-32768 - 32767]	Write a feedback to this parameter via the serial communication port. This parameter must be selected in *20-00 Feedback 1 Source* as a feedback source. (Hex-value 4000 h corresponds to 100% feedback/range is ±200%)

4.9 Main Menu - Smart Logic - Group 13

4.9.1 13-** Prog. Features

Smart Logic Control (SLC) is a sequence of user defined actions (see *parameter 13-52 SL Controller Action* [x]) executed by the SLC when the associated user defined *event* (see *parameter 13-51 SL Controller Event* [x]) is evaluated as TRUE by the SLC. Events and *actions* are each numbered and linked in pairs. This means that when *[0] event* is fulfilled (attains the value TRUE), *[0] action* is executed. After this, the conditions of *[1] event* is evaluated and if evaluated TRUE, *[1] action* is executed and so on. Only one *event* is evaluated at any time. If an *event* is evaluated as FALSE, nothing happens (in the SLC) during the current scan interval and no other *events* are evaluated. This means that when the SLC starts, it evaluates *[0] event* (and only *[0] event*) each scan interval. Only when *[0] event* is evaluated TRUE, the SLC executes *[0] action* and start evaluating *[1] event*. It is possible to programme from 1 to 20 *events* and *actions*. When the last *event*/*action* have been executed, the sequence starts over again from *[0] event*/*[0] action*.

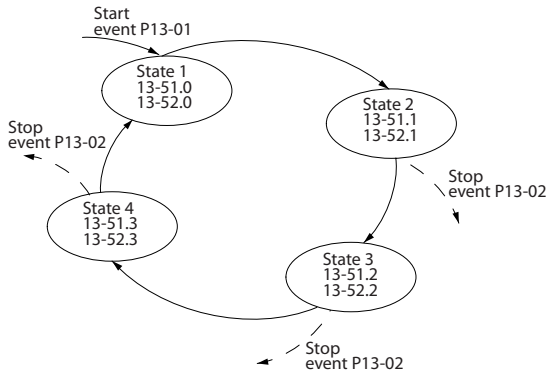


Illustration 4.15 Example with Three Event/Actions

Starting and stopping the SLC

Starting and stopping the SLC can be done by selecting *[1] On* or *[0] Off* in *parameter 13-00 SL Controller Mode*. The SLC always starts in state 0 (where it evaluates *[0] event*). The SLC starts when the Start Event (defined in *parameter 13-01 Start Event*) is evaluated as TRUE (provided that *[1] On* is selected in *parameter 13-00 SL Controller Mode*). The SLC stops when the *Stop Event* (*parameter 13-02 Stop Event*) is TRUE. *Parameter 13-03 Reset SLC* resets all SLC parameters and starts programming from scratch.

4.9.2 13-0* SLC Settings

Use the SLC settings to activate, deactivate and reset the Smart Logic Control sequence. The logic functions and comparators are always running in the background, which opens for separate control of digital inputs and outputs.

13-00 SL Controller Mode		
Option:		**Function:**
		Select *[1] On* to enable the Smart Logic Control to start when a start command is present, e.g. via a digital input. Select *[0] Off* to disable the Smart Logic Control.
[0] *	Off	Disables the Smart Logic Controller.
[1]	On	Enables the Smart Logic Controller.

13-01 Start Event		
Option:		**Function:**
		Select the boolean (TRUE or FALSE) input to activate Smart Logic Control.
[0]	False	Enters the fixed value of FALSE in the logic rule.
[1]	True	Enters the fixed value TRUE in the logic rule.
[2]	Running	The motor is running.
[3]	In range	Motor runs within programmed current ranges (*parameter 4-50 Warning Current*

13-01 Start Event		
Option:		**Function:**
		Low and *parameter 4-51 Warning Current High*)
[4]	On reference	The motor runs at reference speed.
[7]	Out of current range	The motor current is outside the range set in *parameter 4-18 Current Limit*.
[8]	Below I low	The motor current is lower than set in *parameter 4-50 Warning Current Low*.
[9]	Above I high	The motor current is higher than set in *parameter 4-51 Warning Current High*.
[16]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, the frequency converter or the thermistor.
[17]	Mains out of range	
[18]	Reversing	The frequency converter is reversing.
[19]	Warning	A warning is present.
[20]	Alarm (trip)	An alarm is present.
[21]	Alarm (trip lock)	A trip lock alarm is present.
[22]	Comparator 0	Use the result of comparator 0 in the logic rule.
[23]	Comparator 1	Use the result of comparator 1 in the logic rule.
[24]	Comparator 2	Use the result of comparator 2 in the logic rule.
[25]	Comparator 3	Use the result of comparator 3 in the logic rule.
[26]	Logic rule 0	Use the result of logic rule 0 in the logic rule.
[27]	Logic rule 1	Use the result of logic rule 1 in the logic rule.
[28]	Logic rule 2	Use the result of logic rule 2 in the logic rule.
[29]	Logic rule 3	Use the result of logic rule 3 in the logic rule.
[33]	Digital input DI18	Use the value of DI18 in the logic rule (High = TRUE).
[34]	Digital input DI19	Use the value of DI19 in the logic rule (High = TRUE).
[35]	Digital input DI27	Use the value of DI27 in the logic rule (High = TRUE).
[36]	Digital input DI29	Use the value of DI29 in the logic rule (High = TRUE).

13-01 Start Event		
Option:		**Function:**
[39] *	Start command	This event is TRUE if the frequency converter is started (either via digital input, field bus or other).
[40]	Drive stopped	This event is TRUE if the frequency converter is stopped or coasted (either via digital input, fieldbus or other).
[42]	Auto Reset Trip	This event is TRUE if the frequency converter is tripped (but not trip-locked) and an Automatic Reset is issued.
[50]	Comparator 4	Use the result of comparator 4 in the logic rule.
[51]	Comparator 5	Use the result of comparator 5 in the logic rule.
[60]	Logic rule 4	Use the result of logic rule 4 in the logic rule.
[61]	Logic rule 5	Use the result of logic rule 5 in the logic rule.
[83]	Broken Belt	A broken belt condition has been detected. This function must be enabled in *parameter 22-60 Broken Belt Function*.

13-02 Stop Event		
Option:		**Function:**
		Select the condition (TRUE or FALSE) which deactivates the Smart Logic Controller.
[0]	False	Enters the fixed value of FALSE in the logic rule.
[1]	True	Enters the fixed value TRUE in the logic rule.
[2]	Running	See *parameter 13-01 Start Event* for further description.
[3]	In range	See *parameter 13-01 Start Event* for further description.
[4]	On reference	See *parameter 13-01 Start Event* for further description.
[7]	Out of current range	See *parameter 13-01 Start Event* for further description.
[8]	Below I low	See *parameter 13-01 Start Event* for further description.
[9]	Above I high	See *parameter 13-01 Start Event* for further description.
[16]	Thermal warning	See *parameter 13-01 Start Event* for further description.
[17]	Mains out of range	See *parameter 13-01 Start Event* for further description.

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13-02 Stop Event		
Option:		**Function:**
[18]	Reversing	See *parameter 13-01 Start Event* for further description.
[19]	Warning	See *parameter 13-01 Start Event* for further description.
[20]	Alarm (trip)	See *parameter 13-01 Start Event* for further description.
[21]	Alarm (trip lock)	See *parameter 13-01 Start Event* for further description.
[22]	Comparator 0	Use the result of comparator 0 in the logic rule.
[23]	Comparator 1	Use the result of comparator 1 in the logic rule.
[24]	Comparator 2	Use the result of comparator 2 in the logic rule.
[25]	Comparator 3	Use the result of comparator 3 in the logic rule.
[26]	Logic rule 0	Use the result of logic rule 0 in the logic rule.
[27]	Logic rule 1	Use the result of logic rule 1 in the logic rule.
[28]	Logic rule 2	Use the result of logic rule 2 in the logic rule.
[29]	Logic rule 3	Use the result of logic rule 3 in the logic rule.
[30]	SL Time-out 0	Use the result of timer 0 in the logic rule.
[31]	SL Time-out 1	Use the result of timer 1 in the logic rule.
[32]	SL Time-out 2	Use the result of timer 2 in the logic rule.
[33]	Digital input DI18	Use the value of DI18 in the logic rule (High = TRUE).
[34]	Digital input DI19	
[35]	Digital input DI27	Use the value of DI27 in the logic rule (High = TRUE).
[36]	Digital input DI29	Use the value of DI29 in the logic rule (High = TRUE).
[39]	Start command	This event is TRUE if the frequency converter is started by any means (either via digital input, fieldbus or other).
[40] *	Drive stopped	This event is TRUE if the frequency converter is stopped or coasted by any means (either via digital input, fieldbus or other).
[42]	Auto Reset Trip	This event is TRUE if the frequency converter is tripped (but not trip-locked) and an Automatic Reset is issued.

13-02 Stop Event		
Option:		**Function:**
[50]	Comparator 4	Use the result of comparator 4 in the logic rule.
[51]	Comparator 5	Use the result of comparator 5 in the logic rule.
[60]	Logic rule 4	Use the result of logic rule 4 in the logic rule.
[61]	Logic rule 5	Use the result of logic rule 5 in the logic rule.
[70]	SL Time-out 3	Use the result of timer 3 in the logic rule.
[71]	SL Time-out 4	Use the result of timer 4 in the logic rule.
[72]	SL Time-out 5	Use the result of timer 5 in the logic rule.
[73]	SL Time-out 6	Use the result of timer 6 in the logic rule.
[74]	SL Time-out 7	Use the result of timer 7 in the logic rule.
[83]	Broken Belt	A broken belt condition has been detected. This function must be enabled in *parameter 22-60 Broken Belt Function*.

13-03 Reset SLC		
Option:		**Function:**
[0] *	Do not reset SLC	Retains programmed settings in all group 13 parameters (*13-** Smart Logic*).
[1]	Reset SLC	Resets all group 13 parameters (*13-** Smart Logic*) to default settings.

4.9.3 13-1* Comparators

Comparators are used for comparing continuous variables (i.e. output frequency, output current, analog input etc.) to fixed preset values.

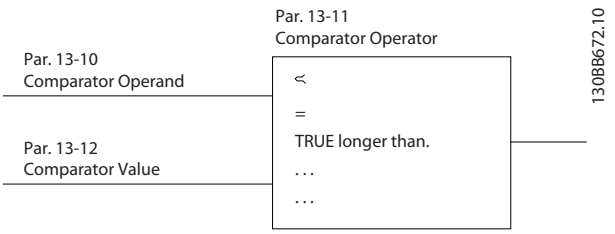

Illustration 4.16 Comparators

In addition, there are digital values that are compared to fixed time values. See explanation in *parameter 13-10 Comparator Operand*. Comparators are evaluated once in each scan interval. Use the result (TRUE or FALSE) directly. All parameters in this parameter group are array parameters with index 0 to 5. Select index 0 to programme Comparator 0, select index 1 to programme Comparator 1, and so on.

13-10 Comparator Operand		
Array [6]		
Option:		**Function:**
		Select the variable to be monitored by the comparator.
[0] *	Disabled	
[1]	Reference	
[2]	Feedback	
[3]	Motor speed	
[4]	Motor Current	
[6]	Motor power	
[7]	Motor voltage	
[12]	Analog input AI53	
[13]	Analog input AI54	
[20]	Alarm number	
[30]	Counter A	
[31]	Counter B	

13-11 Comparator Operator		
Array [6]		
Option:		**Function:**
[0]	Less Than (<)	Select *[0]* < for the result of the evaluation to be TRUE, when the variable selected in *parameter 13-10 Comparator Operand* is smaller than the fixed value in *parameter 13-12 Comparator Value*. The result is FALSE, if the variable selected in *parameter 13-10 Comparator Operand* is greater than the fixed value in *parameter 13-12 Comparator Value*.
[1] *	Approx.Equal (~)	Select *[1]* ≈ for the result of the evaluation to be TRUE, when the variable selected in *parameter 13-10 Comparator Operand* is approximately equal to the fixed value in *parameter 13-12 Comparator Value*.
[2]	Greater Than (>)	Select *[2]* > for the inverse logic of option *[0]* <.

13-12 Comparator Value		
Array [6]		
Range:		**Function:**
0*	[-9999 - 9999]	Enter the 'trigger level' for the variable that is monitored by this comparator. This is an array parameter containing comparator values 0 to 5.

4.9.4 13-2* Timers

Use the result (TRUE or FALSE) from *timers* directly to define an *event* (see *parameter 13-51 SL Controller Event*), or as boolean input in a *logic rule* (see *parameter 13-40 Logic Rule Boolean 1*, *parameter 13-42 Logic Rule Boolean 2* or *parameter 13-44 Logic Rule Boolean 3*). A timer is only FALSE when started by an action (i.e. *[29] Start timer 1*) until the timer value entered in this parameter is elapsed. Then it becomes TRUE again.
All parameters in this parameter group are array parameters with index 0 to 2. Select index 0 to program Timer 0, select index 1 to program Timer 1, and so on.

13-20 SL Controller Timer		
Array [8]		
Range:		**Function:**
0 s*	[0 - 3600 s]	Enter the value to define the duration of the FALSE output from the programmed timer. A timer is only FALSE if it is started by an action (see *13-52 SL Controller Action* [29-31] and *13-52 SL Controller Action* [70-74] Start timer X) and until the timer value has elapsed. Array parameter containing timers 0 to 7.

4.9.5 13-4* Logic Rules

Combine up to 3 boolean inputs (TRUE/FALSE inputs) from timers, comparators, digital inputs, status bits and events using the logical operators AND, OR, and NOT. Select boolean inputs for the calculation in *parameter 13-40 Logic Rule Boolean 1*, *parameter 13-42 Logic Rule Boolean 2* and *parameter 13-44 Logic Rule Boolean 3*. Define the operators used to logically combine the selected inputs in *parameter 13-41 Logic Rule Operator 1* and *parameter 13-43 Logic Rule Operator 2*.

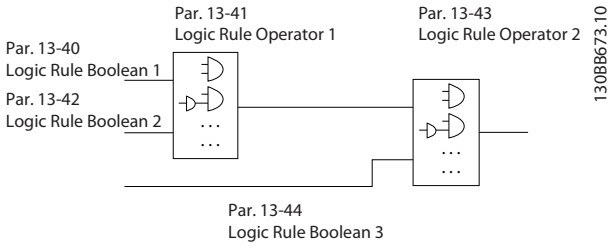

Illustration 4.17 Logic Rules

Priority of calculation
The results of *parameter 13-40 Logic Rule Boolean 1*, *parameter 13-41 Logic Rule Operator 1* and *parameter 13-42 Logic Rule Boolean 2* are calculated first. The outcome (TRUE/FALSE) of this calculation is combined with the settings of *parameter 13-43 Logic Rule Operator 2* and *parameter 13-44 Logic Rule Boolean 3*, yielding the final result (TRUE/FALSE) of the logic rule.

13-40 Logic Rule Boolean 1		
Array [6]		
Option:		**Function:**
[0] *	False	Enters the fixed value of FALSE in the logic rule.

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13-40 Logic Rule Boolean 1		
Array [6]		
Option:		**Function:**
[1]	True	Enters the fixed value TRUE in the logic rule.
[2]	Running	See *parameter 13-01 Start Event* for further description.
[3]	In range	See *parameter 13-01 Start Event* for further description.
[4]	On reference	See *parameter 13-01 Start Event* for further description.
[7]	Out of current range	See *parameter 13-01 Start Event* for further description.
[8]	Below I low	See *parameter 13-01 Start Event* for further description.
[9]	Above I high	See *parameter 13-01 Start Event* for further description.
[16]	Thermal warning	See *parameter 13-01 Start Event* for further description.
[17]	Mains out of range	See *parameter 13-01 Start Event* for further description.
[18]	Reversing	See *parameter 13-01 Start Event* for further description.
[19]	Warning	See *parameter 13-01 Start Event* for further description.
[20]	Alarm (trip)	See *parameter 13-01 Start Event* for further description.
[21]	Alarm (trip lock)	See *parameter 13-01 Start Event* for further description.
[22]	Comparator 0	Use the result of comparator 0 in the logic rule.
[23]	Comparator 1	Use the result of comparator 1 in the logic rule.
[24]	Comparator 2	Use the result of comparator 2 in the logic rule.
[25]	Comparator 3	Use the result of comparator 3 in the logic rule.
[26]	Logic rule 0	Use the result of logic rule 0 in the logic rule.
[27]	Logic rule 1	Use the result of logic rule 1 in the logic rule.
[28]	Logic rule 2	Use the result of logic rule 2 in the logic rule.
[29]	Logic rule 3	Use the result of logic rule 3 in the logic rule.
[30]	SL Time-out 0	Use the result of timer 0 in the logic rule.
[31]	SL Time-out 1	Use the result of timer 1 in the logic rule.

13-40 Logic Rule Boolean 1		
Array [6]		
Option:		**Function:**
[32]	SL Time-out 2	Use the result of timer 2 in the logic rule.
[33]	Digital input DI18	Use the value of DI18 in the logic rule (High = TRUE).
[34]	Digital input DI19	Use the value of DI19 in the logic rule (High = TRUE).
[35]	Digital input DI27	Use the value of DI27 in the logic rule (High = TRUE).
[36]	Digital input DI29	Use the value of DI29 in the logic rule (High = TRUE).
[39]	Start command	This logic rule is TRUE if the frequency converter is started by any means (either via digital input, or other).
[40]	Drive stopped	This logic rule is TRUE if the frequency converter is stopped or coasted by any means (either via digital input, or other).
[42]	Auto Reset Trip	This logic rule is TRUE if the frequency converter is tripped (but not trip-locked) and an Automatic Reset is issued.
[50]	Comparator 4	Use the result of comparator 4 in the logic rule.
[51]	Comparator 5	Use the result of comparator 5 in the logic rule.
[60]	Logic rule 4	Use the result of logic rule 4 in the logic rule.
[61]	Logic rule 5	Use the result of logic rule 5 in the logic rule.
[70]	SL Time-out 3	Use the result of timer 3 in the logic rule.
[71]	SL Time-out 4	Use the result of timer 4 in the logic rule.
[72]	SL Time-out 5	Use the result of timer 5 in the logic rule.
[73]	SL Time-out 6	Use the result of timer 6 in the logic rule.
[74]	SL Time-out 7	Use the result of timer 7 in the logic rule.
[83]	Broken Belt	A broken belt condition has been detected. This function must be enabled in *parameter 22-60 Broken Belt Function*.

13-41 Logic Rule Operator 1		
Option:		**Function:**
[0] *	Disabled	
[1]	AND	
[2]	OR	
[3]	AND NOT	
[4]	OR NOT	
[5]	NOT AND	
[6]	NOT OR	
[7]	NOT AND NOT	
[8]	NOT OR NOT	

13-42 Logic Rule Boolean 2		
Array [6]		
Option:		**Function:**
		Select the second boolean (TRUE or FALSE) input for the selected logic rule. See *parameter 13-40 Logic Rule Boolean 1* for further descriptions of choices and their functions.
[0] *	False	
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL Time-out 0	
[31]	SL Time-out 1	
[32]	SL Time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[39]	Start command	
[40]	Drive stopped	
[42]	Auto Reset Trip	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[70]	SL Time-out 3	
[71]	SL Time-out 4	
[72]	SL Time-out 5	
[73]	SL Time-out 6	
[74]	SL Time-out 7	
[83]	Broken Belt	A broken belt condition has been detected. This function must be enabled in *parameter 22-60 Broken Belt Function*.

13-43 Logic Rule Operator 2		
Array [6]		
Option:		**Function:**
		Select the second logical operator to be used on the boolean input calculated in *parameter 13-40 Logic Rule Boolean 1*, *parameter 13-41 Logic Rule Operator 1*, and *parameter 13-42 Logic Rule Boolean 2*, and the boolean input coming from *parameter 13-42 Logic Rule Boolean 2*. [13-44] signifies the boolean input of *parameter 13-44 Logic Rule Boolean 3*. [13-40/13-42] signifies the boolean input calculated in *parameter 13-40 Logic Rule Boolean 1*, *parameter 13-41 Logic Rule Operator 1*, and *parameter 13-42 Logic Rule Boolean 2*. *[0] DISABLED* (factory setting). select this option to ignore *parameter 13-44 Logic Rule Boolean 3*.
[0] *	Disabled	
[1]	AND	
[2]	OR	
[3]	AND NOT	
[4]	OR NOT	
[5]	NOT AND	
[6]	NOT OR	
[7]	NOT AND NOT	
[8]	NOT OR NOT	

13-44 Logic Rule Boolean 3		
Array [6]		
Option:		**Function:**
		Select the third boolean (TRUE or FALSE) input for the selected logic rule. See *parameter 13-40 Logic Rule Boolean 1* for further descriptions of choices and their functions.
[0] *	False	
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[16]	Thermal warning	

4

13-44 Logic Rule Boolean 3		
Array [6]		
Option:		**Function:**
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL Time-out 0	
[31]	SL Time-out 1	
[32]	SL Time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[39]	Start command	
[40]	Drive stopped	
[42]	Auto Reset Trip	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[70]	SL Time-out 3	
[71]	SL Time-out 4	
[72]	SL Time-out 5	
[73]	SL Time-out 6	
[74]	SL Time-out 7	
[83]	Broken Belt	

4.9.6 13-5* States

13-51 SL Controller Event		
Array [20]		
Option:		**Function:**
		Select the boolean input (TRUE or FALSE) to define the Smart Logic Controller event. See *parameter 13-02 Stop Event* for further descriptions of choices and their functions.
[0] *	False	
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	

13-51 SL Controller Event		
Array [20]		
Option:		**Function:**
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL Time-out 0	
[31]	SL Time-out 1	
[32]	SL Time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[39]	Start command	
[40]	Drive stopped	
[42]	Auto Reset Trip	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[70]	SL Time-out 3	
[71]	SL Time-out 4	
[72]	SL Time-out 5	
[73]	SL Time-out 6	
[74]	SL Time-out 7	
[83]	Broken Belt	

13-52 SL Controller Action		
Array [20]		
Option:		**Function:**
		Select the action corresponding to the SLC event. Actions are executed when the corresponding event (defined in *parameter 13-51 SL Controller Event*) is evaluated as true. The following actions are available for selection:
[0] *	Disabled	
[1]	No action	
[2]	Select set-up 1	Changes the active set-up (*parameter 0-10 Active Set-up*) to '1'.

13-52 SL Controller Action		
Array [20]		
Option:		**Function:**
[3]	Select set-up 2	Changes the active set-up (*parameter 0-10 Active Set-up*) to '2'.
[10]	Select preset ref 0	Selects preset reference 0.
[11]	Select preset ref 1	Selects preset reference 1.
[12]	Select preset ref 2	Selects preset reference 2.
[13]	Select preset ref 3	Selects preset reference 3.
[14]	Select preset ref 4	Selects preset reference 4.
[15]	Select preset ref 5	Selects preset reference 5.
[16]	Select preset ref 6	Selects preset reference 6.
[17]	Select preset ref 7	Selects preset reference 7. If the active preset reference is changed, it will merge with other preset reference commands coming from either the digital inputs or via a fieldbus.
[18]	Select ramp 1	Selects ramp 1
[19]	Select ramp 2	Selects ramp 2
[22]	Run	Issues a start command to the frequency converter.
[23]	Run reverse	Issues a start reverse command to the frequency converter.
[24]	Stop	Issues a stop command to the frequency converter.
[25]	Qstop	Issues a quick stop command to the frequency converter.
[26]	DC Brake	Issues a DC stop command to the frequency converter.
[27]	Coast	The frequency converter coasts immediately. All stop commands including the coast command stop the SLC.
[28]	Freeze output	Freezes the output frequency of the frequency converter.
[29]	Start timer 0	Starts timer 0, see *parameter 13-20 SL Controller Timer* for further description.
[30]	Start timer 1	Starts timer 1, see *parameter 13-20 SL Controller Timer* for further description.
[31]	Start timer 2	Starts timer 2, see *parameter 13-20 SL Controller Timer* for further description.
[32]	Set digital out A low	Any output with 'digital output 1' selected is low (off).

13-52 SL Controller Action		
Array [20]		
Option:		**Function:**
[33]	Set digital out B low	Any output with 'digital output 2' selected is low (off).
[34]	Set digital out C low	Any output with 'digital output 3' selected is low (off).
[35]	Set digital out D low	Any output with 'digital output 4' selected is low (off).
[38]	Set digital out A high	Any output with 'digital output 1' selected is high (closed).
[39]	Set digital out B high	Any output with 'digital output 2' selected is high (closed).
[40]	Set digital out C high	Any output with 'digital output 3' selected is high (closed).
[41]	Set digital out D high	Any output with 'digital output 4' selected is high (closed).
[60]	Reset Counter A	Resets Counter A to zero.
[61]	Reset Counter B	Resets Counter B to zero.
[70]	Start Timer 3	Starts timer 3, see *parameter 13-20 SL Controller Timer* for further description.
[71]	Start Timer 4	Starts timer 4, see *parameter 13-20 SL Controller Timer* for further description.
[72]	Start Timer 5	Starts timer 5, see *parameter 13-20 SL Controller Timer* for further description.
[73]	Start Timer 6	Starts timer 6, see *parameter 13-20 SL Controller Timer* for further description.
[74]	Start Timer 7	Starts timer 7, see *parameter 13-20 SL Controller Timer* for further description.

4.10 Main Menu - Special Functions - Group 14

4.10.1 14-0* Inverter Switching

14-01 Switching Frequency

Option:		Function:
		Select the inverter switching frequency. Changing the switching frequency can help to reduce acoustic noise from the motor. ***NOTICE*** **The output frequency value of the frequency converter must never exceed 1/10 of the switching frequency. When the motor is running, adjust the switching frequency in *parameter 14-01 Switching Frequency* until the motor is as noiseless as possible.** ***NOTICE*** **High switching frequencies heat the frequency converter and may reduce its lifetime.** ***NOTICE*** **Not all choices are available in all power sizes.**
[0]	Ran3	3 kHz true random PWM (White noise modulation)
[1]	Ran5	5 kHz true random PWM (white noise modulation)
[2]	2.0 kHz	
[3]	3.0 kHz	
[4]	4.0 kHz	
[5]	5.0 kHz	
[6]	6.0 kHz	
[7]	8.0 kHz	
[8]	10.0 kHz	
[9]	12.0kHz	
[10]	16.0kHz	

14-03 Overmodulation

Option:	Function:	
[0]	Off	Selects no over-modulation of the output voltage in order to avoid torque ripple on the motor shaft.
[1]	On	The over-modulation function generates an extra voltage of up-to 8% of U_{max}output voltage without over-modulation, which results in an extra torque of 10-12% in the middle of the over-syncronous range (from 0% at nominal speed rising to approximately 12% at double nominal speed).

14-07 Dead Time Compensation Level

Range:		Function:
[1]	On	
* Expres-sionlimit(0)	[0 - 100]	Level of applied deadtime compen-sation in percentage. A high level (>90%) optimises the dynamic motor response, a level of 50-90% is good for both motor-torque-ripple minimi-sation and the motor dynamics, a zero level turns the deadtime compen-sation off.

14-08 Damping Gain Factor

Range:		Function:
96 %*	[0 - 100 %]	Damping factor for DC-Link Voltage Compensation.

4.10.2 14-1* Mains On/Off

Parameters for configuring mains failure monitoring and handling.

14-10 Function at Mains Imbalance

Option:		Function:
		This parameter tells the frequency converter what to do in the event that mains voltage drops below the limit set in *14-11 Mains Voltage at Mains Fault*
[0] *	No function	
[3]	Coasting	

14-11 Mains Voltage at Mains Fault

Range:		Function:
Expres-sionlimit(342) V*	[100 - 800 V]	This parameter defines at which AC voltage the selected function in *14-10 Mains Failure* should be activated.

14-12 Function at Mains Imbalance

Option:		Function:
		Operation under severe mains imbalance conditions reduces the lifetime of the motor. Conditions are considered severe if the motor is operated continuously near nominal load (e.g. a pump or fan running near full speed). When a severe mains imbalance is detected:
[0] *	Trip	Trips the frequency converter.
[1]	Warning	Issues a warning.
[2]	Disabled	No action. **⚠CAUTION** **May cause reduced life time.**

4.10.3 14-2* Trip Reset

14-20 Reset Mode		
Option:		**Function:**
		NOTICE **Automatic reset is also active for resetting safe stop function.** Select the reset function after tripping. Once reset, the frequency converter can be restarted.
[0] *	Manual reset	Select *[0] Manual reset*, to perform a reset via [Reset] or via the digital inputs.
[1]	Automatic reset x 1	Select *[1]-[12] Automatic reset x 1… x20* to perform between 1 and 20 automatic resets after tripping.
[2]	Automatic reset x 2	
[3]	Automatic reset x 3	
[4]	Automatic reset x 4	
[5]	Automatic reset x 5	
[6]	Automatic reset x 6	
[7]	Automatic reset x 7	
[8]	Automatic reset x 8	
[9]	Automatic reset x 9	
[10]	Automatic reset x 10	
[11]	Automatic reset x 15	
[12]	Automatic reset x 20	
[13]	Infinite auto reset	Select *[13] Infinite Automatic Reset* for continuous resetting after tripping.

14-21 Automatic Restart Time		
Range:		**Function:**
10 s*	[0 - 600 s]	Enter the time interval from trip to start of the automatic reset function. This parameter is active when *parameter 14-20 Reset Mode* is set to *[1] - [13] Automatic reset*.

14-22 Operation Mode		
Option:		**Function:**
		Select *[2] Initialisation* to reset all parameter values to default.
[0] *	Normal operation	Select *[0] Normal operation* for normal operation of the frequency converter with the motor in the selected application.
[2]	Initialisation	Select *[2] Initialisation* to reset all parameter values to default settings, except for *parameter 15-03 Power Up's*, *parameter 15-04 Over Temp's* and *parameter 15-05 Over Volt's*. The frequency converter is reset during the next power-up.

14-22 Operation Mode		
Option:		**Function:**
		Parameter 14-22 Operation Mode also reverts to the default setting *[0] Normal operation*.

14-27 Action At Inverter Fault		
Option:		**Function:**
		Select how the frequency converter should react at inverter fault. Action At Inverter Fault
[0]	Trip	
[1] *	Warning	

4.10.4 14-4* Energy Optimising

Parameters for adjusting the energy optimisation level in both Variable Torque (VT) and Automatic Energy Optimisation (AEO) mode.

Automatic Energy Optimisation is only active if *parameter 1-03 Torque Characteristics*, is set for *[3] Auto Energy Optim*.

14-40 VT Level		
Range:		**Function:**
90 %*	[40 - 90 %]	***NOTICE*** **This parameter cannot be adjusted while the motor is running.** Enter the level of motor magnetisation at low speed. Selection of a low value reduces energy loss in the motor, but also reduces load capability.
90%*	[40-90%]	

14-41 AEO Minimum Magnetisation		
Range:		**Function:**
66 %*	[40 - 75 %]	Enter the minimum allowable magnetisation for AEO. Selection of a low value reduces energy loss in the motor, but can also reduce resistance to sudden load changes.
66%*	[40-75%]	

4.10.5 14-5* Environment

These parameters help the frequency converter to operate under special environmental conditions.

14-51 DC-Link Voltage Compensation		
Option:		**Function:**
[0]	Off	Disables DC Link Compensation.
[1] *	On	Enables DC Link Compensation.

14-55 Output Filter		
Option:		**Function:**
		Select whether an output filter is present.
[0] *	No Filter	
[1]	Sine-Wave Filter	
[3]	Sine-Wave Filter with Feedback	

4

4.10.6 14-6* Auto Derate

This group contains parameters for automatic derating of the output current of the frequency converter.

14-63 Min Switch Frequency		
Set the minimum switch frequency allowed by the output filter.		
Option:		**Function:**
[2] *	2.0 kHz	
[3]	3.0 kHz	
[4]	4.0 kHz	
[5]	5.0 kHz	
[6]	6.0 kHz	
[7]	8.0 kHz	
[8]	10.0 kHz	
[9]	12.0kHz	
[10]	16.0kHz	

14-64 Dead Time Compensation Zero Current Level

For a long motor cable, set this parameter to [0] to minimize the motor-torque ripple.

Option:		Function:
[0] *	Disabled	
[1]	Enabled	

14-65 Speed Derate Dead Time Compensation

Range:		Function:
Expres-sionlimit(50) Hz*	[Expres-sionlimit(20) - Expres-sionlimit(1000) Hz]	Deadtime compensation level is reduced linearly in relation to output frequency. The maximum level is set by *14-07 Dead Time Compensation Level*. The minimum output frequency level is defined in *14-65 Speed Derate Dead Time Compensation*.

4.10.7 14-9* Fault Settings

Fault Customisation Settings

14-90 Fault Level

Use this parameter to customise fault levels. Setting the parameter value may change *1-73 Flying Start*.

Option:		Function:
[3] *	Trip lock	
[4]	Trip with delayed reset	
[5]	Flystart	

4.11 Main Menu - Drive Information - Group 15

Parameter group containing frequency converter information such as operating data, hardware configuration and software versions.

4.11.1 15-0* Operating Data

15-00 Operating hours

Range:		Function:
0 h*	[0 - 0x7fffffff. h]	View how many hours the frequency converter has run. The value is saved when the frequency converter is turned off.

15-01 Running Hours

Range:		Function:
0 h*	[0 - 0x7fffffff. h]	View how many hours the motor has run. Reset the counter in *parameter 15-07 Reset Running Hours Counter*. The value is saved when the frequency converter is turned off.

15-02 kWh Counter

Range:		Function:
0 kWh*	[0 - 65535 kWh]	View the output power of the frequency converter in kWh as a mean value over 1 hour. Reset the counter in *parameter 15-06 Reset kWh Counter*.

15-03 Power Up's

Range:		Function:
0*	[0 - 2147483647]	View the number of times the frequency converter has been powered up.

15-04 Over Temp's

Range:		Function:
0*	[0 - 65535]	View the number of frequency converter temperature faults which have occurred.

15-05 Over Volt's

Range:		Function:
0*	[0 - 65535]	View the number of frequency converter overvoltages which have occurred.

15-06 Reset kWh Counter

Option:		Function:
		NOTICE **Pres [OK] to reset.**
[0] *	Do not reset	
[1]	Reset counter	Select *[1] Reset* and press [OK] to reset the kWh counter to zero (see *parameter 15-02 kWh Counter*).

15-07 Reset Running Hours Counter

Option:		Function:
[0] *	Do not reset	
[1]	Reset counter	Select *[1] Reset counter* and press [OK] to reset Running Hours counter (*parameter 15-01 Running Hours*) to zero (see also *parameter 15-01 Running Hours*).

4.11.2 15-3* Alarm Log

Parameters in this group are array parameters, where up to 10 fault logs can be viewed. [0] is the most recent logged data, and [9] the oldest. Error codes, values, and time stamp can be viewed for all logged data.

15-30 Alarm Log: Error Code

Range:		Function:
0*	[0 - 255]	View the error code and look up its meaning in *chapter 5 Diagnostics and Troubleshooting*.

15-31 InternalFaultReason		
Range:		**Function:**
0 *	[-32767 - 32767]	View a description of the error. This parameter is used in combination with alarm 38 Internal Fault.

4.11.3 15-4* Drive Identification

Parameters containing read only information about the hardware and software configuration of the frequency converter.

15-40 FC Type		
Range:		**Function:**
0*	[0 - 0]	View the FC type code. The read-out is identical to the frequency converter series power field of the type code definition, characters 1-6.

15-41 Power Section		
Range:		**Function:**
0*	[0 - 0]	View the FC type code. The read-out is identical to the frequency converter series power field of the type code definition, characters 7-10.

15-42 Voltage		
Range:		**Function:**
0*	[0 - 0]	View the FC type code. The read-out is identical to the frequency converter series power field of the type code definition, characters 11-12.

15-43 Software Version		
Range:		**Function:**
0*	[0 - 0]	View the software version of the frequency converter.

15-44 Ordered TypeCode		
Range:		**Function:**
0*	[0 - 0]	View the type code string used for re-ordering the frequency converter in its original configuration.

15-45 Actual Typecode String		
Range:		**Function:**
0*	[0 - 0]	View the actual type code string.

15-46 Drive Ordering No		
Range:		**Function:**
0*	[0 - 0]	View the 8-digit ordering number used for re-ordering the frequency converter in its original configuration.

15-48 LCP Id No		
Range:		**Function:**
0*	[0 - 0]	View the LCP ID number.

15-49 SW ID Control Card		
Range:		**Function:**
0*	[0 - 0]	View the control card software version number.

15-50 SW ID Power Card		
Range:		**Function:**
0*	[0 - 0]	View the power card software version number.

15-51 Drive Serial Number		
Range:		**Function:**
0*	[0 - 0]	View the frequency converter serial number.

15-52 OEM Information		
Range:		**Function:**
0 *	[0 - 0]	View the OEM Information. [0] OEM Name [1] OEM Type Code [2] OEM Identification number [3] OEM Serial Number

15-53 Power Card Serial Number		
Range:		**Function:**
0*	[0 - 0]	View the power card serial number.

15-57 File version		
Range:		**Function:**
0 *	[0 - 255]	View file version. [0] OEM-SIVP File Version [1] Motor Database File Version [2] Pump Table File Version

15-92 Defined Parameters		
Range:		**Function:**
0*	[0 - 2000]	

15-97 Application Type		
Range:		**Function:**
0*	[0 - 0xFFFFFFFF]	

15-98 Drive Identification		
Range:		**Function:**
0*	[0 - 0]	

4.12 Main Menu - Data Readouts - Group 16

4.12.1 16-0* General Status

16-00 Control Word		
Range:		**Function:**
0*	[0 - 65535]	View the Control word sent from the frequency converter via the serial communication port in hex code.

Bit number															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Bit	Bit = 0									Bit = 1					
00	Preset reference choice lsb														
01	Preset reference choice second bit of preset references														
02	DC brake									Ramp					
03	Coasting									Enable					
04	Quick-stop									Ramp					
05	Freeze output									Ramp					
06	Ramp stop									Start					
07	No function									Reset					
08	No function									Jog					
09	Ramp 1									Ramp 2					
10	Data not valid									Valid					
11	Relay_A not active									Relay_A activated					
12	Relay_B not active									Relay_B activated					
13	Choice of Setup lsb														
14	No function									No function					
15	No function									Reversing					

Table 4.7 Control Word

16-01 Reference [Unit]		
Range:		**Function:**
0 ReferenceFeedbackUnit*	[-4999 - 4999 ReferenceFeedbackUnit]	View the present reference value applied on impulse or analog basis in the unit resulting from the configuration selected in *parameter 1-00 Configuration Mode* (Hz).

16-02 Reference [%]		
Range:		**Function:**
0 %*	[-200 - 200 %]	View the total reference. The total reference is the sum of digital, analog, preset, bus, and freeze references.

16-03 Status Word		
Range:		**Function:**
0*	[0 - 65535]	View the Status word sent from the frequency converter via the serial communication port in hex code.

Bit number															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Bit	Bit = 0									Bit = 1					
00	Control not ready									Ready					
01	VLT not ready									Ready					
02	Coasting									Enable					
03	No fault									Trip					
04	No warning									Warning					
05	Reserved														
06	No trip lock									Trip lock					
07	No warning									Warning					
08	Speed ≠ ref.									Speed = ref.					
09	Local control									Bus control					
10	Out of range									Frequency OK					
11	Not running									Running					
12	No function									No function					
13	Voltage OK									Above limit					
14	Current OK									Above limit					
15	Temperature OK									Above limit					

Table 4.8 Status Word

16-05 Main Actual Value [%]		
Range:		**Function:**
0 %*	[-200 - 200 %]	View the 2-byte word sent with the Status word to the bus Master reporting the Main Actual Value.

16-09 Custom Readout		
Range:		**Function:**
0 CustomReadoutUnit*	[0 - 9999 CustomReadoutUnit]	View the user-defined readouts as defined in *parameter 0-30 Custom Readout Unit*, *parameter 0-31 Custom Readout Min Value* and *parameter 0-32 Custom Readout Max Value*. Custom Readout

4.12.2 16-1* Motor Status

16-10 Power [kW]		
Range:		**Function:**
0 kW*	[0 - 1000 kW]	Displays DC link power in kW. The value shown is calculated on the basis of the actual motor voltage and motor current.

16-11 Power [hp]		
Range:		**Function:**
0 hp*	[0 - 1000 hp]	View the DC link power in hp. The value shown is calculated on the basis of the actual motor voltage and motor current.

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16-12 Motor Voltage

Range:		Function:
0 V*	[0 - 65535 V]	View the motor voltage, a calculated value used for controlling the motor.

16-13 Frequency

Range:		Function:
0 Hz*	[0 - 6553.5 Hz]	View the motor frequency, without resonance dampening.

16-14 Motor current

Range:		Function:
0 A*	[0 - 655.35 A]	View the motor current measured as a mean value, I_{RMS}.

16-15 Frequency [%]

Range:		Function:
0 %*	[0 - 6553.5 %]	View a 2-byte word reporting the actual motor frequency (without resonance dampening) as a percentage (scale 0000-4000 Hex) of *parameter 4-19 Max Output Frequency*.

16–16 Torque [Nm]

Range:		Function:
0.0 Nm*	[-30000.0-30000.0 Nm]	View the torque value with sign, applied to the motor shaft. Some motors supply more than 160% torque. So the min. value and the max. value are dependent on the max. motor current as well as the motor used.

16-18 Motor Thermal

Range:		Function:
0 %*	[0 - 100 %]	View the calculated motor temperature in percentage of allowed maximum. At 100% a trip will occur, if selected in *parameter 1-90 Motor Thermal Protection*. The basis for the calculation is the ETR function selected in *parameter 1-90 Motor Thermal Protection*.

4.12.3 16-2*

16-22 Torque [%]

Range:		Function:
0 %*	[-200 - 200 %]	View the torque in percent of nominal torque, with sign, applied to the motor shaft.

16-26 Power Filtered [kW]

Motor power consumption. The value shown is calculated on basis of the real-time motor voltage and motor current. The value is filtered, and a few seconds may pass from when an input value changes to when the data read-out values change.

Range:		Function:
0 kW*	[0 - 1000 kW]	

16-27 Power Filtered [hp]

Motor power in hp. The value shown is calculated on the basis of real-time motor voltage and motor current. The value is filtered, and a few seconds may pass from when an input value changes to when the data read-out values change.

Range:		Function:
0 hp*	[0 - 1000 hp]	

4.12.4 16-3* Drive Status

16-30 DC Link Voltage

Range:		Function:
0 V*	[0 - 65535 V]	View a measured value.

16-34 Heatsink Temp.

Range:		Function:
0 °C*	[0 - 255 °C]	View the heat sink temperature of the frequency converter.

16-35 Inverter Thermal

Range:		Function:
0 %*	[0 - 255 %]	View the percentage of thermal load on the frequency converter. At 100% a trip occurs.

16-36 Inv. Nom. Current

Range:		Function:
0 A*	[0 - 655.35 A]	View the inverter nominal current, which should match the nameplate data on the connected motor. The data are used for motor protection, etc.

16-37 Inv. Max. Current

Range:		Function:
0 A*	[0 - 655.35 A]	View the inverter maximum current. The data are used for calculation of frequency converter protection, etc.

16-38 SL Controller State

Range:		Function:
0*	[0 - 20]	View the actual state of the Smart Logic Controller (SLC).

4.12.5 16-5* Ref. & Feedb.

16-50 External Reference		
Range:		**Function:**
0 %*	[-200 - 200 %]	View the total reference, the sum of digital, analog, preset, bus and freeze references.

16-52 Feedback[Unit]		
Range:		**Function:**
0 ProcessCtrlUnit*	[-4999 - 4999 ProcessCtrlUnit]	View the feedback resulting from the selection of scaling in *parameter 3-02 Minimum Reference* and *parameter 3-03 Maximum Reference*.

4.12.6 16-6* Inputs and Outputs

16-60 Digital Input		
Range:		**Function:**
0*	[0 - 65535]	View actual state of the digital inputs 18, 19, 27 and 29.

Bit 0	Unused
Bit 1	Unused
Bit 2	Digital input term. 29
Bit 3	Digital input term. 27
Bit 4	Digital input term. 19
Bit 5	Digital input term. 18
Bit 6~15	Unused

Table 4.9 Bits Definition

16-61 Terminal 53 Setting		
Option:		**Function:**
		View the setting of input terminal 53. Current = 0; Voltage = 1.
[0] *	Current mode	
[1]	Voltage mode	

16-62 Analog Input AI53		
Range:		**Function:**
1*	[0 - 20]	View the actual value at input 53.

16-63 Terminal 54 Setting		
Option:		**Function:**
		View the setting of input terminal 54. Current = 0; Voltage = 1.
[0] *	Current mode	
[1]	Voltage mode	

16-64 Analog Input AI54		
Range:		**Function:**
1*	[0 - 20]	View the actual value at input 54.

16-65 Analog Output AO42 [mA]		
Range:		**Function:**
0 mA*	[0 - 20 mA]	View the actual value at output 42 in mA. The value shown reflects the selection in *6-90 Terminal 42 Mode* and *6-91 Terminal 42 Analog Output*.

16-66 Digital Output		
Range:		**Function:**
0*	[0 - 15]	View the binary value of all digital outputs. **Definition:** X: Not used 0: Low 1: High

XX	**None used**
X0	Terminal 42 not used, Terminal 45 low
X1	Terminal 42 not used, Terminal 45 High
0X	Terminal 42 low, Terminal 45 not used
0	Terminal 42 low, Terminal 45 low
1	Terminal 42 low, Terminal 45 high
1X	Terminal 42 high, Terminal 45 not used
10	Terminal 42 high, Terminal 45 low
11	Terminal 42 high, Terminal 45 high

Table 4.10 Binary Value of Digital Outputs

16-67 Pulse Input #29 [Hz]		
Range:		**Function:**
0 *	[0 - 130000]	View the actual frequency rate on terminal 29.

16-71 Relay Output [bin]		
Range:		**Function:**
0*	[0 - 65535]	View the setting of the relay. Bits definition:

Bit 0~2	Unused
Bit 3	Relay 02
Bit 4	Relay 01
Bit 5~15	Unused

Table 4.11 Relay Setting

4

16-72 Counter A		
Range:		**Function:**
0*	[-32768 - 32767]	View the present value of Counter A. Counters are useful as comparator operands, see *parameter 13-10 Comparator Operand*. The value can be reset or changed either via digital inputs (parameter group *5-1* Digital Inputs*) or by using an SLC action (*parameter 13-52 SL Controller Action*).

16-73 Counter B		
Range:		**Function:**
0*	[-32768 - 32767]	View the present value of Counter B. Counters are useful as comparator operands (*13-10 Comparator Operand*). The value can be reset or changed either via digital inputs (parameter group *5-1* Digital Inputs*) or by using an SLC action (*parameter 13-52 SL Controller Action*).

16-79 Analog Output AO45		
Range:		**Function:**
0 mA*	[0 - 20 mA]	

4.12.7 16-8* Fieldbus & FC Port

Parameters for reporting the BUS references and control words.

16-86 FC Port REF 1		
Range:		**Function:**
0*	[-32768 - 32767]	View the last received reference from the FC port.

4.12.8 16-9* Diagnosis Read-Outs

16-90 Alarm Word		
Range:		**Function:**
0*	[0 - 0xFFFFFFFFUL]	View the alarm word sent via the serial communication port in hex code.

16-91 Alarm Word 2		
Range:		**Function:**
0*	[0 - 0xFFFFFFFFUL]	View the alarm word 2 sent via the serial communication port in hex code.

16-92 Warning Word		
Range:		**Function:**
0*	[0 - 0xFFFFFFFFUL]	View the warning word sent via the serial communication port in hex code.

16-93 Warning Word 2		
Range:		**Function:**
0*	[0 - 0xFFFFFFFFUL]	View the warning word 2 sent via the serial communication port in hex code.

16-94 Ext. Status Word		
Range:		**Function:**
0*	[0 - 0xFFFFFFFFUL]	Returns the extended status word sent via the serial communication port in hex code.

16-95 Ext. Status Word 2		
Range:		**Function:**
0*	[0 - 0xFFFFFFFFUL]	Returns the extended status word 2 sent via the serial communication port in hex code.

4.13 Main Menu - Data Readouts 2 - Group 18

Parameters in this group are array parameters, where up to 10 fault logs can be viewed. [0] is the most recent logged data, and [9] the oldest. Error codes, values, and time stamp can be viewed for all logged data

4.13.1 18-1* Fire Mode Log

18-10 FireMode Log:Event		
Range:		**Function:**
0*	[0 - 255]	View Firemode event.

4.13.2 18-5* Ref. & Feedb.

18-50 Sensorless Readout [unit]		
View the pressure or flow resulting from the sensorless calculations. This value is not the value used for control. The value will only be updated if sensorless data supports both flow and pressure.		
Range:		**Function:**
0 SensorlessUnit*	[-999999.999 - 999999.999 SensorlessUnit]	

4.14 Main Menu - FC Closed Loop - Group 20

This parameter group is used for configuring the closed loop PI Controller, that controls the output frequency of the frequency converter.

4.14.1 20-0* Feedback

This parameter group is used to configure the feedback signal for the closed loop PI control of the frequency converter.

20-00 Feedback 1 Source		
Option:		**Function:**
		This parameter defines the inputs used as the source of the feedback signal.
[0]	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[3]	Pulse input 29	
[100]	Bus Feedback 1	
[104]	Sensorless Flow	
[105]	Sensorless Pressure	

20-01 Feedback 1 Conversion		
Option:		**Function:**
		This parameter allows a conversion function to be applied to Feedback 1.
[0] *	Linear	*[0] Linear* has no effect on the feedback.
[1]	Square root	*[1] Square root* is commonly used when a pressure sensor is used to provide flow feedback ($(flow \propto \sqrt{pressure})$).

20-12 Reference/Feedback Unit

4.14.2 20-6* Sensorless

20-60 Sensorless Unit		
Select the unit to be used with *18-50 Sensorless Readout*.		
Option:		**Function:**
[20]	l/s	

20-69 Sensorless Information		
Range:		**Function:**
0 *	[0 - 0]	View information about the sensorless data.

4.14.3 20-8* PI Basic Settings

Parameters for configuring the Process PI control.

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

20-83 PI Start Speed [Hz]		
Range:		**Function:**
0 Hz*	[0 - 200.0 Hz]	Enter the motor speed to be attained as a start signal for commencement of PI control. Upon power up, the frequency converter operates using speed open loop control. When the Process PI start speed is reached, the frequency converter changes to PI control.

20-84 On Reference Bandwidth		
Range:		**Function:**
5 %*	[0 - 200 %]	When the difference between the feedback and the setpoint reference is less than the value of this parameter, the frequency converter's display shows "Run on Reference". This status can be communicated externally by programming the function of a digital output for *[8] Run on Reference/No Warning*. In addition, for serial communications, the On Reference status bit of the frequency converter's Status Word is high (1). The *On Reference Bandwidth* is calculated as a percentage of the setpoint reference.

4

4.14.4 20-9* PI Controller

20-91 PI Anti Windup		
Option:		**Function:**
[0]	Off	Continue regulation of an error even when the output frequency cannot be increased or decreased.
[1] *	On	Cease regulation of an error when the output frequency can no longer be adjusted.

20-93 PI Proportional Gain		
Range:		**Function:**
0.50*	[0 - 10]	Enter the process controller proportional gain. Quick control is obtained at high amplification. However if amplification is too great, the process may become unstable.

20-94 PI Integral Time		
Range:		**Function:**
20 s*	[0.10 - 9999 s]	Enter the process controller integral time. Obtain quick control through a short integral time, though if the integral time is too short, the process becomes unstable. An excessively long integral time disables the integral action.

20-97 PI Feed Forward Factor		
Range:		**Function:**
0 %*	[0 - 400 %]	

4.15 Main Menu - Application Functions - Group 22

4.15.1 22-01 Power Filter Time

22-01 Power Filter Time		
Range:		**Function:**
0.50 s*	[0.02 - 10 s]	Set the time constant for the filtered power readout. A higher value gives a more steady readout, but a slower system response to changes.

4.15.2 22-4* Sleep Mode

The purpose of sleep mode is to allow the frequency converter to stop itself in situations where the system is in balance, that is "satisfied". This saves energy, and keeps system from being "over-satisfied" (excessive pressure, water excessively cooled in cooling towers, building pressurisation problems). This is also important as some applications prevent the frequency converter from adjusting motor down to low speed. This might damage pumps, cause insufficient lubrication in gearboxes, and make fans unstable.

The sleep controller has 2 important functions - the ability to go to sleep at right time, and the ability to come out of a sleep mode at right time. The goal is to keep the frequency converter in sleep mode as long as possible to avoid cycling the motor on and off frequently, and at the same time keep the controlled system variable in acceptable range.

The sequence when running sleep mode in Open Loop:

1. The motor speed is less than *parameter 22-47 Sleep Speed [Hz]* and the motor has been running longer than *parameter 22-40 Minimum Run Time*.
2. The frequency converter ramps the motor speed down to *parameter 1-82 Min Speed for Function at Stop [Hz]*.
3. The frequency converter activates *parameter 1-80 Function at Stop*. The frequency converter is now in sleep mode.
4. The frequency converter compares the speed setpoint with *parameter 22-43 Wake-Up Speed [Hz]* to detect wake up situation.
5. The speed setpoint is greater than *parameter 22-43 Wake-Up Speed [Hz]* and the sleep condition has last for more than *parameter 22-41 Minimum Sleep Time*. The frequency converter is now out of sleep mode.
6. Go back to speed open loop control (ramp motor speed up to the speed setpoint).

The sequence when running sleep mode in Closed Loop:

1. If *parameter 20-81 PI Normal/ Inverse Control = [0] Normal*. When error between Reference and Feedback is greater than *parameter 22-44 Wake-Up Ref./FB Diff*, the frequency converter goes to Boost status. If *parameter 22-45 Setpoint Boost* is not set, the frequency converter goes into sleep mode.
2. After *parameter 22-46 Maximum Boost Time*, the frequency converter ramps the motor speed down to *parameter 1-82 Min Speed for Function at Stop [Hz]*.
3. The frequency converter activates *parameter 1-80 Function at Stop*. The frequency converter is now in Sleep mode.
4. When error between Reference and Feedback is greater than *parameter 22-44 Wake-Up Ref./FB Diff*, and the condition last more than *parameter 22-41 Minimum Sleep Time*, the frequency converter is out of sleep mode.
5. The frequency converter goes back to Close Loop control.

NOTICE

Sleep Mode is not active when Local Reference is active (set speed manually by means of navigation keys on the LCP).
Does not work in Hand-mode. Auto set-up in open loop must be carried out before setting input/output in closed loop.

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

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

22-43 Wake-Up Speed [Hz]		
Range:		**Function:**
10*	[0 - 400.0]	Only to be used if *1-00 Configuration Mode*, is set for Open Loop and speed reference is applied by an external controller. Set the reference speed at which the Sleep Mode should be deactivated

4

22-44 Wake-Up Ref./FB Diff		
Range:		**Function:**
10 %*	[0 - 100 %]	Only to be used if *parameter 1-00 Configuration Mode* is set for Closed Loop and the integrated PI controller is used for controlling the pressure. Set the pressure drop allowed in percentage of set point for the pressure (Pset) before cancelling the Sleep Mode.

22-45 Setpoint Boost		
Range:		**Function:**
0 %*	[-100 - 100 %]	Only to be used if *parameter 1-00 Configuration Mode*, is set for Closed Loop and the integrated PI controller is used. In systems with e.g. constant pressure control, it is advantageous to increase the system pressure before the motor is stopped. This extends the time in which the motor is stopped and help to avoid frequent start/stop. Set the desired over pressure/ temperature in percentage of set point for the pressure (P_{set})/temperature before entering the Sleep Mode. If setting for 5%, the boost pressure is P_{set}*1.05. The negative values can be used for e.g. cooling tower control where a negative change is needed.
0.0%*	[-100.0-100.0%]	

22-46 Maximum Boost Time		
Range:		**Function:**
60 s*	[0 - 600 s]	Only to be used if *parameter 1-00 Configuration Mode* is set for Closed Loop and the integrated PI controller is used for controlling the pressure. Set the maximum time for which boost mode is allowed. If the set time is exceeded, Sleep Mode will be entered, not waiting for the set boost pressure to be reached.

22-47 Sleep Speed [Hz]		
Range:		**Function:**
0*	[0 - 400.0]	Set the speed below which the frequency converter goes into Sleep Mode.

4.15.3 22-6* Broken Belt Detection

Use Broken Belt Detection in both closed and open loop systems for pumps and fans. If the estimated motor torque (current) is below the broken belt torque (current) value (*parameter 22-61 Broken Belt Torque*) and the frequency converter output frequency is above or equal to 15 Hz, *parameter 22-60 Broken Belt Function* is performed.

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 frequency converter continues to run, but activate a Broken Belt Warning [W95]. A frequency converter digital output or a serial communication bus can communicate a warning to other equipment.
[2]	Trip	The frequency converter stops running and activate a Broken Belt alarm [A 95]. A frequency converter digital output or a serial communication bus can communicate an alarm to other equipment.

NOTICE

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

NOTICE

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

22-61 Broken Belt Torque		
Range:		**Function:**
10 %*	[5 - 100 %]	Sets the broken belt torque as a percentage of the rated motor torque.

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

4.16 Main Menu - Application Functions 2 - Group 24

4.16.1 24-0* Fire Mode

⚠CAUTION

Note that the frequency converter is only one component of the system. Correct function of Fire Mode depends on the correct design and selection of system components. Ventilation systems working in life safety applications have to be approved by the local fire Authorities. Non-interruption of the frequency converter due to Fire-Mode operation could cause over pressure and result in damage to the system and components, hereunder dampers and air ducts. The frequency converter itself could be damaged and it may cause damage or fire. Danfoss accepts no responsibility for errors, malfunctions personal injury or any damage to the frequency converter itself or components herein, systems and components herein or other property when the frequency converter has been programmed for Fire Mode. In no event shall Danfoss be liable to the end user or any other party for any direct or indirect, special or consequential damage or loss suffered by such party, which has occurred due to the frequency converter being programmed and operated in Fire Mode.

Background
Fire Mode is for use in critical situations, where it is imperative for the motor to keep running, regardless of the frequency converter's normal protective functions. These could be ventilation fans in tunnels or stairwells for instance, where continued operation of the fan facilitates safe evacuation of personnel in the event of a fire. Some selections of Fire Mode Function cause alarms and trip conditions to be disregarded, enabling the motor to run without interruption.

Activation
Fire Mode is activated only via Digital Input terminals. See parameter group *5-1* Digital Inputs*.

Messages in display
When Fire Mode is activated, the display shows a status message "Fire Mode".
Once the Fire Mode is again deactivated, the status message disappears.
If, while the frequency converter is active in Fire Mode, a warranty-affecting alarm (see *24-09 FM Alarm Handling*) occurs, the display shows the status message "Fire Mode Limits Exceeded". Once this status message appears, it remains permanently, and cannot be removed.
Digital and relay outputs can be configured for the status messages "Fire Mode Active". See parameter group *5-3* Digital Outputs* and parameter group *5-4* Relays*.
The status messages "Fire Mode" and "Fire Mode Limits Exceeded" can be accessed via the extended status word.

Message	Type	LCP	Message	Warning Word 2	Ext. Status Word 2
Fire Mode	Status	+	+		+ (bit 25)
Fire Mode Limits Exceeded	Status	+	+		

Table 4.12 Fire Mode Display Messages

Log
An overview of events related to Fire Mode can be viewed in the Fire Mode log, parameter group *18-1* Fire Mode Log*. The log includes up to 10 of the latest events. *Fire Mode Limits Exceeded* has a higher priority than *Fire Mode Active*. The log cannot be reset.
Following events are logged:
*Warranty affecting alarms (see *24-09 FM Alarm Handling*, Fire Mode Alarm Handling)
*Fire Mode Activated
*Fire Mode Limits Exceeeded
All other alarms occurring while Fire Mode activated are logged as usual.

NOTICE

During Fire Mode operation all stop commands to the frequency converter are ignored, including Coast/Coast inverse and External Interlock.

NOTICE

If setting the command *[11] Start Reversing* on a digital input terminal in *parameter 5-10 Terminal 18 Digital Input*, the frequency converter understands this as a reversing command.

24-00 FM Function		
Option:		**Function:**
[0] *	Disabled	Fire Mode Function is not active.
[1]	Enabled-Run Forward	In this mode the motor will continue to operate in a clockwise direction.
[2]	Enabled-Run Reverse	In this mode the motor will continue to operate in a counter-clockwise direction.
[3]	Enabled-Coast	Whilst this mode is enabled, the output is disabled and the motor is allowed to coast to stop.
[4]	Enabled-Run Fwd/Rev	

NOTICE

In the above, alarms are produced or ignored in accordance with the selection in *24-09 FM Alarm Handling*.

24-05 FM Preset Reference		
Range:		**Function:**
0 %*	[-100 - 100 %]	Enter the required preset reference/set point as a percentage of the Fire Mode Max Reference set in Hz.

24-09 Fire Mode Alarm Handling		
Option:		**Function:**
[0]	Trip+Reset, Critical Alarms	If this mode is selected, the frequency converter will continue to run, ignoring most alarms, even if doing so may result in damage to the frequency converter. Critical alarms are alarms, which cannot be suppressed but a restart attempt is possible (Infinity Automatic Reset).
[1]	Trip, Critical Alarms	In case of a critical alarm, the frequency converter trips and does not auto-restart (Manual Reset).
[2]	Trip, All Alarms/Test	It is possible to test the operation of Fire Mode, but all alarm states are activated normally (Manual Reset).

NOTICE

Warranty-affecting alarms. Certain alarms can affect the lifetime of the frequency converter. Should one of these ignored alarms occur whilst in Fire Mode, a log of the event is stored in the Fire Mode Log.
Here the 10 latest events of warranty-affecting alarms, fire mode activation and fire mode deactivation are stored.

NOTICE

The setting in *14-20 Reset Mode* is disregarded when Fire Mode is active (see parameter group *24-0*, Fire Mode*).

No.	Description	Critical Alarms	Warranty Affecting Alarms
4	Mains oh. loss		x
7	DC over volt	x	x
9	Inverter overloaded		x
13	Over current	x	x
14	Earth fault	x	x
16	Short circuit	x	x
38	Internal fault	x	
69	Power card temp		x

Table 4.13 Fire Mode Alarms

4.16.2 24-1* Drive Bypass

The frequency converter includes a feature, which can be used to automatically activate an external electro-mechanical bypass in case of the event of a Fire Mode Coast (see *parameter 24-00 FM Function*).

The bypass switches the motor to operation direct on line. The external bypass is activated by means of one of the digital outputs or relays in the frequency converter, when programmed in parameter group *5-3* Digital Outputs* or parameter group *5-4* Relays*.

NOTICE

The Drive Bypass cannot be deactivated if in Fire Mode. It can be deactivated only by either removing the Fire Mode command signal or the power supply to the frequency converter!

When the Drive Bypass function is activated, the display on the LCP shows the status message Drive Bypass. This message has a higher priority than the Fire Mode status messages. When the automatic Drive Bypass function is enabled, it cuts in the external bypass according to *Illustration 4.18*

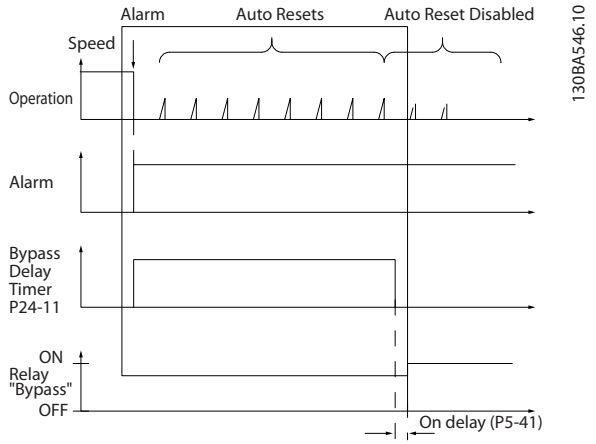

Illustration 4.18 Drive Bypass Function

Status can be read in the Extended Status Word 2, bit number 24.

24-10 Drive Bypass Function		
Option:		**Function:**
		This parameter determines, which circumstances will activate the Drive Bypass Function:
[0] *	Disabled	
[2]	Enabled (Fire Mode only)	The Bypass Function operates at Trip at Critical Alarms, Coast or Bypass Delay Timer

24-10 Drive Bypass Function		
Option:		**Function:**
		if the timer expires before reset attempts have completed.

24-11 Drive Bypass Delay Time		
Range:		**Function:**
0 s*	[0 - 600 s]	Programmable in 1 s increments. Once the Bypass Function is activated in accordance with the setting in *parameter 24-10 Drive Bypass Function*, the Bypass Delay Timer begins to operate. If the frequency converter has been set for a number of restart attempts, the timer continues to run while the frequency converter tries to restart. Should the motor have restarted within the time period of the Bypass Delay Timer, then the timer is reset. Should the motor fail to restart at the end of the Bypass Delay Time, the Drive Bypass relay is activated, which has been programmed for Bypass in *parameter 5-40 Function Relay*. Where no restart attempts are programmed, the timer runs for the delay period set in this parameter and then activates the Drive Bypass relay, which has been programmed for Bypass in *parameter 5-40 Function Relay*, Function Relay.

4.17 Main Menu - Special Features - Group 30

30-22 Locked Rotor Detection		
Locked Rotor Detection for PM-Motor		
Option:		**Function:**
[0]	Off	
[1]	On	

30-23 Locked Rotor Detection Time [s]		
Locked Rotor Detection Time for PM-Motor		
Range:		**Function:**
0.10 s*	[0.05 - 1 s]	

5 Diagnostics and Troubleshooting

5.1 Alarms and Warnings Overview

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

Event type	LED signal
Warning	yellow
Alarm	flashing red

Table 5.1 Event Type LED Signals

A warning remains active until its cause is no longer present. Under certain circumstances, motor operation can continue. Warning messages can be critical, but are not necessarily so.

In the event of an alarm, the frequency converter trips. Reset of alarms is required to restart operation, once the cause has been rectified.

To reset an alarm:

1. Press [Reset], or
2. Use the "Reset" function via a digital input, or
3. Reset via serial communication, or
4. Use the [Auto Reset] function, which is a default setting. See *parameter 14-20 Reset Mode*. This form of reset cannot be used for a trip lock alarm.

NOTICE

To restart the motor after reset using [Reset], press [Auto On] or [Hand On].

When an alarm fails to reset, check

- that the cause has been rectified
- for trip lock. Refer to *Table 5.2*.

Trip
A trip is the action occuring when an alarm has appeared. The original event that caused an alarm cannot damage the frequency converter or cause dangerous conditions. The trip coasts the motor and can be reset by pressing [Reset] or via a digital input (parameter group *5-1* Digital Inputs [1]*). For alarms with trip, but no trip lock, reset using the automatic reset function in *parameter 14-20 Reset Mode*.

Trip lock
A trip lock alarm occurs when a situation arises, which can result in equipment damage. A trip lock alarm offers more protection, because the mains supply must be switched off before the alarm can be reset. After rectification of cause and power cycling, the frequency converter is no longer blocked. Reset as described above.

⚠CAUTION

UNEXPECTED START
Automatic wake-up can occur when using reset via *parameter 14-20 Reset Mode*. Failure to be prepared for start can result in personal injury.

- **Be prepared for unexpected start.**

Warning and alarm
For events marked with warning and alarm in *Table 5.2*, either

- a warning occurs before an alarm, or
- the event can be set to signal either warning or alarm

Example: *Parameter 1-90 Motor Thermal Protection*.
After an alarm or trip, the motor coasts, and both the alarm and warning LEDs flash. Once the cause has been rectified, only the alarm LED continues flashing.

No.	Description	Warning	Alarm	Trip Lock	Parameter Reference
2	Live zero error	(X)	(X)		6-01
3	No motor	(X)			1-80
4	Mains phase loss	(X)	(X)	(X)	14-12
7	DC over voltage	X	X		
8	DC under voltage	X	X		
9	Inverter overload	X	X		

No.	Description	Warning	Alarm	Trip Lock	Parameter Reference
10	Motor ETR over temperature	(X)	(X)		1-90
11	Motor thermistor over temperature	(X)	(X)		1-90
13	Over current	X	X	X	
14	Earth fault	X	X	X	
16	Short circuit		X	X	
17	Control word timeout	(X)	(X)		8-04
30	Motor phase U missing		(X)	(X)	4-58
31	Motor phase V missing		(X)	(X)	4-58
32	Motor phase W missing		(X)	(X)	4-58
38	Internal fault		X	X	
40	Overload T27	X			
41	Overload T29	X			
44	Earth fault DESAT		X	X	
46	Gate drive voltage fault		X	X	
47	24 V Supply Low	X	X	X	
51	AMA U_{nom} , I_{nom}		X		
52	AMA low I_{nom}		X		
53	AMA motor too big		X		
54	AMA motor too small		X		
55	AMA parameter out of range		X		
56	AMA interrupted by user		X		
57	AMA timeout		X		
58	AMA internal fault	X	X		
59	Current limit	X			
60	External interlock		X		
63	Mechanical brake low		X		
69	Pwr card temperature	X	X	X	
80	Drive initialized to default value		X		
87	Auto DC braking	X			
95	Broken belt	(X)	(X)		22-6*
99	Locked rotor		(X)		30-22, 30-23
101	Flow/pressure info missing		X		
126	Motor rotating		X		
127	Back EMF too high	X			
200	Fire Mode	X			
202	Fire M Limits Exceeded	X			

Table 5.2 Alarm and Warning Codes

(X): Dependent on parameter setting

X: Independent of parameter setting

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5.2 Alarm Words

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

Bit	Hex	Dec	parameter 16-90 Alarm Word	parameter 16-91 Alarm Word 2
0	1	1	0	0
1	2	2	Pwr.Card Temp	Gate drive voltage fault
2	4	4	Earth Fault	0
3	8	8	0	0
4	10	16	Ctrl. Word TO	Illegal FC config.
5	20	32	Over Current	0
6	40	64	0	0
7	80	128	Motor Th. Over	0
8	100	256	Motor ETR Over	Broken Belt
9	200	512	Inverter Overld.	0
10	400	1024	DC under Volt	0
11	800	2048	DC over Volt.	0
12	1000	4096	Short Circuit	External Interlock
13	2000	8192	0	0
14	4000	16384	Mains ph. loss	0
15	8000	32768	AMA Not OK	Flow/Pressure info Missing
16	10000	65536	Live Zero Error	0
17	20000	131072	Internal Fault	0
18	40000	262144	0	Fans error
19	80000	524288	U phase Loss	0
20	100000	1048576	V phase Loss	0
21	200000	2097152	W phase Loss	0
22	400000	4194304	0	Locked Rotor
23	800000	8388608	24V Supply Low	0
24	1000000	16777216	0	0
25	2000000	33554432	0	Current limit
26	4000000	67108864	0	0
27	8000000	134217728	0	0
28	10000000	268435456	0	0
29	20000000	536870912	Drive Initialized	0
30	40000000	1073741824	0	0
31	80000000	2147483648	Mechanical brake low	0

Table 5.3 Alarm Words

0: this alarm is not used in FCP 106

5.3 Warning Words

Bit	Hex	Dec	parameter 16-92 Warning Word	parameter 16-93 Warning Word 2
0	1	1	0	0
1	2	2	Pwr.Card Temp	0
2	4	4	Earth Fault	0
3	8	8	0	0
4	10	16	Ctrl. Word TO	0
5	20	32	Over Current	0
6	40	64	0	0
7	80	128	Motor Th. Over	0
8	100	256	Motor ETR Over	Broken Belt
9	200	512	Inverter Overld.	0
10	400	1024	DC under Volt	0
11	800	2048	DC over Volt.	0
12	1000	4096	0	0
13	2000	8192	0	0
14	4000	16384	Mains ph. loss	0
15	8000	32768	No motor	Auto DC Braking
16	10000	65536	Live Zero Error	0
17	20000	131072	0	0
18	40000	262144	0	Fans warning
19	80000	524288	0	0
20	100000	1048576	0	0
21	200000	2097152	0	0
22	400000	4194304	0	0
23	800000	8388608	24V Supply Low	0
24	1000000	16777216	0	0
25	2000000	33554432	Current Limit	0
26	4000000	67108864	Low temp.	0
27	8000000	134217728	0	0
28	10000000	268435456	0	0
29	20000000	536870912	0	0
30	40000000	1073741824	0	0
31	80000000	2147483648	0	0

Table 5.4 Warning Words

0: this alarm is not used in FCP 106

5.4 Extended Status Words

Bit	Hex	Dec	parameter 16 -94 Ext. Status Word	parameter 16-95 Ext. Status Word 2
0	1	1	Ramping	Off
1	2	2	AMA running	Hand/Auto
2	4	4	Start CW/CCW	0
3	8	8	0	0
4	10	16	0	0
5	20	32	Feedback high	0
6	40	64	Feedback low	0
7	80	128	Output current high	Control Ready
8	100	256	Output current low	Drive Ready
9	200	512	Output frequency high	Quick Stop
10	400	1024	Output frequency low	DC Brake
11	800	2048	0	Stop
12	1000	4096	0	0
13	2000	8192	Braking	Freeze Output Request
14	4000	16384	0	Freeze Output
15	8000	32768	OVC active	Jog Request
16	10000	65536	AC brake	Jog
17	20000	131072	0	Start request
18	40000	262144	0	Start
19	80000	524288	Reference high	0
20	100000	1048576	Reference low	Start Delay
21	200000	2097152	Local Ref./ Remote Ref.	Sleep
22	400000	4194304	0	Sleep boost
23	800000	8388608	0	Running
24	1000000	16777216	0	Bypass
25	2000000	33554432	0	Fire Mode
26	4000000	67108864	0	External Interlock
27	8000000	134217728	0	Firemodelimi-texceed
28	10000000	268435456	0	FlyStart Active
29	20000000	536870912	0	0
30	40000000	1073741824	0	0
31	80000000	2147483648	Database busy	0

Table 5.5 Extended Status Words

0: this alarm is not used in FCP 106

5.5 Troubleshooting

WARNING/ALARM 2, Live zero error
This warning or alarm only appears if programmed in *6-01 Live Zero Timeout Function*. The signal on one of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or faulty device sending the signal can cause this condition.

Troubleshooting

- Check connections on all the analog input terminals. Control card terminals 53 and 54 for signals, terminal 55 common. MCB 101 terminals 11 and 12 for signals, terminal 10 common. MCB 109 terminals 1, 3, 5 for signals, terminals 2, 4, 6 common).
- Check that the frequency converter programming and switch settings match the analog signal type.
- Perform input terminal signal test.

WARNING/ALARM 3, No motor
No motor has been connected to the output of the frequency converter.

WARNING/ALARM 4, Mains phase loss
A phase is missing on the supply side, or the mains voltage imbalance is too high. This message also appears for a fault in the input rectifier on the frequency converter. Options are programmed at *14-12 Function at Mains Imbalance*.

Troubleshooting

- Check the supply voltage and supply currents to the frequency converter.

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

Troubleshooting

- Connect a brake resistor
- Extend the ramp time
- Change the ramp type
- Activate the functions in *2-10 Brake Function*
- Increase *14-26 Trip Delay at Inverter Fault*
- If the alarm/warning occurs during a power sag, use kinetic back-up (*14-10 Mains Failure*)

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

Troubleshooting

- Check that the supply voltage matches the frequency converter voltage.
- Perform input voltage test.

- Perform soft charge circuit test.

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

Troubleshooting

- Compare the output current shown on the LCP with the frequency converter rated current.
- Compare the output current shown on the LCP with measured motor current.
- Display the thermal drive load on the LCP and monitor the value. When running above the frequency converter continuous current rating, the counter increases. When running below the frequency converter continuous current rating, the counter decreases.

WARNING/ALARM 10, Motor overload temperature
According to the electronic thermal protection (ETR), the motor is too hot. Select whether the frequency converter issues a warning or an alarm when the counter reaches 100% in *1-90 Motor Thermal Protection*. The fault occurs when the motor runs with more than 100% overload for too long.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded
- Check that the motor current set in *1-24 Motor Current* is correct.
- Ensure that Motor data in parameters 1-20 to 1-25 are set correctly.
- If an external fan is in use, check in *1-91 Motor External Fan* that it is selected.
- Running AMA in *1-29 Automatic Motor Adaptation (AMA)* tunes the frequency converter to the motor more accurately and reduces thermal loading.

WARNING/ALARM 11, Motor thermistor over temp
Check whether the thermistor is disconnected. Select whether the frequency converter issues a warning or an alarm in *1-90 Motor Thermal Protection*.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- When using terminal 53 or 54, check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply). Also check that the terminal switch for 53 or 54 is set for voltage. Check *1-93 Thermistor Source* selects terminal 53 or 54.
- When using digital inputs 18 or 19, check that the thermistor is connected correctly between either terminal 18 or 19 (digital input PNP only) and terminal 50. Check *1-93 Thermistor Source* selects terminal 18 or 19.

WARNING/ALARM 13, Over current
The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts about 1.5 s, then the frequency converter trips and issues an alarm. Shock loading or quick acceleration with high inertia loads can cause this fault. If the acceleration during ramp up is quick, the fault can also appear after kinetic back-up. If extended mechanical brake control is selected, trip can be reset externally.

Troubleshooting

- Remove power and check if the motor shaft can be turned.
- Check that the motor size matches the frequency converter.
- Check parameters 1-20 to 1-25 for correct motor data.

ALARM 14, Earth fault
There is current from the output phases to ground, either in the cable between the frequency converter and the motor or in the motor itself.

Troubleshooting

- Remove power to the frequency converter and repair the earth fault.
- Check for earth faults in the motor by measuring the resistance to ground of the motor leads and the motor with a megohmmeter.

ALARM 16, Short circuit
There is short-circuiting in the motor or motor wiring.

Remove power to the frequency converter and repair the short circuit.

WARNING/ALARM 17, Control word timeout
There is no communication to the frequency converter. The warning is only active when *8-04 Control Word Timeout Function* is NOT set to *[0] Off*.
If *8-04 Control Word Timeout Function* is set to *[5] Stop and Trip*, a warning appears and the frequency converter ramps down until it stops then displays an alarm.

Troubleshooting

- Check connections on the serial communication cable.
- Increase *8-03 Control Word Timeout Time*

- Check the operation of the communication equipment.
- Verify a proper installation based on EMC requirements.

ALARM 30, Motor phase U missing
Motor phase U between the frequency converter and the motor is missing.

Remove power from the frequency converter and check motor phase U.

ALARM 31, Motor phase V missing
Motor phase V between the frequency converter and the motor is missing.

Remove power from the frequency converter and check motor phase V.

ALARM 32, Motor phase W missing
Motor phase W between the frequency converter and the motor is missing.

Remove power from the frequency converter and check motor phase W.

ALARM 38, Internal fault
When an internal fault occurs, a code number defined in *Table 5.6* is displayed.

Troubleshooting
- Cycle power
- Check that the option is properly installed
- Check for loose or missing wiring

Note the code number before contacting the supplier or Danfoss Service Department.

Code no.	Text	Troubleshooting
0	Serial port cannot be initialised.	Contact the supplier or Danfoss Service Department.
256-258	Power EEPROM data is defective or too old.	Replace power card.
512-519	Internal fault.	Contact the supplier or Danfoss Service Department.
783	Parameter value outside of min/max limits	
1024-1284	Internal fault.	Contact the supplier or Danfoss Service Department.
1379-2819	Internal fault.	Contact the supplier or Danfoss Service Department.
2561	Replace control card	
2820	LCP stack overflow	
2821	Serial port overflow	
2822	USB port overflow	
3072-5122	Parameter value is outside its limits	
5376-6231	Internal fault.	Contact the supplier or Danfoss Service Department.

Table 5.6 Internal Fault Codes

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

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

ALARM 44, Earth fault DESAT
There is a discharge from the output phases to earth, either in the cable between the frequency converter and the motor, or in the motor itself.

Troubleshooting
- Turn off the frequency converter and remove the earth fault.
- Measure the resistance to ground of the motor leads and the motor with a megohmmeter to check for earth fault in the motor.

ALARM 46, Gate drive voltage fault
The supply on the power card is out of range.

There are 3 power supplies generated by the switch mode power supply (SMPS) on the power card: 24 V, 5 V, and ±18 V.

Troubleshooting
- Check for a defective power card.

WARNING 47, 24 V supply low
The 24 V DC is measured on the control card. This alarm arises when the detected voltage of terminal 12 is lower than 18 V.

Troubleshooting
- Check for a defective control card.

ALARM 51, AMA check U_{nom} and I_{nom}
The settings for motor voltage, motor current and motor power are wrong. Check the settings in parameters 1-20 to 1-25.

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

ALARM 53, AMA motor too big
The motor is too big for the AMA to operate.

ALARM 54, AMA motor too small
The motor is too small for the AMA to operate.

ALARM 55, AMA parameter out of range
The parameter values of the motor are outside of the acceptable range. AMA cannot run.

ALARM 56, AMA interrupted by user
The user has interrupted the AMA.

WARNING/ALARM 57, AMA internal fault
Try to restart AMA again. Repeated restarts can over heat the motor.

ALARM 58, AMA Internal fault
Contact the Danfoss supplier.

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WARNING 59, Current limit
The current is higher than the value in *4-18 Current Limit*. Ensure that motor data in parameters 1–20 to 1–25 are set correctly. Possibly increase the current limit. Be sure that the system can operate safely at a higher limit.

WARNING 60, External interlock
A digital input signal is indicating a fault condition external to the frequency converter. An external interlock has commanded the frequency converter to trip. Clear the external fault condition. To resume normal operation, apply 24 V DC to the terminal programmed for external interlock. Reset the frequency converter.

ALARM 63, Mechanical brake low
The actual motor current has not exceeded the "release brake" current within the "start delay" time window.

ALARM 69, Power card temperature
The temperature sensor on the power card is either too hot or too cold.

Troubleshooting

- Check that the ambient operating temperature is within limits.
- Check for clogged filters.
- Check fan operation.
- Check the power card.

ALARM 80, Drive initialised to default value
Parameter settings are initialised to default settings after a manual reset. To clear the alarm, reset the unit.

ALARM 87, Auto DC braking
Auto DC braking is a protective function against overvoltage at coast.

Troubleshooting

- Check that AC line input voltage does not exceed maximum limit.

ALARM 95, Broken belt
Torque is below the torque level set for no load, indicating a broken belt. *22-60 Broken Belt Function* is set for alarm. Troubleshoot the system and reset the frequency converter after the fault has been cleared.

ALARM 99, Blocked rotor
Rotor is blocked.

ALARM 101, Flow/pressure info missing
Sensorless pump-table is missing or wrong.

Troubleshooting

- Download sensorless pump-table again.

ALARM 126, Motor rotating
High back EMF voltage. This alarm arises only when running AMA for a PM motor.

Troubleshooting

- Stop the rotor of the PM motor.

WARNING 127, Back EMF too high
This warning applies to PM motors only. When the back EMF is larger than 90%*U_{invmax} (over voltage threshold), and does not fall to normal level within 5s, this warning will be reported. The warning will remian until the back EMF returns to a normal level.

WARNING 200, Fire mode
This warning indicates the frequency converter is operating in fire mode. The warning clears when fire mode is removed. See the fire mode data in the alarm log.

WARNING 202, Fire mode limits exceeded
While operating in fire mode one or more alarm conditions have been ignored which would normally trip the unit. Operating in this condition voids unit warranty. Cycle power to the unit to remove the warning. See the fire mode data in the alarm log.

6 Parameter Lists

6.1 Parameter Options

6.1.1 Default Settings

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

2-Set-up
'All set-up': the parameter can be set individually in each of the 2 set-ups, i.e. one single parameter can have 2 different data values.
'1 set-up': data value is the same in all set-ups.

ExpressionLimit
Size related

N/A
No default value available.

Conversion index
This number refers to a conversion figure used when writing or reading by means of a frequency converter.

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

Data type	Description	Type
2	Integer 8	Int8
3	Integer 16	Int16
4	Integer 32	Int32
5	Unsigned 8	Uint8
6	Unsigned 16	Uint16
7	Unsigned 32	Uint32
9	Visible String	VisStr
33	Normalized value 2 bytes	N2
35	Bit sequence of 16 boolean variables	V2

Table 6.1 Data Type

6.1.2 0-** Operation/Display

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
0-0* Basic Settings						
0-01	Language	[0] English	1 set-up	TRUE	-	Uint8
0-03	Regional Settings	ExpressionLimit	1 set-up	FALSE	-	Uint8
0-04	Operating State at Power-up	[0] Resume	All set-ups	TRUE	-	Uint8
0-06	GridType	ExpressionLimit	1 set-up	FALSE	-	Uint8
0-07	Auto DC Braking	[1] On	1 set-up	FALSE	-	Uint8
0-1* Set-up Operations						
0-10	Active Set-up	[1] Set-up 1	1 set-up	TRUE	-	Uint8
0-11	Programming Set-up	[9] Active Set-up	1 set-up	TRUE	-	Uint8
0-12	Link Setups	[20] Linked	All set-ups	FALSE	-	Uint8
0-3* LCP Custom Readout						
0-30	Custom Readout Unit	[1] %	1 set-up	TRUE	-	Uint8
0-31	Custom Readout Min Value	0 CustomReadoutUnit	1 set-up	TRUE	-2	Int32
0-32	Custom Readout Max Value	100 CustomReadoutUnit	1 set-up	TRUE	-2	Int32
0-37	Display Text 1	[]	1 set-up	TRUE	0	VisStr[21]
0-38	Display Text 2	[]	1 set-up	TRUE	0	VisStr[26]
0-39	Display Text 3	[]	1 set-up	TRUE	0	VisStr[26]
0-4* LCP Keypad						
0-40	[Hand on] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-42	[Auto on] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-44	[Off/Reset] Key on LCP	[1] Enabled	All set-ups	TRUE	-	Uint8
0-5* Copy/Save						
0-50	LCP Copy	[0] No copy	1 set-up	FALSE	-	Uint8
0-51	Set-up Copy	[0] No copy	1 set-up	FALSE	-	Uint8
0-6* Password						
0-60	Main Menu Password	0 N/A	1 set-up	TRUE	0	Uint16

6.1.3 1-** Load and Motor

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
1-0* General Settings						
1-00	Configuration Mode	[0] Open Loop	All set-ups	TRUE	-	Uint8
1-01	Motor Control Principle	[1] VVC+	All set-ups	FALSE	-	Uint8
1-03	Torque Characteristics	[1] Variable Torque	All set-ups	FALSE	-	Uint8
1-06	Clockwise Direction	[0] Normal	1 set-up	FALSE	-	Uint8
1-1* Motor Selection						
1-10	Motor Construction	[0] Asynchron	All set-ups	FALSE	-	Uint8
1-14	Damping Gain	120 %	All set-ups	TRUE	0	Int16
1-15	Low Speed Filter Time Const	ExpressionLimit	All set-ups	TRUE	-2	Uint16
1-16	High Speed Filter Time Const	ExpressionLimit	All set-ups	TRUE	-2	Uint16
1-17	Voltage filter time const	ExpressionLimit	All set-ups	TRUE	-3	Uint16
1-2* Motor Data						
1-20	Motor Power	ExpressionLimit	All set-ups	FALSE	-	Uint8
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

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
1-25	Motor Nominal Speed	ExpressionLimit	All set-ups	FALSE	67	Uint16
1-26	Motor Cont. Rated Torque	ExpressionLimit	All set-ups	FALSE	-1	Uint32
1-29	Automatic Motor Adaption (AMA)	[0] Off	1 set-up	FALSE	-	Uint8
1-3* Adv. Motor Data						
1-30	Stator Resistance (Rs)	ExpressionLimit	All set-ups	FALSE	-3	Uint32
1-33	Stator Leakage Reactance (X1)	ExpressionLimit	All set-ups	FALSE	-3	Uint32
1-35	Main Reactance (Xh)	ExpressionLimit	All set-ups	FALSE	-2	Uint32
1-37	d-axis Inductance (Ld)	ExpressionLimit	All set-ups	FALSE	-3	Int32
1-39	Motor Poles	4 N/A	All set-ups	FALSE	0	Uint8
1-4* Adv. Motor Data II						
1-40	Back EMF at 1000 RPM	ExpressionLimit	All set-ups	FALSE	0	Uint16
1-5* Load Indep. Setting						
1-50	Motor Magnetisation at Zero Speed	100 %	All set-ups	TRUE	0	Uint16
1-52	Min Speed Normal Magnetising [Hz]	0 Hz	All set-ups	TRUE	-1	Uint16
1-55	U/f Characteristic - U	ExpressionLimit	All set-ups	FALSE	-1	Uint16
1-56	U/f Characteristic - F	ExpressionLimit	All set-ups	FALSE	-1	Uint16
1-6* Load Depen. Setting						
1-62	Slip Compensation	0 %	All set-ups	TRUE	0	Int16
1-63	Slip Compensation Time Constant	0.1 s	All set-ups	TRUE	-2	Uint16
1-64	Resonance Dampening	100 %	All set-ups	TRUE	0	Uint16
1-65	Resonance Dampening Time Constant	0.005 s	All set-ups	TRUE	-3	Uint16
1-66	Min. Current at Low Speed	50 %	All set-ups	TRUE	0	Uint32
1-7* Start Adjustments						
1-71	Start Delay	0 s	All set-ups	TRUE	-1	Uint8
1-72	Start Function	[2] Coast/delay time	All set-ups	TRUE	-	Uint8
1-73	Flying Start	[0] Disabled	All set-ups	FALSE	-	Uint8
1-8* Stop Adjustments						
1-80	Function at Stop	[0] Coast	All set-ups	TRUE	-	Uint8
1-82	Min Speed for Function at Stop [Hz]	0 Hz	All set-ups	TRUE	-1	Uint16
1-9* Motor Temperature						
1-90	Motor Thermal Protection	ExpressionLimit	All set-ups	TRUE	-	Uint8
1-93	Thermistor Source	[0] None	All set-ups	FALSE	-	Uint8

6.1.4 2-** Brakes

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
2-0* DC-Brake						
2-00	DC Hold/Motor Preheat Current	50 %	All set-ups	TRUE	0	Uint16
2-01	DC Brake Current	50 %	All set-ups	TRUE	0	Uint16
2-02	DC Braking Time	10 s	All set-ups	TRUE	-1	Uint16
2-04	DC Brake Cut In Speed	0 Hz	All set-ups	TRUE	-1	Uint16
2-06	Parking Current	100 %	All set-ups	TRUE	0	Uint16
2-07	Parking Time	3 s	All set-ups	TRUE	-1	Uint16
2-1* Brake Energy Funct.						
2-10	Brake Function	[0] Off	All set-ups	TRUE	-	Uint8
2-16	AC Brake, Max current	100 %	All set-ups	TRUE	-1	Uint16
2-17	Over-voltage Control	[2] Enabled	All set-ups	TRUE	-	Uint8

6.1.5 3-** Reference/Ramps

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
3-0* Reference Limits						
3-02	Minimum Reference	0 ReferenceFeedbackUnit	All set-ups	TRUE	-3	Int32
3-03	Maximum Reference	ExpressionLimit	All set-ups	TRUE	-3	Int32
3-1* References						
3-10	Preset Reference	0 %	All set-ups	TRUE	-2	Int16
3-11	Jog Speed [Hz]	5 Hz	All set-ups	TRUE	-1	Uint16
3-14	Preset Relative Reference	0 %	All set-ups	TRUE	-2	Int16
3-15	Reference 1 Source	[1] Analog in 53	All set-ups	TRUE	-	Uint8
3-16	Reference 2 Source	[2] Analog in 54	All set-ups	TRUE	-	Uint8
3-17	Reference 3 Source	[11] Local bus reference	All set-ups	TRUE	-	Uint8
3-4* Ramp 1						
3-41	Ramp 1 Ramp Up Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-42	Ramp 1 Ramp Down Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-5* Ramp 2						
3-51	Ramp 2 Ramp Up Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-52	Ramp 2 Ramp Down Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-8* Other Ramps						
3-80	Jog Ramp Time	ExpressionLimit	All set-ups	TRUE	-2	Uint32
3-81	Quick Stop Ramp Time	ExpressionLimit	1 set-up	TRUE	-2	Uint32

6.1.6 4-** Limits/Warnings

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
4-1* Motor Limits						
4-10	Motor Speed Direction	[2] Both directions	All set-ups	FALSE	-	Uint8
4-12	Motor Speed Low Limit [Hz]	0 Hz	All set-ups	FALSE	-1	Uint16
4-14	Motor Speed High Limit [Hz]	65 Hz	All set-ups	FALSE	-1	Uint16
4-18	Current Limit	110 %	All set-ups	TRUE	0	Uint16
4-19	Max Output Frequency	ExpressionLimit	All set-ups	FALSE	-1	Uint16
4-4* Adj. Warnings 2						
4-40	Warning Freq. Low	ExpressionLimit	All set-ups	TRUE	-1	uint16
4-41	Warning Freq. High	ExpressionLimit	All set-ups	TRUE	-1	uint16
4-5* Adj. Warnings						
4-50	Warning Current Low	0 A	All set-ups	TRUE	-2	Uint32
4-51	Warning Current High	ExpressionLimit	All set-ups	TRUE	-2	Uint32
4-54	Warning Reference Low	-4999 N/A	All set-ups	TRUE	-3	Int32
4-55	Warning Reference High	4999 N/A	All set-ups	TRUE	-3	Int32
4-56	Warning Feedback Low	-4999 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
4-57	Warning Feedback High	4999 ProcessCtrlUnit	All set-ups	TRUE	-3	Int32
4-58	Missing Motor Phase Function	[1] On	All set-ups	FALSE	-	Uint8
4-6* Speed Bypass						
4-61	Bypass Speed From [Hz]	0 Hz	All set-ups	TRUE	-1	Uint16
4-63	Bypass Speed To [Hz]	0 Hz	All set-ups	TRUE	-1	Uint16
4-64	Semi-Auto Bypass Set-up	[0] Off	All set-ups	TRUE	-	Uint8

6.1.7 5-** Digital In/Out

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
5-0* Digital I/O mode						
5-00	Digital Input Mode	[0] PNP	1 set-up	FALSE	-	Uint8
5-03	Digital Input 29 Mode	[0] PNP	1 set-up	FALSE	-	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	ExpressionLimit	All set-ups	TRUE	-	Uint8
5-13	Terminal 29 Digital Input	[14] Jog	All set-ups	TRUE	-	Uint8
5-3* Digital Outputs						
5-34	On Delay, Digital Output	0.01 s	All set-ups	TRUE	-2	uint16
5-35	Off Delay, Digital Output	0.01 s	All set-ups	TRUE	-2	uint16
5-4* Relays						
5-40	Function Relay	ExpressionLimit	All set-ups	TRUE	-	Uint8
5-41	On Delay, Relay	0.01 s	All set-ups	TRUE	-2	Uint16
5-42	Off Delay, Relay	0.01 s	All set-ups	TRUE	-2	Uint16
5-5* Pulse Input						
5-50	Term. 29 Low Frequency	4 Hz	All set-ups	TRUE	0	Uint32
5-51	Term. 29 High Frequency	32000 Hz	All set-ups	TRUE	0	Uint32
5-52	Term. 29 Low Ref./Feedb. Value	0 N/A	All set-ups	TRUE	-3	Int32
5-53	Term. 29 High Ref./Feedb. Value	50 N/A	All set-ups	TRUE	-3	Int32
5-9* Bus Controlled						
5-90	Digital & Relay Bus Control	0 N/A	All set-ups	TRUE	0	Uint32

6.1.8 6-** Analog In/Out

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
6-0* Analog I/O Mode						
6-00	Live Zero Timeout Time	10 s	All set-ups	TRUE	0	Uint8
6-01	Live Zero Timeout Function	[0] Off	All set-ups	TRUE	-	Uint8
6-1* Analog Input 53						
6-10	Terminal 53 Low Voltage	0.07 V	All set-ups	TRUE	-2	Uint16
6-11	Terminal 53 High Voltage	10 V	All set-ups	TRUE	-2	Uint16
6-12	Terminal 53 Low Current	4 mA	All set-ups	TRUE	-5	Uint16
6-13	Terminal 53 High Current	20 mA	All set-ups	TRUE	-5	Uint16
6-14	Terminal 53 Low Ref./Feedb. Value	0 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	0.01 s	All set-ups	TRUE	-2	Uint16
6-19	Terminal 53 mode	[1] Voltage mode	1 set-up	TRUE	-	Uint8
6-2* Analog Input 54						
6-20	Terminal 54 Low Voltage	0.07 V	All set-ups	TRUE	-2	Uint16
6-21	Terminal 54 High Voltage	10 V	All set-ups	TRUE	-2	Uint16
6-22	Terminal 54 Low Current	4 mA	All set-ups	TRUE	-5	Uint16
6-23	Terminal 54 High Current	20 mA	All set-ups	TRUE	-5	Uint16
6-24	Terminal 54 Low Ref./Feedb. Value	0 N/A	All set-ups	TRUE	-3	Int32
6-25	Terminal 54 High Ref./Feedb. Value	ExpressionLimit	All set-ups	TRUE	-3	Int32
6-26	Terminal 54 Filter Time Constant	0.01 s	All set-ups	TRUE	-2	Uint16
6-29	Terminal 54 mode	[1] Voltage mode	1 set-up	TRUE	-	Uint8
6-7* Analog/Digital Output 45						
6-70	Terminal 45 Mode	[0] 0-20 mA	All set-ups	TRUE	-	Uint8
6-71	Terminal 45 Analog Output	[0] No operation	All set-ups	TRUE	-	Uint8
6-72	Terminal 45 Digital Output	[0] No operation	All set-ups	TRUE	-	Uint8
6-73	Terminal 45 Output Min Scale	0 %	All set-ups	TRUE	-2	Uint16
6-74	Terminal 45 Output Max Scale	100 %	All set-ups	TRUE	-2	Uint16
6-76	Terminal 45 Output Bus Control	0 N/A	All set-ups	TRUE	0	Uint16
6-9* Analog/Digital Output 42						
6-90	Terminal 42 Mode	[0] 0-20 mA	All set-ups	TRUE	-	Uint8
6-91	Terminal 42 Analog Output	[0] No operation	All set-ups	TRUE	-	Uint8
6-92	Terminal 42 Digital Output	[0] No operation	All set-ups	TRUE	-	Uint8
6-93	Terminal 42 Output Min Scale	0 %	All set-ups	TRUE	-2	Uint16
6-94	Terminal 42 Output Max Scale	100 %	All set-ups	TRUE	-2	Uint16
6-96	Terminal 42 Output Bus Control	0 N/A	All set-ups	TRUE	0	Uint16
6-98	Drive Type	0 N/A	1 set-up	FALSE	0	Uint8

6.1.9 8-** Comm. and Options

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
8-0* General Settings						
8-01	Control Site	[0] Digital and ctrl.word	All set-ups	TRUE	-	Uint8
8-02	Control Source	[1] FC Port	All set-ups	TRUE	-	Uint8
8-03	Control Timeout Time	1.0 s	1 set-up	TRUE	-1	Uint16
8-04	Control Timeout Function	[0] Off	1 set-up	TRUE	-	Uint8
8-3* FC Port Settings						
8-30	Protocol	[0] FC	1 set-up	TRUE	-	Uint8
8-31	Address	1.0 N/A	1 set-up	TRUE	0	Uint8
8-32	Baud Rate	ExpressionLimit	1 set-up	TRUE	-	Uint8
8-33	Parity / Stop Bits	ExpressionLimit	1 set-up	TRUE	-	Uint8
8-35	Minimum Response Delay	0.01 s	1 set-up	TRUE	-3	Uint16
8-36	Maximum Response Delay	ExpressionLimit	1 set-up	TRUE	-3	Uint16
8-4* FC MC protocol set						
8-42	PCD Write Configuration	ExpressionLimit	All set-ups	TRUE	0	Uint8
8-43	PCD Read Configuration	ExpressionLimit	All set-ups	TRUE	0	Uint8
8-5* Digital/Bus						
8-50	Coasting Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-51	Quick Stop Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-52	DC Brake Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-53	Start Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-54	Reversing Select	[0] Digital input	All set-ups	TRUE	-	Uint8
8-55	Set-up Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-56	Preset Reference Select	[3] Logic OR	All set-ups	TRUE	-	Uint8
8-7* BACnet						
8-70	BACnet Device Instance	1 N/A	1 set-up	TRUE	0	Uint32
8-72	MS/TP Max Masters	127.0 N/A	1 set-up	TRUE	0	Uint8
8-73	MS/TP Max Info Frames	1.0 N/A	1 set-up	TRUE	0	Uint16
8-74	"I am" Service	[0] Send at power-up	1 set-up	TRUE	-	Uint8
8-75	Intialisation Password	[admin]	1 set-up	TRUE	0	VisStr[21]
8-79	Protocol Firmware version	ExpressionLimit	1 set-up	TRUE	-2	Uint16
8-8* FC Port Diagnostics						
8-80	Bus Message Count	0.0 N/A	1 set-up	TRUE	0	Uint32
8-81	Bus Error Count	0.0 N/A	1 set-up	TRUE	0	Uint32
8-82	Slave Messages Rcvd	0.0 N/A	1 set-up	TRUE	0	Uint32
8-83	Slave Error Count	0.0 N/A	1 set-up	TRUE	0	Uint32
8-84	Slave Messages Sent	0.0 N/A	1 set-up	TRUE	0	Uint32
8-85	Slave Timeout Errors	0.0 N/A	1 set-up	TRUE	0	Uint32
8-88	Reset FC port Diagnostics	[0] Do not reset	1 set-up	TRUE	-	Uint8
8-9* Bus Feedback						
8-94	Bus Feedback 1	0.0 N/A	All set-ups	TRUE	0	Int16

6.1.10 13-** Smart Logic

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
13-0* SLC Settings						
13-00	SL Controller Mode	[0] Off	1 set-up	TRUE	-	Uint8
13-01	Start Event	[39] Start command	1 set-up	TRUE	-	Uint8

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
13-02	Stop Event	[40] Drive stopped	1 set-up	TRUE	-	Uint8
13-03	Reset SLC	[0] Do not reset SLC	1 set-up	TRUE	-	Uint8
13-1* Comparators						
13-10	Comparator Operand	[0] Disabled	1 set-up	TRUE	-	Uint8
13-11	Comparator Operator	[1] Approx.Equal (~)	1 set-up	TRUE	-	Uint8
13-12	Comparator Value	0 N/A	1 set-up	TRUE	-1	Int32
13-2* Timers						
13-20	SL Controller Timer	0 s	1 set-up	TRUE	-2	Uint32
13-4* Logic Rules						
13-40	Logic Rule Boolean 1	[0] False	1 set-up	TRUE	-	Uint8
13-41	Logic Rule Operator 1	[0] Disabled	1 set-up	TRUE	-	Uint8
13-42	Logic Rule Boolean 2	[0] False	1 set-up	TRUE	-	Uint8
13-43	Logic Rule Operator 2	[0] Disabled	1 set-up	TRUE	-	Uint8
13-44	Logic Rule Boolean 3	[0] False	1 set-up	TRUE	-	Uint8
13-5* States						
13-51	SL Controller Event	[0] False	1 set-up	TRUE	-	Uint8
13-52	SL Controller Action	[0] Disabled	1 set-up	TRUE	-	Uint8

6.1.11 14-** Special Functions

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
14-0* Inverter Switching						
14-01	Switching Frequency	ExpressionLimit	All set-ups	TRUE	-	Uint8
14-03	Overmodulation	[1] On	All set-ups	FALSE	-	Uint8
14-07	Dead Time Compensation	Expression Limit	All set ups	FALSE	-	Uint8
14-08	Damping Gain Factor	96 %	All set-ups	TRUE	0	Uint8
14-1* Mains On/Off						
14-10	Mains Failure	[0] No function	All set-ups	FALSE	-	Uint8
14-11	Mains Voltage at Mains Fault	Expression Limit	All set-ups	TRUE	-	Uint8
14-12	Function at Mains Imbalance	[0] Trip	1 set-up	TRUE	-	Uint8
14-2* Reset Functions						
14-20	Reset Mode	[0] Manual reset	All set-ups	TRUE	-	Uint8
14-21	Automatic Restart Time	10 s	All set-ups	TRUE	0	Uint16
14-22	Operation Mode	[0] Normal operation	1 set-up	TRUE	-	Uint8
14-23	Typecode Setting	0 N/A	1 set-up	FALSE	0	uint8
14-27	Action At Inverter Fault	[1] Warning	All set-ups	TRUE	-	Uint8
14-28	Production Settings	[0] No action	1 set-up	FALSE	-	Uint8
14-29	Service Code	0 N/A	1 set-up	TRUE	0	Uint32
14-4* Energy Optimising						
14-40	VT Level	90 %	All set-ups	FALSE	0	Uint8
14-41	AEO Minimum Magnetisation	66 %	All set-ups	FALSE	0	Uint8
14-5* Environment						
14-50	RFI Filter	[1] On	1 set-up	FALSE	-	Uint8
14-51	DC-Link Voltage Compensation	[1] On	All set-ups	FALSE	-	Uint8
14-52	Fan Control	[0] Auto	1 set-up	TRUE	-	Uint8
14-53	Fan Monitor	[1] Warning	1 set-up	TRUE	-	Uint8
14-55	Output Filter	[0] No Filter	1 set-up	FALSE	-	Uint8
14-6* Auto Derate						
14-63	Min Switch Frequency	[2] 2.0 kHz	1 set-up	FALSE	-	Uint8

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
14-64	Dead Time Compensation Zero Current Level	[0]Disable	All set-ups	FALSE	-	Uint8
14-65	Speed Derate Dead Time Compensation	Expression Limit	All set-ups	FALSE	-	Uint16
14-9*						
14-90	Fault Level	[3]Trip Lock	1 set-up	FALSE	-	Uint8

6.1.12 15-** Drive Information

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
15-0* Operating Data						
15-00	Operating Hours	0 h	All set-ups	TRUE	74	Uint32
15-01	Running Hours	0 h	All set-ups	TRUE	74	Uint32
15-02	kWh Counter	0 kWh	All set-ups	TRUE	75	Uint32
15-03	Power Up's	0 N/A	All set-ups	TRUE	0	Uint32
15-04	Over Temp's	0 N/A	All set-ups	TRUE	0	Uint16
15-05	Over Volt's	0 N/A	All set-ups	TRUE	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
15-3* Alarm Log						
15-30	Alarm Log: Error Code	0 N/A	All set-ups	TRUE	0	Uint8
15-31	InternalFaultReason	0	1 set-up	TRUE	0	Int16
15-4* Drive Identification						
15-40	FC Type	0 N/A	1 set-up	FALSE	0	VisStr[6]
15-41	Power Section	0 N/A	1 set-up	FALSE	0	VisStr[20]
15-42	Voltage	0 N/A	1 set-up	FALSE	0	VisStr[20]
15-43	Software Version	0 N/A	1 set-up	FALSE	0	VisStr[20]
15-44	Ordered TypeCode	0 N/A	1 set-up	FALSE	0	VisStr[40]
15-45	Actual TypeCode	0 N/A	1 set-up	FALSE	0	VisStr[40]
15-46	Drive Ordering No	0 N/A	1 set-up	FALSE	0	VisStr[8]
15-47	Power Card Ordering No	0 N/A	1 set-up	FALSE	0	VisStr[8]
15-48	LCP Id No	0 N/A	1 set-up	FALSE	0	VisStr[21]
15-49	SW ID Control Card	0 N/A	1 set-up	FALSE	0	VisStr[21]
15-50	SW ID Power Card	0 N/A	1 set-up	FALSE	0	VisStr[21]
15-51	Drive Serial Number	0 N/A	1 set-up	FALSE	0	VisStr[10]
15-52	OEM Information	0 N/A	1 set-up	TRUE	0	VisStr[40]
15-53	Power Card Serial Number	0 N/A	1 set-up	FALSE	0	VisStr[20]
15-57	File version	0 N/A	1 set-up	TRUE	0	Uint8
15-9* Parameter Info						
15-92	Defined Parameters	0	1 set-up	TRUE	0	Uint16
15-97	Application Type	0	1 set-up	TRUE	0	Uint32
15-98	Drive Identification	0 N/A	1 set-up	FALSE	0	VisStr[56]

6.1.13 16-** Data Readouts

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
16-0* General Status						
16-00	Control Word	0 N/A	1 set-up	TRUE	0	Uint16

16-01	Reference [Unit]	0.0 ReferenceFeed-backUnit	1 set-up	TRUE	-3	Int32
16-02	Reference [%]	0.0%	1 set-up	TRUE	-1	Int16
16-03	Status Word	0 N/A	1 set-up	TRUE	0	Uint16
16-05	Main Actual Value [%]	0.0%	1 set-up	TRUE	-2	Int16
16-09	Custom Readout	0.0 CustomReadoutUnit	1 set-up	TRUE	-2	Int32
16-1* Motor Status						
16-10	Power [kW]	0.00 kW	1 set-up	TRUE	-3	Uint32
16-11	Power [hp]	0.00 hp	1 set-up	TRUE	-3	Uint32
16-12	Motor Voltage	0.0 V	1 set-up	TRUE	-1	Uint32
16-13	Frequency	0.0 Hz	1 set-up	TRUE	-1	Uint32
16-14	Motor Current	0.00 A	1 set-up	TRUE	-2	Uint16
16-15	Frequency [%]	0.0%	1 set-up	TRUE	-1	Uint16
16-16	Torque [Nm]	0	1 set-up	FALSE	-	Uint32
16-18	Motor Thermal	0.0%	1 set-up	TRUE	0	Uint8
16-2*						
16-22	Torque [%]	0	1 set-up	FALSE	-	Int16
16-26	Power Filtered [kW]	0.000 kW	1 set-up	FALSE	-3	Int32
16-27	Power Filtered [hp]	0.000 hp	1 set-up	FALSE	-3	Int32
16-3* Drive Status						
16-30	DC Link Voltage	0 V	1 set-up	TRUE	0	Uint32
16-34	Heatsink Temp.	0 °C	1 set-up	TRUE	100	Uint8
16-35	Inverter Thermal	0.0%	1 set-up	TRUE	0	Uint8
16-36	Inv. Nom. Current	0.0 A	1 set-up	TRUE	-2	Uint16
16-37	Inv. Max. Current	0.0 A	1 set-up	TRUE	-2	Uint16
16-38	SL Controller State	0 N/A	1 set-up	TRUE	0	Uint8
16-5* Ref. & Feedb.						
16-50	External Reference	0.0%	1 set-up	TRUE	-1	Int16
16-52	Feedback[Unit]	0.0 ProcessCtrlUnit	1 set-up	TRUE	-3	Int32
16-6* Inputs & Outputs						
16-60	Digital input	0 N/A	1 set-up	TRUE	0	Uint16
16-61	Terminal 53 Setting	[0] Current mode	1 set-up	TRUE	-	Uint8
16-62	Analog Input AI53	1.000 N/A	1 set-up	TRUE	-2	Uint16
16-63	Terminal 54 Setting	[0] Current mode	1 set-up	TRUE	-	Uint8
16-64	Analog Input AI54	1.000 N/A	1 set-up	TRUE	-2	Uint16
16-65	Analog Output AO42 [mA]	0.000 mA	1 set-up	TRUE	-2	Uint16
16-66	Digital Output	0 N/A	1 set-up	TRUE	0	VisStr[4]
16-67	Pulse Input	0	All set-ups	FALSE	0	Int32
16-71	Relay Output [bin]	0 N/A	1 set-up	TRUE	0	Uint16
16-72	Counter A	0.0 N/A	1 set-up	TRUE	0	Int16
16-73	Counter B	0.0 N/A	1 set-up	TRUE	0	Int16
16-79	Analog Output AO45	0.000 mA	1 set-up	TRUE	-2	Uint16
16-8* Fieldbus & FC Port						
16-86	FC Port REF 1	0 N/A	1 set-up	TRUE	0	Int16
16-9* Diagnosis Readouts						
16-90	Alarm Word	0.0 N/A	1 set-up	TRUE	0	Uint32
16-91	Alarm Word 2	0.0 N/A	1 set-up	TRUE	0	Uint32
16-92	Warning Word	0.0 N/A	1 set-up	TRUE	0	Uint32
16-93	Warning Word 2	0.0 N/A	1 set-up	TRUE	0	Uint32
16-94	Ext. Status Word	0.0 N/A	1 set-up	TRUE	0	Uint32
16-95	Ext. Status Word 2	0.0 N/A	1 set-up	TRUE	0	Uint32

6.1.14 18-** Info & Readouts

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
18-1* Fire Mode Log						
18-10	FireMode Log:Event	0 N/A	1 set-up	TRUE	0	Uint8
18-5* Ref. & Feedb.						
18-50	Sensorless Readout [unit]	0.000	1 set-up	FALSE	-3	Int32

6.1.15 20-** Drive Closed Loop

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
20-0* Feedback						
20-00	Feedback 1 Source	[0] No function	All set-ups	TRUE	-	Uint8
20-01	Feedback 1 Conversion	[0] Linear	All set-ups	TRUE	-	Uint8
20-1*						
20-12	Reference/Feedback Unit	ExpressionLimit,	All set-ups	TRUE	-	Uint8
20-6* Sensorless						
20-60	Sensorless Unit	ExpressionLimit	All set-ups	TRUE	-	Uint8
20-69	Sensorless Information	0 N/A	1 set-up	TRUE	-	VisStr[25]
20-8* PI Basic Settings						
20-81	PI Normal/ Inverse Control	[0] Normal	All set-ups	TRUE	-	Uint8
20-83	PI Start Speed [Hz]	0.0 Hz	All set-ups	TRUE	-1	Uint16
20-84	On Reference Bandwidth	5.0%	All set-ups	TRUE	0	Uint8
20-9* PI Controller						
20-91	PI Anti Windup	[1] On	All set-ups	TRUE	-	Uint8
20-93	PI Proportional Gain	0.5	All set-ups	TRUE	-2	Uint16
20-94	PI Integral Time	20 s	All set-ups	TRUE	-2	Uint32
20-97	PI Feed Forward Factor	0.0%	All set-ups	TRUE	0	Uint16

6.1.16 22-** Appl. Functions

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
22-0* Miscellaneous						
22-01	Power Filter Time	0.50s	All set-ups	TRUE	-2	Uint16
22-4* Sleep Mode						
22-40	Minimum Run Time	10.0 s	All set-ups	TRUE	0	Uint16
22-41	Minimum Sleep Time	10.0 s	All set-ups	TRUE	0	Uint16
22-43	Wake-Up Speed [Hz]	10.0 Hz	All set-ups	TRUE	-1	Uint16
22-44	Wake-Up Ref./FB Diff	10.0%	All set-ups	TRUE	0	Uint8
22-45	Setpoint Boost	0.0%	All set-ups	TRUE	0	Int8
22-46	Maximum Boost Time	60 s	All set-ups	TRUE	0	Uint16
22-47	Sleep Speed [Hz]	0.0 s	All set-ups	TRUE	-1	Uint16
22-6* Broken Belt Detection						
22-60	Broken Belt Function	[0] Off	All set-ups	TRUE	-	Uint8
22-61	Broken Belt Torque	10%	All set-ups	TRUE	0	Uint8
22-62	Broken Belt Delay	10 s	All set-ups	TRUE	0	Uint16

6.1.17 24-** Appl. Functions 2

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
24-0* Fire Mode						
24-00	FM Function	[0] Disabled	1 set-up	TRUE	-	Uint8
24-05	FM Preset Reference	0 %	All set-ups	TRUE	0	Int16
24-09	FM Alarm Handling	[1] Trip, Crit.Alarms	1 set-up	FALSE	-	Uint8
24-1* Drive Bypass						
24-10	Drive Bypass Function	[0] Disabled	1 set-up	TRUE	-	Uint8
24-11	Drive Bypass Delay Time	0 s	1 set-up	TRUE	0	Uint16

6.1.18 30-** Special Features

Par. No. #	Parameter description	Default value	2-set-up	Change during operation	Conversion index	Type
30-2* Adv. Start Adjust						
30-22	Locked Rotor Detection	[0] Off	All set-ups	TRUE	0	Uint8
30-23	Locked Rotor Detection Time [s]	0.10s	All set-ups	TRUE	-2	Uint8

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