

Programming Guide

VLT[®] DriveMotor FCP 106/FCM 106



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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

Available literature:

- *VLT® DriveMotor FCP 106/FCM 106 Operating Instructions*, for information required to install and commission the frequency converter.
- *VLT® DriveMotor FCP 106/FCM 106 Design Guide* provides information required for integration of the frequency converter into a diversity of applications.
- *VLT® DriveMotor FCP 106/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* and *VLT® DriveMotor FCP 106/FCM 106 BACnet Operating Instructions* for information required for controlling, monitoring, and programming of the frequency converter.
- The *VLT® PROFIBUS DP MCA 101 Installation Guide* provides information about installing the PROFIBUS and troubleshooting.
- The *VLT® PROFIBUS DP MCA 101 Programming Guide* provides information about configuring the system, controlling the frequency converter, accessing the frequency converter, programming, and troubleshooting. It also contains some typical application examples.
- *VLT® Motion Control 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 vlt-drives.danfoss.com/Support/Service/.

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 |
|----------|---|------------------|
| MG03N2xx | Software update. PROFIBUS available. | 5.00 |

Table 1.1 Document and Software Version

1.4 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.

⚠ 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.

| | |
|---------|--|
| 60° AVM | 60° asynchronous vector modulation |
| A | Ampere/AMP |
| AC | Alternating current |
| AD | Air discharge |
| AEO | Automatic energy optimization |
| AI | Analog input |
| AMA | Automatic motor adaptation |
| AWG | American wire gauge |
| °C | Degrees celsius |
| CD | Constant discharge |
| CDM | Complete drive module: The frequency converter, feeding section, and auxiliaries |
| CM | Common mode |
| CT | Constant torque |
| DC | Direct current |
| DI | Digital input |
| DM | Differential mode |
| D-TYPE | Drive dependent |
| EMC | Electromagnetic compatibility |

| | |
|----------------------------------|--|
| EMF | Electromotive force |
| ETR | Electronic thermal relay |
| f _{JOG} | Motor frequency when jog function is activated. |
| f _M | Motor frequency |
| f _{MAX} | Maximum output frequency, the frequency converter applies on its output. |
| f _{MIN} | Minimum motor frequency from the frequency converter |
| f _{M,N} | Nominal motor frequency |
| FC | Frequency converter |
| g | Gram |
| Hiperface® | Hiperface® is a registered trademark by Stegmann. |
| HO | High overload |
| hp | Horse power |
| 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} | Maximum output current |
| I _{VLT,N} | 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 | Inductance in milli Henry |
| mm | Millimeter |
| ms | Millisecond |
| msb | Most significant bit |
| η _{VLT} | Efficiency of the frequency converter defined as ratio between power output and power input. |
| nF | Capacitance in nano Farad |
| NLCP | Numerical local control panel |
| Nm | Newton meter |
| NO | Normal overload |
| n _s | Synchronous motor speed |
| Online/ Offline Parameters | Changes to online 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 |
| PDS | Power drive system: a CDM and a motor |
| PELV | Protective extra low voltage |
| P _m | Frequency converter nominal output power as high overload (HO). |
| P _{M,N} | Nominal motor power |
| PM motor | Permanent magnet motor |
| Process PID | PID (Proportional Integrated Differential) regulator that maintains the speed, pressure, temperature, and so on. |
| R _{br,nom} | Nominal resistor value that ensures a brake power on the 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} | Recommended brake resistor resistance of Danfoss brake resistors |
| 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 ⁺ | Voltage vector control plus |

Table 1.2 Abbreviations
Conventions

Numbered lists indicate procedures.

Bullet lists indicate other information and description of illustrations.

Italicized text indicates:

- Cross-reference.
- Link.
- Footnote.
- Parameter name, parameter group name, parameter option.

All dimensions are in mm (inch).

* indicates a default setting of a parameter.

1.5 Electrical Overview

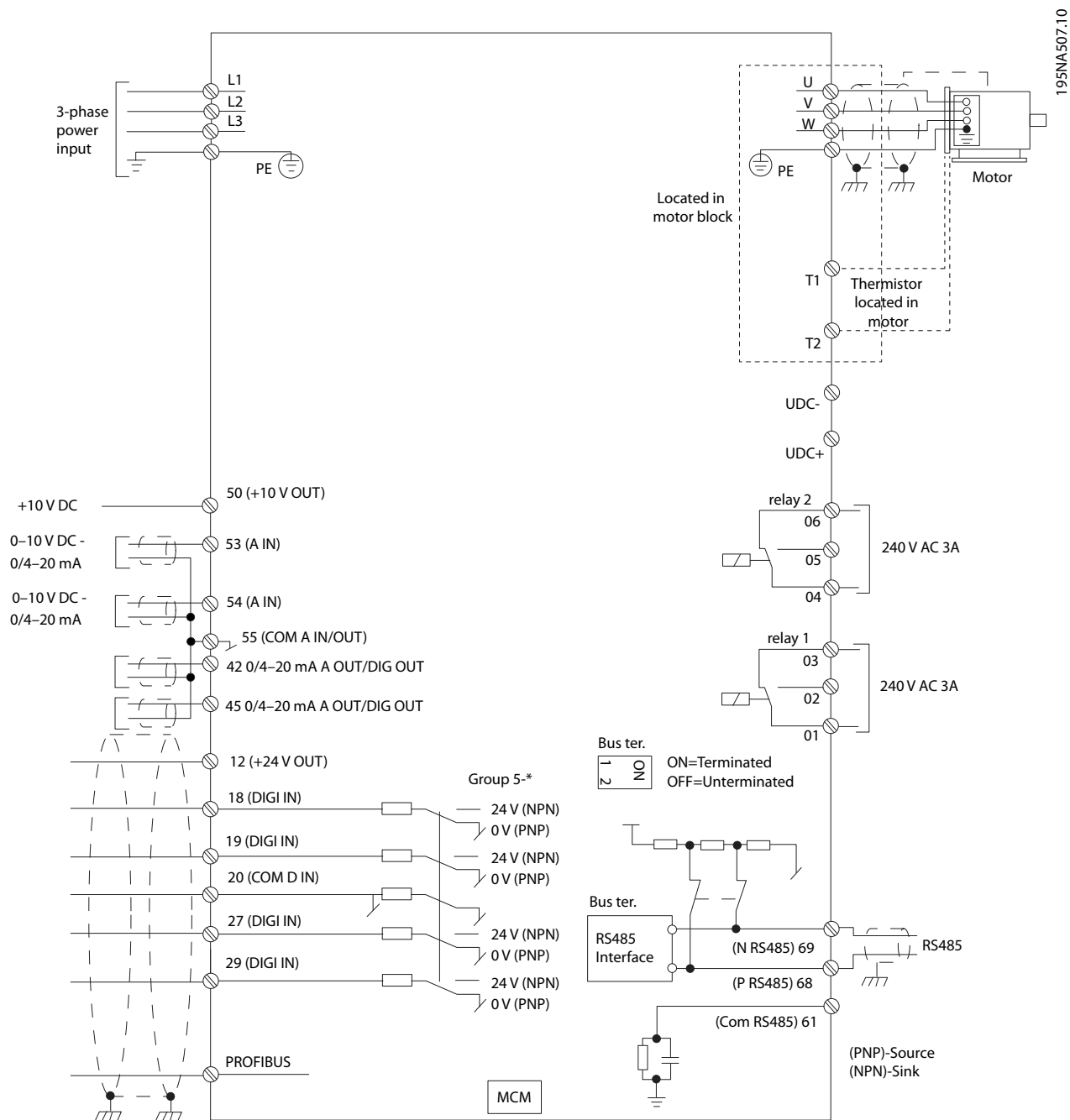


Illustration 1.1 Electrical Overview

2 Programming

2

2.1 Programming with MCT 10 Set-up Software

The frequency converter can be programmed from the LCP, or from a PC via the RS485 COM port by installing the MCT 10 Set-up Software. Refer to *chapter 1.2 Additional Resources* for more details about the software.

2.2 Graphical Local Control Panel (GLCP)

The GLCP 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).

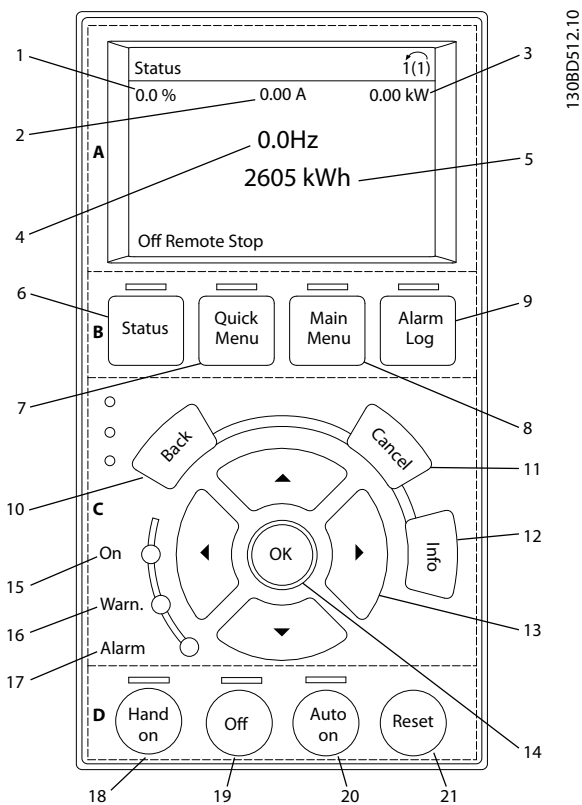


Illustration 2.1 Graphical Local Control Panel (GLCP)

A. Display area

The display area is activated when the frequency converter receives power from mains voltage, a DC bus terminal, or a 24 V DC external supply.

The information shown on the GLCP can be customized for user application. Select options in the Quick Menu Q3-13 *Display settings*.

| Call-out | Display | Parameter number | Default setting |
|----------|---------|------------------|-----------------|
| 1 | 1.1 | 0-20 | Reference % |
| 2 | 1.2 | 0-21 | Motor current |
| 3 | 1.3 | 0-22 | Power [kW] |
| 4 | 2 | 0-23 | Frequency |
| 5 | 3 | 0-24 | kWh counter |

Table 2.1 Legend to Illustration 2.1

B. Display menu key

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

| Callout | Key | Function |
|---------|------------|---|
| 6 | Status | Shows operational information. |
| 7 | Quick Menu | Allows access to programming parameters for initial set-up instructions and many detailed application instructions. |
| 8 | Main Menu | Allows access to all programming parameters. |
| 9 | Alarm Log | Shows a list of current warnings, the last 10 alarms, and the maintenance log. |

Table 2.2 Legend to Illustration 2.1

C. Navigation keys and indicator lights (LEDs)

Navigation keys are used for programming functions and moving the display cursor. The navigation keys also provide speed control in local operation. There are also 3 frequency converter status indicator lights in this area.

| Callout | Key | Function |
|---------|-----------------|---|
| 10 | Back | Reverts to the previous step or list in the menu structure. |
| 11 | Cancel | Cancels the last change or command as long as the display mode has not changed. |
| 12 | Info | Press for a definition of the function shown. |
| 13 | Navigation keys | Press to move between items in the menu. |
| 14 | OK | Press to access parameter groups or to enable a selection. |

Table 2.3 Legend to Illustration 2.1

| Call-out | Indicator | Light | Function |
|----------|-----------|--------|--|
| 15 | ON | Green | The ON light activates when the frequency converter receives power from mains voltage, a DC bus terminal, or a 24 V external supply. |
| 16 | WARN | Yellow | When warning conditions are met, the yellow WARN light turns on, and text appears in the display area identifying the problem. |
| 17 | ALARM | Red | A fault condition causes the red alarm light to flash, and an alarm text is shown. |

Table 2.4 Legend to Illustration 2.1

D. Operation keys and indicator lights (LEDs)

Operation keys are at the bottom of the GLCP.

| Callout | Key | Function |
|---------|---------|--|
| 18 | Hand On | Starts the frequency converter in local control. <ul style="list-style-type: none"> An external stop signal by control input or serial communication overrides the local hand on. |
| 19 | Off | Stops the motor but does not remove power to the frequency converter. |
| 20 | Auto On | Puts the system in remote operational mode. <ul style="list-style-type: none"> Responds to an external start command by control terminals or serial communication. |
| 21 | Reset | Resets the frequency converter manually after a fault has been cleared. |

Table 2.5 Legend to Illustration 2.1

NOTICE

To adjust the display contrast, press [Status] and [▲]/[▼].

2.3 GLCP 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 *parameter 16-10 Power [kW]* for kW, *parameter 16-11 Power [hp]* for hp. If *parameter 0-03 Regional Settings* is set to [1] North

America, motor power is shown in hp instead of kW.

- Custom readout *parameter 16-09 Custom Readout*.

2.3.2 Quick Menu

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

- Wizard for open-loop applications. See *chapter 2.3.4 Configuration for Open-loop Applications* for details.
- Wizard for closed-loop applications. See *chapter 2.3.5 Set-up Wizard for Closed-loop Applications* for details.
- Motor set-up. See *chapter 2.3.6 Quick Menu Motor Set-up* for details.
- Changes made.

2.3.3 Main Menu

The *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 most 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 Configuration for Open-loop Applications

This section 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 utilize a feedback signal from the process.

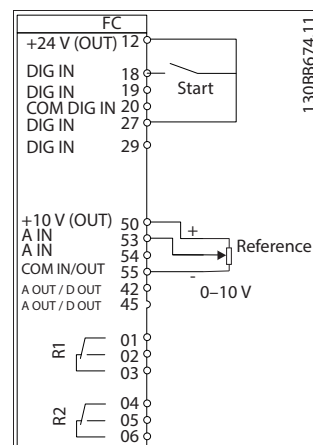


Illustration 2.2 Principle Wiring for Open-loop Applications

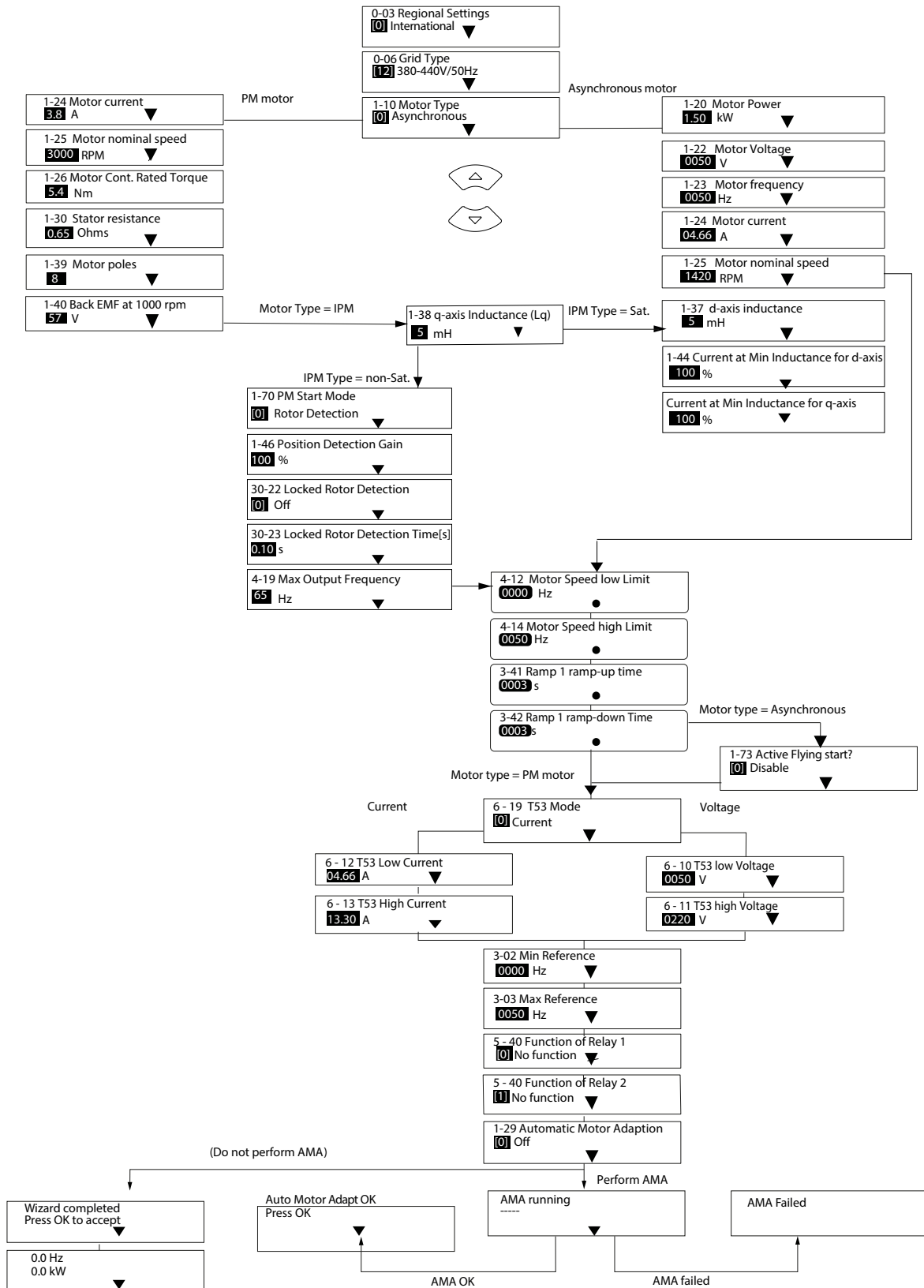
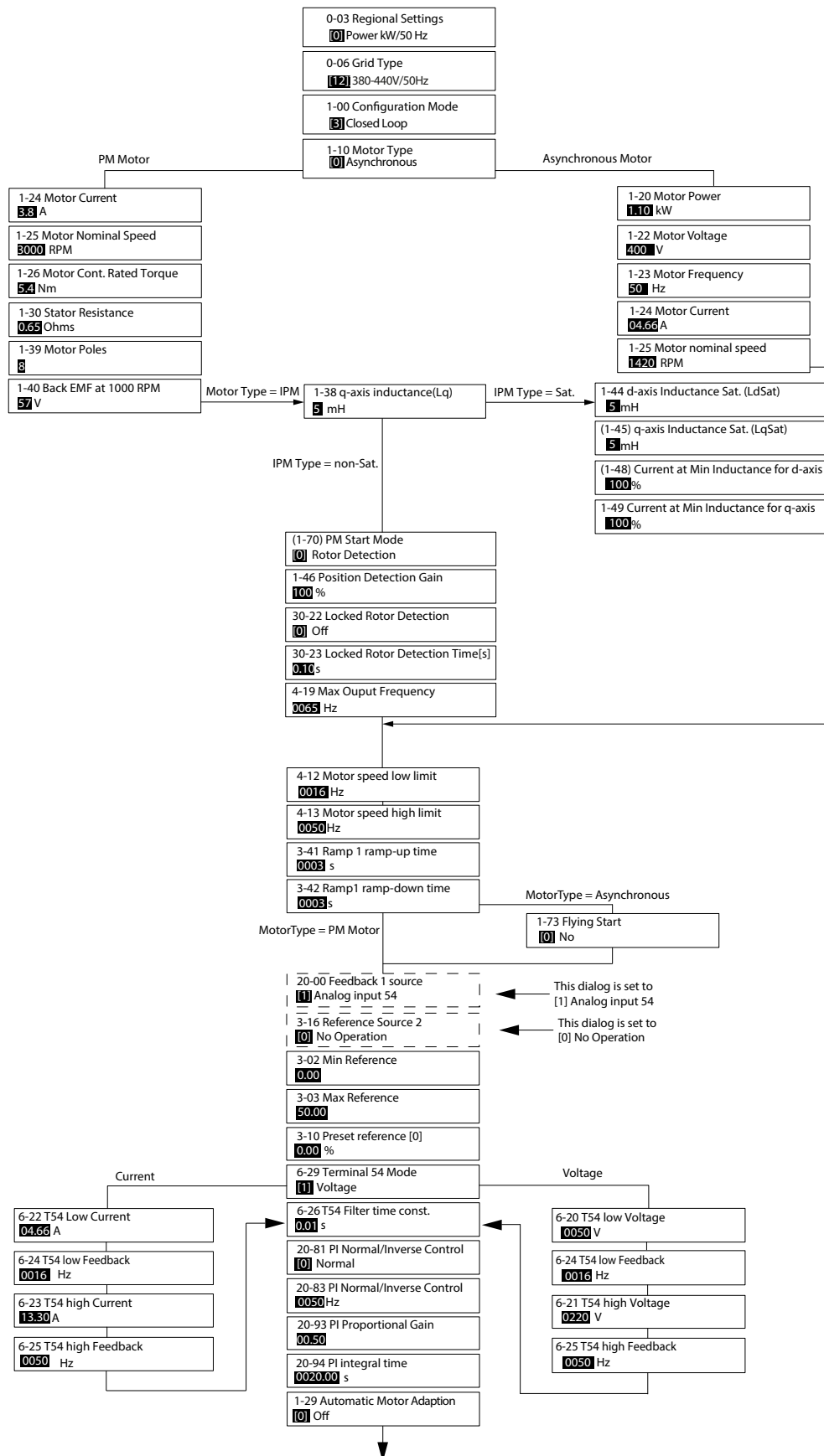


Illustration 2.3 Configuration for Open-loop Applications

2.3.5 Set-up Wizard for Closed-loop Applications



195NA417.11

Illustration 2.4 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. See *chapter Motor Connection* in *VLT® DriveMotor FCP 106/FCM 106 Operating Instructions*, or
- Enable motor thermal protection by setting *parameter 1-90 Motor Thermal Protection* to [4] ETR trip 1.

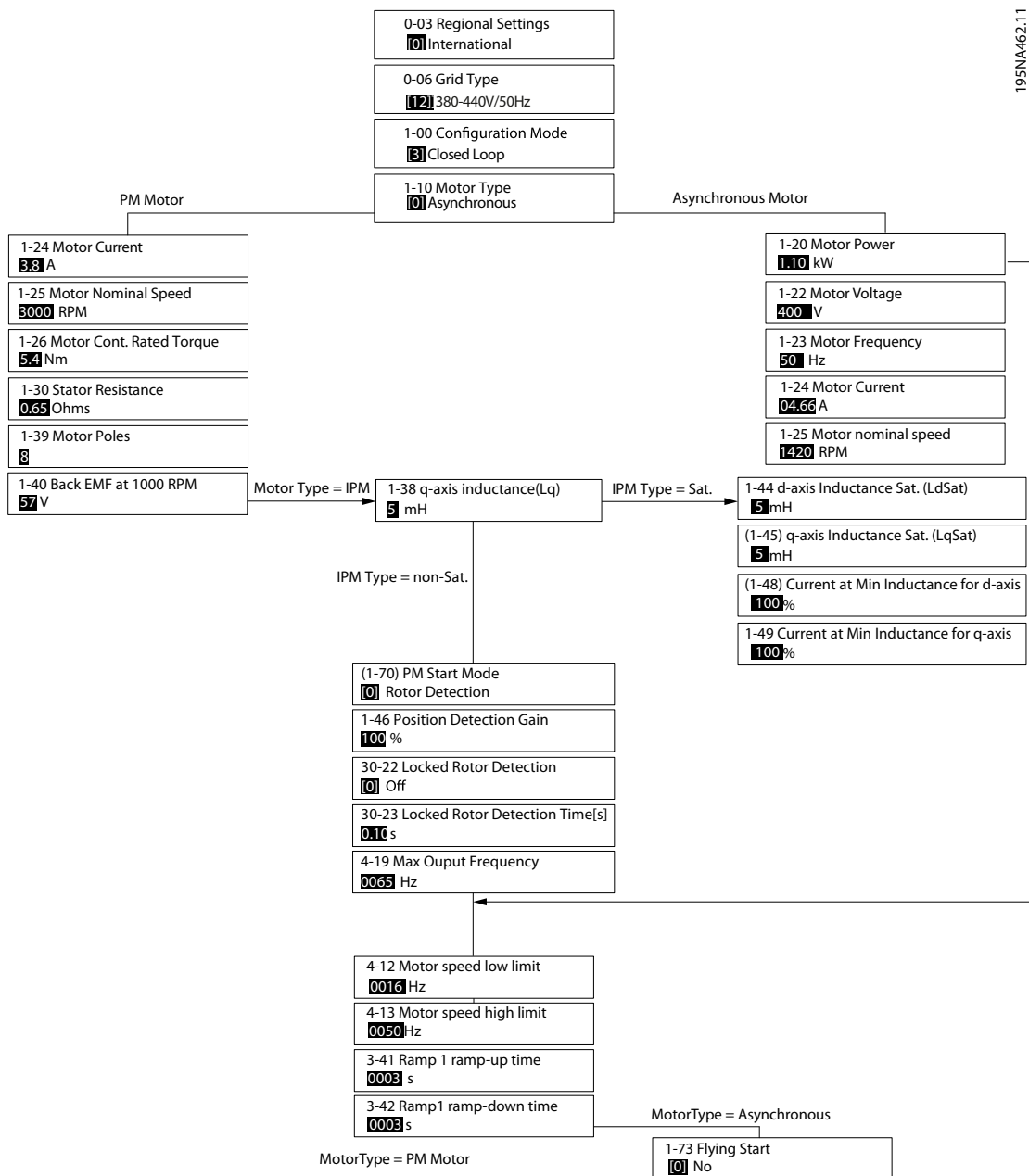


Illustration 2.5 Quick Menu Motor Set-up

2.4 Programming Parameters

Procedure:

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

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 the MCT 10 Set-up Software 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 initialization mode according to the requirement for retaining parameter settings.

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

Use this method to initialize the frequency converter without resetting communication settings.

1. Select *parameter 14-22 Operation Mode*.
2. Press [OK].
3. Select [2] *initialization* and Press [OK].
4. Cut off the mains supply and wait until the display turns off.
5. Reconnect the mains supply.

The frequency converter is now reset, except for the following parameters:

- *Parameter 0-03 Regional Settings.*
- *Parameter 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.*
- *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.*
- *Parameter group 15-4* Drive identification parameters.*
- *Parameter 1-06 Clockwise Direction.*

2

Two-finger initialization

Use this method to initialize the frequency converter, 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 above-mentioned keys for 10 s.

The frequency converter is now reset, except for the following parameters:

- *Parameter 0-03 Regional Settings.*
- *Parameter 15-00 Operating hours.*
- *Parameter 15-03 Power Up's.*
- *Parameter 15-04 Over Temp's.*
- *Parameter 15-05 Over Volt's.*
- *Parameter group 15-4* Drive identification parameters*

Alarm 80, Drive initialised appears as confirmation that parameters are initialized. Press [Reset].

3 RS485 Installation and Set-up

3.1 RS485

3.1.1 Overview

RS485 is a 2-wire bus interface compatible with multi-drop network topology. 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 1 network segment. Repeaters divide network segments, see *Illustration 3.1*.

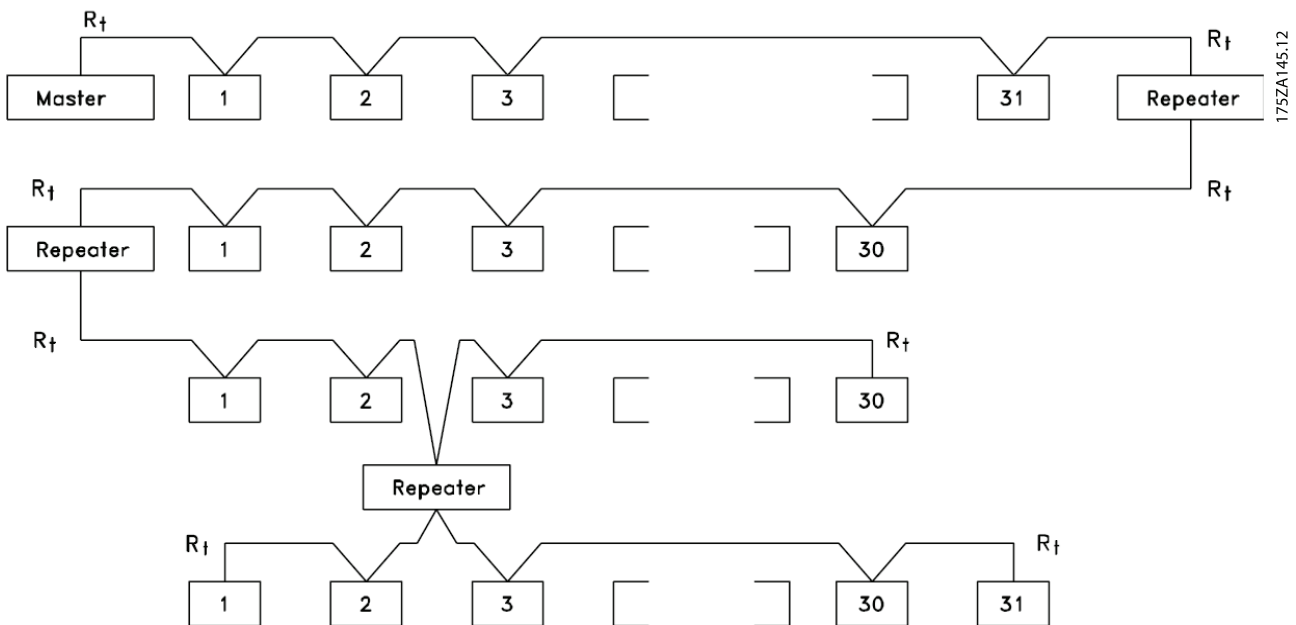


Illustration 3.1 RS485 Bus Interface

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 (S800) 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.

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-equalizing cables to maintain the same ground potential throughout the network - particularly in installations with long cables.

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

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

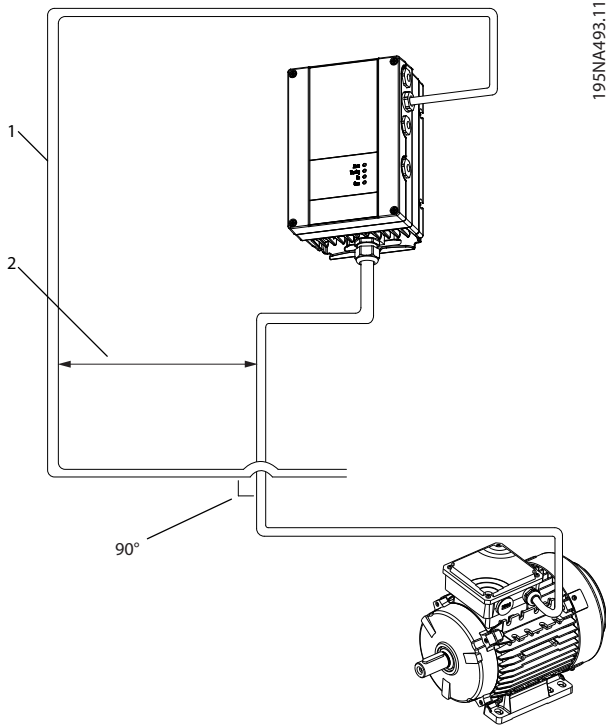
Table 3.1 Cable Specifications

3.1.2 EMC Precautions

NOTICE

Observe relevant national and local regulations regarding protective earth connection. Failure to ground the cables properly can result in communication degradation and equipment damage. To avoid coupling of high-frequency noise between the cables, the RS485 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 RS485 cable must cross motor and brake resistor cables at an angle of 90°.

3



| | |
|---|--------------------------------|
| 1 | Fieldbus cable |
| 2 | Minimum 200 mm (8 in) distance |

Illustration 3.2 Minimum Distance between Communication and Power Cables

3.1.3 Network Connection

Connect the frequency converter to the R4S85 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 RS485 cable to terminal 61. Terminal 61 has an RC filter to eliminate current noise on the cable.

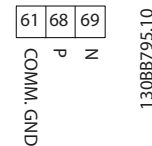
NOTICE

INSULATION REQUIREMENTS, MH1

For control card and relay card wires, the minimum required insulation is 300 V and 75 °C (167 °F).

NOTICE

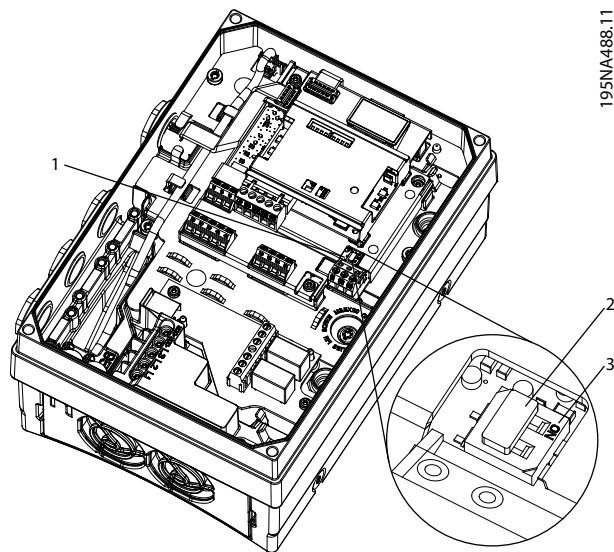
Screened, twisted-pair cables are recommended to reduce noise between conductors.



| | |
|-----------|----------------------|
| 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 RS485 bus, and activate RS485. For position of DIP switch, see *Illustration 3.4*. The factory setting for the DIP switch is OFF.



| | |
|---|---|
| 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 Parameter Settings for Modbus Communication

| Parameter | Function |
|---------------------------------------|--|
| Parameter 8-30 Protocol | Select the application protocol to run for the RS485 interface. |
| Parameter 8-31 Address | Set the node address. NOTICE The address range depends on the protocol selected in parameter 8-30 Protocol. |
| Parameter 8-32 Baud Rate | Set the baud rate. NOTICE The default baud rate depends on the protocol selected in parameter 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 parameter 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 | Function |
|--|---|
| Parameter 8-36 Maximum Response Delay | Specify a maximum delay time between transmitting a request and receiving a response. |
| Parameter 8-37 Maximum Inter-character delay | If transmission is interrupted, specify a maximum delay time between 2 received bytes to ensure timeout. NOTICE The default selection depends on the protocol selected in parameter 8-30 Protocol. |

Table 3.2 Modbus Communication Parameter Settings

3.2 FC Protocol

3.2.1 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/slave principle for communications via a fieldbus.

1 master and a maximum of 126 slaves can be connected to the bus. The master selects the individual slaves via an address character in the telegram. A slave itself can never transmit without first being requested to do so, and direct message transfer between the individual slaves is not possible. Communications occur in the half-duplex mode. The master function cannot be transferred to another node (single-master system).

The physical layer is RS485, thus utilizing the RS485 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.

3.2.2 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. Accessing the parameters offers a range of control options, including controlling the setpoint of the frequency converter when its internal PI controller is used.

3.3 Network Configuration

To enable the FC protocol for the frequency converter, set the following parameters.

| Parameter | Setting |
|-----------------------------------|-----------------------------------|
| Parameter 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 Parameters to Enable the Protocol

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.



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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).

Several data bytes (variable, depending on the type of telegram) follow.

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 |
| Telegrams containing texts | 10 ¹ +n bytes |

Table 3.4 Length of Telegrams

1) The 10 is 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 slave 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⇒slave) and response telegrams (slave⇒master).

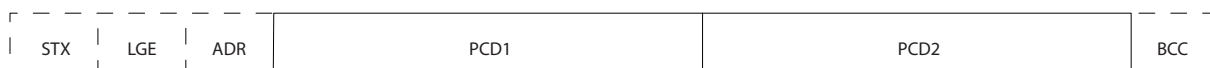
3

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 slave).
- Status word and present output frequency (from slave to master).

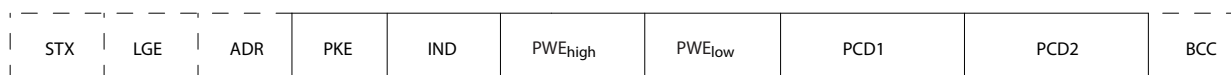


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Illustration 3.7 Process Block

Parameter block

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

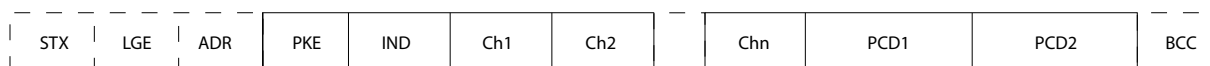


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Illustration 3.8 Parameter Block

Text block

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



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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):

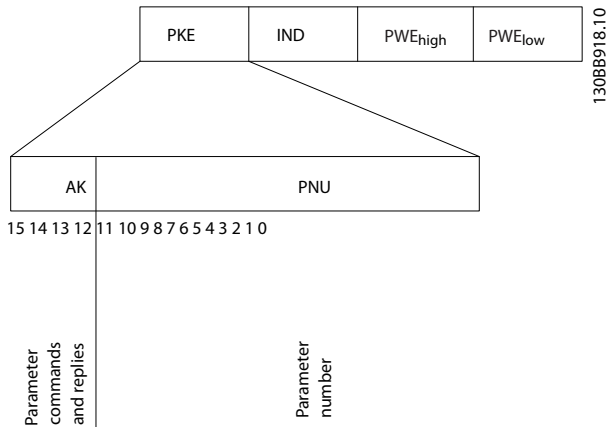


Illustration 3.10 PKE Field

Bits number 12–15 transfer parameter commands from master to slave and return processed slave responses to the master.

| Parameter commands master⇒slave | | | | |
|---------------------------------|----|----|----|---|
| Bit number | | | | 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 slave⇒master | | | | |
|-----------------------|----|----|----|---|
| Bit number | | | | 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 slave sends this response:

0111 Command cannot be performed

- and issues the following fault report in the parameter value:

| Fault 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 Slave Report

3.4.8 Parameter Number (PNU)

Bit numbers 0–11 transfer parameter numbers. The function of the relevant parameter is defined in the parameter description in *chapter 2 Programming*.

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.

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 slave.

When a slave responds to a parameter request (read command), the present parameter value in the PWE block is transferred and returned to the master. If a parameter contains several data options, for example *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 2nd 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 shown in chapter 4 Parameters. Parameter values are transferred as whole numbers only. Conversion factors are 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→slave control word) | Reference value |
| Control telegram (slave→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 Illustration 3.11.

| | | | | | | | |
|------|---|------|---|----------|---|---------|---|
| E19E | H | 0000 | H | 0000 | H | 03E8 | H |
| PKE | | IND | | PWE high | | PWE low | |

Illustration 3.11 Telegram

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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 Motor Speed High Limit [Hz] is 19E in hexadecimal.

The response from the slave to the master is shown in Illustration 3.12.

| | | | | | | | |
|------|---|------|---|---------------------|---|--------------------|---|
| 119E | H | 0000 | H | 0000 | H | 03E8 | H |
| PKE | | IND | | PWE _{high} | | PWE _{low} | |

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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.

| | | | | | | | |
|------|---|------|---|---------------------|---|--------------------|---|
| 1155 | H | 0000 | H | 0000 | H | 0000 | H |
| PKE | | IND | | PWE _{high} | | PWE _{low} | |

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Illustration 3.13 Telegram

If the value in parameter 3-41 Ramp 1 Ramp Up Time is 10 s, the response from the slave to the master is shown in Illustration 3.14.

| | | | | | | | |
|------|---|------|---|---------------------|---|--------------------|---|
| 1155 | H | 0000 | H | 0000 | H | 03E8 | H |
| PKE | | IND | | PWE _{high} | | PWE _{low} | |

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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 Prerequisite Knowledge

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.

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.

3.6.2 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 Overview

Regardless of the type of physical communication networks, this section 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.
- Recognizes 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/slave technique in which only the master can initiate transactions (called queries). Slaves respond by supplying the requested data to the master, or by acting as requested in the query. The master can address individual slaves, or initiate a broadcast message to all slaves. Slaves 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 following information:

- The device (or broadcast) address.
- A function code defining the requested action.
- Any data to be sent.
- An error-checking field.

The slave'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 slave is unable to perform the requested action, the slave constructs and sends an error message. Alternatively, a timeout occurs.

3.6.4 Frequency Converter with Modbus RTU

The frequency converter communicates in Modbus RTU format over the built-in RS485 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.
- Various stops:
 - Coast stop.
 - Quick stop.
 - DC-brake stop.
 - Normal (ramp) stop.
- Reset after a fault trip.
- Run at various 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. Accessing the parameters offers 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 |
|-----------------------------------|-----------------------------------|
| Parameter 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 Introduction

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 | <ul style="list-style-type: none"> • 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 | Cyclic redundancy check (CRC). |

Table 3.13 Byte Details

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 recognize 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 0 are broadcast messages. No response is permitted for broadcast messages. A typical message frame is shown in *Table 3.14*.

| 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 3.14 Typical Modbus RTU Message Structure

3.8.3 Start/Stop Field

Messages start with a silent period of at least 3.5 character intervals. The silent period 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 behavior causes a timeout (no response from the slave), 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 slave device addresses are in the range of 0–247 decimal. The individual slave devices are assigned addresses in the range of 1–247. (0 is reserved for broadcast mode, which all slaves recognize.) A master addresses a slave by placing the slave address in the address field of the message. When the slave sends its response, it places its own address in this address field to let the master know which slave 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 slave. When a message is sent from a master to a slave device, the function code field tells the slave what kind of action to

perform. When the slave 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 slave simply echoes the original function code. For an exception response, the slave returns a code that is equivalent to the original function code with its most significant bit set to logic 1. In addition, the slave places a unique code into the data field of the response message. This code tells the master what kind of error occurred, or the reason for the exception. Also refer to *chapter 3.8.12 Function Codes Supported by Modbus RTU* 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 digits are made up of 1 RTU character. The data field of messages sent from a master to a slave device contains additional information which the slave must use to act according to the function code. The information 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 cyclic 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 timeout results. The error-checking field contains a 16-bit binary value implemented as 2 8-bit bytes. After the implementation, 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 1 telegram. The structure is also flexible so that only 2 registers can be written to, and 10 registers can be read from the controller.

The PCD write list is data sent from the controller to the frequency converter such as:

- Control word.
- Reference.
- 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 frequency converter.

The PCD write list is set up in *parameter 8-42 PCD Write Configuration*.

The PCD read list is data sent from the frequency converter to the controller such as:

- Status word.
- Main actual value.
- Application-dependent data like running hours, motor current, and alarm word.

NOTICE

The status word and main actual value are always sent in the list from the frequency converter to the controller.

| Write | | Read | |
|------------------------------|-------------------------|------------------------------|-------------------------|
| Master → Frequency Converter | | Frequency Converter → Master | |
| Holding Register | Controlled by Parameter | Holding Register | Controlled by Parameter |
| 2810 | CTW 8-42 [0] | 2910 | STW 8-43 [0] |
| 2811 | REF 8-42 [1] | 2911 | MAV 8-43 [1] |
| 2812 | PCD 2 write 8-42 [2] | 2912 | PCD 2 read 8-43 [2] |
| 2813 | PCD 3 write 8-42 [3] | 2913 | PCD 3 read 8-43 [3] |
| 2814 | PCD 4 write 8-42 [4] | 2914 | PCD 4 read 8-43 [4] |
| 2815 | PCD 5 write 8-42 [5] | 2915 | PCD 5 read 8-43 [5] |
| ... | ... write ... | ... | ... read ... |
| 2873 | PCD 63 write 8-42 [63] | 2919 | PCD 63 read 8-43 [63] |

Illustration 3.15 PCD Write/Read Lists

NOTICE

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

NOTICE

Map 32-bit parameters inside the 32-bit boundaries, PCD2 & PCD3 or PCD4 & PCD5, and so on, where the parameter number is mapped twice to *parameter 8-42 PCD Write Configuration* or *parameter 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.

| Frequency Converter → Drive | | | | |
|-----------------------------|------|------|------------------|--------------|
| Register | 2810 | 2811 | 2812 | 2813 |
| Write | CTW | REF | Analog output 42 | Torque limit |

CTW = Parameter 16-85, REF = Parameter 16-86,
Analog output = Parameter 6-52, Torque limit Motor mode = 4-16

Illustration 3.16 PLC Sending Data

Example:

The frequency converter sends status word, main actual value, actual motor current, digital inputs, and torque [Nm].

| Frequency Converter → Master | | | | | |
|------------------------------|------|------|---------------|----------------|--------------------|
| Register | 2910 | 2911 | 2912 | 2913 | 2914 |
| Read | STW | MAV | Motor current | Digital inputs | Actual Torque [Nm] |

STW = Parameter 16-03, MAV = Parameter 16-05,
Motor Current = Parameter 16-14, Digital Inputs = Parameter 16-60
Actual Torque [Nm]

Illustration 3.17 Frequency Converter Sending Data

Example, continued

Map the input and output data of the Modbus RTU to the parameter of the frequency converter. Use *parameter 8-42 PCD Write Configuration* and *parameter 8-43 PCD Read Configuration* for the mapping.

| | | |
|-------|-------------------------|-------------------------|
| 842.0 | PCD write configuration | FC Port CTW 1 |
| 842.1 | PCD write configuration | FC Port REF 1 |
| 842.2 | PCD write configuration | Terminal 42 Output B... |
| 842.3 | PCD write configuration | Torque Limit Motor M... |
| 842.4 | PCD write configuration | None |

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Illustration 3.18 Mapping Input/Output Data in Parameter 8-42 PCD Write Configuration

NOTICE

Gray lines are fixed, red are user-selectable.

Set up the following parameters in the frequency converter:

| | | |
|-------|------------------------|-----------------------|
| 843.0 | PCD read configuration | Status Word |
| 843.1 | PCD read configuration | Main Actual Value [%] |
| 843.2 | PCD read configuration | Motor Current |
| 843.3 | PCD read configuration | Digital Input |
| 843.4 | PCD read configuration | Torque [Nm] |
| 843.5 | PCD read configuration | None |

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Illustration 3.19 Mapping Input/Output Data in Parameter 8-43 PCD Read Configuration

NOTICE

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

For higher Amp readout, use 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 slave ID | 11 hex |
| Read write multiple registers | 17 hex |

Table 3.15 Function Codes

| Function | Function code | Subfunction code | Subfunction |
|-------------|---------------|------------------|---|
| Diagnostics | 8 | 1 | Restart communication. |
| | | 2 | Return diagnostic register. |
| | | 10 | Clear counters and diagnostic register. |
| | | 11 | Return bus message count. |
| | | 12 | Return bus communication error count. |
| | | 13 | Return slave error count. |
| | | 14 | Return slave message count. |

Table 3.16 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 slave). 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 slave) 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 slave). 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. |

| Code | Name | Meaning |
|------|----------------------|---|
| 3 | Illegal data value | A value contained in the query data field is not an allowable value for server (or slave). 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 | Slave device failure | An unrecoverable error occurred while the server (or slave) was attempting to perform the requested action. |

Table 3.17 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 *parameter 3-12 Catch up/slow Down Value* (16 bit): The holding register 3120 holds the parameters value. A value of 1352 (decimal), means that the parameter is set to 12.52%

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

For information on the parameters, size, and conversion index, see *chapter 4 Parameters*.

3.9.2 Storage of Data

The coil 65 decimal determines whether data written to the frequency converter is 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, for example *parameter 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.

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

A parameter value can only be transferred as a whole number. To transfer decimals, use a conversion factor.

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 03 hex *read holding registers*. Parameters are written using the function 6 hex *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 03 hex *read holding registers* and written using function 10 hex *preset multiple registers*. Readable sizes range from 1 register (2 characters) up to 10 registers (20 characters).

3.10 Examples

The following examples show various Modbus RTU commands.

3.10.1 Read Holding Registers (03 hex)

Description

This function reads the contents of holding registers in the slave.

Query

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

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

| Field name | Example (hex) |
|---------------------|--|
| Slave address | 01 |
| Function | 03 (Read holding registers) |
| Starting address HI | 0B (Register address 3029) |
| Starting address LO | D5 (Register address 3029) |
| Number of points HI | 00 |
| Number of points LO | 02 – (<i>parameter 3-03 Maximum Reference is 32 bits long, that is, 2 registers</i>) |
| Error check (CRC) | – |

Table 3.18 Query

Response

The register data in the response message is packed as 2 bytes per register, with the binary contents right justified within each byte. For each register, the 1st byte contains the high-order bits, and the 2nd contains the low-order bits.

Example: hex 000088B8=35.000=35 Hz.

| Field name | Example (hex) |
|-------------------------|---------------|
| Slave 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 3.19 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 0, that is, register 1 is addressed as 0.

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

| Field name | Example (hex) |
|---------------------|---------------------------|
| Slave 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 3.20 Query

Response

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

| Field name | Example (hex) |
|---------------------|---------------|
| Slave address | 01 |
| Function | 06 |
| Register address HI | 03 |
| Register address LO | E7 |
| Preset data HI | 00 |
| Preset data LO | 01 |
| Error check (CRC) | – |

Table 3.21 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 0, that is, register 1 is addressed as 0. Example of a request to preset 2 registers (set *parameter 1-24 Motor Current* to 738 (7.38 A)):

| Field name | Example (hex) |
|----------------------------------|---------------|
| Slave address | 01 |
| Function | 10 |
| Starting address HI | 04 |
| Starting address LO | 07 |
| Number of registers HI | 00 |
| Number 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 3.22 Query

Response

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

| Field name | Example (hex) |
|------------------------|---------------|
| Slave address | 01 |
| Function | 10 |
| Starting address HI | 04 |
| Starting address LO | 19 |
| Number of registers HI | 00 |
| Number of registers LO | 02 |
| Error check (CRC) | - |

Table 3.23 Response

3.10.4 Read/Write Multiple registers (17 hex)

Description

This function code combines 1 read operation and 1 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 0. Example of a request to set *parameter 1-24 Motor Current* to 738 (7.38 A) and read *parameter 3-03 Maximum Reference* which has value 50000 (50000 Hz):

| 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 <i>(parameter 3-03 Maximum Reference is 32 bits long, that is, 2 registers)</i> |
| 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 3.24 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 3.25 Response

3.11 FC Control Profile

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

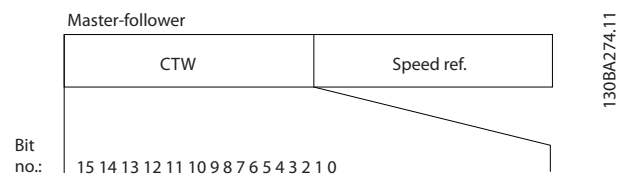


Illustration 3.20 Control Word According to FC Profile

| 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 3.26 Control Word According to FC Profile

Explanation of the control bits

Bits 00/01

Bits 00 and 01 are used to select among the 4 reference values, which are pre-programmed in *parameter 3-10 Preset Reference* according to *Table 3.27*.

| Programmed reference 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 3.27 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 releases the motor (the output transistors are shut off) and it coasts to a standstill.

Bit 03=1: If the other starting conditions are met, the frequency converter starts the motor.

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 [21] Speed up and [22] Speed down.

NOTICE

If freeze output is active, the frequency converter can only be stopped by 1 of 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 [5] DC braking, [2] Coasting stop, or [3] Reset and coasting stop.

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: Allows 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 leading signal edge, that is, when changing from logic 0 to logic 1.

Bit 08, Jog

Bit 08=1: *Parameter 3-11 Jog Speed [Hz]* determines the output frequency.

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. If the control word is not needed when updating or reading parameter, turn it off.

Bit 11, Relay 01

Bit 11=0: Relay not activated.

Bit 11=1: Relay 01 activated if [36] Control word bit 11 is selected 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 if [37] Control word bit 12 is selected 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 3.28*.

| Set-up | Bit 13 |
|--------|--------|
| 1 | 0 |
| 2 | 1 |

Table 3.28 Menu Set-ups

The function is only possible when [9] Multi set-ups is selected in *parameter 0-10 Active Set-up*.

Use *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, [2] Logic OR or [3] Logic AND is selected.

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

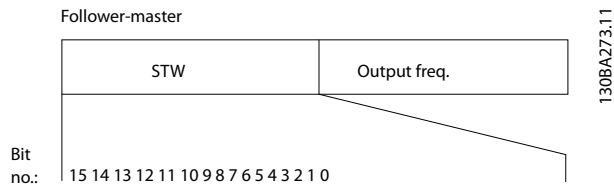


Illustration 3.21 Status Word

| 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 3.29 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 supply (if there is 24 V external 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 runs 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 activated on the control unit or [2] Local in parameter 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 frequency converter has a start signal without coast.

Bit 12, Drive OK/stopped, autostart

Bit 12=0: There is no temporary overtemperature on the frequency converter.
 Bit 12=1: The frequency converter stops because of overtemperature but the unit does not trip and resumes operation once the overtemperature normalizes.

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 DC link is too low or too high.

Bit 14, Torque OK/limit exceeded

Bit 14=0: The motor current is lower than the current limit selected in parameter 4-18 Current Limit.
 Bit 14=1: The current 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 2's complement. The actual output frequency (MAV) is scaled in the same way as the bus reference.

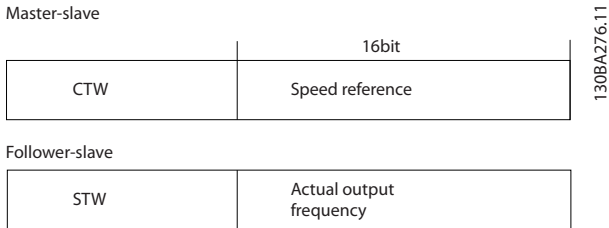


Illustration 3.22 Actual Output Frequency (MAV)

The reference and MAV are scaled as follows:

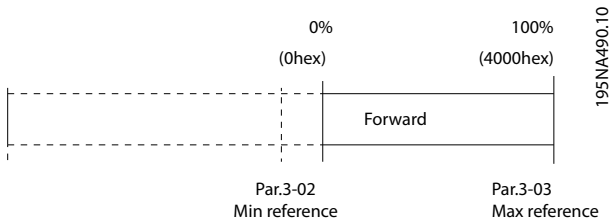


Illustration 3.23 Reference

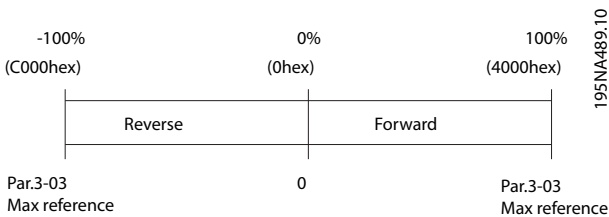


Illustration 3.24 MAV when Parameter 1-00 Configuration Mode is set to [0] Open Loop

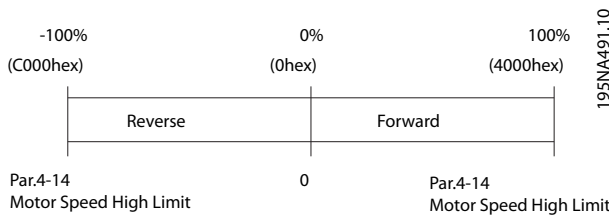


Illustration 3.25 MAV when Parameter 1-00 Configuration Mode is set to [3] Closed Loop

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.

4.1.1 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: |
| | <p>NOTICE</p> <p>This parameter cannot be adjusted while the motor runs.</p> <p>To meet the needs for different default settings in different parts of the world, <i>parameter 0-03 Regional Settings</i> is implemented in the frequency converter. The selected setting influences the default setting of the motor nominal frequency.</p> |
| [0] * | International Sets the default value of <i>parameter 1-23 Motor Frequency</i> to 50 Hz. |
| [1] | North America Sets the default value of <i>parameter 1-23 Motor Frequency</i> to 60 Hz. |

| 0-04 Operating State at Power-up | |
|----------------------------------|--|
| Option: | Function: |
| | Select the operating mode after reconnection of the frequency converter to mains voltage after power-down when operating in <i>Hand (local) mode</i> . |
| [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 local start via a digital input as before the frequency converter was powered down. |

| 0-04 Operating State at Power-up | |
|----------------------------------|---|
| Option: | Function: |
| [1] | <p>Forced stop, ref=old</p> <p>Uses saved reference [1] to stop the frequency converter, but at the same time retains 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 the local start command via a digital input), the frequency converter restarts and operates at the retained speed reference.</p> |

| 0-06 GridType | |
|---------------|--|
| Option: | Function: |
| | <p>Select the grid type of the supply voltage/frequency.</p> <p>NOTICE</p> <p>Not all options are supported in all power sizes.</p> <p>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 <i>VLT® DriveMotor FCP 106/FCM 106 Operating Instructions</i>).</p> <p>Delta is a supply mains where the secondary part of the transformer is delta connected, and 1 phase is connected to ground.</p> |
| [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 |
| [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 | This function is not active. |
| [1] * | On | This 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-up 1 and set-up 2. Furthermore, a fixed set of factory settings can be copied into 1 or both set-ups.

Some of the advantages of having more than 1 set-up in the frequency converter are:

- Run the motor in 1 set-up (active set-up) while updating parameters in another set-up (edit set-up).
- Connect the 2 motors (1 at a time) to the frequency converter. Motor data for the 2 motors can be placed in the 2 set-ups.
- Rapidly change settings of the frequency converter and/or the motor while the motor runs. For example, 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.

To copy set-up 1 to set-up 2, or copy set-up 2 to set-up 1, use *parameter 0-51 Set-up Copy*. To avoid conflicting settings of the same parameter within 2 different set-ups, link the set-ups 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 that 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 operates. |
| [1] * | Set-up 1 | Set-up 1 is active. |
| [2] | Set-up 2 | Set-up 2 is active. |
| [9] | Multi Set-up | Used for remote set-up selections via digital inputs and the serial communication port. This |

| 0-10 Active Set-up | | |
|--------------------|-----------|---|
| Option: | Function: | |
| | | set-up uses the settings from <i>parameter 0-12 Link Setups</i> . |

| 0-11 Programming Set-up | | |
|-------------------------|---------------|--|
| Option: | Function: | |
| | | The number of the set-up being edited is shown 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 runs. |
| [0] | Not linked | When selecting a different set-up for operation, the set-up change does not occur until the motor is coasted. |
| [20] * | Linked | Copies <i>not changeable during operation</i> parameters from 1 set-up to the other. It is possible to switch set-ups while the motor runs. |

| 0-20 Display Line 1.1 Small | | |
|-----------------------------|-----------------------|---|
| Option: | Function: | |
| | | Select a variable for display in line 1, left position. |
| [0] | | No display value selected. |
| [37] | Display Text 1 | Enables an individual text string to be written, for showing in the LCP or to be read via serial communication. |
| [38] | Display Text 2 | Enables an individual text string to be written, for showing in the LCP or to be read via serial communication. |
| [39] | Display Text 3 | Enables an individual text string to be written, for showing in the LCP or to be read via serial communication. |
| [953] | Profibus Warning Word | Shows PROFIBUS communication warnings. |
| [1501] | Running Hours | View the number of running hours of the motor. |
| [1502] | kWh Counter | View the mains power consumption in kWh. |
| [1600] | Control Word | View the Control Word sent from the frequency converter via the serial communication port in hex code. |

| 0-20 Display Line 1.1 Small | | |
|-----------------------------|-----------------------|--|
| Option: | Function: | |
| [1601] | Reference [Unit] | Total reference (sum of digital/analog/preset/bus/freeze ref./catch up and slow down) in selected unit. |
| [1602] | Reference [%] | Total reference (sum of digital/analog/preset/bus/freeze ref./catch up and slow down) in percent. |
| [1603] | Status Word | Present status word. |
| [1605] | Main Actual Value [%] | View the 2-byte word sent with the status word to the bus master reporting the main actual value. |
| [1609] | Custom Readout | View the user-defined readouts as defined in <i>parameter 0-30 Custom Readout Unit</i> , <i>parameter 0-31 Custom Readout Min Value</i> , and <i>parameter 0-32 Custom Readout Max Value</i> . |
| [1610] | Power [kW] | Actual power consumed by the motor in kW. |
| [1611] | Power [hp] | Actual power consumed by the motor in hp. |
| [1612] | Motor Voltage | Voltage supplied to the motor. |
| [1613] | Frequency | Motor frequency, that is, the output frequency from the frequency converter in Hz. |
| [1614] | Motor current | Phase current of the motor measured as effective value. |
| [1615] | Frequency [%] | Motor frequency, that is, the output frequency from the frequency converter in percent. |
| [1616] | Torque [Nm] | Present motor load as a percentage of the rated motor torque. |
| [1618] | Motor Thermal | Thermal load on the motor, calculated by the ETR function. See also parameter group 1-9* Motor Temperature. |
| [1622] | Torque [%] | Shows the actual torque produced, in percentage. |
| [1626] | Power Filtered [kW] | |
| [1627] | Power Filtered [hp] | |
| [1630] | DC Link Voltage | DC-link voltage in the frequency converter. |
| [1634] | Heatsink Temp. | Present heat sink temperature of the frequency converter. The cut-out limit is 95 ± 5 °C; cutting back in occurs at 70 ± 5 °C. |
| [1635] | Inverter Thermal | Percentage load of the inverters. |

| 0-20 Display Line 1.1 Small | | |
|-----------------------------|-------------------------|---|
| Option: | Function: | |
| [1636] | Inv. Nom. Current | Nominal current of the frequency converter. |
| [1637] | Inv. Max. Current | Maximum current of the frequency converter. |
| [1638] | SL Controller State | State of the event executed by the control. |
| [1639] | Control Card Temp. | Temperature of the control card. |
| [1650] | External Reference | Sum of the external reference as a percentage, that is, the sum of analog/pulse/bus. |
| [1652] | Feedback[Unit] | Reference value from programmed digital inputs. |
| [1660] | Digital Input | Shows the status of the digital inputs. Signal low = 0; Signal high = 1. Regarding order, see <i>parameter 16-60 Digital Input</i> . Bit 0 is at the extreme right. |
| [1661] | Terminal 53 Setting | Setting of input terminal 53. Current = 0; Voltage = 1. |
| [1662] | Analog Input AI53 | Actual value at input 53 either as a reference or protection value. |
| [1663] | Terminal 54 Setting | Setting of input terminal 54. Current = 0; Voltage = 1. |
| [1664] | Analog Input AI54 | Actual value at input 54 either as reference or protection value. |
| [1665] | Analog Output AO42 [mA] | Actual value at output 42 in mA. Use <i>parameter 6-50 Terminal 42 Output</i> to select the variable to be represented by output 42. |
| [1666] | Digital Output | Binary value of all digital outputs. |
| [1667] | Pulse Input #29 [Hz] | Actual value of the frequency applied at terminal 29 as a pulse input. |
| [1671] | Relay Output [bin] | View the setting of all relays. |
| [1672] | Counter A | View the present value of Counter A. |
| [1673] | Counter B | View the present value of Counter B. |
| [1679] | Analog Output AO45 | |
| [1680] | Fieldbus CTW 1 | Control word (CTW) received from the Bus Master. |
| [1682] | Fieldbus REF 1 | Main reference value sent with control word via the serial communications network for example, from the BMS, PLC, or other master controller. |
| [1684] | Comm. Option STW | Extended fieldbus communication option status word. |

| 0-20 Display Line 1.1 Small | | |
|-----------------------------|---------------------------|---|
| Option: | Function: | |
| [1685] | FC Port CTW 1 | Control word (CTW) received from the Bus Master. |
| [1686] | FC Port REF 1 | Status word (STW) sent to the Bus Master. |
| [1690] | Alarm Word | One or more alarms in a hex code (used for serial communications). |
| [1691] | Alarm Word 2 | One or more alarms in a hex code (used for serial communications). |
| [1692] | Warning Word | One or more warnings in a hex code (used for serial communications). |
| [1693] | Warning Word 2 | One or more warnings in a hex code (used for serial communications). |
| [1694] | Ext. Status Word | One or more status conditions in a hex code (used for serial communications). |
| [1695] | Ext. Status Word 2 | One or more status conditions in a hex code (used for serial communications). |
| [1697] | Alarm Word 3 | |
| [1850] | Sensorless Readout [unit] | |

0-21 Display Line 1.2 Small

Select a variable for display in line 1, middle position.

| Option: | Function: | |
|----------|---------------|--|
| [1614] * | Motor Current | The options are the same as those listed in <i>parameter 0-20 Display Line 1.1 Small</i> . |

0-22 Display Line 1.3 Small

Select a variable for display in line 1, right position.

| Option: | Function: | |
|----------|------------|--|
| [1610] * | Power [kW] | The options are the same as those listed in <i>parameter 0-20 Display Line 1.1 Small</i> . |

0-23 Display Line 2 Large

Select a variable for display in line 2.

| Option: | Function: | |
|----------|-----------|--|
| [1613] * | Frequency | The options are the same as those listed in <i>parameter 0-20 Display Line 1.1 Small</i> . |

0-24 Display Line 3 Large

Select a variable for display in line 3.

4.1.3 0-3* LCP Custom Readout and Display Text

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

Custom readout

The calculated value to be shown 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.

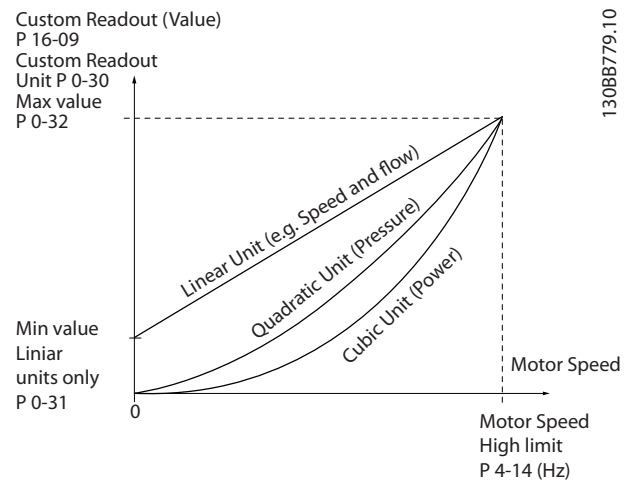


Illustration 4.1 Custom Readout

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 | Quadratic |
| Pressure | |
| Power | Cubic |

Table 4.1 Speed 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 <i>Table 4.1</i>). The actual calculated value can |

| 0-30 Custom Readout Unit | | |
|--------------------------|---------------------|--|
| Option: | Function: | |
| | | be read in <i>parameter 16-09 Custom Readout</i> . |
| [0] | None | |
| [1] * | % | |
| [5] | PPM | |
| [10] | l/Min | |
| [11] | RPM | |
| [12] | Pulse/s | |
| [20] | l/s | |
| [21] | l/min | |
| [22] | l/h | |
| [23] | m ³ /s | |
| [24] | m ³ /min | |
| [25] | m ³ /h | |
| [30] | kg/s | |
| [31] | kg/min | |
| [32] | kg/h | |
| [33] | t/min | |
| [34] | t/h | |
| [40] | m/s | |
| [41] | m/min | |
| [45] | m | |
| [60] | 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] | ft ³ /h | |
| [140] | ft/s | |
| [141] | ft/min | |
| [160] | Degree Fahr | |
| [170] | psi | |
| [171] | lb/in ² | |
| [172] | in WG | |
| [173] | ft WG | |
| [180] | hp | |

| 0-31 Custom Readout Min Value | | |
|-------------------------------|------------------------------------|---|
| Range: | Function: | |
| 0 CustomReadoutUnit* | [0 - 999999.99 CustomReadoutUnit] | This parameter sets the minimum value of the custom-defined readout (occurs at 0 speed). It is only possible to select a value different from 0 when selecting a linear unit in |

| 0-31 Custom Readout Min Value | | |
|-------------------------------|-----------|--|
| Range: | Function: | |
| | | <i>parameter 0-30 Custom Readout Unit</i> . 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 maximum value to be shown when the speed of the motor has reached the set value for <i>parameter 4-14 Motor Speed High Limit [Hz]</i> . |

| 0-37 Display Text 1 | | |
|---------------------|-----------|---|
| Range: | Function: | |
| [0 - 0] | | Use this parameter to write an individual text string to be read via serial communication. Device ID can be included. Only used when running BACnet. |

| 0-38 Display Text 2 | | |
|---------------------|-----------|--|
| Range: | Function: | |
| [0 - 0] | | Use this parameter 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] | | Use this parameter 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 | To avoid unintended start of the frequency converter in <i>local mode</i> , select [0] <i>Disabled</i> . |
| [1] * | Enabled | [Hand On] is enabled. |

| 0-42 [Auto on] Key on LCP | | |
|---------------------------|-----------|---|
| Option: | Function: | |
| [0] | Disabled | To avoid unintended start of the frequency converter from the LCP, select [0] <i>Disabled</i> . |
| [1] * | Enabled | [Auto On] is enabled. |

| 0-44 [Off/Reset] Key on LCP | | |
|-----------------------------|-------------------|--|
| Option: | Function: | |
| [0] | Disabled | Disable the off/reset key. |
| [1] * | Enabled | Enable both off and reset functions. |
| [7] | Enable Reset Only | Enable the reset function, and disable the off function to avoid unintended stop of the frequency converter. |

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, 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 program several frequency converters with the same function without disturbing motor data that is already set. |
| [10] | Delete LCP copy data | |

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

4.1.6 0-6* Password

| 0-60 Main Menu Password | | |
|-------------------------|------------|--|
| Range: | Function: | |
| 0* | [0 - 999] | Define the password for access to the <i>Main Menu</i> via the [Main Menu] key. Setting the 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

| 1-00 Configuration Mode | | |
|------------------------------|-------------|---|
| Option: | Function: | |
| | | NOTICE This parameter cannot be adjusted when the motor runs. |
| [0] * | Open Loop | Motor speed is determined by applying a speed reference or by setting the wanted speed when in local 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 | NOTICE When set for <i>Closed Loop</i> , the commands <i>Reversing</i> and <i>Start Reversing</i> do not reverse the direction of the motor. A reference from the built-in PI controller determines the motor speed. The built-in PI controller varies the motor speed as of a closed-loop control process (for example, constant pressure or flow). Configure the PI controller in parameter group 20-** <i>Drive Closed Loop</i> . |
| 1-01 Motor Control Principle | | |
| Option: | Function: | |
| [0] | U/f | NOTICE When running U/f, control slip and load compensations are not included. Used for parallel-connected motors and/or special motor applications. Set the U/f settings in parameter 1-55 <i>U/f Characteristic - U</i> and parameter 1-56 <i>U/f Characteristic - F</i> . |
| [1] * | VVC+ | NOTICE When parameter 1-10 <i>Motor Construction</i> is set to PM-enabled options, only VVC+ option is available. Normal running mode, including slip and load compensations. |

| 1-03 Torque Characteristics | | |
|-----------------------------|--------------------|---|
| Option: | Function: | |
| [0] | Constant torque | For speed control of PM motors only. |
| [1] * | Variable Torque | For speed control of centrifugal pumps and fans. Also to be used when controlling more than 1 motor from the same frequency converter (for example, multiple condenser fans or cooling tower fans). Provides a voltage that is optimized for a squared torque load characteristic of the motor. |
| [3] | Auto Energy Optim. | For optimum energy efficient speed control of centrifugal pumps and fans, it provides a voltage optimized for a squared torque load characteristic of the motor. In addition, the AEO feature adapts the voltage exactly to the current load situation, by that reducing energy consumption and audible noise from the motor. |

| 1-06 Clockwise Direction | | |
|--------------------------|-----------|--|
| Option: | Function: | |
| | | NOTICE This parameter cannot be adjusted while the motor runs. This parameter defines the term <i>clockwise</i> corresponding to the LCP direction arrow. Used for easy change of direction of shaft rotation without swapping motor wires. |
| [0] * | Normal | The motor shaft turns in clockwise direction when frequency converter is connected U→U; V→V; and W→W to motor. |
| [1] | Inverse | The motor shaft turns in counterclockwise 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. |
| [2] | Low | Optimized for smooth steady-state operation with lowest dynamic response. |
| [3] | Adaptive 1 | Optimized for smooth steady-state operation, with extra active damping. |
| [4] | Adaptive 2 | Alternative to Adaptive1, with focus on low-inductance PM motors. |

4.2.2 1-10 to 1-12 Motor Selection

NOTICE

This parameter group cannot be adjusted while the motor runs.

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

| Parameter 1-10 Motor Construction | [0] Asynchron | [1] PM Motor non-salient |
|--|---------------|--------------------------|
| Parameter 1-00 Configuration Mode | x | x |
| Parameter 1-03 Torque Characteristics | x | |
| Parameter 1-06 Clockwise Direction | x | x |
| Parameter 1-14 Damping Gain | | x |
| Parameter 1-15 Low Speed Filter Time Const. | | x |
| Parameter 1-16 High Speed Filter Time Const. | | x |
| Parameter 1-17 Voltage filter time const. | | x |
| Parameter 1-20 Motor Power [kW] | x | |
| Parameter 1-22 Motor Voltage | x | |
| Parameter 1-23 Motor Frequency | x | x |
| Parameter 1-24 Motor Current | x | x |
| Parameter 1-25 Motor Nominal Speed | x | x |
| Parameter 1-26 Motor Cont. Rated Torque | | x |
| Parameter 1-29 Automatic Motor Adaption (AMA) | x | x |
| Parameter 1-30 Stator Resistance (Rs) | x | x |
| Parameter 1-33 Stator Leakage Reactance (X1) | x | |
| Parameter 1-35 Main Reactance (Xh) | x | |
| Parameter 1-37 d-axis Inductance (Ld) | | x |
| Parameter 1-39 Motor Poles | x | x |
| Parameter 1-40 Back EMF at 1000 RPM | | x |
| Parameter 1-52 Min Speed Normal Magnetising [Hz] | x | |
| Parameter 1-60 Low Speed Load Compensation | x | |
| Parameter 1-61 High Speed Load Compensation | x | |
| Parameter 1-62 Slip Compensation | x | |
| Parameter 1-63 Slip Compensation Time Constant | x | |
| Parameter 1-64 Resonance Dampening | x | |
| Parameter 1-65 Resonance Dampening Time Constant | x | |
| Parameter 1-66 Min. Current at Low Speed | | x |
| Parameter 1-71 Start Delay | x | x |
| Parameter 1-72 Start Function | x | x |
| Parameter 1-73 Flying Start | x | x |

| | | |
|--|---|---|
| Parameter 1-80 Function at Stop | x | x |
| Parameter 1-82 Min Speed for Function at Stop [Hz] | x | x |
| Parameter 1-90 Motor Thermal Protection | x | x |
| Parameter 2-00 DC Hold Current | x | |
| Parameter 2-01 DC Brake Current | x | |
| Parameter 2-02 DC Braking Time | x | |
| Parameter 2-04 DC Brake Cut In Speed [Hz] | x | |
| Parameter 2-06 Parking Current | | x |
| Parameter 2-07 Parking Time | | x |
| Parameter 2-10 Brake Function | x | x |
| Parameter 2-16 AC brake Max. Current | x | |
| Parameter 2-17 Over-voltage Control | x | x |
| Parameter 4-10 Motor Speed Direction | x | x |
| Parameter 4-12 Motor Speed Low Limit [Hz] | x | x |
| Parameter 4-14 Motor Speed High Limit [Hz] | x | x |
| Parameter 4-18 Current Limit | x | x |
| Parameter 4-19 Max Output Frequency | x | x |
| Parameter 4-58 Missing Motor Phase Function | x | x |
| Parameter 14-40 VT Level | x | |
| Parameter 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 Parameter 1-10 Motor Construction

| 1-10 Motor Construction | | |
|-------------------------|------------------------------|--|
| Option: | Function: | |
| [0] * | Asynchron | For asynchronous motors. |
| [1] | PM, non salient SPM, non Sat | For permanent magnet (PM) motors with surface-mounted (non-salient) magnets. Refer to <i>parameter 1-14 Damping Gain</i> to <i>parameter 1-17 Voltage filter time const.</i> for details about optimizing the motor operation. |
| [2] | PM, salient IPM, non Sat | For permanent magnet (PM) motors with interior (salient) magnets, without inductance saturation control. |
| [3] | PM, salient IPM, Sat | For permanent magnet (PM) motors with interior (salient) magnets, with inductance saturation control. |

| 1-11 Motor Selection | | |
|----------------------|-------------------------|--|
| Option: | Function: | |
| [0] * | Default Motor Selection | Automatically sets the manufacturer's settings for the selected motor. |

| 1-11 Motor Selection | | |
|----------------------|--------------------|--|
| Option: | Function: | |
| | | Setting the parameter value might change these parameters. Other parameters also change, when changing motor type selection. |
| [1] | Motor Selection 1 | |
| [2] | Motor Selection 2 | |
| [3] | Motor Selection 3 | |
| [4] | Motor Selection 4 | |
| [5] | Motor Selection 5 | |
| [6] | Motor Selection 6 | |
| [7] | Motor Selection 7 | |
| [8] | Motor Selection 8 | |
| [9] | Motor Selection 9 | |
| [10] | Motor Selection 10 | |
| [11] | Motor Selection 11 | |
| [12] | Motor Selection 12 | |
| [13] | Motor Selection 13 | |
| [14] | Motor Selection 14 | |
| [15] | Motor Selection 15 | |
| [16] | Motor Selection 16 | |
| [17] | Motor Selection 17 | |
| [18] | Motor Selection 18 | |
| [19] | Motor Selection 19 | |
| [20] | Motor Selection 20 | |
| [21] | Motor Selection 21 | |
| [22] | Motor Selection 22 | |
| [23] | Motor Selection 23 | |
| [24] | Motor Selection 24 | |
| [25] | Motor Selection 25 | |
| [26] | Motor Selection 26 | |
| [27] | Motor Selection 27 | |
| [28] | Motor Selection 28 | |
| [29] | Motor Selection 29 | |
| [30] | Motor Selection 30 | |
| [31] | Motor Selection 31 | |
| [32] | Motor Selection 32 | |
| [33] | Motor Selection 33 | |
| [34] | Motor Selection 34 | |
| [35] | Motor Selection 35 | |
| [36] | Motor Selection 36 | |
| [37] | Motor Selection 37 | |
| [38] | Motor Selection 38 | |
| [39] | Motor Selection 39 | |
| [40] | Motor Selection 40 | |
| [41] | Motor Selection 41 | |
| [42] | Motor Selection 42 | |
| [43] | Motor Selection 43 | |
| [44] | Motor Selection 44 | |
| [45] | Motor Selection 45 | |
| [46] | Motor Selection 46 | |
| [47] | Motor Selection 47 | |
| [48] | Motor Selection 48 | |

| 1-11 Motor Selection | | |
|----------------------|--------------------|--|
| Option: | Function: | |
| [49] | Motor Selection 49 | |
| [50] | Motor Selection 50 | |
| [51] | Motor Selection 51 | |
| [52] | Motor Selection 52 | |
| [53] | Motor Selection 53 | |
| [54] | Motor Selection 54 | |
| [55] | Motor Selection 55 | |
| [56] | Motor Selection 56 | |
| [57] | Motor Selection 57 | |
| [58] | Motor Selection 58 | |
| [59] | Motor Selection 59 | |
| [60] | Motor Selection 60 | |
| [61] | Motor Selection 61 | |
| [62] | Motor Selection 62 | |
| [63] | Motor Selection 63 | |
| [64] | Motor Selection 64 | |

| 1-12 Motor ID | | |
|----------------|-----------|---|
| Range: | Function: | |
| Default Motor* | [0 - 0] | Shows motor name according to the selected motor in <i>parameter 1-11 Motor Selection</i> . |

4.2.3 1-14 to 1-17 VVC+ PM

The default control parameters for VVC+ PM motor control core are optimized for HVAC applications and inertia load in the range of $50 > J_l/J_m > 5$. J_l is load inertia from the application and J_m is machine inertia.

For low inertia applications ($J_l/J_m < 5$), it is recommended that *parameter 1-17 Voltage filter time const.* is increased with a factor of 5–10. Sometimes, *parameter 14-08 Damping Gain Factor* should also be reduced to improve performance and stability.

For high inertia applications ($J_l/J_m > 50$), it is recommended that *parameter 1-15 Low Speed Filter Time Const.*, *parameter 1-16 High Speed Filter Time Const.*, and *parameter 14-08 Damping Gain Factor* are increased to improve performance and stability.

For high load at low speed (<30% of rated speed), it is recommended that *parameter 1-17 Voltage filter time const.* is increased due to non-linearity in the inverter at low speed.

| 1-14 Damping Gain | | |
|-------------------|-------------|---|
| Range: | Function: | |
| 120 %* | [0 - 250 %] | The parameter stabilizes 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 |

| 1-14 Damping Gain | | |
|-------------------|-----------|--|
| Range: | Function: | |
| | | 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 becomes 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 becomes unstable. This time constant is used above 10% rated speed. |

| 1-17 Voltage filter time const. | | |
|---------------------------------|---------------|---|
| Range: | Function: | |
| Size related* | [0.001 - 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 runs. | | |
| Option: | Function: | |
| [3] | 0.18 kW - 0.25 hp | |
| [4] | 0.25 kW - 0.33 hp | |
| [5] | 0.37 kW - 0.5 hp | |

| 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 runs. | | |
| Option: | Function: | |
| [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 - 1000 V] | Enter the nominal motor voltage according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit. |

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

| 1-24 Motor Current | | |
|--------------------|---------------------|--|
| Range: | Function: | |
| Size related* | [0.01 - 10000.00 A] | <p>NOTICE</p> <p>This parameter cannot be adjusted while the motor runs.</p> <p>Enter the nominal motor current value from the motor nameplate data. This data is used for calculating motor torque, motor thermal protection, and so on.</p> |

| 1-25 Motor Nominal Speed | | |
|--------------------------|------------------|---|
| Range: | | Function: |
| Size related* | [50 - 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] | <p>NOTICE Changing this parameter affects settings of other parameters.</p> <p>This parameter is available only when parameter 1-10 Motor Construction is set to options that enable permanent motor mode.</p> |

| 1-29 Automatic Motor Adaption (AMA) | | |
|-------------------------------------|---------------------|---|
| Option: | | Function: |
| | | <p>NOTICE This parameter cannot be adjusted while the motor runs.</p> <p>The AMA function optimizes dynamic motor performance by automatically optimizing the advanced motor parameter 1-30 Stator Resistance (Rs) to parameter 1-35 Main Reactance (Xh) while the motor is stationary.</p> |
| [0] | Off | No function |
| [1] | Enable Complete AMA | <p>If parameter 1-10 Motor Construction is set to [0] Asynchron, performs AMA of parameter 1-30 Stator Resistance (Rs), parameter 1-33 Stator Leakage Reactance (X1), and parameter 1-35 Main Reactance (Xh). If parameter 1-10 Motor Construction is set to options that enable PM motor, performs AMA of parameter 1-30 Stator Resistance (Rs), and parameter 1-35 Main Reactance (Xh).</p> <p>NOTICE Terminal 27 Digital Input (parameter 5-12 Terminal 27 Digital Input) has [2] Coast inverse as the default setting. This means that AMA cannot be performed if there is no 24 V to terminal 27.</p> |
| [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 parameter 1-10 Motor Construction is set to options that enable permanent motor mode, the only option available is [1] Enable Complete AMA.

Activate the AMA function by pressing [Hand On] after selecting [1] Enable Complete AMA or [2] Enable Reduced AMA. 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 runs.
- AMA cannot be performed on a motor with a bigger power rating than the frequency converter, for example when a 5.5 kW (7.5 hp) motor is connected to a 4 kW (5 hp) frequency converter.

NOTICE

Avoid generating external torque during AMA.

NOTICE

If 1 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 return to default setting.

NOTICE

Run full AMA without filter only, but run reduced AMA with a filter.

| 1-30 Stator Resistance (Rs) | | |
|-----------------------------|-------------------|--|
| Range: | | Function: |
| Size related* | [0.0 - 99.99 Ohm] | <p>NOTICE This parameter cannot be adjusted while the motor runs.</p> <p>Set the stator resistance value. Enter the value from a motor datasheet or perform an AMA on a cold motor.</p> |

| 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 1 of these methods: <ul style="list-style-type: none"> Run an AMA on a cold motor. The frequency converter measures the value from the motor. Enter the X_h value manually. Obtain the value from the motor supplier. Use the X_h default setting. The frequency converter establishes the setting based on the motor nameplate data. |

| 1-37 d-axis Inductance (Ld) | | |
|-----------------------------|----------------|---|
| Range: | | Function: |
| Size related* | [0 - 1000 mH] | NOTICE This parameter is only active when parameter 1-10 Motor Construction is set to [1] PM, non-salient SPM. Enter the value of the d-axis inductance. Obtain the value from the PM motor datasheet. |

For asynchronous motor, stator resistance, and d-axis inductance values are normally, described in technical specifications as between line and common (startpoint). For PM motors, they are typically described in technical specifications as between line-line. PM motors are typically built for star connection.

| | |
|---|--|
| Parameter 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. 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. For line-line data, where stator resistance is measured between any 2 lines, divide by 2. |
| Parameter 1-40 Back EMF at 1000 RPM (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 (parameter 1-30 Stator Resistance (Rs)) and d-axis inductance (parameter 1-37 d-axis Inductance (Ld)) in technical specifications as between line and common (startpoint) or line between line. There is no general standard. The different set-ups of stator winding resistance and induction are shown in Illustration 4.2. Danfoss frequency converters always require the line-to-common value. The back EMF of a PM motor is defined as induced EMF developed across any of 2 phases of stator winding of a free-running motor. Danfoss frequency converters always require the line-to-line RMS value measured at 1000 RPM, mechanical speed of rotation. This is shown in Illustration 4.3).

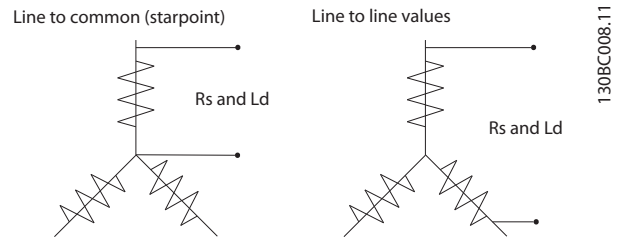


Illustration 4.2 Stator Winding Set-ups

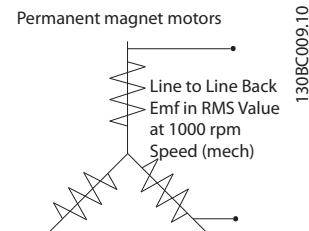


Illustration 4.3 Machine Parameter Definitions of Back EMF of PM Motors

| 1-38 q-axis Inductance (Lq) | | |
|-----------------------------|--------------------|--|
| Range: | | Function: |
| Size related* | [0.000 - 1000 mH] | Set the value of the q-axis inductance. Obtain the value from the permanent magnet motor datasheet. The value cannot be changed when the motor is running. |

| 1-39 Motor Poles | | |
|------------------|-------------|--|
| Range: | | Function: |
| Size related* | [2 - 100] | NOTICE This parameter cannot be adjusted while the motor runs. Enter the number of motor poles. |

| 1-39 Motor Poles | | |
|------------------|-----------|---|
| Range: | Function: | |
| | | The motor pole value is always an even number, because it refers to the total pole numbers, 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. |

| 1-44 d-axis Inductance Sat. (LdSat) | | |
|-------------------------------------|---------------|--|
| Range: | Function: | |
| Size related* | [0 - 1000 mH] | This parameter corresponds to the inductance saturation of Ld. Ideally, this parameter has the same value as <i>parameter 1-37 d-axis Inductance (Ld)</i> . If the motor supplier provides an induction curve, enter the induction value at 200% of the nominal value. |

| 1-45 q-axis Inductance Sat. (LqSat) | | |
|-------------------------------------|---------------|--|
| Range: | Function: | |
| Size related* | [0 - 1000 mH] | This parameter corresponds to the inductance saturation of Lq. Ideally, this parameter has the same value as <i>parameter 1-38 q-axis Inductance (Lq)</i> . If the motor supplier provides an induction curve, enter the induction value at 200% of the nominal value. |

| 1-46 Position Detection Gain | | |
|------------------------------|--------------|--|
| Range: | Function: | |
| 100 %* | [20 - 200 %] | Adjusts the amplitude of the test pulse during position detection at start. Adjust this parameter to improve the position measurement. |

| 1-48 Current at Min Inductance for d-axis | | |
|---|--------------|---|
| Range: | Function: | |
| 100 %* | [20 - 200 %] | This parameter specifies the saturation curve of the d-inductance values. From 20–100% of this parameter, the inductances are linearly approximated due to <i>parameter 1-37 d-axis Inductance (Ld)</i> , <i>parameter 1-38 q-axis Inductance (Lq)</i> , <i>parameter 1-44 d-axis Inductance Sat. (LdSat)</i> , and <i>parameter 1-45 q-axis Inductance Sat. (LqSat)</i> . Below and above they are specified by the corresponding parameters. Parameters are related to the motor nameplate load compensations, the application load type, and the electronic brake function for quick stop/hold of the motor. |

| 1-49 Current at Min Inductance for q-axis | | |
|---|--------------|---|
| Range: | Function: | |
| 100 %* | [20 - 200 %] | This parameter specifies the saturation curve of the q-inductance values. From 20–100% of this parameter, the inductances are linearly approximated due to <i>parameter 1-37 d-axis Inductance (Ld)</i> , <i>parameter 1-38 q-axis Inductance (Lq)</i> , <i>parameter 1-44 d-axis Inductance Sat. (LdSat)</i> , and <i>parameter 1-45 q-axis Inductance Sat. (LqSat)</i> . Below and above they are specified by the corresponding parameters. Parameters are related to the motor nameplate load compensations, the application load type, and the electronic brake function for quick stop/hold of the motor. |

| 1-50 Motor Magnetisation at Zero Speed | | |
|---|-------------|---|
| Range: | Function: | |
| 100 %* | [0 - 300 %] | Use this parameter along with <i>parameter 1-52 Min Speed Normal Magnetising [Hz]</i> to obtain a different thermal load on the motor when running at low speed. Enter a value that is a percentage of the rated magnetizing current. If the setting is too low, the torque on the motor shaft may be reduced. |
| | | |
| Illustration 4.4 Motor Magnetization | | |

| 1-52 Min Speed Normal Magnetising [Hz] | | |
|--|-----------------|---|
| Range: | Function: | |
| 1 Hz* | [0.1 - 10.0 Hz] | Set the required frequency for normal magnetizing current. Use this parameter along with <i>parameter 1-50 Motor Magnetisation at Zero Speed</i> . See <i>Illustration 4.4</i> . |

| 1-55 U/f Characteristic - U | | |
|-----------------------------|--------------|---|
| Range: | Function: | |
| Size related* | [0 - 1000 V] | Enter voltage at each frequency point to form a U/f characteristic matching the motor. Frequency points are defined in <i>parameter 1-56 U/f Characteristic - F</i> . |

| 1-56 U/f Characteristic - F | | |
|---|--|--|
| Range: | Function: | |
| Size related* [0 - 400.0 Hz] | <p>Enter frequency points to form a U/f characteristic matching the motor. Voltage at each point is defined in <i>parameter 1-55 U/f Characteristic - U</i>.</p> <p>Make a U/f characteristic based on 6 definable voltages and frequencies, see <i>Illustration 4.5</i>. Simplify U/f characteristics by merging 2 or more points (voltages and frequencies). Set the points at equal values.</p> | |
| | | |
| <p>Illustration 4.5 U/f Characteristic</p> | | |

| 1-60 Low Speed Load Compensation | | |
|----------------------------------|---|--|
| Range: | Function: | |
| 100 %* [0 - 300 %] | <p>Enter the low speed load voltage compensation value in percent. This parameter is used for optimizing the low speed load performance. This parameter is only active if <i>parameter 1-10 Motor Construction = [0] Asynchron</i>.</p> | |

| 1-61 High Speed Load Compensation | | |
|-----------------------------------|---|--|
| Range: | Function: | |
| 100 %* [0 - 300 %] | <p>Enter the high-speed load voltage compensation value in percent. This parameter is used for optimizing the high-speed load performance. This parameter is only active if <i>parameter 1-10 Motor Construction = [0] Asynchron</i>.</p> | |

| 1-62 Slip Compensation | | |
|---------------------------------|--|--|
| Range: | Function: | |
| Size related* [-400 - 400 %] | <p>Enter the % value for slip compensation to compensate for tolerances in the value of $n_{M,N}$. Slip compensation is calculated automatically, which is based on the nominal motor speed $n_{M,N}$.</p> | |

| 1-63 Slip Compensation Time Constant | | |
|--------------------------------------|--|--|
| Range: | Function: | |
| 0.1 s* [0.05 - 5 s] | <p>Enter the slip compensation reaction speed. A high value results in slow reaction, and a low value results in quick reaction. If low-</p> | |

| 1-63 Slip Compensation Time Constant | | |
|--------------------------------------|---|--|
| Range: | Function: | |
| | <p>frequency resonance problems occur, use a longer time setting.</p> | |

| 1-64 Resonance Dampening | | |
|--------------------------|--|--|
| Range: | Function: | |
| 100 %* [0 - 500 %] | <p>Enter the resonance damping value. Set <i>parameter 1-64 Resonance Dampening</i> and <i>parameter 1-65 Resonance Dampening Time Constant</i> to help eliminate high-frequency resonance problems. To reduce resonance oscillation, increase the value of <i>parameter 1-64 Resonance Dampening</i>.</p> | |

| 1-65 Resonance Dampening Time Constant | | |
|--|---|--|
| Range: | Function: | |
| 0.005 s* [0.001 - 0.050 s] | <p>Set <i>parameter 1-64 Resonance Dampening</i> and <i>parameter 1-65 Resonance Dampening Time Constant</i> to help eliminate high-frequency resonance problems. Enter the time constant that provides the best dampening.</p> | |

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

| 1-70 PM Start Mode | | |
|--|-----------------|--|
| Option: | | |
| <p>This parameter is valid for software version 2.80 and later versions. Use this parameter to select the PM motor start mode, which is to initialize the VVC⁺ control core for previously free-running PM motors. This parameter is active for PM motors in VVC⁺ mode only if the motor is stopped (or running at low speed).</p> | | |
| [0] * | Rotor Detection | The rotor detection function estimates the electrical angle of the rotor and uses the angle as a starting point. This option is the standard selection for automation frequency converter applications. If the flying start function detects that motor is running at low speed or is stopped, the frequency converter can detect the rotor position (the angle). The frequency converter then starts the motor from that angle. |
| [1] | Parking | The parking function applies DC current across the stator winding, and rotates the rotor to electrical zero position. This function is typically selected for HVAC applications. If the flying start function |

| 1-70 PM Start Mode | | |
|---|--|--|
| This parameter is valid for software version 2.80 and later versions. Use this parameter to select the PM motor start mode, which is to initialize the VVC+ control core for previously free-running PM motors. This parameter is active for PM motors in VVC+ mode only if the motor is stopped (or running at low speed). | | |
| Option: | Function: | |
| | detects that motor is running at low speed or is stopped, the frequency converter sends out a DC current to park the motor at an angle. The frequency converter then starts the motor from that angle. | |

| 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 <i>parameter 1-72 Start Function</i> . Set the start delay time until acceleration is to begin. | |

| 1-72 Start Function | | |
|------------------------|--|--|
| Option: | Function: | |
| [0] DC Hold/delay time | The motor is energized with <i>parameter 2-00 DC Hold/Motor Preheat Current</i> during start delay time. | |
| [2] * Coast/delay time | The frequency converter is coasted during start delay time (frequency converter 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 <i>parameter 2-07 Parking Time</i> . | |
| [0] Disabled * | Select [0] Disabled if this function is not required. | |
| [2] Enabled Always | Select [2] Enabled always to enable the frequency converter to “catch” and control a spinning motor. The parameter is always set to [2] Enabled always when <i>parameter 1-10 Motor Construction</i> = [1] PM non-salient. Important related parameters: <ul style="list-style-type: none"> Parameter 2-01 DC Brake Current Parameter 2-06 Parking Current Parameter 2-07 Parking Time | |

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 *parameter 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 this function after a stop command or after the speed is ramped down to the settings in <i>parameter 1-82 Min Speed for Function at Stop [Hz]</i> . | |
| [0] * Coast | Leaves the motor in free mode. | |
| [1] DC hold / Motor Preheat | Energizes the motor with a DC hold current (see <i>parameter 2-00 DC Hold/Motor Preheat Current</i>). | |

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

| 1-88 AC Brake Gain | | |
|---|---|--|
| Range: | Function: | |
| 1.4* [1.0 - 2.0] | Set AC brake power capability (set the ramp-down time when inertia is constant). If the DC-link voltage is not higher than DC-link voltage warning value, the generator torque can be adjusted with this function . The higher the AC-brake gain, the stronger the brake capability. If the brake gain equals to 1.0, there is no AC brake capability. | |
| NOTICE Continuous generator torque can lead to overheating of the motor due to high motor current. Protect the motor against overheating in <i>parameter 2-16 AC Brake, Max current</i> . | | |

| 1-90 Motor Thermal Protection | | |
|-------------------------------|-------------------------------|---|
| Option: | Function: | |
| | | Using ETR (electronic thermal relay), the motor temperature is calculated based on frequency, current, and time. If a thermistor is not present, Danfoss recommends using the ETR function. The functionality is the same for asynchronous motors and PM motors. NOTICE ETR calculation is based on motor data from parameter group 1-2* <i>Motor Data</i> . |
| [0] | No protection | Disables temperature monitoring. |
| [1] | Thermistor warning | A thermistor issues a warning if the upper limit of motor temperature range is exceeded. |
| [2] | Thermistor trip | If the upper limit of motor temperature range is exceeded, a thermistor gives an alarm and makes the frequency converter trip. |
| [3] | ETR warning 1 | If the calculated upper limit of the 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. |
| [22] | ETR Trip - Extended Detection | Start motor thermal calculation based on the actual load and time as well as the motor frequency when the motor current is above 110% of the nominal motor current. Alternatively, start motor thermal calculation when the motor current is less than 110% of the nominal motor current, and the current limit is triggered. |

| 1-93 Thermistor Source | | |
|------------------------|-------------------|--|
| Option: | Function: | |
| | | <i>Resource 1 to parameter 3-17 Reference Resource 3, parameter 20-00 Feedback 1 Source, parameter 20-03 Feedback 2 Source, parameter 24-06 Fire Mode Reference Source, and parameter 24-07 Fire Mode Feedback Source.</i> |
| [0] | None | Do not set thermistor source. |
| [1] | Analog input AI53 | Use analog input 53 as thermistor source. |
| [6] | Digital input 29 | Use digital input 29 as thermistor source. |

| 1-93 Thermistor Source | | |
|------------------------|-----------|---|
| Option: | Function: | |
| | | NOTICE This parameter cannot be adjusted while the motor is running. NOTICE Set the digital input to [0] PNP - Active at 24 V in parameter 5-03 Digital Input 29 Mode. Select the input at which the thermistor (PTC sensor) should be connected. When using an analog input, the same analog cannot be used as a reference in parameter 3-15 Reference |

4.3 Main Menu - Brakes - Group 2

| 2-00 DC Hold/Motor Preheat Current | | |
|------------------------------------|----------------|---|
| Range: | Function: | |
| 50 % * | [0 - 160 %] | <p>NOTICE The maximum value depends on the rated motor current. Avoid 100% current for too long. It may damage the motor due to overheating.</p> <p>Set holding current as a percentage of the rated motor current $I_{M,N}$ in <i>parameter 1-24 Motor Current</i>. <i>Parameter 2-00 DC Hold/Motor Preheat Current</i> holds the motor function (holding torque) or pre-heats the motor. This parameter is active if DC hold is selected in <i>parameter 1-72 Start Function</i> [0] or <i>parameter 1-80 Function at Stop</i> [1].</p> |

| 2-01 DC Brake Current | | |
|-----------------------|----------------|---|
| Range: | Function: | |
| 50 % * | [0 - 150 %] | <p>NOTICE The maximum value depends on the rated motor current. Avoid 100% current for too long. It may damage the motor.</p> <p>Set current as % of rated motor current, <i>parameter 1-24 Motor Current</i>. DC-brake current is applied on stop command, when speed is below the limit set in <i>parameter 2-04 DC Brake Cut In Speed</i>; when the DC-brake inverse function is active (<i>parameters 5-1* Digital Inputs</i> are set to [5] <i>DC-brake inverse</i>; or via the serial port). See <i>parameter 2-02 DC Braking Time</i> for duration.</p> |

| 2-02 DC Braking Time | | |
|----------------------|------------|--|
| Range: | Function: | |
| 10 s* | [0 - 60 s] | Set the duration of the DC-brake current set in <i>parameter 2-01 DC Brake Current</i> , 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 <i>parameter 2-01 DC Brake Current</i> is to be active with a stop command. | |

| 2-06 Parking Current | | |
|----------------------|----------------|---|
| Range: | Function: | |
| 100 % * | [0 - 150 %] | Set current as percentage of rated motor current, <i>parameter 1-24 Motor Current</i> . Active with <i>parameter 1-73 Flying Start</i> . The parking current is active during the time period set in <i>parameter 2-07 Parking Time</i> . |

| 2-06 Parking Current | | |
|----------------------|-----------|--|
| Range: | Function: | |
| | | <p>NOTICE <i>Parameter 2-06 Parking Current</i> is only active when PM motor construction is selected in <i>parameter 1-10 Motor Construction</i></p> |

| 2-07 Parking Time | | |
|----------------------|--|--|
| Range: | Function: | |
| 3 s* [0.1 - 60 s] | Set the duration of the parking current time set in <i>parameter 2-06 Parking Current</i> . Active in connection with <i>parameter 1-73 Flying Start</i> . | |
| | | <p>NOTICE <i>Parameter 2-07 Parking Time</i> is only active when [1] PM, non-salient SPM is selected in <i>parameter 1-10 Motor Construction</i>.</p> |

4.3.1 2-1* Brake Energy Function

Parameter group for selecting dynamic brake parameters.

| 2-10 Brake Function | | |
|---------------------|-----------|-----------------------------------|
| Option: | Function: | |
| [0] * | Off | The brake resistor is not active. |
| [2] | AC brake | AC brake is active. |

| 2-16 AC Brake, Max current | | |
|----------------------------|-------------|--|
| Range: | Function: | |
| 100 % * | [0 - 160 %] | To avoid overheating of motor windings, enter the maximum permissible current when using AC brake. |

| 2-17 Over-voltage Control | | |
|---------------------------|-----------------------|--|
| Option: | Function: | |
| | | Enable OVC during ramp down to reduce the risk of frequency converter trip due to overvoltage on the DC link caused by generative power from load. |
| [0] | Disabled | No OVC required. |
| [1] | Enabled (not at stop) | Activates OVC when the frequency converter is not in the stop state. |
| [2] * | Enabled | Activates OVC. |
| | | <p>NOTICE The ramp time is automatically adjusted to avoid tripping of the frequency converter.</p> |

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* A] | [0 - 100 | Set the motor current for release of the mechanical brake, when a start condition is present. The upper limit is specified in <i>parameter 16-37 Inv. Max. Current.</i> |

| 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* | [-4999-4999] | The minimum reference is the lowest value obtainable by summing all references. |

| 3-03 Maximum Reference | | |
|------------------------|---|--|
| Range: | Function: | |
| Size related* | [-4999.0 - 4999 ReferenceFeed-backUnit] | The maximum reference is the highest value obtainable by summing all references. The maximum reference unit matches the selection of configuration in <i>parameter 1-00 Configuration Mode</i> . |

4.4.2 3-1* References

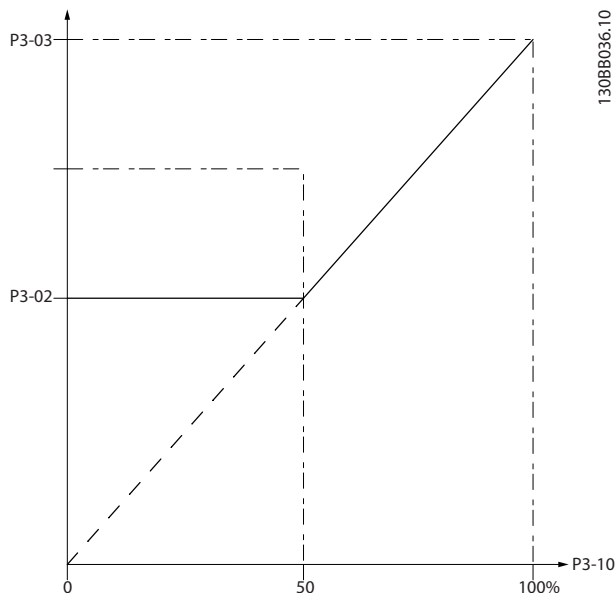


Illustration 4.6 References

| 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 <i>preset reference bit 0/1/2 [16], [17], or [18]</i> |

| 3-10 Preset Reference | | |
|-----------------------|-----------|--|
| Range: | Function: | |
| | | for the corresponding digital inputs in parameter group 5-1* <i>Digital Inputs</i> , for selecting dedicated references. |

| 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 runs when the jog function is activated. See also <i>parameter 3-80 Jog Ramp Time</i> . |

| 3-12 Catch up/slow Down Value | | |
|-------------------------------|-------------|---|
| Range: | Function: | |
| 0 %* | [0 - 100 %] | Enter a percentage (relative) value to be either added to or deducted from the actual reference for catch up or slow down. If <i>catch up</i> is selected via 1 of the digital inputs (<i>parameter 5-10 Terminal 18 Digital Input</i> to <i>parameter 5-15 Terminal 33 Digital Input</i>), the percentage (relative) value is added to the total reference. If <i>slow down</i> is selected via 1 of the digital inputs (<i>parameter 5-10 Terminal 18 Digital Input</i> to <i>parameter 5-15 Terminal 33 Digital Input</i>), the percentage (relative) value is deducted from the total reference. Obtain extended functionality with the DigiPot function. See parameter group 3-9* <i>Digital Potentiometer</i> . |

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

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Illustration 4.7 Preset Relative Reference

| 3-15 Reference 1 Source | | |
|-------------------------|-----------|--|
| Option: | Function: | |
| | | Select the input to be used for the 1st reference signal. <i>Parameter 3-15 Reference 1 Source, parameter 3-16 Reference 2 Source, and parameter 3-17 Reference 3 Source</i> define up to 3 different reference signals. |

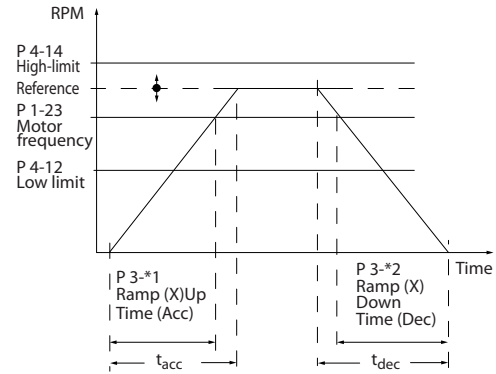
| 3-15 Reference 1 Source | | |
|-------------------------|---------------------|--|
| Option: | Function: | |
| | | The sum of these reference signals defines the actual reference. |
| [0] | No function | |
| [1] * | Analog Input 53 | |
| [2] | Analog Input 54 | |
| [7] | Pulse input 29 | |
| [11] | Local bus reference | |

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

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

4.4.3 3-4* Ramp 1

Configure the ramp time parameters, for each of the 2 ramps (parameter group 3-4* *Ramp 1* and parameter group 3-5* *Ramp 2*). The ramp time is preset to the minimum value of 10 ms for all power sizes.



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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 <i>parameter 1-23 Motor Frequency</i> if asynchronous motor is selected. Enter acceleration time from 0 RPM, to <i>parameter 1-25 Motor Nominal Speed</i> if PM motor is selected. Select a ramp-up time such that the output current does not exceed the current limit in <i>parameter 4-18 Current Limit</i> during ramping. See ramp-down time in <i>parameter 3-42 Ramp 1 Ramp Down Time</i> . |

| 3-42 Ramp 1 Ramp Down Time | | |
|----------------------------|-----------------|---|
| Range: | Function: | |
| Size related* | [0.05 - 3600 s] | If asynchronous motor is selected, enter deceleration time from <i>parameter 1-23 Motor Frequency</i> to 0 Hz. If PM motor is selected, enter deceleration time from <i>parameter 1-25 Motor Nominal Speed</i> to 0 RPM. Select a ramp-down time to avoid tripping on overvoltage in the DC-link. |

4.4.4 3-5* Ramp 2

This parameter group configures ramp 2 parameters.

| 3-51 Ramp 2 Ramp Up Time | | |
|--------------------------|-----------------|---|
| Range: | | Function: |
| Size related* | [0.05 - 3600 s] | If asynchronous motor is selected, enter acceleration time from 0 Hz to <i>parameter 1-23 Motor Frequency</i> . If PM motor is selected, enter acceleration time from 0 RPM to <i>parameter 1-25 Motor Nominal Speed</i> . Select a ramp-up time such that the output current does not exceed the current limit in <i>parameter 4-18 Current Limit</i> during ramping up. |

| 3-52 Ramp 2 Ramp Down Time | | |
|----------------------------|-----------------|---|
| Range: | | Function: |
| Size related* | [0.05 - 3600 s] | Enter deceleration time from <i>parameter 1-25 Motor Nominal Speed</i> to 0 RPM. Select a ramp-down time such that the output current does not exceed the current limit in <i>parameter 4-18 Current Limit</i> during ramping down. |

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, which is the acceleration/deceleration time between 0 Hz to <i>parameter 1-23 Motor Frequency</i> . Ensure that the resulting output current required for the given jog ramp time does not exceed the current limit in <i>parameter 4-18 Current Limit</i> . The jog ramp time starts after activation of a jog signal via the control panel, a selected 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 <i>parameter 1-23 Motor Frequency</i> to 0 Hz. During ramping, no overvoltage may occur in the inverter, nor may the generated current exceed the limit in <i>parameter 4-18 Current Limit</i> . Quick stop is activated with a signal on a selected digital input or via the serial communication port. |

| 3-85 Check Valve Ramp Time | | |
|----------------------------|------------|---|
| Range: | | Function: |
| 0 s* | [0 - 60 s] | To protect ball check valves in a stop situation, the check valve ramp can be utilized as a speed down ramp rate. Set the ramp rate from <i>parameter 4-11 Motor Speed Low Limit [RPM]</i> or <i>parameter 4-12 Motor Speed Low Limit [Hz]</i> to check valve ramp end speed, set in <i>parameter 3-86 Check Valve Ramp End Speed [RPM]</i> or <i>parameter 3-87 Check Valve Ramp End Speed [HZ]</i> . When <i>parameter 3-85 Check Valve Ramp Time</i> is different from 0 s, the check valve ramp time is effectuated and is used to ramp down the speed from motor speed low limit to the check valve end speed in <i>parameter 3-86 Check Valve Ramp End Speed [RPM]</i> or <i>parameter 3-87 Check Valve Ramp End Speed [HZ]</i> . See <i>Illustration 4.9</i> . |

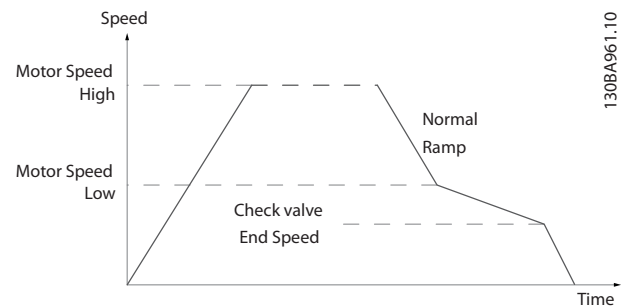


Illustration 4.9 Check Valve Ramp

| 3-87 Check Valve Ramp End Speed [HZ] | | |
|--------------------------------------|--------------|---|
| Range: | | Function: |
| Size related* | [0 - 400 Hz] | Set the speed in [Hz] below motor speed low limit where the check valve ramp is no longer active. See <i>Illustration 4.9</i> . |

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 | <p>NOTICE</p> <p>The setting in <i>parameter 4-10 Motor Speed Direction</i> has impact on <i>parameter 1-73 Flying Start</i>.</p> <p>Only operation in clockwise direction is allowed.</p> |
| [2] * | Both directions | Operation in both clockwise and counter-clockwise directions are allowed. |

| 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 <i>parameter 4-14 Motor Speed High Limit [Hz]</i> . |

| 4-14 Motor Speed High Limit [Hz] | | |
|----------------------------------|-------------------|---|
| Range: | Function: | |
| Size related* | [0.1 - 400.0 Hz] | Enter the maximum limit for motor speed. It can be set to match the recommended maximum motor speed. The motor speed high limit must exceed the value in <i>parameter 4-12 Motor Speed Low Limit [Hz]</i> . |
| | | Motor speed high limit cannot be set higher than <i>parameter 4-19 Max Output Frequency</i> . |

| 4-18 Current Limit | | |
|--------------------|--------------|---|
| Range: | Function: | |
| Size related* | [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 maximum output current of the frequency converter. If a setting in <i>parameter 1-00 Configuration Mode</i> to <i>parameter 1-25 Motor Nominal Speed</i> is changed, <i>parameter 4-18 Current Limit</i> is not automatically reset to the default setting. |

| 4-19 Max Output Frequency | | |
|---------------------------|---------------|---|
| Range: | Function: | |
| Size related* | [0 - 400 Hz] | Enter the maximum output frequency, which defines the absolute limit on the frequency converter output frequency for improved safety in applications where unintended overspeeding must be avoided. This absolute limit applies to all configurations and is independent of the setting in <i>parameter 1-00 Configuration Mode</i> . |

4.5.2 4-4* Adjustable Warnings 2

| 4-40 Warning Freq. Low | | |
|------------------------|---------------|---|
| Range: | Function: | |
| Size related* | [0 - 400 Hz] | Use this parameter to set a lower limit for the frequency range. When the motor speed drops below this limit, the display reads <i>SPEED LOW</i> . Warning bit 10 is set in <i>parameter 16-94 Ext. Status Word</i> . The output relay or the digital output can be configured to indicate this warning. The LCP warning indicator light is not turned on when this parameter set limit is reached. |

| 4-41 Warning Freq. High | | |
|-------------------------|---------------|--|
| Range: | Function: | |
| Size related* | [0 - 400 Hz] | Use this parameter to set a higher limit for the frequency range. When the motor speed exceeds this limit, the display reads <i>SPEED HIGH</i> . Warning bit 9 is set in <i>parameter 16-94 Ext. Status Word</i> . The output relay or the digital output can be configured to indicate this warning. The LCP warning indicator light is not turned on when this parameter set limit is reached. |

4.5.3 4-5* Adj. Warnings

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

| 4-50 Warning Current Low | | |
|--------------------------|----------------|---|
| Range: | Function: | |
| 0 A* | [0 - 194.0 A] | Enter the I_{LOW} value. When the motor current drops below this limit, a bit in the status word 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 status word 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 drops below this limit, the display reads <i>Ref_{LOW}</i> . 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* | [-4999 - 4999] | Use this parameter to set a higher limit for the reference range. When the actual reference exceeds this limit, the display reads <i>Reference High</i> . Warning bit 19 is set in <i>parameter 16-94 Ext. Status Word</i> . The output relay or the digital output can be configured to indicate this warning. The LCP warning indicator light is not turned on when this parameter set limit is reached. |

| 4-56 Warning Feedback Low | | |
|---------------------------|-----------------------------------|---|
| Range: | | Function: |
| -4999 ProcessCtrlUnit* | [-4999 - 4999 ProcessCtrlUnit] | Use this parameter to set a lower limit for the feedback range. When the feedback drops below this limit, the display reads <i>Feedback Low</i> . Warning bit 6 is set in <i>parameter 16-94 Ext. Status Word</i> . The output relay or digital output can be configured to indicate this warning. The LCP warning indicator light does not light up when this parameter set limit is reached. |

| 4-57 Warning Feedback High | | |
|----------------------------|-----------------------------------|--|
| Range: | | Function: |
| 4999 ProcessCtrlUnit* | [-4999 - 4999 ProcessCtrlUnit] | Use this parameter to set a higher limit for the feedback range. When the feedback exceeds this limit, the display reads <i>Feedback High</i> . Warning bit 5 |

| 4-57 Warning Feedback High | | |
|----------------------------|--|--|
| Range: | | Function: |
| | | is set in <i>parameter 16-94 Ext. Status Word</i> . The output relay or digital output can be configured to indicate this warning. The LCP warning indicator light does not light up when this parameter set limit is reached. |

| 4-58 Missing Motor Phase Function | | |
|-----------------------------------|-----|--|
| Option: | | Function: |
| [0] | Off | No alarm is shown if a missing motor phase occurs. |
| [1] * | On | An alarm is shown if a missing motor phase occurs. |

4.5.4 4-6* Speed Bypass

Define the speed bypass areas for the ramps. 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

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 [2] *Coast inverse* as default setting. If there is no 24 V to terminal 27, [Hand On] does not start the motor. If 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 *parameter 4-63 Bypass Speed To [Hz]* (array). Repeat this procedure 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 this procedure when speed is leaving the resonance bands during the deceleration. The actual frequencies registered when pressing [OK] are stored in *parameter 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 *parameter 4-63 Bypass Speed To [Hz]* are \geq the values in *parameter 4-61 Bypass Speed From [Hz]*), or if they do not have the same numbers of registrations for the *parameter 4-61 Bypass Speed From [Hz]* and *parameter 4-63 Bypass Speed To [Hz]*, all registrations are canceled and the following message is shown: *Collected speed areas overlapping or not determined. Press [Cancel] to abort.*

| 4-64 Semi-Auto Bypass Set-up | |
|------------------------------|--|
| Option: | Function: |
| [0] * Off | |
| [1] | Enable If this option is selected, speed ranges are automatically swept to identify bands of resonances. |

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 runs.

| 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 ground (GND). |
| [1] | NPN | Action on negative directional pulses (1). NPN systems are pulled up to +24 V, internally in the frequency converter. |

| 5-01 Terminal 27 Mode | | |
|-----------------------|-----------|--|
| Option: | Function: | |
| | | NOTICE This parameter cannot be adjusted while the motor runs. |
| [0] * | Input | Defines terminal 27 as a digital input. |
| [1] | Output | Defines terminal 27 as a digital output. |

| 5-02 Terminal 29 Mode | | |
|-----------------------|-----------|--|
| Option: | Function: | |
| | | NOTICE This parameter cannot be adjusted while the motor runs. |
| [0] * | Input | Defines terminal 29 as a digital input. |
| [1] | Output | Defines terminal 29 as a digital output. |

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 the terminal. |
| [1] Reset | Resets the frequency converter after a trip/alarm. Trip lock alarms can be reset. |
| [2] Coast inverse | Leaves the motor in free mode. Logic 0⇒coast stop. |
| [3] Coast and reset inverse | Reset and coast stop inverted input (NC). Leaves the motor in free mode and resets the frequency converter. Logic 0⇒coast stop and reset. |
| [4] Quick stop inverse | Inverted input (NC). Generates a stop in accordance with the quick-stop ramp time set in <i>parameter 3-81 Quick Stop Ramp Time</i> . After ramping down, the shaft is in free mode. |
| [5] DC brake inverse | Inverted input for DC braking (NC). Stops the motor by energizing it with DC current for a certain time period, see <i>parameter 2-01 DC Brake Current</i> . The function is only active when the value in <i>parameter 2-02 DC Braking Time</i> is different from 0. This selection is not possible when <i>parameter 1-10 Motor Construction</i> is set to [1] <i>PM non-salient SPM</i> . |
| [6] Stop inverse | The stop inverse function generates the stop function when the 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 coast stop, inverse, but external interlock generates the alarm message <i>external fault</i> on the display when the terminal programmed for coast inverse is logic 0. If programmed for external interlock, the alarm message is also active via digital outputs and relay outputs. If the cause for the external interlock is removed, the alarm can be reset using a digital input, fieldbus, or the [Reset] key. |
| [8] Start | Select start for a start/stop command. Logic 1=start, logic 0=stop. (Default digital input 18). |
| [9] Latched start | If a pulse is applied for a minimum of 2 ms, the motor starts. The motor stops when stop inverse is activated. |
| [10] Reversing | Change direction of motor shaft rotation. The reversing signal only changes the direction of rotation, it does not activate the start function. Select [2] <i>Both directions</i> in <i>parameter 4-10 Motor Speed Direction</i> . 0=normal, 1=reversing. |

| Digital input function | Description |
|--------------------------|--|
| [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 <i>parameter 3-11 Jog Speed [Hz]</i> . (Default digital input 29). |
| [16] Preset ref bit 0 | Enables a selection of 1 of the 8 preset references according to <i>Table 4.5</i> . |
| [17] Preset ref bit 1 | Enables a selection of 1 of the 8 preset references according to <i>Table 4.5</i> . |
| [18] Preset ref bit 2 | Enables a selection of 1 of the 8 preset references according to <i>Table 4.5</i> . |
| [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/speed down is used, a speed change always follows ramp 2 (<i>parameter 3-51 Ramp 2 Ramp Up Time</i> and <i>parameter 3-52 Ramp 2 Ramp Down Time</i>) in the range <i>parameter 3-02 Minimum Reference - parameter 3-03 Maximum Reference</i> . |
| [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/speed down is used, the speed change always follows ramp 2. |
| [21] Speed up | For digital control of the up/down speed (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 <i>parameter 3-41 Ramp 1 Ramp Up Time</i> . |
| [22] Speed down | Same as [21] <i>Speed up</i> , but reference decreases. |
| [23] Set-up select bit 0 | Selects 1 of the 2 set-ups. Set <i>parameter 0-10 Active Set-up</i> 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* <i>Pulse Input</i> . 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 disregards all other commands. See 24-0* <i>Fire Mode</i> . |

| Digital input function | Description |
|------------------------|--|
| [52] Run permissive | The input terminal, for which the run permissive is 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. To start running the motor, both conditions must be fulfilled. If run permissive is programmed on multiple terminals, run permissive only has to be logic 1 on 1 of the terminals for the function to be carried out. Run permissive does not affect the digital output signal for run request ([8] Start, [14] Jog, or [20] Freeze Output) programmed in parameter group 5-3* <i>Digital Outputs</i> , or parameter group 5-4* <i>Relays</i> . 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 on mode as if [Hand On] is pressed and a normal stop command is overridden. If the signal is disconnected, the motor stops. To make any other start commands valid, assign another digital input to <i>Auto Start</i> and apply a signal. The [Hand On] and [Auto On] keys have no impact. The [Off] key overrides <i>Hand Start</i> and <i>Auto Start</i> . Press either [Hand On] or [Auto On] to reactivate <i>Hand Start</i> and <i>Auto Start</i> . If there is no signal on <i>Hand Start</i> or <i>Auto Start</i> , the motor stops regardless of any normal start command applied. If a signal is applied to both <i>Hand Start</i> and <i>Auto Start</i> , the function is <i>Auto Start</i> . |
| [54] Auto start | A signal applied puts the frequency converter into <i>Auto</i> mode as if [Auto On] is pressed. See also [53] <i>Hand Start</i> . |
| [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. |
| [63] Counter B (up) | Input for increment counting in the SLC counter. |

| Digital input function | Description |
|------------------------|--|
| [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 reference: | Preset reference bit 2 | Preset reference bit 1 | Preset reference 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 | |
| [22] | Speed down | |

| 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: | |
| [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 | |
| [101] | Sleep | |

| 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 | |

| 5-11 Terminal 19 Digital Input | | |
|--|------------------|--|
| Parameter for configuring the input function on input terminal 19. | | |
| Option: | Function: | |
| [101] | Sleep | |

| 5-12 Terminal 27 Digital Input | | |
|---|-------------------------|--|
| Parameter for configuring the input function on input terminal 27. When <i>parameter 0-03 Regional Settings</i> is set to [0] <i>International</i> , the default value is [2] <i>Coast inverse</i> . When <i>parameter 0-03 Regional Settings</i> is set to [1] <i>North America</i> , the default value is [7] <i>External Interlock</i> . | | |
| 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 | |
| [101] | Sleep | |

| 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 | |

| 5-13 Terminal 29 Digital Input | | |
|--|---------------------|--|
| Parameter for configuring the input function on input terminal 29. | | |
| Option: | Function: | |
| [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 | |
| [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 | |
| [101] | Sleep | |

4.6.3 5-3* Digital Outputs

Parameters for configuring the output functions for the output terminals.

| 5-30 Terminal 27 Digital Output | | |
|---|------------------|--|
| This parameter has the options described in <i>chapter 4.6.3 5-3* Digital Outputs</i> . | | |
| Option: | Function: | |
| [0] * | No operation | |

| 5-31 Terminal 29 Digital Output | | |
|---|------------------|--|
| This parameter has the options described in <i>chapter 4.6.3 5-3* Digital Outputs</i> . | | |
| Option: | Function: | |
| [0] * | No operation | |

| 5-34 On Delay, Digital Output | | |
|-------------------------------|---|--|
| Range: | Function: | |
| 0.01 s* [0 - 600 s] | Enter the delay time before the digital output is switched on. The digital output (terminal 42/45) condition must not be interrupted during the delay time. | |

| 5-35 Off Delay, Digital Output | | |
|--------------------------------|--|--|
| Range: | Function: | |
| 0.01 s* [0 - 600 s] | Enter the delay time before the digital output is switched off. The digital output (terminal 42/45) condition must not be interrupted during the delay time. | |

4.6.4 5-4* Relays

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

| 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 realized in an array parameter. | | |
| Default values for <i>parameter 5-40 Function Relay</i> : When <i>parameter 0-03 Regional Settings</i> is set to [0] International, the default value of Relay1 is Alarm, and default value of Relay2 is Drive Running. When <i>parameter 0-03 Regional Settings</i> 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 | The control board receives supply voltage. |
| [2] | Drive ready | The frequency converter is ready for operation and applies supply signal on control board. |
| [3] | Drive ready/ remote control | The frequency converter is ready for operation in Auto On mode. |
| [4] | Standby / no warning | The frequency converter is ready for operation. No start or stop command is given. No warnings are present. |
| [5] | Drive running | The motor runs. |
| [6] | Running / no warning | The motor runs, and no warnings are present. |
| [7] | Run in range/no warning | The motor runs within programmed current ranges, see <i>parameter 4-50 Warning Current Low</i> and <i>parameter 4-51 Warning Current High</i> . No warnings are present. |
| [8] | Run on ref/no warning | The motor runs at reference speed and with no warnings. |

| 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 realized in an array parameter. | | |
| Default values for <i>parameter 5-40 Function Relay</i> : When <i>parameter 0-03 Regional Settings</i> is set to [0] International, the default value of Relay1 is Alarm, and default value of Relay2 is Drive Running. When <i>parameter 0-03 Regional Settings</i> is set to [1] North America, the default value of Relay1 is No Alarm, and default value of Relay2 is Drive Running. | | |
| Option: | Function: | |
| [9] | Alarm | An alarm activates output. |
| [10] | Alarm or warning | An alarm or warning activates output. |
| [12] | Out of current range | The motor current is outside the range set in <i>parameter 4-50 Warning Current Low</i> and <i>parameter 4-51 Warning Current High</i> . |
| [13] | Below current, low | The motor current is lower than set in <i>parameter 4-50 Warning Current Low</i> . |
| [14] | Above current, high | The motor current is higher than set in <i>parameter 4-51 Warning Current High</i> . |
| [16] | Below speed, low | |
| [17] | Above speed, high | |
| [19] | Below feedback, low | |
| [20] | Above feedback, high | |
| [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 | The frequency converter is ready for operation and no overtemperature warning is present. |
| [23] | Remote, ready, no thermal warning | The frequency converter is ready for operation in Auto mode, and no overtemperature warning is present. |
| [24] | Ready, Voltage OK | The frequency converter is ready for operation, and mains voltage is within specified voltage range. |
| [25] | Reverse | The motor runs/is ready to run clockwise when logic = 0 and counterclockwise when logic = 1. Output changes when reversing signal is applied. |
| [26] | Bus OK | Active communication (no timeout) via serial communication port. |
| [32] | Mech brake ctrl | |
| [35] | External Interlock | See digital input. |

| 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 realized in an array parameter. | | |
| Default values for <i>parameter 5-40 Function Relay</i> : | | |
| When <i>parameter 0-03 Regional Settings</i> is set to [0] <i>International</i> , the default value of Relay1 is Alarm, and default value of Relay2 is Drive Running. | | |
| When <i>parameter 0-03 Regional Settings</i> is set to [1] <i>North America</i> , the default value of Relay1 is No Alarm, and default value of Relay2 is Drive Running. | | |
| Option: | Function: | |
| [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* <i>Comparators</i> . If comparator 0 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [61] | Comparator 1 | See parameter group 13-1* <i>Comparators</i> . If comparator 1 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [62] | Comparator 2 | See parameter group 13-1* <i>Comparators</i> . If comparator 2 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [63] | Comparator 3 | See parameter group 13-1* <i>Comparators</i> . If comparator 3 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [64] | Comparator 4 | See parameter group 13-1* <i>Comparators</i> . If comparator 4 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [65] | Comparator 5 | See parameter group 13-1* <i>Comparators</i> . If comparator 5 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [70] | Logic rule 0 | See parameter group 13-4* <i>Logic Rules</i> . If logic rule 0 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [71] | Logic rule 1 | See parameter group 13-4* <i>Logic Rules</i> . 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* <i>Logic Rules</i> . 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* <i>Logic Rules</i> . If logic rule 3 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 realized in an array parameter. | | |
| Default values for <i>parameter 5-40 Function Relay</i> : | | |
| When <i>parameter 0-03 Regional Settings</i> is set to [0] <i>International</i> , the default value of Relay1 is Alarm, and default value of Relay2 is Drive Running. | | |
| When <i>parameter 0-03 Regional Settings</i> is set to [1] <i>North America</i> , the default value of Relay1 is No Alarm, and default value of Relay2 is Drive Running. | | |
| Option: | Function: | |
| [74] | Logic rule 4 | See parameter group 13-4* <i>Logic Rules</i> . 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* <i>Logic Rules</i> . If logic rule 5 is evaluated as TRUE, the output goes high. Otherwise, it is low. |
| [80] | SL digital output A | See <i>parameter 13-52 SL Controller Action</i> . The input goes high whenever the smart logic action [38] <i>Set dig. out. A high</i> is executed. The input goes low whenever the smart logic [32] <i>Action Set dig. out. A low</i> is executed. |
| [81] | SL digital output B | See <i>parameter 13-52 SL Controller Action</i> . The input goes high whenever the smart logic action [39] <i>Set dig. out. B high</i> is executed. The input goes low whenever the smart logic [33] <i>Action Set dig. out. B low</i> is executed. |
| [82] | SL digital output C | See <i>parameter 13-52 SL Controller Action</i> . The input goes high whenever the smart logic action [40] <i>Set dig. out. C high</i> is executed. The input goes low whenever the smart logic [34] <i>Action Set dig. out. C low</i> is executed. |
| [83] | SL digital output D | See <i>parameter 13-52 SL Controller Action</i> . The input goes high whenever the smart logic [41] <i>Action Set dig. out. D high</i> is executed. The input goes low whenever the smart logic [35] <i>Action Set dig. out. D low</i> 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 runs counterclockwise (the logical product of the status bits running AND reverse). |
| [165] | Local ref. active | The output is high when <i>parameter 3-13 Reference Site</i> = [2] <i>Local</i> or when <i>parameter 3-13 Reference Site</i> = |

| 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 realized in an array parameter. | | |
| Default values for <i>parameter 5-40 Function Relay</i> : | | |
| When <i>parameter 0-03 Regional Settings</i> is set to [0] <i>International</i> , the default value of Relay1 is Alarm, and default value of Relay2 is Drive Running. | | |
| When <i>parameter 0-03 Regional Settings</i> is set to [1] <i>North America</i> , the default value of Relay1 is No Alarm, and default value of Relay2 is Drive Running. | | |
| Option: | Function: | |
| | [0] <i>Linked to hand auto</i> at the same time as the LCP is in [Hand on] mode. | |
| [166] Remote ref. active | The output is high when <i>parameter 3-13 Reference Site [1]</i> or <i>Linked to hand/auto [0]</i> while the LCP is in [Auto on] mode. | |
| [167] Start command activ | The output is high when there is an active start command (that is 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 auto on mode (as indicated by the LED light above [Auto on]). | |
| [191] Dry Pump | | |
| [192] End Of Curve | | |
| [193] Sleep Mode | The frequency converter/system is in sleep mode. See parameter group 22-4* - <i>Sleep Mode</i> . | |
| [194] Broken Belt Function | A broken-belt condition is detected. Enable this function in <i>parameter 22-60 Broken Belt Function</i> . | |
| [196] Fire Mode | The frequency converter is operating in fire mode. See parameter group 24-0* <i>Fire mode</i> . | |
| [198] Drive Bypass | To be used as signal for activating an external electromechanical bypass, switching the motor direct on line. See 24-1* <i>Drive Bypass</i> . | |
| [235] Check Valve Ramping | | |

| 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 only cuts in if the condition in <i>parameter 5-40 Function Relay</i> is uninterrupted during the specified time. Select 1 of the available mechanical relays in an array function. See <i>parameter 5-40 Function Relay</i> . | |

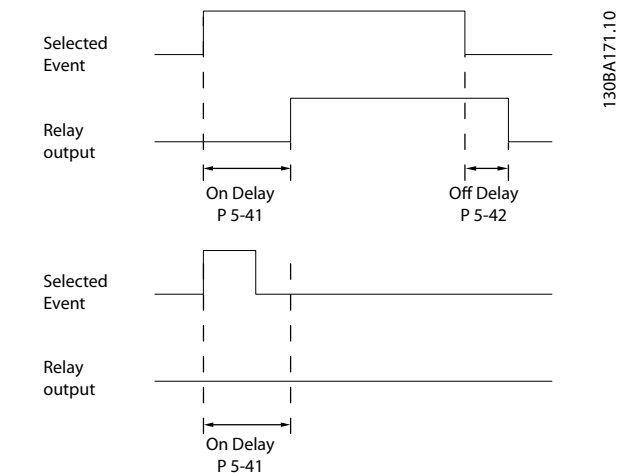


Illustration 4.10 On Delay, Relay

| 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 1 of the available mechanical relays in an array function. See <i>parameter 5-40 Function Relay</i> . | |

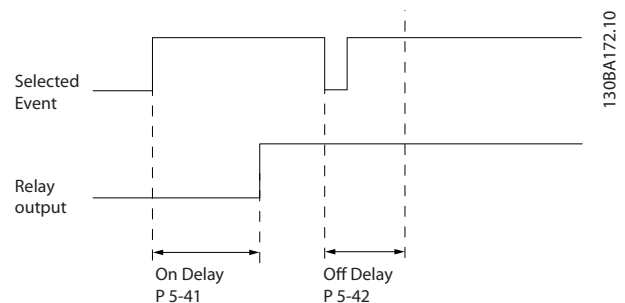


Illustration 4.11 Off Delay, Relay

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 (*parameter 5-13 Terminal 29 Digital Input* to [32] *Pulse input*).

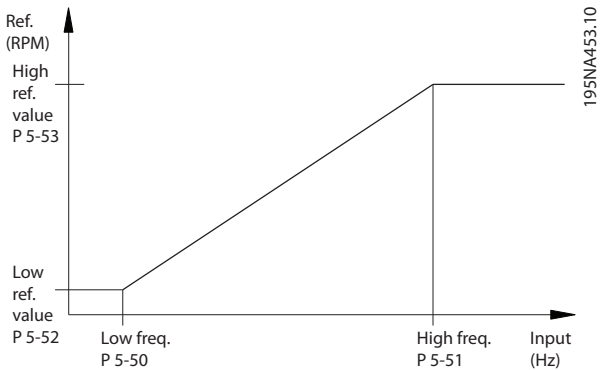


Illustration 4.12 Pulse Input

| 5-50 Term. 29 Low Frequency | | |
|-----------------------------|--|--|
| Range: | Function: | |
| 20 Hz* [20 - 31999 Hz] | Enter the low frequency limit corresponding to the low motor shaft speed (that is low reference value) in <i>parameter 5-52 Term. 29 Low Ref./Feedb. Value</i> . Refer to <i>Illustration 4.12</i> . | |

| 5-51 Term. 29 High Frequency | | |
|------------------------------|--|--|
| Range: | Function: | |
| 32000 Hz* [21 - 32000 Hz] | Enter the high frequency limit corresponding to the high motor shaft speed (that is high reference value) in <i>parameter 5-53 Term. 29 High Ref./Feedb. Value</i> . | |

| 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 value is also the lowest feedback value, see also <i>parameter 5-13 Terminal 29 Digital Input = [32] Pulse Input</i> . | |

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

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 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 provides 2 analog inputs:

- Terminal 53.
- Terminal 54.

The analog inputs can be freely 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 timeout time. |

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

4.7.2 6-1* Analog Input 53

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

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

| 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 <i>parameter 6-15 Terminal 53 High Ref./Feedb. Value</i>). |

| 6-12 Terminal 53 Low Current | | |
|------------------------------|-------------|--|
| Range: | Function: | |
| 4 mA* | [0 - 20 mA] | Enter the low current value. This reference signal corresponds to the low reference/feedback value that is set in <i>parameter 6-14 Terminal 53 Low Ref./Feedb. Value</i> . To activate <i>parameter 6-01 Live Zero Timeout Function</i> , set the value to >2 mA. |

| 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 <i>parameter 6-15 Terminal 53 High Ref./Feedb. Value</i> . |

| 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 <i>parameter 6-10 Terminal 53 Low Voltage</i> to <i>parameter 6-12 Terminal 53 Low Current</i> . |

| 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 <i>parameter 6-11 Terminal 53 High Voltage</i> to <i>parameter 6-13 Terminal 53 High Current</i> . |

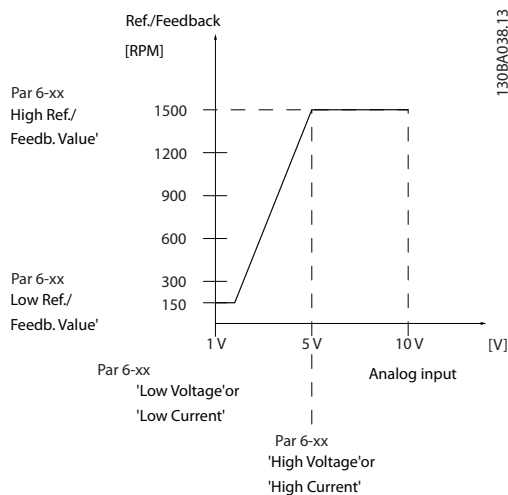


Illustration 4.13 Live Zero Timeout Function

| 6-16 Terminal 53 Filter Time Constant | | |
|---------------------------------------|---------------|---|
| Range: | | Function: |
| 0.01 s* | [0.01 - 10 s] | Enter the time constant. This constant 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 whether 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 <i>parameter 6-24 Terminal 54 Low Ref./Feedb. Value</i>). To activate <i>parameter 6-01 Live Zero Timeout Function</i> , set the value at >1 V. |

| 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 <i>parameter 6-25 Terminal 54 High Ref./Feedb. Value</i>). |

| 6-22 Terminal 54 Low Current | | |
|------------------------------|-------------|---|
| Range: | | Function: |
| 4 mA* | [0 - 20 mA] | Enter the low current value. This reference signal corresponds to the low reference/feedback value, set in <i>parameter 6-24 Terminal 54 Low Ref./Feedb. Value</i> . To activate the live zero timeout function in <i>parameter 6-01 Live Zero Timeout Function</i> , set the value to >2 mA. |

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

| 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 <i>parameter 6-21 Terminal 54 High Voltage/parameter 6-22 Terminal 54 Low Current</i> . |

| 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 <i>parameter 6-21 Terminal 54 High Voltage/parameter 6-23 Terminal 54 High Current</i> . |

| 6-26 Terminal 54 Filter Time Constant | | |
|---------------------------------------|---------------|---|
| Range: | | Function: |
| 0.01 s* | [0.01 - 10 s] | Enter the time constant, which 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 input 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 set up 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 <i>parameter 6-70 Terminal 45 Mode</i> . |
| [0] * | No operation | |

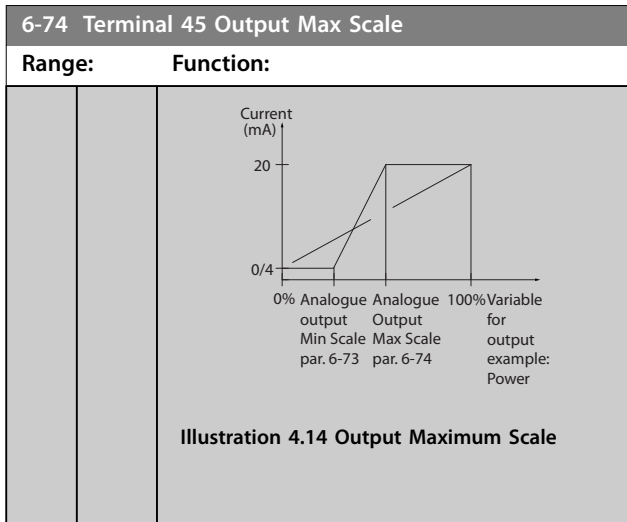
| 6-71 Terminal 45 Analog Output | | |
|--------------------------------|------------------|--|
| Option: | Function: | |
| [100] | Output frequency | 0–100 Hz |
| [101] | Reference | Min _{Ref.} –Max _{Ref.} |
| [102] | Feedback | Min _{FB} –Max _{FB} |
| [103] | Motor Current | 0–I _{max} |
| [106] | Power | 0–P _{nom} |
| [139] | Bus Control | 0–100% |

| 6-72 Terminal 45 Digital Output | | |
|---------------------------------|-----------------------------------|--|
| Option: | Function: | |
| | | Select the function of terminal 45 as a digital current output. See also <i>parameter 6-70 Terminal 45 Mode</i> . See <i>parameter 5-40 Function Relay</i> for description of the options. |
| [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 | |

| 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 | |
| [191] | Dry Pump | |
| [192] | End Of Curve | |
| [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 mA 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 <i>parameter 6-71 Terminal 45 Analog Output</i> . | |

| 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 <i>parameter 6-71 Terminal 45 Analog Output</i> . | |



6-76 Terminal 45 Output Bus Control

Range: **Function:**

| | | |
|----|--------------|--|
| 0* | [0 - 16384] | Holds the level of analog output if controlled by bus. |
|----|--------------|--|

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 <i>parameter 6–90 Terminal 42 Mode</i> . |
| [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 <i>parameter 6–90 Terminal 42 Mode</i> . See <i>parameter 5-40 Function Relay</i> for description of the options. |
| [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 | |

| 6-92 Terminal 42 Digital Output | |
|---------------------------------|----------------------|
| Option: | Function: |
| [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 |
| [191] | Dry Pump |
| [192] | End Of Curve |
| [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 mA 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 <i>parameter 6-91 Terminal 42 Analog Output</i> . |

| 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 <i>parameter 6-91 Terminal 42 Analog Output</i> . |

Illustration 4.15 Output Maximum Scale

| 6-96 Terminal 42 Output Bus Control | |
|-------------------------------------|--|
| Range: | Function: |
| 0* [0 - 16384] | Holds the analog output at terminal 42 if controlled by bus. |

4.8 Main Menu - Communications and Options - Group 8

4.8.1 8-0* General Settings

| 8-01 Control Site | | |
|-------------------|-----------------------|---|
| Option: | Function: | |
| | | This parameter overrides settings in <i>parameter 8-50 Coasting Select</i> to <i>parameter 8-56 Preset Reference Select</i> . |
| [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 | |
| [3] | Option A | PROFIBUS and PROFINET. |

| 8-03 Control Timeout Time | | |
|---------------------------|----------------|---|
| Range: | Function: | |
| 1 s* | [0.1 - 6000 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 <i>parameter 8-04 Control Timeout Function</i> is carried out. |

| 8-04 Control Timeout Function | | |
|-------------------------------|---------------|--|
| Option: | Function: | |
| | | Select the timeout function. The timeout function is activated when the control word fails to be updated within the time period specified in <i>parameter 8-03 Control Timeout Time</i> . Option [20] <i>N2 Override Release</i> only appears after setting the Metasys N2 protocol. |
| [0] * | Off | |
| [1] | Freeze output | |
| [2] | Stop | |
| [3] | Jogging | |
| [4] | Max. speed | |
| [5] | Stop and trip | |

| 8-04 Control Timeout Function | | |
|-------------------------------|---------------------|--|
| Option: | Function: | |
| [20] | N2 Override Release | |

| 8-07 Diagnosis Trigger | | |
|------------------------|---------------------|--|
| Option: | Function: | |
| | | Select [0] <i>Disable</i> to send no extended diagnosis data (EDD). Select [1] <i>Trigger on alarms</i> to send EDD upon alarms or [2] <i>Trigger alarm/warn.</i> to send EDD upon alarms or warnings. Not all fieldbuses support the diagnosis functions. |
| [0] * | Disable | |
| [1] | Trigger on alarms | |
| [2] | Trigger alarm/warn. | |

4.8.2 8-1* Ctrl. Word Settings

| 8-10 Control Word Profile | | |
|---------------------------|-------------------|---|
| Option: | Function: | |
| | | Select the interpretation of the control and status words corresponding to the installed fieldbus. Only the selections valid for the fieldbus installed in slot A are visible in the LPC display. |
| [0] * | FC profile | |
| [1] | PROFdrive profile | |

| 8-14 Configurable Control Word CTW | | |
|------------------------------------|-----------------------|---|
| Option: | Function: | |
| [0] | None | The frequency converter ignores the information in this bit. |
| [1] * | Profile default | The functionality of the bit is depending on the selection <i>parameter 8-10 Control Word Profile</i> . |
| [2] | CTW Valid, active low | If set to 1, the frequency converter ignores the remaining bits of the control word. |

| 8-19 Product Code | | |
|-------------------|------------------|--|
| Range: | Function: | |
| Size related* | [0 - 2147483647] | Select 0 to readout the actual fieldbus product code according to the mounted fieldbus option. Select 1 to readout the actual vendor ID. |

4.8.3 8-3* FC Port Settings

| 8-30 Protocol | | |
|---------------|------------|---|
| Option: | Function: | |
| | | Select the protocol for the integrated RS485 port. Change of settings in <i>parameter 8-30 Protocol</i> may change the baud rate. |
| [0] * | FC | Communication according to the FC Protocol. |
| [2] | Modbus RTU | Communication according to the Modbus RTU protocol. |
| [4] | FLN | |
| [5] | BACNet | |

| 8-31 Address | | |
|--------------|---------------|---|
| Range: | Function: | |
| 1* | [0.0 - 247] | Enter the address for the RS485 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 RS485 port Default refers to the FC protocol. Changing the protocol in <i>parameter 8-30 Protocol</i> may change the baud rate. Changing protocol in <i>parameter 8-30 Protocol</i> may change the baud rate. |
| [0] | 2400 Baud | |
| [1] | 4800 Baud | Default setting for FLN. |
| [2] | 9600 Baud | Default setting for BACnet. |
| [3] | 19200 Baud | Default setting for Modbus RTU. |
| [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 <i>parameter 8-30 Protocol</i> may change the baud rate. |
| [0] | Even Parity, 1 Stop Bit | |
| [1] | Odd Parity, 1 Stop Bit | |
| [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 minimum delay time 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. |

| 8-37 Maximum Inter-char delay | | |
|-------------------------------|--------------------|--|
| Range: | Function: | |
| 0.025 s* | [0.025 - 0.025 s] | Specify the maximum permissible time interval between receipt of 2 bytes. This parameter activates timeout if transmission is interrupted. |

4.8.4 8-4* MC Protocol Set

| 8-40 Telegram Selection | | |
|-------------------------|--------------------------|---|
| Option: | Function: | |
| | | Enables use of freely configurable telegrams or standard telegrams for the FC Port. |
| [1] * | Standard telegram 1 | |
| [300] | Standard telegram FCM300 | |

| 8-42 PCD Write Configuration | | |
|---|-----------------------------------|--|
| Different parameters can be assigned to PCD 3–10 of the PPOs. The number of PCDs depends on the PPO type. The values in PCD 3–10 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] | |

| 8-42 PCD Write Configuration | | |
|---|--------------------------------------|--|
| Different parameters can be assigned to PCD 3–10 of the PPOs. The number of PCDs depends on the PPO type. The values in PCD 3–10 are written to the selected parameters as data values. | | |
| Option: | Function: | |
| [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 3–10 of the PPOs. The number of PCDs depends on the PPO type. PCD 3–10 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] | [1616] Torque [Nm] | |
| [17] | [1618] Motor Thermal | |
| [18] | [1630] DC Link Voltage | |
| [19] | [1634] Heatsink Temp. | |
| [20] | [1635] Inverter Thermal | |
| [21] | [1638] SL Controller State | |
| [22] | [1650] External Reference | |
| [23] | [1652] Feedback [Unit] | |
| [24] | [1660] Digital Input 18,19,27,33 | |
| [25] | [1661] Terminal 53 Switch Setting | |
| [26] | [1662] Analog Input 53(V) | |
| [27] | [1663] Terminal 54 Switch Setting | |
| [28] | [1664] Analog Input 54 | |
| [29] | [1665] Analog Output 42 [mA] | |
| [30] | [1671] Relay Output [bin] | |
| [31] | [1672] Counter A | |
| [32] | [1673] Counter B | |

| 8-43 PCD Read Configuration | | |
|--|----------------------------------|--|
| Different parameters can be assigned to PCD 3–10 of the PPOs. The number of PCDs depends on the PPO type. PCD 3–10 hold the real-time data value of the selected parameters. | | |
| Option: | Function: | |
| [33] | [1690] Alarm Word | |
| [34] | [1692] Warning Word | |
| [35] | [1694] Ext. Status Word | |
| [36] | [1850] Sensorless Readout [Unit] | |

4.8.5 8-5* Digital/Bus

Parameters for configuring the control word digital/bus merging.

| 8-50 Coasting Select | | |
|----------------------|---------------|---|
| Option: | Function: | |
| | | NOTICE This parameter is active only when <i>parameter 8-01 Control Site</i> is set to [0] <i>Digital and control word</i> . Select control of the coasting function via the terminals (digital input) and/or via the bus. |
| [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 via 1 of the digital inputs. |
| [3] * | Logic OR | Activates coast via the serial communication port or via 1 of the digital inputs. |

| 8-51 Quick Stop Select | | |
|------------------------|---------------|--|
| Option: | Function: | |
| | | NOTICE This parameter is active only when <i>parameter 8-01 Control Site</i> is set to [0] <i>Digital and control word</i> . Select control of the <i>Quick Stop</i> function via the terminals (digital input) and/or via the bus. |
| [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 via 1 of the digital inputs. |
| [3] * | Logic OR | Activates quick stop via the serial communication port or via 1 of the digital inputs. |

| 8-52 DC Brake Select | | |
|----------------------|---------------|--|
| Option: | Function: | |
| | | <p>NOTICE This parameter is active only when <i>parameter 8-01 Control Site</i> is set to [0] <i>Digital and control word</i>.</p> <p>Select control of the DC brake via the terminals (digital input).</p> |
| [0] | Digital input | Activates DC brake via a digital input. |
| [1] | Bus | Activates DC brake via the serial communication port. |
| [2] | Logic AND | Activates DC brake via the serial communication port, and via 1 of the digital inputs. |
| [3] | Logic OR | Activates DC brake via the serial communication port or via 1 of the digital inputs. |

| 8-53 Start Select | | |
|-------------------|---------------|--|
| Option: | Function: | |
| | | <p>NOTICE This parameter is active only when <i>parameter 8-01 Control Site</i> is set to [0] <i>Digital and control word</i>.</p> <p>Select control of the frequency converter start function via the terminals (digital input).</p> |
| [0] | Digital input | Activates a start command via a digital input. |
| [1] | Bus | Activates a start command via the serial communication port or fieldbus options. |
| [2] | Logic AND | Activates a start command via the serial communication port, and via 1 of the digital inputs. |
| [3] * | Logic OR | Activates a start command via the serial communication port or via 1 of the digital inputs. |

| 8-54 Reversing Select | | |
|-----------------------|---------------|--|
| Option: | Function: | |
| | | <p>NOTICE This parameter is active only when <i>parameter 8-01 Control Site</i> is set to [0] <i>Digital and control word</i>.</p> <p>Select control of the frequency converter <i>Reverse</i> function via the terminals (digital input) and/or via the serial communication port.</p> |
| [0] * | Digital input | Activates a reverse command via a digital input. |
| [1] | Bus | Activates a reverse command via the serial communication port. |

| 8-54 Reversing Select | | |
|-----------------------|-----------|---|
| Option: | Function: | |
| [2] | Logic AND | Activates a reverse command via the serial communication port, and via 1 of the digital inputs. |
| [3] | Logic OR | Activates a reverse command via the serial communication port or via 1 of the digital inputs. |

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

| 8-57 Profidrive OFF2 Select | | |
|-----------------------------|---------------|--|
| Option: | Function: | |
| [0] | Digital input | |

Select control of the frequency converter OFF2 selection via the terminals (digital input) and/or via the fieldbus. This parameter is active only when *parameter 8-01 Control Site* is set to [0] *Digital and ctrl. word*, and *parameter 8-10 Control Word Profile* is set to [1] *Profidrive profile*.

| 8-57 Profdrive OFF2 Select | | |
|---|------------------|--|
| Select control of the frequency converter OFF2 selection via the terminals (digital input) and/or via the fieldbus. This parameter is active only when <i>parameter 8-01 Control Site</i> is set to [0] <i>Digital and ctrl. word</i> , and <i>parameter 8-10 Control Word Profile</i> is set to [1] <i>Profdrive profile</i> . | | |
| Option: | Function: | |
| [1] | Bus | |
| [2] | Logic AND | |
| [3] * | Logic OR | |

| 8-58 Profdrive OFF3 Select | | |
|---|------------------|--|
| Select control of the frequency converter OFF3 selection via the terminals (digital input) and/or via the fieldbus. This parameter is active only when <i>parameter 8-01 Control Site</i> is set to [0] <i>Digital and ctrl. word</i> , and <i>parameter 8-10 Control Word Profile</i> is set to [1] <i>Profdrive profile</i> . | | |
| Option: | Function: | |
| [0] | Digital input | |
| [1] | Bus | |
| [2] | Logic AND | |
| [3] * | Logic OR | |

4.8.6 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 optimizes 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 approximately 1 minute. |

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

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

4.8.7 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 - 4294967295] | This parameter shows the number of valid telegrams detected on the bus. |

| 8-81 Bus Error Count | | |
|----------------------|-------------------|---|
| Range: | Function: | |
| 0* | [0 - 4294967295] | This parameter shows the number of telegrams with faults (for example, CRC fault), detected on the bus. |

| 8-82 Slave Messages Rcvd | | |
|--------------------------|-------------------|---|
| Range: | Function: | |
| 0* | [0 - 4294967295] | This parameter shows the number of valid telegrams addressed to the slave, sent by the frequency converter. |

| 8-83 Slave Error Count | | |
|------------------------|-------------------|--|
| Range: | Function: | |
| 0* | [0 - 4294967295] | This parameter shows the number of error telegrams, which the frequency converter could not execute. |

| 8-84 Slave Messages Sent | | |
|--------------------------|-------------------|--|
| Range: | Function: | |
| 0* | [0 - 4294967295] | This parameter shows the number of messages sent from the slave. |

| 8-85 Slave Timeout Errors | | |
|---------------------------|-------------------|--|
| Range: | Function: | |
| 0* | [0 - 4294967295] | This parameter shows the number of slave timeout errors. |

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

4.8.8 8-9* Bus Feedback

| 8-90 Bus Jog 1 Speed | | |
|----------------------|--------------------|--|
| Range: | | Function: |
| 100 RPM* | [0 - 1500 RPM] | Enter the jog speed. Activate this fixed jog speed via the serial port or fieldbus option. |

| 8-91 Bus Jog 2 Speed | | |
|----------------------|--------------------|--|
| Range: | | Function: |
| 200 RPM* | [0 - 1500 RPM] | Enter the jog speed. Activate this fixed jog speed via the serial port or fieldbus option. |

| 8-94 Bus Feedback 1 | | |
|---------------------|----------------------|--|
| Range: | | Function: |
| 0* | [-32768 - 32767] | Write feedback to this parameter via the serial communication port. Select this parameter in <i>parameter 20-00 Feedback 1 Source</i> or <i>parameter 20-03 Feedback 2 Source</i> as a feedback source. Hex-value 4000 h corresponds to 100% feedback/range is $\pm 200\%$. |

4.9 Main Menu - PROFIdrive - Group 9

| 9-00 Setpoint | | |
|-----------------|--|--|
| Range: | Function: | |
| 0* [0 - 65535] | This parameter receives cyclic reference from a master class 2. If the control priority is set to master class 2, the reference for the frequency converter is taken from this parameter, whereas the cyclic reference is ignored. | |

| 9-07 Actual Value | | |
|-------------------|--|--|
| Range: | Function: | |
| 0* [0 - 65535] | This parameter delivers the MAV for a master class 2. The parameter is valid if the control priority is set to master class 2. | |

| 9-15 PCD Write Configuration | | |
|--|------------------------------------|--|
| Select the parameters to be assigned to PCD 3–10 of the telegrams. The number of available PCDs depends on the telegram type. Values in PCD 3–10 are written to the selected parameters as data. For standard PROFIBUS telegrams, see <i>parameter 9-22 Telegram Selection</i> . | | |
| Option: | Function: | |
| [0] | | |
| [302] | Minimum Reference | |
| [303] | Maximum Reference | |
| [312] | Catch up/slow Down Value | |
| [341] | Ramp 1 Ramp Up Time | |
| [342] | Ramp 1 Ramp Down Time | |
| [351] | Ramp 2 Ramp Up Time | |
| [352] | Ramp 2 Ramp Down Time | |
| [380] | Jog Ramp Time | |
| [381] | Quick Stop Ramp Time | |
| [412] | Motor Speed Low Limit [Hz] | |
| [414] | Motor Speed High Limit [Hz] | |
| [553] | Term. 29 High Ref./Feedb. Value | |
| [590] | Digital & Relay Bus Control | |
| [615] | Terminal 53 High Ref./Feedb. Value | |
| [625] | Terminal 54 High Ref./Feedb. Value | |
| [696] | Terminal 42 Output Bus Control | |
| [890] | Bus Jog 1 Speed | |
| [891] | Bus Jog 2 Speed | |
| [894] | Bus Feedback 1 | |
| [1680] | Fieldbus CTW 1 | |
| [1682] | Fieldbus REF 1 | |
| [2021] | Setpoint 1 | |

| 9-16 PCD Read Configuration | | |
|---|-------------------------|--|
| Select the parameters to be assigned to PCD 3–10 of the telegrams. The number of available PCDs depends on the telegram type. Values in PCD 3–10 contain the actual data values of the selected parameters. | | |
| Option: | Function: | |
| [0] | | |
| [894] | Bus Feedback 1 | |
| [1500] | Operating hours | |
| [1501] | Running Hours | |
| [1502] | kWh Counter | |
| [1600] | Control Word | |
| [1601] | Reference [Unit] | |
| [1602] | Reference [%] | |
| [1603] | Status Word | |
| [1605] | Main Actual Value [%] | |
| [1609] | Custom Readout | |
| [1610] | Power [kW] | |
| [1611] | Power [hp] | |
| [1612] | Motor Voltage | |
| [1613] | Frequency | |
| [1614] | Motor current | |
| [1615] | Frequency [%] | |
| [1616] | Torque [Nm] | |
| [1618] | Motor Thermal | |
| [1622] | Torque [%] | |
| [1626] | Power Filtered [kW] | |
| [1627] | Power Filtered [hp] | |
| [1630] | DC Link Voltage | |
| [1634] | Heatsink Temp. | |
| [1635] | Inverter Thermal | |
| [1638] | SL Controller State | |
| [1639] | Control Card Temp. | |
| [1650] | External Reference | |
| [1652] | Feedback[Unit] | |
| [1660] | Digital Input | |
| [1661] | Terminal 53 Setting | |
| [1662] | Analog Input AI53 | |
| [1663] | Terminal 54 Setting | |
| [1664] | Analog Input AI54 | |
| [1665] | Analog Output AO42 [mA] | |
| [1666] | Digital Output | |
| [1667] | Pulse Input #29 [Hz] | |
| [1671] | Relay Output [bin] | |
| [1672] | Counter A | |
| [1673] | Counter B | |
| [1679] | Analog Output AO45 | |
| [1684] | Comm. Option STW | |
| [1685] | FC Port CTW 1 | |
| [1690] | Alarm Word | |
| [1691] | Alarm Word 2 | |
| [1692] | Warning Word | |
| [1693] | Warning Word 2 | |
| [1694] | Ext. Status Word | |

| 9-16 PCD Read Configuration | | |
|---|---------------------------|------------------|
| Select the parameters to be assigned to PCD 3–10 of the telegrams. The number of available PCDs depends on the telegram type. Values in PCD 3–10 contain the actual data values of the selected parameters. | | |
| Option: | | Function: |
| [1695] | Ext. Status Word 2 | |
| [1697] | Alarm Word 3 | |
| [1850] | Sensorless Readout [unit] | |

| 9-18 Node Address | | |
|-------------------|-------------|--|
| Range: | | Function: |
| 126* | [0 - 126] | Enter the station address in this parameter or, alternatively, in the hardware switch. To adjust the station address in <i>parameter 9-18 Node Address</i> , set the hardware switch to 126 or 127 (that is all switches set to <i>on</i>). Otherwise, this parameter shows the actual setting of the switch. |

| 9-19 Drive Unit System Number | | |
|-------------------------------|---------------|----------------------------------|
| Range: | | Function: |
| 1038* | [0 - 65535] | Manufacturer-specific system ID. |

| 9-22 Telegram Selection | | |
|-------------------------|---------------------|--|
| Option: | | Function: |
| [1] | Standard telegram 1 | Select a standard PROFIBUS telegram configuration for the frequency converter as an alternative to the freely configurable telegrams in <i>parameter 9-15 PCD Write Configuration</i> and <i>parameter 9-16 PCD Read Configuration</i> . |
| [100] * | None | |
| [101] | PPO 1 | |
| [102] | PPO 2 | |
| [103] | PPO 3 | |
| [104] | PPO 4 | |
| [105] | PPO 5 | |
| [106] | PPO 6 | |
| [107] | PPO 7 | |
| [108] | PPO 8 | |
| [200] | Custom telegram 1 | |

| 9-23 Parameters for Signals | | |
|-----------------------------|--------------------------|------------------|
| Option: | | Function: |
| [0] * | | |
| [302] | Minimum Reference | |
| [303] | Maximum Reference | |
| [312] | Catch up/slow Down Value | |
| [341] | Ramp 1 Ramp Up Time | |
| [342] | Ramp 1 Ramp Down Time | |
| [351] | Ramp 2 Ramp Up Time | |
| [352] | Ramp 2 Ramp Down Time | |

| 9-23 Parameters for Signals | | |
|-----------------------------|------------------------------------|------------------|
| Option: | | Function: |
| [380] | Jog Ramp Time | |
| [381] | Quick Stop Ramp Time | |
| [412] | Motor Speed Low Limit [Hz] | |
| [414] | Motor Speed High Limit [Hz] | |
| [553] | Term. 29 High Ref./Feedb. Value | |
| [590] | Digital & Relay Bus Control | |
| [615] | Terminal 53 High Ref./Feedb. Value | |
| [625] | Terminal 54 High Ref./Feedb. Value | |
| [696] | Terminal 42 Output Bus Control | |
| [890] | Bus Jog 1 Speed | |
| [891] | Bus Jog 2 Speed | |
| [894] | Bus Feedback 1 | |
| [1500] | Operating hours | |
| [1501] | Running Hours | |
| [1502] | kWh Counter | |
| [1600] | Control Word | |
| [1601] | Reference [Unit] | |
| [1602] | Reference [%] | |
| [1603] | Status Word | |
| [1605] | Main Actual Value [%] | |
| [1609] | Custom Readout | |
| [1610] | Power [kW] | |
| [1611] | Power [hp] | |
| [1612] | Motor Voltage | |
| [1613] | Frequency | |
| [1614] | Motor current | |
| [1615] | Frequency [%] | |
| [1616] | Torque [Nm] | |
| [1618] | Motor Thermal | |
| [1622] | Torque [%] | |
| [1626] | Power Filtered [kW] | |
| [1627] | Power Filtered [hp] | |
| [1630] | DC Link Voltage | |
| [1634] | Heatsink Temp. | |
| [1635] | Inverter Thermal | |
| [1638] | SL Controller State | |
| [1639] | Control Card Temp. | |
| [1650] | External Reference | |
| [1652] | Feedback[Unit] | |
| [1660] | Digital Input | |
| [1661] | Terminal 53 Setting | |
| [1662] | Analog Input AI53 | |
| [1663] | Terminal 54 Setting | |
| [1664] | Analog Input AI54 | |
| [1665] | Analog Output AO42 [mA] | |
| [1666] | Digital Output | |
| [1667] | Pulse Input #29 [Hz] | |
| [1671] | Relay Output [bin] | |
| [1672] | Counter A | |
| [1673] | Counter B | |
| [1679] | Analog Output AO45 | |
| [1680] | Fieldbus CTW 1 | |

| 9-23 Parameters for Signals | | |
|-----------------------------|---------------------------|--|
| Option: | Function: | |
| [1682] | Fieldbus REF 1 | |
| [1684] | Comm. Option STW | |
| [1685] | FC Port CTW 1 | |
| [1690] | Alarm Word | |
| [1691] | Alarm Word 2 | |
| [1692] | Warning Word | |
| [1693] | Warning Word 2 | |
| [1694] | Ext. Status Word | |
| [1695] | Ext. Status Word 2 | |
| [1697] | Alarm Word 3 | |
| [1850] | Sensorless Readout [unit] | |
| [2021] | Setpoint 1 | |

| 9-27 Parameter Edit | | |
|---------------------|-----------|--|
| Option: | Function: | |
| | | Parameters can be edited via PROFIBUS, the standard RS485 interface, or the LCP. |
| [0] | Disabled | Disables editing via PROFIBUS. |
| [1] * | Enabled | Enables editing via PROFIBUS. |

| 9-28 Process Control | | |
|----------------------|----------------------|--|
| Option: | Function: | |
| | | Process control (setting of control word, speed reference, and process data) is possible via either PROFIBUS or standard fieldbus, but not both simultaneously. Local control is always possible via the LCP. Control via process control is possible via either terminals or fieldbus depending on the settings in <i>parameter 8-50 Coasting Select</i> to <i>parameter 8-56 Preset Reference Select</i> . |
| [0] | Disable | Disables process control via PROFIBUS master class 1, and enables process control via standard fieldbus or PROFIBUS master class 2. |
| [1] * | Enable cyclic master | Enables process control via PROFIBUS master class 1, and disables process control via standard fieldbus or PROFIBUS master class 2. |

| 9-44 Fault Message Counter | | |
|----------------------------|-----------|--|
| Range: | Function: | |
| 0* [0 - 65535] | | Indicates the number of fault events presently stored in <i>parameter 9-45 Fault Code</i> . The buffer capacity is maximum 8 error events. The buffer and counter are set to 0 by reset or power-up. |

| 9-45 Fault Code | | |
|-----------------|-----------|---|
| Range: | Function: | |
| 0* [0 - 0] | | This buffer contains the alarm word for all alarms and warnings that have occurred since last reset or power-up. The buffer capacity is maximum 8 error events. |

| 9-47 Fault Number | | |
|-------------------|-----------|---|
| Range: | Function: | |
| 0* [0 - 0] | | This buffer contains the alarm word for all alarms and warnings that have occurred since last reset or power-up. The buffer capacity is maximum 8 error events. |

| 9-52 Fault Situation Counter | | |
|------------------------------|-----------|---|
| Range: | Function: | |
| 0* [0 - 1000] | | Indicates the number of fault events that have occurred since last reset or power-up. |

| 9-53 Profibus Warning Word | | |
|---------------------------------|------------|---|
| Range: | Function: | |
| 0* [0 - 65535] | | This parameter shows PROFIBUS communication warnings. |
| | Bit | Description |
| | 0 | Connection with DP master is lost. |
| | 1 | Not used. |
| | 2 | FDL (fieldbus data link layer) is not OK. |
| | 3 | Clear data command received. |
| | 4 | Actual value is not updated. |
| | 5 | Baud rate search. |
| | 6 | PROFIBUS ASIC is not transmitting. |
| | 7 | Initializing of PROFIBUS is not OK. |
| | 8 | Frequency converter is tripped. |
| | 9 | Internal CAN error. |
| | 10 | Wrong configuration data from PLC. |
| | 11 | Wrong ID sent by PLC. |
| | 12 | Internal fault occurred. |
| | 13 | Not configured. |
| | 14 | Timeout active. |
| | 15 | Warning 34 active. |
| Table 4.7 Bit Definition | | |

| 9-63 Actual Baud Rate | | |
|-----------------------|--------------|---|
| Option: | Function: | |
| | | This parameter shows the actual PROFIBUS baud rate. The PROFIBUS master automatically sets the baud rate. |
| [0] | 9,6 kbit/s | |
| [1] | 19,2 kbit/s | |
| [2] | 93,75 kbit/s | |
| [3] | 187,5 kbit/s | |
| [4] | 500 kbit/s | |
| [6] | 1500 kbit/s | |
| [7] | 3000 kbit/s | |
| [8] | 6000 kbit/s | |
| [9] | 12000 kbit/s | |
| [10] | 31,25 kbit/s | |

| 9-63 Actual Baud Rate | | |
|-----------------------|-------------------|--|
| Option: | Function: | |
| [11] | 45,45 kbit/s | |
| [255] * | No baudrate found | |

| 9-64 Device Identification | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------------------|-----------------------------------|---|-------|---------|-------|---|--------------|-----|---|-------------|---|---|---------|------|---|--------------------|------|---|---------------------|------|---|-------------|----------|---|-----------------------------|------|---|-----------------------------------|------|---|------------------------------|------|---|------------------------------|------|
| Range: | Function: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0* | [0 - 0] | <p>NOTICE This parameter is not visible via LCP.</p> <p>The device identification parameter. The data type is array[n] of unsigned16. The assignment of the first subindexes is defined and shown in <i>Table 4.8</i>.</p> <table border="1"> <thead> <tr> <th>Index</th> <th>Content</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Manufacturer</td> <td>128</td> </tr> <tr> <td>1</td> <td>Device type</td> <td>1</td> </tr> <tr> <td>2</td> <td>Version</td> <td>xxyy</td> </tr> <tr> <td>3</td> <td>Firmware date year</td> <td>yyyy</td> </tr> <tr> <td>4</td> <td>Firmware date month</td> <td>ddmm</td> </tr> <tr> <td>5</td> <td>No. of axes</td> <td>Variable</td> </tr> <tr> <td>6</td> <td>Vendor specific: PB Version</td> <td>xxyy</td> </tr> <tr> <td>7</td> <td>Vendor specific: Database Version</td> <td>xxyy</td> </tr> <tr> <td>8</td> <td>Vendor specific: AOC Version</td> <td>xxyy</td> </tr> <tr> <td>9</td> <td>Vendor specific: MOC Version</td> <td>xxyy</td> </tr> </tbody> </table> | Index | Content | Value | 0 | Manufacturer | 128 | 1 | Device type | 1 | 2 | Version | xxyy | 3 | Firmware date year | yyyy | 4 | Firmware date month | ddmm | 5 | No. of axes | Variable | 6 | Vendor specific: PB Version | xxyy | 7 | Vendor specific: Database Version | xxyy | 8 | Vendor specific: AOC Version | xxyy | 9 | Vendor specific: MOC Version | xxyy |
| Index | Content | Value | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | Manufacturer | 128 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | Device type | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Version | xxyy | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Firmware date year | yyyy | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Firmware date month | ddmm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | No. of axes | Variable | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | Vendor specific: PB Version | xxyy | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | Vendor specific: Database Version | xxyy | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | Vendor specific: AOC Version | xxyy | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | Vendor specific: MOC Version | xxyy | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| 9-65 Profile Number | | |
|---------------------|-----------|---|
| Range: | Function: | |
| 0* | [0 - 0] | <p>NOTICE This parameter is not visible via LCP.</p> <p>This parameter contains the profile identification. Byte 1 contains the profile number and byte 2 the version number of the profile.</p> |

| 9-67 Control Word 1 | | |
|---------------------|-------------|--|
| Range: | Function: | |
| 0* | [0 - 65535] | This parameter accepts the control word from a master class 2 in the same format as PCD 1. |

| 9-68 Status Word 1 | | |
|--------------------|-------------|---|
| Range: | Function: | |
| 0* | [0 - 65535] | This parameter delivers the status word for a master class 2 in the same format as PCD 2. |

| 9-70 Edit Set-up | | |
|------------------|---------------|---|
| Option: | Function: | |
| | | Select the set-up in which programming (change of data) is performed during operation. It is possible to program the 4 set-ups independently of the set-up selected as active set-up. Parameter access from each master is directed to the set-up selected by the individual master (cyclic, acyclic MCL1, 1st acyclic MCL2, 2nd acyclic MCL2, 3rd acyclic MCL2). |
| [1] | Set-up 1 | |
| [2] | Set-up 2 | |
| [9] * | Active Set-up | |

| 9-71 Profibus Save Data Values | | |
|--------------------------------|------------------|---|
| Option: | Function: | |
| | | Parameter values changed via RS485 are not automatically stored in a non-volatile memory. Use this parameter to activate a function that stores parameter values in the EEPROM non-volatile memory, so changed parameter values are retained at power-down. |
| [0] * | Off | Deactivates the non-volatile storage function. |
| [1] | Store all setups | Stores all parameter values in the set-up selected in <i>parameter 9-70 Edit Set-up</i> in the non-volatile memory. The selection returns to [0] Off when all values are stored. |
| [2] | Store all setups | Stores all parameter values for all set-ups in the non-volatile memory. The selection returns to [0] Off when all parameter values are stored. |

| 9-72 ProfibusDriveReset | | |
|-------------------------|---------------------|--|
| Option: | Function: | |
| | | <p>NOTICE Resets the VLT® PROFIBUS DP MCA 101 option only.</p> |
| [0] * | No action | |
| [1] | Power-on reset | Resets frequency converter after power-up, as for power cycle. |
| [2] | Power-on reset prep | |
| [3] | Comm option reset | When reset, the frequency converter disappears from the fieldbus, which may cause a communication error from the master. |

| 9-75 DO Identification | | |
|------------------------|-------------|---|
| Range: | Function: | |
| 0* | [0 - 65535] | Provides information about the DO (drive object). |

| 9-80 Defined Parameters (1) | | |
|-----------------------------|---|--|
| Range: | Function: | |
| 0* [0 - 9999] | This parameter shows a list of all the defined frequency converter parameters available for PROFIBUS. | |

| 9-81 Defined Parameters (2) | | |
|-----------------------------|---|--|
| Range: | Function: | |
| 0* [0 - 9999] | This parameter shows a list of all the defined frequency converter parameters available for PROFIBUS. | |

| 9-82 Defined Parameters (3) | | |
|-----------------------------|---|--|
| Range: | Function: | |
| 0* [0 - 9999] | This parameter shows a list of all the defined frequency converter parameters available for PROFIBUS. | |

| 9-83 Defined Parameters (4) | | |
|-----------------------------|---|--|
| Range: | Function: | |
| 0* [0 - 9999] | This parameter shows a list of all the defined frequency converter parameters available for PROFIBUS. | |

| 9-84 Defined Parameters (5) | | |
|-----------------------------|---|--|
| Range: | Function: | |
| 0* [0 - 9999] | This parameter shows a list of all the defined frequency converter parameters available for PROFIBUS. | |

| 9-85 Defined Parameters (6) | | |
|-----------------------------|---|--|
| Range: | Function: | |
| 0* [0 - 9999] | This parameter shows a list of all the defined frequency converter parameters available for PROFIBUS. | |

| 9-90 Changed Parameters (1) | | |
|-----------------------------|---|--|
| Range: | Function: | |
| 0* [0 - 9999] | This parameter shows a list of all the frequency converter parameters deviating from default setting. | |

| 9-91 Changed Parameters (2) | | |
|-----------------------------|---|--|
| Range: | Function: | |
| 0* [0 - 9999] | This parameter shows a list of all the frequency converter parameters deviating from default setting. | |

| 9-92 Changed Parameters (3) | | |
|-----------------------------|---|--|
| Range: | Function: | |
| 0* [0 - 9999] | This parameter shows a list of all the frequency converter parameters deviating from default setting. | |

| 9-93 Changed Parameters (4) | | |
|-----------------------------|---|--|
| Range: | Function: | |
| 0* [0 - 9999] | This parameter shows a list of all the frequency converter parameters deviating from default setting. | |

| 9-94 Changed Parameters (5) | | |
|-----------------------------|---|--|
| Range: | Function: | |
| 0* [0 - 9999] | This parameter shows a list of all the frequency converter parameters deviating from default setting. | |

| 9-99 Profibus Revision Counter | | |
|--------------------------------|----------------------------|--|
| Range: | Function: | |
| 0* [0 - 65535] | Readout of revision count. | |

4.10 Main Menu - Smart Logic - Group 13

4.10.1 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 SLC evaluates the associated user-defined event (see *parameter 13-51 SL Controller Event [x]*) as true. 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 executing this action, the conditions of [1] event is evaluated and if evaluated true, [1] action is executed, and so on. Only 1 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 program from 1–20 events and actions. When the last event/action has been executed, the sequence starts over again from [0] event/[0] action.

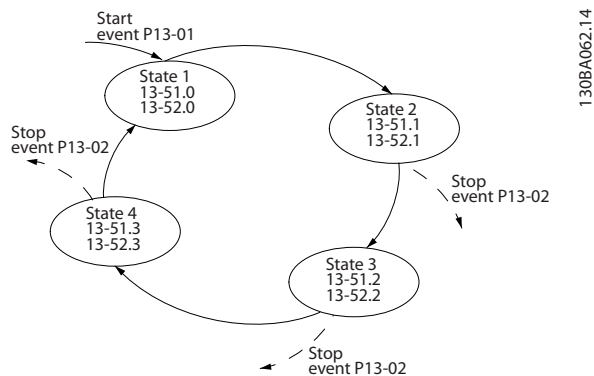


Illustration 4.16 Example with 3 Event/Actions

Starting and stopping the SLC

To start or stop the SLC, select [1] On or [2] 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 (if [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 the beginning.

4.10.2 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, for example, via a digital input. To disable the smart logic control, select [0] Off. |
| [0] * | Off | Disables the smart logic controller. |
| [1] | On | Enables the smart logic controller. |

| 13-01 Start Event | | |
|-------------------|----------------------|--|
| Option: | Function: | |
| | | To activate smart logic control, select the boolean (true or false) input. |
| [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 runs. |
| [3] | In range | The motor runs within programmed current ranges (<i>parameter 4-50 Warning Current Low</i> and <i>parameter 4-51 Warning Current High</i>) |
| [4] | On reference | The motor runs at reference speed. |
| [7] | Out of current range | The motor current is outside the range set in <i>parameter 4-18 Current Limit</i> . |
| [8] | Below I low | The motor current is lower than set in <i>parameter 4-50 Warning Current Low</i> . |
| [9] | Above I high | The motor current is higher than set in <i>parameter 4-51 Warning Current High</i> . |
| [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 | Mains phase loss warning or alarm, if <i>parameter 14-12 Function at Mains Imbalance</i> is not set at [2] Disabled. |
| [18] | Reversing | The frequency converter reverses. |
| [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. |

| 13-01 Start Event | | |
|-------------------|--------------------|---|
| Option: | Function: | |
| [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). |
| [39] * | Start command | This event is true if the frequency converter is started (either via digital input, fieldbus 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 is detected. Enable this function in <i>parameter 22-60 Broken Belt Function</i> . |

| 13-02 Stop Event | | |
|------------------|----------------------|--|
| Option: | Function: | |
| | | Select the condition (true or false) which deactivates the smart logic controller. |
| [0] | False | |
| [1] | True | |
| [2] | Running | |
| [3] | In range | |
| [4] | On reference | |
| [7] | Out of current range | |

| 13-02 Stop Event | | |
|------------------|--------------------|--|
| Option: | Function: | |
| [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 | |
| [81] | Dry Pump | |
| [82] | End of Curve | |
| [83] | Broken Belt | |

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

4.10.3 13-1* Comparators

Comparators are used for comparing continuous variables (such as output frequency, output current, and analog input) to fixed preset values.

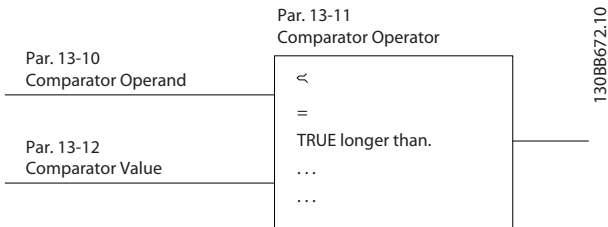


Illustration 4.17 Comparators

In addition, there are digital values that are compared to fixed time values. See the 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 0–5. Select index 0 to program comparator 0, select index 1 to program 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 | |
| [18] | Pulse input FI29 | |
| [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 <i>parameter 13-10 Comparator Operand</i> is smaller than the fixed value in <i>parameter 13-12 Comparator Value</i> . The result is false, if the variable selected in <i>parameter 13-10 Comparator Operand</i> is |

| 13-11 Comparator Operator | | |
|---------------------------|------------------|--|
| Array [6] | | |
| Option: | Function: | |
| | | greater than the fixed value in <i>parameter 13-12 Comparator Value</i> . |
| [1] * | Approx.Equal (~) | Select [1] ≈ for the result of the evaluation to be true, when the variable selected in <i>parameter 13-10 Comparator Operand</i> is approximately equal to the fixed value in <i>parameter 13-12 Comparator Value</i> . |
| [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 parameter is an array parameter containing comparator values 0–5. |

4.10.4 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 (for example [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 0–2. 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 <i>parameter 13-52 SL Controller Action [29–31]</i> and <i>parameter 13-52 SL Controller Action [70–74]</i> Start timer X) and until the timer value has elapsed. Array parameters contain timers 0–7. |

4.10.5 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 combine the selected inputs logically in parameter 13-41 Logic Rule Operator 1, and parameter 13-43 Logic Rule Operator 2.

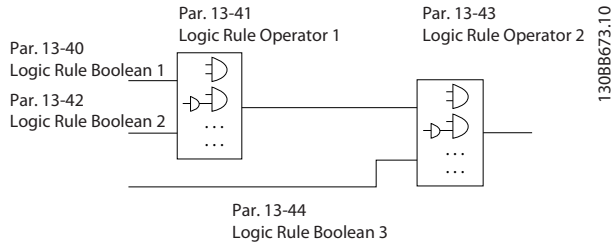


Illustration 4.18 Logic Rules

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 | |
| [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 | |

| 13-40 Logic Rule Boolean 1 | | |
|----------------------------|--------------------|--|
| Array [6] | | |
| Option: | Function: | |
| [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 | |
| [81] | Dry Pump | |
| [82] | End of Curve | |
| [83] | Broken Belt | |

| 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 2nd boolean (true or false) input for the selected logic rule. See parameter 13-40 Logic Rule Boolean 1 for further descriptions of options 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) | |

| 13-42 Logic Rule Boolean 2 | | |
|----------------------------|--------------------|--|
| Array [6] | | |
| Option: | Function: | |
| [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 | |
| [81] | Dry Pump | |
| [82] | End of Curve | |
| [83] | Broken Belt | |

| 13-43 Logic Rule Operator 2 | | |
|-----------------------------|-----------|---|
| Array [6] | | |
| Option: | Function: | |
| [0] * | Disabled | Select the 2nd logical operator to be used on the boolean input calculated in <i>parameter 13-40 Logic Rule Boolean 1</i> , <i>parameter 13-41 Logic Rule Operator 1</i> , and <i>parameter 13-42 Logic Rule Boolean 2</i> , and the boolean input coming from <i>parameter 13-42 Logic Rule Boolean 2</i> . [13-44] signifies the boolean input of <i>parameter 13-44 Logic Rule Boolean 3</i> . [13-40/13-42] signifies the boolean input calculated in <i>parameter 13-40 Logic Rule Boolean 1</i> , <i>parameter 13-41 Logic Rule Operator 1</i> , and <i>parameter 13-42 Logic Rule Boolean 2</i> . [0] Disabled (factory setting): Select this option to ignore <i>parameter 13-44 Logic Rule Boolean 3</i> . |

| 13-43 Logic Rule Operator 2 | | |
|-----------------------------|-------------|--|
| Array [6] | | |
| Option: | Function: | |
| [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 3rd boolean (true or false) input for the selected logic rule. See <i>parameter 13-40 Logic Rule Boolean 1</i> for further descriptions of options 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 | |

| 13-44 Logic Rule Boolean 3 | | |
|----------------------------|---------------|--|
| Array [6] | | |
| Option: | Function: | |
| [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 | |
| [81] | Dry Pump | |
| [82] | End of Curve | |
| [83] | Broken Belt | |

4.10.6 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 <i>parameter 13-02 Stop Event</i> for further descriptions of options 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 | |

| 13-51 SL Controller Event | | |
|---------------------------|--------------------|--|
| Array [20] | | |
| Option: | Function: | |
| [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 | |
| [81] | Dry Pump | |
| [82] | End of Curve | |
| [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 <i>parameter 13-51 SL Controller Event</i>) 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 (<i>parameter 0-10 Active Set-up</i>) to set-up 1. |
| [3] | Select set-up 2 | Changes the active set-up (<i>parameter 0-10 Active Set-up</i>) to set-up 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 merges with other preset reference commands |

| 13-52 SL Controller Action | | |
|----------------------------|------------------------|---|
| Array [20] | | |
| Option: | Function: | |
| | | 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 <i>parameter 13-20 SL Controller Timer</i> for further description. |
| [30] | Start timer 1 | Starts timer 1, see <i>parameter 13-20 SL Controller Timer</i> for further description. |
| [31] | Start timer 2 | Starts timer 2, see <i>parameter 13-20 SL Controller Timer</i> for further description. |
| [32] | Set digital out A low | Any output with <i>digital output 1</i> selected is low (off). |
| [33] | Set digital out B low | Any output with <i>digital output 2</i> selected is low (off). |
| [34] | Set digital out C low | Any output with <i>digital output 3</i> selected is low (off). |
| [35] | Set digital out D low | Any output with <i>digital output 4</i> selected is low (off). |
| [38] | Set digital out A high | Any output with <i>digital output 1</i> selected is high (closed). |
| [39] | Set digital out B high | Any output with <i>digital output 2</i> selected is high (closed). |
| [40] | Set digital out C high | Any output with <i>digital output 3</i> selected is high (closed). |
| [41] | Set digital out D high | Any output with <i>digital output 4</i> selected is high (closed). |
| [60] | Reset Counter A | Resets counter A to 0. |
| [61] | Reset Counter B | Resets counter B to 0. |

| 13-52 SL Controller Action | | |
|----------------------------|---------------|---|
| Array [20] | | |
| Option: | Function: | |
| [70] | Start Timer 3 | Starts timer 3, see <i>parameter 13-20 SL Controller Timer</i> for further description. |
| [71] | Start Timer 4 | Starts timer 4, see <i>parameter 13-20 SL Controller Timer</i> for further description. |
| [72] | Start Timer 5 | Starts timer 5, see <i>parameter 13-20 SL Controller Timer</i> for further description. |
| [73] | Start Timer 6 | Starts timer 6, see <i>parameter 13-20 SL Controller Timer</i> for further description. |
| [74] | Start Timer 7 | Starts timer 7, see <i>parameter 13-20 SL Controller Timer</i> for further description. |

4.11 Main Menu - Special Functions - Group 14

4.11.1 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 runs, adjust the switching frequency in <i>parameter 14-01 Switching Frequency</i> until the motor is as quiet as possible. NOTICE High switching frequencies increase heat generation in the frequency converter and may reduce its lifetime. NOTICE Not all options 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] | 12.0 kHz | |
| [10] | 16.0 kHz | |

| 14-03 Overmodulation | | |
|----------------------|-----------|--|
| Option: | Function: | |
| [0] * | Off | Selects no overmodulation of the output voltage to avoid torque ripple on the motor shaft. |
| [1] | On | The overmodulation function generates an extra voltage of up to 8% of U_{max} output voltage without overmodulation. This extra voltage results in an extra torque of 10–12% in the middle of the oversynchronous range (from 0% at nominal speed, rising to approximately 12% at double nominal speed). |

| 14-07 Dead Time Compensation Level | | |
|------------------------------------|------------|--|
| Range: | Function: | |
| Size related* | [0 - 100] | Level of applied deadtime compensation in percentage. A high level (>90%) optimizes the dynamic motor response, a level of 50–90% is good for both motor-torque-ripple minimization and the motor dynamics, a 0 level turns off the deadtime compensation. |

| 14-08 Damping Gain Factor | | |
|---------------------------|-------------|--|
| Range: | Function: | |
| Size related* | [0 - 100 %] | Damping factor for DC-link voltage compensation. |

| 14-09 Dead Time Bias Current Level | | |
|------------------------------------|-------------|---|
| Range: | Function: | |
| Size related* | [0 - 100 %] | To add to the current-sense signal for dead time compensation for some motors, set a bias signal (in percentage). |

4.11.2 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 if mains voltage drops below the limit set in <i>parameter 14-11 Mains Voltage at Mains Fault</i> . |
| [0] * | No function | |
| [3] | Coasting | |

| 14-11 Mains Voltage at Mains Fault | | |
|------------------------------------|---------------|---|
| Range: | Function: | |
| Size related* | [100 - 800 V] | This parameter defines at which AC voltage the selected function in <i>parameter 14-10 Mains Failure</i> must be activated. |

| 14-12 Function at Mains Imbalance | | |
|-----------------------------------|-----------|---|
| Option: | Function: | |
| | | <p>NOTICE</p> <p>Selecting this option may reduce the life time of the frequency converter.</p> <p>Operation under severe mains imbalance conditions reduces the lifetime of the motor. If the motor is operated continuously near nominal load, conditions are considered severe. When a severe mains imbalance is detected, select 1 of the available functions.</p> |
| [0] * | Trip | Trips the frequency converter. |
| [1] | Warning | Issues a warning. |
| [2] | Disabled | No action. |

4.11.3 14-2* Trip Reset

| 14-20 Reset Mode | | |
|------------------|----------------------|---|
| Option: | Function: | |
| | | <p>NOTICE</p> <p>Automatic reset is also active for resetting the Safe Torque Off function.</p> <p>Select the reset function after tripping. Once reset, the frequency converter can be restarted.</p> |
| [0] * | Manual reset | Select [0] <i>Manual reset</i> , to perform a reset via [Reset] or via the digital inputs. |
| [1] | Automatic reset x 1 | Select [1]-[12] <i>Automatic reset x 1... x20</i> 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] <i>Infinite Automatic Reset</i> for continuous resetting after tripping. |

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

| 14-22 Operation Mode | | |
|----------------------|------------------|---|
| Option: | Function: | |
| | | To reset all parameter values to default, select [2] <i>initialization</i> . |
| [0] * | Normal operation | Select [0] <i>Normal operation</i> for normal operation of the frequency converter with the motor in the selected application. |
| [2] | Initialisation | Select [2] <i>initialization</i> to reset all parameter values to default settings, excluding bus communication parameters, parameter groups 15-0* <i>Operating Data</i> and 15-3* <i>Alarm Log</i> . The frequency converter is reset during the next power-up. <i>Parameter 14-22 Operation Mode</i> also reverts to the default setting [0] <i>Normal operation</i> . |

| 14-27 Action At Inverter Fault | | |
|--------------------------------|-----------|--|
| Option: | Function: | |
| [0] | Trip | |
| [1] * | Warning | |

| 14-28 Production Settings | | |
|---------------------------|----------------|--|
| Option: | Function: | |
| [0] * | No action | |
| [1] | Service reset | |
| [3] | Software Reset | |

| 14-29 Service Code | | |
|--------------------|-------------------|-------------------|
| Range: | Function: | |
| 0* | [0 - 0x7FFFFFFF] | Service use only. |

4.11.4 14-3* Current Limit Control

The frequency converter features an integral current limit controller which is activated when the motor current, and thus the torque, is higher than the torque limits set in *parameter 4-16 Torque Limit Motor Mode* and *parameter 4-17 Torque Limit Generator Mode*.

When the current limit is reached during motor operation or regenerative operation, the frequency converter tries to reduce torque below the preset torque limits as quickly as possible without losing control of the motor.

While the current control is active, the frequency converter can only be stopped by setting a digital input to [2] *Coast inverse* or [3] *Coast and reset inv*. Any signal on terminals 18

to 33 are not active until the frequency converter is no longer near the current limit.

By using a digital input set to [2] *Coast inverse* or [3] *Coast and reset inv.*, the motor does not use the ramp down time, since the frequency converter is coasted.

| 14-30 Current Lim Ctrl, Proportional Gain | | |
|---|-------------|--|
| Range: | | Function: |
| 100 %* | [0 - 500 %] | Enter the proportional gain value for the current limit controller. Selection of a high value makes the controller react faster. Too high a setting leads to controller instability. |

| 14-31 Current Lim Ctrl, Integration Time | | |
|--|---------------|---|
| Range: | | Function: |
| Size related* | [0.002 - 2 s] | Controls the current limit control integration time. Setting it to a lower value makes it react faster. A setting too low leads to control instability. |

| 14-32 Current Lim Ctrl, Filter Time | | |
|-------------------------------------|--------------|--|
| Range: | | Function: |
| Size related* | [1 - 100 ms] | Sets a time constant for the current limit controller low-pass filter. |

4.11.5 14-4* Energy Optimization

Parameters for adjusting the energy optimization level in both variable torque (VT) and automatic energy optimization (AEO) mode.

Automatic energy optimization 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 runs. Enter the level of motor magnetization at low speed. Selection of a low value reduces energy loss in the motor, but also reduces load capability. |

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

| 14-44 d-axis current optimization for IPM | | |
|---|-------------|--|
| Range: | | Function: |
| 100 %* | [0 - 200 %] | This parameter is available only when <i>parameter 1-10 Motor Construction</i> is set to [2] <i>PM, salient IPM, non-Sat.</i> Normally VVC+ PM control automatically optimizes d-axis demagnetizing current based on d-axis and q-axis settings. When <i>parameter 1-10 Motor Construction</i> is set to [2] <i>PM, salient IPM, non-Sat</i> , use this parameter to compensate the saturation effect at high load. Usually, decreasing this value improves the efficiency. However, 0% means no optimization and the d-axis current is zero (not recommended). |

4.11.6 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 | The overmodulation for output voltage is off to avoid torque ripple on the motor shaft. |
| [1] * | On | Enables the overmodulation for output voltage to obtain an output voltage up to 15% greater than the mains voltage. |

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

4.11.7 14-6* Auto Derate

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

| 14-61 Function at Inverter Overload | | |
|--|-----------|---|
| Is used if there is steady overload beyond the thermal limits (110% for 60 s). | | |
| Option: | Function: | |
| [0] * | Trip | The frequency converter trips and issues an alarm. |
| [1] | Derate | Reduces pump speed to decrease the load on the power section, allowing this to cool down. |

14-63 Min Switch Frequency

Set the minimum switching 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] | 12.0 kHz | |
| [10] | 16.0 kHz | |

14-64 Dead Time Compensation Zero Current Level

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

Option: **Function:**

| | | |
|-------|----------|--|
| [0] * | Disabled | |
| [1] | Enabled | |

14-65 Speed Derate Dead Time Compensation

Range: **Function:**

| | | |
|---------------|-----------------|--|
| Size related* | [20 - 1000 Hz] | Deadtime compensation level is reduced linearly in relation to output frequency. <i>Parameter 14-07 Dead Time Compensation Level</i> sets the maximum level. The minimum output frequency level is defined in <i>parameter 14-65 Speed Derate Dead Time Compensation</i> . |
|---------------|-----------------|--|

4.11.8 14-8* Options

14-89 Option Detection

Selects the behavior when an option change is detected. This parameter returns to [0] *Protect Option Config.* after an option change.

Option: **Function:**

| | | |
|-------|------------------------|--|
| [0] * | Protect Option Config. | Freezes the current settings and prevents unwanted changes when missing or defective options are detected. |
| [1] | Enable Option Change | Settings can be changed when the system configuration is being modified. |

4.11.9 14-9* Fault Settings

Fault customization settings

14-90 Fault Level

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

Option: **Function:**

| | | |
|-------|-------------------------|--|
| [3] * | Trip lock | |
| [4] | Trip with delayed reset | |
| [5] | Flystart | |

4.12 Main Menu - Drive Information - Group 15

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

4.12.1 15-0* Operating Data

| 15-00 Operating hours | | |
|-------------------------|---|--|
| Range: | Function: | |
| 0 h* [0 - 0x7ffffff. 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 - 0x7ffffff. h] | View how many hours the motor has run. Reset the counter in <i>parameter 15-07 Reset Running Hours Counter</i> . The value is saved when the frequency converter is turned off. | |

| 15-02 kWh Counter | | |
|-----------------------------|--|--|
| Range: | Function: | |
| 0 kWh* [0 - 2147483647 kWh] | View the output power of the frequency converter in kWh as an average value over 1 hour. Reset the counter in <i>parameter 15-06 Reset kWh Counter</i> . | |

| 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 that have occurred. | |

| 15-05 Over Volt's | | |
|-------------------|---|--|
| Range: | Function: | |
| 0* [0 - 65535] | View the number of frequency converter overvoltages that have occurred. | |

| 15-06 Reset kWh Counter | | |
|-------------------------|---|--|
| Option: | Function: | |
| | NOTICE To reset, press [OK] . | |
| [0] * | Do not reset | |

| 15-06 Reset kWh Counter | | |
|-------------------------|---------------|--|
| Option: | Function: | |
| [1] | Reset counter | To reset the kWh counter to 0, select [1] <i>Reset</i> and press [OK] (see <i>parameter 15-02 kWh Counter</i>). |

| 15-07 Reset Running Hours Counter | | |
|-----------------------------------|---------------|---|
| Option: | Function: | |
| [0] * | Do not reset | |
| [1] | Reset counter | To reset the running hours counter to 0, select [1] <i>Reset</i> and press [OK] (see <i>parameter 15-01 Running Hours</i>). This parameter cannot be selected via the serial port, RS485. Select [0] <i>Do not reset</i> if no reset of the running-hours counter is required. |

4.12.2 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. Fault 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 fault code and look up its meaning in <i>chapter 5 Diagnostics and Troubleshooting</i> . | |

| 15-31 InternalFaultReason | | |
|---------------------------|--|--|
| Range: | Function: | |
| 0* [-32767 - 32767] | View a description of the error. This parameter is used with <i>alarm 38, Internal fault</i> . | |

4.12.3 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 - 6] | View the FC type code. The readout 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 - 20] | View the FC type code. The readout is identical to the frequency converter series power field of the type code definition, characters 7-10. | |

| 15-42 Voltage | | |
|---------------|-----------|--|
| Range: | Function: | |
| 0* | [0 - 20] | View the FC type code. The readout 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 - 40] | View the type code string used for reordering the frequency converter in its original configuration. |

| 15-45 Actual Typecode String | | |
|------------------------------|-----------|-----------------------------------|
| Range: | Function: | |
| 0* | [0 - 40] | View the actual type code string. |

| 15-46 Drive Ordering No | | |
|-------------------------|-----------|---|
| Range: | Function: | |
| 0* | [0 - 8] | View the 8-digit ordering number used for reordering 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 - 10] | View the frequency converter serial number. |

| 15-52 OEM Information | | |
|-----------------------|-----------|--|
| Range: | Function: | |
| 0* | [0 - 0] | View the OEM Information. The information is set in set-up software MCT 21. [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. The file version is set in set-up software MCT21. [0] OEM-SIVP File Version [1] Motor Database File Version [2] Pump Table File Version |

| 15-59 Filename | | |
|----------------|-----------|------------------------|
| Range: | Function: | |
| 0* | [0 - 16] | CSIV Filename readout. |

4.12.4 15-6* Option Ident.

This read-only parameter group contains information about the hardware and software configuration of the options installed in slots A, B, C0, and C1.

| 15-60 Option Mounted | | |
|----------------------|-----------|---------------------------------|
| Array [8] | | |
| Range: | Function: | |
| Size related* | [0 - 30] | View the installed option type. |

| 15-61 Option SW Version | | |
|-------------------------|-----------|---|
| Array [8] | | |
| Range: | Function: | |
| Size related* | [0 - 20] | View the installed option software version. |

| 15-62 Option Ordering No | | |
|--------------------------|-----------|--|
| Range: | Function: | |
| Size related* | [0 - 8] | Shows the ordering number for the installed options. |

| 15-63 Option Serial No | | |
|------------------------|-----------|--|
| Range: | Function: | |
| Size related* | [0 - 18] | View the installed option serial number. |

| 15-70 Option in Slot A | | |
|------------------------|-----------|--|
| Range: | Function: | |
| 0* | [0 - 30] | View the type code string for the option installed in slot A, and a translation of the type code string. For example, for type code string AX, the translation is No option. |

| 15-71 Slot A Option SW Version | | |
|--------------------------------|-----------|---|
| Range: | Function: | |
| 0* | [0 - 20] | View the software version for the option installed in slot A. |

| 15-92 Defined Parameters | | |
|--------------------------|-------------|---|
| Range: | | Function: |
| 0* | [0 - 2000] | View a list of all defined parameters in the frequency converter. The list ends with 0. |

| 15-97 Application Type | | |
|------------------------|-------------------|---|
| Range: | | Function: |
| 0* | [0 - 0xFFFFFFFF] | This parameter contains data used for the MCT 10 Set-up Software. |

| 15-98 Drive Identification | | |
|----------------------------|-----------|---|
| Range: | | Function: |
| 0* | [0 - 56] | This parameter contains data used for the MCT 10 Set-up Software. |

4.13 Main Menu - Data Readouts - Group 16

4.13.1 16-0* General Status

4

| 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 | Bit=0 | Bit=1 |
|-----|--|-------------------|
| 00 | Preset reference option lsb | – |
| 01 | Preset reference option 2 nd 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 set-up lsb | – |
| 14 | No function | No function |
| 15 | No function | Reversing |

Table 4.8 Control Word

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

| 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 | 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 4.9 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 <i>parameter 0-30 Custom Readout Unit, parameter 0-31 Custom Readout Min Value, and parameter 0-32 Custom Readout Max Value</i> . |

4.13.2 16-1* Motor Status

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

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

| 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 damping. |

| 16-14 Motor current | | |
|---------------------|----------------|---|
| Range: | Function: | |
| 0 A* | [0 - 655.35 A] | View the motor current measured as an average value, I _{RMS} . |

| 16-15 Frequency [%] | | |
|---------------------|----------------|---|
| Range: | Function: | |
| 0 %* | [0 - 6553.5 %] | View a 2-byte word reporting the actual motor frequency (without resonance damping) as a percentage (scale 0000–4000 hex) of <i>parameter 4-19 Max Output Frequency</i> . |

| 16-16 Torque [Nm] | | |
|-------------------|-------------------|--|
| Range: | Function: | |
| 0 Nm* | [-3000 - 3000 Nm] | View the torque value with sign, applied to the motor shaft. Linearity is not exact between 160% motor current and torque in relation to the rated torque. Some motors supply more than 160% torque. Therefore, the minimum value and the maximum value depend on the maximum motor current and the motor used. The value is filtered, and thus approximately 30 ms may pass from when an input changes value to when the data readout values change. In flux control principle, this readout is compensated for in <i>parameter 1-68 Motor Inertia</i> for improved accuracy. |

| 16-18 Motor Thermal | | |
|---------------------|-------------|--|
| Range: | Function: | |
| 0 %* | [0 - 100 %] | View the calculated motor temperature in percentage of allowed maximum. At 100%, a trip occurs, if selected in <i>parameter 1-90 Motor Thermal Protection</i> . The basis for the calculation is the ETR function selected in <i>parameter 1-90 Motor Thermal Protection</i> . |

4.13.3 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] | | |
|---------------------------|---------------|---|
| Range: | Function: | |
| 0 kW* | [0 - 1000 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 between the input value change and the data readout value change. |

| 16-27 Power Filtered [hp] | | |
|---------------------------|---------------|--|
| Range: | Function: | |
| 0 hp* | [0 - 1000 hp] | Motor power in hp. The value shown is calculated based on real-time motor voltage and motor current. The value is filtered, and a few seconds may pass between the input value change and the data readout value change. |

4.13.4 16-3* Drive Status

| 16-30 DC Link Voltage | | |
|-----------------------|---------------|-----------------------------------|
| Range: | Function: | |
| 0 V* | [0 - 65535 V] | Shows the actual DC-link voltage. |

| 16-34 Heatsink Temp. | | |
|----------------------|-----------------|--|
| Range: | Function: | |
| 0 °C* | [-128 - 127 °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. The data is used for motor overload protection, and so on. |

| 16-37 Inv. Max. Current | | |
|-------------------------|----------------|---|
| Range: | Function: | |
| 0 A* | [0 - 655.35 A] | View the inverter maximum current. The data is used for calculation of frequency converter protection, and so on. |

| 16-38 SL Controller State | | |
|---------------------------|-----------|--|
| Range: | Function: | |
| 0* | [0 - 20] | View the actual state of the smart logic controller (SLC). |

| 16-39 Control Card Temp. | | |
|--------------------------|----------------|---|
| Range: | Function: | |
| 0 °C* | [0 - 65535 °C] | View the temperature on the control card, stated in °C. |

4.13.5 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 <i>parameter 3-02 Minimum Reference</i> and <i>parameter 3-03 Maximum Reference</i> . |

4.13.6 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 terminal 29 |
| | Bit 3 | Digital input terminal 27 |
| | Bit 4 | Digital input terminal 19 |
| | Bit 5 | Digital input terminal 18 |
| | Bit 6-15 | Unused |
| Table 4.10 Bits Definition | | |

| 16-61 Terminal 53 Setting | | |
|---------------------------|--------------|---|
| Option: | Function: | |
| | | View the setting of input terminal 53. <ul style="list-style-type: none"> 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 | | |
|---|--------------|--|
| View the setting of input terminal 54. <ul style="list-style-type: none"> Current=0 Voltage=1 | | |
| Option: | Function: | |
| [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 <i>parameter 6-90 Terminal 42 Mode</i> and <i>parameter 6-91 Terminal 42 Analog Output</i> . |

| 16-66 Digital Output | | | | | | | | | | | | | | | | | | | | |
|----------------------|---|---|----|-----------|----|--|----|---|----|--|---|-----------------------------------|---|------------------------------------|----|---|----|------------------------------------|----|-------------------------------------|
| Range: | Function: | | | | | | | | | | | | | | | | | | | |
| 0* | [0 - 15] | View the binary value of all digital outputs. <p>Definition: X: Not used 0: Low 1: High</p> <table border="1"> <thead> <tr> <th>XX</th> <th>None used</th> </tr> </thead> <tbody> <tr> <td>X0</td> <td>Terminal 42 not used, terminal 45 low.</td> </tr> <tr> <td>X1</td> <td>Terminal 42 not used, terminal 45 high.</td> </tr> <tr> <td>0X</td> <td>Terminal 42 low, terminal 45 not used.</td> </tr> <tr> <td>0</td> <td>Terminal 42 low, terminal 45 low.</td> </tr> <tr> <td>1</td> <td>Terminal 42 low, terminal 45 high.</td> </tr> <tr> <td>1X</td> <td>Terminal 42 high, terminal 45 not used.</td> </tr> <tr> <td>10</td> <td>Terminal 42 high, terminal 45 low.</td> </tr> <tr> <td>11</td> <td>Terminal 42 high, terminal 45 high.</td> </tr> </tbody> </table> <p style="text-align: center;">Table 4.11 Binary Value of Digital Outputs</p> | 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. |
| 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. | | | | | | | | | | | | | | | | | | | |

| 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 4.12 Relay Setting | | |

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

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

| 16-79 Analog Output AO45 | | |
|--------------------------|--|--|
| Range: | Function: | |
| 0 mA* [0 - 20 mA] | View the actual value at output 45 in mA. The value shown reflects the selection in <i>parameter 6-70 Terminal 45 Mode</i> and <i>parameter 6-71 Terminal 45 Analog Output</i> . | |

4.13.7 16-8* Fieldbus & FC Port

Parameters for reporting the bus references and control words.

| 16-80 Fieldbus CTW 1 | | |
|----------------------|---|--|
| Range: | Function: | |
| 0* [0 - 65535] | View the 2-byte control word (CTW) received from the bus master. Interpretation of the CTW depends on the fieldbus option installed and the CTW profile selected in <i>parameter 8-10 Control Word Profile</i> . For more information, see relevant fieldbus manuals. | |

| 16-82 Fieldbus REF 1 | | |
|----------------------|---|--|
| Range: | Function: | |
| 0* [-32768 - 32767] | To set the reference value, view the 2-byte word sent with the control word from the bus master. For more information, refer to the relevant fieldbus manual. | |

| 16-84 Comm. Option STW | | |
|------------------------|---|--|
| Range: | Function: | |
| 0* [0 - 65535] | View the extended fieldbus communication option status word. For more information, refer to the relevant fieldbus manual. | |

| 16-85 FC Port CTW 1 | | |
|---------------------|--|--|
| Range: | Function: | |
| 1084* [0 - 65535] | View the 2-byte control word (CTW) received from the bus master. Interpretation of the control word depends on the fieldbus option installed and the control word profile selected in <i>parameter 8-10 Control Word Profile</i> . | |

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

4.13.8 16-9* Diagnosis Read-Outs

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

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

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

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

4

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

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

| 16-97 Alarm Word 3 | | |
|--------------------|---------------------|---|
| Range: | Function: | |
| 0* | [0 - 0xFFFFFFFFUL] | View the alarm word 3 sent via the serial communication port in hex code. |

4.14 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] is the oldest. Fault codes, values, and time stamp can be viewed for all logged data.

4.14.1 18-1* Fire Mode Log

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

4.14.2 18-5* Ref. & Feedb.

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

| 18-51 Memory Module Warning Reason | | |
|------------------------------------|---------------------|--|
| Range: | | Function: |
| 0* | [0 - 0xFFFFFFFFUL] | View the reason for the memory module warning. |

| 18-52 Memory Module ID | | |
|------------------------|----------|--|
| Range: | | Function: |
| 0* | [0 - 0] | View the ID number of the memory module. |

| 18-53 Memory Module Function | | |
|------------------------------|----------|--|
| Option: | | Function: |
| | | Disable or enable the memory module function. |
| [0] | Disabled | No data transferring between the memory module and frequency converter. The frequency converter cannot use the dongle file in the memory module. |
| [1] * | Enabled | The memory module function is enabled. |

4.15 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.

4.15.1 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] <i>Linear</i> has no effect on the feedback. |
| [1] | Square root | [1] <i>Square root</i> is commonly used when a pressure sensor is used to provide flow feedback $((flow \propto \sqrt{pressure}))$. |

| 20-12 Reference/Feedback Unit | | |
|-------------------------------|-----------|---|
| Option: | Function: | |
| [0] | None | See parameter 20-02 Feedback 1 Source Unit for details. |

4.15.2 20-2* Feedback/Setpoint

This parameter group is used to determine how the PID controller uses the 3 possible feedback signals to control the output frequency of the frequency converter. This group is also used to store the 3 internal setpoint references.

| 20-21 Setpoint 1 | | |
|-----------------------|---|--|
| Range: | Function: | |
| 0 ProcessCtrlUnit* | [-999999.999 - 999999.999 ProcessCtrlUnit] | Setpoint 1 is used in closed-loop mode to enter a setpoint reference that is used by the frequency converter's PID controller. See the description |

| 20-21 Setpoint 1 | | |
|------------------|-----------|--|
| Range: | Function: | |
| | | of parameter 20-20 Feedback Function. NOTICE The setpoint reference entered here is added to any other references that are enabled (see parameter group 3-1* References). |

4.15.3 20-6* Sensorless

| 20-60 Sensorless Unit | | |
|--|-----------|--|
| Select the unit to be used with parameter 18-50 Sensorless Readout [unit]. | | |
| Option: | Function: | |
| [0] | None | |
| [20] | l/s | |

| 20-69 Sensorless Information | | |
|------------------------------|-----------|---|
| Range: | Function: | |
| 0* | [0 - 25] | View information about the sensorless data. |

4.15.4 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 output frequency to decrease when the feedback is greater than the setpoint reference. This behavior is common for pressure-controlled supply fan and pump applications. |
| [1] | Inverse | Causes the frequency converter output frequency to increase when the feedback is greater than the setpoint reference. This behavior 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. After 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 <i>Run on Reference</i> . This status can be communicated externally by programming the function of a digital output for [8] <i>Run on Reference/No Warning</i> . In addition, for serial communications, the <i>On Reference</i> status bit of the frequency converter status word is high (value=1). The <i>On Reference Bandwidth</i> is calculated as a percentage of the setpoint reference. |

4.15.5 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 %] | Enter the PI feed forward factor. The FF factor sends a constant fraction of the reference signal to bypass PI control. Therefore, the PI can affect only the remaining fraction of the control signal. The FF factor can increase dynamic performance. |

4.16 Main Menu - Application Functions - Group 22

| 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. |

| 22-02 Sleepmode CL Control Mode | | |
|---------------------------------|------------|--|
| Option: | Function: | |
| [0] * | Normal | The feedback is detected. Some parameters are checked. |
| [1] | Simplified | The feedback is not detected. Only sleep speed and time are checked. |

This parameter is for sleep mode running in process close loop mode. Use this parameter to configure whether to detect the feedback for sleep mode.

4

4.16.1 22-2* No-Flow Detection

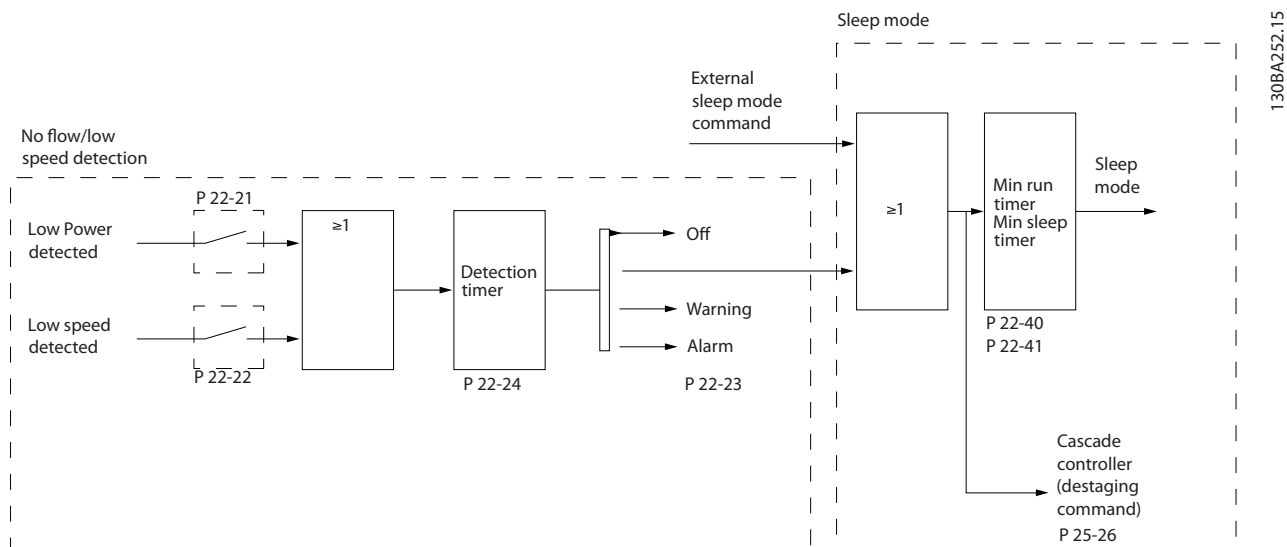


Illustration 4.19 No-flow Detection

The frequency converter includes functions for detecting if the load conditions in the system allow the motor to be stopped:

- Low power detection.
- Low speed detection.

One of these 2 signals must be active for a set time (*parameter 22-24 No-Flow Delay*) before selected action takes place. Possible actions to select (*parameter 22-23 No-Flow Function*):

- No action
- Warning
- Alarm
- Sleep mode

No-flow detection

This function is used for detecting a no-flow situation in pump systems where all valves can be closed. Can be used both when controlled by the integrated PI controller in the frequency converter or an external PI controller. Program the actual configuration in *parameter 1-00 Configuration Mode*.

Configuration mode for

- Integrated PI controller: Closed loop.
- External PI controller: Open loop.

NOTICE

Carry out no-flow tuning before setting the PI controller parameters.

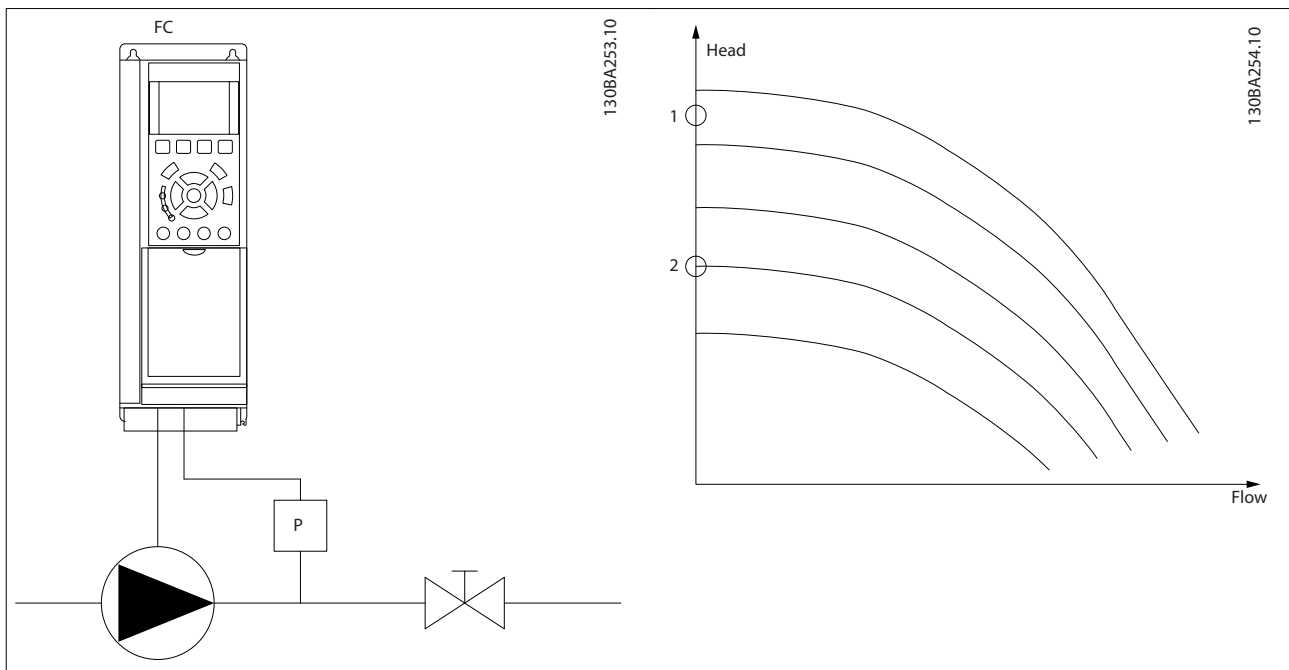


Table 4.13 No-flow Detection

No-flow detection is based on the measurement of speed and power. For a certain speed, the frequency converter calculates the power at no-flow.

This coherence is based on the adjustment of 2 sets of speed and associated power at no-flow. Monitoring power enables detection of no-flow conditions in systems with fluctuating suction pressure, or of the pump having a flat characteristic towards low speed.

The 2 sets of data must be based on measurement of power at approximately 50% and 85% of maximum speed with the valves closed. The data is programmed in parameter group 22-3* No-Flow Power Tuning. It is also possible to run a [0] Low Power Auto Set Up (*parameter 22-20 Low Power Auto Set-up*) automatically stepping through the commissioning process and storing the data measured. Set the frequency converter for [0] Open Loop in *parameter 1-00 Configuration Mode*, when carrying out the auto set-up, see *parameter group 22-3* No-Flow Power Tuning No-flow Power Tuning*.

NOTICE

If to use the integrated PI controller, carry out no-flow tuning before setting the PI controller parameters.

Low-speed detection

Low-speed detection gives a signal if the motor operates with minimum speed as set in *parameter 4-11 Motor Speed Low Limit [RPM]* or *parameter 4-12 Motor Speed Low Limit [Hz]*. Actions are common with no-flow detection (individual selection not possible).

The use of low-speed detection is not limited to systems with a no-flow situation. Low-speed detection can be used in any system where operation at minimum speed allows a stop of the motor until the load calls for a speed higher than minimum speed. This could, for example, be in systems with fans and compressors.

NOTICE

In pump systems, ensure that the minimum speed in *parameter 4-11 Motor Speed Low Limit [RPM]* or *parameter 4-12 Motor Speed Low Limit [Hz]* is set high enough for detection as the pump can run with a rather high speed even with valves closed.

Dry-pump detection

If the pump has run dry (low power consumption-high speed), no-flow detection can also be used for detecting. Can be used with both the integrated PI controller and an external PI controller.

The condition for dry-pump signal:

- Power consumption below no-flow level.

and

- Pump running at maximum speed or maximum reference open loop, whichever is lowest.

The signal must be active for a set time (*parameter 22-27 Dry Pump Delay*) before the selected action takes place.

Possible actions to select (*parameter 22-26 Dry Pump Function*):

- Warning
- Alarm

Enable and commission no-flow detection in *parameter 22-23 No-Flow Function* and parameter group 22-3* *No-Flow Power Tuning*.

4

| 22-26 Dry Pump Function | | |
|---|---|--|
| Select the action for dry-pump operation. | | |
| Option: | Function: | |
| [0] Off | NOTICE To use dry-pump detection: | |
| * | <ol style="list-style-type: none"> 1. Enable low-power detection in <i>parameter 22-21 Low Power Detection</i>. 2. Commission low-power detection using parameter group 22-3* <i>No-flow Power Tuning No-flow Power Tuning</i>. | |
| | NOTICE Do not set <i>parameter 14-20 Reset Mode</i> to [13] <i>Infinite auto reset</i> , when <i>parameter 22-26 Dry Pump Function</i> is set to [2] <i>Alarm</i> . Doing so causes the frequency converter to continuously cycle between running and stopping when a dry-pump condition is detected. | |

| 22-26 Dry Pump Function | | |
|---|--|---|
| Select the action for dry-pump operation. | | |
| Option: | Function: | |
| | NOTICE For frequency converters with constant-speed bypass. If an automatic bypass function starts the bypass at persistent alarm conditions, disable the automatic bypass function, if [2] <i>Alarm</i> or [3] <i>Man. Reset Alarm</i> is selected as the dry-pump function. | |
| | The frequency converter continues to run, but activates a dry-pump warning (<i>Warning 93, Dry pump</i>). A frequency converter digital output or a serial communication bus can communicate a warning to other equipment. | |
| [1] | Warning | |
| [2] | Alarm | The frequency converter stops running and activates a dry-pump alarm (<i>Alarm 93, Dry pump</i>). A frequency converter digital output or a serial communication bus can communicate an alarm to other equipment. |
| [3] | Man. Reset Alarm | The frequency converter stops running and activates a dry-pump alarm (<i>Alarm 93, Dry pump</i>). A frequency converter digital output or a serial communication bus can communicate an alarm to other equipment. |

| 22-27 Dry Pump Delay | | |
|----------------------|--|--|
| Range: | Function: | |
| 10 s* [0 - 600 s] | Defines for how long the dry-pump condition must be active before activating a warning or an alarm. The frequency converter waits for the no-flow delay time (<i>parameter 22-24 No-Flow Delay</i>) to expire before the timer for the dry-pump delay starts. | |

4.16.2 22-3* No-flow Power Tuning

If auto set-up is disabled in *parameter 22-20 Low Power Auto Set-up*, the tuning sequence is:

1. Close the main valve to stop flow.
2. Run with motor until the system has reached normal operating temperature.
3. Press [Hand On] and adjust speed for approximately 85% of rated speed. Note the exact speed.
4. Read power consumption either by looking for actual power in the data line in the LCP or by viewing 1 of the following parameters:
 - 4a *Parameter 16-10 Power [kW]*.
or
 - 4b *Parameter 16-11 Power [hp]* in the Main Menu.

Note the power readout.

5. Change speed to approximately 50% of rated speed. Note the exact speed.
6. Read power consumption either by looking for actual power in the data line in the LCP or by viewing 1 of the following parameters:
 - 6a *Parameter 16-10 Power [kW]*.
or
 - 6b *Parameter 16-11 Power [hp]* in the Main Menu.

Note the power readout.

7. Program the speeds used in:
 - 7a *Parameter 22-32 Low Speed [RPM]*.
 - 7b *Parameter 22-33 Low Speed [Hz]*.
 - 7c *Parameter 22-36 High Speed [RPM]*.
 - 7d *Parameter 22-37 High Speed [Hz]*.
8. Program the associated power values in:
 - 8a *Parameter 22-34 Low Speed Power [kW]*.
 - 8b *Parameter 22-35 Low Speed Power [HP]*.
 - 8c *Parameter 22-38 High Speed Power [kW]*.

8d *Parameter 22-39 High Speed Power [HP]*.

9. Switch back with [Auto On] or [Off].

NOTICE

Set *parameter 1-03 Torque Characteristics* before tuning takes place.

| 22-38 High Speed Power [kW] | | |
|--------------------------------|---|--|
| Range: | Function: | |
| Size related* [0 - 5.50 kW] | To be used, if <i>parameter 0-03 Regional Settings</i> is set for [0] <i>International</i> (parameter not visible if [1] <i>North America</i> is selected). Set power consumption at 85% speed level. This function is used for storing values necessary to tune no-flow detection. | |

4.16.3 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. This function saves energy, and keeps the system from being over-satisfied (excessive pressure, water excessively cooled in cooling towers, building pressurization 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 within the acceptable range.

The sequence when running sleep mode in open loop:

1. The motor speed is less than the speed set in *parameter 22-47 Sleep Speed [Hz]*. The motor runs longer than the time duration set in *parameter 22-40 Minimum Run Time*. The sleep condition lasts longer than the time set in *parameter 22-48 Sleep Delay 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 a wake-up situation.

5. The speed setpoint is greater than *parameter 22-43 Wake-Up Speed [Hz]*. The sleep condition has lasted longer than the time set in *parameter 22-41 Minimum Sleep Time*. The wake-up condition lasts longer than the time set in *parameter 22-49 Wake-Up Delay 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. The frequency converter goes into boost status if the following conditions are met.
 - If *parameter 22-02 Sleepmode CL Control Mode* is set to [0] *Normal*:
 - The motor speed is less than the value in *parameter 22-47 Sleep Speed [Hz]*.
 - The feedback is above the reference.
 - The motor runs longer than the time in *parameter 22-40 Minimum Run Time*.
 - The sleep condition lasts longer than the time in *parameter 22-48 Sleep Delay Time*.
 - If *parameter 22-02 Sleepmode CL Control Mode* is set to [1] *Simplified*:
 - The motor speed is less than the value in *parameter 22-47 Sleep Speed [Hz]*.
 - The motor runs longer than the time in *parameter 22-40 Minimum Run Time*.
 - The sleep condition lasts longer than the time in *parameter 22-48 Sleep Delay Time*.

If *parameter 22-45 Setpoint Boost* is not set, the frequency converter goes into sleep mode.
2. After the time in *parameter 22-46 Maximum Boost Time* has passed, the frequency converter ramps down the motor speed to the speed in *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 is out of sleep mode:
 - 4a When the error between the reference and the feedback is greater than *parameter 22-44 Wake-Up Ref./FB Diff*, and
 - 4b the sleep time is longer than the time in *parameter 22-41 Minimum Sleep Time*, and
 - 4c the wake-up condition lasts longer than the time set in *parameter 22-48 Sleep Delay Time*.
5. The frequency converter goes back to closed-loop control.

NOTICE

Sleep mode is not active when local reference is active (set speed manually using the navigation keys on the LCP).

Sleep mode does not work in local mode. Perform an auto set-up in open loop before setting input/output in closed loop.

| 22-40 Minimum Run Time | | |
|------------------------|-------------|--|
| Range: | Function: | |
| 10 s* | [0 - 600 s] | Set the wanted 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 minimum time for staying in sleep mode. This time overrides any wake-up conditions. |

| 22-43 Wake-Up Speed [Hz] | | |
|--------------------------|--------------|---|
| Range: | Function: | |
| 10* | [0 - 400.0] | Only to be used if <i>parameter 1-00 Configuration Mode</i> , is set for open loop and an external controller applies speed reference. Set the reference speed at which the sleep mode should be deactivated. |

| 22-44 Wake-Up Ref./FB Diff | | |
|----------------------------|-------------|---|
| Range: | Function: | |
| 10 %* | [0 - 100 %] | Only to be used if <i>parameter 1-00 Configuration Mode</i> is set for closed loop and the integrated PI controller is used for controlling the pressure. Set the pressure drop allowed in percentage of setpoint for the pressure (P _{set}) before canceling the sleep mode. |

| 22-45 Setpoint Boost | | |
|----------------------|----------------|--|
| Range: | | Function: |
| 0 % * | [-100 - 100 %] | Only to be used if <i>parameter 1-00 Configuration Mode</i> is set for closed loop and the integrated PI controller is used. In systems with for example constant pressure control, it is advantageous to increase the system pressure before the motor is stopped. This increase extends the time the motor is stopped and helps to avoid frequent start/stop. Set the required overpressure/overtemperature in percentage of setpoint for the pressure (P_{set})/temperature before entering the sleep mode. If setting for 5%, the boost pressure is $P_{set} \times 1.05$. The negative values can be used for cooling tower control where a negative change is needed. |

| 22-46 Maximum Boost Time | | |
|--------------------------|-------------|---|
| Range: | | Function: |
| 60 s* | [0 - 600 s] | Only to be used if <i>parameter 1-00 Configuration Mode</i> is set for [3] <i>Closed loop</i> 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, the frequency converter enters the sleep mode without 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. |

| 22-48 Sleep Delay Time | | |
|------------------------|--------------|--|
| Range: | | Function: |
| 0 s | [0 - 3600 s] | Set the delay time that the motor waits before entering sleep mode when the condition to entering sleep mode is met. |

| 22-49 Wake-Up Delay Time | | |
|--------------------------|--------------|---|
| Range: | | Function: |
| 0 s | [0 - 3600 s] | Set the delay time that the motor waits before waking up from sleep mode when the condition for wake-up is met. |

4.16.4 22-5* End of Curve

The end-of-curve conditions occur when a pump is yielding a too large volume to ensure the set pressure. This situation can occur if there is a leakage in the distribution pipe system after the pump causing the pump to operate at the end of the pump characteristic, valid for the maximum speed set in *parameter 4-13 Motor Speed High Limit [RPM]* or *parameter 4-14 Motor Speed High Limit [Hz]*. If the feedback is 2.5% of the programmed value in *parameter 20-14 Maximum Reference/Feedb.* (or numerical value of *parameter 20-13 Minimum Reference/Feedb.*

whichever is highest) below the setpoint for the required pressure for a set time (*parameter 22-51 End of Curve Delay*), and the pump runs with maximum speed set in *parameter 4-13 Motor Speed High Limit [RPM]* or *parameter 4-14 Motor Speed High Limit [Hz]*, the function selected in *parameter 22-50 End of Curve Function* takes place.

It is possible to get a signal on 1 of the digital outputs by selecting [192] *End of Curve* in parameter group 5-3* *Digital Outputs* and/or parameter group 5-4* *Relays*. The signal is present, when an end-of-curve condition occurs and the selection in *parameter 22-50 End of Curve Function* is different from [0] *Off*. The end-of-curve function can only be used when operating with the built-in PID controller ([3] *Closed loop* in *parameter 1-00 Configuration Mode*).

| 22-50 End of Curve Function | | |
|-----------------------------|-----------|---|
| Option: | Function: | |
| | | <p>NOTICE</p> <p>Automatic restart resets the alarm and restarts the system.</p> <p>NOTICE</p> <p>Do not set <i>parameter 14-20 Reset Mode</i>, to [13] <i>Infinite auto reset</i>, when <i>parameter 22-50 End of Curve Function</i> is set to [2] <i>Alarm</i>. Doing so causes the frequency converter to continuously cycle between running and stopping when an end-of-curve condition is detected.</p> <p>NOTICE</p> <p>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, disable the automatic bypass function if [2] <i>Alarm</i> or [3] <i>Man. Reset Alarm</i> is selected as the end-of-curve function.</p> |
| [0] * | Off | End-of-curve monitoring is not active. |
| [1] | Warning | The frequency converter continues to run, but activates an end-of-curve warning (<i>Warning 94, End of curve</i>). A frequency converter digital output or a serial communication bus can communicate a warning to other equipment. |
| [2] | Alarm | The frequency converter stops running and activates an end-of-curve alarm (<i>Alarm 94, End of curve</i>). A frequency converter digital output or a serial communication bus can communicate an alarm to other equipment. |

| 22-50 End of Curve Function | | |
|-----------------------------|--|--|
| Option: | Function: | |
| [3] Man. Reset Alarm | The frequency converter stops running and activates an end-of-curve alarm (<i>Alarm 94, End of curve</i>). A frequency converter digital output or a fieldbus can communicate an alarm to other equipment. | |

| 22-51 End of Curve Delay | | |
|--------------------------|--|--|
| Range: | Function: | |
| 10 s* [0 - 600 s] | When an end-of-curve condition is detected, a timer is activated. When the time set in this parameter expires, and the end-of-curve condition is steady during the entire period, the function set in <i>parameter 22-50 End of Curve Function</i> is activated. If the condition disappears before the timer expires, the timer is reset. | |

4.16.5 22-6* Broken Belt Detection

Use broken-belt detection in both closed-loop 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 activates a broken-belt warning <i>Warning 95, Broken Belt</i> . 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 activates a broken-belt alarm <i>Alarm 95, Broken Belt</i> . A frequency converter digital output or a serial communication bus can communicate an alarm to other equipment. | |

⚠ WARNING

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 automatic bypass function is enabled, the bypass starts when the frequency converter experiences a persistent alarm condition. In this case, disable the 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 <i>parameter 22-60 Broken Belt Function</i> . | |

4.16.6 22-8* Flow Compensation

In certain applications, it is not possible for a pressure transducer to be placed at a remote point in the system, and it can only be located close to the fan/pump outlet. Flow compensation operates by adjusting the setpoint according to the output frequency, which is almost proportional to flow. Thus, it compensates for higher losses at higher flow rates.

H_{DESIGN} (required pressure) is the setpoint for closed-loop (PI) operation of the frequency converter and is set as for closed-loop operation without flow compensation.

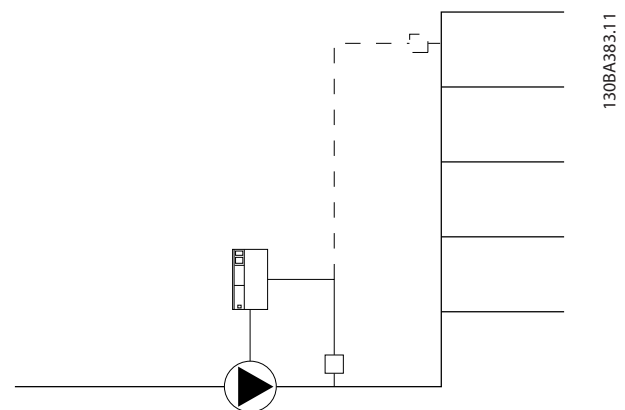


Illustration 4.20 Flow Compensation Set-up

There are 2 methods which can be employed, depending on whether the speed at system design working point is known.

| Parameter used | Speed at design point KNOWN | Speed at design point UNKNOWN |
|--|-----------------------------|-------------------------------|
| Parameter 22-80 Flow Compensation | + | + |
| Parameter 22-81 Square-linear Curve Approximation | + | + |
| Parameter 22-82 Work Point Calculation | + | + |
| Parameter 22-83 Speed at No-Flow [RPM]/parameter 22-84 Speed at No-Flow [Hz] | + | + |
| Parameter 22-85 Speed at Design Point [RPM]/parameter 22-86 Speed at Design Point [Hz] | + | - |
| Parameter 22-87 Pressure at No-Flow Speed | + | + |
| Parameter 22-88 Pressure at Rated Speed | - | + |
| Parameter 22-89 Flow at Design Point | - | + |
| Parameter 22-90 Flow at Rated Speed | - | + |

Table 4.14 Speed at Design Point Known/Unknown

| 22-80 Flow Compensation | | |
|-------------------------|-----------|--|
| Option: | Function: | |
| [0] * | Disabled | Setpoint compensation not active. |
| [1] | Enabled | Setpoint compensation is active. Enabling this parameter allows the flow-compensated setpoint operation. |

| 22-81 Square-linear Curve Approximation | | |
|---|-------------|---|
| Range: | Function: | |
| 100 %* | [0 - 100 %] | NOTICE Not visible when running in cascade. |
| | | Example 1 Adjustment of this parameter allows the shape of the control curve to be adjusted. 0=Linear 100%=Ideal shape (theoretical). |

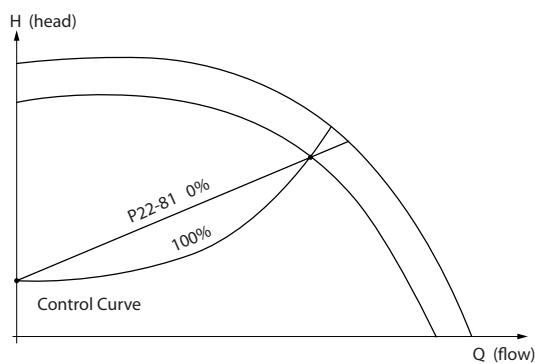


Illustration 4.21 Square-Linear Curve Approximation

| 22-82 Work Point Calculation | |
|------------------------------|-----------|
| Option: | Function: |

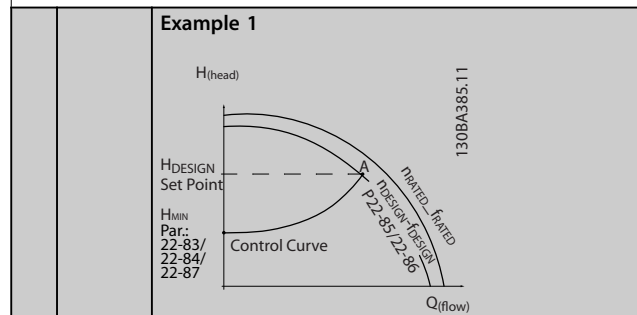


Illustration 4.22 Speed at System Design Working Point is Known

From the datasheet showing characteristics for the specific equipment at different speeds, simply reading across from the H_{DESIGN} point and the Q_{DESIGN} point allows finding point A, which is the system design working point. The pump characteristics at this point should be identified and the associated speed programmed. Closing the valves and adjusting the speed until H_{MIN} has been achieved allows the speed at the no-flow point to be identified.

Adjustment of *parameter 22-81 Square-linear Curve Approximation* then allows the shape of the control curve to be adjusted infinitely.

Example 2

Speed at system design working point is not known: Where the speed at system design working point is unknown, another reference point on the control curve needs to be determined based on the datasheet. By looking at the curve for the rated speed and plotting the design pressure (H_{DESIGN} , Point C), the flow at that pressure, Q_{RATED} , can be determined. Similarly, by plotting the design flow (Q_{DESIGN} , Point D), the

| 22-82 Work Point Calculation | | |
|------------------------------|--|--|
| Option: | Function: | |
| | <p>pressure H_{DESIGN} at that flow can be determined. Knowing these 2 points on the pump curve, along with H_{MIN} as described above, allows the frequency converter to calculate the reference point B and thus to plot the control curve, which also includes the system design working point A.</p> <p>Illustration 4.23 Speed at System Design Working Point is not Known</p> | |
| [0] | Disabled | Work point calculation not active. To be used if speed at design point is known. |
| [1] | Enabled | <p>Work point calculation is active. Enabling this parameter allows the calculation of the unknown system design working point at 50/60 Hz speed, from the input data set in:</p> <ul style="list-style-type: none"> Parameter 22-83 Speed at No-Flow [RPM]. Parameter 22-84 Speed at No-Flow [Hz]. Parameter 22-87 Pressure at No-Flow Speed. Parameter 22-88 Pressure at Rated Speed. Parameter 22-89 Flow at Design Point. Parameter 22-90 Flow at Rated Speed. |

| 22-84 Speed at No-Flow [Hz] | | |
|-----------------------------|-----------------|--|
| Range: | Function: | |
| 0 Hz* | [0 - 400.0 Hz] | <p>Resolution 0.033 Hz.</p> <p>Enter the motor speed in Hz at which flow has effectively stopped and minimum pressure H_{MIN} is achieved. Alternatively, enter the speed in RPM in parameter 22-83 Speed at No-Flow [RPM]. If it has been decided to use Hz in parameter 0-02 Motor Speed Unit, parameter 22-86 Speed at Design Point [Hz] should also be used. Closing the valves and reducing the speed until minimum pressure H_{MIN} is achieved determines this value.</p> |

| 22-86 Speed at Design Point [Hz] | | |
|----------------------------------|-------------------|--|
| Range: | Function: | |
| Size related* | [0.0 - 400.0 Hz] | <p>Resolution 0.033 Hz.</p> <p>Only visible when parameter 22-82 Work Point Calculation is set to [0] Disabled. Enter the motor speed in Hz at which the system design working point is achieved. Alternatively, enter the speed in RPM in parameter 22-85 Speed at Design Point [RPM]. If it has been decided to use Hz in parameter 0-02 Motor Speed Unit, parameter 22-83 Speed at No-Flow [RPM] should also be used.</p> |

| 22-87 Pressure at No-Flow Speed | | |
|---------------------------------|--------------------|---|
| Range: | Function: | |
| 0* | [0 - 999999.999] | Enter the pressure H_{MIN} corresponding to speed at no-flow in reference/feedback units. |

| 22-88 Pressure at Rated Speed | | |
|-------------------------------|--------------------|--|
| Range: | Function: | |
| 999999.999* | [0 - 999999.999] | Enter the value corresponding to the pressure at rated speed, in reference/feedback units. This value can be defined using the pump datasheet. |

See parameter 22-88 Pressure at Rated Speed point A.

| 22-89 Flow at Design Point | | |
|----------------------------|--------------------|----------------------------------|
| Range: | Function: | |
| 0* | [0 - 999999.999] | Flow at design point (no units). |

| 22-90 Flow at Rated Speed | | |
|--|--------------------|---|
| Also see parameter 22-82 Work Point Calculation. | | |
| Range: | Function: | |
| 0* | [0 - 999999.999] | Enter the value corresponding to flow at rated speed. This value can be defined using the pump datasheet. |

4.17 Main Menu - Application Functions 2 - Group 24

4.17.1 24-0* Fire Mode

⚠ WARNING

EQUIPMENT DAMAGE AND PERSONAL INJURY

Non-interruption of the frequency converter due to fire mode operation could cause overpressure and damage the system and its components, hereunder dampers, and air ducts. The frequency converter itself could be damaged and it may cause damage or fire.

- Ensure that the system is properly designed and components used are carefully selected.
- Ensure that the ventilation systems working in life safety applications are approved by the local fire authorities.

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 if there is a fire. Some selections of fire mode function cause alarms and trip conditions to be ignored, 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 the status message *Fire Mode*.

Once the fire mode is deactivated, the status message disappears.

If an alarm with warranty implications (see parameter 24-09 *FM Alarm Handling*) occurs while the frequency converter is active in fire mode, 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*.

Access the status messages *Fire Mode* and *Fire Mode Limits Exceeded* via the extended status word.

| Message | Type | LCP | Message | Warning Word 2 | Extended status Word 2 |
|---------------------------|--------|-----|---------|----------------|------------------------|
| Fire Mode | Status | + | + | | + (bit 25) |
| Fire Mode Limits Exceeded | Status | + | + | | + (bit 27) |

Table 4.15 Fire Mode Display Messages

Log

The fire mode log shows an overview of events related to fire mode in the fire mode log, see also 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.

The following events are logged:

- Fire mode activated.
- Fire mode limits exceeded (warranty affecting alarms).

All other alarms occurring while fire mode is active 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 command as a reversing command.

| 24-00 FM Function | | |
|-------------------|---------------------|--|
| Option: | Function: | |
| | | NOTICE In fire mode, alarms are produced or ignored in accordance with the selection in parameter 24-09 <i>FM Alarm Handling</i> . |
| [0] * | Disabled | Fire mode function is not active. |
| [1] | Enabled-Run Forward | In this mode, the motor continues to operate in a clockwise direction. |
| [2] | Enabled-Run Reverse | In this mode, the motor continues to operate in a counterclockwise direction. |
| [3] | Enabled-Coast | While this mode is selected, the output is disabled, and the motor is allowed to coast to stop. When parameter 24-01 <i>Fire Mode Configuration</i> is set to [3] <i>Closed Loop</i> , this mode cannot be selected. |

| 24-00 FM Function | | |
|-------------------------|--|--|
| Option: | Function: | |
| [4] Enabled-Run Fwd/Rev | In this mode, the motor operates in a clockwise direction. When receiving a reversing signal, the motor operates in counterclockwise direction. If <i>parameter 24-01 Fire Mode Configuration</i> is set to [3] <i>Closed Loop</i> , the motor cannot operate in counterclockwise direction. | |

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

| 24-09 FM Alarm Handling | | |
|---------------------------------|---|--|
| Option: | Function: | |
| | <p>NOTICE Warranty-affecting alarms. Certain alarms can affect the lifetime of the frequency converter. If 1 of these ignored alarms occurs while in fire mode, a log of the event is stored in the fire mode log. The fire mode log stores the 10 latest events of warranty-affecting alarms, fire mode activation, and fire mode deactivation.</p> <p>NOTICE The setting in <i>parameter 14-20 Reset Mode</i> is disregarded when fire mode is active (see <i>parameter group 24-0*</i>, <i>Fire Mode</i>).</p> | |
| [0] Trip+Reset, Critical Alarms | If this mode is selected, the frequency converter continues 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, * Crit.Alarms | If there is a critical alarm, the frequency converter trips and does not autorestart (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). | |

| Num-ber | Description | Critical alarms | Warranty affecting alarms |
|---------|---------------------|-----------------|---------------------------|
| 4 | Mains ph. 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 4.16 Fire Mode Alarms

4.17.2 24-1* Drive Bypass

If a fire mode coast occurs (see *parameter 24-00 FM Function*), the frequency converter includes a feature that can automatically activate an external electro-mechanical bypass.

The bypass switches the motor to operation directly on line. One of the digital outputs or relays in the frequency converter activates the external bypass, 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 is deactivated only by either removing the fire mode command signal or the 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 4.24*.

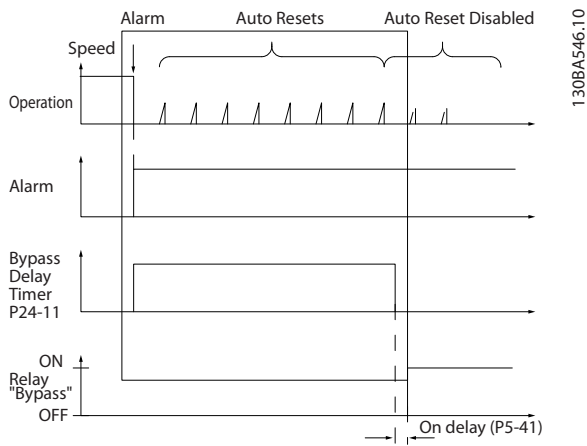


Illustration 4.24 Drive Bypass Function

Read the status in the extended status word 2, bit number 24.

| 24-10 Drive Bypass Function | | |
|-----------------------------|--------------------------|---|
| Option: | Function: | |
| | | This parameter determines which circumstances activate the bypass function: |
| [0] * | Disabled | |
| [2] | Enabled (Fire Mode only) | If the timer expires before reset attempts have completed, the bypass function operates at trip at critical alarms, coast, or bypass delay timer. |

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

4.18 Main Menu - Special Features - Group

30

4.18.1 30-2* Adv. Start Adjust

4

| 30-20 High Starting Torque Time [s] | | |
|-------------------------------------|------------|--|
| Range: | | Function: |
| Size related* | [0 - 60 s] | High starting torque time for PM motors in VVC ⁺ mode without feedback. |

| 30-21 High Starting Torque Current [%] | | |
|--|---------------|--|
| Range: | | Function: |
| Size related* | [0 - 200.0 %] | High starting torque current for PM motor in VVC ⁺ mode without feedback. |

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

| 30-23 Locked Rotor Detection Time [s] | | |
|---------------------------------------|--------------|---|
| Range: | | Function: |
| 1 s* | [0.05 - 1 s] | Locked Rotor Detection Time for PM motor. |

5 Diagnostics and Troubleshooting

5.1 Alarms and Warnings Overview

The LEDs on the front of the frequency converter signal a warning or an alarm, which is then 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.

If an alarm occurs, the frequency converter trips. Reset of alarms is required to restart operation, once the cause is rectified.

To reset an alarm:

- Press [Reset].
- Use the reset function via a digital input.
- Reset via serial communication.
- 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 pressing [Reset], press [Auto On] or [Hand On].

When an alarm fails to reset, check:

- That the cause is rectified.
- For trip lock, refer to *Table 5.2*.

Trip

A trip is the action occurring when an alarm has appeared. The 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] Reset*). 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 in situations, 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 the cause and after power cycling, the frequency converter is no longer blocked. Reset as described in the previous.

CAUTION

UNINTENDED 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*:

- A warning occurs before an alarm.
- The event can be set to signal either warning or alarm.

Example: *Parameter 1-90 Motor Thermal Protection*.

If this parameter is set to warning options after an alarm, the motor coasts, and both the alarm and warning LEDs flash. Once the cause is rectified, only the alarm LED continues flashing. If this parameter is set to trip options after an alarm or trip, the motor coasts and the warning LED stops flashing when the alarm LED starts flashing.

| Alarm/warning number | Fault text | Warning | Alarm | Trip lock | Cause of problem |
|----------------------|-----------------|---------|-------|-----------|---|
| 2 | Live zero error | X | X | - | Signal on terminal 53 or 54 is less than 50% of value set in: <ul style="list-style-type: none"> • <i>Parameter 6-10 Terminal 53 Low Voltage</i>. • <i>Parameter 6-12 Terminal 53 Low Current</i>. • <i>Parameter 6-20 Terminal 54 Low Voltage</i>. • <i>Parameter 6-22 Terminal 54 Low Current</i>. See also parameter group 6-0* <i>Analog In/Out</i> . |
| 3 | No motor | X | - | - | A motor has not been connected to the frequency converter. |
| 4 | Mains ph. loss | X | X | X | Missing phase on supply side or excess voltage imbalance. Check supply voltage. See <i>parameter 14-12 Function at Mains Imbalance</i> . |

| Alarm/ warning number | Fault text | Warning | Alarm | Trip lock | Cause of problem |
|-----------------------------|-------------------------------|---------|-------|-----------|---|
| 7 | DC over volt | X | X | – | DC-link voltage exceeds limit. |
| 8 | DC under volt | X | X | – | DC-link voltage is lower than voltage warning low-limit. |
| 9 | Inverter overload | X | X | – | More than 100% load for too long. |
| 10 | Motor ETR over | X | X | – | Motor is overheated due to more than 100% load for too long. See <i>parameter 1-90 Motor Thermal Protection</i> . |
| 11 | Motor th over | X | X | – | Thermistor or thermistor connection is disconnected. See <i>parameter 1-90 Motor Thermal Protection</i> . |
| 13 | Over Current | X | X | X | Inverter peak current limit is exceeded. |
| 14 | Earth Fault | X | X | X | Discharge from output phases to ground. |
| 16 | Short Circuit | – | X | X | Short circuit in motor or on motor terminals. |
| 17 | Control word timeout | X | X | – | No communication to frequency converter. See parameter group 8-0* <i>Comm. and Options</i> . |
| 24 | Fan fault | – | – | – | External fans have failed either due to defect hardware, or due to missing fans. |
| 30 | U phase loss | – | X | X | Motor phase U is missing. Check the phase. See <i>parameter 4-58 Missing Motor Phase Function</i> . |
| 31 | V phase loss | – | X | X | Motor phase V is missing. Check the phase. See <i>parameter 4-58 Missing Motor Phase Function</i> . |
| 32 | W phase loss | – | X | X | Motor phase W is missing. Check the phase. See <i>parameter 4-58 Missing Motor Phase Function</i> . |
| 34 | Fieldbus fault | X | – | – | – |
| 35 | Option fault | – | X | – | – |
| 36 | Mains failure | X | – | – | – |
| 38 | Internal fault | – | X | X | Contact the local Danfoss supplier. |
| 40 | Overload T27 | X | – | – | – |
| 41 | Overload T29 | X | – | – | – |
| 46 | Gate drive voltage fault | – | X | X | – |
| 47 | Control voltage fault | X | X | X | 24 V DC is possibly overloaded. |
| 51 | AMA U_{nom} , I_{nom} | – | X | – | The setting of motor voltage, motor current, and motor power is presumably wrong. Check the settings. |
| 52 | AMA low I_{nom} | – | X | – | The motor current is too low. Check the settings. |
| 53 | AMA motor too big | – | X | – | The motor is too large to perform AMA. |
| 54 | AMA motor too small | – | X | – | The motor is too small to perform AMA. |
| 55 | AMA parameter out of range | – | X | – | The parameter values found from the motor are outside acceptable range. |
| 56 | AMA interrupted by user | – | X | – | The user has interrupted the AMA. |
| 57 | AMA time-out | – | X | – | Restart the AMA some times, until the AMA is complete. NOTICE Repeated runs can heat the motor to a level where the resistance R_s and R_r are increased. Usually, however, this increased resistance is not critical. |
| 58 | AMA internal | – | X | – | Contact the local Danfoss supplier. |
| 59 | Current limit | X | – | – | The current is higher than the value in <i>parameter 4-18 Current Limit</i> . |

| Alarm/ warning number | Fault text | Warning | Alarm | Trip lock | Cause of problem |
|-----------------------------|----------------------------|---------|-------|-----------|--|
| 60 | External Interlock | – | X | – | External interlock is activated. To resume normal operation, apply 24 V DC to the terminal programmed for external interlock and reset the frequency converter. Reset via serial communication, digital I/O, or [Reset] on the LCP). |
| 63 | Mech. brake low | – | X | – | The minimum required current for opening the mechanical brake has not been reached. |
| 65 | Ctr. card temp | X | X | X | – |
| 66 | Heat sink temperature low | X | – | – | The heat sink temperature is measured as 0 °C. This result could indicate that the temperature sensor is defect. The defect causes the fan speed to increase to its maximum to cool down the power part or control card. |
| 67 | Option change | – | X | – | – |
| 69 | Pwr. Card Temp | X | X | X | The temperature sensor on the power card is either too hot or too cold. |
| 70 | Illegal FC config | – | X | X | Power size configuration fault on the power card. |
| 80 | Drive initialised | – | X | – | All parameter settings are initialized to default settings. |
| 87 | Auto DC Braking | X | – | – | The frequency converter is auto DC braking. |
| 88 | Option detection | – | X | X | – |
| 93 | Dry pump | X | X | – | – |
| 94 | End of curve | X | X | – | – |
| 95 | Broken belt | X | X | – | Torque is below the torque level set for no load, indicating a broken belt. See parameter group 22-6* <i>Broken Belt Detection</i> . |
| 99 | Locked rotor | – | X | – | The frequency converter detected a locked rotor situation. See <i>parameter 30–22 Locked Rotor Protection</i> and <i>parameter 30–23 Locked Rotor Detection Time [s]</i> . |
| 101 | Flow/pressure info missing | – | X | – | Flow/pressure information is missing. |
| 126 | Motor Rotating | – | X | – | High back EMF voltage. Stop the rotor of the PM motor. |
| 127 | Back EMF too high | X | – | – | – |
| 200 | Fire Mode | X | – | – | Fire mode is activated. |
| 202 | Fire Mode Limits Exceeded | X | – | – | Fire mode has suppressed 1 or more warranty voiding alarms. |
| 206 | Memory module | X | – | – | – |
| 207 | Memory module alarm | – | X | X | – |

Table 5.2 Warnings and Alarms

5.2 Alarm Words

The alarm words, warning words, and extended status words can be readout 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*.

5

| Bit | Hex | Dec | Parameter 16-90 Alarm Word | Parameter 16-91 Alarm Word 2 | Parameter 16-97 Alarm Word 3 |
|-----|----------|------------|----------------------------|------------------------------|------------------------------|
| 0 | 1 | 1 | 1) | 1) | 1) |
| 1 | 2 | 2 | Pwr.Card Temp | Gate drive voltage fault | Memory module alarm. |
| 2 | 4 | 4 | Earth Fault | 1) | 1) |
| 3 | 8 | 8 | 1) | 1) | Synchronization fault. |
| 4 | 10 | 16 | Ctrl. Word TO | Illegal FC config. | 1) |
| 5 | 20 | 32 | Over Current | 1) | 1) |
| 6 | 40 | 64 | 1) | 1) | 1) |
| 7 | 80 | 128 | Motor Th. Over | 1) | 1) |
| 8 | 100 | 256 | Motor ETR Over | Broken Belt | 1) |
| 9 | 200 | 512 | Inverter Overld. | 1) | 1) |
| 10 | 400 | 1024 | DC under Volt | 1) | 1) |
| 11 | 800 | 2048 | DC over Volt. | 1) | 1) |
| 12 | 1000 | 4096 | Short Circuit | External Interlock | 1) |
| 13 | 2000 | 8192 | 1) | 1) | 1) |
| 14 | 4000 | 16384 | Mains ph. loss | 1) | 1) |
| 15 | 8000 | 32768 | AMA Not OK | Flow/Pressure info Missing | 1) |
| 16 | 10000 | 65536 | Live Zero Error | 1) | 1) |
| 17 | 20000 | 131072 | Internal Fault | 1) | 1) |
| 18 | 40000 | 262144 | 1) | Fans error | 1) |
| 19 | 80000 | 524288 | U phase Loss | 1) | 1) |
| 20 | 100000 | 1048576 | V phase Loss | 1) | 1) |
| 21 | 200000 | 2097152 | W phase Loss | 1) | 1) |
| 22 | 400000 | 4194304 | 1) | Locked Rotor | 1) |
| 23 | 800000 | 8388608 | 24 V Supply Low | 1) | 1) |
| 24 | 1000000 | 16777216 | 1) | 1) | 1) |
| 25 | 2000000 | 33554432 | 1) | Current limit | 1) |
| 26 | 4000000 | 67108864 | 1) | 1) | 1) |
| 27 | 8000000 | 134217728 | 1) | 1) | 1) |
| 28 | 10000000 | 268435456 | 1) | 1) | 1) |
| 29 | 20000000 | 536870912 | Drive Initialized | 1) | 1) |
| 30 | 40000000 | 1073741824 | 1) | 1) | 1) |
| 31 | 80000000 | 2147483648 | Mechanical brake low | 1) | 1) |

Table 5.3 Alarm Words

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

Table 5.4 Warning Words

1) 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 | 1) |
| 3 | 8 | 8 | 1) | 1) |
| 4 | 10 | 16 | 1) | 1) |
| 5 | 20 | 32 | Feedback high | 1) |
| 6 | 40 | 64 | Feedback low | 1) |
| 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 | 1) | Stop |
| 12 | 1000 | 4096 | 1) | 1) |
| 13 | 2000 | 8192 | Braking | Freeze Output Request |
| 14 | 4000 | 16384 | 1) | Freeze Output |
| 15 | 8000 | 32768 | OVC active | Jog Request |
| 16 | 10000 | 65536 | AC brake | Jog |
| 17 | 20000 | 131072 | 1) | Start request |
| 18 | 40000 | 262144 | 1) | Start |
| 19 | 80000 | 524288 | Reference high | 1) |
| 20 | 100000 | 1048576 | Reference low | Start Delay |
| 21 | 200000 | 2097152 | Local Ref./Remote Ref. | Sleep |
| 22 | 400000 | 4194304 | 1) | Sleep boost |
| 23 | 800000 | 8388608 | 1) | Running |
| 24 | 1000000 | 16777216 | 1) | Bypass |
| 25 | 2000000 | 33554432 | 1) | Fire Mode |
| 26 | 4000000 | 67108864 | 1) | External Interlock |
| 27 | 8000000 | 134217728 | 1) | Firemodelimitexceed |
| 28 | 10000000 | 268435456 | 1) | FlyStart Active |
| 29 | 20000000 | 536870912 | 1) | 1) |
| 30 | 40000000 | 1073741824 | 1) | 1) |
| 31 | 80000000 | 2147483648 | Database busy | 1) |

Table 5.5 Extended Status Words

1) 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 *parameter 6-01 Live Zero Timeout Function*. The signal on 1 of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or a faulty device sending the signal can cause this condition.

Troubleshooting

- Check connections on all analog mains terminals.
 - Control card terminals 53 and 54 for signals, terminal 55 common.
- Check that the frequency converter programming and switch settings match the analog signal type.
- Perform an input terminal signal test.

WARNING/ALARM 3, No motor

No motor is 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. Options are programmed in *parameter 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 DC-link voltage exceeds the limit, the frequency converter trips after a certain time.

Troubleshooting

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

WARNING/ALARM 8, DC under voltage

If the DC-link voltage drops below the undervoltage limit, 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 an input voltage test.
- Perform a soft charge circuit test.

WARNING/ALARM 9, Inverter overload

The frequency converter has run with more than 100% overload for too long and is about to cut out. The counter for electronic thermal inverter protection issues a warning at 90% and trips at 100% with an alarm. The frequency converter can be reset only when the counter is 0.

Troubleshooting

- Compare the output current shown on the LCP with the frequency converter rated current.
- Compare the output current shown on the LCP with the measured motor current.
- Show the thermal frequency converter 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 is >90% if *parameter 1-90 Motor Thermal Protection* is set to warning options, or whether the frequency converter trips when the counter reaches 100% if *parameter 1-90 Motor Thermal Protection* is set to trip options. 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 *parameter 1-24 Motor Current* is correct.
- Ensure that the motor data in *parameters 1-20 to 1-25* are set correctly.
- If an external fan is in use, check that it is selected in *parameter 1-91 Motor External Fan*.
- Running AMA in *parameter 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 *parameter 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 that *parameter 1-93 Thermistor Source* selects terminal 53 or 54.

- When using terminal 18, 19, 31, 32, or 33 (digital inputs), check that the thermistor is connected correctly between the digital input terminal used (digital input PNP only) and terminal 50. Select the terminal to use in *parameter 1-93 Thermistor Source*.

WARNING/ALARM 13, Over current

The peak current limit of the frequency converter (approximately 145–177% of the frequency converter rated current) is exceeded. The warning lasts approximately 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, a trip can be reset externally.

Troubleshooting

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

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

ALARM 16, Short circuit

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

Troubleshooting

- Remove the 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 *parameter 8-04 Control Word Timeout Function* is NOT set to [0] Off. If *parameter 8-04 Control Word Timeout Function* is set to [5] Stop and Trip, a warning appears, and the frequency converter ramps down to a stop and shows an alarm.

Troubleshooting

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

- Check the operation of the communication equipment.
- Verify that proper EMC installation was performed.

ALARM 30, Motor phase U missing

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

Troubleshooting

- Remove the 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.

Troubleshooting

- Remove the 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.

Troubleshooting

- Remove the 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 shown.

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 number | Text | Troubleshooting |
|-------------|--|---|
| 0 | Serial port cannot be initialized. | 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 | – |

| Code number | Text | Troubleshooting |
|-------------|---------------------------------------|---|
| 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 the short-circuit connection. Check *parameter 5-00 Digital I/O Mode* and *parameter 5-01 Terminal 27 Mode*.

WARNING 41, Overload of digital output terminal 29

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

ALARM 46, Gate drive voltage fault

The supply on the power card is out of range.

There are 3 supplies generated by the switch mode power supply (SMPS) on the power card:

- 24 V.
- 5 V.
- ± 18 V.

Troubleshooting

- Check for a defective power card.

WARNING 47, 24 V supply low

The supply on the power card is out of range.

Troubleshooting

- Check for a defective power card.

ALARM 51, AMA check U_{nom} and I_{nom}

The settings for motor voltage, motor current, and motor power are wrong.

Troubleshooting

- Check the settings in *parameters 1–20 to 1–25*.

ALARM 52, AMA low I_{nom}

The motor current is too low.

Troubleshooting

- Check the settings in *parameter 1-24 Motor Current*.

ALARM 53, AMA motor too big

The motor is too large 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

AMA cannot run because the parameter values of the motor are outside of the acceptable range.

ALARM 56, AMA interrupted by user

The AMA is manually interrupted.

WARNING/ALARM 57, AMA internal fault

Try to restart AMA. Repeated restarts can overheat the motor.

ALARM 58, AMA Internal fault

Contact the Danfoss supplier.

WARNING 59, Current limit

The current is higher than the value in *parameter 4-18 Current Limit*. Ensure that motor data in *parameters 1–20 to 1–25* is set correctly. Increase the current limit if necessary. Ensure that the system can operate safely at a higher limit.

WARNING 60, External interlock

A digital input signal indicates 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, and 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 initialized 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. *Parameter 22-60 Broken Belt Function* is set for alarm.

Troubleshooting

- Troubleshoot the system and reset the frequency converter after clearing the fault.

ALARM 99, Blocked rotor

The 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 occurs only when running AMA on 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 exceeds $90\% \times U_{in\max}$ (overvoltage threshold), and does not drop to normal level within 5 s, this warning is reported. The warning remains until the back EMF returns to a normal level.

WARNING 200, Fire mode

The frequency converter is operating in fire mode. The warning clears when fire mode is removed. Refer to the fire mode data in the alarm log.

WARNING 202, Fire mode limits exceeded

While operating in fire mode, 1 or more alarm conditions that would normally trip the unit have been ignored. Operating in this condition voids unit warranty. Cycle power to the unit to remove the warning. Refer to the fire mode data in the alarm log.

6 Parameter Lists

6.1 Parameter Options

6.1.1 Default Settings

Changes during operation

True: The parameter can be changed while the frequency converter is in operation.

False: The parameter can only be changed when the frequency converter stops.

2-Set-up

All set-up: The parameter can be set individually in each of the 2 set-ups. 1 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 via 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 | 4-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 | [0] International | 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 |
| 0-2* LCP Display | | | | | | |
| 0-20 | Display Line 1.1 Small | 1602 | All set-ups | TRUE | - | UInt16 |
| 0-21 | Display Line 1.2 Small | 1614 | All set-ups | TRUE | - | UInt16 |
| 0-22 | Display Line 1.3 Small | 1610 | All set-ups | TRUE | - | UInt16 |
| 0-23 | Display Line 2 Large | 1613 | All set-ups | TRUE | - | UInt16 |
| 0-24 | Display Line 3 Large | 1502 | All set-ups | TRUE | - | UInt16 |
| 0-3* 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 | 0 N/A | 1 set-up | TRUE | 0 | VisStr[20] |
| 0-38 | Display Text 2 | 0 N/A | 1 set-up | TRUE | 0 | VisStr[25] |
| 0-39 | Display Text 3 | 0 N/A | 1 set-up | TRUE | 0 | VisStr[25] |
| 0-4* LCP Keypad | | | | | | |
| 0-40 | [Hand on] Key on LCP | [1] Enabled | All set-ups | TRUE | - | UInt8 |
| 0-42 | [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 | 4-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 |
| 1-08 | Motor Control Bandwidth | ExpressionLimit | All set-ups | FALSE | - | UInt8 |
| 1-1* Motor Selection | | | | | | |
| 1-10 | Motor Construction | [0] Asynchron | All set-ups | FALSE | - | UInt8 |
| 1-11 | Motor Selection | [0] Default Motor Selection | All set-ups | FALSE | - | uint8 |
| 1-12 | Motor ID | [Default Motor] | All set-ups | FALSE | 0 | VisStr[16] |
| 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 |

| Par. No. # | Parameter description | Default value | 4-set-up | Change during operation | Conversion index | Type |
|---------------------------------|--------------------------------------|----------------------|-------------|-------------------------|------------------|--------|
| 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 |
| 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 | All set-ups | 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 | -6 | Int32 |
| 1-38 | q-axis Inductance (Lq) | ExpressionLimit | All set-ups | FALSE | -6 | Int32 |
| 1-39 | Motor Poles | ExpressionLimit | 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 |
| 1-44 | d-axis Inductance Sat. (LdSat) | ExpressionLimit | All set-ups | FALSE | -6 | Int32 |
| 1-45 | q-axis Inductance Sat. (LqSat) | ExpressionLimit | All set-ups | FALSE | -6 | Int32 |
| 1-46 | Position Detection Gain | 100% | All set-ups | TRUE | 0 | Uint16 |
| 1-48 | Current at Min Inductance for d-axis | 100% | All set-ups | FALSE | 0 | Int16 |
| 1-49 | Current at Min Inductance for q-axis | 100% | 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] | 1 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 | | | | | | |
| 1-60 | Low Speed Load Compensation | 100% | All set-ups | TRUE | 0 | Int16 |
| 1-61 | High Speed Load Compensation | 100% | All set-ups | TRUE | 0 | Int16 |
| 1-62 | Slip Compensation | ExpressionLimit | 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 | | | | | | |
| 1-70 | PM Start Mode | [0] Rotor Detection | All set-ups | TRUE | - | Uint8 |
| 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 | TRUE | - | 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 |
| 1-88 | AC Brake Gain | 1.4 N/A | All set-ups | TRUE | -1 | Uint16 |
| 1-9* Motor Temperature | | | | | | |
| 1-90 | Motor Thermal Protection | ExpressionLimit | All set-ups | TRUE | - | Uint8 |

6.1.4 2-** Brakes

| Par. No. # | Parameter description | Default value | 4-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 |
| 2-2* Mechanical Brake | | | | | | |
| 2-20 | Release Brake Current | 0 A | All set-ups | TRUE | -2 | Uint32 |
| 2-22 | Activate Brake Speed [Hz] | 0 Hz | All set-ups | TRUE | -1 | Uint16 |

6.1.5 3-** Reference/Ramps

| Par. No. # | Parameter description | Default value | 4-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 |
| 3-12 | Catch up/slow Down Value | 0% | All set-ups | TRUE | -2 | Int16 |
| 3-14 | Preset Relative Reference | 0% | All set-ups | TRUE | -2 | Int16 |
| 3-15 | Reference 1 Source | [1] Analog Input 53 | All set-ups | TRUE | - | Uint8 |
| 3-16 | Reference 2 Source | [2] Analog Input 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 |
| 3-85 | Check Valve Ramp Time | 0 s | All set-ups | TRUE | -2 | Uint16 |
| 3-87 | Check Valve Ramp End Speed [HZ] | ExpressionLimit | All set-ups | TRUE | -1 | Uint16 |

6.1.6 4-** Limits/Warnings

| Par. No. # | Parameter description | Default value | 4-set-up | Change during operation | Conversion index | Type |
|-----------------------------|------------------------------|-----------------------|-------------|-------------------------|------------------|--------|
| 4-1* Motor Limits | | | | | | |
| 4-10 | Motor Speed Direction | [2] Both directions | All set-ups | FALSE | - | Uint8 |
| 4-12 | Motor Speed Low Limit [Hz] | 0 Hz | All set-ups | FALSE | -1 | Uint16 |
| 4-14 | Motor Speed High Limit [Hz] | ExpressionLimit | All set-ups | FALSE | -1 | Uint16 |
| 4-18 | Current Limit | ExpressionLimit | 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 | 4-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 |
| 5-01 | Terminal 27 Mode | [0] Input | All set-ups | TRUE | - | Uint8 |
| 5-02 | Terminal 29 Mode | [0] Input | All set-ups | TRUE | - | Uint8 |
| 5-1* Digital Inputs | | | | | | |
| 5-10 | Terminal 18 Digital Input | [8] Start | All set-ups | TRUE | - | Uint8 |
| 5-11 | Terminal 19 Digital Input | [0] No operation | All set-ups | TRUE | - | Uint8 |
| 5-12 | Terminal 27 Digital Input | ExpressionLimit | All set-ups | TRUE | - | Uint8 |
| 5-13 | Terminal 29 Digital Input | [14] Jog | All set-ups | TRUE | - | Uint8 |
| 5-3* Digital Outputs | | | | | | |
| 5-30 | Terminal 27 Digital Output | [0] No operation | All set-ups | TRUE | - | Uint8 |
| 5-31 | Terminal 29 Digital Output | [0] No operation | All set-ups | TRUE | - | Uint8 |
| 5-34 | 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 | 20 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 |

| Par. No. # | Parameter description | Default value | 4-set-up | Change during operation | Conversion index | Type |
|----------------------------|---------------------------------|-----------------|-------------|-------------------------|------------------|--------|
| 5-53 | Term. 29 High Ref./Feedb. Value | ExpressionLimit | 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 | 4-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 |

6.1.9 8-** Comm. and Options

| Par. No. # | Parameter description | Default value | 4-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 | ExpressionLimit | All set-ups | TRUE | - | Uint8 |
| 8-03 | Control Timeout Time | 1 s | 1 set-up | TRUE | -1 | Uint16 |
| 8-04 | Control Timeout Function | [0] Off | 1 set-up | TRUE | - | Uint8 |
| 8-07 | Diagnosis Trigger | [0] Disable | 1 set-up | TRUE | - | Uint8 |
| 8-1* Ctrl. Word Settings | | | | | | |
| 8-10 | Control Word Profile | [0] FC profile | All set-ups | TRUE | - | Uint8 |
| 8-14 | Configurable Control Word CTW | [1] Profile default | All set-ups | TRUE | - | Uint8 |
| 8-19 | Product Code | ExpressionLimit | 1 set-up | TRUE | 0 | Uint32 |
| 8-3* FC Port Settings | | | | | | |
| 8-30 | Protocol | [0] FC | 1 set-up | TRUE | - | Uint8 |
| 8-31 | Address | 1 N/A | 1 set-up | TRUE | 0 | Uint8 |
| 8-32 | 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 |
| 8-37 | Maximum Inter-char delay | 0.025 s | 1 set-up | TRUE | -3 | Uint16 |
| 8-4* FC MC protocol set | | | | | | |
| 8-40 | Telegram Selection | [1] Standard telegram 1 | 2 set-ups | TRUE | - | Uint8 |
| 8-42 | PCD Write Configuration | ExpressionLimit | 2 set-ups | TRUE | - | Uint8 |
| 8-43 | PCD Read Configuration | ExpressionLimit | 1 set-up | TRUE | - | 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 |
| 8-57 | Profidrive OFF2 Select | [3] Logic OR | All set-ups | TRUE | - | Uint8 |
| 8-58 | Profidrive OFF3 Select | [3] Logic OR | All set-ups | TRUE | - | Uint8 |
| 8-7* BACnet | | | | | | |
| 8-70 | BACnet Device Instance | 1 N/A | 1 set-up | TRUE | 0 | Uint32 |
| 8-72 | MS/TP Max Masters | 127 N/A | 1 set-up | TRUE | 0 | Uint8 |
| 8-73 | MS/TP Max Info Frames | 1 N/A | 1 set-up | TRUE | 0 | Uint16 |
| 8-74 | "I am" Service | [0] Send at power-up | 1 set-up | TRUE | - | Uint8 |
| 8-75 | Initialisation Password | [admin] | 1 set-up | TRUE | 0 | VisStr[20] |
| 8-79 | Protocol Firmware version | ExpressionLimit | 1 set-up | FALSE | -2 | Uint16 |
| 8-8* FC Port Diagnostics | | | | | | |
| 8-80 | Bus Message Count | 0 N/A | 1 set-up | TRUE | 0 | Uint32 |
| 8-81 | Bus Error Count | 0 N/A | 1 set-up | TRUE | 0 | Uint32 |
| 8-82 | Slave Messages Rcvd | 0 N/A | 1 set-up | TRUE | 0 | Uint32 |
| 8-83 | Slave Error Count | 0 N/A | 1 set-up | TRUE | 0 | Uint32 |
| 8-84 | Slave Messages Sent | 0 N/A | 1 set-up | TRUE | 0 | Uint32 |
| 8-85 | Slave Timeout Errors | 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 Jog / Feedback | | | | | | |
| 8-90 | Bus Jog 1 Speed | 100 RPM | All set-ups | TRUE | 67 | Uint16 |
| 8-91 | Bus Jog 2 Speed | 200 RPM | All set-ups | TRUE | 67 | Uint16 |

| Par. No. # | Parameter description | Default value | 4-set-up | Change during operation | Conversion index | Type |
|------------|-----------------------|---------------|-------------|-------------------------|------------------|-------|
| 8-94 | Bus Feedback 1 | 0 N/A | All set-ups | TRUE | 0 | Int16 |

6.1.10 9-** PROFIdrive

| Par. No. # | Parameter description | Default value | 4-set-up | Change during operation | Conversion index | Type |
|------------|---------------------------|--------------------------|-------------|-------------------------|------------------|-----------|
| 9-00 | Setpoint | 0 N/A | All set-ups | TRUE | 0 | Uint16 |
| 9-07 | Actual Value | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 9-15 | PCD Write Configuration | ExpressionLimit | 1 set-up | TRUE | - | Uint16 |
| 9-16 | PCD Read Configuration | ExpressionLimit | 1 set-up | TRUE | - | Uint16 |
| 9-18 | Node Address | 126 N/A | 1 set-up | TRUE | 0 | Uint8 |
| 9-19 | Drive Unit System Number | 1038 N/A | All set-ups | TRUE | 0 | Uint16 |
| 9-22 | Telegram Selection | [100] None | 1 set-up | TRUE | - | Uint8 |
| 9-23 | Parameters for Signals | 0 | All set-ups | TRUE | - | Uint16 |
| 9-27 | Parameter Edit | [1] Enabled | 1 set-up | FALSE | - | Uint16 |
| 9-28 | Process Control | [1] Enable cyclic master | 1 set-up | FALSE | - | Uint8 |
| 9-44 | Fault Message Counter | 0 N/A | All set-ups | TRUE | 0 | Uint16 |
| 9-45 | Fault Code | 0 N/A | All set-ups | TRUE | 0 | Uint16 |
| 9-47 | Fault Number | 0 N/A | All set-ups | TRUE | 0 | Uint16 |
| 9-52 | Fault Situation Counter | 0 N/A | All set-ups | TRUE | 0 | Uint16 |
| 9-53 | Profibus Warning Word | 0 N/A | All set-ups | TRUE | 0 | V2 |
| 9-63 | Actual Baud Rate | [255] No baud rate found | All set-ups | TRUE | - | Uint8 |
| 9-64 | Device Identification | 0 N/A | All set-ups | TRUE | 0 | Uint16 |
| 9-65 | Profile Number | 0 N/A | All set-ups | TRUE | 0 | OctStr[2] |
| 9-67 | Control Word 1 | 0 N/A | All set-ups | TRUE | 0 | V2 |
| 9-68 | Status Word 1 | 0 N/A | All set-ups | TRUE | 0 | V2 |
| 9-70 | Edit Set-up | [9] Active Set-up | 1 set-up | TRUE | - | Uint8 |
| 9-71 | Profibus Save Data Values | [0] Off | All set-ups | TRUE | - | Uint8 |
| 9-72 | ProfibusDriveReset | [0] No action | 1 set-up | FALSE | - | Uint8 |
| 9-75 | DO Identification | 0 N/A | All set-ups | TRUE | 0 | Uint16 |
| 9-80 | Defined Parameters (1) | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 9-81 | Defined Parameters (2) | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 9-82 | Defined Parameters (3) | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 9-83 | Defined Parameters (4) | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 9-84 | Defined Parameters (5) | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 9-85 | Defined Parameters (6) | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 9-90 | Changed Parameters (1) | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 9-91 | Changed Parameters (2) | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 9-92 | Changed Parameters (3) | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 9-93 | Changed Parameters (4) | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 9-94 | Changed Parameters (5) | 0 N/A | All set-ups | FALSE | 0 | Uint16 |
| 9-99 | Profibus Revision Counter | 0 N/A | All set-ups | TRUE | 0 | Uint16 |

6.1.11 13-** Smart Logic

| Par. No. # | Parameter description | Default value | 4-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 |
| 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 | -3 | 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 |

6.1.12 14-** Special Functions

| Par. No. # | Parameter description | Default value | 4-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 | [0] Off | All set-ups | FALSE | - | Uint8 |
| 14-07 | Dead Time Compensation Level | ExpressionLimit | All set-ups | FALSE | 0 | Uint8 |
| 14-08 | Damping Gain Factor | ExpressionLimit | All set-ups | TRUE | 0 | Uint8 |
| 14-09 | Dead Time Bias Current Level | ExpressionLimit | All set-ups | FALSE | 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 | ExpressionLimit | All set-ups | TRUE | 0 | Uint16 |
| 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 |
| 14-27 | 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 |
| 14-3* Current Limit Ctrl. | | | | | | |
| 14-30 | Current Lim Ctrl, Proportional Gain | 100% | All set-ups | TRUE | 0 | Uint16 |
| 14-31 | Current Lim Ctrl, Integration Time | ExpressionLimit | All set-ups | TRUE | -3 | Uint16 |
| 14-32 | Current Lim Ctrl, Filter Time | ExpressionLimit | All set-ups | TRUE | -4 | Uint16 |
| 14-4* Energy Optimising | | | | | | |
| 14-40 | VT Level | 90% | All set-ups | FALSE | 0 | Uint8 |

| Par. No. # | Parameter description | Default value | 4-set-up | Change during operation | Conversion index | Type |
|-----------------------------|---|----------------------------|-------------|-------------------------|------------------|--------|
| 14-41 | AEO Minimum Magnetisation | 66% | All set-ups | FALSE | 0 | UInt8 |
| 14-44 | d-axis current optimization for IPM | 100% | All set-ups | TRUE | 0 | UInt8 |
| 14-5* Environment | | | | | | |
| 14-51 | DC-Link Voltage Compensation | [1] On | All set-ups | FALSE | - | UInt8 |
| 14-55 | Output Filter | [0] No Filter | 1 set-up | FALSE | - | UInt8 |
| 14-6* Auto Derate | | | | | | |
| 14-61 | Function at Inverter Overload | [0] Trip | All set-ups | TRUE | - | UInt8 |
| 14-63 | Min Switch Frequency | [2] 2.0 kHz | 1 set-up | FALSE | - | UInt8 |
| 14-64 | Dead Time Compensation Zero Current Level | [0] Disabled | All set-ups | FALSE | - | UInt8 |
| 14-65 | Speed Derate Dead Time Compensation | ExpressionLimit | All set-ups | FALSE | 0 | UInt16 |
| 14-8* Options | | | | | | |
| 14-89 | Option Detection | [0] Protect Option Config. | 1 set-up | TRUE | - | UInt8 |
| 14-9* Fault Settings | | | | | | |
| 14-90 | Fault Level | [3] Trip lock | All set-ups | FALSE | - | UInt8 |

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6.1.13 15-** Drive Information

| Par. No. # | Parameter description | Default value | 4-set-up | Change during operation | Conversion index | Type |
|-----------------------------------|-----------------------------|------------------|-------------|-------------------------|------------------|------------|
| 15-0* Operating Data | | | | | | |
| 15-00 | Operating hours | 0 h | 1 set-up | TRUE | 74 | UInt32 |
| 15-01 | Running Hours | 0 h | 1 set-up | TRUE | 74 | UInt32 |
| 15-02 | kWh Counter | 0 kWh | 1 set-up | TRUE | 75 | UInt32 |
| 15-03 | Power Up's | 0 N/A | 1 set-up | TRUE | 0 | UInt32 |
| 15-04 | Over Temp's | 0 N/A | 1 set-up | TRUE | 0 | UInt16 |
| 15-05 | Over Volt's | 0 N/A | 1 set-up | TRUE | 0 | UInt16 |
| 15-06 | Reset kWh Counter | [0] Do not reset | 1 set-up | TRUE | - | UInt8 |
| 15-07 | Reset Running Hours Counter | [0] Do not reset | 1 set-up | TRUE | - | UInt8 |
| 15-3* Alarm Log | | | | | | |
| 15-30 | Alarm Log: Error Code | 0 N/A | 1 set-up | TRUE | 0 | UInt8 |
| 15-31 | InternalFaultReason | 0 N/A | 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 String | 0 N/A | All set-ups | FALSE | 0 | VisStr[40] |
| 15-46 | Drive 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 | FALSE | 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 | FALSE | 0 | UInt8 |
| 15-59 | File name | 0 N/A | 1 set-up | FALSE | 0 | VisStr[16] |
| 15-6* Option Ident | | | | | | |
| 15-60 | Option Mounted | ExpressionLimit | All set-ups | FALSE | 0 | VisStr[30] |
| 15-61 | Option SW Version | ExpressionLimit | All set-ups | FALSE | 0 | VisStr[20] |

| Par. No. # | Parameter description | Default value | 4-set-up | Change during operation | Conversion index | Type |
|-----------------------------|--------------------------|-----------------|-------------|-------------------------|------------------|------------|
| 15-62 | Option Ordering No | ExpressionLimit | All set-ups | FALSE | 0 | VisStr[8] |
| 15-63 | Option Serial No | ExpressionLimit | All set-ups | FALSE | 0 | VisStr[18] |
| 15-70 | Option in Slot A | 0 N/A | All set-ups | FALSE | 0 | VisStr[30] |
| 15-71 | Slot A Option SW Version | 0 N/A | All set-ups | FALSE | 0 | VisStr[20] |
| 15-9* Parameter Info | | | | | | |
| 15-92 | Defined Parameters | 0 N/A | 1 set-up | TRUE | 0 | Uint16 |
| 15-97 | Application Type | 0 N/A | 1 set-up | TRUE | 0 | Uint32 |
| 15-98 | Drive Identification | 0 N/A | 1 set-up | FALSE | 0 | VisStr[56] |

6.1.14 16-** Data Readouts

| Par. No. # | Parameter description | Default value | 4-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 ReferenceFeedbackUnit | 1 set-up | TRUE | -3 | Int32 |
| 16-02 | Reference [%] | 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% | 1 set-up | TRUE | -2 | Int16 |
| 16-09 | Custom Readout | 0 CustomReadoutUnit | 1 set-up | TRUE | -2 | Int32 |
| 16-1* Motor Status | | | | | | |
| 16-10 | Power [kW] | 0 kW | 1 set-up | TRUE | -3 | Uint32 |
| 16-11 | Power [hp] | 0 hp | 1 set-up | TRUE | -3 | Uint32 |
| 16-12 | Motor Voltage | 0 V | 1 set-up | TRUE | -1 | Uint32 |
| 16-13 | Frequency | 0 Hz | 1 set-up | TRUE | -1 | Uint32 |
| 16-14 | Motor current | 0 A | 1 set-up | TRUE | -2 | Uint16 |
| 16-15 | Frequency [%] | 0% | 1 set-up | TRUE | -1 | Uint16 |
| 16-16 | Torque [Nm] | 0 Nm | All set-ups | FALSE | -1 | Int32 |
| 16-18 | Motor Thermal | 0% | 1 set-up | TRUE | 0 | Uint8 |
| 16-22 | Torque [%] | 0% | All set-ups | FALSE | 0 | Int16 |
| 16-26 | Power Filtered [kW] | 0 kW | 1 set-up | FALSE | 0 | Int32 |
| 16-27 | Power Filtered [hp] | 0 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 | Int8 |
| 16-35 | Inverter Thermal | 0% | 1 set-up | TRUE | 0 | Uint8 |
| 16-36 | Inv. Nom. Current | 0 A | 1 set-up | TRUE | -2 | Uint16 |
| 16-37 | Inv. Max. Current | 0 A | 1 set-up | TRUE | -2 | Uint16 |
| 16-38 | SL Controller State | 0 N/A | 1 set-up | TRUE | 0 | Uint8 |
| 16-39 | Control Card Temp. | 0 °C | All set-ups | FALSE | 100 | Uint16 |
| 16-5* Ref. & Feedb. | | | | | | |
| 16-50 | External Reference | 0% | 1 set-up | TRUE | -1 | Int16 |
| 16-52 | Feedback[Unit] | 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 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 N/A | 1 set-up | TRUE | -2 | Uint16 |
| 16-65 | Analog Output AO42 [mA] | 0 mA | 1 set-up | TRUE | -2 | Uint16 |

| Par. No. # | Parameter description | Default value | 4-set-up | Change during operation | Conversion index | Type |
|-------------------------------------|-----------------------|---------------|-------------|-------------------------|------------------|-----------|
| 16-66 | Digital Output | 0 N/A | 1 set-up | TRUE | 0 | VisStr[4] |
| 16-67 | Pulse Input #29 [Hz] | 0 N/A | 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 N/A | 1 set-up | TRUE | 0 | Int16 |
| 16-73 | Counter B | 0 N/A | 1 set-up | TRUE | 0 | Int16 |
| 16-79 | Analog Output AO45 | 0 mA | 1 set-up | TRUE | -2 | UInt16 |
| 16-8* Fieldbus & FC Port | | | | | | |
| 16-80 | Fieldbus CTW 1 | 0 N/A | 1 set-up | TRUE | 0 | UInt16 |
| 16-82 | Fieldbus REF 1 | 0 N/A | 1 set-up | TRUE | 0 | Int16 |
| 16-84 | Comm. Option STW | 0 N/A | 1 set-up | TRUE | 0 | UInt16 |
| 16-85 | FC Port CTW 1 | 1084 N/A | 1 set-up | FALSE | 0 | uint16 |
| 16-86 | FC Port REF 1 | 0 N/A | 1 set-up | TRUE | 0 | Int16 |
| 16-9* Diagnosis Readouts | | | | | | |
| 16-90 | Alarm Word | 0 N/A | 1 set-up | TRUE | 0 | UInt32 |
| 16-91 | Alarm Word 2 | 0 N/A | 1 set-up | TRUE | 0 | UInt32 |
| 16-92 | Warning Word | 0 N/A | 1 set-up | TRUE | 0 | UInt32 |
| 16-93 | Warning Word 2 | 0 N/A | 1 set-up | TRUE | 0 | UInt32 |
| 16-94 | Ext. Status Word | 0 N/A | 1 set-up | TRUE | 0 | UInt32 |
| 16-95 | Ext. Status Word 2 | 0 N/A | 1 set-up | TRUE | 0 | UInt32 |
| 16-97 | Alarm Word 3 | 0 N/A | 1 set-up | TRUE | 0 | UInt32 |

6.1.15 18-** Info & Readouts

| Par. No. # | Parameter description | Default value | 4-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 SensorlessUnit | 1 set-up | FALSE | -3 | Int32 |
| 18-51 | Memory Module Warning Reason | 0 N/A | 1 set-up | TRUE | 0 | uint32 |
| 18-52 | Memory Module ID | 0 N/A | All set-ups | FALSE | 0 | VisStr[18] |
| 18-53 | Memory Module Function | [1] Enabled | 1 set-up | TRUE | - | UInt8 |

6.1.16 20-** Drive Closed Loop

| Par. No. # | Parameter description | Default value | 4-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 |
| 20-12 | Reference/Feedback Unit | ExpressionLimit | All set-ups | TRUE | - | UInt8 |
| 20-2* Feedback/Setpoint | | | | | | |
| 20-21 | Setpoint 1 | 0 ProcessCtrlUnit | All set-ups | TRUE | -3 | Int32 |
| 20-6* Sensorless | | | | | | |
| 20-60 | Sensorless Unit | ExpressionLimit | All set-ups | TRUE | - | UInt8 |
| 20-69 | Sensorless Information | 0 N/A | 1 set-up | TRUE | 0 | 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 Hz | All set-ups | TRUE | -1 | UInt16 |

| Par. No. # | Parameter description | Default value | 4-set-up | Change during operation | Conversion index | Type |
|----------------------------|------------------------|---------------|-------------|-------------------------|------------------|--------|
| 20-84 | On Reference Bandwidth | 5% | 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 | 0.50 N/A | 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% | All set-ups | TRUE | 0 | Uint16 |

6.1.17 22-** Appl. Functions

| Par. No. # | Parameter description | Default value | 4-set-up | Change during operation | Conversion index | Type |
|------------------------------------|-----------------------------------|-----------------|-------------|-------------------------|------------------|--------|
| 22-0* Miscellaneous | | | | | | |
| 22-01 | Power Filter Time | 0.50 s | 2 set-ups | TRUE | -2 | Uint16 |
| 22-02 | Sleepmode CL Control Mode | [0] Normal | All set-ups | TRUE | - | Uint8 |
| 22-2* No-Flow Detection | | | | | | |
| 22-26 | Dry Pump Function | [0] Off | All set-ups | TRUE | - | Uint8 |
| 22-27 | Dry Pump Delay | 10 s | All set-ups | TRUE | 0 | Uint16 |
| 22-3* No-Flow Power Tuning | | | | | | |
| 22-38 | High Speed Power [kW] | ExpressionLimit | All set-ups | TRUE | 1 | Uint32 |
| 22-4* Sleep Mode | | | | | | |
| 22-40 | Minimum Run Time | 10 s | All set-ups | TRUE | 0 | Uint16 |
| 22-41 | Minimum Sleep Time | 10 s | All set-ups | TRUE | 0 | Uint16 |
| 22-43 | Wake-Up Speed [Hz] | 10 N/A | All set-ups | TRUE | -1 | Uint16 |
| 22-44 | Wake-Up Ref./FB Diff | 10% | All set-ups | TRUE | 0 | Uint8 |
| 22-45 | Setpoint Boost | 0% | All set-ups | TRUE | 0 | Int8 |
| 22-46 | Maximum Boost Time | 60 s | All set-ups | TRUE | 0 | Uint16 |
| 22-47 | Sleep Speed [Hz] | 0 N/A | All set-ups | TRUE | -1 | Uint16 |
| 22-48 | Sleep Delay Time | 0 s | All set-ups | TRUE | 0 | Uint16 |
| 22-49 | Wake-Up Delay Time | 0 s | All set-ups | TRUE | 0 | Uint16 |
| 22-5* End of Curve | | | | | | |
| 22-50 | End of Curve Function | [0] Off | All set-ups | TRUE | - | Uint8 |
| 22-51 | End of Curve Delay | 10 s | All set-ups | TRUE | 0 | Uint16 |
| 22-6* Broken Belt Detection | | | | | | |
| 22-60 | Broken Belt Function | [0] Off | All set-ups | TRUE | - | Uint8 |
| 22-61 | Broken Belt Torque | 10% | All set-ups | TRUE | 0 | Uint8 |
| 22-62 | Broken Belt Delay | 10 s | All set-ups | TRUE | 0 | Uint16 |
| 22-8* Flow Compensation | | | | | | |
| 22-80 | Flow Compensation | [0] Disabled | All set-ups | TRUE | - | Uint8 |
| 22-81 | Square-linear Curve Approximation | 100% | All set-ups | TRUE | 0 | Uint8 |
| 22-82 | Work Point Calculation | [0] Disabled | All set-ups | TRUE | - | Uint8 |
| 22-84 | Speed at No-Flow [Hz] | 0 Hz | All set-ups | TRUE | -1 | Uint16 |
| 22-86 | Speed at Design Point [Hz] | ExpressionLimit | All set-ups | TRUE | -1 | Uint16 |
| 22-87 | Pressure at No-Flow Speed | 0 N/A | All set-ups | TRUE | -3 | Uint32 |
| 22-88 | Pressure at Rated Speed | 999999.999 N/A | All set-ups | TRUE | -3 | Uint32 |
| 22-89 | Flow at Design Point | 0 N/A | All set-ups | TRUE | -3 | Int32 |
| 22-90 | Flow at Rated Speed | 0 N/A | All set-ups | TRUE | -3 | Int32 |

6.1.18 24-** Appl. Functions 2

| Par. No. # | Parameter description | Default value | 4-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 |

6.1.19 30-** Special Features

| Par. No. # | Parameter description | Default value | 4-set-up | Change during operation | Conversion index | Type |
|--------------------------------|----------------------------------|-----------------|-------------|-------------------------|------------------|--------|
| 30-2* Adv. Start Adjust | | | | | | |
| 30-20 | High Starting Torque Time [s] | ExpressionLimit | All set-ups | TRUE | -2 | UInt16 |
| 30-21 | High Starting Torque Current [%] | ExpressionLimit | All set-ups | TRUE | -1 | UInt32 |
| 30-22 | Locked Rotor Detection | [1] On | All set-ups | TRUE | - | UInt8 |
| 30-23 | Locked Rotor Detection Time [s] | 1 s | All set-ups | TRUE | -2 | UInt8 |

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